BHEL-PEM-MAUX
PRE-QUALIFICATION CRITERIA

	PACKAGE: AIR CONDITIONING SYSTEM **PROJECT: 2X 660 MW TALCHER TPP STAGE-III** **PRE-QUALIFICATION REQUIREMENT.**	PE-PQ-497-553-A001	
		DATE	19/04/2023
		REV NO	00

1.0	The Bidder should have designed, supplied, erected and commissioned at least one (1) number of Air conditioning system having a total installed capacity of 300TR or more including stand-by chiller unit (if any), which should have included at least one chilling unit with a minimum capacity of 60TR. The system have been in successful operation for at least one (1) year as on 06.06.2022
2.0	The supplier has to submit following supporting documents meeting above mentioned pre-qualifying requirement Copy of minimum one (1) performance certificate (in English) from end user along with copy of related Purchase Order (PO) or Letter of intent (LOI) or Letter of Award (LOA) or Work Order (WO) in support of PQR clause at S.No.1.0 above.
3.0	Bidder shall submit all necessary data such as type, design, make, capacity, duty conditions, date of commissioning/ operation etc. to substantiate technical parameters specified in PQR, if the same is not mentioned in performance certificate/purchase order.
4.0	Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.
5.0	Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.
6.0	Consideration of offer shall be subject to customer's approval of bidders, if applicable.
7.0	After satisfactory fulfilment of all the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.
8.0	The bidder shall meet PQR based on its own credentials. Bid from joint venture (JV) company / Consortium bid is not acceptable.
9.0	Sub-supplier Qualification Requirement for chiller: The chiller unit(s) proposed to be supplied for this package shall be sourced from the manufacturer(s) who have manufactured and supplied at least one (1) no. of similar type of chiller unit each having a capacity of not less than 150 TR, which should have been in successful operation for at least one (1) year as on 06.06.2022. Bidder has to furnish a confirmation to meet above sub-supplier Qualification Requirement in prescribed format attached in Section II of tender specification. However, required documents (as mentioned against Sr. no. 2 above) for establishing chiller proven-ness shall be furnished by successful bidder after placement of order.

NTPC LIMITED

TALCHER THERMAL POWER PROJECT
STAGE-III (2 X 660 MW)

TECHNICAL SPECIFICATION

FOR

AIR CONDITIONING SYSTEM

SPECIFICATION NO.: - PE-TS-497-553-A001

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
POWER PROJECT INSTITUTE BUILDING
PLOT NO.-25, SECTOR-16A, NOIDA, INDIA

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SECTION - I

SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

1.0 INTENT OF SPECIFICATION

1.1 The specification covers Supply part, Services part and Mandatory spares comprising of 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 including chemicals for softening plant till handing over, mandatory spares along with spares for erection, start-up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site and carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff (if applicable), operation of the AC Plant(s) after commissioning till handing over and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order for 2X660 **MW TALCHER STAGE III at Angul District, Odisha**.

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **AIR CONDITIONING SYSTEM.**

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.

1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all

attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under SEC-II of the specification **within 10 days of receipt of tender documents.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Sec – II); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.

1.9 In the event of any conflict between the requirements of two clauses of this specification & requirements of different codes/standards and between respective clauses of sub-section C & sub-section D, more stringent clause as per the interpretation of the owner shall apply.

1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please refer relevant clause of General Conditions of Contract (GCC).

SECTION: I

SUB-SECTION: B

PROJECT INFORMATION WITH WIND CRITERIA

SUB-SECTION–I-B

PROJECT INFORMATION

TALCHER TPP STAGE-III (2X660 MW)

1.00.00 BACKGROUND

Talcher Thermal Power Project is situated near Talcher town in Angul district of Orissa having capacity of 460 MW (4x60 MW + 2x110 MW). The project was implemented by Orissa State Electricity Board (OSEB). Subsequently TTPS was taken over by NTPC on 03.06.1995. The present proposal is for expansion of TTPS by adding 2 units of 660 MW.

2.00.00 PROJECT HIGHLIGHTS

2.01.00 **Location**

The proposed site is located near Talcher town in Angul district of Orissa having latitude and longitude as 20°55' N and longitude 85°25' E respectively. The site is approachable from Banarpal–Talcher section of National Highway No. 23 at a distance of about 1 km from Anand Bazar. Nearest railway station is at Talcher on Talcher-Cuttack section of North Eastern Railway at about 4 Kms. The nearest commercial airport is Bhubaneswar at about 90 km.

Vicinity Plan of the proposed project is placed at **Annexure-I**.

3.00.00 BASIC INPUTS

3.01.00 **Land**

The plant facilities for this expansion stage would be accommodated within the land available in the existing power station and ash disposal shall be in mine voids.

3.02.00 **Water**

Make up water requirement for Talcher Thermal power project, Stage-III expansion (2x660 MW) would be about 40 Cusec with ash water recirculation system. Water requirement for the project will be met from upstream of the Samal barrage discharge on the River Brahmani and shall be pumped to the raw water reservoir located about 28 kms from intake well.

3.03.00 **FUEL**

3.03.01 **Coal Requirement, Availability and Linkage**

The Coal Linkage for the project granted by SLC(LT) and CLOA has allocated 5.854 MMTPA coal from MCL.

The primary fuel for the main steam generator shall be coal. The domestic coal quality parameters are indicated in **Annexure-IV-2** and imported coal parameters are indicated in **Annexure-IV-4** are to be considered for steam generator design.

3.03.03 **Coal Transportation**

The envisaged mode of coal transportation from the coal mines to the power plant is through Indian Railways network and will be unloaded in underground RCC Track Hoppers.

3.03.03 **Fuel Oil**

The fuel oil to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Light Diesel oil (LDO) having the characteristics given at **Annexure-IV-1** and HSD Oil characteristics given at **Annexure-IV-3**.

4.00.00 **STEAM GENERATOR TECHNOLOGY**

The steam generators shall be super critical once through type, water tube, direct pulverized coal fired, top supported, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (Tower type) or two pass type.

5.00.00 **FLUE GAS DESULPHURIZATION SYSTEM (FGD) & SCR ready system:**

The project is envisaged with Flue Gas Desulfurization (FGD) system and DeNOx ready system meeting Ministry of Environment, Forest & Climate Change notification dated 07.12.2015. Limestone to be used for design of FGD system shall be as per the characteristic given at **Annexure-IV-5.**

6.00.00 **CAPACITY**

Talcher TPP, Stage-III : 2x660 MW - Present proposal

7.00.00 **BENEFICIARY STATES**

The project is being implemented as a regional project for meeting the power demand of Eastern Region Beneficiaries including Orissa – the home-state. The exact allocation of power shall be subject to the approval of Ministry of Power, Govt. of India.

8.00.00 **METEOROLOGICAL DATA**

The meteorological data from nearest observatory is placed at **Annexure-II.**

9.00.00 **Plant Water Scheme**

The Plant water scheme is included in Part-E of Technical Specification.

9.01.00 **Condenser Cooling (CW) Water System**

It is proposed to adopt a recirculating type cooling water system with cooling towers for the project. For the re-circulating type CW system it is proposed to supply clarified water as make up. Circulating water from CW pumps to TG area and from TG area to cooling tower will be carried through pipes/ducts. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.

9.02.00 **Equipment Cooling Water (ECW) System (Unit Auxiliaries)**

All plant auxiliaries shall be cooled by De-mineralized water (DM) in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system.

It is proposed to provide independent primary cooling water circuit for TG & its auxiliaries and Steam Generator & auxiliaries (including station auxiliaries) on Unit basis.

9.03.00 **Other Miscellaneous Water Systems**

CW system blow down water shall be used for the FGD process requirement, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water system. The service water shall be taken from clarified water tank of Pre-treatment plant. The service (wash water) water collected from various areas and coal handling plant shall be treated as per requirement and reused. The drinking water requirement shall be provided from water treatment plant.

The quality of Raw water is given in this sub-section at **Annexure-III**

10.00.00 POWER EVACUATION SYSTEM

In view of above and considering the present capacity of the project (1320 MW), it is proposed to adopt the step-up/power evacuation voltage as 400kV. Accordingly provision for 4 Nos. of 400 kV line bays has been considered in the generation switchyard. Station supply shall be derived directly from 400kV voltage level through 400kV Class station transformers. The issue of power evacuation of the project shall be taken up with appropriate Transmission Utility as per regulatory provision, based on final power allocation received from Ministry of Power.

11.00.00 Criteria for Earthquake Resistant Design of Structures and Equipment

All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in Part-B of this section**.**

12.00.00 Criteria for Wind Resistant Design of Structures and Equipment

All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in Part-B of this section.

13.00.00 Vulnerability Atlas of India(VAI), prepared by Building Materials, Training and Promotion Council (BMTPC) under Ministry of Housing and Urban Affairs, is a comprehensive document which provides existing hazard scenario for the entire country and presents the digitized State/UT-wise hazard, maps with respect to earthquakes, winds and floods for district-wise identification of vulnerable areas. It also includes additional digitized maps for thunderstorms, cyclones and landslides. The main purpose of this Atlas is its use for disaster preparedness and mitigation at policy planning and project formulation and construction stage. The VAI provides necessary information for risk analysis and hazard assessment and is available at website www.bmtpc.org.

As per Government's directive, it is mandatory for the bidders to refer VAI for multi-hazard risk assessment and include the relevant hazard proneness specific to project location while planning, designing and execution of the project in terms of following details:

i) Seismic zone (II to V) for earthquakes
ii) Wind velocity
iii) Area liable to floods and Probable max. surge height
iv) Thunderstorms history
v) Number of cyclone storms/sever cyclone storms and max sustained wind specific to coastal region
vi) Landslides incidences with Annual rainfall normal
vii) District wise Probable Max. Precipitation

Accordingly, bidder should refer VAI while planning, designing and execution of the project.

However, for design of structures/facilities and equipment, the criteria for earthquake resistant design of structures and equipment, the criteria for Wind Resistant Design of Structures and Equipment and design parameters for drainage facilities, stipulated in the Technical Specification shall be followed.

For other information like area liable to floods, probable max. surge height, landslide, thunderstorm, cyclone etc. agencies are required to refer the VAI.

ANNEXURE-I

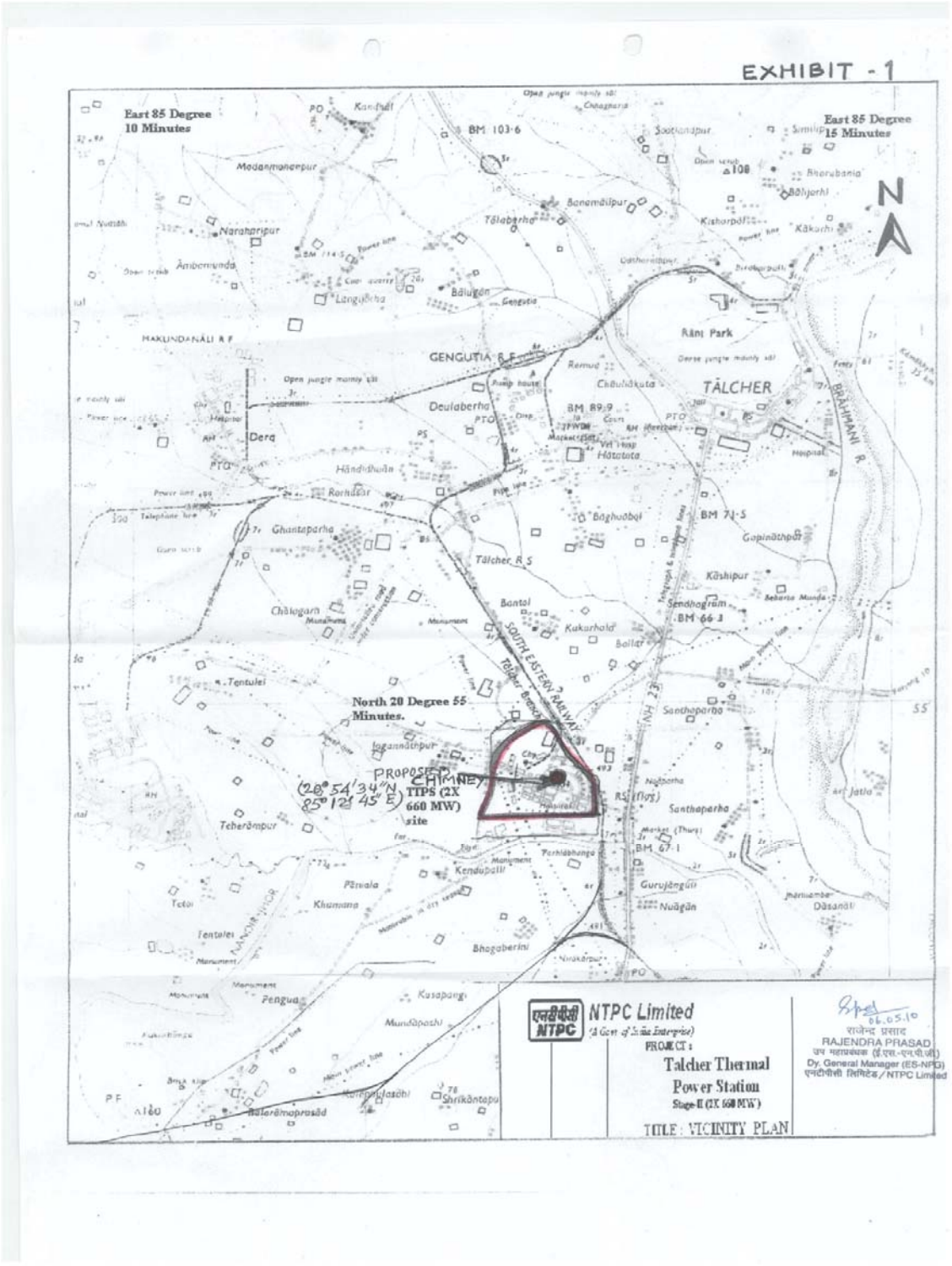
EXHIBIT - 1
East 85 Degree 10 Minutes
East 85 Degree 15 Minutes
North 20 Degree 55 Minutes.
N
TÄLCHER
GENGUTIA R.F
HAKUNDANALI R.F
BRAHMANI R.
Rani Park
Talcher R.S
SOUTH EASTERN RAILWAY
PROPOSED CHIMNEY TIPS (2X 660 MW) site
(20° 54' 34" N 85° 12' 45" E)
NTPC Limited
(A Govt. of India Enterprise)
PROJECT : Talcher Thermal Power Station
Stage-II (2X 660 MW)
TITLE : VICINITY PLAN
राजेन्द्र प्रसाद
RAJENDRA PRASAD
Dy. General Manager (ES-NPG)
एनटीपीसी लिमिटेड / NTPC Limited

जलवायवी सारणी
CLIMATOLOGICAL TABLE

केन्द्र : अंगुल STATION : Angul — अक्षांश LAT. 20°50' — देशांतर LONG. 85°06' — समुद्री स्तर से ऊंचाई HEIGHT ABOVE M.S.L. 139 METRES — BASED ON OBSERVATIONS 1971-2000

माह MONTH		स्टेशन स्तर पर वायुदाब STATION LEVEL PRESSURE	वायु तापमान AIR TEMPERATURE																				वर्षा RAINFALL					
			मध्य MEAN																									
			सूखा बल्ब DRY BULB	गीला बल्ब WET BULB	दैनिक अधिकतम का मध्य DAILY MAX	दैनिक न्यूनतम का मध्य DAILY MIN	माह के उच्चतम का मध्य HIGHEST IN THE MONTH	माह के निम्नतम का मध्य LOWEST IN THE MONTH	चरम EXTREMES				आर्द्रता HUMIDITY		बादल CLOUD AMOUNTS											
									उच्चतम HIGHEST	दिनांक और वर्ष DATE AND YEAR	निम्नतम LOWEST	दिनांक और वर्ष DATE AND YEAR	RELATIVE HUMIDITY	VAPOUR PRESSURE	ALL CLOUDS	LOW CLOUDS	MONTHLY TOTAL	वर्षा के दिनों की संख्या NO.OF RAINY DAYS	सर्वाधिक वर्षा वाले माह का योग TOTAL IN WETTEST MONTH WITH YEAR	सर्वाधिक शुष्कता वाले माह का योग TOTAL IN DRIEST MONTH WITH YEAR	24 घंटों में सर्वाधिक वर्षा HEAVIEST RAIN IN 24 HOURS	दिनांक और वर्ष DATE AND YEAR	माध्य पवन गति MEAN WIND SPEED

ANNEXURE-III

RAW WATER ANALYSIS

SN	Constituent	As	mg/l (except pH & turbidity)
1	Calcium	CaCO3	80
2	Magnesium	CaCO3	35
3	Sodium	CaCO3	20
4	Potassium	CaCO3	5
5	Total Cation	CaCO3	140
6	HCO3	CaCO3	85
7	p Alkalinity	CaCO3	0
8	Chlorides	CaCO3	35
9	Sulphate	CaCO3	20
10	Total Anion	CaCO3	140
11	Reactive Silica	SiO2	25
12	Silica non-Reactive	SiO2	5
13	Total Iron	Fe	0.5
14	pH value	-	6.8-8.0
15	Turbidity	NTU	2000
16	TDS	ppm	190
17	Temp	deg C	20-35
18	KMnO4	ppm	2
19	TOC	ppm	5

ANNEXURE-IV-1

TABLE-1

LIGHT DIESEL OIL CHARACTERISTICS

AS PER IS 15770-2008

	Characteristics	LDO
1.	Pour Point (max)	21 °C & 12°C for Summer and Winter respectively
2.	Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15.0
3.	Sediment percent by mass (max)	0.10
4.	Total sulphur percent by mass (max)	1.5
5.	Ash percentage by mass (max)	0.02
6.	Carbon residue (Rams bottom) percent by pass (max.)	1.50
7.	Acidity inorganic	Nil
8.	Flash point (Min.) - Pensky Martens	66 deg.C
9.	Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2
10.	Water content, % by volume (max)	0.25
11.	GCV(kcal/kg)	10,000

DOMESTIC COAL CHARACTERISTICS ANNEXURE-IV-2

TABLE-1 – A

S No.	Characteristics (As received basis)	Range of 95% coal supplies			Range of 5% coal supplies	
		Column -1	Column-2	Column-3	Range of Adequacy coal	
1.0	**PROXIMATE ANALYSIS**	**Design**	**Worst**	**Best**	**Worst**	**Best**
1.1	Total Moisture (%)	14	16	12	17	11
1.2	Ash (%)	41	45	38	46	34
1.3	Volatile matter (%)	22	19	24	18	25
1.4	Fixed carbon (%)	23	20	26	19	30
	Total (%)	100	100	100	100	100
2.0	**ULTIMATE ANALYSIS**					
2.1	Carbon (%)	34.04	30.53	37.84	29.33	41.7
2.2	Hydrogen (%)	2.73	2.45	2.8	2.1	3.1
2.3	Sulphur (%)	0.55	0.45	0.65	0.45	0.8
2.4	Nitrogen (%)	0.83	0.63	1.2	0.55	1.3
2.5	Oxygen (%) (By difference)	6.85	4.94	7.51	4.57	8.1
2.6	Total Moisture (%)	14	16	12	17	11
2.7	Ash (%)	41	45	38	46	34
2.8	Total (%)	100	100	100	100	100
2.8	GCV (kcal/kg)	3400	3100	3700	3100	4000
2.9	Hard grove index	50	45	60	45	65
2.10	YGP (mg/kg)	75	80	70	85	65
3.0	**ASH ANALYSIS**					
3.1	Silica (%)	57.61	55.60	59.62	53.10	60.50
3.2	Alumina (%)	29.65	30.20	28.67	32.38	28.10
3.3	Iron Oxide (%)	6.96	7.75	6.03	8.28	5.51
3.4	Titania (%)	1.60	1.50	1.70	1.40	1.80
3.5	Phosphoric Anhydride (%)	0.53	0.58	0.46	0.60	0.40
3.6	Lime (%)	0.89	1.10	1.50	0.80	1.70
3.7	Magnesia (%)	0.35	0.40	0.30	0.50	0.25
3.8	Sulphuric Anhydride (%)	0.05	0.05	0.05	0.05	0.05
3.9	Sodium Oxide (%)	0.30	0.30	0.50	0.25	0.55
3.10	Balance Alkalies(By Difference) (%)	2.06	2.52	1.17	2.64	1.14
4.0	**ASH FUSION RANGE** (Under reducing atmosphere)					
4.1	Initial Deformation Temperature (degree Celsius)	1100	1100	1150	1100	1150
4.2	Hemispherical temperature (degree Celsius)	1300	1250	1350	1250	1350
4.3	Flow temperature (degree Celsius)	1400	1400	1400	1400	1400

TABLE-2 **ANNEXURE-IV-3**

HIGH SPEED DIESEL OIL CHARACTERISTICS

[AS PER IS **1460-2005 (BS-II)**]

S. No.	Particulars	Unit	Value
1.	PHYSICAL PROPERTIES		
	a. Distillation volume recovery @ 350^0C	% vol. (min)	85
	b. Distillation volume recovery @ 370^0C	% vol. (min)	95
	c. Kinematic Viscosity @ 40 Degree C	cSt	2.0 – 5.0
	d. Density @ 15 Degree C	kg/m^3	820 – 860
	e. Pour Point		
	- Summer	Degree C (max)	15
	- Winter	Degree C (max)	03
	f. Cold Filter Plugging Point		
	- Summer	Degree C (max)	18
	- Winter	Degree C (max)	06
	g. Flash Point (Abal)	Degree C (max)	35
	h. Lubricity WSD 1.4 @ 60 Degree C	Microns (max)	460
2.	HEATING VALUE		
	a. Higher Heating Value (HHV)	Kcal/Kg	11,000
	b. Lower Heating Value (LHV)	Kcal/Kg	10,300
3.	ACIDITY		
	a. Inorganic	mg KOH/g	Nil
	b. Total	mg KOH/g	0.2 (max.)
4.	Copper Strip Corrosion 3 hours @100^0C	No.	1 (max)
5.	RCR on 10% residue	% wt.	0.3 (max)
6.	CONTAMINANTS		
	a. Ash	ppm (wt.)	100 (max)
	b. Sediments	% wt	0.05 (max)
	c. Total Sulphur	% wt	0.05 (max)
	d. Water Content	% volume	0.05 (max)
	e. Trace Metals		
	- Na + K	ppm (wt)	0.30 (max)
	- Vanadium	ppm (wt)	0.50 (max)
	- Lead	ppm (wt)	0.50 (max)
	- Calcium	ppm (wt)	2.0
	- Ni + Zn	ppm (wt)	Nil
7.	Nitrogen content (FBN)	% wt.	0.015

ANNEXURE-IV-4

TABLE – 4

TYPICAL IMPORTED COAL AND ASH CHARACTERISTICS

Sl.No.	Characteristics (as received basis)	Imported Coal	
		Worst	Best
1.0	**Proximate Analysis**		
1.1	Total Moisture (%)	20	16
1.2	Ash (%)	10	10
1.3	Volatile Matter (%)	30	45
1.4	Fixed Carbon (%)	40	29
1.5	Total (%)	100	100
2.0	**Ultimate Analysis**		
2.1	Carbon (%)	56.4	62.4
2.2	Hydrogen (%)	4.5	4.9
2.3	Sulphur (%)	0.9	0.8
2.4	Nitrogen (%)	0.9	0.5
2.5	Oxygen (%) (By difference)	7.3	5.4
2.6	Carbonates (%)	0	0
2.7	Phosphorous (%)	0	0
2.8	Total Moisture (%)	20	16
2.9	Ash (%)	10	10
	Total	100	100
2.10	GCV (Kcal/Kg)	5800	6500
2.11	Hard Grove Index	45	60
2.12	YGP (mg/kg)	100	70
3.0	**Ash Analysis**		
3.1	Silica (SiO_2) (%)	32.74	34.94
3.2	Alumina(Al_2O_3) (%)	30.5	28.43
3.3	Iron Oxides(Fe_2O_3) (%)	18.2	15.2
3.4	Titania (TiO_2)	1.56	1.76
3.5	Phosphoric Anhydride(P_2O_5) (%)	0.44	0.54
3.6	Lime (CaO) (%)	6.12	7.62
3.7	Magnesia (MgO) (%)	1.83	1.93
3.8	Sulphuric Anhydride (%)	6.95	7.65
3.9	Sodium Oxide (Na_2O) (%)	0.3	0.4
3.10	Balance alkalies (by difference)	1.36	1.56
	Total	100	100
4.0	**Ash Fusion Temperature reducing temperature**		
4.1	Initial deformation Temp (ºC)	1100	1250
4.2	Hemispherical Temp. (ºC)	1300	1350
4.3	Flow Temp. (ºC)	1400	1400

Annexure – IV-5

LIMESTONE CHARACTERISTICS

Chemical Analysis(% by mass)			
1.	CaO	%	47-51.0*
2.	MgO	%	0.9-3.8
3.	Fe_2O_3	%	0.45-1.0
4.	Al_2O_3	%	1.19-2.1
5.	Si_2O_3	%	2.1-4.5
6.	Mn_2O_3	%	<0.12
7.	P_2O_5,	%	Traces
8.	Cl_2	%	<0.015
9.	Na_2O	%	<0.16
10.	K_2O	%	<0.01
11.	TiO_2	%	<0.02
12.	Total Sulphur	%	<0.1
13.	LOI	%	39.0-41.3
Physical properties			
1	Bond Index	kWh/t	13
2	Granule size		Medium

Notes:

1. *Guaranteed parameters (guarantee on limestone consumption, auxiliary power consumption & gypsum purity) shall be based on available (reactive) CaCO3 content of 89%. The design of Flue Gas Desulphurisation (FGD) system & auxiliaries shall be based on available (reactive) $CaCO_3$ content of 79%.
2. For the purpose of volumetric computations of limestone handling & storage system the bulk density of limestone shall be taken as 1400 kg/m^3. However for torque, drive & structural load requirements the density of lime stone shall be taken as 1700 kg/m^3. For gypsum, the bulk density shall be taken as 900 kg/m^3 for volumetric computation and 1250 kg/m^3 for torque, drive & structural load requirements.
3. For the purpose of sizing of equipments and guarantee, $MgCO_3$ shall be considered as unreactive dolomitic form.

Annexure-IV-6

METHANOL CHARACTERSTICS

SN	Fuel Property	Unit	Methanol
1	Chemical Formula		CH3-OH
2	Fuel Carbon	Wt%	38
3	Fuel Oxygen	Wt%	12
4	Density at 20 deg C	kg/m3	792
5	LHV	Kcal/kg	4800
6	Boiling Temp	^{0}C at 1 bar	65
7	Vapour Pressure	bar at 20^{0}C	0.13
8	Kinematic viscosity	cSt at 20^{0}C	0.74
11	Auto Ignition	^{0}C	470
12	Heat of Vapourization	kcal/kg	260
15	Flammability limit	vol %	6-36
16	Flash Point	^{0}C	12

Annexure-IV-7(A)

S.N.	Technical Data	Unit	Specifications for Torrefied Pellet
1.	Base Material		**Agro residue:** Which means the leftover portion of the agriculture produce such as stubble/straw/stalk/husk of those agro residue which are surplus and not being used as animal fodder such as paddy, soya, arhar, gwar, cotton, gram, jawar, bajara, moong, mustard, seasam, til, maize, sunflower, jute, coffee etc., groundnut shell, coconut shell, castor seed shell etc., pine needle, elephant grass, sarkanda and horticulture waste such as dry leaves and trimmings generated during the maintenance and pruning of trees and plants. Wood obtained from tree cutting shall not be treated as agro residue and shall be not to be used as base material or mixing purpose whatsoever.
2.	Diameter	mm	In case of cylindrical shape: Diameter: Not more than 35 mm Length: Random For other shapes: No dimension should exceed 35 mm.
3.	Fines % (<3 mm) (ARB*)	Wt%	fines ≤ 5%
4.	Gross Calorific Value (GCVARB*)	Kcal/Kg	**Refer below**
5.	Moisture (ARB*)	Wt%	<= 15% (not more than 15%)
6.	Bulk density	Kg^3	600

*ARB – As Received Basis

Annexure-IV-7(B)

The sample was prepared by torrefying rice straw at 300 deg C with a holding time of one hour. Following analysis are carried out at NETRA using the powdered torrefied rice straw samples and the results of various testing for the specific sample is tabulated below:

a. Proximate Analysis (wt %, Air Dried Basis)

M	Ash	VM	FC
6.68	21.66	47.68	23.98

b. Ultimate Analysis (wt %, Air Dried Basis)

C	H	N	S	O
46.65	3.93	1.13	0.14	19.81

c. GCV : 4201 kcal/kg

d. Ash Fusion Temperature under reducing conditions: ^{0}C

IDT	ST	HT	FT
1134	1357	1374	1422

e. Ash Elemental Analysis (Elements expressed as Oxides in %w/w)

Na2O	MgO	Al2O3	SiO2	P2O5	SO3	K2O	CaO	TiO2	MnO	Fe2O3
2.423	7.783	4.623	67.48	1.9	1.9	6.15	4.21	0.39	0.03	2.83

Annexure-IV-7(C)

For the Torrefied Rice Straw Pellets (Prepared by torrefaction of rice straw at 300 deg C with holding time of 1 hr) tested at NETRA, the test results are as follows:

A. For Anion (ISO 16994:2016 E-Solid Biofuels- Determination of total content of sulphur and chlorine)-reported as wt % dry basis

a. Chlorine (Cl): 0.32%

b. Fluorine (F) : 0.09%

B. For Cation (ISO 16967:2015 E-Solid Biofuels- Determination of major elements …)- Reported as wt % dry basis

a. Sodium (Na): 0.31%

b. Potassium (K): 2.04%

Note: The above details as at Annexure-IV-7(A), IV-7(B & IV-7(C) are indicative only and shall vary based on the exact raw material and its subsequent processing.

D-1-12(D)

Annexure- (D)

CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – I for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a) Welded steel structures : 1.0%

b) Bolted steel structures/ RCC structures : 2.0%

c) Prestressed concrete structures : 1.6%

d) Steel stacks : As per IS: 6533 & CICIND Model Code whichever is more critical.

ANNEXURE-I

SITE SPECIFIC DESIGN PARAMETERS

The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:

a) The basic wind speed "V_b" at ten metres above the mean ground level : 50 metres/second

b) The risk coefficient "K_1" : 1.08

c) Category of terrain : Category-2

D-1-12(E)

Annexure-(E)

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a)	Steel structures	:	2%
b)	Reinforced Concrete structures	:	5%
c)	Reinforced Concrete Stacks	:	3%
d)	Steel stacks	:	2%

Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893.

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.

For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B.

Design/Detailing for Ductility for Structures

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

APPENDIX-I

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

1) Peak ground horizontal acceleration (MCE) : 0.16 g

2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra

   a) for special moment resisting steel frames designed and detailed as per IS:800 : 0.04

   b) for special concentrically braced steel frames designed and detailed as per IS:800 : 0.03

   c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024

   d) for RCC chimney, RCC Natural Draft Cooling Tower : 0.08

   e) for liquid retaining tanks : 0.048

   f) for Steel chimney, Absorber tower, Vessels : 0.06

   g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/configuration/ materials) : 0.04

3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.08

Note: g = acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished as **Annexure – S** in subsequent pages.

ANNEXURE - S

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS for Talcher TPP
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0	1	1	1
0.03	1	1	1
0.04	1.388	1.338	1.261
0.05	1.790	1.676	1.509
0.06	2.204	2.015	1.748
0.07	2.627	2.355	1.980
0.08	3.059	2.696	2.205
0.09	3.499	3.036	2.424
0.097	3.810	3.275	2.575
0.098	3.810	3.310	2.596
0.1	3.810	3.310	2.640
0.11	3.810	3.310	2.640
0.108	3.810	3.310	2.640
0.11	3.810	3.310	2.640
0.115	3.810	3.310	2.640
0.12	3.810	3.310	2.640
0.125	3.810	3.310	2.640
0.13	3.810	3.310	2.640
0.135	3.810	3.310	2.640
0.14	3.810	3.310	2.640
0.145	3.810	3.310	2.640
0.15	3.810	3.310	2.640
0.2	3.810	3.310	2.640
0.25	3.810	3.310	2.640
0.3	3.810	3.310	2.640
0.35	3.810	3.310	2.640
0.37	3.810	3.310	2.640
0.38	3.810	3.310	2.640
0.39	3.713	3.310	2.640
0.4	3.620	3.310	2.640
0.43	3.367	3.079	2.456
0.45	3.218	2.942	2.347
0.52	2.785	2.546	2.031

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.555	2.609	2.386	1.903
0.56	2.586	2.364	1.886
0.565	2.563	2.343	1.869
0.57	2.540	2.323	1.853
0.575	2.518	2.303	1.837
0.58	2.497	2.283	1.821
0.585	2.475	2.263	1.805
0.59	2.454	2.244	1.790
0.595	2.434	2.225	1.775
0.6	2.413	2.207	1.760
0.65	2.228	2.037	1.625
0.7	2.069	1.891	1.509
0.75	1.931	1.765	1.408
0.8	1.810	1.655	1.320
0.85	1.704	1.558	1.242
0.9	1.609	1.471	1.173
0.95	1.524	1.394	1.112
1	1.448	1.324	1.056
1.05	1.379	1.261	1.006
1.1	1.316	1.204	0.960
1.15	1.259	1.151	0.918
1.2	1.207	1.103	0.880
1.25	1.158	1.059	0.845
1.3	1.114	1.018	0.812
1.35	1.073	0.981	0.782
1.4	1.034	0.946	0.754
1.45	0.999	0.913	0.728
1.5	0.965	0.883	0.704
1.55	0.934	0.854	0.681
1.6	0.905	0.828	0.660
1.65	0.878	0.802	0.640
1.7	0.852	0.779	0.621
1.75	0.827	0.757	0.603
1.8	0.804	0.736	0.587
1.85	0.783	0.716	0.571
1.9	0.762	0.697	0.556
1.95	0.743	0.679	0.542
2	0.724	0.662	0.528
2.05	0.706	0.646	0.515
2.1	0.690	0.630	0.503

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
2.15	0.673	0.616	0.491
2.2	0.658	0.602	0.480
2.25	0.644	0.588	0.469
2.3	0.630	0.576	0.459
2.35	0.616	0.563	0.449
2.4	0.603	0.552	0.440
2.45	0.591	0.540	0.431
2.5	0.579	0.530	0.422
2.55	0.568	0.519	0.414
2.6	0.557	0.509	0.406
2.65	0.546	0.500	0.398
2.7	0.536	0.490	0.391
2.75	0.527	0.481	0.384
2.8	0.517	0.473	0.377
2.85	0.508	0.465	0.371
2.9	0.499	0.457	0.364
2.95	0.491	0.449	0.358
3	0.483	0.441	0.352
3.05	0.467	0.434	0.346
3.1	0.452	0.427	0.341
3.15	0.438	0.427	0.335
3.2	0.424	0.414	0.330
3.25	0.411	0.401	0.320
3.3	0.399	0.389	0.310
3.35	0.387	0.378	0.301
3.4	0.376	0.367	0.292
3.45	0.365	0.356	0.284
3.5	0.355	0.346	0.276

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATIONS

SECTION: C1

SPECIFIC TECHNICAL REQUIREMENT

1. FUNCTION

1.1 The purpose of the system is to provide air-conditioning system for different areas of 2x 660 MW Talcher Stage-III under the scope of this tender.

2. SYSTEM DESCRIPTION

2.1 Main Plant areas (Control Room, CER, UPS & Battery Charger room (except battery room), SWAS room, Water Analysis Lab, CEP-VFD room of unit 2 – ac plant-1

a. As per NTPC spec. clause no. 3.01.00 a) of Section VI, part B, sub section A-17.

b. All the pumps shall be horizontal split casing type. Fans in cooling tower shall be top discharged mounted at top of cooling tower. Chilled water & Condensate water pipes shall be routed outside of the CCR & CER area and pipes supporting arrangement shall be suitably done from outside of the control tower area.

c. Fresh Air fan (for each AHU room): 1X100 % or 2X50 %.

2.2 ASH Handling Control room, Ash Handling VFD room (If applicable), FGD control room, ESP Control Room building unit-1, 2 – ac plant-2

a. As per NTPC spec. clause no. 3.01.00 b) of Section VI, part B, sub section A-17. All the pumps shall be horizontal split casing type. Fans in cooling tower shall be top discharged mounted at top of cooling tower. Further, Pump head in Chilled water system shall be optimised by selecting higher pipe size for long routed pipes and also it is to be endeavoured to have common serving chiller for all AHP Control buildings. However, during detail engineering, if there is difficulty for selection of optimum Chilled water pump, Air Conditioning for the same may be provided with dedicated local AC.

b. Fresh Air fan for AHU room: 1X100 % or 2X50 %.

2.3 SERVICE BUILDING - AC PLANT-3

a. As per NTPC spec. clause no. 3.01.00 c) of Section VI, part B, sub section A-17. BTU meter shall be provided at each individual chiller. All the pumps shall be horizontal split casing type. Fans in cooling tower shall be top discharged mounted at top of cooling tower.

b. Fresh Air fan with modulating Fresh Air Damper and CO2 sensor (for each AHU room): 1X100 % or 2X50 %.

2.4 ADMINISTRATIVE BUILDING - AC PLANT-4

a. As per NTPC spec. clause no. 3.01.00 d) of Section VI, part B, sub section A-17. BTU meter shall be provided at each individual chiller. All the pumps shall be horizontal split casing type. Fans in cooling tower shall be top discharged mounted at top of cooling tower.

b. Fresh Air fan with modulating Fresh Air Damper and CO2 sensor (for each AHU room): 1X100 % or 2X50 %.

2.5 WATER SYSTEM CONTROL ROOM BUILDING - AC PLANT-5

a. As per NTPC spec. clause no. 3.01.00 e) of Section VI, part B, sub section A-17

b. Fresh Air fan for AHU room: 1X100 % or 2X50 %.

2.6 CEP VFD UNIT #1 - AC PLANT-6

a. Air cooled (D-X Type) condensing units: 2X100%

b. AHUs: 2x100%

c. Fresh Air fan for AHU room: 1X100 % or 2X50 %.

2.7 CANTEEN BUILDING - AC PLANT-7

a. As per NTPC spec. clause no. 3.01.00 g) of Section VI, part B, sub section A-17

b. Fresh Air fan with modulating Fresh Air Damper and CO2 sensor (for each AHU room): 1X100 % or 2X50 %.

2.8 OFFSITE BUILDING. OFFSITE CONTROL ROOMS/RIO ROOM ETC.

a. As per NTPC spec. clause no. 3.01.00 h) of Section VI, part B, sub section A-17

3. DESIGN CRITERIA

a. As per section C2-A, NTPC Technical specification section-VI, Part-B, Sub section-A-01, clause no. 3.13.00 and 3.13.01.

4. LAYOUT CONSIDERATIONS:

4.1 AC PLANT-1

a. The central chilled water plant, Condenser Water & Chilled Water Pumps for AC Plant shall be housed in AC Plant Room at 0.0 M level in F'-G'-H' Bay between grid 16-17 of Power House Building.

b. The AHUs for this AC Plant would be located as under:

AHU Room at 8.5 M level of Power House Building in E'-F'-G'-H' Bay between grid 15-16.

AHU Room at 25.5 M level of Power House Building in B-C Bay between grid 14a-17.

c. The Cooling Towers, Make-up water Storage Tank, Expansion Tank, water softening plant and soft water storage tank shall be located at 34.0 M level in F'-G'-H' Bay between grid 15-17.

4.2 AC PLANT-2

a. The central chilled water plant, Condenser Water & Chilled Water Pumps and expansion tank shall be placed at roof of ESP control room of Unit-1

b. AHUs shall be place inside AHU room at different location of ESP control room unit-1, ESP control room unit 2, AHP Control Rooms.

4.3 AC PLANT-3

a. The central chilled water plant, Condenser Water, primary & secondary Chilled Water Pumps for AC Plant shall be housed in AC Plant Room at 0.0 M level in of Service Building.

b. The AHUs for this AC Plant would be located at each floor of service building:

c. The Cooling Towers, Make-up water Storage Tank, Expansion Tank, water softening plant and soft water storage tank shall be located at roof of service building

4.4 AC PLANT-4

a. The central chilled water plant, Condenser Water, primary & secondary Chilled Water Pumps for AC Plant shall be housed in AC Plant Room at 0.0 M level in of Admin. Building.

b. The AHUs for this AC Plant would be located at each floor of Admin building:

c. The Cooling Towers, Make-up water Storage Tank, Expansion Tank, water softening plant and soft water storage tank shall be located at roof of Admin building

4.5 AC PLANT-5

a. Outdoor unit of condensing unit shall be placed at roof of water system control building.

b. AHUs shall be place inside AHU room in water system control room

4.6 AC PLANT-6

a. Outdoor unit of condensing unit shall be placed at roof of CEP VFD Unit-1.

b. AHUs for CEP VFD shall be place inside AHU room above CEP VFD unit -1 building.

4.7 AC PLANT-7

a. Outdoor unit of condensing unit shall be placed at roof of Canteen Building.

b. AHUs shall be place inside AHU room inside Canteen building.

Note: The locations given above for different plants are tentative and may change during detail engineering.

5 GENERAL –

1) Basis of design all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering stage.

2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.

3) All drawings and documents shall be computer based.

4) All commissioning spares & consumables for trouble free operation until handing over of the system shall be provided

5) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification for reference.

6) Indicative list of makes is enclosed as per Annexure-I. However, these makes shall be subject to Customer & BHEL approval during detail engineering Stage.

7) Fixing frame works for diffusers and grilles in the scope of Vendor.

8) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.

9) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipment etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.

10) Drain piping up to the drain point to be provided by the Vendor.

11) Vendor shall furnish schedule of power and control cables. Vendor shall also furnish cable termination details interconnection drawings etc. during detail engineering stage.

12) The tools and machine required for erection of equipment shall be arranged by Vendor.

13) Tools & tackles as required for regular maintenance shall be supplied by Vendor.

14) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.

15) Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.

16) Temperature gauges/ Temperature Element shall be provided with thermowells and fixing arrangement.

17) Pressure gauges shall have provision for air venting. Three-way valves shall be used which shall have air venting provision.

18) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.

19) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.

20) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipment as per design basis / details furnished.

21) The guarantee tests shall be performed as per section I-Sub Section C2B of customer specification.

22) For motorized fire damper / 3 Way valve actuators / motorised valves, power supply shall be derived by vendor from respective control panels. Suitable transformer shall be provided by bidder (if required) to derive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.

23) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.

24) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to DCS / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope.

25) In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.

26) Bidder to note that BHEL reserve the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.

27) The drawings/ documents submitted by vendor 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 vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place as per the requirement for across the table discussions/ finalizations/ submissions of drawings.

28) Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Air-conditioning system vendor.

29) Flat, platform type RCC / PCC foundation shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners, as applicable, to secure the equipment obtain parameters related to vibration and noise.

30) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication. Further, redundancy of instruments shall be governed by respective clause of C&I specification.

31) RCC foundation of cooling tower shall be provided by BHEL. However, steel beam / joist etc as required shall be supplied by air-conditioning plant supplier.

32) Air-conditioning plant supplier to furnish drawings/ documents as per the drawing. / documents distribution as per project requirement.

33) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.

34) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.

35) The bidder shall furnish complete Technical Particulars in data sheet and schedules as specified elsewhere in the specification during detail engineering.

36) Training of officials, for AC system shall be provided as per customer specification.

37) Supports required for supporting the fan and/or filter section for FA fans shall be under bidder's scope

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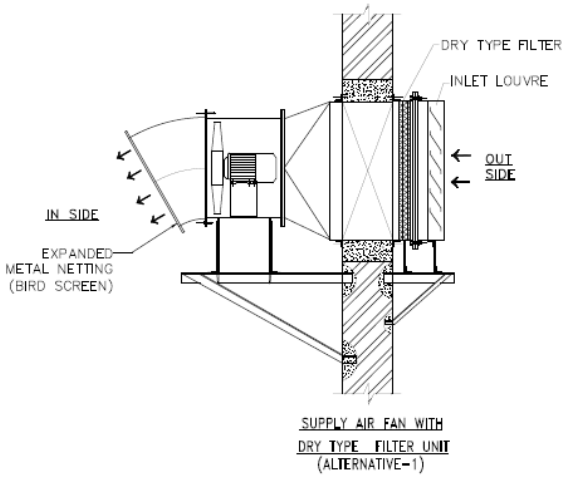
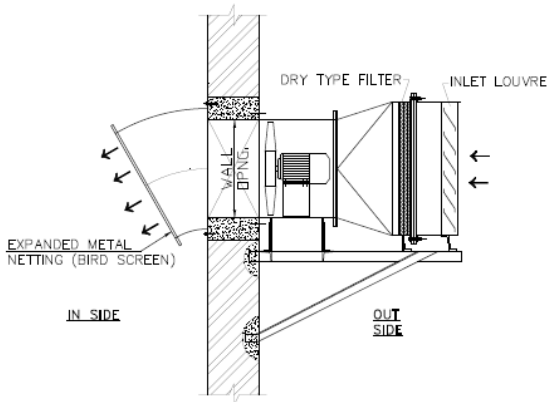


SUPPLY AIR FAN WITH DRY TYPE FILTER UNIT (ALTERNATIVE-1)



SUPPLY AIR FAN WITH DRY TYPE FILTER UNIT (ALTERNATIVE-2)

38) All VVFD drives shall be provided with enclosure

39) **Operation services & consumables** – Commissioning of various AC plants under scope of this tender is expected in phased manner depending upon front availability and other site conditions. Bidder shall include in their scope operation of such AC plants which are commissioned, until final handing over of complete AC system to customer. Consumables like chemicals for softening plant etc. during this period of operation shall also be considered by bidder in their scope. Any shortcoming in the AC plant (s) which may have happened during the operation of the plant, due to regular wear and tear or otherwise, shall be made good before handing over of complete AC system to customer.

40) **Instruments to be used for PG test shall be additionally supplied over and above the instruments shown in tender P&IDs**. PG test equipment being supplied, installed and commissioned for each unit, shall be retained by employer after completion of PG test.

41) Water softening plant – Water softening plant shall be complete in all respect with ACF, DMF, Softener, Pumps for water softening plant, pumps for regeneration, pumps for transferring softening plant reject and cooling tower blow down to CMB, chemical cleaning/dozing pump with necessary tank and circulating water system. Dedicated control panel shall be provided each softening plant with proper interlock of pump, desired parameter of soft water quality. Power of pump shall be routed through control panel of softening plant having inbuilt starter panel. A single source supply feeder shall be provided for each softening plant which shall be terminated at control panel. Soft water outlet quality shall be maintained such that it shall not be corrosive in any condition by blending clarified water maintaining quality of soft water within acceptable limit suitable for chiller. Cooling coil and pipe. Provision for Blowdown, corrosion inhibitor, scale inhibitor and chemical dosing shall also be provided along with suitable quantity of salt.

6 EXCLUSION –

Items of works listed below are excluded from scope of the air-conditioning plant supplier.

a) Construction of AC plant room, Air Handling Unit room, foundations for AC equipment.

b) False ceiling, drop ceiling.

c) Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers. However minor civil work like making opening to suit / finishing of opening, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of AC system vendor.

d) Provision of drain traps / points.

e) For Electrical scope, refer Electrical scope matrix sheet.

NTPC LIMITED

2X660 MW TALCHER SUPER THERMAL POWER PROJECT

TECHNICAL SPECIFICATION
FOR
MATERIAL HANDLING EQUIPMENTS

BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)

POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PROJECT ENGIEERING INSTITUTE BUILDING
SECTOR-16A, PLOT NO. 25, NOIDA, INDIA

Material Handling Equipments

1.0 ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

Manual hoists (hand operated) shall be designed to duty class 2 as per IS 3832 and electric wire rope hoist shall be designed to duty class 2 as per IS: 3938 (latest).

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

DESIGN CRITERIA

1.0.0 Electrically operated wire rope hoists of suitable capacity, lift, and travel length shall be provided for handling of items weighing 2T and / or having lifting height more than 10m. Other hoist blocks shall be of hand operated type for both travel and lift. The hoist capacity shall be selected considering 25% margin over the weight of heaviest component /equipment to be handled. The hoist parameters (i.e. lift & travel) are subject to change/s, to suit the final layout of the area in which it is intended to be installed.

Electric hoist shall be provided for capacity >2T. Electric hoists shall be provided for lifts >10m irrespective of the capacity.
Chain pulley block (Manual hoist) - 500kg to <2T, wherever feasible, considering layout constraints.

Capacity of electric and manual (Chain pulley block) hoists shall be decided keeping 25% margin over equipment to be handled.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical/ manual hoist with the help of floor operated pendant

MINIMUM LIFTING REQUIREMENT

S.N.	AREA DESCRIPTION	QTY (nos)	CAPACITY (T)	TYPE
1	LIST TO BE MENTIONED AS APPLICABLE			
2				
3				

Note:
1. Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication.
2. Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication.
3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

2.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet A.

Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.
Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

2.1.0 Electric hoist shall include but not be limited to the following: -

a) Equipment offered shall be suitable for indoor duty conforming to Class II of IS: 3938.
b) Equipment shall be designed to operate in non- hazardous area.
c) Electric hoists shall be pendent operated.
d) Both hoisting and trolley movement shall be motor driven.
e) Hoisting motion shall be thru' VVVF drives to achieve creep speed of 10% of main speed.
f) Wheels shall be single flanged type.
g) Hook shall be swivelling type and fitted with a safety latch.
h) Control panel shall be hoist mounted.
i) Power feeding to the electric hoists shall be thru' PVC shrouded DSL.
j) Brakes shall be fail to safety.
k) Load/overload testing of the hoists shall be carried out as per IS: 3938.
l) All material, castings and forgings will be of tested quality & certificates shall be made available for review as per approved QAP

2.2.0 Erection and Commissioning spares (ELECTRIC HOIST)
The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.

2.3.0 Services to be provided by the bidder
Packing, forwarding and transportation to site, storage and handling at site.

2.4.0 Erection and Commissioning

2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards)

2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

As per enclosed reference quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be Consultant/ End Customer. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ End Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.0 Works Excluded

Supply of ISMB monorail.

5.0 PAINTING SPECIFICATION

As per painting details specified elsewhere in specification.

6.0 PACKING

In general packing shall be wooden box packing.

7.0 TESTING AT VENDOR'S WORKS

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as

specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client.

9.0 TESTING AT SITE

A) ELECTRIC HOIST:

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
b) The correctness of all circuits and interlocks and sequence of operation; and
c) The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

B) MANUAL HOIST:

As required for statutory clearance for operating at site with following minimum test i.e. overload and load test.

10.0 TECHNICAL DATA SHEET:

A) Technical data sheet-A for ELECTRIC HOIST:

Sl.no	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Scope (Qty., Capacity, Lift, Travel Length)	As mentioned in specification
3.0	Type of service	Indoor
4.0	Overload test	125% of SWL
5.0	Design Ambient temperature	50° C
6.0	General Design	As per IS: 3938 / 1983 or latest, Class-II duty

7.0	Operating speed	
7.1	Hoisting speed/ Creep speed (thru' VVVF drive)	3 MPM with creep speed 10% of main speed.
7.2	Trolley speed	10 MPM
8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	
9.1	Construction / core	6 x 36 or 6 x 37 construction, steel/ Fibre core
9.2	Code	IS:2266
9.3	Tensile designation	1770/1960 N/mm2
9.4	Number of falls	Min. 4
9.5	Factor of safety	Not less than 5
10.0	Load Hook and block	Normalized hook only
10.1	Type of load hook	Plain shank trapezoidal section with safety latch.
10.2	Load hook Code	IS: 15560
10.3	Load hook Material	Alloy steel/carbon steel as per IS:15560
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
10.6	Hook can swivel freely under full load	Yes
10.7	Safety latch on hook provided	Yes
10.8	Locking device on swivelling hook	Provided
10.9	Bearing type	Antifriction Ball / Roller
10.10	Bearing life	10,000 working hours.
11.0	Gearing	
11.1	Type	Spur / Helical, hardened and tempered with machine cut teeth
11.2	Gear material	Forged steel as per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction Ball / Roller
11.5	Bearing life	10,000 working hours.
12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Wheel conform to (Std. / code)	IS: 3938

12.3	Wheel material	Heat treated carbon steel/ low alloy steel, graded cast iron.
12.4	Bearing type	Antifriction Ball / Roller
12.5	Bearing life	10,000 working hours.
12.6	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.
12.7	Hardness	Max hardness 200 BHN
13.0	SHEAVE	
13.1	Material	Cast steel or mild steel.
13.2	Bearing type	Antifriction Ball / Roller.
13.3	Bearing life	10,000 working hours.
14.0	BRAKE (HOIST)	
14.1	Type	DC EM brakes disc type (fail to safety).
14.2	Capacity	As per IS 3938.
14.3	Number	One number for each motor.
15.0	BRAKE (TROLLEY)	
15.1	Type	DC EM brakes disc type (fail to safety).
15.2	Capacity	As per IS 3938.
15.3	Number	One number for each motor
16.0	ROPE DRUM	
16.1	Material	Cast iron, cast steel or mild steel.
16.2	Flange / Flangeless	Flanged
16.3	Type of groove	As per manufacturers standard to suit the layout requirement. (Shall be decided during detail engineering)
17.0	TYPE OF DSL	
17.1	CT travel	PVC shrouded GI conductor bus bar -DSL shall be sized with a margin of 10% over load requirement.
18.0	MOTORS	
18.1	Type	Sq. Cage induction, TEFC, S4 duty, 40% CDF.
18.2	Number of starts	150 starts /hr, Motors shall be suitable for direct on-line (DOL) starting
18.3	Voltage, Phase and Frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +3 to -5% occurring separately or combined voltage and frequency variation of

		10%. 3 phase, 4 wire	
18.4	Class of insulation	Class “F” and temperature rise limited to class B.	
18.5	Type of enclosure	TEFC	
18.6	Degree of protection provided for enclosure	IP-55	
18.7	Margin	Motor nameplate rating at 50 deg C shall have Motor rating will be calculated keeping margin of at least 10% over the maximum power requirement.	
19.0	LIMIT SWITCHES	Hoisting	Trolley
19.1	Type	One (1) no. Snap action, self-actuating type	One (1) no. two way limit switch
20.0	Control panel	* Fabricated from CRCA sheet steel not less than 1.6 mm thick * Degree of protection shall be IP 52 * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthling terminals on panel. * Gland plate thickness shall be minimum 3mm. * Gland plate shall be double brass compression type.	
20.1	Qty	1 No.	
21.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.	
22.0	Fixed type Power cables	Copper/Aluminum material, minimum size: Min. 2.5 mm2 for Cu/ min 6 mm2 for Aluminum. Extruded PVC insulated, armoured and FRLS PVC sheathed heavy duty 1100 V	
23.0	Fixed type Control cable	Copper material, min. 1.5 mm2 Control cables shall have stranded copper conductor, Extruded PVC insulated, armoured and FRLS PVC sheathed heavy duty 1100 V	
24.0	Trailing cable (Power/ Control)	EPR insulated, copper conductor trailing cables, as per IS:9968.	
25.0	Control Voltage	110 V	
26.0	End stopper for CT	2 nos., MOC shall be as per IS 2062	
27.0	Buffer for CT	2 nos. Spring/rubber type shall be provided on trolley	
28.0	Bearing (Type/life)	Antifriction Ball / Roller, 10,000 working hours life	

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

DATA SHEET-A

1.0	**Type**	Chain pulley block with/without trolley
2.0	**General Design**	IS: 3832
3.0	**Duty Class as per IS:3832**	Class –II
4.0	**Hoisting Mechanism**	
a)	Type	Hand operated gear transmission
b)	Type of gear	Spur / Helical
c) i) ii) iii)	Load Chain Type Material Conforms to (Std./Code)	 Link type As per relevant standard IS: 6216 / IS 3077/IS 3019
d) i) ii) iii) :	Hand Chain Type Material Conform to Std.	 Link type Mild steel Grade 30 IS:2429 (Part II)
e)	Load Hook & Hook Block	
i)	Type of load hook	Plain shank- Trapezoidal section/ 'C' type
ii)	Load hooks conforms to	IS: 15560
iii)	Type of hook suspension	Swivelling type with safety latch
iv)	Type of make of bearing	Thrust ball bearing of hook suspension
v)	Type & Material of hook	As per IS 15560
f)	Gears/ Pinions	
i) ii)	Type Material Type of Bearing	Spur Alloy steel / carbon steel/ High graded cast iron Antifriction ball bearing / Roller
g)	Sprockets: Type of bearings used	 Antifriction ball bearing / Roller
i)	Method of lubrication Bearings Gearing & Pinions Sprocket	 Grease Grease Grease
h)	Brakes Type	 Screw and friction disc type
5.0	**Trolley and Bridge drive**	
a) i) ii)	Trolley Type Material of frame	Geared (Manually operated) Mild steel (IS:2062 Grade A or B)
b) i) ii) iii)	Drive Chain Type Material Design of drive chain	Link type Steel Gr.30 IS: 2429 part 1 :1870
c) i) ii) iii) iv)	Wheel Number of pairs of wheel Flange Type of bearings need Wheel material	Two in each trolley/bridge Single flanged Antifriction As per IS 3832

d) i) ii) iii)	Gears Type Material Type of bearings used	 Spur / helical Cast iron/EN8 Antifriction
e) i) ii) iii)	Method of lubrication for Bearings General Sprockets	 Grease Grease Grease
6.0	**Painting**	As per manufacturer's standard

11.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S. No.	Description	Qty.
1	Complete set of ring spanners	1 Set
2	Complete set of screwdrivers (Min. 6 nos of suitable sizes)	1 Set
3	Adjustable Spanner	1 No.
4	Insulated pliers	1 No.
5	Wrench spanner	1 No.
6	Grease Gun	1 No.
7	Oil Gun	1 No.
8	Hand Lamp	1 No.
9	Line tester	1 No.

Note: -The tools shall be supplied in one tool box. Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

12.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

A) ELECTRIC HOIST

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-497-553-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V0-497-553-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details

3	PE-V0-497-553-A102	Schematic Circuit Diagram
4	PE-V0-497-553-A103	Mechanism Sizing Calculation
5	PE-V0-497-553-A105	O & M Manual including erection procedure

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-497-553-A200	Manufacturing Quality Plan
2	PE-V0-497-553-A201	GA Drawing for Chain Pulley Block with detail BOM with painting details
3	PE-V0-497-553-A202	O & M Manual including erection procedure

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.

2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

3. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc:-

   a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

   b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

   c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

   d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

   e) Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.

MAKES OF ELECTRIC HOIST AND CHAIN PULLEY BLOCK: Refer List attached

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

S. No.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	MOOZUMDAR / SIMRITI FORGING / HARMAN MOHTA / STEEL FORGING & ENGG. CO., KOLKATA /
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN Black / BOMBAY WIRE ROPES / FORT WILLIAMS / UNITED WIRE ROPE/BHARAT WIRE ROPES.
5.0	BEARINGS	SKF/ FAG
6.0	MOTORS	SIEMEN/ ABB /NGEF/ CROMPTON /KIRLOSKAR /GECA / BHARAT BIJLI / MARATHON / LHP.
7.0	BRAKES	STROM CRAFT/ ELECTROMAG /SPEED-O- CONTROL / EMCO LENZE
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC/GE Power
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR/ GEC A
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ GEC A
14.0	TRANSFORMERS	INDCOIL/AE / LOGICSTAT/ PRAGATI / KAPPA / SOUTHERN ELECTRIC
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS
17.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT / FINOLEX/ POLYCAB/KEI/HAVELL
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER / DELTON / FINOLEX / TORRENT / CCI / ICL / RADIANT POLYCAB / KEI/ HAVELL.
c)	TRAILING CABLE	UNIVERSAL/ FGL/CCL/HVP/KEI/RADIANT.
18.0	CABLE GLAND	COMMET / SIEMEN / SUNIL&CO.
19.0	PUSH BUTTONS	SIEMENS / L&T / BCH /TEKNIC/VAISHNO
20.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG / JAI BALA JI / KAYCEE / BCH
21	SELECTOR SWITCHES	KAYCEE/ SULZER
22	PENDENT PUSH BUTTON STATION	OEM
23	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD/ VAISHNO
24	MCB	MDS / INDO COPP / STANDARD
25	PANELS	OEM/BCH
26	DSL	SUSHEEL/STROMAG
27	TERMINAL BLOCKS	ELMEX/CONNECTWELL/WAGO (FOR CONTROL ONLY)
28	VVVF	YASAKAWA(L&T)/ABB/SIEMENS/SCHNIDER
29	CASTING	KOLHAPUR STEEL / GNAT FOUNDARY / KIRTI ALLOYS
30	Tools & tackles	Reputed make

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO MANUAL HOIST:

S. No.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	STEEL FORGINGS/ KARACHIWALA/SMRITI/NASIK FORGE.
3.0	STEEL FORGINGS	CHOWDHARY/WESTERN INDIA FORGINGS/ HINDUSTAN STEEL FORGINGS/ RUBY FORGINGS OR AS APPROVED BY BHEL.
4.0	BRAKES	OEM

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.

PAINTING SPECIFICATION

1) Painting specification for steel structures: -

Surface preparation	De greasing and Mechanical cleaning with wire brush and Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns
Primer	Inorganic Ethyl Zinc Silicate- 1 coat, Minimum DFT 75 µ per coat
Intermediate coat	Epoxy based TiO2 pigmented coat, 1 coat, Minimum DFT 35 µ per coat
Finish Coat	a) Epoxy coat- 2 coats, Minimum DFT 25 µ per coat b) Final coat of paint- Aliphatic Acrylic Polyurethane CDE134,V=40.0(min.), 1 coat, Minimum DFT 30 µ per coat
Total DFT	150 µm (min.)

2) Painting specification for Indoor components such as motors, electrical parts etc:-
As per painting specification included elsewhere in the specification.

3) Color Shade:

SL. No	Item Description	Color Shade
1	Crane Structure	Golden Yellow shade 356 as per IS-5
2	Trolley and hook	Crimson shade 540 as per IS-5
3	Motors	RAL 5012
4	Control Panels	Paint shade shall be RAL 9002 for front & rear and RAL 5012 for side covers.
5	Bottom Block assembly.	Golden Yellow shade 356 as per IS-5
6	End Carriage sweep.	Golden Yellow shade 356 as per IS-5

एनटीपीसी NTPC	Project/ परियोजना : TALCHER-III Package/ पैकेज : EPC Supplier/ आपूर्तिकर्ता: Contract No./ अनुबंध सं.:	INDICATIVE LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL क्वालिटी प्लान तथा सब -वेंडर के अनुमोदन सहित मदों की सूची SUB-SYSTEM उप-प्रणाली: BOP SYSTEMS (MECHANICAL)	DOC. NO./ दस्तावेज सं.: REV. NO.: DATE/ तिथि : 04-02-2022 PAGE/ पृष्ठ :	

S. N. क्र.सं.	Item / मद	QP/ Insp. Cat. क्यूपी/ निरी. श्रेणी.	QP No. / क्यूपी. सं.	QP Sub. Schedule क्यूपी उप.अनुसूचि	Proposed sub-supplier/ प्रस्तावित उप आपूर्तिकर्ता	Place/ स्थान	Sub-suppliers approval status / category उप आपूर्तिकर्ता के अनुमोदन की स्थिति /श्रेणी (NOTE-1)	Sub-supplier Details submission schedule/ उप आपूर्तिकर्ता के विवरण प्रस्तुतीकरण की सूची	Remarks/ टिप्पणी	Applicable Systems
2.A	EOT CRANE & ELECTRIC HOIST >5 MT	I (> 10T) / III (>5T UP TO 10T)			REVA INDUSTRIES	FARIDABAD	A		UP TO 60 MT	WTP,CT.AC&VENTILATION,CHP,LHP&GHP,AHP, CW , FDPS
					EDDY CRANE	PUNE	A		UPTO 10 MT	
					CONSOLIDATED HOIST	SATARA /PUNE *	A		SATARA UP TO 20 MT,*PUNE FOR ELECTRIC HOIST UPTO 15 MT	
					ELECTROTHERAPHY	RISHRA	A		UPTO 15 MT FOR ELECTRIC HOIST ONLY	
					HERCULES HOIST	RAIGAD	A		UPTO 15 MT FOR ELECTRIC HOIST ONLY	
					TUBRO FERGUSSON	KOLKATA			UP TO 20MT FOR EOT, UP TO 5 MT FOR FOR ELECTRIC HOIST	
					PRAYAS ENGG (PBL)	V V NAGAR	A		UPTO 10 MT FOR ELECTRIC HOIST ONLY	
					ALPHA SERVICES	ALWAR	A		SINGLE GIRDER EOT CRANE & ELECTRIC HOIST UPTO 15 MT ONLY. GEARBOX FROM	
					CENTURY CRANE ENGINEERS PVT. LTD	BALLABHGARH	A		UP TO 25 MT	
					ARMSEL	BANGALORE	A		UPTO 10 MT EOT & UPTO 15 MT ELECTRIC HOIST	
					TRACTEL TIRFOR	PALWAL	A		UPTO 15 MT FOR ELECTRIC HOIST AND UPTO 10 MT FOR EOT	
					MILLARS INDIA	KARAMSAD	A		UP TO 25 MT	
					AVON CRANES	GURGAON	A		UP TO 25 MT	
					GRIP ENGINEERS	HYDERABAD	A		50 MT (GEARBOX FROM NTPC APPROVED SOURCES FOR EOT CRANE).	
					GRIP ENGINEERS	FARIDABAD	A		UPTO 20 MT ELECTRIC HOIST ONLY	
					CRANEX	GHAZIABAD	A		UP TO 140 MT FOR EOT ONLY	

	MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT	2X660 MW TALCHER SUPER THERMAL POWER PROJECT				
	AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST				
					REV	0	CONTRACT No					
					DATE		CONTRACTOR	BHEL-PEM				
					PAGE	1 of 4						

Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9		**	10		11
1.0	**RAW-MATERIALS**												
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE, ROPE DRUM IF FABRICATED ETC	CHEM & MECH PROPS	MA	Lab analysis	1 SAMPLE PER LOT%	IS 2062 /APPD. DRG./ DATA SHEET		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection.
		NDT	MA	UT	100%	ASTM A388-2004	NOTE 1	IR	√	P	V	V	For dia / plate thickness above 25 mm
1.1 A	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL , MECHANICAL	MA	Lab analysis	1 SAMPLE /pipe	Approved drg/ASTM A 106 Grade A or B		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection
		Flattening & Acid Etching test	MA	PHYSICAL & METALLOGRAPHY	1 SAMPLE /pipe	No cracks, pitting, rusting , damage etc		IR	√	P	V	V	
		SURFACE DEFECTS	MA	Visual	100%								
1.2	FORGINGS FOR GEARS BLANKS ,PINIONS, SHAFT/AXLES, WHEELS , STEEL CASTINGS	MECH , CHEM. PROPS	MA	Lab analysis	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	
		NDT	CR	UT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	**V**	V	IF DIA or THK > 50mm
		Hardeness , surface defects after hardfacing and machining/grinding	MA	DPT/MPI	100%	ASTM E -165 /E-709, No linear indication		MTC	√	P	**V**	V	
1.3	WIRE ROPE	Dimensional, type, constrcution ,	MI	measurement	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V	
		EXAMINATION OF REPORT OF BREAKING LOAD CAPACITY	CR	Review of TC	100%	IS: 2266		MFRS' TEST CERT.	√	P	V	V	
1.4	HOOKS	MECH. , CHEM. PROPS.	MA	LAb analysis	100%	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V/W	V	SHANK PORTION ONLY
		Dimension & PROOF LOAD TESTING	CR	Measurment , PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	√	P	V/W	V	IF REQUIRED BY END CUSTOMER.
		DPT AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V	
1.5	SHEAVES	MECH	MA	Tensile & hardness	1/lot	Approved drgs		MTC/IR	√	P	V	V	

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		2X660 MW TALCHER SUPER THERMAL POWER PROJECT			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE		CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
1.6	CASTING FOR BEARING PLATED, ROPE GUIDES, PULLEYS ETC	CHEMICAL & MECHANICAL	MAJOR	LAB ANALYSIS	1/LOT	APPROVED DRG/MFG STANDARD	APPROVED DRG/MFG STANDARD	LAB REPORT	√	P	V	V	
2.0	**IN-PROCESS**												
2.1	Welding process capability and welder skill	WPS,PQR & WPQ	MA	Welding procedure approval and Welder performance qualification in accordance with ASME Section IX	100%	ASME Section IX		WPS,PQR & WPQ		P	V	V	In case approved WPS/PQR/WPQ from BHEL/NTPC/EIL/LLOYDS/TPL available, then documents/records to be submitted for verification during inspection, else, Vendor shall get the approval of Welding Procedure / Welder from the identified agency prior to carrying out welding at the job.
2.2	Welding of trolley, rope drum etc	Fillet weld	MA	DPT	10%	ASTM E165 or Eq/ No cracks or linear indication		INSPN. REPORT	√	P	V	V	
		Butt welds	MA	RT, DPT	100%	ASME SEC VIII, DIV 1, UW 51/52		RT FILM & REPORT	√	P	V	V	100% RT for butt weld in tension and 10 % in compression. 100% RT on butt weld of rope drum
		DPT AFTER STRESS RELIEVING OF ROPE DRUM	MA	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V	V	
2.3	NDT OF LOAD BEARING BUTT WELDS (**IF ANY)**	WELD QUALITY OF BUTT WELDS IN TENSION	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	W	V/ W	FILMS TO BE REVIEWED BY BHEL & END CUSTOMER/THIRD PARTY. DPT SHALL BE CHP .
2.4	**GEAR BOXES**												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS. LEAK TEST, REDUCTION RATIO, BACK LASH AND CONTACT PATTERN,	MA	MEAS./VISUAL	100%	MFG. DRG./KERSON E TEST	MFG. DRG./NO LEAKAGE WHEN FILLED	INSPN. REPORT	√	P	V		
	NO LOAD RUN TEST FOR 4 HRS	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE ,TEMP. RISE. REDUCTION RATIO, BACKLASH , CONTACT PATTERN	MA	PERFORMANCE	100%	APPROVED DRGS /No leakage,Noise 85dbA maxat 1 mtrs, vibration 75 microns max, oil temp rise 20 deg above ambient max		- DO -	√	P	V	V	
3.0	**ELECTRICALS**												
1	MOTORS & CABLES	Make, type , rating	MA	Visual /measurment	100%	Apprvd drg	IS 325 / IS:3938	IR, MTC	√	P	V	V	For motor refer Note: 2
		ROUTINE TESTS											
3	LIMIT SWITCHES,SFU, ISOLATOR/ O/L RELAY, MCB, FUSES,PUSH BUTTONS,CONTACTOR, INDICATING LAMPS etc	Make , type , rating, functional, Continuity	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
4	BRAKES	Make , type , rating, HV/IR, Functional test	MA	Review of TC	100%	Approved drgs		IR, MTC	√	P	V	V	
5	DSL	Make , type , rating, dimension	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
6	Control transformer	Make , type , rating, input/output	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT					2X660 MW TALCHER SUPER THERMAL POWER PROJECT
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE					ELECTRIC WIRE ROPE HOIST
						REV	0	CONTRACT No					
						DATE		CONTRACTOR					BHEL-PEM
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
`	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICHKNESS, ADHESION TEST * DIMENSION	MA	VISUAL/MEASUR	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V	
8	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V	
4.0	FINAL INSPECTION												

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT			2X660 MW TALCHER SUPER THERMAL POWER PROJECT		
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE			ELECTRIC WIRE ROPE HOIST		
						REV	0	CONTRACT No					
						DATE		CONTRACTOR			BHEL-PEM		
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS.	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:39.	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION , CURRENT MEASUREMENT,LIMIT SWITCH OPERATION.	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD TEST.	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	V	CHP
5	PAINTING												
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade , DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample					P	V		
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P			
	NOTE:												
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.												
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between centerof stud and gland plate and tested in accordance with approved drawing/data sheet.												

		LEGNDS			
		* RECORDS INDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.			
		** M: MANUFACTURER/SUBCONTRACTOR			
		C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY			
MANUFACTURER/ SUB CONTRACTOR		N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY			
		'P'- PERFORM", W"- WITNESS AND "V"- VERIFICATION			
SIGNATURE		" CHP" CUSTOMER HOLD POINT	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL	

1	**RAW MATERIAL & B/OUT ITEMS:**												
1.1	HOOKS	CHEMICAL & MECH	MA	LAB ANALYSIS	ONE SAMPLE PER HEAT	MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS.		MTC.	✓	P	V	V	
		MARK & IDENTIFICATION	MA	VISUAL	100%	HOOK TC FROM COMPETENT AUTHORITY		TC	✓	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%	ASTM A-388	(REFER NOTE I)	IR	✓	P	V	V	ON SHANK PORTION
		PROOF LOAD TEST	MA	REVIEW	100%	IS 15560		TC	✓	P	V	V	
		NDT AFTER PROOF LOAD TEST	MA	DPT	100%	ASTM E-165	NO RELEVANT INDICATTION	TC	✓	P	V	V	
1.2	LOAD CHAIN	- DIMENSIONS	MA	MEASUREMENT	100%	APPD. DRGS	APPD. DRGS.	IR	✓	P	V	V	
		- BREAKING STR & % ELONGATION	MA	-TENSILE TEST	1/LOT	-DO-	-DO-	MTC	✓	P	V	V	
		- PROOF LOAD -HEAT TREATMENT	MA	-TENSILE TEST	100%	-DO-	-DO-	MTC	✓	P	V	V	
			MA	REVIEW	100%	-DO-	-DO-	HT CHRT	✓	P	V	V	
		-GRADE	MA	REVIEW	1/BATCH	-DO-	-DO-	MTC	✓	P	V	V	

1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION MECHANICAL INTERNAL DEFECTS NDT AFTER MACHINING	MA MA MA MA	Review Review UT DPT	ONE SAMPLE PER HEAT 100% 100%	Material specification as per approved drawings. ASTM A-388 REFER NOTE 1 ASTM E-165 NO RELEVANT INDICATION		MFR'S TC IR TC	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.
1.4.	LOAD CHAIN WHEELS	- CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOUGE NO.	MA	VISUAL	RANDOM	APP DRG / MFR"S CATALOGUE	APP DRG / MFR"S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100%	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	

1.8	TROLLEY GEARS, PINION,WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	**IN PROCESS**												
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS -SURFACE CRACK	MA MA	HARDNESS DPT	100% 100 %	IS:3832/ APPD DRG. ASTM E165	IS:3832/ APPD. DRG. NO DEFECT	IR IR	✓ ✓	P P	V V	V V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT SURFACE HARDNESS SURFACE CRACK DIMENSION	MA MA MA MA	HT CHART HARDNESS DPT FOR SURFACE CRACK MEASURE	100% 10% 100% 10%	IS 1875/IS 4367/IS 3832 --DO-- ASTM E 165 IS 3832	NO DEFECT	IR IR IR IR	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	
3.0	**FINAL INSPECTION**												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION ENDURANCE TYPE TEST OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT. HEIGHT OF LIFT	CR MA CR MA	MEASUREMENT TYPE TEST LOAD TEST VISUAL	100 % 1 PER SIZE 100% 100 %	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IR TC IR IR	✓ ✓ ✓ ✓	P P P P	W V W W	V V V V	

		SWIVELING OF HOOK EFFORT	MA MA	VISUAL PULL ON CHAIN	100% 100%	APPROVED DRG -DO-	APPROVED DRG -DO-	IR IR	✓ ✓	P P	W W	V V	
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM	APPROVED DRAWING/ **SPECIFICATION**	APPROVED DRAWING/ **SPECIFICATION**	IR IR		P p	--- W	--- ---	
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	---	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	---	---	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	

CR – CRITICAL, MA – MAJOR , MI – MINOR

NOTE 1: WHEN BACK WALL ECHO (BWE) IS SET AT 100% OF FULL SCREEN HEIGHT (FSH) IN DEFECT FREE AREA THEN
(A) DEFECT ECHO SHALL NOT EXCEED 20% OF FSH &
(B) BWE SHOULD BE MINIMUM 80% OF FSH IN ANY AREA.
NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

SECTION- I
SUB-SECTION-C-1
TECHNICAL SPECIFICATION
(OPERATION AND MAINTENANCE SERVICES FOR AC SYSTEM)

1.0 OPERATION AND MAINTENANCE SERVICES

The bidder scope also covers the Operation and Maintenance (O&M) services for Preventive and Breakdown maintenance from the date of successful commissioning till handing over to end customer. However, actual date of start of O&M services shall be communicated to successful bidder by BHEL site personnel.

Bidder to note that the spares and consumables required for maintenance of the equipment during this O&M period shall be in bidder's scope of supply. Bidder shall use only genuine parts as mentioned in O&M Manual. Any damage or malfunction caused by the use of unauthentic parts or unqualified personnel shall be responsibility of bidder and as a consequence of above bidder is required to replenish the unauthorised part and abridge the qualified person without any commercial implication to BHEL.

O&M Services scope also covers all regular maintenance by trained service engineers and supply of genuine parts and lubricants as per the original equipment manufacturer's recommendations.

For the purpose of Operation of AC System, One-day shall be considered as 24 hours i.e. 3 shifts of 8 hours each. The AC System (along with related accessories) shall be operated on Round-the-clock basis on all the days of the year including Sundays and Public Holidays

O & M Personnel should be acquainted with local language. Governmental / Statutory approval w.r.t. O&M service as applicable shall be in bidder's scope.

Total duration of the Operation and Maintenance services has been envisaged for six (06) months for individual AC plants/control buildings identified in price format/specification. The duration of operation & maintenance services can be increased or decreased as per requirement and payment in such case shall be made on pro-rata basis.

The operation and maintenance services can be continuous or intermittent as per site requirement for individual AC plants/control buildings identified in price format/specification.

Bidder has to compulsorily maintain log book for the O & M staff engaged for O&M jobs and submit to Engineer in charge for certification for realization of the bills. After certification of the bill by Engineer in charge of BHEL, bidder shall claim the amount after completion of minimum 30 days.

Depending on start of O&M services, there is a possibility that some period of O&M services and Warranty period may overlap. **However, it is clarified that any maintenance required or any spare of AC System required to be replaced during Warranty period (as part of warranty clause requirement) shall not be made part of O&M Services. Bidder may take care of this fact while working out the prices of O&M services**

Wherever AC system has been written in O&M Service Specification, the same shall be deemed as complete AC System.

The vendor shall deploy following minimum manpower for Operation of AC System.

i. Two qualified and experienced AC operator per shift on "Round the Clock" basis throughout the year for all days of the year including Sundays & Public Holidays. There must be minimum 30 minutes overlapping between two shift operators to get familiarize with the status of AC System.

ii. Two Helper per shift on " Round the Clock" basis throughout the year for all the days of the year including Sundays and Public Holidays. The helper shall assist the AC System Operator in day to day operation of AC System and accessories and shall assist him for keeping AC System equipment's in neat and tidy condition.

1.1 Responsibility of AC System Operator

i. AC System operator shall be responsible for proper sequential operation of AC System including operation of standby equipment in a predefined sequence and stopping the same (when necessary) as per the procedural practice. In case of any abnormality (like non availability of power supply at incomer of AC System), he shall immediately report the matter to BHEL site Engineer for further action. Similarly, any malfunctioning in the system shall be immediately reported by him to BHEL site Engineer for suitable corrective action irrespective of time of occurrence of malfunctioning / abnormality in the system. A log book of all such outrages shall be maintained by AC system operator, which shall be shared with BHEL site engineer on periodic basis.

ii. AC System operator shall take hourly readings of all the parameters of AC System / Equipment's including reading on main electrical panel of AC System. Temperature & RH readings inside all AC areas shall be taken at least once in a day. All the readings shall be recorded in a logbook register.

1.2 Responsibility of Helper.

i. The AC System helper shall assist AC System operator for day to day smooth operation of AC System, like Checking of water levels of cooling tower, cleaning of Tanks, cleaning of strainers, checking water parameters of softening plant cleaning of AHU filters and other filters etc. as and when required. He shall be responsible for keeping all the equipment's of AC System as applicable in clean and tidy condition. He shall also carry out general cleaning of all AC equipment's including Electrical Panels (Part of AC System), AHU's etc. on regular basis.

ii. The helper shall work under the control of AC System operator and shall always ensure that unusable junk materials are not allowed to be kept in AC System room or AHU rooms.

iii. Under such eventuality, he will report the matter to Plant Operator, who in turn will take suitable action including reporting the matter to BHEL site Engineer.

1.2.1 All the log book registers shall be arranged by vendor. Log book register duly paged and bounded will be maintained in good condition by vendor.

1.2.2 All the necessary tools & tackles and other materials, required for operation of AC System shall be kept by vendor under the control of AC System operator. These tools & tackles shall be separate from tools & tackles (as per price format) which shall be handed over to customer in new condition. Required testing instruments like refrigerant leak detector, Multi Meter (for Electrical portion of AC System), Sling pshycrometer, Line Tester, Tool Kit, Torch, vacuum pump, oil charging pump, Pressure testing kit etc. should also be always available with Plant Operator.

1.2.3 In case of any operator / helper being on leave, vendor shall immediately take advance action and provide substitution so that minimum manpower as indicated above is not reduced on any day. In case a particular shift duty A/C Operator or helper does not turn up due to any reasons, the earlier duty person shall continue to make sure that AC System never remains unattended.

2.0 Maintenance of AC System

i. Maintenance work under scope of the vendor shall broadly include but in no way limited to the following:

a) Preventive maintenance of the plant.

b) Servicing of the AC plants and associated equipment's at regular interval

c) Attending to complaints.

d) Replacement of worn out or defective components

e) Replacing of consumables like refrigerant gas, oil, chemicals and salt for softening plant as and when required.

No consumable or any other items of AC system shall be arranged by Customer and no extra payment shall be made by customer in this regard.

ii. Vendor shall be responsible at all time, during the entire period of contract for satisfactory performance of AC system (including accessories) with zero down time. During emergency or breakdown, vendor's Engineer along with related technicians shall be available immediately even though it may be beyond normal working hours or on public holidays till the AC System is restored back into normal satisfactory condition. Response time for attending breakdown complaints shall not exceed 2 hours.

iii. Defective / worn out components shall be replaced only by genuine and original parts. OEM or its authorized dealer's invoice shall be submitted as proof of using genuine parts. All common spares required for AC system shall normally be kept available in the plant by the vendor. However, for critical spares, the same shall be made available in not more than 72 hours from the time of break-down requiring such spare.

iv. Preventive Maintenance, servicing of AC System equipment's and accessories etc. shall be done by vendor in a planned manner in consultation with concerned customer's engineer. Preventive maintenance and service should be done as per the recommendations / guidelines of various OEMs

v. Major servicing & over handling of equipment's like compressors, evaporators, condensers, pumps, AHU's, piping / ducting works, valves etc. shall be done by vendor once in a year.

vi. In case any repair/services of particular equipment of system like chiller unit is to be carried out by vendor through OEM (or their authorized dealer), all the arrangements including tools, O&M spares etc. shall be the total responsibility of vendor.

vii. Vendor shall arrange and maintain separate logbook register for services / maintenance of AC System. Record of work done for services/maintenance repairs etc. shall be recorded by vendor's engineer in this register. This register shall always be with updated records & shall be produced to customer's engineer on weekly basis or as & when required by him.

viii. Vendor shall arrange and maintain sufficient stock of spares and consumable at site (AC room). Similarly, all necessary tools & instruments required for the purpose of servicing / maintenance / routine testing etc. shall also be arranged by vendor and should be available at site at all times.

ix. Repairs / servicing works shall normally be done by vendor at site up to maximum possible extent. However, in case any equipment or accessories is essentially required to be taken by vendor out of the plant premises for repairing / servicing, all necessary arrangements including to and fro transportation shall be the responsibility of vendor. Vendor shall also inform concerned customer's engineer for doing procedural formalities (like issue of gate pass etc.), prior to taking out the materials out of Plant premises.

x. In case bidder fails to supply the spares required for maintenance of the equipment, same shall be provided by BHEL at Bidders risk and cost.

xi. Vendor shall be fully responsible for safety of his personal at all times. Vendor shall also be responsible for taking all safety precautions at all the times, especially during servicing / preventive maintenance and repairs of AC System equipment's etc.

xii. All the safety controls of AC Plant such as HP, LP, OP, Water pressure switch, inter locking etc. shall be positively checked at least once a month and same shall be recorded by vendor engineer

xiii. Technicians & helpers engaged by the vendor shall wear uniform with nameplate for easy identification, while being within plant premises

xiv. Vendor's engineer shall be focal point for customer. He shall report to customer engineer on daily basis, for taking necessary instructions and to update the status of AC system

xv. If any damage to the equipment and its accessories has happened due to improper maintenance by bidder shall be recovered from the bidder.

xvi. Bidder is to arrange all the safety gears like helmets, air plugs, safety shoes etc. during the maintenance for the O&M Staff.

xvii. Bidder shall have to maintain storage shed along with site office during O & M contract also

xviii. Fabrication and erection of platform/extra support for AC areas if felt necessary during operation and maintenance of the system has to be done by the bidder.

Notes:

1. The bidder shall take approval from Engineer-in charge of BHEL by submitting organization Chart of O&M staff for this site clearly indicating man power deployment with their educational background & experience with supporting documents.

2. The bidder shall be solely and wholly responsible for safety and security of workers engaged in the job and the BHEL property. In case of any accident the contractor shall pay proper compensation to the workers as per workmen's compensation act and repair/replace BHEL property at their own cost & arrangement. The bidder shall also make adequate provision of insurance for their workers at their own cost to cover them against the risk of accident.

3. The bidder and their workers engaged in the job shall follow all safety rules at the time of execution of work. It shall be responsibility of the bidder to supply all safety equipment as necessary to its O&M staff.
4. Beyond general shift if any trouble/breakdown occurs in the plant, Maintenance team must reach the plant without any delay along with Engineer/Site In-charge.
5. No Person from the list of manpower shall leave the plant site without prior permission from the Engineer in charge of BHEL.
6. However, in operation part, if any person is absent, substitute must be given immediately otherwise proportionate deduction will be made

7. The replacement / substitute personnel for maintenance, manpower shall have the same educational qualification and experience.
8. If any additional manpower is required during O&M whatsoever under the scope of contract the same shall be made available by bidder in time within the cost. To cater the need of time bound maintenance jobs, the bidder shall depute additional manpower without any cost implication to BHEL
9. During execution of work if any personnel is found not suitable for the job or his presence inside powerhouse premises is felt undesirable, the personnel has to be replaced within 15 days.
10. BHEL will not be responsible for payment towards idle labour charges

Statutory Compliance by the bidder:

All Statutory compliances related to Labour, Health & Safety, Quality & Environment protection and insurance shall be as GCC Rev-07.

SECTION: I

SUB-SECTION: C 2

CUSTOMER SPECIFICATION

SECTION: I

SUB-SECTION: C2A

CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT

1.00.00 AIR CONDITIONING SYSTEM

a) General

Complete air conditioning system consisting of water cooled chilling units, condensing units, chilled water pumps & drives, condenser water pumps & drives, piping, valves & fittings, cooling towers, air handling units, VFD drives for motors (wherever applicable), hi-wall / cassette split air conditioners, fresh air fans, air distribution system (ducting, filters, isolation/volume control dampers, motorized fire dampers, diffusers, grills, VAV box as applicable, etc.) along with all electrical equipment and instrumentation as detailed out in Part-B of Section-VI.

b) Centralized air-conditioning system for main plant TG building

There shall be one (1) central chilled water type air-conditioning plant comprising of screw chilling units, chilled water pumps, condenser water pumps, AHUs, cooling towers, etc. to cater to the A/C requirement of the areas identified for main plant areas like common control rooms, control equipment rooms, UPS/Battery charger rooms, static excitation control rooms (if applicable), SWAS room, water analysis lab, etc. of Unit # 1 and Unit # 2.

c) Centralized air-conditioning system for Ash handling control room, ESP control room buildings and FGD control room building

There shall be one (1) central, water cooled chilled water type air-conditioning plant comprising of screw chilling units, chilled water pumps, condenser water pumps, AHUs, cooling towers, etc. to cater the A/C requirement of the areas identified for Ash handling control room, FGD control room, ESP control rooms, etc. of Unit # 1 and # 2.

d) Centralized air-conditioning system for service building

Energy efficient air-conditioning system for service building shall be designed in-line with ECBC code to make it “Green Building”.

There shall be one (1) central chilled water type air-conditioning plant comprising of screw chilling units, chilled water pumps, condenser water pumps, AHUs, cooling towers, etc. to cater to the A/C requirement of the office areas, etc. of service building.

e) Centralized air-conditioning system for administrative building

Energy efficient air-conditioning system for administrative building shall be designed in-line with ECBC code to make it “Green Building”.

There shall be one (1) central chilled water type air-conditioning plant comprising of screw chilling units, chilled water pumps, condenser water pumps, AHUs, cooling towers, etc. to cater to the A/C requirement of the office areas, etc. of administrative building.

f) Air-conditioning system for Water System Control Building

Air cooled condensing units (D-X type) mainly comprising scroll compressor, drive unit, condenser, AHUs, interconnected refrigerant piping, controls, instruments, base frame, etc.

g) **Air-conditioning system for switchyard (GIS Control Building)**

NA

Air cooled condensing units (D-X type) mainly comprising scroll compressor, drive unit, condenser, AHUs, interconnected refrigerant piping, controls, instruments, base frame, etc.

h) **Air-conditioning system for Canteen Building**

Air cooled condensing units (D-X type) mainly comprising scroll compressor, drive unit, condenser, AHUs, interconnected refrigerant piping, controls, instruments, base frame, etc.

Canteen building shall be designed in-line with ECBC code to make the building 'Green Building'.

i) Packaged/Split air-conditioners for various auxiliary control rooms/RIO rooms/VFD rooms and office areas of offsite buildings (like O&M store, Gate Complex, O&M workshop, etc.) as detailed out in Part-B of Technical Specification.

j) Apart from the above, any area/building which are in the scope of the Bidder and require air conditioning, those areas/buildings shall be provided with air conditioning system, as detailed out in Part-B of Technical Specification.

k) Supply of mandatory spares as specified.

l) Any additional items which may not be specifically stated in the specifications but are required for completeness of the system shall be supplied by the Contractor.

m) For air conditioning system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition. The Bidder shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications.

n) Control system of air-conditioning system is indicated in Sub-Section-IIC, Control & Instrumentation, Scope of Supply & Services, Part-A of Technical Specifications.

2.00.00 VENTILATION SYSTEM

a) **General**

NA

Complete Ventilation system consisting of modular type air washer units, supply air fans, roof extractor fans, exhaust air fans, louvers, filters, ducting, diffusers, piping, instrumentation etc., for all the buildings which are in the scope of the Bidder, as detailed out in Part-B of Section-VI.

b) **Turbine hall building and associated areas**

i) Minimum ten (10) nos. of air washer units (of metallic construction modular type) each of minimum capacity 1,00,000 m^3/hr, with all accessories, 1 no.

e) The complete installation, testing, commissioning & training shall be carried out by the Contractor under the supervision of the Manufacturer/ designer at site.

f) The performance test of the system shall be carried out by releasing the agent gas in a selected area and design parameters shall be measured. All equipments, refilling of gas after test, instruments etc. shall be provided by the contractor for the same.

SAFETY

(a) All the safety requirements recommended in NFPA -2001 or as specified by listing authorities shall be incorporated in the installation by the bidder.

(b) Appropriate warning signs shall be fixed outside of those areas protected by the system and also in areas where the gas may spread indicating clearly the hazard associated with the system such as Noise, turbulence, cold temperature, physiological effects on personnel etc.

(c) Apart from written warnin[illegible]rning signs (i.e) hooters & strobe lights shall be provided [illegible] discharge activity. The sounder shall have selectable tone options.

NOT APPLICABLE

(d) The gas shall be discharged after a set time delay on receiving signal from the fire detection system. The duration of the timer shall be upto a range of 0- 5 minutes (adjustable in I minute variation) at site after conducting test to find out the duration for evacuation of the personnel from the area.

(e) To prevent the loss/release of gas automatically or manually during maintenance, the system shall have the facility of "LOCKOUT". The status of the system lockout condition shall be annunciated audio-visually in the panel.

Pressure Venting

Since huge quantity of gas is envisaged to be released, proper pressure relief and ventilation systems such as fans, dampers, etc. shall be provided by the contractor. Required openings in the civil structure shall be provided by the owner. The contractor shall submit pressure relief, venting calculations, its requirement and suggestive mode of ventilation during detailed engineering for approval.

3.13.00 AIR CONDITIONING AND VENTILATION SYSTEM

Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
Summer	43	27
Monsoon	34	28
Winter	11	5

GENERAL REQUIREMENTS

1. The layout of all equipment and accessories shall be developed in a way to facilitate easy accessibility and maintenance of all equipments.

2. Each equipment shall be provided with suitable lifting arrangement, e.g. Lifting lugs, eye bolts, etc to facilitate maintenance.

3.13.01 **DESIGN PHILOSOPHY - Air conditioning system**

1. Design ambient conditions for all air conditioning system shall be as indicated below:
2. All equipments of Air Conditioning system shall be designed for continuous duty.
3. All air conditioned areas like control room, control equipment rooms, Service building, administrative building etc. shall be maintained at 24 deg. C ± (plus or minus) 1 deg. C and relative humidity of 50% ± (plus or minus) 5%.
4. The fresh air quantity for air-conditioned areas of ESP Control Room / AHP Control Room /FGD control room, Control Room / Control Equipment Room / UPS, Water System Control Room Building, GIS Control Room Building, etc. shall be 0.45 M3/minutes/person or 1.0 air change per hour whichever is greater. However, for areas like service building, administrative building, canteen, etc. quantity of fresh air shall be minimum 1.5 air changes per hour.
5. Lighting load shall be one (1) Watts/Sq.feet or actual whichever is higher.
6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room/meeting room the same shall be one per 3 Sq.M. In the control rooms, control equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum).
7. In Air conditioning system the return air shall be through ducts and use of plenum space for return air shall be avoided. Further, FGD control room and ESP Control Room, service building, etc. where various floors are air-conditioned and no intermediate or intervening floor are left non-air-conditioned, the space above false ceiling shall be used as return air plenum.
8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls (with perfect partition i.e. partition both above & below false ceiling) and floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts shall be provided in control panel of A/C plant by the Contractor for further wiring upto fire alarm panels.
9. Soft water make up (if required) for complete air conditioning and ventilation system shall be provided by the bidder.
10. Design Chilled water flow shall not be less than 0.7 Cu.M/hr per TR air-conditioning load and design condensing water flow shall not be less than 1 Cu.M /hr per TR air-conditioning load.
11. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec. Water piping shall be sized for a maximum velocity of 2.0 m/sec. However, gravity flow / pump suction line shall be sized for a maximum water velocity of 1.5 m/sec.
12. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec.
13. Requirement of Underdeck Insulation (for A/C area)

14. Underdeck insulation of 50 mm nominal thickness of glass wool (32 Kg/cu.m) or rock wool (48 Kg/cu.m) shall be provided if

i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area.

ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area.

iii) Underneath the ceiling of AHU room located below the non-A/C area or exposed to Atmosphere.

15. For air handling unit (AHU) serving main plant control area, where microprocessor based equipments are located, the dehumidified air shall be filtered at three different stages i.e. pre (coarse) filter followed by fine filter followed by HEPA filter before discharge it to conditioned space. For all other areas, AHU's shall be provided with two stage of filteration i.e. pre and fine filter. All fresh air supply fans shall also be filtered using pre and fine filter.

16. A minimum design margin of ten (10) % shall be considered in design of AC Plant Capacity for each area. Twenty (20) % design margin shall be considered for the cooling tower capacity over the selected A/C capacity provided. Head of the pumps shall take into account min. ten (10)% margin on friction head. For pumps, continuous motor rating (at 50^{o}C ambient) shall be atleast 10% above the maximum load demand of the pump in the entire operating range.

17. For other areas, where A/C load is of the order of 25-60 TR, Direct Expansion (D-X) type air cooled condensing units alongwith AHUs shall be provided depending on the availability of space/ layout etc. For areas, where A/C load is of the order of 5-25TR, ductable split/packaged A/C shall be provided. Smaller areas which are away from the D-X type condensing unit /central chilling units which may require air conditioning upto 5 TR rating shall be served with Hi-wall Split/Cassette air conditioner units as per requirement. Above 60TR of A/C load, chilled water type centralized A/C system shall be provided.

18. Valves at discharge of pumps, outlet of chillers and inlet of cooling towers or any other valve (if needed as per system requirement) in the system shall be motor operated type for remote operation of the Air conditioning system.

19. Air Conditioning system for Service Building, Canteen Building, Administrative Building, etc. shall be designed in- line with ECBC code to make it "Green Building". Mandatory Requirements of ECBC to be followed for A/C Equipments:

19.1. Pumping System	:	Pumping System: Secondary chilled water pumping system should be of variable flow type i.e. secondary pumps should be VVVFD driven. condenser water pumping shall be constant flow type.
19.2. Variable air flow	:	AHUs should be of variable flow type i.e VVVFD driven.
19.3. Refrigerant	:	Refrigerant should be CFC/HCFC free.

19.4. Insulation for A/C air ducts: A/C ducts shall be insulated.

19.5. All types of Insulation used for HVAC application shall be CFC/HCFC free.

19.6. CO2 Sensors for optimum use of fresh air and Occupancy Sensors for operation of VAV Box .

20. During normal operation period, all the working equipment shall run on A.C. power supply. However, in case of complete black-out condition, DG sets being provided are required to cater the load of some of the air-conditioning equipment so that Main Plant Control Rooms and CER remain air-conditioned. The equipment to run on DG set are:

- 1 No. Chilling machine
- 1 No. chilled water pump.
- 1 No. condenser water pump.
- 1 No. cooling tower fan.
- 2 nos. AHUs for CR & CER
- 1 No. fresh air fan.

21. As per ECBC codes minimum coefficient of performance (COP) for the chiller shall be as follows (based on AHRI conditions):

A. COP of the water cooled chiller:

Sl. No.	Chiller Capacity (kWr)	Min COP
01.	<260	4.7
02.	≥ 260 & < 530 TR	4.9
03.	≥ 530 & < 1050 TR	5.4

B. COP for air-cooled chillers:

Sl. No	Chiller Capacity (kWr)	Min COP
01.	< 260	2.8
02.	≥260	3.0

3.13.02 DESIGN PHILOSOPHY – Ventilation System

1. Minimum Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:

i)	For all evaporative cooled areas	-	8
ii)	General areas	-	20
iii)	Hydrogen generation plant/MCC/ Switchgear rooms and Battery rooms& other are gaseous fumes/ vapours are generated	-	30

NOT APPLICABLE

2. However in areas producing lot of heat, temperature shall be the criteria as follows:-

a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas.

b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas.

SUB-SECTION–A-17

AIR CONDITIONING

AIR CONDITIONING SYSTEM

1.00.00 GENERAL

1.01.00 This section of specification covers details of system specifications, detailing the areas to be air conditioned, basis of design, brief description of the system, equipment and services to be furnished by bidder. The supply, delivery and erection of the entire equipment listed here shall be in bidder's scope of work.

2.00.00 CODES & STANDARDS

2.01.00 The design, manufacture and performance of equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipments are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility.

2.02.00 Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.

3.00.00 REDUNDANCY OF EQUIPMENTS

3.01.00 Redundancy of various A/C system equipments shall be as follows:

a) For Main Plant Areas [control room, control equipment room, UPS room, battery charger, static excitation control room (if applicable) SWAS room & water analysis lab] for Unit 1& 2:

i) Vapor compression type water chilling units: 3X50%
ii) Chilled water pumps: 3X50%
iii) Condenser water pumps: 3X50%
iv) Cooling Towers: 3X50%
v) AHUs: At least one (1) no. unit, capacity same as each working unit shall be provided as common standby.

b) For ESP control rooms, FGD control room, AHP control room, etc. of Unit # 1 & 2:

i) Vapour compression type water cooled chiller units: 3X50%
ii) Chilled water pumps: 3X50%.
iii) Condenser water pumps: 3X50%.
iv) Cooling Towers: 3X50%.
v) AHUs: 2x100% AHUs for each control room of ESP/FGD/AHP Building.

c) Service Building:

i) Screw type water chilling units: 2X50%
ii) Primary Chilled water pumps: 2X50%
iii) Secondary chilled water pumps (with VVVFD): 2X50%
iv) Condenser water pumps: 2X50%
v) Cooling Towers (with VVVFD Fan): 2X50%
vi) AHUs (with VVVFD Fan): All working & no standby.

d) Administrative Building:

i) Screw type water chilling units: 2X50%
ii) Primary Chilled water pumps: 2X50%
iii) Secondary chilled water pumps (with VVVFD): 2X50%
iv) Condenser water pumps: 2X50%
v) Cooling Towers (with VVVFD Fan): 2X50%
vi) AHUs (with VVVFD Fan): All working & no standby.

e) Water System Control Room Building:

i) Air cooled (D-X Type) condensing units: 2X100%

ii) AHUs: 2x100%

f) GIS Control Room Building:

i) Air cooled (D-X Type) condensing units: 2X100%
ii) AHUs: 2x100%

g) Canteen Building:

i) Air cooled (D-X Type) condensing units: 2X50%
ii) AHUs (with VVVFD): 2x50%

h) 100% standby shall be provided for control rooms/RIO room/etc. served by ductable split/package type air conditioners.

At least one (1) no. unit, capacity same as each working unit as a common standby shall be provided for control rooms/RIO room/etc. served by non-ductable split (cassette / Hi-wall) type air conditioners.

No stand-by shall be provided for office areas of offsite buildings (like O&M store, Gate Complex, O&M workshop, etc.).

i) Fresh air fans shall be 1 x 100 % capacity for each AHU room. However, AHUs of Service Building/Admin Building/Canteen Building shall be provided with modulating fresh air dampers (with filters) to regulate fresh air based on feedback from CO2 Sensors.

j) 24 hours operational rooms/areas (located in buildings served by 12 hours operational centralized A/C system) shall be provided with standalone A/C system as standby. Type of A/C system shall be as per design criteria stipulated in the specification.

k) VFD Drive shall be provided with bypass contactor for motors with standard features like indication, manual and Auto set point facility, control power source, capable of changing supply frequency from 50% to 125%, bypass harmonies suppression, etc.

3.02.00 Redundancy of ventilation system equipments shall be as follows:

a) Pump and fan for Air washer / UAF units shall be 1x100% for each unit.

4.00.00 EQUIPMENT DESCRIPTION – AIR CONDITIONING SYSTEM

4.01.00 **Vapour compression type machines**

4.01.01 Each chilling unit shall comprise of compressor with drive motor, Water Chiller/evaporator, Chilled water pumps, Condenser Cooling Water pumps (if applicable) other accessories such as supporting structure, vibration isolators, insulation, piping, valves, instrumentation, microprocessor / PLC based Control panel, etc. Chilling unit shall have stepless capacity control. The screw/centrifugal compressor based chilling unit to be supplied shall be ARI /Eurovent/Equivalent standard certified (if applicable).

4.02.00 **Chilling Unit**

Type		Type: Water-cooled type. (Chillers for main plant shall preferably be with multiple compressors)
Vibration isolators	:	Steel spring/ Neoprene rubber cushy foot/ neoprene serrated rubber pad type with isolation efficiency not less than 85%.
Compressor Type	:	Compressor shall be Screw type (open/semi-hermetic/multiple hermetic)
Type of drive	:	Motor driven, along with Star delta/Double delta Starter.
Capacity	:	Minimum capacity shall be suitable for the identified/selected evaporating temperature and

		condensing temperature.
Condenser		
Type	:	Water cooled shell and tube type.
Fluid	:	Shell side – Refrigerant
	:	Tube side - Water
Capacity	:	To match with respective compressor and to provide atleast 2 deg. C sub-cooling. To store full charge of refrigerant.
Design fouling Factor	:	Not less than 0.0002 (in MKS units)
Shell material	:	Mild steel (IS: 2062) / SA 106 Gr. B
Tube material	:	Replaceable seamless copper
Fin material		Copper
Accessories	:	As required such as Purge and drain connections, relief valves, liquid line shut-off valves, refrigerant filling charging, flow switches, Isolating valves, pressure & temperature indicators at inlet and outlet etc.
Refrigerant	:	The refrigerant shall be R-134a/R-410A/R-407C or any other environment friendly refrigerant.
Steel structure	:	The complete condensing/ chilling unit shall be mounted on steel structure and shall be provided with necessary vibration isolators
Inlet temperature		33-36 o C.
Leaving temperature differential	:	Maximum 5 o C.
Evaporator		
Type	:	Shell and tube type
Superheating of	:	At least 2 deg.C
Design Fouling Factor	:	Minimum 0.0001 (MKS units)
Fluid	:	Shell side - Refrigerant
	:	Tube side - Water
Capacity	:	To match with respective plant capacity.
Shell material	:	Mild steel (IS : 2062) / SA 106 Gr. B
Tube material		Plain tube internally /externally finned copper as per the manufacturer's standard practice.
Fin material	:	Integral
Accessories	:	Purge and drain connections, Isolating valves, flow switches, Pressure & temperature indicators at inlet and outlet, Anti-freeze thermostats, electronic expansion valve or float assembly as applicable, pilot solenoid valve, Relief valves, Operating thermostats for capacity control, supporting frame, etc.
Steel Structure	:	The complete condensing/ chilling unit shall be mounted on steel structure and shall be provided with necessary vibration isolators.

4.03.00 Condensing Unit -Air-Cooled (D-X type)

Condensing unit

Type	:	Air cooled scroll type
Vibration isolators	:	Steel spring / Neoprene rubber cushy foot type with isolation efficiency not less than 85%.
Compressor		
Type	:	The Compressor shall be scroll, serviceable, either hermetic type or semi-hermetic type with automatic

		capacity control (minimum 3 steps).
Type of drive	:	Motor driven.
Refrigerant	:	The refrigerant shall be R-134a/ R-410A/R-407C or any other environment friendly refrigerant.
Accessories	:	High/Low pressure cutouts, oil pressure switches, relief valves, pressure gauges at each stage, lube oil and control oil pressure gauges, suction & discharge stop valves, Muffler, Crank case heaters, oil filters, magnetic oil separators, temperature indicators for lube oil/heaters, oil level indicators, safety thermostat for crank case heater, vibration isolators, etc.
Capacity	:	Minimum capacity shall be suitable for the identified/selected at evaporating temperature and condensing temperature and shall be indicated.

4.04.00 **Air Handling Unit (AHU)**

4.04.01 Each AHU shall consist of casing, fan impeller section, cooling coil section, damper section, steel frame with anti vibration mountings (AVMs) having minimum 85% vibration dampening efficiency and flame retardant, water proof neoprene impregnated flexible connection on fan discharge. Isolation dampers at the suction and discharge of each AHU shall be provided, in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) and absolute (HEPA type) filters (wherever applicable) at the discharge of each individual AHU, and heater section in the common discharge of AHUs. NRD shall be provided at outlet of each AHU when multiple AHU used for a common plenum.

4.04.02 The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24g) galvanized steel sheet (thickness of galvanization as per manufacturer's standard) , with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements shall be provided to give structural strength to prevent any deformation/buckling.

4.04.03 Sloping condensate drain pan shall be made of minimum 1.2 mm thick Stainless Sheet Steel. It shall be isolated from bottom floor panel through 25mm thick heavy duty treated for Fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.

4.04.04 Cooling coil (min. 4 row deep) shall be made of seamless copper tubes with aluminium fins firmly bonded to copper tubes and shall be provided with suitable drains and vents connections.

4.04.05 All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.

4.04.06 **Centrifugal fan**

a)	Fan Type	:	Double Width Double Inlet (DWDI) Centrifugal Type
b)	Fan impeller	:	Backward curved blades
c)	Casing material	:	GI /Mild steel with minimum thickness of 3 mm.
d)	Impeller material	:	Carbon steel
e)	Shaft	:	EN 8 Steel

f)	Fan bearings	:	Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.
g)	Critical speed	:	First critical speed of rotating assembly shall be at least 25% above the operating speed.
h)	Drive	:	Motor driven with removable belt guard. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.
i)	Fans	:	For AHUs of capacity 50,000 CMH and above, Bidder may offer two (2) Nos. centrifugal fans of equal capacity for each AHU provided all such AHUs are accommodated within the space identified by the Employer.

4.04.07 **Mixing Box:**

Mixing box shall be complete with fresh and return air dampers. Mixing box shall be provided whenever the return air is ducted back to the AHU.

4.04.08 **Pan Humidifier:**

Pan humidifier shall be made of 22 gauge SS 304 tank, duly insulated with 25 mm thick resin bonded fiber glass insulation (min. 24 Kg/m3 density) with 0.5 mm GSS cladding. The humidifier shall be complete with stainless steel immersion heaters, safety thermostat, float valve with stainless steel ball, sight glass, overflow and drain connections, steam outlet nozzle and float switch. Step controller shall be provided for switching on / off heater banks as per system requirement.

4.05.00 NON DUCTABLE SPLIT (HI-WALL/CASSETTE), DUCTABLE SPLIT, PACKAGED AIR-CONDITIONERS

4.05.01 Air conditioners shall in general consist of the following:

i) Casing
ii) Hermetically sealed rotary/scroll Compressor
iii) Air-cooled condenser
iv) Evaporator and condenser cooling fan
v) Cooling coil
vi) Filters
vii) Piping, valves, refrigerant strainer, etc.
viii) Controls, instruments, control panel/starter panels.
ix) Vibration isolator pads, ducting (if applicable), etc. as required.
x) Refrigerant as per manufacturer practice.

Note: (1) Humidity control inside air-conditioned space served by non-ductable split air conditioners is not envisaged.
(2) Split air conditioner shall conform to minimum three (3) star (***) rating and above of latest version of Bureau of Energy Efficiency (BEE) HVAC code issued by Ministry of Power, Govt of India.

4.05.02 Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type):

The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view.

Unit shall have four-way supply air grills on sides and return air grill in center.

Each unit shall have high lift drain pump and very low operating sound.

4.05.03 **PACKAGED AIR-CONDITIONERS**

(a) Packaged air conditioners shall be an encased assembly as a self-contained unit primarily for floor mounting, designed to provide free delivery of conditioned air to the conditioned space. It shall include a primary source of refrigeration for cooling and dehumidification, means for circulating and cleaning air and means for heating and humidifying air. Fresh air fan shall be provided in PAC Room.

(b) The cabinet, housing the components of packaged air conditioners, shall be of heavy gauge sheet steel and suitable for floor mounting. The access panels shall be of easily removable type. The entire casing shall be thermally insulated with 25 mm thick insulation of totally flame proof type (T.F. type). Suitable drain connection shall be provided for removal of condensate collected inside a tray under cooling coil.

(c) Controls shall be so provided that failure of one equipment of PAC will automatically trip that PAC unit.

(d) HP and LP cutout shall be provided for compressor protection. A thermostat with adjustable setting shall also be provided in the return air circuit to control the room temperature by ON-OFF mode.

(e) Provision shall also be made for manual re-starting and stopping of the compressor.

(f) Interlock shall be provided such that compressor can start only starting the air handling fan.

(g) Interlock shall be provided so that compressor can start only if condenser fan in running. Further if the condenser fan stops, the compressor shall also trip.

(h) To control the humidity throughout the year, the humidistat shall be interlocked with humidifier and reheater.

4.06.00 **COOLING TOWERS (for chilling units)**

4.06.01	Type	:	Induced draft, cross or counter flow, vertical discharge
4.06.02	Casing & Sump tank	:	F.R.P/G.R.P
4.06.03	Fan	:	Cast Aluminum / FRP Propeller type and multi-blade aerofoil construction with adjustable pitch.
4.06.04	Fill	:	Non combustible PVC or equivalent
4.06.05	Louvers	:	F.R.P. /PVC/ Aluminum.
4.06.06	Nozzles	:	Brass with chrome plating / Polypropylene.
4.06.07	Eliminators	:	In removable sections to reduce the drift loss to 0.2% of water flow.
4.06.08	Supporting structure	:	Mild steel with spray galvanization or epoxy painting.

4.06.09	Strainer at water outlet	:	Plate strainer made of GI/SS wire mesh of 16 gauge.
4.06.10	Bird screen on top of tower	:	25 mm square made of GI/SS wire mesh of 16 gauge.
4.06.11	Distribution Pipe (if any)	:	Galvanised MS pipe.
4.06.12	Accessories		a) Drain connection with isolation valve. b) Make up connection with ball – float valve, back up gate valve and a bypass with a gate valve for manual operation. c) Overflow connection. d) Equalizing connection to connect sump of all the towers wherever applicable. e) Access door in louvers/fan deck.

5.00.00 EQUIPMENT DESCRIPTION - VENTILATION SYSTEM

5.01.00 Air Washer Unit

5.01.01 Each double skin Air Washer Units (Modular Type which shall be completely enclosed ,Evaporative System) shall consist of the various Sections such as Air washer chamber / Casing, Tank, Distribution plates, set of metallic/fabric filters at suction, suction louvers, bird screens, water headers, Spray nozzle, piping, pumps, valves, Drift eliminators, Fans, and all other required accessories.

Housing/Casing of Air Washer Unit

The housing/casing of the Air Washer Unit shall be double skin construction. (25±2) mm thick Double Skin Panels shall be made of 0.80 mm pre-painted sheet on outer side and 0.8 mm Galvanized sheet (275 GSM) inside with 40kgs/cub mtr density, fire retardant P.U. insulation injected in between. This panel shall be screwed on to the aluminum frame work with soft rubber Gasket in between to make the joints air tight.

Frame work for each section shall be jointed together with soft rubber gasket in between to make the joints air tight wit NOT APPLICABLE access door at various sections for maintenance. The entire fan section housing shall be mounted on rolled formed GSS Channel frame work.

5.01.02 The air washer tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the tank shall be spray galvanized **(minimum 60 microns DFT).** Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe.

5.01.03 The distribution plate shall be fabricated out of 18G galvanized steel sheets & galvanized steel angle supports with minimum 50% free area.

5.01.04 Air washer shall be two-bank construction (one uni-flow and the other cross flow). All header and stand pipes shall be galvanised. Cat Walks of suitable width shall be provided for maintenance of nozzles.

5.01.05 The spray nozzles shall be of brass or bronze with chrome plating and shall be self cleaning type. The nozzle shall be designed to produce fine atomized spray and shall be properly

	spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm2
5.01.06	The eliminator plates shall be of 24G thick GS sheets class 275 or from 100% virgin PVC of minimum finished thickness of 2 mm. The eliminator section made of GSS shall have minimum six bends. The PVC eliminators shall be UV stabilized using Titanium di-oxide and shall withstand the weathering test as per IS:4892 for 500 hrs. Type test report of the compound testing carried out in any reputed laboratory shall be submitted for approval. All supports, tie rods and space bar shall be of either galvanised steel or PVC construction and shall be complete with suitable drip tray and drain pipe.
5.01.07	An airtight inspection door of 600mm X 700mm size and a water marine light be provided for each air washer unit.
5.01.08	Suitable number of brass screen shall be provided in the air washer tank to arrest the dirt entering the circulating water pump suction. Suitable GI grid shall be used inside the screen for reinforcement
5.01.09	The specification for centrifugal fans shall generally be as indicated below. Centrifugal fans for air washer units shall be of DIDW type.
5.01.10	Saturation efficiency of Air Washer units shall be minimum 90%.
5.01.11	Air washer units shall be provided at various elevations in TG building (AB & BC Bay). However, air washer units if required to be placed on the roof shall be provided with steel shed (open).
5.02.00	**Unitary Air Filtration**
	NOT APPLICABLE
5.02.01	Each modular unitary air filtration shall consist of Casing, Tanks, Fans, Distribution plates, Moisture eliminator and water repellant type nylon filter with frame and support, Header and standpipe with support, Spray and flooding type nozzle. Screen type suction strainer, Pumps, Necessary controls & Instrumentation, and all other required accessories.
5.02.02	The housing/ casing of air washer unit shall be double skin construction. Double skin panels shall be made of 22G galvanized sheet on outer side and 20G galvanized sheet inside with 25mm thick polyurethane foam insulation of minimum 38 kg/cub. Mtr. Density in between. Thickness of galvanization shall be minimum 60 microns DFT. Frame work for section shall be joined together with soft rubber gasket in between to make the joints air tight. The entire fan section shall be mounted on rolled formed GSS channel frame work.
5.02.03	The unitary air filtration tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the tank shall be spray galvanized **(minimum 60 microns DFT).** Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe.
5.02.04	The distribution plate shall be fabricated out of 18G galvanised steel sheets & galvanised steel angle supports with minimum 50% free area.
5.02.05	Unitary air filtration shall be one-bank construction. All header and stand pipes shall be galvanised. Cat walks of suitable width shall be provided for maintenance of nozzle, filter etc.
5.02.06	The spray nozzles shall be of brass or bronze with chrome plating and shall be self cleaning type. The nozzle shall be designed to produce fine atomized spray and shall be

	properly spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm2.
5.02.07	The eliminator plates shall be of 24G thick GS sheets class 275 or from 100% virgin PVC of minimum finished thickness of 2 mm. The eliminator section made of GSS shall have minimum six bends. The PVC eliminators shall be UV stabilized using Titanium di-oxide and shall withstand the weathering test as per IS:4892 for 500 hrs. Type test report of the compound testing carried out in any reputed laboratory shall be submitted for approval. All supports, tie rods and space bar shall be of either galvanised steel or PVC construction and shall be complete with suitable drip tray and drain pipe.
5.02.08	Air tight inspection doors of suitable size shall be provided for suction chamber. Spray chamber and fan suction for easy accessibility and maintenance and a water marine light be provided for each unitary air filtration.
5.02.09	Suitable number of brass screen shall be provided in the air washer tank to arrest the dirt entering the circulating water pump suction. Suitable GI grid shall be used inside the screen for reinforcement.
5.02.10	The specification for centrifugal fans shall generally be as indicated below. Centrifugal fans for UAF units shall be of DIDW type.
5.02.11	All equipments, components used in unitary air filtration system shall be in line with the specification requirements stipulated in air washer units.
5.02.12	Saturation efficiency of Unitary Air Filtration (UAF) units shall be minimum 60%.
5.02.13	UAF units placed on the roof shall be provided with steel shed (open).
5.03.00	**Centrifugal Fan** NOT APPLICABLE
5.03.01	The casing shall be of welded construction fabricated with heavy gauge galvanised sheet steel or MS sheet with spray galvanization (**minimum** 60 micron DFT). The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required.
5.03.02	The impeller shall have die-formed backward-curved blades tie welded to the rim and back plate to have a non overloading characteristic of the fan. Rim shall be spun to have a smooth contour. If required intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts.
5.03.03	The bearing shall be self aligning, heavy duly ball, roller or sleeve bearing. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside.
5.03.04	Inlet guard shall be spun to have a smooth contour. Inlet screen, if provided, shall be of galvanised wire mesh of 25 mm square.
5.03.05	Base plate with necessary number of spring type vibration isolators or ribbed neoprene rubber pad or cushy foot mounting shall be provided. The vibration isolators should have a minimum of 70% efficiency.
5.03.06	The first critical speed of the rotating assembly shall be at least 25% above the opening speed.
5.03.07	The fans shall be provided with V-belts and sheaves. All belts shall be sized for 150% rated HP. All V-belt shall be equipped with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive. Motor rating (at 50 deg.C

ambient) shall be atleast fifte~~NOT APPILCABLE~~ ~~he maximum load demand of drives at the design duty point.~~

6.00.00 BALANCE EQUIPMENT SPECIFICATION

6.01.00 **CENTRIFUGAL PUMPS**

a)	Type	:	Horizontal Centrifugal, Axially split type casing pump End suction, top discharge horizontal centrifugal pump may be provided for modular air washer units & UAF unit.
b)	Impeller	:	Closed type
c)	Material of Construction		
	i) Casing	:	2% Ni Cast Iron : IS:210 Gr. FG-260
	ii) Impeller	:	Bronze IS:318 Gr-2
	iii) Wearing rings	:	Bronze
	iv) Shaft	:	SS 316
	v) Shaft sleeve	:	SS 316
	vi) Lantern ring	:	Brass / Bronze
	vii) Packing	:	Asbestos free
	viii) Base Plate	:	Carbon steel as per IS:2062
	ix) Speed	:	Maximum 1500 rpm
	x) Other requirements	:	To refer to **Annexure-I** titled "Horizontal Pumps" of this sub section.

6.02.00 **Material of Construction for Piping & Fittings**

a)	Piping for Chilled and Condenser water lines	:	Heavy grade-IS:1239 or Equivalent upto150 NB and Grade 410 of IS:3589 or Equivalent for pipes beyond 200 NB with thickness as indicated in **Annexure-II**
b)	Circulating water piping of Ventilation System		Heavy grade-IS: 1239 or Equivalent upto150 NB and Grade 410 of IS: 3589 or Equivalent for pipes beyond 200 NB with thickness as detailed at **Annexure-II.** The piping upto 100 mm diameter shall be of galvanized steel **(galvanization shall be as per IS: 4736)** and those above 100 mm dia. shall be black steel. The piping shall be adequately supported
c)	Refrigerant piping :	:	Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade).
d)	Drain piping	:	Same as (a) above & galvanized as per IS:4736.
e)	Fittings	:	1) The steel fittings shall conform to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above. 2) For sizes 50 NB and below, the material shall conform to ASTM A-105. 3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5 4) For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends shall be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections shall not be more than 22.5 deg and shall be as per BS:2633/BS:534. 5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5

6.03.00 **VALVES**

6.03.01 Technical data sheet of the various types of valves (Gate, Globe, Butterfly and check valve) shall be as per **Annexure-III**.

6.03.02 Valves shall have full sizes port and suitable for horizontal and as well as vertical installation.

6.03.03 Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.

6.03.04 All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.

6.03.05 Valves shall be furnished with back seating arrangement for repacking while working under full working pressure.

6.03.06 Manual gear operators be provided for valves of size 200 NB and above.

6.03.07 All valves shall be supplied with companion flanges, nut, bolts & washers, etc.

6.03.08 The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.

6.03.09 **Balancing / Controller Valves:**

The valves of sizes 32 mm to 50 mm dia shall be of gun metal / cast iron construction with screwed ends. Whereas valves of sizes 65 mm and above shall be of cast iron construction with internal parts of SS 410 and EPDM / nitrile seat with flanged ends.

6.04.00 **AIR FILTERS**

6.04.01 **Pre Filter**

1)	Type : Flange / Cassette			
2)	**Fabric Filter:** Pre-filter shall contain washable non-woven synthetic fiber or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.			
3)	**Other requirements : (as applicable)**			
	a)	Suitable aluminium spacers be provided for uniform air flow;		
	b)	Casing shall be provided with neoprene sponge rubber sealing.		
	c)	Capable of being cleaned by water flushing.		
	d)	Density of filter medium shall increase in the direction of air flow in case of metallic filter.		
	e)	Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.		
4)	**Efficiency :**			
	Average arrestance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 – 76 / EN-779.			
5)	Minimum thickness	:	50 mm	
6)	Face Velocity	:	Not more than 2.5 m/sec.	

7)	Pressure drop	:	Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC.
8)	Location	:	a) At the suction of each AHUs
		:	b) At the suction of each Fresh air fan
		:	c) At the suction of each Supply air fan

6.04.02 **Fine Filters (Microvee type)**

1)	Type	:	Flange / Cassette
2)	Fine filter shall contain washable non-woven synthetic fibre or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.		
3)	Other requirements	:	a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame. b) Capable of being cleaned by air or water flushing. c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.
4)	Efficiency	:	Average arrestance > 90% when tested in accordance with BS:6540/ASHRAE–52-76 / EN-779.
5)	Minimum thickness	:	150 mm or 300 mm.
6)	Face Velocity	:	Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.
7)	Pressure drop	:	Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC.
8)	Location	:	i) At the discharge of each individual AHU. ii) At the discharge of each Fresh air fan. iii) At the discharge of each supply air fan having static pressure 30mm wc or more.

6.04.03 **Absolute Filter / Hepa Filter**

1)	Media	:	100% sub-microscopic glass fibers.
2)	Frame	:	Aluminium alloy of (minimum 16 gauge conforming to IS: 737) with handles.
3)	Other requirements	:	A neoprene sponge rubber sealing shall be provided on either face of the filter frame.
4)	Efficiency	:	99.97 % down to 0.3 micron when tested in accordance with BS: 3928 (Sodium flame test)/FED–209B.
5)	Minimum thickness	:	300 mm
6)	Face Velocity	:	Not more than 1.2 m/sec.
7)	Pressure drop	:	Initial pressure drop - Not to exceed 25 mm WC at rated flow; Final pressure drop - Up to 75 mm WC.
8)	Location	:	At the discharge of each individual AHUs for Control Equipment Room / Control room /UPS & battery Charger Rooms.

6.05.00 **LOW PRESSURE AIR DISTRIBUTION SYSTEM**

6.05.01 Material of air distribution system shall be through galvanized steel sheet (Conforming to Class 275 of IS: 277) or Aluminium alloy (grade 19000 / SIC or 3100 / NS3 of IS: 737)

6.05.02 **Thickness of rectangular ducts shall be as follows:**

Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)

up to 750 mm	0.63 (24 G)	0.80
751 to 1500	0.80 (22 G)	1.00
1501 to 2250	1.00 (20 G)	1.50
2251 & above	1.25 (18 G)	1.80

6.05.03 **Thickness of round ducts shall be as follows :**

Diameter of Round duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)
150 to 500	0.63	0.80
501 to 750	0.80	1.00
751 to 1000	0.80	1.00
1001 to 1250	1.00	1.50
1251 & above	1.25	1.80

6.05.04 **Duct Fabrication and Supports:**

a) Duct fabrication shall be as per the latest relevant BIS/SMACNA standard.

b) Ducts for A/C system may be site fabricated or factory fabricated and installed at site. However, in case of partly used factory fabricated ducts, vendor shall take back the unused ducts.

c) The ducts routed inside the buildings with larger side greater than 2250 mm shall be supported by 16mm MS rods and 50x50x3 mm MS double Angles while those below 2250 mm shall be supported by 10mm MS Rods and 40x40x3 MS angles. The duct supports shall be at a distance of not more than 2000 mm for A/C system. The MS rods for these ducts routed inside the building shall be hung from the existing floor beams/wall beams/roof beams/columns as provided by the Employer with provision of necessary auxiliary or special steel members or by hooks or can be provided by contractor by dash fasteners fixed to the ceiling slab. No supports shall be taken from horizontal/vertical bracings of the structures. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required shall be provided by the bidder.

d) Where the sheet metal duct connects to the intake or discharge of fan units a flexible connection of fire retarding, at least 150 mm width shall be provided of closely woven, rubber impregnated double layer canvas or neoprene coated fibre glass.

e) All curves, bends, off-sets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same velocity as in the main duct to which the branch duct is connected.

f) Wherever duct passes through a wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space.

g) Wherever pipe hangers or rods pass through the ducts, light and streamline easement around the same shall be provided to maintain smooth flow of air.

h) Access doors shall be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash of approved type. All doors shall be set so as to flush with insulation or plaster finish on the duct.

i) Where ever horizontal ducts are running outside the building and or at locations where it is not possible to support the ducts from Employers ceiling/floor due to non-availability of the same, the base steel frame/truss work for supporting the ducts

between two columns shall be provided by Employer. However, all other auxiliary steel members, hooks, rods, etc. for supporting the duct work with the base frame/truss work shall be provided by the bidder. For vertical ducts running outside the building, bidder to take support from building columns and beams which is in Employer scope. However, all other auxiliary steel members, hooks, rods, etc. for supporting the duct work with the employers beam & columns shall be provided by the bidder.

6.05.05 Splitters and dampers shall be provided for equipment/area isolation and for proportional volume control of system. The same shall be minimum 16 gauge GS sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.

6.06.00 **Factory fabricated ducts:**

i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I.

ii) Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA)

iii) All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory fabricated by utilizing the machines and processes as specified in SMACNA or by equivalent technology. In equivalent method, the fabrication shall be done by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply:

a. Coil lines to ensure location of longitudinal seams at corners/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.
b. All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.
c. All edges to be machine treated using lock formers, flangers and roll-bending for turning up edges.
d. Sealant dispensing equipment should be used for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified. Sealing of longitudinal joint is compulsory for the ducts over 2" w.g. static pressure

iv) All transverse connectors shall be 4-bolt slip-on flange system with built-in sealant, if any. To avoid any leakage additional sealant shall be used.

v) Factory fabricated ducts shall have the thickness of the sheet as follows:

Sl.No.	Size of Duct	Sheet Thickness
i)	upto 750 mm	0.63 mm
ii)	751 mm to 1500 mm	0.80 mm
iii)	1501 mm to 2250 mm	1.00 mm
iv)	2251 mm and above	1.25 mm

6.07.00 **Diffusers, Grills & Dampers:**

6.07.01 Supply air diffusers/grills with factory fitted volume control dampers be provided for all air-conditioned areas and evaporative cooling system areas.

6.07.02 Return air diffusers of air-conditioned areas shall be without volume control dampers.

	Inlet/Exhaust air grills/louvers are required for all negatively pressure ventilated areas. Back draft dampers shall be provided for all areas pressurized under ventilation system.
6.07.03	For AC system the diffusers/grills shall be of extruded Aluminum of minimum 1.2 mm thick with powder coating. The color of power coating shall be as per the interior Décor. The diffusers/grills shall be of powder coated mild steel construction for Ventilation system.
6.07.04	For AC system Supply air grills shall be of double deflection type and return air grills shall be of single deflection type. For ventilation system supply air grills shall be of double deflection type.
6.07.05	The nozzle type diffusers shall be fabricated from minimum 1.5mm aluminium sheet. The base shall be fixed type. The nozzle shall be of volute design with the Spout diameter being half the base dia. and designed for low noise and long throw. The nozzle shall be able to rotate to any angle within the base. The whole assembly shall be powder coated as per interior decor.
6.07.06	All volume control (VC) damper shall be operated by a key from the front of the grills/diffusers and shall be of GI sheet.
6.07.07	The thickness of VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 22 gauge.
6.07.08	Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required shall also be provided.
6.07.09	Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes.
6.07.10	All plenum chambers of connections to fans, dampers etc. shall be constructed in 18 gauge GS sheet and supported on MS angle frames,
6.07.11	All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.
6.07.12	Suitable number of VAV box shall be provided for optimum use of VFD driven AHU.
6.08.00	**Thermal and Acoustic Insulation**
6.08.01	**A)** Application with Glass Wool (a.) All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products or Equivalent) be applied @ 1.5 Kg /Sqm on the surface. (b.) Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber or Equivalent) shall be struck to the surface. All the joints shall be sealed with bitumen. (c.) Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side. (d.) Insulation Finish of types specified under shall be provided thereafter. **B)** Application with Nitrile Rubber: (a) All surfaces to be insulated shall be properly cleaned. (b) A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces.

(c) Insulating material shall than be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within.

(d) Two layers of Glass Cloth with a suitable adhesive as SR 998 or equivalent shall be then applied over the insulating material to avoid surface weathering.

C) Application with Polyurethane Foam & Polyisocyanurate Foam

(a) All surfaces to be insulated shall be cleaned.

(b) A suitable adhesive such as CPRX or Loid Bond 83 or equivalent shall be applied over the surface to be insulated and insulation material surfaces.

(c) Insulating material with aluminum foil lamination shall then be pasted onto the surface in a manner to avoid stretching and any air entrapment within.

(d) Two layers of Glass Cloth with a suitable adhesive as Loid Bond 130 shall be then applied over the insulating material, to avoid surface weathering.

(e) Insulation Finish of types specified under shall be provided thereafter.

D) Application with FR Closed Cell Chemically Cross Linked Polyethylene Material (XLPE)

(a) All surfaces to be insulated shall be properly cleaned of any dust, grease and moisture.

(b) A suitable adhesive, normally, a pressure sensitive acrylic base, such as SR 998/STAR Glue R242 or Neosole AA 900 or equivalent shall be used to paste the insulating material over the cleaned surface.

(c) XLPE cut to size for each surface, with overlaps provided for two faces shall be stuck to the surfaces in a manner to avoid air entrapment. The extent of over-lap shall be equivalent to the thickness of the material to be applied. The adhesive is applied on both the surfaces to be insulated and the insulation foam material.

(d) Application of the insulating material to surfaces should preferably be carried out at ground level, in a clean dust free area.

(e) All joints- lateral & longitudinal, shall be taped with self adhesive aluminium foil tape 75 mm wide. The insulation over the surface shall be then held in position with 12mm wide PVC straps at every 600mm, to provide a neat & clean finish.

6.08.02 **Type of Insulation & Finish**

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
1.	Supply & return air duct of AC System	Resin bonded glass wool or	Roll /Slab	50	F-3
		Closed Cell Elastomeric Nitrile Rubber	sheet	19	As per manufacturer std.
		Or Polyisocyanurate Foam	Slab	30	F-3
2.	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
		Or Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)
3.	AHU drain pipe	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.
		or Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)
4.	AHU condensate pan (insulation if required)	Mineral wool or resin bonded glass wool	Slab	25	As per manufacturer std.
5.	Chilled water piping, valves & specialties	Resin bonded Mineral wool or resin bonded glass wool	Pipe section	75	F-1/F-3
		or Rigid Polyurethane Foam	Pipe Section	50	F-3
6.	Chiller (insulation if required)	---------- As per manufacturer std.----------			
7.	Chilled water pumps	Resin bonded Rockwool wool or resin bonded glass wool	Slab	75	F-1/ F-3
		or Rigid Polyurethane Foam	Slab	50	F-3
8.	Expansion tank with associated piping	Resin bonded Rockwool wool or resin bonded glass wool	Slab/ Pipe section	75	F-1/ F-3
		or Rigid Polyurethane Foam	Slab	50	F-3
9.	Acoustic insulation of duct	Resin bonded Glass wool	Slab	25	As per specifications
10.	Exposed air duct	Resin bonded Glass wool/Rockwool	Roll/Slab	50	F-4
		or Polyisocyanurate Foam	Slab	50	F-4(a)

6.08.03 **Specification for insulation shall be as follows: -**

Insulation Material	Code	Thermal conductivity (w/m/^{o}C	Density Kg/m^3
Resin bonded glass wool	IS:8183	0.049 at 50oC 0.043 at 50oC	i) 24 (For Glass wool) ii) 48 (For Rockwool) iii) 48(For acoustic insulation)
Mineral wool pipe section. Min.Gr.2	IS:9842	0.043 at 50oC	144
Closed Cell Elastomeric Nitrile Rubber		0.036 at 20oC	40 – 60
Polyurethane Foam		0.03 at 50 oC	34 + 2

Polyisocyanurate Foam	IS12436	0.03 at 50 oC	34 + 2
Note : Insulation used for HVAC application shall be CFC/HCFC free			

6.08.04 The specification for various finishes shall be as follows

a)	Finish F-1 (with Resin Bonded Glass Wool/Resin Bonded Mineral Wool) Step-1 Wrapping of Poly-Bonded Hessain (PBH – to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound.
	Step-2 The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.
	Step-3 Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.
aa)	**Finish F-1(a) (With Polyurethane Foam & Polyisocyanurate Foam)** Wrapping of two layers of 7 mil 10 x 10 mesh glass cloth dipped in suitable adhesive such as SR 998 or Loid Bond 130 equivalent
b)	Finish F-2 Step-1 Insulation shall be covered with 500g polythene with 50mm overlap and sealing of overlap with synthetic adhesive like CPRX/ Loid Bond 83 or Equivalent compound.
	Step-2 Same as Step-2 of Finish F-1 above.
	Step-3 Same as Step-3 of Finish F-1 above.
c)	Finish F-3 Step-1 Same as Step-1 of Finish F-2 above
	Step-2 The polythene shall be covered with 26 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100 mm.
d)	Finish F-4 Step-1 Same as Step-1 of Finish F-1 above. Step-2 Same as Step-2 of Finish F-1 above. Step-3 Same as Step-3 of Finish F-1 above. Step-4 Application of 3 mm thick coat of suitable water proofing compound and wrapped with fibre glass RP tissue followed by final coat of 3 mm thick water proofing compound over the RP tissue. Step-5 After the above treatment, 22G Aluminium sheet cladding, properly stiched at all joints shall be provided over the external surface.
dd)	Finish F-4(a) (With FR Closed Cell Chemically Cross Linked Polyethylene) Application of aluminium sheet 22G cladding to be provided over the XLPE insulating material. Cladding sheet is held in position with SDST screws @ 150 mm C/c over tongue-in-groove joints applied with a felt for sealing joint against water ingress. All sheet joints to be done in a manner to shed water.

6.08.05 For all inspection covers and hatches on equipment, pump casing, valve bodies and flanges (100 mm and above), insulation shall be applied so as to facilitate removal without minimum damage to the insulation by encasing the insulation in 24 gauge GI box or 22 gauge Aluminium sheet metal boxes which are bolted together around the equipment. However continuity of the vapour seal between the static and removable portions of the insulation is to be maintained.

6.08.06	**ACOUSTIC INSULATION** a) All ducts up to a distance of 5 meters from AHU , Air washer unit fan, UAF fan and other centrifugal fan outlet shall be acoustically lined from inside with 25 mm thick resin bonded glass wool of 48 Kg/Cu.M. density and 30 gauge perforated aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre-to-centre distance. Insulation shall be fixed on wooden frame of 600 x 600 mm dimension. b) Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated aluminium sheet. Application of acoustic insulation shall be inline with the requirements specified above.
6.09.00	**Axial Fans** a) These fans shall have fixed / variable pitch cast aluminum blades of aerofoil design. b) The fan casing shall be of heavy gauge sheet steel construction. c) Necessary rain protection cowl, inlet and outlet cones, bird protection screen, adjustable damper, vibration isolators, back draft dampers etc. shall be provided. d) The speed of the fan shall not exceed 1000 rpm for fan with impeller diameter above 450 mm and 1500 rpm for fan with impeller diameter 450 mm or less. However for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1500 rpm for fan with impeller diameter of above 450 mm and 3000 rpm for fan with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be atleast 25% above the operating speed. e) All other accessories like supporting structure etc. as required shall be provided. f) Fans of capacity 1000 m^3/hr & lower shall be of propeller exhaust type. g) Fuel oil pressurizing pump house, fuel oil unloading pump house, central lube oil purification room, Gas rooms in TG building and battery rooms of TG building, GIS control building, etc. shall be provided with spark proof (with flame proof motor) fans.
6.10.00	**Roof Ventilators**
6.10.01	The roof extractors shall be “COWL” type.
6.10.02	Impeller shall be of axial flow type, cast Aluminum in one piece and dynamically balanced. Casing shall be heavy gauge sheet steel construction of 3 mm thick for impeller upto 750 mm diameter and 5 mm for fans with impeller of diameter 750 and above. In casing, access door with locking arrangement be provided.
6.10.03	The cowl shall be designed for weather protection of the fan also inside of the roof on which the extractor is installed. Galv NOT APPLICABLE 5 mm Square be provided with the cowl. All accessories, steel supports as required will be provided.
6.10.04	The speed of the fan be limited as per limitation given above for axial fans.
6.10.05	All accessories rain protection exhaust hood, transformation piece, vibration isolators, steel supports vibration isolators, bird screen, etc. as required shall be provided.
6.10.06	The vibration level for fans shall be as per ISO: 14694.
7.00.00	**PLANT CONTROL OF AC SYSTEM:**
7.01.00	Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer. The descriptions in the sub-sections of the control & instrument sections shall also be referred to.
7.02.00	**Control Scheme for Air-Conditioning System**
7.02.01	All the functional requirements specified below and general control logic specified under this section shall be implemented in the respective control system.

7.02.02	The basic function of the system shall be to closely control and monitor temperature and humidity conditions inside the air-conditioned spaces, to optimize / minimize energy consumption by automated operation, to provide remote centralized monitoring & control for various mechanical facilities including sequential start/stop of the whole Air conditioning System, automatically calculate record and cooling load for each hour /day/season, to generate maintenance data & alarms, to maintain records of plant operation & energy consumption for varying loads, duty cycling to operate all the equipment including standby equipment for equal duration, automatic startup of standby equipment in case of failure of operating unit and displaying fault alarm status of the tripped unit, activating /deactivating water valves to startup/stop water flow through chiller/condenser circuit. For sequential operation /duty cycling, Programmed startup/stop of individual AHU as per operating requirements and inside room temperature and humidity of "CR, CER, SWAS control room, UPS and Battery Charger room, static excitation room (as applicable)", "ESP control rooms, AHP control room, FGD control room" shall be maintained by controlling the chilled water flow by means of motor operated three way modulating valve at chilled water line, humidified system and duct heater.
7.02.03	For Service building & Admin Building, inside room temperature and humidity shall be maintained by varying the chilled water flow of secondary chilled water pumps through VFD driven motor and by varying the air flow of AHU through VFD driven motor, humidified system and duct heater. For sequential operation/duty cycling, programmed startup/stop of individual AHU's, pumps and cooling towers as per operating requirements and inside room temperature and humidity. Adequate no's of VAV box shall be provided for optimum use of VFD driven AHUs. Adequate nos. of occupancy sensor shall be provided. CO2 sensor shall be provided in each AHU room to regulate the fresh air.
7.02.04	The operation of each Air Conditioning system shall be possible through Microprocessor based dedicated controllers to be provided by Contractor for each Screw /centrifugal Chiller units with local start / stop & indication for main plant A/C system in addition to Main DDCMIS based Control system of A/C plant for "Main plant area", "ESP control rooms, FGD control room & AHP control room", "Service Building", "Admin Building". Further these microprocessor-based control panels of Chiller units shall be suitably interfaced with DDCMIS based Control panels.
7.02.05	Air-Conditioning system for "Water system control room" shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS). Air-Conditioning system for "Switchyard control room building" and "Canteen Building" shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS) / control system as per Manufacturer's standard & proven practice.
7.03.00	**Water Chilling Plant Control**
7.03.01	Microprocessor based controls shall be provided as per manufacturer's standard practice along with facilities to interface with control system and to meet the requirement of all system operations and controls. Water chilling unit control system shall be designed to have a constant chilled water outlet temperature from evaporator at all load condition by means of controlling ON-OFF thermostat (one for each compressor). The closure of liquid line solenoid valve and tripping of compressor at lower water temperature and opening of solenoid valve and starting of compressor at high water temperature set point shall be automatic through the thermostat. Between the above set points the compressor capacity shall be controlled automatically through cylinder "load-unload" mechanism activated through the suction pressure or return chilled water temperature.

7.03.02	Water chilling unit shall be equipped with superheat control of water chilling unit through thermostatic expansion valve which gets its impulse from temperature element connected with suction line after chiller outlet.
7.03.03	High discharge pressure cut-out and oil pressure (OP) differential cut-out shall be of manual reset type and low pressure cut-out shall be automatic reset type. The OP cut-out shall trip the compressor in case of low oil pressure.
7.03.04	Facility toggle switch to close the liquid refrigerant line solenoid valve shall be provided to shut the compressor by the operation of low pressure cut-out (after the refrigerant has been pumped to the condenser).
7.03.05	Switching of Crank case heaters shall be interlocked with starting and stopping/tripping of compressor motor. Further, the safety thermostat shall switch off the crank-case heater in the event temperature rises above safe limit.
7.03.06	Provision shall also be made for the manual restarting of the compressor.
7.03.07	On-off type anti-freeze thermostats, one for each chiller shall be provided in addition to the controlling on-off thermostat for safety purpose and shall act in the event of failure of on-off thermostat to close the liquid line solenoid valve and also to simultaneously trip the compressor.
7.03.08	Compressor starting/running shall be interlocked with the low / adequate flow at the outlet of each chiller and each condenser and as well as with pressure in the inlet of the condensers. In addition, closure or open status of various valves shall be used for interlock, alarm and control of Air Conditioning System.
7.03.09	Condenser water pumps shall be interlocked with the low - level switch in each cooling tower sump and operation of cooling tower fans. High level in the cooling tower shall be annunciated in the panel by means of a separate level switch.
7.03.10	The standby condenser water pumps, standby chilled water pumps & standby AHU shall be started automatically when the working equipments are stopped/ tripped. Auto/ Manual selecting and working/ standby selecting facility for the pumps/ AHU/ fresh air fan shall be provided.
7.03.11	Closure of fire dampers shall raise an alarm in the system.
7.03.12	There shall be provision for temperature and flow measurement in chilled water inlet and outlet line across AHUs to monitor the air conditioning load of each area.
7.03.13	Operation of air conditioning system shall be interlocked with the required minimum pressure and temperature of cooling tower at inlet to the condenser. Status indication of condenser water pumps and associated cooling towers shall be provided in the control panel of air conditioning plant.
7.04.00	**Air Handling Unit** a) Inside room temperature and humidity shall be maintained by controlling the chilled water flow by means of motor operated three way modulating valve and by varying the flow by means of VFD driven AHU's which shall get its signal from the Control system for main plant A/C system and ESP/FGD/AHP control rooms A/C system. For Service building & Administrative Building, inside room temperature and humidity shall be controlled by varying the chilled water flow of secondary chilled water pumps through VFD driven motor and by varying the air flow of AHU through VFD driven motor.

b) Humidity sensor and gyserstat located in the return air duct shall actuate the PAN humidifier to obtain the desired degree of humidification.

c) Humidity and temp. sensor shall be provided and interlocked in steps with winter heater / re-heater / strip heaters for monsoon and winter re-heating or heating as the case may be.

d) Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat - located in front of the each heater in the supply air duct)

e) AHU shall be started either locally or from the main control room of AC system by means of Remote / Manual selection facility.

f) The closure of fire dampers, automatic tripping of AHU fans and fresh air fans shall be interlocked with fire detection system.

g) Each AHU shall be provided with temperature indicators and pressure transmitter in the chilled water piping inlet and outlet to monitor the air-conditioning load of each area.

7.05.00 **D-X Air-Conditioning System**

a) The control and interlocks described above for water chilling plants are applicable for this system also.

b) Further the compressor starting/running shall be interlocked with the flow switches in condenser water (if applicable) circuit as well as with AHU motors.

c) The standby condenser water pumps (if applicable) & standby AHU shall be started automatically when the working equipments are stopped / tripped. Auto/ Manual selector Switches and working / standby selector switches for the pumps, fresh air fans and AHU shall be provided in the panel.

7.06.00 **Cassette /Hi-wall Split Air Conditioners**

Control and interlocks for these type of units shall be as per manufacturer's standard practice.

7.07.00 **Miscellaneous Control Requirements**

a) Separate emergency local stop push button shall be provided for each pump, compressor, fans etc. of A/C system.

b) Status shall be provided of each pump, compressor, fans etc. of A/C system and Ventilation system on HMI system at control room.

c) All the annunciations related to failure of equipments, tripping of equipments, source of failure / reason due to which the equipment is stopped/tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc. shall be provided for each pump, fan, compressor, AHU, PAC, etc. of centralized A/C system.

d) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.

e) Relative humidity and temperature measurement of all control rooms, CERs, Service Building and all major air-conditioned areas shall be available in DDCMIS. Relative humidity and temp. measurement for main plant control room and CERs to be available in multiple numbers.

8.00.00 PLANT CONTROL OF VENTILATION SYSTEM

8.01.00 GENERAL

NOT APPLICABLE

8.01.01 Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from Employer.

8.01.02 **Control Scheme of Ventilation System**

The Ventilation system for main Plant area (excluding roof extraction fans, standalone Air supply and Air Exhaust fans) shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS). This DDCMIS system shall perform all functions such as auto/manual operation of valves, pumps, drives, local/remote selection of operation, status indication, annunciation, interlock and protection of pumps/drives, etc.

NOT APPLICABLE

8.02.00 Air Washer Units (AWU) & Unitary Air Filtration Units (UAF)

8.02.01 Air washer units shall be started/stopped by initiation from Main DDCMIS based control system of A/C plant (provided by contractor) for Main plant area and ESP/FGD/AHP control rooms. Starting/stopping of pumps shall be automatic upon such initiation.

8.02.02 The operation of the pumps shall be interlocked with the low level of water in the sump. High level of the sump shall be alarmed.

8.03.00 Miscellaneous control requirements

8.03.01 Separate emergency local stop push button shall be provided for each pump, fans, etc. of Ventilation system.

8.03.02 The status of each pump, centrifugal fans, etc. of centralized ventilation system is available on OWS in control room locally.

8.03.03 All the alarms related to failure of equipments, tripping of equipments, source of failure / reason due to which the equipment is stopped / tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc shall be provided for each pump, fan, AWU etc. in the control system.

8.03.04 The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.

9.00.00 PAINTING:

9.01.00 All the Equipments shall be protected against external corrosion by providing suitable painting.

9.02.00 The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting, etc. as per the agreed procedure.

9.03.00 For all the steel surfaces (external) exposed to atmosphere (outdoor installation), one (1) coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.

9.04.00 For all the steel surfaces inside the building (indoor installation), One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat shall be applied. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.

9.05.00	For centrifugal fans/axial/Roof extractor fans - Casing shall have hot dip/ spray galvanization (**minimum** 60 micron DFT).
9.05.00	However for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and colour with glossy finish of minimum thickness of 25 microns.
9.07.00	Touch up painting shall be as per standard industrial practice.
10.00.00	Cooling Tower, Expansion Tank, Water Softening Plant (if required) of A/C System shall preferably be placed on the roof of respective building under open sky.
11.00.00	Centrifugal fans alongwith filter plenum of mechanical centralized ventilation system envisaged for GIS switchyard shall atleast be provided with steel shed (open).

Annexure –I

GENERAL SPECIFICATION FOR HORIZONTAL PUMPS

1) **SCOPE**

This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

2) **CODES AND STANDARDS**

The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

3) List of Applicable Standards.

IS : 1520 : Horizontal Centrifugal Pumps for clear cold fresh water
IS : 5120 : Technical requirements of roto dynamic special purpose pumps
API : 610 : Centrifugal pumps for general refinery service.
IS : 5639 : Pumps Handling Chemicals & corrosion liquids
IS : 5659 : Pumps for process water
HIS : Hydraulic Institute Standards, USA
ASTM-1-165-65 Standards Methods for Liquid Penetration Inspection.

In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

4) **DESIGN REQUIREMENTS**

Annexure –I

a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within ± 10% of the rated design flow as indicated in data sheets.

b) The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of about 15% more than the design head.

c) Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

d) Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

Speed	Antifriction Bearing	Sleeve Bearing
1500 rpm and below	75.0 micron	75.0 micron
3000 rpm	50.0 micron	65.0 micron

The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface.

e) The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

f) The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

g) Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

h) The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

5) **DESIGN CONSTRUCTION**

a) Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.

Annexure –I

b) **Pump Casing**

Pump casing shall have axially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

c) **Impeller**

Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled.

The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

d) **Impeller/Casing Wearing Rings**

Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

e) **Shaft**

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

f) **Shaft Sleeves**

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.

Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

Annexure –I

g) **Bearings**

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

h) **Stuffing Boxes**

Stuffing box design should permit replacement of packing without removing any part other than the gland.

Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

i) **Mechanical Seals**

Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

j) The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

k) **Pump Shaft Motor Shaft Coupling**

The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

Annexure –I

l) **Base Plate**

A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimise misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

m) **Assembly and Dismantling**

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

n) **Drive Motor (Prime Mover)**

The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

ANNEXURE-II

PIPING THICKNESS: Pipes for sizes 200 NB & above shall confirm to IS: 3589 Grade 410. The final thickness shall not be less then that specified as per IS: 3589 as indicated below.

Nominal pipe Size (mm)	Outside Diameter (mm)	Wall Thickness (mm)
200 NB	219.1	4.5
250 NB	273	5
300 NB	323.9	5.6
350 NB	355.6	5.6
400 NB	406.4	6.3
450 NB	457	6.3
500 NB	508	6.3
600 NB	610	6.3

ANNEXURE-III

I. DATA SHEET FOR WATER LINE GATE / SLUICE VALVES

1.0	1. Size Range	50 MM & Above
2.0	2. Design Code	a) IS: 14846 or BS : 5150
3.0	3. Pressure Rating	a) PN 1.0 (as per IS:14846) b) PN 10 (as per BS:5150)
4.0	**Construction Features**	
4.1	Stem	Outside screw and yoke type, rising stem
4.2	Ends	Flanged, ANSI B16.5 Cl 150 (minimum)
4.3	Bonnet	Bolted
4.4	Wedge	Solid Wedge

5.0	Operation	by handwheel (Gear reduction unit for valve size 200 NB and above wherever applicable)
6.0	Seat	
	a) Body	Renewable
	b) Disc.	Renewable
7.0	**Material of Construction**	
7.1	Body/Bonnet/Handwheel	Cast Iron to IS:210 FG-200
7.2	Wedge Gland	Cast Iron to IS:210 FG-200
7.3	Stem	S.S. 410
7.4	Body Seat	GM to IS:318 Gr.-2
7.5	Wedge Seat	GM to IS:318 Gr.-2
7.6	Packing	Non-Asbestos
7.7	Back Seat Bushing	GM to IS:318 Gr.-2
7.8	Bolts, Nuts, & Studs	Carbon Steel to IS:1367, CL – 4.6/4.0
8.0	**Accessories Required**	
	a) Position Indicator	
	b) Draining arrangement for Valve Seat	
	c) Locking Facility with lock	
	d) Gear reduction unit for valve size 200 NB and above.	

II. DATA SHEET FOR GLOBE VALVES

1.0	Size Range	50 MM & Above
2.0	Design Code	a) BS : 5152 / Equiv.
3.0	Pressure Rating	a) PN 10 (as per BS:5152)
4.0	**Construction Features**	
4.1	Stem	Outside screwed & rising spindle
4.2	Ends	Flanged, ANSI B16.5 Cl 125 / Cl. 150
4.3	Bonnet	Bolted
4.4	Wedge	Solid Wedge
5.0	Operation	by handwheel (Gear reduction unit for valve size 200 NB and above wherever applicable)
6.0	Seat	
	a) Body	Renewable
	b) Disc.	Renewable
7.0	**Material of Construction**	
7.1	Body/Bonnet/Handwheel	Cast Iron to IS:210 FG-200
7.2	Wedge Gland	Cast Iron to IS:210 FG-200
7.3	Stem	S.S. 410
7.4	Body Seat	GM to IS:318 Gr.-2
7.5	Wedge Seat	GM to IS:318 Gr.-2
7.6	Packing	Non-Asbestos
7.7	Back Seat Bushing	GM to IS:318 Gr.-2
7.8	Bolts, Nuts, & Studs	Carbon Steel to IS:1367, CL – 4.6/4.0
8.0	**Accessories Required**	
	a) Position Indicator	
	b) Draining arrangement for Valve Seat	
	c) Locking Facility with lock	
	d) Gear reduction unit for valve size 200 NB and above.	

III. **DATA SHEET FOR CHECK VALVES**

1.0	Size range	Below 50 NB	50 NB and above
2.0	Design Code/rating	IS : 778	IS : 5312/ BS:5153
3.0	Type	———Swing check type———	
4.0	Pressure Rating	a) PN 1.0 (as per IS:5312) b) PN 10 (as per BS:5153)	
5.0	End connection	Screwed ends ANSI B16.5	Flanged to Class 150 min
6.0	Material Specifications		
	a) Body, cover, flap, hinges	GM to IS:318 Gr.2	Cast Iron IS:210 Gr. FG.200
	b) Hinge pin, door pin	HT Brass	SS
	c) Body seat ring, Disc. facing ring	————	GM to IS:318, LTB 2
	d) Gaskets	————	Non-Asbestos

IV. **DATA SHEET FOR BUTTERFLY VALVE**

1.0	Size Range	50 MM & Above
2.0	Design Code	Double flanged or lugged wafer type of low leakage rate confirming to AWWA C-504/BS:EN:593/API 609/equivalent
3.0	Pressure Rating	PN 10
4.0	End Connection	Flanged as per ANSI B.16.5 Class 125 / BS-EN 1092
5.0	**Material of Construction**	
5.1	Body & Disc	Cast Iron
5.2	Shaft	SS 410 / SS 420
5.3	Seat Rings	EPDM
6.0	**Accessories Required**	
	a) Position Indicator	
	b) Locking Facility with lock	
	c) Gear reduction unit for valve size 200 NB and above.	

SECTION: I

SUB-SECTION: C 2B

CUSTOMER SPECIFICATIONS
PROJECT SPECIFIC GENERAL REQUIREMENTS

NTPC Limited

(A Government of India Enterprise)

TALCHER THERMAL POWER PROJECT

STAGE - III (2x660MW)

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

BIDDING DOCUMENT NO.: CS-4540-001A-2

(This document is meant for the exclusive purpose of bidding against this Package and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued).

1.00.00 **INTRODUCTION**

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.

2.00.00 **BRAND NAME**

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.00.00 **BASE OFFER & ALTERNATE PROPOSALS**

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.

4.00.00 **COMPLETENESS OF FACILITIES**

4.01.00 Bidders may note that this is a EPC Package contract. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All same standard components/ parts of same equipment provided, shall be interchangeable with one another.

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 **CODES & STANDARDS**

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following :

a) Indian Electricity Act

b) Indian Electricity Rules

c) Indian Explosives Act

d) Indian Factories Act and State Factories Act

e) Indian Boiler Regulations (IBR)

f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

h) Pollution Control Regulations of Department of Environment, Government of India

i) State Pollution Control Board.

(j) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m) Explosive Rules, 1983

(n) Petroleum Act, 1984

(o) Petroleum Rules, 1976,

(p) Gas Cylinder Rules, 1981

(q) Static and Mobile Pressure Vessels (Unified) Rules, 1981

(r) Workmen's Compensation Act, 1923

(s) Workmen's Compensation Rules, 1924

(t) NTPC Safety Rules for Construction and Erection

(u) NTPC Safety Policy

(v) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise in the specifications, the latest editions (as applicable as on the date of bid opening), of the codes and standards given below shall also apply:

a) Bureau of Indian standards (BIS)

b) Japanese Industrial Standards (JIS)

c) American National Standards Institute (ANSI)

d) American Society of Testing and Materials (ASTM)

e) American Society of Mechanical Engineers (ASME)

f) American Petroleum Institute (API)

g) Standards of the Hydraulic Institute, U.S.A.

h) International Organization for Standardization (ISO)

i) Tubular Exchanger Manufacturer's Association (TEMA)

j) American Welding Society (AWS)

k) National Electrical Manufacturers Association (NEMA)

l) National Fire Protection Association (NFPA)

m) International Electro-Technical Commission (IEC)/ European Norm (EN)

n) Expansion Joint Manufacturers Association (EJMA)

o) Heat Exchange Institute (HEI)

p) IEEE standard

	q) JEC standard
5.03.00	Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.
5.04.00	As regards highly standardized equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.
6.00.00	**EQUIPMENT FUNCTIONAL GUARANTEE**
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.

6.02.00 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

7.00.00 **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**

7.01.00 **DESIGN OF FACILITIES**

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 **MAINTENANCE AND AVILABILITY CONSIDERATIONS**

Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path, turbine & equipments, inspection of the steam path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.

8.00.00 **DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**

8.01.00 Bidders may note that this is an **EPC Package contract**. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works as per the scope.

Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated.

The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.

A comprehensive engineering and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this Part-C, Section-VI of the Technical Specification.

8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:

8.03.01 A) **BASIC ENGINEERING DOCUMENTATION**

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i) System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii) Technology scan for each system / sub-system & equipment.

iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv) Optimization studies including thermal cycle optimization.

v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.

vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii) Water Balance diagram.

viii) Operation Philosophy and the control philosophy of the Main Plant and other plants.

ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area, transformer yard, switchyard and other areas included in the scope of the bidder.

xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) **DETAILED ENGINEERING DOCUMENTS**

i) General layout plan of the station.

ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii) Flow diagram, Process and Instrumentation diagrams along with write up and system description.

iv) Start-up curves for boiler and both turbines and boiler combined together as a unit for various start-ups, viz. Cold, Warm and Hot start up.

v) Piping isometric, composite layout and fabrication drawings.

vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.

vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.

viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like Mills, Fans, BFPs, CEPs, Heaters/ Deaerators, Air cooled Condensers, Vacuum pumps etc.

ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.

x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.

xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.).

xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.

xiii) Comprehensive list of all Terminal Points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiv) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xv) Protection system diagrams and relay settings.

xvi) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.

xx) Sequence and protection interlock schemes.

xxi) Type test reports, insulation co-ordination study report and power system stability study report.

xxii) Control system configuration diagrams and card circuit diagrams and maintenance details.

xxiii) Detailed DDCMIS system manuals.

xxiv) Detailed flow chart for digital control system.

xv) Mimic diagram layout, Assignment for other application engg.

xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.

xxvii) Underground facilities, levelling, sanitary, land scaping drawings.

xxviii) Geotechnical investigation and site survey reports (if and as applicable).

xxix) Model study reports wherever applicable.

xxx) Functional & guarantee test procedures and test reports.

xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.02 **INSTRUCTION MANUALS**

The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each

equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-IV.** The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of a particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tools, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project

Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows:

1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (This to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by

the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

8.03.03.01 **PLANT HANDBOOK**

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 **PROJECT COMPLETION REPORT**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **DRAWINGS**

a) i) All the plant layouts shall be made in computerized 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number

of hard copies as per **Annexure-VI** of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.

The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI** of Part-C.

iv) Contractor shall prepare the model of all the facilities located within plant boundary covering facilities in Main Plant Block area and Balance of plant (BOP) area in an integrated & intelligent 3D software solution. Main Plant Block area shall include Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area, FGD area and any other facility located in main plant block. BOP area shall include all facilities pertaining to AHP, CHP, LHP, GHP, DM PT plant, pipe & cable racks and any other facility located within plant boundary.

All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings and RCC layout of major buildings and structural arrangement drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.

Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer.

The complete 3D data (editable model) which shall be utilised for all future detailed engineering related to maintenance, operation, R&M, efficiency improvement of the project etc. Complete 3D model along with as built GADs, layout, isometrics, reports extracted and 3D models for all disciplines , with any other document generated from 3D model and naming conventions with as-built updates along with complete reference databases, component catalogues for all the size range shall be handed over to owner. Apart from the 3D Model, all

drawings like GADs, Isometrics etc. extracted from the model shall also be submitted by the Contractor in Electronic form. 3D model along with complete Project databases shall be submitted at each model review stage and as final as-built. The contractor shall also submit all the configuration files, customization files, templates and all referenced databases.

All input files of software used for design of Equipments / Piping like CAESAR2 files, input files for Pressure vessel design, datasheets etc., shall be handed over to NTPC as per NTPC specifications for handover of Engineering Information.

Further, two Licenses of the used 3D Modelling Software (One for Engineering View and One for Site View) shall be provided along with compatible Hardware for possible review and study of the Model Files being submitted by the Bidder Time to time.

Handover Plan: There shall be continuous handover of documents and data at various stages of the project including rules and trigger points for handover of data to NTPC shall be at 30%, 60% and 90 % of 3D model stage.

Database backup shall be taken every month and handed over to NTPC.

b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's)

own drawing number. Employer's drawing numbering system shall be made available to the successful bidder to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission **in line with suggestive MDL**.

Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per **Annexure VI**.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

8.03.05 **e-Learning Package:**

e-learning packages shall be supplied for the equipment / system for the following Steam Turbine Generator & auxiliaries and Steam Generator & auxiliaries along with associated electrical and C&I system.

8.03.05.01 Steam Turbine Generator & Auxiliaries

Steam Turbine including stop valves, control valves, overload valves and cross over piping. Steam Turbine Auxiliary Systems including Quick Closing and Ordinary NRVs, Turbine gland sealing system, Lubricating oil system and its purification system, Centralized oil storage and its purification system, Control fluid and its purification system, governing and protection system, exhaust hood spray cooling system, drainage and vent system, turbine preservation system, HP/LP Bypass system.

Generator and Auxiliary System including Generator, complete hydrogen cooling, carbon dioxide and nitrogen gas systems as applicable, complete seal oil system, complete water cooling system where applicable and complete excitation system.

Condensing Plant including Condenser, Condenser air evacuation system and Condenser on load tube cleaning system as applicable etc.

Drip Pump along with all accessories as applicable, Condensate Extraction Pumps along with all accessories, Deaerator level Control Station, Feed Water Heating Plant including Drain Cooler, low pressure heaters, deaerator and feed storage tank, high pressure heaters and associated accessories, Boiler Feed Pumps along with all accessories, Drive Turbine for Boiler Feed Pump along with all accessories, Feed regulating station, Make up system to Condenser, Gland Steam Condenser Recirculation System, Turbine Hall EOT Cranes and EOT Crane for Boiler Feed Pump as applicable.

8.03.05.02 **Steam Generator & Auxiliaries**

Furnace/evaporator, separator & drain collection vessel, superheater, reheater, economiser, startup recirculation & drain system, desuperheating spray system, safety valves, soot blowing system, draft plant including FD & ID fans, PA fan, air preheaters, SCAPH, coal preparation and firing system including raw coal feeder and pulverisers, coal burners, fuel oil system and oil burners, Electrostatic precipitator, NOx control system and Flue gas desulphurisation system, Aux. PRDS system.

8.03.05.03 These packages shall be installed on the Learning Management Server (LMS) of Power Management Institute (PMI), NTPC located at Noida. The Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI.

1. The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified

above is to facilitate the employees to have first hand information / requirement with respect to above activities for the supplied equipment / system .

2. The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied as above.

a. The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure etc.

b. The commissioning course(s) should include instructions on pre-commissioning, commissioning, initial operation etc.

c. The operation course(s) should include instructions on the permissive, interlocks, physical check-ups, start-up, shutdown and protections etc.

d. The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling.

Depth of coverage of above courses shall be as specified for **"Instruction Manuals"** in above clauses. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system.

3. The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of EIC or representative before acceptance by NTPC. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site.

The respective module for operation & maintenance shall be delivered and successfully test run at least three months before scheduled first synchronization of first unit.

4. e-Learning course broad requirements:

a. The courses shall be web based and mobile based Application type. It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc.

b. The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices.

c. Course content text shall be in English language and be associated with a voiceover in English language with Indian accent.

d. Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI.

e. Each course shall have every physical and functional detail of the equipment / system supplied.

f. Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules.

g. There shall be option for self-assessment test after every course. In case the user doesn't opt for self-assessment test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz.

h. If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same.

i. Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window.

j. The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course.

k. The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.

l. The system shall provide the user with the ability to select the information with a Cursor.

m. The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop-up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function.

n. Every course shall contain the 3D design/drawing/exploded view/360^0 turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable), animation and audio.

o. The users shall be able to control audio sound level associated with the courses.

p. Drawings / text in the courses shall be scalable (Zoom In/ Out).

q. The user shall have the capability to record a **bookmark** to mark displayed information for later recall, whenever he accesses the same course next time.

Notes:

1. e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system.
2. e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system.
3. The vendor shall get the approval of one sample course from EIC before proceeding for further courses.

8.04.00 Provision for Fail Safe operation of vital Equipments

All the Plant and equipments / Systems supplied under the contract shall be designed following “Fail Safe” concept. In case of failure of Power supply like Electric power, Hydraulic pressure, Pneumatic pressure, Vacuum etc. the system should be designed in such a way that the equipment/Valves/dampers etc. shall always move/remains (as applicable) to safest position as per system requirement to ensure safety of Man and Machinery.

8.05.00 Engineering Co-ordination Procedure

8.05.01 The following principal coordinators will be identified by respective organizations at time of award of contract:

NTPC Engineering Coordinator (NTPC EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

Contractor’s/ Vendor’s Engineering Coordinator (VENDOR EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

8.05.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

8.05.03 Contractor's/Vendor's Drawing Submission and Approval Procedure:

a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".

b) Not used

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance.

d) Not used

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) **Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.**

g) The Contractor shall submit drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within three (3) weeks of receipt of drawings. Upon review of each drawing, depending on

the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories:

CATEGORY- I: Approved

CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.

CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.

CATEGORY -IV For information and records.

h) Contractor shall resubmit the drawings approved under Category II, III & IVR within two (2) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

8.06.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.06.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

b) Drawings which were not submitted as per agreed schedule.

8.06.02 The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

9.00.00 **TECHNICAL CO-ORDINATION MEETING**

9.01.00 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

9.02.00 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the comments of the Employer shall be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.

9.02.01 The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

9.02.02 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

9.03.0 Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.

10.00.00 **DESIGN IMPROVEMENTS**

The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

11.00.00 **EQUIPMENT BASES**

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

12.00.00 **PROTECTIVE GUARDS**

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

13.00.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

13.01.00 All the first fill and one year's topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids, gases (excluding H_2, CO_2 and N_2 for Generator) 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 supplied by the contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

Bidder scope shall include supply of H_2, CO_2 and N_2 as applicable for the Generator till successful commissioning of Generator.

Bidder shall supply a quantity not less than 10% of the full charge or one (1) year topping requirement mentioned above (Whichever is higher) of each variety of lubricants, servo fluids, gases etc. (as detailed above) used which is expected to be

	utilized during the first year of operation. This additional quantity shall be supplied in separate containers.
13.02.00	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.
14.00.00	**LUBRICATION**
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.
15.00.00	**MATERIAL OF CONSTRUCTION**
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.
16.00.00	**RATING PLATES, NAME PLATES & LABELS**
16.01.00	Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.
16.03.00	Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

16.05.00 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support.

16.06.00 Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non-pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

16.07.00 Safety and relief valves shall be provided with the following:

a) Manufacturer's identification.

b) Nominal inlet and outlet sizes in mm.

c) Set pressure in Kg/cm^2 (abs).

d) Blowdown and accumulation as percentage of set pressure.

e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

16.08.00 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.09.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

17.00.00 **TOOLS AND TACKLES**

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.

18.00.00	**WELDING**
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.
19.00.00	**COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.
20.00.00	**PROTECTION AND PRESERVATIVE SHOP COATING**
20.01.00	**PROTECTION** All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a non-metallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.
20.02.00	**PRESERVATIVE SHOP COATING** All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.
20.03.00	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature

higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

20.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

20.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

20.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.

21.00.00 **QUALITY ASSURANCE PROGRAMME**

21.01.00 To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following:

a) His organisation structure for the management and implementation of the proposed quality assurance programme

b) Quality System Manual

c) Design Control System

d) Documentation Control System

e) Qualification data for Bidder's key Personnel.

f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

h) Control of non-conforming items and system for corrective actions.

i) Inspection and test procedure both for manufacture and field activities.

j) Control of calibration and testing of measuring testing equipments.

k) System for Quality Audits.

l) System for indication and appraisal of inspection status.

m) System for authorising release of manufactured product to the Employer.

n) System for handling storage and delivery.

o) System for maintenance of records, and

p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component .Formats for the same will be shared along with QA Coordination procedure.

22.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

22.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.

22.02.00 Manufacturing Quality Plan will detail out for all the components and equipment,various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms,inspection documents raised etc., during all stages of materials procurement,manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP, for review and approval.

22.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.

22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at **Annexure-V.** The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.
22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC / CHP Clearance).
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorized representative prior to carrying out the welding/brazing.
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be

	qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer. All welding / brazing procedures qualified / used at shop, will be made available to NTPC during audit / inspection. Procedures to be qualified at site will be submitted to NTPC for approval.
22.11.00	Not Used.
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping shall be as per relevant code. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
22.14.00	No welding shall be carried out on cast iron components for repair.
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be Ultrasonically tested.
22.17.00	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-vendors proposed by the Main contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format as Annexure-III. List of NTPC approved sub vendors against similar Pkg/items is attached as Section-VI, Part-B ,Chapter E-60 Indicative sub-vendor list. The contractor’s proposal for any new sub vendor for any of the items identified in indicative sub-vendor list shall necessarily be furnished in the sub vendor questionnaire & main Contractor Evaluation report format attached as Annexure- VII with all relevant documents and main contractor's own assessment report

assessed as per their quality management system for NTPC review and acceptance .

New sub vendor proposal will only be considered for NTPC review, provided the proposal is received sufficiently in time: 90 days prior to ordering date of a Bought-Out Items/Start of Manufacturing so as not to impede the progress of the contract.

Major checks and quality requirements as mentioned below shall necessarily be assessed by main contractor and complied with documentary support in case the same is not the part of their Quality management system.

i. Duly Filled Main supplier Evaluation Report.
ii. Duly Filled Sub-Supplier Questionnaire.
iii. Factory Registration Certificate.
iv. Overall Organization Chart with Manpower details (Design, Manufacturing, Quality etc.)
v. Supply reference list of the Sub-Supplier indicating similar product supply order reference no., customer name, rating of product, date /year of supply, date / year of commissioning.
vi. List of Manufacturing Equipment available with sub vendor.
vii. List of Testing Equipment available with sub vendor.
viii. Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any.
ix. Details of Outsourced Manufacturing Processes, if any.
x. Quality control exercised during receipt, in-process & final inspection.
xi. Compliance of Statutory requirements (As applicable)

After first submission of proposal to NTPC , In absence of relevant documents/ Incompleteness of the proposal, The main contractor will be given a period of maximum 10 days to submit the compliance of the NTPC comments. In case of noncompliance it will be presumed that main contractor is not serious about pursuing the proposal & the proposal will be foreclosed.

The proposed Sub vendor will be assessed broadly on following criteria

i) Quality Management System Compliance including raw material/BOI control, traceability & control over outsources process
ii) Design Capabilities (As applicable)
iii) Manufacturing, Testing & Storage Facility
iv) Processing Capabilities
v) Supply Experience
vi) Safety Aspect

In case of major observations or non-compliance observed during sub vendor works visit (Jointly with the main contractor) with respect to the submitted documents, proposed sub vendor will not be considered for acceptance and Main contractor will be solely responsible in such cases.

Monthly progress reports on sub-vendor detail. Submission / approval shall be furnished preferably on enclosed format at Annexure-IV. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

22.18.00	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within two (2) weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.
22.19.00	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his subcontractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
22.21.00	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
22.23.00	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
22.24.00	**Environmental Stress Screening** Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having

	substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be furnished for NTPC acceptance
22.25.00	The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.
22.26.00	**Software Reliability / Quality Certification** Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.
23.00.00	**QUALITY ASSURANCE DOCUMENTS**
23.01.00	The Contractor shall be required to submit the QA Documentation in soft copies, as identified in respective quality plan with tick (✓)mark.
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However, **soft copies will be furnished** not later than two (2) weeks.
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

(e.) Heat Treatment Certificate/Record (Time- temperature Chart)

(f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure).

(g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

23.03.00 Similarly, the contractor shall be required to submit soft copies containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

23.04.00 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than two (2) weeks after the despatch of equipment.

23.05.00 **TRANSMISSION OF QA DOCUMENTATION**

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than two (2) weeks after the date of the last delivery of equipment.

24.00.00 **PROJECT MANAGER'S SUPERVISION**

24.01.00 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.

24.02.00 The work shall be performed under the supervision of the Project Manager.

The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc.

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract

(d.) Inspect, accept or reject any equipment, material and work under the contract

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

25.00.00	**INSPECTION, TESTING AND INSPECTION CERTIFICATES**
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
25.04.00	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
25.05.00	When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Failure on the part of Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

25.06.00	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no. 25.03.00 - of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
25.09.00	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.
25.10.00	**ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME**
25.10.01	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 **(Annexure-III).**
25.10.02	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at **Annexure-IV.**
25.10.03	Field Welding Schedule Format enclosed at **Annexure-V.**
25.11.00	**TESTING OF MAJOR DESIGN FEATURES:** The major design features of the system shall be demonstrated by the Contractor at the Contractor's works or any other place mutually agreed within Six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder

before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following.

a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B.

b) Loop reaction time for sample loops/ logics.

c) SOE functionality tests.

d) Server changeover.

e) Various response times, having serious implication on operation & maintenance philosophy.

f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load.

g) Connectivity of Switchgear DDCMIS with Switchgear Relay Network.

The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer.

If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report.

25.12.00 **DEMONSTRATION OF APPLICATION ENGINEERING**

25.12.01 Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following.

(i) Logics/Loops:

a) Drive logics implementation for each type of binary drive along with its display in HMI.

b) Sequence implementation along with its display in HMI.

c) Single non-cascade controller implementation.

d) Cascade loop implementation.

e) Master slave implementation with different slave combination.

f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.

(ii) HMI Functions:

a) LVS Annunciation.

b) Graphics.

c) HSR

d) Logs/Reports.

e) Calculations (Basic & Performance Calculations).

25.12.02 The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.

After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.

25.12.03 During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.

26.00.00 **PRE-COMMISSIONING AND COMMISSIONING FACILITIES**

26.01.00 (a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and

included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.

(b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

(c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.

(d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e) The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer.

(f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

26.01.00 Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain:

(1.) Biodata including experience of the Commissioning Engineers.
(2.) Role and responsibilities of the Commissioning Organisation members.
(3.) Expected duration of posting of the above Commissioning Engineers at site.

26.02.00 **Initial Operation**

(a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

(b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.

The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

(c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation.

(d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.

26.03.00 **Guarantee Tests**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up **Engineer** shall make the unit ready to conduct such test **before start of initial operation**. Such test **shall be conducted along with the** Initial Operations.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.

26.04.00 Before start of commissioning of critical equipment, Commissioning Clearance Certificate (CCC) to be submitted by Main contractor. List of the critical equipments **and CCC format will be provided along with QA Coordination procedure.**

27.00.00 **TAKING OVER**

Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

28.00.00 **TRAINING OF EMPLOYER'S PERSONNEL**

28.01.00 The scope of service under training of Employer’s engineers shall include a training module covering the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer:

(a) Training for Steam Generator & ESP Equipment, TG & Auxiliaries and related equipments.

(b) Training for Electric Systems including VFD and Electric power supply system.

(c) Training for other SG/TG related C&I systems/equipments including training on Flame Monitoring System, Furnace and Flame Viewing System , Turbine Supervisory System (TSS) including vibration analyzer, vibration monitoring system axial shift, eccentricity measurements etc. for Main Turbine, BFP Turbine etc. Burner management study, control loop study, misc. system for SG C&I, EHTC, Turbine stress control system, Turbine protection system, ATRS, instrumentation etc.

c1: Training on Engineering, Model building,pre-testing, Post -test fine tuning of Advance process control systems with faculty having experience of atleast 5 years in Model Process Control.

(d) Training for special packages specified elsewhere in Technical Specification, Section-VI.

(e) Training for various C&I systems/equipment supplied includes the following:

i) DDCMIS - Human Machine Interface – Hardware & Operating System

ii) DDCMIS-Human Machine Interface System Engineering & Application Software.

iii) DDCMIS – Control System Hardware and Control system Application Software.

iv) DDCMIS – Operator Training : Use of the system at Works + at site.

v) DDCMIS – Specialized Network security.

(f) Training for power cycle piping/critical piping.

(g) Training for UPS systems Annunciation system, SWAS, PA system, flue gas analyzers, CCTV and 24 VDC system.

(h) Training on following aspects of fieldbus (i) Hardware & Software features (ii) System design, diagnostic and testing (iii) maintenance, troubleshooting and fault analysis.

(i) Training on Non-Intrusive hardwired Electric Actuator and Fieldbus based Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator

(k) Training for numerical relays & networking systems supplied under MV & LT switchgear system.

(l) Training courses on offered PLC system in the following areas:

(a.) Operator training

(b.) Hardware Maintenance training

(c.) Software training

(d.) Any other specialized training as required for system operation and maintenance.

(m) Training for Ash Handling System & Coal Handling Plant Equipment and Auxiliaries

Area	Topics	Mandays
Ash Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ash handling plant and design Plant Visit - Operational feedback	300

	- O&M history/problems related to Ash handling plant Visit to Manufacturer's Work - Manufacturing process of Ash handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	
Coal Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Coal handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Coal handling plant Visit to Manufacturer's Work - Manufacturing process of Coal handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	150

n) Training for UF Membranes, RO membranes, Zero Liquid Discharge (ZLD) Chlorine Di-Oxide (ClO_2) generation & dosing system, Condensate Polishing Plant (CPU) and CW Treatment System.

Area	Topics	MANDAYS
UF Membranes	**Product design** -Basic design features -Theory & principle of operation -Latest technological trends in Ultrafiltration membranes and design -CIP & CEB of UF system **Plant Visit**	**7**

	-Operational feedback -O&M history/problems related to UF membranes **Visit to Manufacturer's Work** -Manufacturing process of UF membranes and equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	

Area	Topics	MANDAYS
RO membranes	**Product design** -Basic design features -Theory & principle of operation -Latest technological trends in RO membranes and design -Failure analysis, types of failures, causes & its evaluation, remedies -CIP of RO system **Plant Visit** -Operational feedback -O&M history/problems related to RO membranes **Visit to Manufacturer's Work** -Manufacturing process of RO membranes and equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	**7**

Zero Liquid Discharge (ZLD)	**System Design** - Plant water optimization and Scheme to achieve the ZLD - Basic design features - Latest technological trends for ZLD in Thermal Power Plant **Plant Visit** - Operational feedback - O&M history/problems related to plant	**5**
Chlorine Di-Oxide (ClO_2) generation & dosing system	**System/Product Design** - Basic design features - Theory & principle of operation - Latest technological trends in Chlorine Di-Oxide (ClO2) generation & dosing system and design aspects & Selection criteria. **Plant Visit** - Operational feedback - O&M history/ problems related to ClO2 plant **Performance Test of generator** - Generator capacity performance testing. **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	**5**
Condensate Polishing Plant (CPU)	**System/Product Design** - Basic design features including Pre-filters - Theory & principle of operation - Latest technological trends in CPU & Pre-filters and design aspects & Selection criteria. **Plant Visit** - Operational feedback - O&M history / problems related to CPU plant **Visit to Manufacturer's Work** -Manufacturing process of pre-filters and major equipment	**3**

	-Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	
CW Treatment System	**System/Product Design** - Basic design features - Theory & principle of operation - Latest technological trends and design aspects & Selection criteria. **Operation & Maintenance of Plant** - Operational feedback - O&M history / problems related to plant - Trouble shooting and fault analysis Familiarization of special maintenance techniques - Special tool and tackles familiarization	**3**
Note: One week shall constitute of five (5) man days.		

(o) Training for **Substation Automation System**

PRODUCT	**AREAS OF TRAINING REQUIEMENT**
	PRODUCT/SYSTEM DESIGN
Substation Automation System	The contractor shall provide training for NTPC personnel comprehensively covering following courses. 1 Computer System Hardware 2 Computer System Software 3 Application Software

MANDAYS: 60 (Total) inclusive of visit to Manufacturer's site)

(p) Training on Erection methodologies for all the Sub-packages, System and Equipments associated with the EPC Package, including a visit to power plant construction site.

The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval.

28.03.00	The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering entire scope for the package. This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc.
28.04.00	Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.
28.05.00	Contractor shall provide training on application of PAUT (Phased array ultrasonic testing) and TOFD (Time of flight diffraction) techniques for two weeks (at least 80 Hours). The training shall be arranged at least six months prior to the start of erection works of SG & TG works.
28.06.00	Exact details, extent of training and the training schedule shall be finalized based on the Bidder's proposal within two (2) months from placement of award.
28.07.00	In all the above cases, the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.
28.08.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award. **Note**: 1. For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person. 2. The total man months in each area shall be divided into suitable number of modules which shall be discussed and finalized during post award stage. 3. Duration of each module shall not be less than 10 (ten) working days out of which 20 % shall be for plant/manufacturers' works visits and 80% shall be classroom training. 4. A) Location of classroom training for engineering shall be at Design/Engineering office. B) Classroom training for erection/O&M shall be at location of Manufacturers' works.

28.09.00 **TRAINING REQUIRED IN MAN MONTH**

Area	Engineering (Man months)	Erection (Man months)	O&M (Man months)
Steam Turbine Generator and its Auxiliaries including electricals	6.5	9.0	23
Steam Generator and its Auxiliaries including electricals	6.5	9.0	23
Station C&I (Control and Instrumentation)	3.5	5.5	10
Ash Handling Plant	2.0	3.0	5.0
Coal Handling Plant	1.0	1.5	2.5
UF Membranes, RO Membranes, ZLD, Chlorine Di Oxide (ClO2) generation & dosing system, Condensate Polishing Plant (CPU), CW Treatment System	0.2	0.3	0.5
Substation Automation System	0.3	0.7	1
Total	**20**	**29**	**65**

29.00.00 **SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION**

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

i) Working platforms should be fenced and shall have means of access.

ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

30.00.00 **NOISE LEVEL**

The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) meter horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

i) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA.

ii) Regulating drain valves in which case it shall be limited to 90 dBA-115 dBA.

iii) Mill noise which will be limited to 85-90 dBA.

iv) TG unit in which case it shall not exceed 90 dBA.

v) For HP-LP bypass valves and other intermittently operating control valves, the noise level shall be within the limit of 90 dBA.

vi) For BFP Motor Noise level shall be within the limit of 90 dBA.

31.00.00 **PACKAGING, TRANSPORTATION AND STORAGE**

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage at site due to improper packing and presevation. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

In addition to above, the contractor shall take all necessary measures for storage of all electronic equipment / systems at site in a dust free Air conditioned space ensuring proper temperature & humidity.

32.00.00 **ELECTRICAL EQUIPMENTS/ENCLOSURES**

32.01.00 All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.

33.00.00 **INSTRUMENTATION AND CONTROL**

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

33.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

1	Temperature	-	Degree centigrade (deg C)
2.	Pressure	-	Kilograms per square centimetre (Kg/cm^2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
3.	Draught	-	Millimetres of water column (mm wc).
4.	Vacuum	-	Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).
5.	Flow (Gas)	-	Tonnes/ hour
6.	Flow (Steam)	-	Tonnes/ hour
7.	Flow (Liquid)	-	Tonnes / hour
8.	Flow base	-	760 mm Hg. 15 deg.C
9.	Density	-	Grams per cubic centimetre.

33.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.

34.00.00 **ELECTRICAL NOISE CONTROL**

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).

35.00.00 **SURGE PROTECTION FOR SOLID STATE EQUIPMENT**

All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.

36.00.00 **INSTRUMENT AIR SYSTEM**

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

37.00.00 **TAPPING POINTS FOR MEASUREMENTS**

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.

i) Temperature test pockets with stub and thermowell

ii) Pressure test pockets

38.00.00 **SYSTEM DOCUMENTATION**

The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Techncial Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification.

The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

38.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.

39.00.00 **MAINTENANCE MANUALS OF ELECTRONIC MODULES**

The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further, the contractor shall furnish a set of operating manuals which should include block diagrams, make, model/type, details wiring and external connection drawings etc. as required to do the testing and maintenance of the electronic modules.

Backup & Restoration Procedures of DDCMIS, Station LAN & Advance Process Control shall be provided.

40.00.00 **MAKE IN INDIA REQUIREMENTS**

a) The bidder shall follow Indian laws, regulations and standards. There shall not be any restriction in terms of compliance to codes & standards of foreign origin only. The compliance to equivalent/better Indian as well as other codes & standards, wherever available, shall also be acceptable.

b) The technologies/ products offered shall be environmentally friendly, consuming less energy, and safe, energy efficient, durable and long lasting under the prescribed operational conditions.

c)	The bidder/its sub vendor/supplier shall ensure supply of spares, materials and technological support for the entire life of the project.
d)	The bidder shall list out the products and components producing Toxic E-waste and other waste as specified. It shall have an Extended Producers Responsibility (EPR) so that after the completion of the lifecycle, the materials are safely recycled/ disposed of by the contractor and for this, the bidder has to establish recycling/disposal unit as specified.
e)	The equipment/ material sourced from foreign companies will be tested in accredited labs in India before acceptance wherever such facilities are available. The testing shall be carried out in accordance with MOP extant order/guidelines.
f)	The bidder shall have to furnish a certificate regarding cyber security/safety of the equipment/process to be supplied/services to be rendered as safe to connect.
g)	All applicable safety requirements shall be met. Regular safety audit shall be carried out by the manufacturer/ supplier.
h)	Wherever required, the foreign supplier shall establish fully functional service centers in India and shall keep spares/material locally for future needs of Employer.
i)	To protect the security, integrity and reliability of equipment in this package, it is essential to remove vulnerabilities arising out of the possibility of cyber-attack through malware/ Trojans etc. embedded in imported equipments. This requirement shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in this package. Contractor shall comply all the requirements of Order No 25-11/6/2018-PG, dated 02/07/2020 (attached as **Appendix-I**), issued by Ministry of Power, Government of India and its subsequent amendments/revisions. Contractor shall furnish declaration of compliance of MOP order dated 02/07/2020 requirements with dispatch of equipment/ item. Further, Contractor shall furnish back up testing certificates, whenever Employer asks the same.
j)	All equipment/materials/parts/items required in this package which are domestically manufactured with sufficient domestic capacity as identified in Annexure-I of MOP order dated 16/11/2021 including its subsequent revisions (copy attached as **Appendix-II**) shall necessarily be sourced from the class-I local suppliers only as per the extant provisions of the Public Procurement (Preference to Make in India) Orders issued by DPIIT and MoP. Any violation w.r.t Make in India and minimum local content (MLC) requirements as specified shall be sole responsibility of the Bidder.

LIST OF CODES AND STANDARDS

Indian Standards	Title	International and Internationally recognised standards
IS:277	Galvanised steel sheets (plain or corrugated)	
IS:655	Specification for metal air duct	
IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952
IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev
IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1

IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)
IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965
IS:2825	Code for unfired vessels	
IS:1520	Horizontal centrifugal pumps for clear cold and fresh water	
IS:1600	Code for practice for performance of constant speed IC Engines for general purpose	
IS:1601	Specification for perform-ance of constant speed IC Engines for general Purpose	
IS:1893	Criteria for earthquake resistant design of structures	
IS1978-1971	Line Pipe April 1969.	API Standards 5L
IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954
IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968
IS:2312	Propellant type Ventilation fans	
IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957

IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963
IS:3354	Outline dimensions for electric lifts.	
IS:3401	Silica gel	
IS:3588	Specification for electrical axial flow fans	
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)	
IS:3677	Unbonded rock and slag wool for thermal insulation	
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
IS:3895	Specification for monocrystallines semiconductor rectifier cells and stacks	
IS:3963	Roof extractor unit	
IS:3975	Mild steel wires, strips and tapes for armouring cables	
IS:4503	Shell and tube type heat Exchanger	

IS:4540	Specification for monory-stallines rectifire assembly equipment	
IS:4671	Expanded polystyrene for thermal insulation purpose	
IS:4736	Hot dip zinc coating on steel tubes	
IS:4894	Centrifugal fans	
IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958
IS:6392	Steel pipe flanges	BS 4504 : 1969
IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956
IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524
IS:7373	Specification for wrought aluminium and aluminium sheet and strips	
IS:7938	Air receivers for compressed air installation	
ISO:1217	Displacement compressor-Acceplance test	
ASHRAE-33 and air heating coils.	Methods of testing for rating of forced circulation air cooling	
ASHRAE-52-76 particle matter.	Air cleaning device used in general ventilation for removing	

ASHRAE-22-72	Method of testing for rating of water cooled refrigerant condensers.
ASHRAE 23-67	Methods of testing for rating of positive displacement refrigerant compressors.
ARI-450-6	Standard for water cooled refrigerant condensers.
ARI-550	Standard for centrifugal water chilling packages.
ARI-410	Standard for forced circulation air cooling and air heating coils
ARI-430/435 BS:848 (Part-1,2)	Central station AHU/Application of Central Station AHU Fans
BS:400	Low carbon steel cylinders for the storage & transport of permanent gases.
BS:401	Low carbon steel cylinders for the storage & transport of liquified gases.
CTI Code ACT-105	Acceptance test code for Water Cooling Tower.
ANSI-31.5	Refrigerant piping
ASME-PTC- 23-1958	Atmospheric Water Cooling Equipment
AMCA A-21C	Test Code for air moving devices
API:618	Reciprocating Compressor for general refinary services.

HYDRAULIC INSTITUTE STANDARDS.

HYDRANT SYSTEM MANUALS OF TAC.

TAC MANUALS OF SPRAY SYSTEM

NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.

CODE AND STANDARD FOR CIVIL WORKS

Some of the applicable Standards, Codes and references are as follows:

Excavation & Filling

IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc.

IS: 4701	Code of practice for earth work on canals.
IS: 9758	Guidelines for Dewatering during construction.
IS: 10379	Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

Properties, Storage and Handling of Common Building Materials

IS: 269	Specification for ordinary Portland cement, 33 grade.
IS: 383	Specification for coarse and fine aggregates from natural sources for concrete.
IS: 432	Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.
IS: 455	Specification for Portland slag cement.
IS: 702	Specification for Industrial bitumen.
IS: 712	Specification for building limes.
IS: 808	Rolled steel Beam channel and angle sections.
IS: 1077	Specification for common burnt clay building bricks.
IS: 1161	Specification of steel tubes for structural purposes.
IS: 1363	Hexagon head Bolts, Screws and nuts of production grade C.
IS: 1364	Hexagon head Bolts, Screws and Nuts of Production grade A & B.
IS: 1367	Technical supply conditions for Threaded fasteners.

IS: 1489	Specification for Portland-pozzolana cement:
(Part-I)	Fly ash based.
(Part-II)	Calcined clay based.
IS: 1542	Specification for sand for plaster.
IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS: 1786	Specification for high strength deformed bars for concrete reinforcement.
IS: 2062	Specification for steel for general structural purposes.
IS: 2116	Specification for sand for masonry mortars.
IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.
IS: 3150	Hexagonal wire netting for general purpose.
IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.
IS: 3812	Specification for fly ash, for use as pozzolana and admixture.
IS: 4031	Methods of physical tests for hydraulic cement.
IS: 4032	Methods of chemical analysis of hydraulic cement.
IS: 4082	Recommendations on stacking and storage of construction materials at site.
IS: 8112	Specification for 43 grade ordinary portland cement.
IS: 8500	Medium and high strength structural steel.
IS: 12269	53 grade ordinary portland cement.
IS: 12894	Specification for Fly ash lime bricks.

Cast-In-Situ Concrete and Allied Works

IS: 280	Specification for mild steel wire for general engineering purposes.
IS: 456	Code of practice for plain and reinforced concrete.
IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.
IS: 516	Method of test for strength of concrete.
IS: 650	Specification for standard sand for testing of cement.
IS: 1199	Methods of sampling and analysis of concrete.
IS: 1791	General requirements for batch type concrete mixers.
IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
IS: 2204	Code of practice for construction of reinforced concrete shell roof.
IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
IS: 2438	Specification for roller pan mixer.
IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS: 2505	General requirements for concrete vibrators, immersion type.
IS: 2506	General requirements for concrete vibrators, screed board type.
IS: 2514	Specification for concrete vibrating tables.
IS: 2645	Specification for Integral cement water proofing compounds.
IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)
IS: 2750	Specification for Steel scaffolding.

IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS: 3025	Methods of sampling and test waste water.
IS: 3366	Specification for Pan vibrators.
IS: 3370 (Part I to IV)	Code of practice for concrete structures for the storage of liquids.
IS: 3414	Code of practice for design and installation of joints in buildings.
IS: 3550	Methods of test for routine control for water used in industry.
IS: 3558 concrete.	Code of practice for use of immersion vibrators for consolidating
IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS: 4326 of buildings.	Code of practice for earthquake resistant design and construction
IS: 4461	Code of practice for joints in surface hydro-electric power stations.
IS: 4656	Specification for form vibrators for concrete.
IS: 4925	Specification for batching and mixing plant.
IS: 4990	Specification for plywood for concrete shuttering work.
IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.
IS: 5256	Code or practice for sealing joints in concrete lining on canals.
IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
IS: 5624	Specification for foundation bolts.
IS: 6461	Glossary of terms relating to cement concrete.

IS: 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS: 6509	Code of practice for installation of joints in concrete pavements.
IS: 7861	Code of practice for extreme weather concreting. (Parts I & II)
IS: 9012	Recommended practice for shot concreting.
IS: 9103	Specification for admixtures for concrete.
IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
IS: 10262	Recommended guidelines for concrete mix design.
IS: 11384	Code of practice for composite construction in structural steel and concrete.
IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.
IS: 12118	Specification for two-parts poly sulphide.
IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
IS: 13311	Method of non-destructive testing of concrete.
Part-1	Ultrasonic pulse velocity.
Part-2	Rebound hammer.
SP:23	Handbook of concrete mixes
SP: 24	Explanatory Handbook on IS: 456-1978
SP: 34	Handbook on concrete reinforcement and detailing.

Precast Concrete Works

SP: 7(PartVI/ prefabrication and Sec.7)	National Building Code- Structural design of systems building.

IS: 10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.
IS: 10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.

Masonary and Allied Works

IS: 1905	Code of Practice for Structural Safety of Buildings-Masonry walls.
IS: 2212	Code of Practice for Brickwork.
IS: 2250	Code of Practice for Preparation and use of Masonry Mortar.
SP: 20	Explanatory handbook on masonry code.

Sheeting Works

IS:277	Galvanised steel sheets (plain or corrugated).
IS: 459	Unreinforced corrugated and semi-corrugated asbestos cement sheets.
IS: 513	Cold-rolled carbon steel sheets.
IS: 730	Specification for fixing accessories for corrugated sheet roofing.
IS: 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.
IS: 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.
IS: 3007	Code of practice for laying of asbestos cement sheets.
IS: 5913	Methods of test for asbestos cement products.
IS: 7178	Technical supply conditions for tapping screw.
IS: 8183	Bonded mineral wool.

IS: 8869	Washers for corrugated sheet roofing.
IS: 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.
IS: 12866	Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced).
IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.

Fabrication and Erection of Structural Steel Work

IS: 2016	Specification for plain washers.
IS: 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS: 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS: 3502	Specifications for chequered plate.
IS: 6911	Specification for stainless steel plate, sheet and strip.
IS: 3757	Specification for high strength structural bolts
IS: 6623	Specification for high strength structural nuts.
IS: 6649	High Tensile friction grip washers.
IS: 800	Code of practice for use of structural steel in general building construction.
IS: 816	Code of practice for use of Metal Arc Welding for General Construction.
IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.
IS: 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS: 817	Code of practice for Training and Testing of Metal Arc Welders.

IS: 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS: 9178	Criteria for Design of steel bins for storage of Bulk Materials.
IS: 9006	Recommended Practice for Welding of Clad Steel.
IS: 7215	Tolerances for fabrication steel structures.
IS: 12843	Tolerance for erection of structural steel.
IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.
SP: 6 (Part 1 to 7)	ISI Handbook for structural Engineers.
IS: 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS: 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube
IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.
IS : 2595	Code of Practice for Radio graphic testing.
IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.
IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

Plastering and Allied Works

IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.
IS : 1661	Application of cement and cement lime plaster finishes.
IS : 2333	Plaster-of-paris.
IS : 2402	Code of practice for external rendered finishes.
IS : 2547	Gypsum building plaster.
IS : 3150	Hexagonal wire netting for general purpose.

Acid and Alkali Resistant Lining

IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS : 412	Specification for expanded metal steel sheets for general purpose.
IS : 4441	Code of practice for use of silicate type chemical resistant mortars.
IS : 4443	Code of practice for use of resin type chemical resistant mortars.
IS : 4456	Method of test for chemical resistant tiles. (Part I & II)
IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.
IS : 4832	Specification for chemical resistant mortars.
	Part I Silicate type
	Part II Resin type
	Part III Sulphur type
IS : 4860	Specification for acid resistant bricks.
IS : 9510	Specification for bitumasitc, Acid resisting grade.

Water Supply, Drainage and Sanitation

IS : 458	Specification for concrete pipes.
IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.
IS : 651	Specification for salt glazed stoneware pipes.
IS : 774	Flushing cisterns for water closets and urinals.
IS : 775	Cast iron brackets and supports for wash basins and sinks.
IS : 778	Copper alloy gate, globe and check valves for water works purposes.
IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.
IS : 782	Caulking lead.
IS : 783	Code of practice for laying of concrete pipes.
IS : 1172	Basic requirements for water supply, drainage and sanitation.
IS : 1230	Cast iron rain water pipes and fittings.
IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.
IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.
IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.
IS : 1726	Cast iron manhole covers and frames.
IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.

IS : 1742	Code of practice for building drainage.
IS : 1795	Pillar taps for water supply purposes.
IS : 1879	Malleable cast iron pipe fittings.
IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.
IS : 2065	Code of practice for water supply in building.
IS : 2326	Automatic flushing cisterns for urinals.
IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.
IS : 2501	Copper tubes for general engineering purposes.
IS : 2548	Plastic seat and cover for water-closets.
IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
IS : 2963	Non-ferrous waste fittings for wash basins and sinks.
IS : 3114	Code of practice for laying of cast iron pipes.
IS : 3311	Waste plug and its accessories for sinks and wash basins.
IS : 3438	Silvered glass mirrors for general purposes.
IS : 3486	Cast iron spigot and socket drain pipes.
IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
IS : 4127	Code of practice for laying of glazed stone-ware pipes.

	IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.
	IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
	IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
	IS : 5822	Code of practice for laying of welded steel pipes for water supply.
	IS : 5961	Cast iron grating for drainage purpose.
	IS : 7740	Code of practice for road gullies.
	IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.
	IS : 8934	Cast copper alloy fancy pillar taps for water services.
	IS : 9762	Polyethylene floats for ball valves.
	IS : 10446	Glossary of terms for water supply and sanitation.
	IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
	IS : 12592	Specification for precast concrete manhole covers and frames.
	IS : 12701	Rotational moulded polyethylene water storage tanks.
	SP: 35	Handbook on water supply and drainage.
	-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.
	Doors, Windows and Allied Works	
	IS : 204	Tower Bolts
	Part-I	Ferrous metals.
	Part-II	Nonferrous metals.

IS : 208	Door Handles.
IS : 281	Mild steel sliding door bolts for use with padlocks.
IS : 362	Parliament Hinges.
IS : 420	Specification for putty, for use on metal frames.
IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.
IS : 1038	Steel doors, windows and ventilators.
IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS : 1341	Steel butt hinges.
IS : 1361	Steel windows for industrial buildings.
IS : 1823	Floor door stoppers.
IS : 1868	Anodic coatings on Aluminium and its alloys.
IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels
IS:2209	Mortice locks (vertical type).
IS:2553	Safety glass
IS:2835	Flat transparent sheet glass.
IS:3548	Code of practice for glazing in buildings.
IS:3564	Door closers (Hydraulically regulated).
IS : 3614	Fire check doors; plate, metal covered and rolling type.
IS:4351	Steel door frames.
IS:5187	Flush bolts.
IS:5437	Wired and figured glass

	IS:6248	Metal rolling shutters and rolling grills.
	IS:6315	Floor springs (hydraulically regulated) for heavy doors.
	IS:7196	Hold fasts.
	IS:7452	Hot rolled steel sections for doors, windows and ventilators.
	IS:10019	Mild steel stays and fasteners.
	IS:10451	Steel sliding shutters (top hung type).
	IS:10521	Collapsible gates.
	Roof Water Proofing and Allied Works	
	IS:1203	Methods of testing tar and bitumen.
	IS:1322	Specification for bitumen felts for water proofing and damp proofing.
	IS:1346	Code of practice for water proofing of roofs with bitumen felts.
	IS:1580	Specification for bituminous compound for water proofing and caulking purposes.
	IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
	IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.
	Floor Finishes and Allied Works	
	IS:1237	Specification for cement concrete flooring tiles.
	IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.
	IS:2114	Code of practice for laying in-situ terrazzo floor finish.
	IS:2571	Code of practice for laying in-situ cement concrete flooring.
	IS:3462	Specification for unbacked flexible PVC flooring.
	IS:4971	Recommendations for selection of industrial floor finishes.

IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS:8042	Specification for white portland cement.
IS:13801	Specification for chequered cement concrete flooring tiles.

Painting and Allied Works

IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.
IS:1477	Code of practice for painting of ferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:1650	Specification for colours for building and decorative finishes.
IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.
IS:2338	Code of practice for finishing of wood and wood based materials.
Part-I	Operations and workmanship
Part-II	Schedules
IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.
Part-I	Operations and workmanship.
Part-II	Schedule.
IS:2524	Code of practice for painting of nonferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.
IS:2933	Specification enamel paint, under coating and finishing.
IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.
IS:5410	Specification for cement paint

IS:5411 (Part-I)	Specification for plastic emulsion paint-for exterior use
IS:6278	Code of practices for white washing and colour washing.
IS:10403	Glossary of terms relating to building finishes.
Piling and Foundation	
IS:1080	Code of practice for design and construction of simple spread foundations.
IS:1904	Code of practice for design and construction of foundations in Soils; General Requirements.
IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).
IS:2950 (Part-I)	Code of practice for designs and construction of Raft foundation.
IS:2974 (Part-I TO V)	Code of practice for design and construction of machine foundations.
IS:6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.
IS:8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.
Part-I	Shallow foundations.
Part-II	Deep foundations.
IS:12070	Code of practice for design and construction of shallow foundations on rocks.
DIN:4024	Flexible supporting structures for machines with rotating machines.
VDI:2056	Criteria for assessing mechanical vibrations of machines.
VDI:2060	Criteria for assessing rotating imbalances in machines.
Stop Log and Trash Rack	
IS:4622	Recommendations for fixed - wheel gates structural design.
IS:5620	Recommendations for structural design criteria for low head slide gates.
IS:11388	Recommendations for design of trash rack for intakes.
IS:11855	General requirements for rubber seals for hydraulic gates.
Roads	

	IRC:5	Standard specifications and Code of practice for road bridges, section-I general Features of Design.
	IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.
	IRC:16	Specification for priming of base course with bituminous primers.
	IRC:19	Standard specifications and code of practice for water bound macadam.
	IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).
	IRC:34	Recommendations for road construction in waterlogged areas.
	IRC:36	Recommended practice for the construction of earth embankments for road works.
	IRC:37	Guidelines for the Design of flexible pavements.
	IRC:56	Recommended practice for treatment of embankment slopes for erosion control.
	IRC:73	Geometric design standards for rural (non-urban) highways.
	IRC:86	Geometric Design standards for urban roads in plains.
	IRC:SP:13	Guidelines for the design of small bridges & culverts.
	IRC - Public-	Ministry of Surface Transport (Roads Wing), Specifications
	ation	for road and bridge works.
	IS:73	Specification for paving bitumen
	Loadings	
	IS:875	Code of practice for design loads other than earthquake) for
	(Pt. I to V)	buildings and structures.
	IS:1893	Criteria for earthquake resistant design of structures.
	IS:4091	Code of Practice for design and construction of foundation for transmission line towers & poles.
	IRC:6	Standard specifications & code of practice for road bridges, Section-II Loads and stresses.
	M.O.T.	Deptt. of railways Bridge Rules.
	Safety	
	IS:3696	Safety code for scaffolds and ladders.
	(Part I & II)	

IS:3764	Safety code for excavation work.
IS:4081	Safety code for blasting and related drilling operations.
IS:4130	Safety code for demolition of buildings.
IS:5121	Safety code for piling and other deep foundations.
IS:5916	Safety code for construction involving use of hot bituminous materials.
IS:7205	Safety code for erection on structural steelwork.
IS:7293	Safety code for working with construction machinery.
IS:7969	Safety code for handling and storage of building materials
IS:11769	Guidelines for safe use of products containing asbestos.

- Indian Explosives Act. 1940 as updated.

Architectural design of buildings

SP:7	National Building Code of India
SP:41	Handbook on functional requirements of buildings (other than industrial buildings)

Miscellaneous

IS:802	Code of practice for use of structural steel in
(Relevant parts)	overhead transmission line towers.
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.
IS:10430	Creteria for design of lined canals and liner for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
CIRIA	Design and construction of buried thin-wall pipes.
Publication	

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

Temperature Measurements

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.
3. Temperature measuremnet by electrical Resistance thermometers - IS:2806.
4. Thermometer - element - Platinum resistance - IS:2848.

Pressure Measurements

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).

   b) Electonic transmitters BS:6447.
2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.
3. Process operated switch devices (Pr. Switch) BS-6134.

Flow Measurements

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

Electronic Measuring Instrument & Control Hardware/ Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.
2. Safety requirements for electrical and electronic measuring and controling instrument - ANSI C 39.5 - 1974.
3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).

5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.

6. Printed circuit boards - IPC TM - 650, IEC 326 C.

7. General requirement 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 C 73 - 1973 (Supplement ANSI C 73 a - 1980).

11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).

12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.

13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.

14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.

15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.

17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.

18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.

19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.

20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.

21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.

22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.
2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).
2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).
3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

Apparatus, enclosures and installation practices in hazardous area

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.
2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.
3. Instrinsically safe apparatus - NFPA 493 1978.
4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.
5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.
3. Water and steam in power cycle - ASME PTC 19.11.
4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.
2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472
3. Damp heat cycling test - IS:2106

4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.
2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.
3. Turbine water damage prevention - ASME TDP-1-1980.
4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.
2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.
3. Surge withstand capability test - ANSI C 37.90 1 -1989.
4. Performance testing of UPS - IEC 146.
5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.
6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.
7. Printed Circuit Board - IPC TM 650, IEC 326C.
8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.
2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.
3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).
4. Codes for pressure piping - ANSI B 31.1
5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.
2. Seamless carbon steel pipe ASTM - A - 106.
3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.
4. Material for socket welded fittings - ASTM - A - 105.
5. Seamless ferritic alloy steep pipe - ASTM - A - 335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.
7. Composition bronze of ounce metal castings - ASTM - B - 62.
8. Seamless Copper tube, bright annealed - ASTM - B - 168.
9. Seamless copper tube - ASTM - B - 75.
10. Dimension of fittings - ANSI - B - 16.11.
11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.
2. Material of socketweld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI - B - 16.11.
4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.
2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.
3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorugh 2/83.
4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).
5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.
6. Rules for Testing insulated cables and flexible cables : VVDE - 0472
7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)

8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.

9. Oxygen index and temperature index test - ASTM D - 2863.

10. Smoke density measurement test - ASTMD - 2843.

11. Acid gas generation test - IEC - 754 - 1.

12. Swedish Chimney test - SEN - 4241475 (F3).

13. Teflon (FEP) insulation & sheath test - ASTMD - 2116.

14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.

15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).

Cable Trays, Conduits

1. Guide for design and installation of cable systems in power generating staiton (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.

2. -do- Test Standards. NEMA VE-1-1979.

3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTMA - 386-78.

Public Address System

1. Specifications for lod speakers - IS:7741 (Part-I, II and III)

2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301

3. Specification for Public Address Amplifiers - IS:10426.

4. Code of practice for outdoor installation of PA system - IS:1982.

5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.

6. Basic environmental testing procedures for electronic and electrical items - IS:9000.

7. Characteristics and methods of measurements for sound system equipment - IS:9302

8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732

9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)

10. Fittings for rigid steel conduits for electrical wiring - IS:2667

11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.

Vibration Monitoring System

1. API 670 - 1994

2. BS : 4675 Part-2

ANNEXURE-III

एनटीपीसी NTPC	Project : Stage : : Package : Supplier : Contractor No. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL SUB-SYSTEM :	DOC. NO.: REV. NO.: DATE : PAGE : OF

S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

LEGENDS

SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – **For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list alongwith the condition of approval, if any.**

DR – **For these items "Detailed required" for NTPC review. To be identified with letter "DR" in the list.**

NOTED – **For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with "NOTED.'**

QP/INSPN CATEGORY:

CAT-I **: For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.**

CAT-II **: For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.**

CAT-III **: For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.**

UNITS/WORKS **: Place of manufacturing Place of Main Supplier of multi units/works.**

ANNEXURE-IV

एनटीपीसी NTPC	Project : Stage :: Package : Contractor : Contractor No. :	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL	DOC. NO.: REV. NO.: DATE : PAGE : OF

S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks

FORMAT 1/1 Engg. Div. / QA&I

ANNEXURE-V

एनटीपीसी NTPC	Project : Stage : Contractor : Contractor No. : System :	FIELD WELDING SCHEDULE (To be raised by the contractor) Welding Code: ……	DOC. NO.: REV. NO.: DATE : PAGE : OF

Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	

NOTES:

SIGNATURE

FORMAT	1/1	**Engg. Div. / QA&I**

S. No.	Description of Drgs./Docs.	No. of Prints	No. of Portable Hard Disk
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents		
	First submission and submission with major changes		
	▪ Layout (A0&A1 sizes)	4	-
	▪ Other Drawings/Documents (A0 & A1 sizes)	2	-
	▪ P&ID (All sizes)	4	-
	a) Final drawings/documents (Directly to site)	6	2
	b) "As Built" Drawing/Documents (Directly to site)	6	2
	c) Analysis reports of Equipments / piping / structures components/system employing software packages as detailed in the specifications.	2	2
2	Erection Manual (Directly to site)	4 sets	2
3	Operation & Maintenance manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2
4	Plant Hand Book i) First Submission	1	1
5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2

S. No.	Description of Drgs./Docs.	No. of Prints	No. of Portable Hard Disk
6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	--
	ii) Approved Copies (Direct to Site)	4 sets	2
7	Project Completion Report (Directly to site)	6 sets	2

CORPORATE QUALITY ASSURANCE/ कॉरपोरेट गुणवत्ता आश्वासन

MAIN CONTRACTOR'S PROPOSAL CUM EVALUATION REPORT

मुख्य संविदाकार प्रस्ताव सह मुल्यांकन रिपोर्ट

Ref No: संदर्भ सं.:			***Date:*** तिथिः		
i.	***Main Contractor*** मुख्य संविदाकार				
ii.	***Project*** परियोजना				
iii.	***Package Name*** पैकेज का नाम		***Package No*** पैकेज सं.		
iv.	***Proposed Item/Scope of Sub-contracting*** उप-संविदा(अनुबंध) का प्रस्तावित मद/ दायरा				
v.	***Item covered under*** *निम्नलिखित के अंतर्गत शामिल मद*	***Schedule-1*** */अनुसूची- 1*		***As per contract clause No-*** *अनुबंध के अनुसार खंड सं.-- -*	
		Schedule-2 *अनुसूची- -2*			
vi.	***If item is Schedule-1 and proposed sub-vendor is indigenous, Main Contractor to explain how the contractual provisions will be fulfilled*** /यदि मद अनुसूची -**1** है और प्रस्तावित उप-विक्रेता स्वदेशी है, तो मुख्य संविदाकार को स्पष्ट करना होगा कि संविदा/अनुबंध के प्रावधान कैसे पूरे किए जाएंगे				
vii.	***Name and Address of the proposed Sub-vendor's works*** /प्रस्तावित सब-वेंडर का नाम तथा पता				
viii.	***PO placement date/ Start of manufacturing (if self-manufactured) as per L2 network*** **पीओ नियोजन की तिथि / एल-** 2 **नेटवर्क के अनुसार विनिर्माण (यदि स्व-निर्मित है) की शुरुआत**				

ix.	***Item Description (Type/Size/Rating/Scope of Sub-Contracting)*** मद का विवरण (प्रकार / आकार / रेटिंग / उप-अनुबंध का दायरा)	***Total quantity of proposed item envisaged in this package (Nos/ Running Meters/ Kgs/ Tons etc)*** इस पैकेज में परिकल्पित प्रस्तावित मद की कुल मात्रा (संख्या / क्रियाशील मीटर / किलोग्राम / टन आदि)	***Quantity proposed to be procured from proposed sub-vendor (Nos/ Running Meters /Kgs /Tons etc)*** प्रस्तावित उप-विक्रेता (संख्या / क्रियाशील मीटर / किलोग्राम / टन आदि) से खरीदी जाने वाली मात्रा	***Timeline for quantity requirements as per project schedule & whether the proposed Sub-vendor equipped with adequate capacity to supply proposed order quantity in time*** / परियोजना समय सूची के अनुसार मात्रा आवश्यकताओं के लिए समय-सीमा और क्या प्रस्तावित उप-विक्रेता समय पर प्रस्तावित मांग की मात्रा की आपूर्ति करने में पूरी तरह से सक्षम है

x.	***Supply experience of the proposed sub-vendor (including supplies to Main Contractor, if any) for similar item/scope of sub-contracting, for last 3 years (Note:- Only relevant experience details w.r.t. proposed item/scope of subcontracting to be brought out here)*** पिछले **3** वर्षों के लिए उप-अनुबंध के समान मद / दायरे के लिए प्रस्तावित सब-वेंडर (मुख्य संविदाकार हेतु

आपूर्ति, यदि कोई हो, सहित) का आपूर्ति अनुभव (नोट: - उप-अनुबंध के प्रस्तावित मद / दायरे के संबंध में केवल प्रासंगिक अनुभव के विवरण का उल्लेख हो

Project/Package परियोजना/पैकेज	***Customer Name*** ग्राहक का नाम	***Supplied Item (Type/Rating/Model /Capacity/Size etc)*** आपूर्त्तित मद (प्रकार/रेटिंग /मॉडल /क्षमता/आकार आदि)	***PO ref no/date*** पीओ संदर्भ सं. /तिथि	***Supplied Quantity*** आपूर्ति की मात्रा	***Date of Supply*** आपूर्त्ति की तिथि

We confirm that as per our assessment, the proposed sub-vendor has requisite capabilities & supply experience and is suitable for supplying the proposed item/scope of sub-contracting/हम अपने आकलन के अनुसार इस बात की पुष्टि करते हैं कि, प्रस्तावित उप-विक्रेता के पास अपेक्षित क्षमता और आपूर्ति करने का अनुभव है और उप-अनुबंध के दायरे /प्रस्तावित मद की आपूर्ति के लिए उपयुक्त है।

Name: नाम:		***Desig:*** पद:		***Contact No:*** दूरभाष सं.:		***Sign:*** हस्ताक्षर:		***Date:*** तिथि:	

Company's Seal/Stamp:- कंपनी का मुहर:-

SUB-VENDOR QUESTIONNAIRE/ सब-वेंडर प्रश्नावली

i.	***Item/Scope of Sub-contracting*** **उप-संविदा(अनुबंध) का मद/ दायरा**			
ii.	***Address of the registered office*** पंजीकृत कार्यालय का पता		***Details of Contact Person*** संपर्क व्यक्ति का विवरण ***(Name, Designation, Mobile, Email)*** (नाम, पदनाम, मोबाइल, ईमेल)	
iii.	***Name and Address of the proposed Sub-vendor's works where item is being manufactured*** प्रस्तावित उप-विक्रेता के कार्यों का नाम और पता, जहां मद का निर्माण किया जा रहा है		***Details of Contact Person:*** संपर्क व्यक्ति का विवरण ***(Name, Designation, Mobile, Email)*** (नाम, पदनाम, मोबाइल, ईमेल)	
iv.	***Annual Production Capacity for proposed item/scope of sub-contracting*** **उप-संविदा(अनुबंध)** के प्रस्तावित मद / दायरे के लिए वार्षिक उत्पादन क्षमता			
v.	***Annual production for last 3 years for proposed item/scope of sub-contracting*** **उप-संविदा(अनुबंध)** के प्रस्तावित मद / दायरे के लिए पिछले 3 वर्षों का वार्षिक उत्पादन			
vi.	***Details of proposed works*** **प्रस्तावित कार्यों का विवरण**			
1.	***Year of establishment of present works*** वर्तमान फैक्टरी की स्थापना का वर्ष			
2.	***Year of commencement of manufacturing at above works*** उपरोक्त फैक्टरी में निर्माण कार्य शुरू होने का वर्ष			
3.	***Details of change in Works address in past (if any*** पूर्व में फैक्टरी स्थल में परिवर्तन का विवरण (यदि कोई हो))			
4.	***Total Area*** कुल क्षेत्र			
	Covered Area शामिल क्षेत्र			
5.	***Factory Registration Certificate*** फैक्टरी पंजीकरण प्रमाण पत्र		***Details attached at Annexure – F2.1*** विवरण अनुलग्नक- एफ 2.1 पर संलग्न है	
6.	***Design/ Research & development set-up*** डिजाइन / अनुसंधान और विकास सेटअप ***(No. of manpower, their qualification, machines & tools employed etc.)*** (श्रमिकों की संख्या, उनकी योग्यता, मशीन और उपलब्ध उपकरण आदि)		***Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design)*** ***Details attached at Annexure – F2.2*** ***(if applicable)*** लागू / लागू नहीं, अगर विनिर्माण मुख्य संविदाकार / खरीददार के डिजाइन के अनुसार है) विवरण अनुलग्नक –एफ 2.2 पर संलग्न है। (यदि लागू हो)	
7.	***Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc)*** मैनपावर विवरण के साथ समग्र संगठन का चार्ट(डिजाइन / विनिर्माण / गुणवत्ता आदि)		***Details attached at Annexure – F2.3*** विवरण अनुलग्नक – F2.3 में संलग्न है।	
8.	***After sales service set up in India, in case of foreign sub-vendor(Location, Contact Person, Contact details etc.)*** भारत		***Applicable / Not applicable*** लागू / लागू नहीं	

	में बिक्री सेवा की स्थापना के बाद, विदेशी उप-विक्रेता के मामले में(स्थल , संपर्क व्यक्ति, संपर्क विवरण आदि)	***Details attached at Annexure – F2.4*** विवरण अनुलग्नक -2.4 पर संलग्न है।
9.	***Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any*** फ्लोचार्ट सहित विनिर्माण प्रक्रिया निष्पादन योजना , जिसमें आउटसोर्स प्रक्रिया, यदि कोई हो, सहित कच्चे माल से तैयार उत्पाद तक विनिर्माण के विभिन्न चरणों को दर्शाया गया हो,	***Details attached at Annexure – F2.5*** विवरण अनुलग्नक - F2.5में संलग्न है।
10.	***Sources of Raw Material/Major Bought Out Item*** कच्चे माल के स्रोत / खरीदे हुए मुख्य मद	***Details attached at Annexure – F2.6*** विवरण अनुलग्नक - F2.6में संलग्न है।
11.	***Quality Control exercised during receipt of raw material/BOI, in-process , Final Testing, packing*** कच्चे माल / खरीदे हुए मद, प्रक्रियाबद्ध, अंतिम परीक्षण, पैकिंग करते समय गुणवत्ता नियंत्रण	***Details attached at Annexure – F2.7*** विवरण अनुलग्नक - F2.7 पर संलग्न है
12.	***Manufacturing facilities (List of machines, special process facilities, material handling etc.)*** विनिर्माण सुविधा(मशीनों की सूची , विशेष प्रक्रिया सुविधाएं, सामग्री रख-रखाव आदि)	***Details attached at Annexure – F2.8*** विवरण अनुलग्नक - F2.8में संलग्न है।
13.	***Testing facilities (List of testing equipment)*** परीक्षण सुविधाएं(परीक्षण उपकरण की सूची)	***Details attached at Annexure – F2.9*** विवरण अनुलग्नक – F2. 9 में संलग्न है।
14.	***If manufacturing process involves fabrication then-*** यदि निर्माण प्रक्रिया में फेब्रिकेशन की गई है तो-	***Applicable / Not applicable*** लागू / लागू नहीं ***Details attached at Annexure – F2.10*** विवरण अनुलग्नक - F2.10में संलग्न है। ***(if applicable)*** लागू / लागू नहीं
	List of qualified Welders पात्र वेल्डर की सूची	
	List of qualified NDT personnel with area of specialization विशेषज्ञता के क्षेत्र सहित पात्र एनडीटी कार्मिकों की सूची	
15.	***List of out-sourced manufacturing processes with Sub-Vendors' names & addresses*** सब-वेंडर द्वारा बाह्य स्रोतों (उनके नाम और पते सहित)से करवाएं गए निर्माण प्रक्रियाओं की सूची	***Applicable / Not applicable*** लागू / लागू नहीं ***Details attached at Annexure. –F2.11*** विवरण अनुलग्नक - F2.10में संलग्न है। ***(if applicable)*** (यदि लागू हो)
16.	***Supply reference list including recent supplies*** नवीनतम आपूर्ति सहित आपूर्ति संदर्भ सूची	***Details attached at Annexure – F2.12*** विवरण अनुलग्नक - F2.12 में संलग्न है। ***(as per format given below)*** (नीचे दिए गए प्रारूप के अनुसार)

Project/ package परियोजना /पैकेज	***Customer Name*** ग्राहक का नाम	***Supplied Item (Type/Rating/Model /Capacity/Size etc)*** आपूर्ति की गई वस्तु (प्रकार / रेटिंग / मॉडल / क्षमता / आकार आदि)	***PO ref no/date*** पीओ संदर्भ सं. / तिथि	***Supplied Quantity*** आपूर्ति की मात्रा	***Date of Supply*** आपूर्ति की तारीख

17.	***Product satisfactory performance feedback letter/certificates/End User Feedback*** उत्पाद के संतोषजनक प्रदर्शन संबंधी फीडबैक पत्र / प्रमाण पत्र / अंतिम उपयोगकर्ता फ़ीडबैक	***Attached at annexure - F2.13*** अनुलग्नक F2. 3पर संलग्न है
18.	***Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product***	***Applicable / Not applicable*** लागू / लागू नहीं

	(similar or higher rating) प्रस्तावित उत्पाद (एक समान या उच्च रेटिंग वाले) के लिए टाइप टेस्ट रिपोर्ट (टाइप टेस्ट विवरण, रिपोर्ट संख्या, एजेंसी, जांच की तारीख) का सारांश नोट: - रिपोर्ट प्रस्तुत करने की आवश्यकता नहीं है ***Note:- Reports need not to be submitted***	***Details attached at Annexure – F2.14*** विवरण अनुलग्नक - F2.1 4में संलग्न है ***(if applicable)*** (यदि लागू हो)
19.	***Statutory / mandatory certification for the proposed product*** प्रस्तावित उत्पाद के लिए वैधानिक / अनिवार्य प्रमाणीकरण	***Applicable / Not applicable*** लागू / लागू नहीं ***Details attached at Annexure – F2.15*** ***(if applicable)*** (यदि लागू हो)
20.	***Copy of ISO 9001 certificate*** आईएसओ 9001 प्रमाण पत्र की प्रति ***(if available***(यदि उपलब्ध हो)	***Attached at Annexure – F2.16*** अनुलग्नक में संलग्न - F2.1 6 है
21.	***Product technical catalogues for proposed item (if available)*** प्रस्तावित मद के लिए उत्पाद तकनीकी कैटलॉग (यदि उपलब्ध हो)	***Details attached at Annexure – F2.17*** विवरण अनुलग्नक - F2.1 7 में संलग्न है

Name: ***नाम:***		***Desig:*** ***पद:***		***Sign:*** ***हस्ताक्षर:***		***Date:*** ***तिथि:***	

Company's Seal/Stamp:- कंपनी की मुहर / मोहर: -

SUB-SECTION–IV

FUNCTIONAL GUARANTEES

FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS

The term "Performance Guarantees" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)".

The term “BMCR” (Boiler Maximum Continuous Rating) appearing in the Technical Specification shall mean the maximum continuous steam output of Steam Generator (as defined Cl. No. 1.02.00 Sub-section A-01, Part-B) at super heater outlet at rated parameters.

The term “TMCR” (Turbine maximum continuous rating) appearing in the technical specification shall mean 660 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this sub-section) under rated steam parameters, 0% cycle make-up and 77 mmHg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure and /or a different throttle steam pressure.

1.00.00 **PERFORMANCE GUARANTEES**

1.00.01 **General Requirements**

a) The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.

b) The guaranteed performance parameters indicated in furnished by the bidder in his offer, shall be without any tolerance values whatsoever and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.

c) The Contractor shall conduct performance test and demonstrate all the guarantees covered herein, during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance test are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.

d) All costs associated with the tests including cost associated with the supply, calibration shall be included in the bid price.

e) It is the responsibility of the contractor to perform the Performance Guarantee/ Acceptance test as specified in this subsection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.

f) The Contractor shall make the plant ready for the performance guarantee tests before start of Initial Operation.

All CAT-1 Performance Guarantee tests shall be conducted along with initial operation except following

a) Coal Pulverisor Wear Parts Warranty
b) Particulate Emission/ESP Efficiency, FGD.
c) Auxiliary power consumption for Station Auxiliaries (PG Test for Station Auxiliary Power Consumption to be done along with unit#2 initial operation)
d) "PG test of Cooling Tower (NDCT) shall be carried out by the contractor within one year of successful completion of trial operation of the cooling tower and at a time when the atmospheric conditions are within limits of deviation from the design conditions as specified, preferably in the period from May to September. If Unit trial operation falls in these months then PG test of NDCT can be clubbed with Unit trial operation.

e) PG test of A/C System (for aux. power consumption under station auxiliaries) shall be carried out by the contractor within one year of successful completion of trial operation of the respective A/C system during summer in the months of May-August. If unit#2 trial operation falls in these months then PG test of A/C system can be clubbed with unit#2 trial operation.

g) PG test shall be performed by using process instruments envisaged for normal operation and control of unit. Any additional instrument/ item required for PG test shall also be supplied by the contractor. Instruments to be used for PG test shall be indicated in the respective P&IDs.

Control system loop tuning required to limit the variation of parameters during performance guarantee testing shall be completed prior to PG Test / initial operation.

Test result for PG test is envisaged to be computed in DDCMIS.

h) Tools and tackles, instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost.

i) The Performance / Acceptance test shall be carried out as per the standard procedure included in the specification. For some of the PG tests, standard PG test procedures have not been included in the specification. PG test procedure for such PG tests shall be submitted, as per latest International codes / standard meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees, within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.

1. For Cat-I Performance / Acceptance tests to be conducted along with the initial operation: After the conductance of Performance test, the test results shall be calculated automatically by the server/software provided by the contractor. The correction curves shall be fed/inbuilt in the PG test program/software. Provision of manual entry of offline data which cannot be captured online (such as Relative humidity, Atmospheric pressure etc.) and necessary for calculation of PG Test result shall also be provided. The contractor shall submit the detailed test evaluation report of Performance test results to Employer promptly but not later than 7 days from the date of conductance of Performance test.

2. For Performance / Acceptance tests other than those identified at 1 above: After the conductance of Performance test, the contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than 7 (seven) days from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run.

j) The contractor shall submit for Employer's approval the detailed Performance Test procedure (except for the guarantee tests for which the standard PG test procedure is identified in technical specification) containing the following:

i. Object of the test.
ii. Various guaranteed parameters & tests as per contract.
iii. Method of conductance of test and test code.
iv. Duration of test, frequency of readings & number of test runs.
v. Method of calculation.
vi. Correction curves and respective equations for graphs to be fed for the online computation.
vii. Instrument list consisting of range, accuracy, least count, and location of

instruments along with reference approved P&IDs.

viii. Scheme showing measurement points.

ix. Sample calculation.

x. Acceptance criteria.

xi. Any other information required for conducting the test.

k) In case during performance guarantee tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. However, if the specified performance guarantee(s) are still not met even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed Employer will have the right to the following:

i) For Category-I Guarantees

Accept the equipment/system/plant after levying Liquidated Damages as specified hereunder. The liquidated damages, for shortfall in performance indicated in clause 1.01.02 for this sub-section are on per unit basis and shall be levied separately for each unit, except for the rate indicated for auxiliary power consumption for station auxiliaries which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category - I' Guarantees.

ii) For Category-II Guarantees

In case the performance guarantee(s) are not met by the Contractor during demonstration test, the Contractor shall carry out all necessary modifications and/or replacements to comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent.

If, however, the demonstrated guarantee(s) are not met even after the above modifications / replacements within ninety (90) days, it will be concluded that, the equipment has failed to meet the guarantee(s).

In such a case, Employer shall Reject the equipment/plant/system and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category - II ' Guarantees. Conformance to the performance requirements under Category -II is mandatory.

iii) For Category-III Guarantees

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the EMPLOYER. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s) replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters/capacities shall be termed as category - III, guarantees.

1.01.00 **GUARANTEES UNDER CATEGORY - I**

1.01.01 The performance guarantees which attract liquidated damages (LD) are as follows:

i) Unit Heat Rate at 100% TMCR load

Guaranteed Unit Heat rate in kcal/kWhr under rated steam conditions at 77 mmHg(abs) condenser pressure with zero make up at 660 MW load (i.e. 100% of

section. Power consumption of all unit auxiliaries shall be taken for continuous unit operation at 660 MW (i.e. 100% rated load) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up with design coal.

xi) Auxiliary Power Consumption for Station Auxiliaries

Station auxiliary power consumption comprising of all station Auxiliaries required for continuous station operation at 2 x 660 MW (i.e. 100% rated load of all the units) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up with design coal shall be guaranteed in line with the requirements stipulated in clause 1.01.07.02 of this sub section.

Notes:

(a) Power consumption of each of the pump/fan/compressors/ Conveyors etc. wherever mentioned shall be measured with its own drive at the switchgear end.

xii) Cooling Tower

The cold-water temperature of 32.5 deg C shall be guaranteed for the design conditions of CW flow, range, ambient WBT and RH as per the performance test procedure of cooling tower elaborated elsewhere in the specification.

"Predicted cold water temperature" shall be arrived from the guaranteed cold-water temperature by correcting the same for the test conditions of range, ambient conditions and circulating water flow using the performance curves furnished by the contractor. In case the "Test cold water temperature" is higher than the "Predicted cold water temperature", Employer reserves the right to accept the tower after assessing the liquidated damages. The liquidated damages for shortfall in cold water temperature shall be worked out for all the cooling towers as per relevant clause & sub-section.

xiii) LD for 0.1% increase in APH Leakage against the shortfall (as per part-B guarantee condition description).

1.01.02 **AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY-I GUARANTEES**

If the performance guarantee(s) are not met by the Contractor during PG Test, it will be concluded that, the equipment has failed to meet the guarantee(s) and action shall be taken as per the Contract Requirement. If the performance guarantee(s) specified at clause 1.01.01 are not met by the Contractor even after the modifications and/or replacements mentioned at clause 1.00.01 of this Sub-section, Employer will accept the equipment/system only after levying liquidated damages against the Contractor, at the rates listed herein, and such liquidated damages shall be deducted from the Contract Price:

S. No	Guarantee	Rate of Liquidated Damages (LD)	Limiting Value
(i)	For Increase in the Guaranteed unit heat rate in kcal/kWhr at 660 MW under rated steam conditions at 77 mmHg(abs) condenser pressure with zero make up	**US $ 587488** (US Dollar Five Lakh Eighty Seven Thousand Four Hundred Eighty Eight only) per 1 kcal/kWhr increase in heat rate	Not more than 2070 Kcal/KWHr
(ii)	For Increase in the Guaranteed unit Heat rate in kcal/kWhr under	**US $ 215412**	Not more than 2188 Kcal/KWHr

S. No	Guarantee	Rate of Liquidated Damages (LD)	Limiting Value
	turbine throttle main steam pressure of 150 kg/cm2 (abs) and rated Main Steam and Reheat Steam temperature at 77 mmHg(abs) condenser pressure with zero make up at 363 MW load (i.e. 55 % of rated load).	(US Dollar Two Lakh Fifteen Thousand Four Hundred Twelve only) per 1 kcal/kWhr increase in heat rate	
(iii)	For deficiency in Continuous TG output of 693 MW unit load (i.e. 105% of rated load) under rated steam conditions, 77 mmHg (abs) condenser pressure with 0% make-up.	**US $ 1602** (US Dollar One Thousand Six Hundred Two only) per 1 kW shortfall in TG output	
(iv)	For deficiency in Average Condenser Pressure in mm Hg(abs) measured at 300mm above top row of condenser tube at 693 MW, 0% makeup, design CW temperature and design CW flow	**US $ 651995** (US Dollar Six Lakh Fifty One Thousand Nine Hundred Ninety Five only) per 1 mm Hg increase in condenser pressure	Not more than 65 mmHg (abs)
(v)	**Steam Generator Capacity** For shortfall in the guaranteed steam generating capacity in T/h at rated steam parameters at superheater outlet & rated steam temperature at reheater outlet (with any combination of mills working as per Employer's choice) with the coal being fired from within the range specified	**US $ 211415** (US Dollar Two lac Eleven thousand Four Hundred and Fifteen only) for every 1 T/hr short fall in steam output	Not less than 102% of the turbine VWO steam flow requirement
(vi)	**Coal Pulveriser Wear Parts Warranty** Life of Coal Pulveriser wear parts in hours of operation	To be calculated as per clause 1.01.04 of the Functional Guarantees subsection	Not less than 8000 hours
(vii)	**ESP Efficiency** For shortfall in guaranteed ESP efficiency in percentage points under conditions specified at clause 1.01.01 (vii) of this sub section	**US $ 1604776** (US Dollar Sixteen Lac Four Thousand Seven Hundred and Seventy Six only) for every 0.01% point shortfall in ESP Efficiency	Not less than as worked out to limit ODB to 17 mg/Nm^3 (max.) at ESP outlet before FGD inlet

S. No	Guarantee	Rate of Liquidated Damages (LD)	Limiting Value
(viii)	**FGD SO2 Removal Efficiency** For shortfall in guaranteed SO2 removal efficiency in percentage points under condition stipulated in clause 1.01.01 (viii) of this Sub Section of Technical Specification	**US $ 36351** (US Dollar Thirty Six Thousand Three Hundred and Fifty One only) for every 0.1% point shortfall in SO2 removal efficiency	SO_2 removal efficiency to achieve SO_2 emission in the Chimney to less than 60 mg per Nm^3 as per Part-B, Sub-section-A-01
(ix)	**Limestone Consumption Rate** For increase in guaranteed limestone consumption of FGD system in kg/hr/unit under condition stipulated in clause 1.01.01 (ix) of this Sub Section of Technical Specification	**US $ 392430** (US Dollar Three Lac Ninety Two Thousand Four Hundred and Thirty only) for every 100 kg/hr increase in limestone consumption rate	Not more than **9440** kg/hr.
(x)	For increase in the Unit Auxiliary power consumption in kW for unit auxiliaries required for continuous unit operation at 100% TMCR i.e. 660 MW unit load.	**US $ 5195** (US Dollar Five Thousand One Hundred Ninety Five only) per 1 kW increase in Auxiliary Power Consumption.	Not more than **32000** KW
(xi)	For increase in Station auxiliary power consumption comprising of all station Auxiliaries required for continuous station operation at 2 x 660 MW (i.e. 100% rated load of all the units).	**US $ 5195** (US Dollar Five Thousand One Hundred Ninety Five only) per 1 kW increase in Auxiliary Power Consumption.	Not more than **16500** KW
(xii)	Per Cooling Tower - For every 0.2 deg. C rise in Cold Water Temperature from the guaranteed value	**US $ 7,32,402** (US Dollar Seven Lakh Thirty Two Thousand Four Hundred and Two only) per for every 0.2 deg C rise in cold water temperature	
(xiii)	LD for 0.1% increase in APH Leakage (as per part-B guarantee condition description)	**US $ 129864** (US Dollar One Lac Twenty Nine Thousand Eight Hundred and Sixty Four only) for every 0.1% point increase from the guaranteed or specified	

$P_{au-Stn} = SUM (P_i \times D_i)$

Where,

P_{-Stn} = Power consumed by the station auxiliaries

P_{au-Stn} = Total Power Consumption, while running at 100% design load for all the auxiliaries of the station supplied by bidder.

P_i = Power consumed by each station auxiliary.

D_i = Duty factor to be considered for each station auxiliary.

T_{L-Stn} = Transformer Losses of the station transformers and that of any other transformer associated with station auxiliary power supply system (excluding those included in Unit system like GT, UT, UAT,UST etc.) and shunt reactor supplied by the bidder for meeting the station auxiliary power supply shall be included based on work test report.

Losses of transformers shall be considered based on the works test reports as per the criteria specified under Clause 1.01.07.02 (h) under the subheading Transformers.

While guaranteeing the station auxiliary power consumption the bidder shall necessarily include all the station auxiliaries running at full load with duty factors as have been defined at the ensuing para of this chapter.

The station auxiliaries that shall be running during the guarantee test for calculating **" P_{au-Stn} "** shall include but not be limited to the following:

(Where duty factor is not indicated the same is to be considered as 1.0)

a) Plant & Instrument air compressors & Air drying plant

Power consumption of:-

i)	Instrument Air compressor	3 Nos.	Duty Factor =0.6
ii)	Plant Air compressor	2 Nos.	Duty Factor = 0.33
iii)	Air Drying plant (Heaters) (if applicable)	3 Nos.	Duty Factor =0.5
iv)	Air Drying plant (Blowers) (if applicable)	3 Nos.	Duty Factor = 1.0

Power consumption at rated duty point for compressors to be arrived based on shop test and power consumption at rated duty point for Air Drying plant to be arrived based on site test.

b) Air Conditioning & Ventilation System

Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of Chilling machines, Chilled water Pumps, Condenser water Pumps, Air handling unit (AHU) fans, for the Air conditioning system of main plant building, FGD control room, ESP control room of each units, AHP control room, service building, administrative building. Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of water system control building, switchyard control building and canteen building. Power consumption at motor input terminals of centrifugal fans of mechanical ventilation system of GIS building.

Power consumption at rated duty point for water cooled chillers & air cooled condensing units shall be based on site test and for other drives like chilled water pumps, Condenser water Pumps & AHU/centrifugal fans shall be based on shop test.

(Duty factor for power consumption of A/C equipments of canteen building, administrative building and service building shall be 0.5)

c) FGD System

i. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries
ii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries
iii. Booster water pump
iv. Waste water pump
v. Limestone Slurry Tank Agitators
vi. Filtrate Pump(s)
vii. Belt Filter Wash Water Pump
viii. Hydro-cyclone Waste Water Sump Pump and Waste Water Pump
ix. all other continuous running Agitators

d) Auxiliary Water System Pumps (Working Pumps)

i. Makeup (Clarified water) water pump (if applicable)
ii. AC & Ventilation make-up pumps
iii. FGD Gypsum wash system make-up pumps
iv. DM water make up pumps
v. Potable water pumps
vi. Filtered water feed pumps for DM plant
vii. Degassed water pump (if applicable)
viii. High pressure pumps for RO based DM plant (if applicable)
ix. UF feed pumps for RO based DM plant (if applicable)
x. Service water pumps
xi. Raw water (PT) Pumps
xii. Raw water (Ash) Pumps (as applicable)
xiii. Make-up Water Pumps

e) Ash Handling Plant

List of drives with corresponding weightage factors thereof for which power consumption is to be guaranteed is as follows:

1.	Bottom Ash Crushers	0.3125 for jet pump system & 1.0 for submerged scrapper conveyor system/dry type bottom ash system.
2.	Bottom Ash H.P. Water Pumps	0.625 for jet pump system & 1.0 for submerged scrapper chain conveyor system/dry type bottom ash system.

(ii) Wet ball Mill wear parts guarantee

Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in Part B of the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulveriser based on actual total hours of operation.

(iii) Wet ball Mill ball consumption

Contractor shall guarantee ball consumption per ton of limestone throughput in line with requirements stipulated in Part B of the Technical Specification. Contractor shall furnish the minimum ball diameter below which the balls shall be replaced.

(iv) Pressure Drop across FGD

The contractor shall demonstrate that the total pressure drop in the gas path across the FGD System shall not exceed the guaranteed values for the range of coal and loads specified in the Technical Specification

(v) Vacuum Belt Filter Capacity

Contractor shall demonstrate the capacity of the Vaccum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in Part B of the Technical Specification.

(vi) Gypsum Purity

The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm and the moisture content shall not be more than 10% for the range of specified coal(s) and based on CaO content of 51% in limestone.

(vii) Waste Water

The Contractor guarantees that the maximum purge flow rate to waste water treatment system from FGD system for 2x660 MW units shall be less than 20m^3/s averaged over a 24 hour period for a the range of specified coal(s).

(viii) Mist Outlet Droplet Content

The mist eliminator outlet droplet content shall be guaranteed to be $\leq$ 20 mg/Nm3 at absorber outlet measured over a period of 24 hrs continuous operation. Mist outlet-droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer.

1.03.04 **Air Conditioning & ~~Ventilation~~ System**

(i) Air Conditioning System:

A. Following shall be demonstrated at Shop

1) Capacity and discharge pressure of chilled water pumps, condenser water pumps at its rated duty point.

2) Capacity and static pressure of AHU fans at its rated duty point.

B. Following shall be demonstrated at Site

1) Capacity (TR) of water cooled chillers for A/C system of Main Plant Area (TG Building), A/C system of Service & Administrative Building and A/C system of ESP/AHP/FGD control rooms.

2) Capacity (TR) of Air cooled condensing (D-X) unit for A/C system of water system control building, switchyard control building, canteen building.

3) Guaranteed room conditions during summer for all the Air conditioned areas.

4) Parallel operation of chilled water and condenser water pumps.

5) Vibration level of chillers, condensing units, centrifugal fans of AHUs and all pumps.

(ii) Ventilation System

A. Following shall be demonstrated at Shop

1) Capacity and discharge pressure of pumps of air washer units and UAF units at its rated duty point of Ventilation system.

2) Capacity and static pressure of centrifugal fans, roof exhausters at its rated duty point of Ventilation system.

B. Following shall be demonstrated at Site

1) Parallel operation, Vibration level of centrifugal fans & pumps of Ventilation system.

1.03.05 **Fuel Oil Handling Plant**

a) All pumps shall be guaranteed for capacity, total dynamic head either in isolation or during parallel operation.
b) Each storage tank shall be guaranteed for capacity and stability.
c) Entire piping and supports for smooth operation.

1.03.06 The parameters/capabilities to be demonstrated for following systems/ equipments of Raw Water Pump House and ACW pump house shall be:

1.03.06.01 **(i) GANTRY Cranes:** Over load tests, travel and hoist speed checks as per relevant Indian standards IS (latest edition).

(ii) Electrically operated hoist etc.: Over load test, Travel and speed checks, functional and performance tests as per relevant Indian standards IS (latest edition).

APPENDIX-II

PREREQUISITES TO GUARANTEE TESTS TO BE ENSURED BY CONTRACTOR

1. Deputation of team to site to associate with the Guarantee tests,
2. Calibration of belt weigher scales and accuracy of same to be demonstrated to NTPC.
3. Arrangement of wattmeters / energymeters calibrated and sealed from approved Govt. test house or NTPC site laboratory. Arrangement of any other instrument/ accessory for the test.
4. Proper adjustment of skirt boards and belt cleaners prior to the start of tests.
5. Arrangement of calibrated equipments for measurement of vibration & noise levels.
6. Protection Relays of LT/HT switchgears and all motor feeders shall be checked.
7. Belt protection switches, local push buttons, hooters, brakes/rail clamps to be in working order.
8. Free rotation of idlers and pulleys.
9. Protection relays of LT/HT switchgears and all motors/transformer feeders to be checked.
10. Sufficient illumination.

ANNEXURE – IIA

FORMAT FOR SUBMISSION OF GUARANTEE TEST PROCEDURE

Clause No. as per LOA/ Tech. Specs.	Provision of LOA / Tech. Specs.	Name and Methodology of Test proposed by Vendor	NTPC comments on the tests proposed by vendor

APPENDIX-IV

GUARANTEE TEST PROFORMA

POWER MEASUREMENT

Project :

Package :

Date :

1. Equipment/Stream Composition :
2. Motor Description :
3. Sr. No. of meters used :
4. Date of Calibration of instrument and name of test house :
5. Multiplying factor (M.F.) of the wattmeter :
6. Wattmeter Readings (to be taken at 1 minute intervals) :

Sl. No.	Measurement Terminal Location	Time	Voltage (Volts)	Current (amps)	kw Reading M.F.		Total (W1+W2) MF kw	Remarks
					W1	W2		

APPENDIX-IV

7. **Energy meter Readings**

Sl.	Equip-Ment	Time Duration		Energy meter Readings kwHr		Equipment kw (R2-R1)/ (t2-t1)	Remarks*
		Initial	Final	Initial	Final		

*Reason and duration for system trip/stop may be recorded in remarks column.

NTPC **Contractor**

APPENDIX-V

GUARANTEE TEST PROFORMA

VIBRATION LEVEL MEASUREMENTS

Project :

Package :

Date :

Time :

Details of vibration Level Meter

1. Make

2. Model & Sl.No.

3. Date of calibration with name of Test House

Sl.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity		
			Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.

* Reading shall be taken at all the bearings of motor, gear box and driven equipment. In case of conveyor galleries, vibrations shall be measured at min. three locations, at midpoint of stringer between two short supports.

NTPC **Contractor**

APPENDIX-VI

GUARANTEE TEST PROFORMA

NOISE LEVEL MEASUREMENT

Project :

Package :

Date :

Details of Sound Level Meter

1. Make
2. Model
3. Date of calibration with name of Test House

Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks

NTPC **Contractor**

* For each equipment location, a Projected Plan Diagram shall be made and the location of measurement points shall be identified.

SUB-SECTION – G-04

STANDARD PG TEST PROCEDURE

STANDARD PERFORMANCE GUARANTEE AND ACCEPTANCE TEST

PROCEDURE FOR AIRCONDITIONING SYSTEM FOR VARIOUS AREAS OF ……..……

1.0.0 INTRODUCTION

In accordance with the condition of contract /letter of award on successful completion of system trial operation at site and liquidation of all defects, the system/ individual equipments shall be subjected to performance and Guarantee Tests at site.

2.0.0 SCOPE

The test procedure shall cover the Performance and Guarantee Tests to be conducted at site for the entire system / subsystems and individual equipments covered in the A.C. Package. The test procedure shall cover the testing method for parameters covered as — Guaranteed Parameters in LOA and checking of ratings and performance requirements stipulated for various equipments covered in the specifications.

3.0.0 OBJECTIVE O F THE TEST

3.1.0 To check healthy working of all the equipments forming the total air conditioning system.

3.2.0 To check the power consumption of the motors for which power consumption limits are guaranteed at specified capacity of equipments.

3.3.0 To verify the total capacity of the plant including stand-by equipments. The tonnage rating obtained from all AHUS/Chillers is to be cross checked from the heat rejection across the condensers. However, capacity of plant shall be verified during summer (May-August) but room temperature verification for 24 hours shall be done in both summer and monsoon.

3.4.0 Capacity rating and guaranteed power consumption to be established during summer only during May to August when the ambient temperature (DBT) is generally high (Additional heating load if required shall be provided by NTPC / Vendor).

3.5.0 To check the temperature and relative humidity conditions during summer and monsoon in the air-conditioned space with those incorporated in the contract.

However Relative Humidity shall not be guaranteed for areas catered by High wall/Cassette/Ductable split air conditioners

3.6.0 Operating parameters of the system to be logged for complete cycle with calibrated instruments at the time of capacity test during summer.

3.7.0 Operating parameters of the system to be logged with online instruments except calibrated psychrometer for Room condition test during Monsoon test.

3.8.0 To check satisfactory operation of all safety switches and electrical interlocks for each individual equipment and for the complete system.

3.9.0 Vibration and noise level to be measured for all rotating equipments.

4.0.0 CONDTIONS OF TEST

4.1.0 Conductance of test

Performance and Guarantee Test at site shall be conducted by accredited representatives of the CONTRACTOR/ Vendor and NTPC Limited. The contractor shall be given permission to inspect the entire system in advance and make it ready for test. Contractor representatives shall witness and associate with all phases of test and record the data jointly with NTPC representatives.

4.1.1 The responsibility for conducting the test rests with the contractor.

4.2.0 TEST INSTRUMENTS

4.2.1 All instruments required for the PG test will be provided by the contractor at their cost.

4.2.2 Calibration of test instruments shall be responsibility of the contractor.

4.2.3 Calibration of instruments (to be used in the test) shall be carried out at a Govt. /NTPC approved test laboratory.

4.2.4 Calibration of the instruments should be carried out prior to, but not more than six months before the commencement of the test. The calibration certificate of the instruments should be valid for the period of the test.

4.2.5 Calibration certificates (in original) of all instruments from Govt. /NTPC approved Test Laboratory shall be submitted by the contractor for NTPC approval prior to start of the test. Original Calibration certificate will be returned to Contractor after review & acceptance of the certificate.

4.2.6 All the calibrated instruments preferably shall be sealed after calibration at Test Lab & intactness of the seal shall be checked by NTPC before start of the test. If sealed, NTPC shall issue a certificate confirming the breakage of the seal after verification of instruments.

4.2.7 All on line instruments, which will be used during the test, shall be calibrated at Govt. /NTPC Test Laboratory.

4.2.8 On line pressure gauges shall be used for recording the parameters of compressor cycle.

4.2.9 Calibrated gauges of± 0.5% accuracy shall be used on water circuit for pressure and temperature measurement.

4.2.10 Airflow of AHU shall be measured by using calibrated anemometer / velometer.

4.2.11 Bearing temperature is to be measured with thermometer of ±1degree C accuracy with Least count LC of 0.5 degree C.

4.2.12 Dry and wet bulb temperatures shall be measured using sling psychrometers. The thermometers of sling psychrometer shall be of±0.5% accuracy with LC of 0.5 degree C.

4.2.13 All power consumption measurements shall be done by2-wattmeter method OR Clamp-ON power analyser/tong tester method of accuracy class ±1% duly calibrated shall be used.

4.2.14 Tachometer for RPM measurement shall be of ±1.0% accuracy.

4.2.15 Calibrated instruments shall be used for vibration and noise level measurement.

4.3.0 PRE-REQUISITES TO THE PG TESTS.

4.3.1 The contractor should furnish a written statement to the effect that work covered in the contract has been completed for the system for which PG test will be carried out.

4.3.2 All the erection /commissioning protocols in respect of hydro test of pipe lines headers, alarm /annunciation /control system, vibration and noise level data of AHU, condenser and chiller pump etc. During commissioning shall be made available during PG test by the Contractor.

4.3.3 All NTPC approved data sheets for the plant /system for which PG test is to be carried out to be made available during PG test.

4.3.4 Uninterrupted power supply within specified parameters for the duration of the Test to be ensured by other agencies

4.3.5 Proper lubrication and oil level of all equipments to be ensured.

4.3. 6 Cleanliness of plant /system

4.3.7 Protection relays of switchgears and all motor feeders shall be checked by other agencies.

4.3.8 Readiness of all protections, interlocks and safety switches to be ensured. Joint protocol in this respect shall be signed

4.3.9 Availability of suitable fire protection systems /fire fighting equipments to be ensured by other agencies during PG test.

4.3.10 Deputation of team to site to associate with the P&G test to be ensured by the contractor.

4.3.11 Arrangement of all calibrated test instruments as per cl 4.2.0 to be ensured by the contractor.

4.3.12 The plant /system shall be jointly inspected by NTPC and the contractor and a joint protocol shall be signed that the plant is fit for P&G Test.

4.3.13 All the power measurement shall be done by 2 watt meter method. The watt meters of accuracy +/- 1% duly calibrated shall be used.

4.4.0 GUARANTEED PARAMETERS DECLARATION

4.4.1 The contractor should furnish a declaration in the manner as per Appendix -I for the guaranteed parameters which attract levy of liquidated damages for Shortfall in performance. Also declaration shall be given by contractor for other parameter covered as guaranteed parameter (Without liquidity damages).

4.4.2 TEST METHODOLOGY

The test can be classified into four following groups:

1) Equipment performance

2) Capacity Assessment - Verify the plant capacity (tonnage rating) during summer (May to August) when ambient temperature (DBT) is generally high.

3) Power consumption -At specified capacity of the equipment

4) Room condition test- During summer and monsoon.

5.0.0 Equipment performance

The plant should run continuously for 2 to 3 hours for stabilization of the system before measurements. After stabilization of the system, various parameters of the major equipment will be recorded in hourly log sheet. Four sets of such readings are to be recorded under stable conditions.

Following are the parameters to be recorded during equipment performance check

5.1.1 Current rating and voltage of all motors with on line panel meter or calibrated tong tester to be logged.

5.1.2 Bearing temperature of all motors with calibrated thermometer.

5.1.3 Pressure of water at condenser water pump inlet and outlet with calibrated gauges (To be done preferably with differential pressure gauge in order to avoid inaccuracy).

5.1.4 Pressure of water at chilled water pump inlet and outlet with calibrated gauges (To be done preferably with differential pressure gauge in order to avoid inaccuracy).

5.1.5 Temperature of water at condenser inlet and outlet with calibrated gauges.

5.1.6 Temperature of water at chiller inlet and outlet with calibrated gauges.

5.1.7 Dry and wet bulb temperature of entering air to AHU and of leaving air from cooling coil with calibrated psychrometer. DBT and WBT measurement of leaving air from Cooling coil of AHU shall be done at plenum or canvas connection of AHU.

5.1.8 Velocity of air shall be measured on the filters at the suction area the AHUs with calibrated anemometer /velometer.

5.1.9 After completion of capacity tests, working of heaters and humidifiers shall be demonstrated by adjusting the set points. The instruments controlling these equipments are to be kept in their set points during PG test and shall operate automatically only, if the inside conditions demand for.

5.1.10 Following shall be checked for cooling tower

a. Correct direction of fan with proper orientation of leading and trailing edges shall be checked.
b. Free &clear flow of all nozzles shall be checked.
c. Inlet & outlet temperature of cooling tower shall be recorded.

5.1.11 Speed of rotating equipment, wherever possible, shall be checked with calibrated Tachometer.

5.1.12 Proper working of modulating type mixing valves to be demonstrated by adjusting set points.

5.1.13 Noise and vibration level measurement

Vibration and noise level of compressor, condenser water pump, chilled water pump, AHU fan, cooling tower motor shall be measured during PG test. Permissible limit of vibration for pumps shall be ___ microns peak to peak and for AHU, shall be in line with VDI-2056 class IV machines (good zone). Vibration level of compressor shall not exceed ___ mm/sec RMS velocity. Vibration level of Cooling Tower and other equipments shall be as per manufacturer recommendation shall be made available during testing. However acceptance vibration limit of all the equipments shall be made available at the time of testing.

The maximum noise level shall be ____dbA at 1.5 meter elevation and at a horizontal distance of 1.0 meter from the equipment.

5.1.14 Parallel operation of chilled water pumps and condenser water pumps to be demonstrated at site.

5.2.0 CAPACITYASSESSMENT:

i) CHILLED WATER SYSTEM:

The capacity of the plant shall be assessed by chiller method as detailed in 5.2.2. The same will however, be cross checked also by condenser and AHU method as detailed at 5.2.3. and 5.2.1 respectively.

In centralised chiller plant cumulative tonnage capacity (by chiller method) of all running equipment shall match with all running AHU's chiller system

ii) PAC /AIR-COOL CONDENSING UNIT

PAC/Air Cooled condensing units is -Direct Expansion type of AC Plant and hence the capacity of these units shall be assessed based on AHU method as detailed below in 5.2.1

(iii) AIR COOLED CHILLING SYSTEM:

The capacity of the plant shall be assessed by chiller method as detailed in 5.2.2. The same will however, be cross checked also by AHU method as detailed at 5.2.1.
In centralised chiller plant cumulative tonnage capacity (by chiller method) of all running equipment shall match with all running AHU's chiller system

5.2.1 Plant capacity from AHU method

For verifying the plant capacity by AHU method the total air quantity handled by individual AHU shall be measured as mentioned below:

Air quantity measurement will be taken on filters in front of AHU suction area. The air velocity shall be measured with calibrated anemometer / velometer. While taking this measurement, the following conditions are to be maintained:

a. All the AHUs except the standby unit should be in running condition.

b. Doors leading to AHU room should be kept closed and all other openings in AHU room as well as in the air-conditioned space and the areas in the return air path are to be sealed.

c. Air quantity of fresh air should be measured and damper is to be adjusted to allow the required quantity of fresh air only.

d. Air velocity should be measured using calibrated Anemometer /velometer. Velocity shall be taken at 9 traverse in the direction perpendicular to AHU suction area on the each filter. Measurements shall be carried out to compute average air flow.

AHU being the ultimate equipment for heat transfer, capacity of the system shall be arrived at by calculations based on various recorded data of AHU.

It is to be ensured that while recording different parameters of AHU, the compressor shall run at full load.

METHOD OF CALCULATIONS:

AHU capacity (TR) = Qa x (E1-E2) x D/3024

Where, Qa = Quantity of air in M3/hr
D = Density of air at AHU inlet in kg/m3
E1 = Enthalpy of entering air at AHU in Kcal/kg
E2 = Enthalpy of leaving air from AHU in Kcal/kg

Q is to be calculated by multiplying mean velocity of air by inlet suction area of AHU.

i.e. Q (in M3/hr)= Effective Filter size x No of Filters x Average Velocity x 3600

E1 & E2 are to be found out by plotting dry and wet bulb temperatures of entering and leaving air on psychometric chart.

5.2.2 PLANT CAPACITY FROM CHILLER:

Capacity of plant shall be assessed by chiller method. Same however will be cross checked by AHU method as detailed in 5.2.1

$$TR = \frac{Q_W \times (T1 - T2) \times 1000}{3024}$$

Where
TR = Capacity in TR
Qw = Water flow rate through chiller (M^3/Hr) = Quantity of water circulated by chilled water pump in M3/Hr
T1 = Water temperature at chiller inlet (°C)
T2 = Water temperature at chiller outlet (°C)
1000 = Multiplying factor
Qw is to be obtained from the characteristic curve of the chiller water pump and pressure differential across the pump. Necessary correction for actual speed with respect to design speed shall be made. Original Characteristic curves of the chiller water pump shall be submitted by vender along with test results.

5.2.3 PLANT CAPACITY FROM CONDENSER/ HEAT REJECTION FROM CONDENSER

Heat rejection across the condenser should be equal to the sum of the heat absorbed by the evaporator (cooling coil) and the equivalent heat of the compressor shaft K.W.

Heat absorbed by the evaporator maybe calculated from the corresponding data of the AHU recorded simultaneously by the formula in 5.2.1 above

Heat rejection across the condenser (Kcal/hr)

=Qw x (T1 - T2) x 1000 k-Cal/Hr .....A

Where,

Qw = Water flow rate thru condenser (M^3/Hr) = Qty of water circulated by cond. water pump in M^1/hr

T1 = Water temp. at condenser outlet (degC)

T2 = Water temp. at condenser inlet (degC).

1000 = Multiplying factor

Q_w is to be obtained from the original characteristic curve of the pump and pressure differential across the pump. Necessary correction for actual speed with respect to design speed shall be made.

Characteristic curves of the condenser water pump shall be submitted by the vendor along with test result.

Heat equivalent of compressor shaft KW (Kcal/hr) = Input KW of compressor motor x motor efficiency x 860..... B

1KW = 860 Kcal

Tonnage Capacity= (A-B)/3024

Since 1Ton = 3024Kcal/hr.

5.3.0 POWER CONSUMPTION TEST:

Measurement of power for all motors shall be done by Power Analyzer or Two wattmeter method only. Power measurements shall be done at rated capacity during capacity test of equipments.

5.4.0 ROOM CONDITION TEST:

Room condition test shall consist of taking the readings of dry and wet bulb temperatures at different location points to be mutually decided at site in the areas which are air-conditioned by the respective system /plant. Room Condition test shall be done after stabilization of system.

The dry and wet bulb temperature shall be measured by sling psychrometer which will have accuracy of ±0.5% with a least count of 0.5 °C.

This will be carried out for 24 hours continuously and readings will be taken every two hours. Standby equipment should be changed over during this 24 hours. This test hall be carried out during summer when the maximum ambient temperature is at least 40°C and during monsoon when relative humidity prevalent is not less than (-)10% of design value.

6.0.0 AIR COOLED CONDENSOR SYSTEM

6.1.1 PLANT CAPACITY FROM AHU METHOD

For verifying the plant capacity by AHU method total air quantity handled by individual AHU shall be measured as mentioned below.

Air quantity measurement will be taken in AHU suction in a direction perpendicular to AHU suction area. The air velocity shall be measured with calibrated anemometer/Velometer. While taking this measurement, following conditions are to be maintained:

I. All the AHUs except the standby should be in running condition.
II. Doors leading to AHU room should be kept closed and all other openings in AHU room as well in the air conditioned space and areas in return path are to be sealed.
III. Air quantity of fresh air should be measured and damper to be adjusted to allow the required quantity of fresh air only.
IV. Air velocity shall be measured using calibrated Anemometer / velometer. Velocity shall be taken at 9 traverse points in a direction perpendicular to AHU suction area. Measurements shall be carried out to compute average air flow.

AHU being the ultimate equipment for heat transfer, capacity of the system shall be arrived at by calculations based on various recorded data of AHU.
It is to be ensured that while recording different parameters of AHU the compressor shall be at full load.

METHOD OF CALCULATION

$T = Q \times d \times (E1-E2)$
Where
T= Capacity in TR
Q= Quantity of air in m3/hr

d= density of air at AHU inlet in Kg/m3 (At AHU inlet temperature and pressure to be measured and density to be calculated)

E1= Enthalpy of entering air at AHU in Kcal/kg

E2 = Enthalpy of leaving air from AHU in Kcal/kg
Q is to be calculated by multiplying mean velocity of air by inlet suction area of AHU.

i.e. Q (in M3/hr)= Effective Filter size x No of Filters x Average Velocity x 3600

E1 & E2 are to be found out by plotting dry and wet bulb temperatures of entering and leaving air on psychometric chart.

6.1.2 PLANT CAPACITY FROM CONDENSOR

Heat rejection across the condenser should be equal to sum of the heat absorbed by the evaporator (cooling coil) and the equivalent heat of compressor shaft KCal/Hr.

Heat absorbed by the evaporator may be calculated from corresponding data of AHU recorded simultaneously by the formula of 6.1.1 above.

Heat rejection across the condenser (K Cal/Hr)

Qa= ma x Cp x ΔT (T1-T2)……A

Where Qa = Heat rejection capacity of compressor (KW)

ma= mass flow rate of air (Vax Da) Kg/sec
Va = Volume flow rate per fan M3/sec
Da= Density of Ambient Air 1.0933 Kg/sec
Cpa = Specific heat of air 1.006 KJ/KgK
T1 = Outlet air temp in ° C at condenser
T2 = Inlet temperature in ° C at condenser

Qa is to be obtained from condenser approved data sheet/selection sheet

Original Characteristics curves of the condenser fan shall be submitted by the vendor along with test results

Heat equivalent of compressor shaft (Kcal/hr)

= Input KW of compressor motor x motor efficiency X 860 …….. B

(As 1KWh =860 KCal)
Tonnage Capacity= (A-B)/3024

Since 1TR= 3024 KCal / Hr

ANNEXURE – I

TECHNICAL PARAMETERS OF AC SYSTEM

Design Ambient Temperature (summer) i) DB – …..°C
ii) WB – ……°C
Design Ambient Temperature (monsoon) i) DB – ……..°C
ii) WB – ……°C
Design Ambient Temperature (winter) i) DB – ……°C
ii) WB –……°C

Design Indoor Conditions DB RH
i) All Building 24°C±1°C 50%±5%

Selected AC plant capacity as per NTPC Technical specification/Heat load calculation.

Sl. No.	Item	Capacity (each)	Quantity
1.0	**Centralized AC system for Main plant Control Rooms**		
1.1	Water cooled Chiller	…….. TR	(…..Working + ….Standby)
1.2	Chilled water pumps & motor	…….. m^3/hr at …… MWC	(…..Working + ….Standby)
1.3	Condenser cooling water pump & motor.	(…..Working + ….Standby)	(…..Working + ….Standby)
1.4	Cooling tower with fan & drive.	…… m^3/hr	(…..Working + ….Standby)
1.5	Air Handling Units	…… m^3/hr	(…..Working + ….Standby)
2.0	**A/C system for ESP Control Room of Unit #1 & #2**		
2.1	Air cooled condensing units.	…… TR	(…..Working + ….Standby)
2.2	Air Handling Units	…… m^3/hr	(…..Working + ….Standby)
3.0	**A/C system for Water System Control Building.**		
3.1	Air cooled condensing units.	…… TR	(…..Working + ….Standby)
3.2	Air Handling Units	…… m^3/hr	(…..Working + ….Standby)

Note : Bidder to indicate equipment rating for Service Building, Administrative Building, Auditorium building, Canteen building, IT building, ASH handling plant VFD/control room, FGD control room, VFD control of Air cooled condenser(if applicable), Simulator Building (if applicable) and other buildings as per scope of work.

Appendix – I

GUARANTEED PARAMETERS WITH LIQUIDATED DAMAGES

Main Power House (TG Building)				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Water cooled Chiller - 1	(Continous/Standby)	….	…..
2	Water cooled Chiller - 2		….	…..
3	Water cooled Chiller - 3		….	…..
4	Chilled water pumps – 1		….	…..
5	Chilled water pumps – 2		….	…..
6	Chilled water pumps – 3		….	…..
7	Condenser water pumps – 1		….	…..
8	Condenser water pumps – 2		….	…..
9	Condenser water pumps – 3		….	…..
10	AHU - 1		….	…..
11	AHU - 2		….	…..
12	AHU - 3		….	…..

ESP/VFD Control Building				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Air Cooled Condensing Unit - 1	(Continous/Standby)	….	…..
2	Air Cooled Condensing Unit - 2		….	…..
3	AHU - 1		….	…..
4	AHU - 2		….	…..

Water System Control Building				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Air Cooled Condensing Unit - 1	(Continous/Standby)	….	…..
2	Air Cooled Condensing Unit - 2		….	…..
3	AHU - 1		….	…..
4	AHU - 2		….	…..

Service Building				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Water cooled Chiller - 1	(Continous/Standby)	….	…..
2	Water cooled Chiller - 2		….	…..
4	Primary Chilled water pumps – 1		….	…..
5	Primary Chilled water pumps – 2		….	…..
6	Secondary Chilled water pumps – 1		….	…..
7	Secondary Chilled water pumps – 2		….	…..
8	Condenser water pumps – 1		….	…..
9	Condenser water pumps – 2		….	…..
10	AHU - 1		….	…..
11	AHU - 2		….	…..
12	AHU - 3		….	…..

Administrative Building				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Water cooled Chiller - 1	(Continous/Standby)	….	…..
2	Water cooled Chiller - 2		….	…..
4	Primary Chilled water pumps – 1		….	…..
5	Primary Chilled water pumps – 2		….	…..
6	Secondary Chilled water pumps – 1		….	…..
7	Secondary Chilled water pumps – 2		….	…..
8	Condenser water pumps – 1		….	…..
9	Condenser water pumps – 2		….	…..
10	AHU - 1		….	…..
11	AHU - 2		….	…..
12	AHU - 3		….	…..

Total cumulative power consumption of AC system package is …….. KW as per bidding documents. (Bidder to attach relevant page of bidding document)

Note: The above list is indicative only. Bidder to furnish the guaranteed power consumption of all equipment which attract Liquidated damages as per specification/contract.

Project :……., STAGE-…. (…x….. MW)
Package: Air condition System COA No. :……..
Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE AIR CONDITIONING SYSTEM

Equipment		Description of Parameter	Guaranteed Value as per LOA	Quantity (Working quantity as per Tech. Spec.)	Value Noted during PG Test
AC Plant for Main Plant Area: TG BUILDING					
1	Chilling Unit Plant .	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	…. KW	….Nos	
2	Chilled Water Pump for main AC Plant ……. M³/hr at ….M total Head	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	….KW	….Nos	
AC Plant for ESP Building & WSCB					
3	CONDENSING UNITS: …. TR	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drivedrive	….KW	….Nos.	
4	CONDENSING UNITS: …. TR .	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	…. KW	…. Nos.	
5	Condenser Water Pump for main AC Plant ….M³/hr at ….M total Head	Auxiliary Power consumption in KW at motor input terminal at rated duty point for each drive	…..KW	….Nos.	
AHU Fans for Various Areas					
6	i) AHU - 1 to 6 - M³/hr at …..mmWC	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	….KW	Nos	
	ii) AHU -7 to 8 -.... M³/hr at ….mmWC	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	….KW	….Nos	
	iii) AHU - 9 to …No.s - ….M³/hr at .mmWC	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	….KW	….Nos	

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AIR CONDITIONING SYSTEM

Project :……., STAGE-…. (…x….. MW)
Package: Air condition System COA No. :……..
Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE
AIR CONDITIONING SYSTEM

GUARANTEED PARAMETERS (Parameter covered under liquidity damages)

SL No	Equipment	Description of Parameter	Guaranteed value as per LOA	Quantity (Working quantity as per Tech. Spec.)	Value noted During PG Test

Contractor :

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Project :……., STAGE-…. (…x….. MW)
Package: Air condition System COA No. :……..
Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

OTHER GUARANTEED PARAMETERS (Without liquidity damages)

SL No	Equipment / System	Description of Parameter	Guaranteed value
1	Design Indoor Condition	Dry Bulb Temperature in deg. C	24°C ± 1°C
		Relative Humidity	50% ± 5%

Contractor :

Appendix I

FORMAT FOR RECORDING AIR QUANTITY ACROSS AHU

Project :……., STAGE-…. (…x….. MW)
Package: Air condition System COA No. :……..
Contractor: …….. Owner :NTPC Limited
STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Date :

Reading Set : Unit of Operation No. of Filters : Effecting Filter Size (L x W) m² :

Filter No	No of Reading in each Filter / Point (m/s)				
	1	2	3	4	5

Average Velocity (m/s) :

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Appendix - II

Project :……., STAGE-…. (…x….. MW)

Package: Air condition System COA No. :……..

Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Date :

FORMAT OF CHECKING POWER CONSUMPTION OF MOTORS - AIR CONDITIONING PACKAGE

SL No	Time in hr	Current in amps	Voltage in volts	Wattmeter reading	Actual power	Power factor	Remarks
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			

NTPC **CONTRACTOR**

Appendix -III

Project :……., STAGE-…. (…x….. MW)
Package: Air condition System COA No. :……..
Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Date :

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

FORMAT OF CHECKING POWER CONSUMPTION OF MOTORS - AIR CONDITIONING PACKAGE

SL No	Time in hr	Current in amps	Voltage in volts	Wattmeter reading	Actual power	Power factor	Remarks
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		RR - Y - B	RY RY - YB - RB	RR - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			

NTPC CONTRACTOR

Appendix – V

Project :……., STAGE-…. (…x….. MW)

Package: Air condition System COA No. :……..

Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Motor make :

Location & application :

Guaranteed power cons. (as per LOA/Contract)

Dated of calibration of instrument and name of test :

Reading Set No :

Date :

FORMAT OF CHECKING POWER CONSUMPTION OF MOTORS - AIR CONDITIONING PACKAGE

SL No	Time in hr	Current in amps	Voltage in volts	Wattmeter reading	Actual power	Power factor	Remarks
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		RR - Y - B	RY RY - YB - RB	RR - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			

NTPC **CONTRACTOR**

Appendix -III

Project :……., STAGE-…. (…x….. MW)
Package: Air condition System COA No. :……..
Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Motor make :
Location & application :
Guaranteed power cons. (as per LOA/Contract)
Dated of calibration of instrument and name of test :

Reading Set No :

Date :

FORMAT OF CHECKING POWER CONSUMPTION OF MOTORS - AIR CONDITIONING PACKAGE

SL No	Time in hr	Current in amps	Voltage in volts	Wattmeter reading	Actual power	Power factor	Remarks
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - YY - B	RY - YB YB - RB	R - YY - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			

NTPC **CONTRACTOR**

FORMAT FOR RECORDING OF EQUIPMENT PARAMETERS

Appendix-IV
Project :……., STAGE-…. (…x….. MW)
Package: Air condition System COA No. :……..
Contractor: …….. Owner :NTPC Limited
STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Date :

Area : MAIN POWER HOUSE
Instrument Used & SL No : .
Reading set no :

SL No	EQUIPMENT	Parameters	Reading 1	Reading 2	Reading 3	Reading 4
			Time :	Time :	Time :	Time :
1	CHILLER No :	Water temp. at inlet (°C)				
		Water temp. at outlet (°C)				
2	CHILLER No :	Water temp. at inlet (°C)				
		Water temp. at outlet (°C)				
3	CONDENSER No :	Water temp. at inlet (°C)				
		Water temp. at outlet (°C)				
4	CONDENSER No :	Water temp. at inlet (°C)				
		Water temp. at outlet (°C)				
5	CHILLED WATER PUMP No :	Pressure at suction (kg/cm²)				
		Pressure at discharge (kg/cm²)				
		Bearing temp. of motor (°C)				
		Rotating speed (RPM)				
		Full Load Current				
6	CHILLED WATER PUMP No :	Pressure at suction (kg/cm²)				
		Pressure at discharge (kg/cm²)				
		Bearing temp. of motor (°C)				
		Rotating speed (RPM)				
		Full Load Current				
		Pressure at discharge (kg/cm²)				
		Bearing temp. of motor (°C)				
		Rotating speed (RPM)				
		Full Load Current				
7	COOLING TOWER & FAN MOTOR No :	Inlet Temperature (°C)				
		Outlet Temperature (°C)				
		Flow through nozzle				
	COOLING TOWER & FAN MOTOR No :	Inlet Temperature (°C)				
		Outlet Temperature (°C)				
		Flow through nozzle				

NTPC **CONTRACTOR**

FORMAT FOR RECORDING VIBRATION LEVEL & NOISE LEVEL OF EQUIPMENT

Appendix - V

Project :……., STAGE-…. (…x….. MW)

Package: Air condition System COA No. :……..

Contractor: …….. Owner :NTPC Limited Date :

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Instrument Used & SL No :

Reading set no : Area : MAIN POWER HOUSE

SL No	EQUIPMENT	READING No	TIME	DISPLACEMENT IN MICRON (Acceptable value ----- microns)			NOISE LEVEL IN dBA (acceptable value ---- dBA)	RPM	REMARKS
				V	A	H			
1	AHU No :	1							
		2							
		3							
		4							
2	AHU No :	1							
		2							
		3							
		4							
3	AHU No :	1							
		2							
		3							
		4							
4	AHU No :	1							
		2							
		3							
		4							
5	AHU No :	1							
		2							
		3							
		4							
6	AHU No :	1							
		2							
		3							
		4							
7	AHU No :	1							
		2							
		3							
		4							
		2							
		3							
		4							

NTPC CONTRACTOR

FORMAT FOR RECORDING VIBRATION LEVEL & NOISE LEVEL OF EQUIPMENT

Appendix - V

Project :……., STAGE-…. (…x….. MW)

Package: Air condition System COA No. :……..

Contractor: …….. Owner :NTPC Limited **Date :**

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Instrument Used & SL No :

Reading set no : Area : ESP CONTROL ROOM

SL No	EQUIPMENT	READING No	TIME	DISPLACEMENT IN MICRON (Acceptable value ----- microns)			NOISE LEVEL IN dBA (acceptable value ---- dBA)	RPM	REMARKS
				V	A	H			
1	AHU No :	1							
		2							
		3							
		4							
2	AHU No :	1							
		2							
		3							
		4							
3	AHU No :	1							
		2							
		3							
		4							
4	AHU No :	1							
		2							
		3							
		4							
5	AHU No :	1							
		2							
		3							
		4							
6	AHU No :	1							
		2							
		3							
		4							
7	AHU No :	1							
		2							
		3							
		4							

NTPC **CONTRACTOR**

Appendix - VI

Project :……., STAGE-…. (…x….. MW)

Package: Air condition System COA No. :……..

Contractor: …….. Owner :NTPC Limited **Date :**

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Instrument Used & SL No :

Reading set no : Area : ESP CONTROL ROOM

SL No	EQUIPMENT	READING No	TIME	Entering Air Parameters			Leaving air parameters		
				DB (C)	WB(C)	Enthalpy Kcal/Kg	DB (C)	WB(C)	Enthalpy Kcal/Kg
1	AHU No :	1							
		2							
		3							
		4							
2	AHU No :	1							
		2							
		3							
		4							
3	AHU No :	1							
		2							
		3							
		4							
4	AHU No :	1							
		2							
		3							
		4							
5	AHU No :	1							
		2							
		3							
		4							
6	AHU No :	1							
		2							
		3							
		4							
7	AHU No :	1							
		2							
		3							
		4							

NTPC **CONTRACTOR**

FORMAT FOR RECORDING VIBRATION LEVEL & NOISE LEVEL OF EQUIPMENT

Appendix -VII

Project :……., STAGE-…. (…x….. MW)

Package: Air condition System COA No. :……..

Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Instrument Used & SL No :

Date :

Reading set no : Area : MAIN POWER HOUSE

SL No	EQUIPMENT	READING No	TIME	DISPLACEMENT IN MICRON (Acceptable value ---- microns)			NOISE LEVEL IN dBA (acceptable value ---- dBA)	REMARKS
				V				
1	CHILLING UNIT No :	1						
		2						
		3						
		4						
2	CHILLING UNIT No :	1						
		2						
		3						
		4						
3	CHW PUMP No :	1						
		2						
		3						
		4						
4	CHW PUMP No :	1						
		2						
		3						
		4						
5	CHW PUMP No :	1						
		2						
		3						
		4						
6	CCW PUMP No :	1						
		2						
		3						
		4						

NTPC **CONTRACTOR**

Area : **FORMAT FOR RECORDING VIBRATION LEVEL & NOISE LEVEL OF EQUIPMENT**

Appendix-VIII

Project :……., STAGE-…. (…x….. MW)

Package: Air condition System COA No. :……..

Contractor: …….. Owner :NTPC Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Instrument Used & SL No :

Date :

Reading set no : Area ESP & WSC BUILDING

SL No	EQUIPMENT	READING No	TIME	DISPLACEMENT IN MICRON (Acceptable value ----- microns)			NOISE LEVEL IN dBA (acceptable value ---- dBA)	REMARKS
				V				
1	COND. UNITS	1						
		2						
		3						
		4						
2	COND. UNITS	1						
		2						
		3						
		4						

NTPC **CONTRACTOR**

Note:

1. Vendor to sign /digitally sign and stamp on all pages of PG procedure.
2. Attachment 10 giving guaranteed parameters to be enclosed.
3. Relevant pages of Functional Guarantee & LD to be enclosed.
4. Relevant pages of Tech Specs to be enclosed.

PG TEST PROCEDURE FOR VENTILATION SYSTEM PACKAGE
PROJECT : ------ SUPER THEMAL POWER PROJECT (-- X -- MW)

OBJECTIVES OF THE TESTS:

I.	To Verify the guarantee parameters.
II.	To check healthy working of all the equipment forming the total Ventilation system.
	Following parameters shall be measured during Guarantee Test.
III..	D.B., W.B. temp. and saturation efficiency of Evaporative Cooling
IV..	System and D.B and W.B temperature of UAF System during summer
V.	Capacity of Centrifugal Fans
VI.	Power Consumption of fans & pumps at rated capacity using watt meters. Current and voltage rating of motors shall also be recorded.
VII.	Vibration & Noise Level of pumps and fans
VIII.	Bearing Temp. of Motors, fans & pumps.
IX.	Fan speed.
X.	Pressure drop across air washer and UAF units.
XI.	To check satisfactory operation of all electrical interlocks for each individual equipment and for the complete system.
XII.	Performance test for Centrifugal & Axial flow (i.e. R. Exhauster, Propeller type Tube Axial fan etc.) Fans

1. EQUIPMENT PERFORMANCE

The plant should continuously run for two hours for stabilization of the system before commencement of taking measurement of different parameters.

Following are the parameters to be recorded during equipment performance test:

I. Current and Voltage or Power drawn by motors.

II. Bearing temperature of motors, fans and pumps to be measured

III. Pressure developed by pumps shall be measured

IV. The Air flow quantity shall be calculated by measuring velocity with help of anemometer /velometer in front of suction filters in a direction perpendicular to filter planes and at 1" distance from the filter. Air Washer Room shall be closed while taking reading on Anemometer/Velometer. Velocity shall be measured at 5-7 transverse points across the filters to compute average velocity for flow calculations.

Test Capacity (M^3/sec) = Inlet Suction Area(M^2) x Average Velocity (M/sec)

V. Dry bulb temperature, Wet bulb temperature of entering air before the air washer and leaving air just after the eliminators.

VI. Vibration and noise level of centrifugal fans and associated motors to be measured. The limit will be as per QAP/Relevant standard.

VII. Fan speed by Tachometer .

2. CONDUCTANCE OF TEST

i) Responsibility for conducting the test rests lies with Contractor.

ii) Guarantee Test shall be conducted at site by representatives of Vendor and NTPC as per the procedure hereunder. Contractor shall be given permission to inspect the system in advance and make it ready for the test.

3. TEST INSTRUMENTS

All instruments required for the test shall be arranged by Vendor free of cost.
Calibration of test instruments shall be responsibility of Vendor.

I. Calibration of instruments (to be used in the test) shall be carried out at an Govt./NABL approved test laboratory and calibration certificate of the instruments should be valid during the period of the test.

II. Calibration certificate (in original) of all instruments shall be submitted to NTPC Site for approval.

III. All the calibrated instruments shall be sealed after calibration at test lab and intactness of the seal shall be checked by NTPC before start of the test.

IV. Bearing Temperature is to be measured using thermometers of $\pm$ 1 deg. C accuracy having least count of 0.5 deg. C.

V. Online pressure gauges shall be used for recording the parameters of pumps.

VI. Calibrated gauges of accuracy $\pm$ 0.5% shall be used on water circuit for temperature & pressure measurements.

VII. Air flow shall be measured using calibrated velometer / Anemometer.

VIII. Dry bulb & Wet bulb temp shall be measured using sling psychrometer. The thermometers of psychrometer, shall be $\pm$ 0.5 deg. C accuracy with least count of 0.5 deg. C.

IX. Wattmeter of $\pm$ 1.0% accuracy class shall be used for power consumption measurement.

X. Vibration & Noise level of motors, fans & pumps shall be measured by calibrated instruments.

XI. Tachometer for R.P.M. measurement shall be of $\pm$ 1.0% accuracy.

XII. Manometer for pressure drop across filters.

XIII. Voltage and current shall be measured using tong tester/Clamp meter of +/- 1% accuracy class.

4. PRE-REQUISITES TO THE GUARANTEE TEST

I. All the installation / commissioning protocols in respect of alarm/ annunciation/ control system, pipeline flushing, vibration & noise level measurement data of motors, fans & pumps during

commissioning shall be made available during Guarantee Test by the contractor.

II. All NTPC approved data sheets for the plant/system for which Guarantee Test is to be carried out shall be made available during the test.

III. Uninterrupted power supply within specified parameters for the duration of the test shall be ensured by NTPC.

IV. Proper lubrication and oil level of all equipment to be ensured.

V. Cleanliness of Plant/System shall be ensured by NTPC.

VI. Protection relays of switchgears and all motor feeders shall be checked.

VII. Readiness of all protections, interlocks and safety switches to be ensured. Joint protocol in this respect shall be signed.

VIII. Availability of suitable fire protection system/ fire fighting equipment to be ensured by NTPC during Guarantee Test.

IX. Deputation of team to site to associate with the test to be ensured by the Contractor.

X. Arrangement of all calibrated test instrument as per Cl. No. 2.02.00 to be ensured by the Contractor.

XI. The plant/ system shall be jointly inspected by NTPC and the contractor and a joint protocol shall be signed that the plant is fit for conducting guarantee Test.

1 Successful completion of trial operation.

5.TEST METHODOLOGY

I. **SATURATION EFFICIENCY OF AIR WASHER UNIT**

Before commencement of Guarantee Test of Air Washer System, the plant shall run for at least 2-3 hours for stabilization of system and all required adjustments shall be done by vendor till all guaranteed parameters are achieved.

Also before start of test working of various mechanical/electrical parts to be checked visually and satisfactory operation of all electrical interlocks and controls to be checked.

SATURATION EFFICIENCY shall be computed using following formula:-

$$\text{Saturation Efficiency} = \frac{Te - T1}{Te - te} > \text{-------}$$ (As per Technical Specification)

Where,

Te = Dry Bulb temperature Entering Air Washer Unit

T1 = Dry Bulb Temperature leaving Air Washer Unit.

te =Wet Bulb Temperature entering Air Washer Unit

Dry Bulb & Wet Bulb Temperature at Inlet & Outlet of Air Washer shall be measured by Sling Phychrometer. Sling Phychrometer reading will be taken through moving air and continued till thermometer reading becomes steady. The thermometer forming part of Sling Phychrometer shall be of $\pm$ 0.5% accuracy with least count of 0.5 deg. C.

II. In case of UAF units, Dry Bulb & Wet Bulb temperature at inlet and outlet of UAF unit shall be measured by sling phychrometer.

III. **VIBRATION & NOISE LEVEL**

Vibration of Centrifugal Fans and Pumps and Associated Motors shall be measured. Acceptance criterion for Vibrations and noise level shall be as per technical specification.

SUB-SECTION–E-17

AIR CONDITIONING
&
VENTILATION SYSTEM

AIR CONDITIONINGAND ~~VENTILATION~~ SYSTEM

1.00.00	**CHILLING UNIT**
1.01.00	**Refrigerant Compressor (Screw/Scroll)**
1.01.01	Hydraulic/Pneumatic test of castings of casings shall be carried out. No leakage shall be permitted.
1.01.02	DPT of screw, impeller, shaft, vanes, casing etc. after machining shall be carried out.
1.01.03	All rotating parts of screw and centrifugal compressor shall be dynamically balanced to ISO 1940 Gr. 6.3/IS 21940.
1.01.04	Leak tightness & vacuum check for chilling units / compressor in assembled condition shall be carried out. No leakage shall be permitted.
1.01.05	Performance test of assembled compressor and Chiller assembly shall be done to check for following : i) No load air run (free run) test of all types of compressor to check FAD (Free air delivery), Noise, Vibration & Temp. rise of bearing & body. ii) Functional run test for Chiller assembly shall be carried out.
1.02.00	**CONDENSER & EVAPORATOR**
1.02.01	DPT shall be carried out on welds if applicable.
1.02.02	10% RT of butt weld joint on shell shall be carried out if applicable.
1.02.03	Dimensional check including tube hole dia, ligament, pitch etc. shall be carried out.
1.02.04	Mock-up test of tubes to tube sheet expansion shall be carried out.In case such test is already carried out for similar tube/tube sheet thickness and materials, records for the same shall be furnished for NTPC review.
1.02.05	Hydraulic/Pneumatic test of Shell Side and Tube Side of condenser and evaporator as applicable shall be carried out. 'No leakage' shall be permitted.
2.00.00	**AIR HANDLING UNIT**
2.01.00	For Fans refer tests as mentioned at 4.00.00
2.02.00	One per type of assembled AHU (AHU casing and fan assembly) shall be subjected to free run test. Noise, Vibration and Temp. Rise of bearing shall be measured during run test.
2.01.00	All cooling coil shall be pneumatically tested and no leakage shall be permitted.
3.00.00	**CENTRIFUGAL PUMP**
3.01.00	UT on pump shaft (dia equal to or above 40 mm) and MPI/DPT on pump shaft and impeller after machining shall be carried out.
3.02.00	All rotating components of the pumps shall be dynamically balanced to ISO-1940 Gr. 6.3/IS 21940.
3.03.00	A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the shut off pressure on the head characteristics curve or twice the rated pressure whichever is higher, for a minimum duration of 30 minutes.
3.04.00	Standard Running Test

	i) All pumps shall be tested in the manufacturer's works preferably with contract motor (or as specified in Engg Tech spec) for capacity, efficiency, head and brake horse power. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. The duration of test shall be minimum one (1) hr. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and/or as per applicable Indian Standard or equivalent. Acceptance norms shall be as per approved datasheet & HIS standard and/or as per applicable Indian Standard or equivalent only.
	ii) Noise and vibration shall be measured at shop for reference purpose only.
	iii) Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and/or excessive vibration are observed during the shop test.
	iv) NPSH test shall be conducted with water as the medium, if required as per approved data sheets.
4.00.00	**FANS:**
4.01.00	20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.
4.02.00	DPT of fan shafts shall be carried out after machining.
4.03.00	UT of fan shafts (dia equal to or above 40mm) shall be carried out.
4.04.00	Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3/IS 21490
4.05.00	All Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test.
4.06.0	One fan of each type and size will be performance tested as per corresponding BIS code/ AMCA for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.
5.00.00	**LOW PRESSURE AIR DISTRIBUTION SYSTEM**
5.01.00	Functional test for fire damper along with solenoid shall be done.
5.02.00	Prototype tests report of fire damper (duly approved/accepted by ENGG) for each type and size as per UL-555 for fire rating shall be furnished.
5.03.00	Site Test- After completion, all ducting system shall be checked/tested for air leakages/tightness (smoke test) at site.
6.00.00	**INSULATION:**
6.01.00	Insulation material shall be tested for all mandatory tests only as per relevant code/standard.
6.02.00	Resin bonded mineral wool/Glass wool: Thermal conductivity tests (for thermal insulation only) shall be done the same density of material as applicable as per IS:3346 or equivalent standard//Engg spec.
6.03.00	XLPE/Nitrile Rubber: Thermal conductivity tests (for thermal insulation only) shall be done as per relevant code for the same density and thickness of material and validity of test shall be as per relevant standard/Engg spec.
7.00.00	**COOLING TOWER**
7.01.00	UT of fan shaft and drive shaft (dia equal to or above 40mm) shall be carried out.
7.02.00	DPT of fan hub and shafts shall be carried out after machining.

7.03.00	Color of fills shall be as per approved data sheet.
7.04.00	Fan assembly shall be statically/dynamically balanced.
7.05.00	Cooling Towers being supplied to site in assembled condition shall be subjected to run test at shop to measure FAD, Noise & Vibration. For Cooling Towers being supplied in knocked-down condition, these tests shall be done at site
8.00.00	**AIR FILTERS:**
	Pre/Fine filters shall be tested for initial and final pressure drop Vs flow, efficiency and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779. HEPA (Absolute) filters shall be tested as per applicable code.
9.00.00	**PIPES & FITTINGS:**
9.01.00	All pipes and fittings shall be tested as per applicable codes / standard.
9.02.00	Site test- Pipes shall be tested at site hydraulically/pneumatically as per application requirement
10.00.00	**VALVES & SPECIALTIES**
10.01.00	Visual and dimensional check of valves as per relevant codes and approved drawing.
10.02.0	All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.
10.03.0	Refrigerant line valves shall be pneumatically tested for body and seat leakage test.
10.04.00	Valves shall be offered for hydro test and pneumatic test in unpainted condition.
10.05.0	Functional check of the valves for smooth opening and closing shall be done.
10.06.0	Performance test to check pressure drop Vs flow shall be carried out for one valve of each type, size and rating for 'Balancing Valve'/Globe Valves with orifice.
11.00.00	**SPLIT, CASSETTE, WINDOW, PRECISION/PACKAGED AC (PAC) & CONDENSING UNITS**
11.01.00	Split/Cassette/ Window AC/PAC will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate.
11.02.00	PAC/Condensing unit: Each Unit shall be subjected to production routine Test as per relevant standard.
11.03.00	Capacity, noise level and vibration of PAC/ Condensing unit shall be demonstrated as per relevant standard on one unit of each type and rating.
12.00.00	**Air Washer and Unitary Air Filter (UAF)**
12.01.00	Random 10% DPT on weld joints shall be carried out.
12.02.00	Hydraulic test of pressure parts at 1.5 times the design or 2 times of working pressure whichever is higher. Pressure and water fill test of tanks shall be carried out.
12.03.00	Trial assembly of Air washer/UAF for one of each size shall be done in shop.
12.04.00	Performance test to check pressure drop Vs flow shall be carried out for one Nozzle of each type, size and rating.

SECTION: I

SUB-SECTION: C 2C

CUSTOMER SPECIFICATIONS

PAINTING SPECIFICATIONS

SUB-SECTION–A-12

SURFACE PREPARATION & PAINTING

1.00.00 **Specification of surface preparation & painting**

1.01.00 Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.

1.02.00 All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.

1.03.00 Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.

1.04.00 All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering.

1.05.00 **SURFACE PREPARATION**

1.05.01 All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents.

1.05.02 The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.

SP1	Solvent cleaning
SP2	Application of rust converter (Ruskil or equivalent grade)
SP3	Power tool cleaning
SP4	Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)
SP4*	Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns
SP5	Shot blasting/ abrasive blasting.
SP6	Emery sheet cleaning/Manual wire brush cleaning.

1.06.00 **APPLICATION OF PRIMER/PAINT**

1.06.01 The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.

1.06.02 Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.

1.06.03 Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.

1.06.04 Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.

1.06.05 Following are the Primer/painting schemes envisaged herein:

PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104.

PS3* - Zinc Chrome primer (Alkyd base) by dip coat.

PS4 - Synthetic Enamel (long oil alkyd) to IS2932.

PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744

PS9 - Aluminum paint to IS 2339.

PS9* - Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature 400 degC – 600 degC), IS-13183 Gr.-II (for temperature 200 degC- 400 degC and IS-13183 Gr.-III (for temperature upto 200 degC)

PS13 - Rust preventive fluid by spray, dip or brush.

PS14 - Weldable primer-Deoxaluminate or equivalent.

PS16 - High Build Epoxy CDC mastic `15'.

PS17 - Aliphatic Acrylic Polyurethane CDE134, %V=40.0(min.)

PS18 - Epoxy based TiO2 pigmented coat

PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=35.0(min.)

PS-20 - Epoxy based finish paint

1.06.06 All weld edge preparation for site welding shall be applied with one coat of wieldable primer.

1.06.07 For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.

1.06.08 SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

1.06.09 a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron.

The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner:

- Primer coat – Epoxy based zinc phosphate
- Intermediate - Epoxy based TiO2 pigmented coat
- Finish coat - Epoxy based finish coat/Two pack polyurethane coat

b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron.

c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard

1.06.10 A) Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows:

Primer : One coat of unmodified epoxy resin along with polymide hardener.

Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct

hardener.

Total thickness of primer and paint should not be less than 400 microns.

B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows:

i) For Indoor vessel, tanks, piping, valves & other equipments:

(a) Surface preparation shall be done either manually or by any other approved method.

(b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns.

(c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns.

(d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns.

Total DFT of paint system shall not be less than 150 microns.

ii) For Outdoor vessel, tanks, piping, valves & other equipments:

(a) Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard.

(b) Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.

(c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.

(d) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided.

The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied.

Total DFT shall not be less than 300 microns.

1.06.11 Primer/Painting Schedule

Sl. No	Description		Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painting DFT (Microns)	Colour Shade
				Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)		
A) Power Cycle Piping														As per NTPC Colour shade/ coding scheme
1.	All insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.		SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
2.	All un-insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipment etc.	Design temperature < or equal to 60^0C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 **$**	35 **$**	155 **$**	
		Design temperature above 60^0C-200^0C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200^0C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH) and Variable Load Hanger (VLH)		SP4*	PS19	1	40	-	-	-	PS17	1	30	70	
4	Piping hangers / supports (other than (3) above. (un-insulated)		SP3/SP5	PS5	2	25	-	-	-	PS4	2	25	100	

	Valves												
5.	Cast/Forged	Design temperature < or equal to 60 degC #	SP3/SP5	PS5	2	35	-	-	-	PS4	2	25	120
		Design temperature above 60 degC	SP3/SP5	PS9*	1	20	-	-	-	PS9*	1	20	40
6.	All auxiliary Structural Steel components for pipe supports	Outside TG building and in SG envelope	SP4*	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	75	a) Epoxy coat b) Final coat of paint PS17	2 1	35 30	250
		Within TG building	SP4*	-do-	1	35	PS18	1	35	a) Epoxy coat b) Final coat of paint PS17	2 1	25 30	150
7.	Weld Edges		SP6 (Hand cleaning by wire brushing)	PS13 (Weldable primer)	1	25	-	-	-	-	-	-	25

1. **$ -** The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3rd finish coat (min.DFT 35 Microns) shall be applied at site.
2. For valves below 65NB and temperature upto and including 540 DegC, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint.
3. For corrosion protection of threaded hanger rods and variable spring cages, electro galvanizing in full compliance to minimum Corrosion category C3 as per EN ISO12944 is also acceptable.
4. For spring cages, 2 coats of 30 µm (min) zinc-rich epoxy resin primer with zinc content> 80 weight% in dry film followed by 2 coats of 30 µm (min) top coat of Acrylic resin Co-polymerisate with a total combined minimum DFT of 120µm is also acceptable in lieu of above specified paint scheme.
5. For corrosion protection, all inner parts of the hangers (CLH/VLH) shall be at least in full compliance to Corrosion category C3 as per EN ISO12944.
6. # - For Cast/forged valves upto & including design temperature 60Deg.C, Aluminium painting as per IS-13183 Gr-3 or better with total DFT 40Micron is also acceptable.

B) Steam Generator & Auxiliaries:

1	All surfaces with temperature 95°C or less and which are insulated	SP3/SP4	PS 5	2	30	-	-	-	PS 4	2 **$**	20 **$**	100 **$**
2	All surfaces with temperature above 95°C and which are insulated	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40

Note**:** **1)** SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

2) Painting specification for all other exposed steel surfaces not covered above shall be same as that given in Civil Sub-section, Part-B, Section VI for corrosion protection of steel structures.

C) LOW PRESSURE PIPING													
1	All Piping, fittings / components, valves, Equipments etc.	SP3/SP5	PS3/ PS5	2	25	PS 4	1	30	PS 4	2	35	150	As per NTPC Color shade/ coding scheme.
2	Stainless steel surface, Galvanized steel surface and gun metal surface.	No Painting											
3	On the internal surface for pipes 1000 Nb and above	A coat of primer followed by hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.											
D) Fire Detection & Protection System, Compressed air system and Air-conditioning & Ventilation System													
For Fire Detection & Protection System, Surface preparation and painting of Fire Water Storage Tanks, all Steel Surfaces (external) exposed to atmosphere (outdoor & indoor installation), Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc. should be as per the Part-B, Sub Section-A-18, Fire Detection & Protection System For Air Conditioning System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Air Conditioning System. For Ventilation System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Ventilation System. For compressed air system, Surface preparation and painting of all the steel surfaces should be as per the Part-B, Sub Section--A-16 compressed air system.													
E) ESP													
1	All surfaces with surface temperature 95°C or less (with or without insulation)	SP3/SP4	PS3/ PS3*	1	25	-	-	-	PS 4	1	30	55	
2	All surfaces with surface temperature above 95°C (with or without insulation)	SP3/SP4	PS5	2	30	-	-	-	-	-	-	60	

General Notes (Applicable for all above points A to E)

i) Painting specification for all surfaces with surface temperature 95°C or less (un-insulated) that are not covered above shall be same as that given in Civil Sub-section, Part-B, Section-VI for corrosion protection of steel structures.

ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

F) FGD System

(i) Surface preparation shall be blast cleaned conforming *to* Sa *2-1/2* Swiss Standard.

(ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.

(iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.

(iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat *of* polyurethane of minimum DFT of 25 microns shall be provided.

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

TECHNICAL SPECIFICATION

FOR
AIR CONDITIONING SYSTEM

(ELECTRICAL PORTION)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

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

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

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

d) Electrical load requirement for **AIR CONDITIONING 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.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of

compliance certificate/No deviation certificate.

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

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor

b) Specification for Motors

c) Specification for cable lugs and glands

d) Quality plan for motors with list of makes

e) Electrical Load data format

f) BHEL cable listing format

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: AIR CONDITIONING SYSTEM.

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW NTPC TALCHER TPP STAGE III (EPC)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	**Normal AC supply:** 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor. **Emergency AC supply (From DG):** 415 V AC (3 PHASE 3 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	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.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) &	BHEL	BHEL	Refer note no. 4 for electronic earthing

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ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: AIR CONDITIONING SYSTEM.

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW NTPC TALCHER TPP STAGE III (EPC)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	lightning protection			
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

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ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: AIR CONDITIONING SYSTEM.
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: 2X660 MW NTPC TALCHER TPP STAGE III (EPC)

3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

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MOTORS

MOTORS

1.00.00 GENERAL REQUIREMENTS

1.01.00 This chapter has to be read in conjunction with sub-section B-0 "General electrical specification" of Technical specification Section- VI, Part-B and Sub-Section-IIB Electrical system/Equipment of Technical Specifications Section-VI, Part-A"

Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows :-

i)	Indoor motors	-	IP 55
ii)	Outdoor motors	-	IP 55 (Additional Canopy to be provided)
iii)	Cable box-indoor area	-	IP 55
iv)	Cable box-Outdoor area	-	IP 55

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS15999/IEC:60034
2)	Single phase AC motors	:	IS 996/ IEC:60034
3)	Crane duty motors	:	IS:3177, IEC:60034
4)	DC motors/generators	:	IS:4722, IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC:60034-30

3.00.00 TYPE

3.01.00 **AC Motors:**

a) Squirrel cage induction motor suitable for direct-on-line starting.

b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be **Premium Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30. HT motors shall have minimum design efficiency of 95 %. However, tolerance on this efficiency value shall be applicable as per IEC 60034

c) Motor operating through variable frequency drives shall be suitable for inverter duty with VPI insulation. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

3.02.00 DC Motors: Shunt wound.

4.00.00 RATING

(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

(b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

5.00.00 TEMPERATURE RISE

Air cooled motors

70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.

Water cooled

80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.

CLAUSE NO.	TECHNICAL REQUIREMENTS
6.00.00	**OPERATIONAL REQUIREMENTS**
6.01.00	**Starting Time**
6.01.01	For motors with starting time upto 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.
6.01.02	For motors with starting time more than 20 secs. and upto 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.
6.01.03	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.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	**Torque Requirements**
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor rated torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of rated torque. It shall be 275% for crane duty motors.
6.03.00	**NOT USED.**
7.00.00	**DESIGN AND CONSTRUCTIONAL FEATURES**
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below (a) Fuel oil area : Group – IIB (b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)
7.03.00	Winding and Insulation Type : Electrolytic grade Copper conductor, Non-hygroscopic, oil resistant, flame resistant Insulation. Starting duty : Two hot starts in succession, with motor initially at normal running temperature. However, conveyor motors shall be suitable for 3 consecutive hot starts 11kV, 6.6 KV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15.

	240VAC, 415V AC & 220V DC motors : Thermal Class (F) or better
7.04.00	Motors rated above 1000KW shall have insulated bearings/housing to prevent flow of shaft currents.
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7.06.00	Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting vibration pads.
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with three numbers duplex RTDs connected to three numbers dual input transmitters with display. However for air compressor, being high speed drive, each motor bearing shall be provided with minimum two numbers of duplex RTDs connected to two numbers dual input transmitters with display unit.7.08.00 Motor body shall have two earthing points on diagonally opposite sides.
7.09.00	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
7.10.00	3.3/6.6 KV motors shall be offered with dust tight phase segregated double walled (metallic as well as insulated barrier) Terminal box. Contractor shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.
7.11.00	The spacing between gland plate & centre of bottom terminal stud shall be as per Table-I.
7.12.00	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.
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 6.6 KV, 3.3 kV /415V systems without any injurious effect on its life.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	NOT USED
8.00.00	NOT USED
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
	LIST OF TYPE TESTS TO BE CONDUCTED
	The following type tests shall be conducted on each type and rating of HT 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 (subject to test bed constraint).
	(d) Full load test(subject to test bed constraint)

(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.

LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

The following type test reports shall be submitted for each type and rating of HT motor

(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.

(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15

(d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

10.02.00 **LT Motors**

LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

The following type test reports shall be submitted for each type and rating of LT motor of above 100 KW only

1. Measurement of resistance of windings of stator and wound rotor.
2. No load test at rated voltage to determine input current power and speed
3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
4. Full load test to determine efficiency power factor and slip
5. Temperature rise test
6. Momentary excess torque test.
7. High voltage test
8. Test for vibration severity of motor.
9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)
10. Test for degree of protection and
11. Overspeed test.
12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

10.03.00 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.

10.04.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

10.05.00 **MOTORS The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance):**
(a) From 50KW & upto 110KW : 11.0
(b) From 110 KW & upto 200 KW : 9.0
(c) Above 200 KW & upto 1000KW : 10.0
(d) From 1001KW & upto 4000KW : 9.0
(e) Above 4000KW : 6 to 6.5
Starting voltage requirement :permissible starting voltage for motor shall be as follows:
(a) Up to 85% of rated voltage for ratings below 110 KW
(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW
(c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW
(d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW
(e) Up to 75 % of rated voltage for ratings above 4000KW

CLAUSE NO.	TECHNICAL REQUIREMENTS

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

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: 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

Cable glands

Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall 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 or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

Cable lugs/ferrules

Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections.

Item Code	Item	Sr.no	Vendor Code	Vendor Name	Address	Phone	Remarks
ES11	CABLE GLANDS	1	E1201	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA	Mr. Vijay Mohan Sood +(91)-(120)-2525694 +(91)-(120)-3052594 +(91)-(11)-23287156	
		2	E1017	ARUP ENGG & FOUNDARY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068	033 2473 0850	
		3	E1206	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018	44-24995505,22680990-4	
		4	E1036	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063	91-022-26852961/62/63 comet@vsnl.net	
		5	DW08	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.	CEO : Mr. Jayantibhai S. Patel TEL: 022-32504770./022-29270876/ 022-29270878.	
		6	E1044	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI-400059	91-22-28324829 / 66919034 devang@electromacglands.com	
		7	I01	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001	91-33-2480161/62/63/64 Fax : 91-33-2485766	
ES12	CABLE LUGS	1	E1040	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.	CEO : Mr. Jayantibhai S. Patel TEL: 022-32504770./022-29270876/ 022-29270878.	
		2	E1149	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA-700001	033 2282 2540	

VENDOR CAN PROPOSE ADDITIONAL MAKE WITH COMPLETE CREDENTIALS ALONG WITH BID WHICH SHALL BE REVIEWED AND ASSESSED BY BHEL/CUSTOMER. NON-ACCEPTANCE OF ADDITIONAL MAKE BY BHEL/CUSTOMER SHALL HAVE NO COMMERCIAL IMPLICATION TO BHEL. IN CASE OF NON ACCEPTANCE OF ADDITIONAL MAKE BY CUSTOMER, ABOVE LIST SHALL BE APPLICABLE. IN CASE OF NON-COMPLIANCE TO THIS REQUIREMENT, BID IS LIKELY TO BE REJECTED.

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
1	2	3	4	5	6		7	8	9					
					M	C/ N				D	M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI		
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

2804/0623

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL
D: DOCUMENTATION

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI		
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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Approved by:			

28/7/5/0/6/20

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
		CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

2880/0623

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

289706623

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
		CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180º	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

29/08/2023

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 4 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET			P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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Approved by:			

29/06/23

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

29206623

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 6 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

BHEL					
ENGINEERING			QUALITY		
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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

29.10.0623

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

29420623

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325//IS-12615& DATA SHEET	IS-325/IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

29/06/23

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
		CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

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

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL

D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

29/06/23

ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
ES53	LV MOTORS (NON FLAME PROOF)	1	A24	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003	0129-2567580, 09871799449	
	LV MOTORS (NON FLAME PROOF)	2	E1027	BHARAT BIJLEE LTD.	BHARAT BIJLEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK, PUSA ROAD, NEW DELHI - 110 060.	Tel.: + 91 (11) 25816931-33, 35 & 36| DT: +91 25724318 Fax: + 91 (11) 25819640| M:+ 91	
	LV MOTORS (NON FLAME PROOF)	3	C02	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA	91 11 23460700 - 999 Sunil.Das@cgglobal.com	
	LV MOTORS (NON FLAME PROOF)	4	A35	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032	044-49681447	
	LV MOTORS (NON FLAME PROOF)	5	K01	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055	Tel: +91-80-23374865 Fax: +91-80-23377706	
	LV MOTORS (NON FLAME PROOF)	6	L04	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA	0217- 2357001-005	APPROVED UPTO 200KW
	LV MOTORS (NON FLAME PROOF)	7	M01	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006	Ph: +91-129-2286421, 2265340, 4006601 to 4006610	
	LV MOTORS (NON FLAME PROOF)	8	A35	NGEF	POCKET NO.10, FLAT NO. 37 & 38, EXPANDABLE DDA FLATS, NASIRPUR DWARKA, PHASE-I NEW	Ph: (011) 2539 7763	
	LV MOTORS (NON FLAME PROOF)	9	E1115	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053	91-22-26730823, 26730789; 91)-(22)-26730154	
	LV MOTORS (NON FLAME PROOF)	10	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331 amit.bhadauria@siemens.com	
ES54	LV MOTORS (FLAME PROOF)	1	E1115	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053	91-22-26730823, 26730789; 91)-(22)-26730154	

VENDOR CAN PROPOSE ADDITIONAL MAKE WITH COMPLETE CREDENTIALS ALONG WITH BID WHICH SHALL BE REVIEWED AND ASSESSED BY BHEL/CUSTOMER. NON-ACCEPTANCE OF ADDITIONAL MAKE BY BHEL/CUSTOMER SHALL HAVE NO COMMERCIAL IMPLICATION TO BHEL. IN CASE OF NON ACCEPTANCE OF ADDITIONAL MAKE BY CUSTOMER, ABOVE LIST SHALL BE APPLICABLE. IN CASE OF NON-COMPLIANCE TO THIS REQUIREMENT, BID IS LIKELY TO BE REJECTED.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

ANNEXURE-III

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.		ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE		NAME		DATA FILLED UP ON	
	SYSTEM		SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

29/06/23

CABLE ID	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/VENDOR)	REMARKS	CABLE SIZE	PATH CABLE NO

SECTION: I

SUB-SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)

SYSTEM

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V (3ph, 3W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs 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 & control cables.
7	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.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

C&I SPECIFICATION FOR AIR CONDITIONING SYSTEM

Specific Technical Requirements (C&I):

1. Complete C&I system for Air Conditioning System is in bidder's scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder without any commercial implication.

2. Air Conditioning System shall be operated from DDCMIS (BHEL's scope) for Area's/Building indicated elsewhere in the specification.

3. Microprocessor based controls of Chiller units , Air cooled condensing unit (D-X type), PAC (if applicable) etc. shall be provided with local display along with facilities to Soft link & Hardwired interface with DDCMIS and to meet the requirement of all system operations and controls. Soft link communication between Microprocessor (MP) based control panels & DDCMIS shall be redundant Bi-directional via TCP/IP on OPC or MODBUS with RS485 link. Bidder shall include required hardware at MP end.

4. Time synchronization of Microprocessor (MP) with DCS is to be carried out. Necessary hardware/software for same at MP end to be provided by Bidder .

5. Each Screw /centrifugal Chiller units shall be provided with local start / stop & indication in addition to DDCMIS based Control system of A/C plant for Main plant area, ESP Control Room, FGD Control Room & AHP Control Room, Service Building, Admin Building and other areas specified elsewhere in the specification.

6. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire Air conditioning system. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section 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 customer shall prevail without any commercial implication.

7. Interface of MCC, field Equipment, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.

8. Bidder to supply all the instruments required for the package along with necessary fittings, accessories and valve manifold etc. for control monitoring and operation of Air conditioning system. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

9. **All motorized valves shall be supplied with Non-intrusive Profibus based Electric Actuator(with integral starter)** for AC plant package along with necessary interface units for linking to corresponding Control System as applicable.The interface of these actuators with DCS shall be with PROFIBUS DP interface. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body. Open/Close command termination logic suitably built inside the actuator Details shall be referring in the specification.

10. All ON, OFF, INCHING type electric actuators shall be PROFIBUS DP compatible. PROFIBUS DP protocol based actuators shall have two (redundant) PROFIBUS DP ports for connecting the redundant PROFIBUS DP cables. That is if one PROFIBUS DP cable is cut or not working/not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.

11. All the Electronic Transmitter for Pressure, Temperature, Differential Pressure and DP based Flow /Level measurements shall be genuine, verifiable PROFIBUS PA protocol compatible instruments. The transmitters shall be connected to DDCMIS through PROFIBUS PA protocol complying to IEC 61158 directly from transmitter. This is subject to customer approval and BHEL decision shall be final.

12. The PROFIBUS protocol design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by bidder without any implications.

13. Profibus DP based IMC in LV SWGR/MCC (BHEL's scope) shall be provided.

14. Bidder shall provide the following :-
    a) Configuration/ diagnostic tool for Non-intrusive profibus based actuators - 5 Nos. or 5% of total quantity of actuator whichever is more.
    b) Configuration/ diagnostic tool for all Profibus based instruments – 2 Nos of each make.

    Bidder shall also provide all required software (lifetime licensed) and hardware (cables/connectors, Tablet/ Laptop etc.) along with these tools.

15. 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 price implication.

16. Redundancy of sensors shall be provided by bidder
    (i) Triple redundancy for all analog and binary inputs required for protection of system/drives.
    (ii) For all other control functions dual redundancy of the sensors shall be provided by the bidders.

17. All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications. Bidder to provide temperature transmitter along with compensating cable, JB/Rack & other erection hardware.

18. Use of process actuated switch shall be avoided unless unavoidable.

19. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply.

20. All transmitters shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) In Local Instrument Racks (LIRs) in case of covered areas.

21. For measurement of level of tanks/vessels/sumps containing oil, chemicals or water, Ultrasonic type level transmitters shall be provided. However, other type of level transmitters, if any, shall be acceptable only if there are constraints on account of process/equipment/device for having an effective measurement using the above. The acceptability of the same shall be subject to BHEL/NTPC's approval.

22. All instruments and control elements shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.

23. Instrument installation and accessories required for the same shall be in Bidder's scope. However, any instrument/ analyzer installation not covered in the

specification, same shall be subject to customer and BHEL approval during detailed engineering. All instruments required for the package shall be supplied, mounted on the gauge board racks, along with accessories like impulse pipe, fittings & valve manifolds etc.

24. All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.

25. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test 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 implication. The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

26. All transmitters (except PROFIBUS PA compatible transmitters) shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART) as per this specification.

27. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.

28. Epoxy coated painting is required for all I & C Equipment & Instruments.

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

30. 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. 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.

31. 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 by vendor without any price/time implication.

32. The contacts of equipment mounted instruments; sensors, switches etc. For external connection including spare contacts shall be wired out to suitably located junction boxes by bidder.

33. Local control panel if any required for operation shall be in bidder scope.

34. VAV box shall be provided for optimum use of AHU through VFD.VAV box shall be regulated by Temperature sensor & occupancy sensor provided in respective rooms of service building, admin building and other areas specified elsewhere in the specification. Adequate nos. of occupancy sensor and day light sensor shall be provided. CO2 sensor shall be provided in each AHU room to regulate the fresh air fan damper.

35. AHUs shall be provided with modulating fresh air dampers (with filters) to regulate fresh air based on feedback from CO2 Sensors.

36. Temperature sensor(TS) and Relative Humidity sensor shall be provided in each AHU room. Relative humidity and temp. measurement for main plant control room and CERs to be available in multiple numbers.

37. LCP (If applicable) shall have the provision of command (start/stop) & feedback interface with DDCMIS.

38. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback.

39. Bidder to include IO from fire protection system (supplied by others) for closing the dampers in the event of fire, the no of IO & other specifications in this regard shall be finalized during detail engineering.

40. VFD panels for applicable drives are in Bidders scope. Typical signal exchange with DCS has been indicated in the specification elsewhere.

41. VFD Drive shall be provided with bypass contactor for motors with standard features like indication, manual and Auto set point facility, control power source, capable of changing supply frequency from 50% to 125%, bypass harmonies suppression, etc.

42. There shall be provision for temperature, pressure and flow measurement in chilled water inlet and outlet line across AHUs to monitor the air conditioning load of each area.

43. AHU shall be started either locally or from the main control room of AC system by means of Remote / Manual selection facility. Auto/ Manual selector Switches and working / standby selector switches for the pumps, fresh air fans and AHU shall be provided in the panel.

44. Drive control philosophy/signal exchange list attached elsewhere in the specification are Tentative. Shall be finalized during detailed engineering.

45. Signal exchange between equipment /instrument and DDCMIS indicated in the specification are minimum and the same Shall be finalized during detail Engineering. Any addition of signal at equipment (supplied by bidder) end shall be complied without any implication.

46. All panels, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).

47. The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards.

48. Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.

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

50. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

51. To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.

52. The design of the control systems and related equipment shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved and shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided/ minimized.

53. For instruments which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved during detail engineering.

54. All the wetted parts of the instruments including the accessories like root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments as well as valves shall be of SS-316 material, suitable pressure class and same shall be in bidder's scope .

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

56. Bidder to provide mandatory spares as per mandatory spares list. Attached elsewhere in the specification.

57. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc

58. All the instruments PG/DPG/DPT/PT etc. (as applicable) having contact with corrosive media shall be provided with chemical/diaphragm seal.

59. JB provided on the valves for manually operated valves Limit switches wherever specified.

60. Separate emergency local stop push button shall be provided for each pump, fans, compressor etc. of Air conditioning system.

61. Bidder shall ensure that various C&I instruments /equipment like electronic transmitters / transducers, Temperature elements and other instruments/ local devices etc. that are being furnished by the Bidder, are of the same make, series and family of hardware to the extent possible so as to ensure smooth and optimal maintenance.

62. Limit switches shall be silver plated with high conductivity and non-corrosive type Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.

63. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.

64. Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.

65. Bidder's presence is required for 15 Man days (in three visits) at site during commissioning of DDCMIS for assistance related to process correctness. Three visit shall be made with total 15 Man days (Excluding travel time) in which one visit shall be of 5 Man days each. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.

66. Bidder's C&I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme of Air conditioning system. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.

67. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.

68. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of deviation, a No deviation certificate is to be furnished.

69. The specifications for instruments mentioned in the specification are minimum requirements.The detail specifications shall be finalized during detail engineering.

70. All measuring instruments/equipment/analysers and subsystems offered by the Bidder shall be from reputed experienced manufacturers ((from BHEL/customer approved vendor list) of specified type and range of equipment, whose guaranteed and troublefree operation has been proven. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards.Further, Bidder to meet the **provenness criteria** for all the supplied C&I items mentioned elsewhere in the specification

71. 415V AC/ 230V UPS Power supply shall be provided by BHEL at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board/change over switch 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.

72. All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. BHEL/NTPC shall have right to insist for completion of works in shops before despatch of materials for transportation.

73. Bidder shall furnish Instrument Schedule, Control Scheme, I/O list, Drive list, Cable Schedule, Cable interconnection, Instrument/SOV/Analyzers Installation diagram, Instrument/Analyzer datasheets, JB grouping, SOV grouping,Annunciation list, List of Instruments/devices for Profibus/HART,configuration diagram for Profibus based actuators/instruments in BHEL approved format. Also, editable database format like MS Excel, MS Access etc. of these documents shall also be provided by Bidder.

ACTUATORS

ELECTRICAL ACTUATORS

1.00.00 **General Requirements**

Actuators shall be designed for valve operation to ensure proper function in accordance with specifications given below and complying to EN15714-2 or equivalent. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

4.00.00 REQUIREMENT FOR NON-INTRUSIVE PROFIBUS ACTUATOR

4.01.00 **Type**

1. The actuators shall have integral starters with built in SPP (Single Phasing Preventer). 415 V, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.
2. The actuators shall be Non- Intrusive electric actuator. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body

4.02.00 **Rating**

1. Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire & 50HZ +/- 5%.
2. Sizing:
   Open/Close at rated speed against designed differential pressure at 90% of rated voltage.
   For ON/OFF type: Three successive open-close operations or 15 minutes, whichever is higher.
   For inching type: 150 starts per hour or required cycles, whichever is higher

4.03.00 **Construction**

1. Enclosure: Totally enclosed weatherproof, minimum IP-68 degree of protection.
2. Manual Wheel: Shall disengage automatically during motor operation.

4.04.00 **Motor**

Type: Squirrel cage induction motor suitable for Direct On-Line (DOL) starting
Enclosure: Totally enclosed, self-ventilated
Insulation: Class F. Temperature rise 70 Deg C. over 50 Deg C ambient.
Bearings: Double shielded, grease lubricated antifriction

		Earth Terminals: Two Protection: Single Phasing Protection, Over-heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design. Suitable means shall be provided to diagnose the type of fault locally.
4.05.00	**Position / Torque Transmitter**	The Position/ Limit measurement shall be done using absolute encoders which will give information of position/ limit in both the directions. Electronic measurement of torque shall be provided.
4.06.00	**Local Operation**	It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.
4.07.00	**LCD Display**	A local LCD display shall be provided to give information regarding actuator alarms, status and valve position indications as a minimum in local.
4.08.00	**Wiring**	Suitable voltage grade copper wire.
4.09.00	**Terminal Block**	For power cables, the grade of TBs shall be minimum 650V.
4.10.00	**Accessories**	All required accessories for calibration / settings/ configuration of various parameters of actuator shall be provided.
4.11.00	**SIL Certification**	All actuators shall be certified for SIL 2 or better.

contd. on next page

REQUIREMENT FOR NON-INTRUSIVE PROFIBUS ACTUATOR

4.12.00 **Interfaces**

For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network.

a) Open/ close commands, open/ close feedback status, disturbance signal etc. shall be available to the Control System through the fieldbus network along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DDCMIS through the fieldbus network.

b) All actuators shall be Profibus compatible.
However the exact protocol shall be based on finalized protocol of If Profibus DP protocol is envisaged then actuator shall have two (redundant) Profibus DP ports for connecting the redundant Profibus DP cables. That is if one profibus cable is cut or not working/ not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention. Also, for Profibus DP cable connection, suitable connector integral to the actuator, or external devices/ accessories (mounted inside minimum IP65 protection class enclosure) shall be provided so that the actuator can be isolated online from the profibus network without disturbing the Profibus communication of other actuators of the segment.

c) Open/close command termination logic shall be suitably built inside actuator.

d) For all actuators GSD and DTM files are to be provided which shall be configured/ tested with DCS for proper interfacing and diagnostics.

4.13.00 **Terminal Box**

Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided. Necessary glands for power cables and armored fieldbus cables shall be provided.

4.14.00 **Training**

Contractor shall provide training on Non-Intrusive Profibus Electric Actuator along with detail training on Profibus interface used in actuator for Employer's personnel.

	DATASHEET FOR MOTORISED VALVE ACTUATOR (2X660MW Talcher STPP)	SPECIFICATION NO.:
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE:06/03/2020
		SHEET 1 OF 4

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	2X660 MW TALCHER STPP
	OFFER REFERENCE	
	* TAG NO. SERVICE	
	* DUTY	☐ ON / OFF ** ☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL	
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY
	* OPENING / CLOSING TIME	
	* WORKING PRESSURE	
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF -20 to70 DEG C AND RELATIVE HUMIDITY OF 0-95%IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF,DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/IP:68
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM** as per IEC60034-1
HANDWHEEL as per standard EN 12570:2000	* REQUIRED	■ YES ☐ NO
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.	
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY
	MOTOR MAKE / MODEL / TYPE / RATING (KW) (REFER NOTE NO. 6 & 7)	BIDDER TO SPECIFY
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF **I.S.** TOLERANCE
	ACTUATOR APPLICABLE WIRING DIAGRAM (TO BE DECIDED DURING DETAILED ENGINEERING)	BIDDER TO FURNISH WIRING DIAGRAM
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ SIEMENS GRAYRAL 7030/32 ■TO BE DECIDED DURING DETAILED ENGINEERING
	PAINT TYPE	☐ ENAMEL ☐ EPOXY CONFIRMING TO CORROSION CATEGORY C5-I ■ TO BE DECIDED DURING DETAILED ENGINEERING
	SHAFT RPM	BIDDER TO SPECIFY
	OLR SET VALUE	BIDDER TO SPECIFY
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ■ 230 V ■ 110 V	
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ■ IP 68 ■ FLAME PROOF TO BE DECIDED DURING DETAILED ENGINEERING	
	@MOTOR BEARING WITH 2 EARTH TERMINALS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI FRICTION	
	@ INSULATION CLASS	CLASS F. TEMPERATURE RISE 70 Deg C. OVER 50 Deg C AMBIENT	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE)	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED (THERMISTOR PTC)	
INTEGRAL STARTER	INTEGRAL STARTER	■ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ■ CONTACTORS(REVERSING TYPE) ■ THYRISTORS	
	TYPE	☐ CONVENTIONAL ■ NON-INTRUSIVE PROFIBUS	
	IF NON-INTRUSIVE PROFIBUS (REFER BELOW POINT a – g)		
	a) INTERFACE WITH CONTROL SYSTEM	■ PROFIBUS ☐ HARDWIRED	
	b) FIELDBUS PROTOCOL	■ PROFIBUS DP ☐ PROFIBUS PA ☐ FOUNDATION FIELDBUS	
	c) REDUNDANT PORTS(IN CASE,PROFIBUS DP PROTOCOL)	■ REQUIRED ☐ NOT REQUIRED	
	d)TORQUE/LIMIT MEASUREMENT TRANSMITTER(REFER NOTE NO.9)	■ REQUIRED ☐ NOT REQUIRED	
	e)POSITION MEASUREMENT TRANSMITTER(REFER NOTE NO.9)	■ REQUIRED ☐ NOT REQUIRED	
	f)LCD DISPLAY INTEGRAL TO ACTUATOR BODY(REFER NOTE NO.10)	■ REQUIRED ☐ NOT REQUIRED	
	g) SIL CERTIFICATION(SIL 2 OR BETTER)	■ REQUIRED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED	
	OPEN / CLOSE PB	■ REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S(LOCKABLE)	■REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL (TO BE DECIDED DURING DETAILED ENGINEERING)	REQUIRED MOTOR THERMOSTSTTRIP O/L RELAY OPTD, CONT./POWER SUPPLY FAILED,S/S IN LOCAL/REMOTE/OFF MODE,TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD,VALVE JAMMED ETC)	
	ACTION ON LOSS OF EXTERNAL ELECTRIC POWER	■ STAYPUT ■ FAIL SAFE TO BE DECIDED DURING DETAILED ENGINEERING	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) DATASHEET & WIRING DIAGRAM OF	TYPE OF ISOLATING DEVICE	■ INTERPOSING RELAY ■ OPTO COUPLER TO BE DECIDED DURING DETAILED ENGINEERING	
	QUANTITY	■ 2 NOs. ■3 NOs. TO BE DECIDED DURING DETAILED ENGINEERING	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
ISOLATION DEVICE TO BE PROVIDED(NOT APPLICABLE FOR NON-INTRUSIVE PROFIBUS ACTUATOR)	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms					
TORQUE SWITCH(NOT APPLICABLE FOR NON-INTRUSIVE PROFIBUS ACTUATOR)	MFR & MODEL NO.	BIDDER TO SPECIFY					
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos					
	CONTACT TYPE	2 NO + 2 NC					
	RATING	5A 240V AC AND 0.5A 220V DC					
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE					
	ACCURACY	+3% OF SET VALUE					
LIMIT SWITCH(NOT APPLICABLE FOR NON-INTRUSIVE PROFIBUS ACTUATOR)	MFR & MODEL NO.	BIDDER TO SPECIFY					
	OPEN : INT : CLOSE	☐1 No ■2 Nos.	2 Nos. (ADJ.)	☐1 No. ■2Nos.			
	CONTACT TYPE	2 NO + 2 NC					
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V					
	ACCURACY	2% OF SET VALUE					

POSITION TRANSMITTER (ALSO REFER NOTE NO.9)	POSITION TRANSMITTER	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	■ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS TO BE DECIDED DURING DETAILED ENGINEERING	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON NTEGRAL)	240V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@■ IP 68 @■ TO BE DECIDED DURING DETAILED ENGINEERING	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET	■ REQUIRED ■ NOT REQUIRED (TO BE DECIDED DURING DETAILED ENGINEERING)	
	NO. OF PINS REQUIRED	■ 9 PINS ■ 13 PINS (TO BE DECIDED DURING DETAILEDENGINEERING)	
	NOS. OF PLUG & SOCKET	☐ 1 Nos. for ON/OFF ☐ 2 NOS.(for inching duty)	
CABLE GLANDS	@ POWER CABLE GLAND	QUANTITY & SIZE TO BE DECIDED DURING DETAILED ENGINEERING	
	@ SPACE HEATER CABLE GLAND		
	CONTROL CABLE GLANDS-1		

Data Sheet A & B

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

	CONTROL CABLE GLANDS-2		
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS-4722, IEC 60947-5-1 AND EN 15714-3 :2010 OR LATEST VERSION.
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
7. THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH
8. IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, MECHANICAL END STOP WITH ACCURACY OF 2% SHALL BE SUPPLIED.
9. THE POSITION/LIMIT MEASUREMENT SHALL BE DONE USING ABSOLUTE ENCODERS WHICH WILL GIVE INFORMATION OF POSITION/LIMIT IN BOTH THE DIRECTIONS.ELECTRONIC MEASUREMENT OF TORQUE SHALL BE PROVIDED
10. A LOCAL LCD DISPLAY SHALL BE PROVIDED TO GIVE INFORMATION REGARDING ACTUATOR ALARMS, STATUS AND VALVE POSITION INDICATION AS A MINIMUM IN LOCAL.
11. IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
12. LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.
13. CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE OF 1.5 SQ. MM.
14. ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.
15. TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.
16. THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE.
17. AUTOMATIC PHASE CORRECTION FACILITY AND POTENTIAL FREE CONTACT FOR ANNUNCIATION OF POWER FAILURE SHALL BE PROVIDED.
18. LIMIT SWITCHES SHALL BE SILVER PLATED WITH HIGH CONDUCTIVITY AND NON-CORROSIVE TYPE. CONTACT RATING SHALL BE SUFFICIENT TO MEET THE REQUIREMENT OF CONTROL SYSTEM SUBJECT TO A MINIMUM OF 60 V, 6 VA RATING. PROTECTION CLASS SHALL BE IP67.
19. SUITABLE TERMINALS/CONNECTORS.INTEGRAL TO ACTUATORS ,FOR TERMINATING FIELDBUS(PROFIBUS-DP) CABLES AND POWER CABLES SHALL BE PROVIDED.NECESSARY GLANDS FOR POWER CABLES AND ARMORED FIELDBUS CABLES SHALL BE PROVIDED.
20. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +5% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
21. ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
22. OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE.

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ BE FILLED BY ES

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

1.FIELD & MEASURING INSTRUMENTS.
2.PROCESS CONNECTION AND PIPING.
3.INSTRUMENT INSTALLATION DIAGRAM.

2.00.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

2.01.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS**

Microprocessor based 2 wire loop powered electronic transmitter with 4-20 mA DC HART/ /Profibus PA complying to IEC 61158.) output signal shall be provided.

Range	Accuracy (For calibrated Range)	Turndown (For span)	Stability (% of Calibrated range)
<=400mmwc	0.1%	20:1	+/-0.2% for 1 year
>400mmwc	0.060%	50:1	+/-0.25 % for 10 year
>250 kg/cm2	0.065%	10:1	+/- 0.15 % for 5 years

Above parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.

Transmitter shall have weather proof IP-67 metallic housing with durable corrosion resistant coating, integral digital display with self-indicating diagnostics, Plug and socket type electrical connection for HART and ½ "NPT (F) for Profibus type Transmitter, calibration using HART/Fieldbus calibrator, 2/3/5 Valve non integral manifold and rack with canopy. For HART transmitter SIL 2 certification is required.

For primary air and flue gas applications, DPT shall be provided for pressure measurement below range of 2000 mmwc.

For corrosive, viscous, solid bearing, slurry type process fluids, suitable diaphragm seal shall be provided. Parts below seal shall be removable for cleaning. Entire volume shall be completely filled with inert liquid suitable for instruments. LVDT type transmitter is not acceptable.

2.02.00 **GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER**

Type	Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.
Principle	TDR (Time domain reflectometry)
Probe Type & Material	(i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention. (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.
Output signal	4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.
Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
Power supply	24 VDC +/- 10%.
Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
Adjustment/ calibration	Using hand held HART calibrator/ centralized PC based system (as applicable).
Zero & span	Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument

adjustment	without any level in the tank/sump etc.
Display	Integral digital display.
Load Impedance	500 ohms (minimum).
Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2
Mounting	(i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor. (ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor. (iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.

Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

2.03.00 Ultrasonic Type level Transmitter

S.No.	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
4.	Power supply	24 V DC +/- 10%.
5.	Temperature compensation	To be provided within transducer.
6.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
7.	Adjustment/calibration/ maintenance	Using hand held HART calibrator/ centralized PC based system (as applicable).
8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
9.	Sensor Material	Corrosion resistant material to suit individual application requirement.
10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.

11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
12.	Display	Integral digital display
13.	Diagnostics	Loss of echo alarm etc.
14.	Load Impedance	500 ohms (minimum).
15.	Electrical Connection	Plug and socket
16.	Accessories	• All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. • All mounting accessories required for erection and commissioning shall be provided. • For hazardous area, explosion proof enclosure as described in NEC article 500

Note:

1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under "ultrasonic transmitters" category for fly ash silo level.

2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.

2.04.00 HART Hand Held calibrator

Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.

3.02.00 **Resistance Temperature Detector (RTD)**

Sr. No.	Features		Essential/Minimum Requirements
1	Type of RTD.	:	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be

			provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well
4	Insulation and sheathing of RTD	:	Mineral (magnesium oxide) insulation and SS316 sheath,
5	Calibration and accuracy	:	As per As per IEC-751/ DIN-43760 Class-A for RTD
6	Accessories	:	Thermo well and associated fittings
7	Standard	:	IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

NOTES :

1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.

2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

	Minimum bending radius	30 mm
	Length of T/C	On as required basis considering location of measurement point and the JB/TTJB location.

Notes :

1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.

2) For boiler metal temperature applications, considering the location of installations and response time, manufacturer's standard and proven specification for metal temperature measurement can also be accepted subject to employer's approval. The manufacturer shall submit adequate supporting documents for establishing their standard and proven practice.

3.04.00 **Thermo well** (for all process temp. elements)

(a) Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974)

(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.

(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).

(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.

3.05.00 **Not Used**

3.06.00 **TEMPERATURE TRANSMITTER**

Minimum technical requirements shall be as follows:
Single input/Dual input temperature transmitter shall be 2-wire loop powered directly from 4-20mA input cards of DDCMIS. Transmitter shall be fully compatible with thermocouples and RTDs being provided. It shall be capable to handle Pt-100 RTD, Thermocouple –K, R & S types (selectable through HART/Fieldbus terminal/calibrator).Temperature compensation for T/C shall be performed in the transmitter itself.

In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output. Transmitter shall be /Fieldbus (Profibus PA complying to IEC 61158)compatible, have EMC compatibility as per EN 61326, weather proof IP-67 metallic housing with durable corrosion resistant coating, plug and socket type electrical connection for HART and 1/2" NPT(F) connection for Fielbus , integral digital display with self-indicating diagnostics, operating ambient temperature of 85 deg C without display & 70 deg C with display, suitable for 2 inch pipe mounting in enclosure/rack . Composite Accuracy shall be as follows :. RTD =<0.25% of 0-250 deg C span, T/C -K type =<0.2 % of 0-600 deg C span, CJC accuracy (for T/C) shall be < 1 deg C.

Notes :

1. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed in control system.
2. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., A/D accuracy, basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified.
3. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.
4. Dual input temperature transmitters can also be accepted in place of single input TT.

3.07.00 **Din rail temperature transmitter** 4-20mA HART based suitable for mounting on DIN-rails in JBs. The specifications of the JBs shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category. Accuracy of Din rail should be :. RTD =<0.4% of 0-250 deg C span, T/C -K type =<0.4 % of 0-600 deg C span, CJC accuracy (for T/C) shall be < 1 deg C. Oher specifications shall be as mentioned in clause 3.06.00. Exact applications shall be as defined in PART-A of specifications.

3.08.00 **Multi Input Temperature transmitter (Temperature Multiplexer)**

For only information related temperature inputs fieldbus based Multi input temperature transmitters can be provided. Transmitters shall be capable of withstanding ambient temperature upto 85 deg C. Maximum number of inputs per such temperature transmitter shall be eight. One (1) no. input shall be kept as spare wired upto TBs of field mounted panel in each multi input TT. These shall be installed in field mounted panels with minimum IP 55 protection class. Exact applications shall be as defined in PART-A of specifications.

4.00.00 **ELECTRICAL METERING INSTRUMENTS**

Electrical metering instruments shall be furnished in accordance with the following general specifications. Application standard for electrical metering instruments shall be as per IS: 1248- 2003 (Revised). The size of each instrument shall be as approved by Employer during detailed engg. All metering instruments shall be flush panel mounting type.

4.01.00 (a) Frequency meters for Synchronization purposes: Accuracy: ± 1.5% of full scale.

(b) Synchroscope: Accuracy class: 0.5 or better.

(c) Voltmeters: Accuracy: ± 2.0% of full scale or better.

4.02.00 Synchronizing Relays

Synchronizing check relay 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 10 Degree 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 220V DC and PT input Voltage shall be 110 V AC.

4.03.00 Auxiliary PTs for Measurement & Synchronization

Applicable Standard	IS : 3156
Rated Voltage	110V
Insulation Level	660V grade
Frequency	50 Hz
Mounting	Panel Mounting
Test Voltage (Power frequency)	2.5 KV for 1 min.
Operating temperature	(-) 40 Deg C to (+) 85 Deg C
Primary Voltage	63.5 V to 115V
Secondary Voltage	63.5 V to 115V
Class of accuracy	1
Burden	25 VA
Class of Insulation	E or better

5.00.00 IMPACT HEAD TYPE FLOW ELEMENT

The impact head type element shall be tubular insert type with four impact ports facing upstream direction, located precisely for determination of average flow velocity and shall be of SS 316 L.

Accuracy shall be 1.0% of actual value or better. Repeatability shall be + 0.1% of actual value or better.

The elements shall be supplied complete with mounting hardware; end support plugs and CS valve manifold (1/2" NPT connection) for instrument connections. All pertinent data including instrument tag no. for the flow element shall be punched on a stainless steel plate and affixed to the element.

Flushing arrangement shall be provided.

For quantity and line size etc., refer Part-A.

Dual path transit time clamp-on Ultrasonic Flow meter may also be used for measurement of CW flow.

12.00.00 **SPECIFICATION FOR CORIOLIS FLOW TRANSMITTER**

Type	Coriolis
Material of Wetted Parts	316 SS
Material of Housing	304L SS
Accuracy	± 0.2% of Rate
Repeatability	± 0.1% of Rate
Output	4-20 mA DC, HART Compatible
Power Supply	230 VAC or 24VDC operated
Process Temperature range	0-200 degree Celsius
Others	Drain / purging arrangement shall be provided as per standard practice.

Notes: Coriolis Mass flow meter upstream of Burners shall be sized to measure minimum flow corresponding to one burner operation and maximum BMCR rating flow with 25% margin.

The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer's approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer's approval.

13.00.00 SPECIFICATION FOR FLOW ELEMENTS

13.01.00 Orifice Plate

Features	Essential/Minimum Requirements
Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167
Material	316 SS
Thickness	3 mm for main pipe diameter up to 300 mm and6 mm for main pipe dia above300 mm.
Tappings	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
Beta Ratio	0.34 to 0.7

13.04.00 **NOT USED**

14.00.00 NOT USED

15.00.00 PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. .
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
Over range/ proof pressure	150% of maximum operating pr.	-	150% of maximum operating pr.
Repeatability	+/- 0.5% of full range		
No. of contacts	2 No.+2NC. SPDT snap action dry contact		
Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)		
Elect. Connection	Plug in socket.		
Set point adjustment	Provided over full range.		

Dead band adjustment	Adjustable/ fixed as per requirement of application.		
Enclosure	Weather and dust proof as per IP-55, metallic housing.		
Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
Power Supply (wherever required)	As per Contractor's Standard practice.		

Notes :-

1) 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.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

5) For ESP Level Switches following requirements are to be met:
   i) ESP Level Switches calibration shall not be affected by changes in ambient temperature.
   ii) Active build up compensation to be provided to sense and auto correct the effect of ash deposition on level probe.
   iii) Self- -diagnostic features like health status, maintenance requirement, instrument failure, false alarm etc. to be provided.

   The manufacturer shall submit adequate supporting documents, catalogues for establishing the above features.

6) Vibration Rod type switches to be provided for first two fields of ESP.

16.00.00 **NOT USED**

17.00.00 **SOLENOID VALVES**

Solenoid valves shall fulfil the following requirements:

a. Type 2/3/4 way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.)

b. Power supply : 24 V DC ± 10%.

c. Plug and socket electrical connection.

d. Insulation : Class 'H'

e. IP Class : IP65

18.00.00 REVERSE ROTATION INDICATOR (RRI)

Reverse rotation indicator comprising of proximity sensors, processing electronics with output of 4-20mA (corresponding to speed) interconnecting cables, speed display in rpm, normal, reverse indication and required channel alarm contact shall be provided. The contact rating shall be 60VDC, 6VA (or more if required by Control system). The exact details of the RRI shall be strictly as approved by Employer during detailed engineering. The power supply of RRI is to be arranged by the Bidder.

19.05.00 **Electronic Flow-Meter**

The electronic flow meter shall include flow sensor and flow indicator cum integrator / totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner.

The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feed back on satisfactory performance of the instruments.

The flow meter shall meet or exceed the following requirement :

(a)	Output	:	4-20 mA DC Isolated output
(b)	Accuracy	:	± 0.5% of calibrated span or better *
(c)	Repeatability	:	± 0.2% of calibrated span or better
(d)	Power Supply	:	240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arranged by the contractor.
(f)	Protection class	:	IP-55
(e)	Flow tube		SS304
(f)	liner		Hard Rubber

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser/ integrator to get the daily and monthly discharge as stated above.

20.00.00 **AC PLANT RELATED SPECIAL INSTRUNMENTS**

20.01.00 **HUMIDITY SENSOR**

Sensor	:	Capacitance type
Accuracy	:	+/-3% R.H
Range	:	0-100% R.H
Output	:	4-20 ma
Time constant	:	2 mins.

Output from the sensor is to be connected to respective control system. Contractor can also provide combined instrument for measurement of humidity and temperature subject to Employer's approval during detailed engineering. In all such cases, 4-20 ma outputs, each for temperature and humidity measurements are to be provided.

20.02.00 **TEMPERATURE/ HUMIDITY INDICATOR**

Sensor	:	RTD for(Pt 100) for temperature
	:	Capacitance Type for Humidity (specs for humidity and temperature shall be as mentioned above)
Display	:	Combined enclosure with two three digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.
Range	:	0-60 Deg C for temperature.
	:	0-95.0 % for Relative Humidity.
Accuracy	:	Better than +/_0.5 % for Temperature
	:	Better than +/_2.5 % for Relative Humidity
Mounting	:	Table Top/ wall mounting.
Power supply	:	240 V AC, 50 Hz.
Output	:	4-20 mA signal each for temperature.
Qty.	:	15 nos. each of temperature & Humidity indicators (combined indicators for Humidity and temperature is also applicable).

One Set of output signal is to be connected to respective control system. Apart from displaying the temperature/humidity values on indicator.

21.00.00 **Limit switches**

For offsite plant (except PT, DM, Chlorination, chemical treatment, Liquid effluent treatment) application Limit switches shall be silver plated with high conductivity and non corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.

For main plant application limit switches are to be provided as per contractor standard and proven practice.

For PT, DM, Chlorination system , chemical treatment, Liquid effluent treatment plant , limit switches of manual valves and solenoid operated on-off valves shall be of inductive proximity type and shall be mounted inside the enclosure: pl. refer the minimum specification requirement below .

Operating voltage Range	10-40 V DC
Sensing system	Inductive Proximity type , 2 Wire
Sensor Contact Type	NO
Reverse polarity and short circuit protection	Yes
IP Class-Sensor	IP67
IP Class-Enclosure(Switch box)	IP67
Cable entry-Enclosure(Switch box)	2no-1/2" NPT
Casing material-Sensor	Brass /SS
Enclosure(Switch box) Housing material	FRP or SS
Operating Ambient temp(sensors)	-5 to 70 deg C
Max allowed Voltage Drop across sensor	5 V
Standard applicable	EN 60947-5-2 or equivalent.

SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.

Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
1	Sensing Element and material	Bourdon for high pressure, Diaphragm/Bellow for low pr. Of 316 SS	Mercury in steel for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary.	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	SS 316	SS 316	Forged carbon steel/304 SS
3	Dial size	150mm	150 mm	Tubular covering entire range
4	End connection	1/2 inch NPT (M)	3/4" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
5	Accuracy	±1% of span	± 1% of span	± 2%
6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Test pr. for the assembly shall be1.5 to the max. Design pr. at 38°C.		
9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
10	Zero/span adjustment	Provided	Provided	--
11	Identification	Engraved with service legend or laminated phenolic name plate		

12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
13	Material of Bourdon/ movement	316 SS / 304 SS	316 SS / 304 SS	

Notes:-

*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

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.

CONTROL VALVES, ACTUATORS & ACCESSORIES

1.00.00	**CONTROL VALVES, ACTUATORS & ACCESSORIES**
1.01.00	**General Requirements**
1.01.01	The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.
1.01.02	All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves. Ceramic lined control valves shall be provided as per standard and proven practice of QFGDM.
1.01.03	For special type of control valves such as combined pressure and temperature control valves for Aux PRDS application, separator drain control valves, refer to the corresponding mechanical sections.
1.01.04	Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.
1.02.00	**CONTROL VALVE SIZING & CONSTRUCTION**
1.02.01	The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
1.02.02	The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering.
1.02.03	Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished. For flashing services, valve with hardened trim shall be provided.
1.02.04	Control valves for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system, HP/LP heater Emergency level control, Emergency Make-up to condenser hotwell, GSC minimum flow, Deaerator Drain to Condenser Hotwell, Condensate spill to condensate reserve tank, condenser normal make-up and valve gland sealing supplying pressure control, CEPS minimum flow control, BFP circulation control valve shall have permissible leakage rate as per leakage Class V. All other

control valves shall have leakage rate as per leakage Class-IV as per ANSI / FCI /70.2,2006 or equivalent.

1.02.05 The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers except for few cases as per contractor's standard and proven practice subject to employer's approval.

1.02.06 Control valves for steam and water application shall be provided with rangability of 30:1 for all services except for applications wherein control valves are envisaged to be operated in lower range like Reheater spray and superheater spray system wherein control valve with rangability of 50:1 shall be provided

2.00.00 VALVE CONSTRUCTION

2.01.00 All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.

2.02.00 Valves with high lift cage guided plugs & quick-change trims shall be supplied.

2.03.00 Cast Iron valves are not acceptable.

2.04.00 Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.

2.05.00 Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.

2.06.00 All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing or with extra deep gland packing, which shall be equipped with lantern rings to admit pressurized water for gland sealing.)

2.07.00 Valve characteristic shall match with the process characteristics.

2.08.00 Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.

2.09.00 Flanged valves shall be in accordance to ANSI B 16.5.

3.00.00 VALVE MATERIALS

Sr. No.	Service	Body material	Trim Material
1	Non-corrosive, non-flashing and non-cavitation service except DM water	Carbon steel ASTM-A216 Gr. WCB for design fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC6 for design fluid temperature above 275 Deg. C and upto 400 Deg. C Alloy steel ASTM-A217Gr. WC9 for design fluid temperature above 400 Deg. C	316SS stellited with stellited faced guide posts and bushings.

	2.	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. WC9	440 C
	3.	Low flashing/cavitation service	Alloy steel ASTM-A217 Gr. WC6	17-4 PH SS
	4.	DM water service	316 SS	316 SS

NOTE: (a) Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.

(b) Severe flashing / cavitation services includes as a minimum all control valves whose downstream piping is connected to condenser or flash tank.

However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.

4.00.00 **END PREPARATION**

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

5.00.00 **VALVE ACTUATORS**

All control valves shall be furnished with pneumatic actuators except for pressure and temperature control valve for auxiliary PRDS application (electro-hydraulic / pneumatically operated) and separator drain control valve (electro-hydraulic type).The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

6.00.00 **CONTROL VALVE ACCESSORY DEVICES**

6.01.00 All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for

Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

7.00.00 SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER

1	Environment	a) Protection class.	IP-65 Minimum
2	EMC & CE Compliance	Required to International Standard like EN/IEC.	EN50081-2 & EN50082 or equivalent.
3	Accessories	In-built Operator Panel	Display with push buttons for configuration and display on the positioner itself (Password protected/Hardware lock).
		Hand Held Calibrator	(i) Universal HART Calibrator to be provided for conventional positioners. (for quantity, refer Part-A. Contract quantities of the specification). (ii) Fieldbus compatible calibrator to be provided for fieldbus based positioners. (for quantity, refer Part-A)

7.01.00 **POSITIONER WITH INTRINSIC PARTIAL STROKE TEST (PST) FACILITY**

FGD Bypass Damper is very critical for the safe evacuation of flue gas when FGD is not in operation. Normally it shall be in CLOSED condition most of the times when FGD is in operation. But during emergency need, if it fails to OPEN, it can lead to high furnace pressure and subsequent MFT. Therefore, a PARTIAL STROKE TEST for the Bypass damper to be carried out in AUTO at regular intervals.

A timer is set to conduct partial stroke test weekly (programmable). When timer is due, an alarm message is sent to both Main Unit Control Room and FGD Control Room: "FGD PARTIAL STROKE TEST SCHEDULED". A soft Push Button is to be provided in the Main Control Room only. Once the Operator presses the PB, the timer is reset and "FGD PARTIAL STROKE TEST INITIATED "message should flash in both Main Unit CR and FGD CR.
An analog output command shall be sent to the FGD Bypass Damper for programmable opening. Once the Damper OPENS to the predetermined Set Point, a close command is issued to close the damper (approx. 10% opening PFT SP is to be given and for CLOSE Limit switch is to be used). After getting, the close feedback "FGD PARTIAL STROKE TEST SUCCESSFUL" message is flashed. This test should complete successfully within a scheduled time. If it does not, "FGD PARTIAL STROKE TEST FAIL" alarm shall be flashed in both Unit CR and FGD CR. Scheme shall be finalised during detailed engineering.

Contractor shall provide ***positioner*** with intrinsic ***Partial Stroke Test (PST)*** facility to achieve the above functionalities for the FGD Bypass Damper with all suitable pneumatic and electrical connections.

	All other or better specifications of Positioners shall be applicable to PST positioners as mentioned in Section – VI, Part-B, Control Valves, Actuators & Accessories, Sub-Section-IIIC-08, Clause 7.00.00.
8.00.00	**TEST AND EXAMINATION**
	All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:
8.01.00	Non Destructive Test as per ANSI B-16.34.
8.02.00	Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.
8.03.00	Valve closure test and seat leakage test in accordance with ANSI-B 16.34/ FCI 70.2 standard and as per the leakage class indicated above
8.04.00	Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.
8.05.00	CV Test: Please refer Cl No. 1.00.00 & 3.00.00 OF Sub-section- IIIC-10 (Type test requirements), Control Valves.
	Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.

PROCESS CONNECTION AND PIPING

1.00.00 **PROCESS CONNECTION PIPING**

Process connection & piping including all impulse piping, sample piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories required for proper installation & completeness of impulse piping system, sampling piping system and air supply system shall be provided by the Contractor on as required basis.

The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:

Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34
Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009
Installation Schemes	BS 6739-2009, ANSI/ISA 77.70

Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply.

1.01.00 All transmitters and switches (except for fuel oil applications) shall be suitably grouped together and mounted inside
(i) Local Instruments Enclosures (LIE) in case of Open Areas of the Plant like Boiler Area, Coal Handling, Chimney Area, FGD area, CW Pump House, DM Plant, PT Plant, Ash Handling Plant etc.
(ii) Local Instrument Racks (LIR) in case of covered areas like Turbine Area, Generator Area etc.
(iii) Local Indicators/Gauges shall also be suitably grouped in Local Instrument Racks

In case grouping is not possible and these are to be installed individually, canopy with suitable mounting arrangement shall be provided.

All electric actuators, pneumatic control valves, Junction Boxes, Solenoid boxes and Local control panels which are not installed inside building, suitable canopy shall be provided and design of canopy shall be approved by Employer during detailed engineering.

1.02.00 Local Instrument Enclosures (LIEs) and Local Instrument Racks (LIRs) complete with all fittings, mountings & accessories, drains and Utility Lighting, Cable & Grounding cable etc. shall be provided by the Contractor on as required basis. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55. The instrument racks shall be constructed from 1.6 mm sheet plate and shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel and extended beyond the ends of the rack.

1.03.00 All temperature transmitters shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant like Boiler Area, Coal Handling,

Chimney Area, FGD area, CW Pump House, DM Plant, PT Plant, Ash Handling Plant etc. and (ii) Racks in case of covered areas like Turbine Area, Generator Area etc. on as required basis. In case grouping is not possible and temperature transmitter is to be installed individually, canopy with suitable mounting arrangement shall be provided.

1.04.00 For skid mounted instruments and instruments integral to equipments, process connection and piping can be in line with bidder's standard and proven practice.

1.05.00 Contractor shall furnish "Certificate of Compliance" of erection of PCP as per NTPC approved documents.

1.06.00 PAINTING COLOR SCHEME FOR IMPULSE PIPING

S. No.	Area / Equipment	Impulse Pipe Ground Color		Identification Tag/Band		
		Color	RAL	Color	ISC No.	RAL
1)	Air	Grey	9002	Sky Blue	101	
2)	Water	Grey	9002	Sea Green	217	
3)	Steam	Aluminum		Signal Red	537	3001
4)	Air Steam Mixture	Aluminum		Sky Blue	101	
5)	Gas	Grey	9002	Canary Yellow	309	
6)	Oils	Grey	9002	Light Brown	410	
7)	Pulverized Fuel	Grey	9002	Silver Grey	628	
8)	Fire Installations	Fire Red	536 (ISC) 3001 (RAL)	White		9010
9)	HP Dosing	Grey	9002	Dark Admiralty Grey	632	
10)	LP Dosing / acid / alkali Piping	Grey	9002	Signal Red	537	
11)	Ash Piping	Grey	9002	French Blue	166	

Note: Ground color indicated against each piping shall be followed in case piping is not insulated /cladded.

INSTRUMENTATION CABLE, CONTROL & POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYs ETC

Specification of Instrumentation cable

1.00.00 Common Requirements

S. No.	Property	Requirement
1	Operating Voltage	225 V (peak value)
2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.
3.	Continuous operation suitability	At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.
4.	Marking :- a.*Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath.* *b.*Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable	
5.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet
6.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.
7.	Color	The outer sheath shall be of blue color.
8.	Others	Repaired cables shall not be acceptable.

1.01.00 Specific Requirements

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
A. CONDUCTORS				
Cross section area	0.5 sq. mm			
Conductor material	ANSI type KX	ANSI type SX	Annealed bare copper	ANSI type KX
Colour code	Yellow -Red	Black-Red	As per VDE-815	Yellow-Red

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1
No & dia of strands	7x0.3 mm (nom)			
No. of Pairs	2	2	2/4/8/12/16/24 / 48	2
Max. conductor loop resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4	As per ANSI MC 96.1
Reference Standard	As per ANSI MC 96.1		VDE : 0815	As per ANSI MC 96.1
B. INSULATION				
Material	Extruded PVC type YI 3			Teflon
Thickness in mm (Min/Max)	0.25/0.35			0.4 / 0.50 (nominal)
Volume Resistivity (Min) in ohm-cm	1 x 10^{14} at 20 deg. C & 1x10^{11} at 70 deg. C.			2.8x 10^{14} at 20 deg. C & 2x10^{11} at 205 deg. C.
C. PAIRING & TWISTING				
Max. lay of pairs (mm)	50			
Single layer of binder tape on each pair provided	Each core printed with number or Numbered binder tape to be provided on each pair		Yes	Each core printed with number
Bunch (Unit Formation) for more than 4P	N.A		To be provided	N.A
Conductor /pair identification as per VDE0815	N.A.		To be provided	N.A.
D. SHIELDING				
Type of shielding	Al-Mylar tape			

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Individual pair shielding	No		To be provided for F-type cable	No
Minimum thickness of Individual pair shielding	No		0.028mm (28 micron)	No
Overall cable assembly shielding	To be provided			
Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)			
Coverage / Overlapping	100% / 20%			
Drain wire provided for individual (F Type)/overall shield	Yes, Size- 0.5 sqmm,No of strands-7,Dia of strands-0.3mm,Annealed Tin coated copper			
E. FILLERS (if applicable)				
Non-hygroscopic, flame retardant	To be provided			
F. OUTER SHEATH				
Material	Extruded PVC compound YM1 with FRLS properties			Teflon (i.e. extruded FRP)
Minimum Thickness at any point	1.8 mm			0.4 mm
Nominal Thickness at any point	>1.8 mm			0.5 mm
Resistant to water, fungus, termite & rodent attack	Required			
Minimum Oxygen index as per ASTMD-2863	29 %			N.A.
Minimum Temperature index as per ASTMD-2863	250 deg.C			N.A.
Maximum Acid gas generation by weight as per IEC-60754-1	20%			N.A.
Maximum Smoke Density	60% (defined as the average area under the curve when of smoke density test			N.A.

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Rating as per ASTMD-2843	plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			
Reference standard	VDE207 Part 5,VDE-816			VDE207 Part 6 ASTM D2116
G. Electrical Parameters				
Mutual Capacitance Between Conductors At 0.8 Khz (Max.)	200 nF/km		120 nF/km for F 100 nF/km for G	200 nF/km
Insulation Resistance (Min.)	100 M Ohm/Km			
Cross Talk Figure (Min.) At 0.8 Khz	60 dB		60 dB	60dB
Characteristic Impedance (Max) At 1 Khz	N.A.		320 OHM FOR F-TYPE 340 OHM FOR G-TYPE	N.A.
Attenuation Figure At 1 Khz (Max)	N.A.		1.2 db/km	N.A.
H. COMPLETE CABLE				
Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.			N.A.
Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			As per manufacturer's standard subject to employer's approval
I. CABLE DRUM				
Type	Non-returnable wooden drum or steel drum.			
Length	1000 m ± 5% for up to & including 12 pairs 500 m ± 5% for above12 pairs			

	Note: Heat resistant instrumentation cable shall have same specification as of G/F type instrumentation cable as specified above, except that insulation and outer sheath material shall be Teflon and cable shall be suitable for continuous operation at 205 Deg. C
2.00.00	**SPECIFICATION OF OPTICAL FIBER CABLES (OFC)**
2.01.00	Optic Fiber cable shall be 4/8/12 core, Electrolytically chrome plated corrugated steel taped (ECCST), fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter.
2.02.00	The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Dielectric central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be – 20 deg. C to 70 deg.C
2.03.00	All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards. Spliced / Repaired cables are not acceptable.
2.04.00	Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.
3.00.00	**SPCIFICATION OF CONTROL & POWER SUPPLY CABLES**
	Refer Electrical sub-sections
4.00.00	**INSTRUMENTATION CABLE INSTALLATION AND ROUTING**
4.01.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:
	From 11 kV/6.6 kV/3.3 kV tray system - 914 mm
	From 415V tray system - 610 mm
	From control cable tray system - 305 mm
4.02.00	The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.
4.03.00	Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables .
4.04.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.
4.05.00	Internal Panels / System cabinets wiring and termination of signal cables at DCS

marshalling shall be as per standard and proven practice of contractor

5.00.00 CABLE LAYING AND ACCESSORIES

Laying of Optic Fiber cables (OFCs) :

Outside Building Area – to be laid necessarily inside cable tray of 100 mm with support from trestle structure

Inside Building area- to be laid on separate cable sub trays

While Buried – in separate buried trench approx. 1 meter depth to be laid in 2 " rodent proof HDPE conduits covered with sand, brick, laid breadth -wise and soil along the pipe line.

While crossing roads- to be laid in rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete.

While crossing canals/ rivers – to be laid in rodent proof HDPE conduits with hume pipe

Laying of Network Cable (UTP/ STP):

Outside Building Area – to be laid necessarily inside cable tray of 100 mm with support from trestle structure

Inside Building Area- to be laid necessarily inside separate covered cable sub-trays**.**

6.00.00 FIELD MOUNTED LOCAL JUNCTION BOXES (AS PER STANDARD AND PROVEN Practice of vendor

(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
(iii)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm^2. A M6 earthing stud shall be provided.
(iv)	Protection Class	IP: 55 min. for indoor & IP-65 min for outdoor applications.
(v)	Grounding	To be provided.
(vi)	Color	RAL 7035

11.00.00 CONDUITS AND CABLE TRAYS TO BE PROVIDED AS PER STANDARD AND PROVEN PRACTISE OF CONTRACTOR.

VFD

1.00.0 **GENERAL**

This chapter has to be read in conjunction with sub-section B-0 "General electrical specification" of Technical specification Section- VI, Part-B and Sub-Section-IIB Electrical system/Equipment of Technical Specifications Section-VI, Part-A.

2.00.00 **CODES AND STANDARDS**

HT breaker	IEC:60056
DC reactor	IEC 60289
Transformers	IS:2026, IEC:60076, IEC 61378
Bushing	IS: 2099, IEC 60137
Adjustable Speed Electrical Power Drive Systems	IEC 61800
Semiconductor converters–General requirements	IEC 60146
IEEE Recommended practices and requirements for harmonic control in electrical power systems	- IEEE 519
Degrees of protection provided by enclosures (IP Code)	IEC 60529
Electrostatic immunity test	IEC1000-4-2
Fast transient immunity test	IEC1000-4-4
Surge immunity test	IEC1000-4-5
High-voltage switchgear and controlgear; Pt.102: Alternating current disconnectors and earthing switches	IEC 62271-102

High-voltage switchgear and controlgear; Pt.200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 KV	IS/IEC: 62271-200
AC electricity meters	IS: 722
Metal oxide surge arrestor without gap for AC system	IEC: 60099-4
Terminal blocks for copper conductors	IEC: 60947-7-1
Dry transformer	IS: 11171
Motor	IS:15999, IEC-60034, IEC60034 / NEMA 30 & 31
Contactor/Switches/Fuses etc.	IEC:60947, IS: 13947
Harmonics & EM compatibility	IEEE:519/IEC: 61000
VFD	IEC: 60034/ IEC: 61800

3.00.00 **OPERATING CONDITIONS**

3.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and also relative humidity of 95% at 40 deg. Celsius shall be considered.

3.02.00 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

3.03.00 The voltage level for the VFD output to be fed to motor shall be as follows:-

1. Upto 400 kW : 415V/690V, Low Voltage, Three Phase AC
2. Above 400kW and upto 700 KW : 690V, Low Voltage, Three Phase AC
3. Above 700KW : Medium Voltage

From here onwards in the specifications all the VFD Systems consisting of either 415 V or 690 V may be termed as LV VFD while the higher rated VFD System shall be termed as MV VFD. If nothing is mentioned than the Clause is applicable for both the LV and the MV VFD until deliberated otherwise.

4.00.00 **SYSTEM DESCRIPTION**

Type of drive	3-Phase Diode / Thyristor / Multi Stage IGBT / IGCT / SGCT/ IEGT
Type of Cooling of VFD	Naturally air cooled/forced air cooled/Liquid cooled
Converter Type	Full wave diode rectifier/active front end type
Inverter Type	Thyristor/IGBT/IGCT/SGCT/IEGT

5.00.00 **GENERAL REQUIREMENTS**

5.01.00 **Medium Voltage VFD**: The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum eighteen (18) pulse design.

5.02.00 **415 V/690 V LV VFD:** The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum Twelve (12) pulse design / 6 pulse with active front end harmonic filter. For drives less than 100 KW Six (6) pulse can be offered meeting all other requirements.

5.04.00 The offered equipment shall be with state of art technology and proven field track record. No prototype equipment shall be offered.

5.05.00 The VFD manufacturer shall ensure the proper coordination of their VFD with the Driven Motor and the supply system. The VFD operation shall have no inherent detrimental impact on the Motors/ cables & supply system.

6.00.00 **TECHNICAL AND OPERATIONAL REQUIREMENTS**

6.01.00 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with worst input supply voltage and frequency variation. The system shall be suitable for the load characteristics and the operational duty of the driven equipment.

6.02.00 The overload capacity of the controller shall be 150% of the rated current of the motor for one minute for constant torque applications and 110% of rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload.

6.03.00 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment or specified by the load:

a. Variable torque changing as a function of speed.

b. Constant torque over a specific speed range.

c. Constant power over a specific speed range.

	d. Any other as specified in data-sheet
6.04.00	VFDs shall comply with the latest edition of IEEE 519 & IEC 61000 for both individual as well as total harmonic voltage and current distortion limits. The Voltage and Current limits shall be applicable at the Point of Common Coupling (PCC), which shall be the MCC/ Switchgear/ from which the VFD system is fed.
6.05.00	The above compliance shall be verified by the field measurements of harmonics at the PCC with and without VFDs operation.
6.06.00	VFD shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit. Any damage resulting from such a short circuit or internal fault shall be limited to the component concerned.
6.07.00	The system shall be suitable to maintain speed variation within range 10-110% or as per the requirement of driven equipment with speed set accuracy of +1% of rated maximum speed and steady state regulation of +0.5% of rated speed as per system requirement.
6.08.00	The VFD System shall maintain a power factor of 0.95 (minimum) (for LV VFD system) and 0.9 (minimum) (for MV VFD system) in the entire operating range.
6.09.00	Maximum allowable audible noise from the VFD system will be 85 dB (A) at a distance of one meter under rated loaded with all cooling fan operating conditions.
6.10.00	All the circuit components shall be suitably protected against over voltages, surges, lightning etc.
6.11.00	The panels shall be designed to provide easy access to hardware, to facilitate replacement of cards in case of any failure.
6.12.00	All the VFDs for particular application shall be of same design so as to ensure 100 % interchangeability of components.
6.13.00	For each programmed warning and fault protection function, the VFD shall display a message in complete English words or Standard English abbreviations. At least 30 time tagged fault messages shall be stored in the drive's fault history.
6.14.00	The VFD cubicles shall be placed in air conditioned environment. However if VFDs of less than 100 kW are designed to operate in non-air condition environment the same shall also be acceptable.
6.15.00	The 3-Phase Thyristor/IGCT/SGCT/ multistage IGBT/IEGT based VFD system shall have minimum number of components to ensure very high reliability. The input side converter shall have 3-Phase Diode/Thyristor bridge configuration modular type and inverter shall be of 3-Phase Thyristor/IGCT/SGCT/multi stage IGBT/IEGT type, using Pulse Width Modulation or better technique for generating near sine wave output to motor.
6.16.00	Fiber optic cable connection shall be provided preferably to ensure high network reliability.
7.00.00	**VFD COMPATIBILITY WITH THE MOTOR**
7.01.00	MV VFD output current waveform, as measured at the motor, shall be inherently sinusoidal at nominal loads, with a total harmonic current and voltage distortion within acceptable/standard limits. VFD with transformers on output side are not acceptable.

7.02.00	The system design shall not have any inherent output harmonic resonance in the operating speed range.
7.03.00	VFD shall provide stable operation of motor from high-voltage dv/dt stress, regardless of cable length to motor. The vendor shall clearly state the limitations in the motor cable distance in his proposal. However, due to system requirements & constraints if the cable length becomes critical, filters/ chokes etc. shall be provided by the VFD manufacturers as an integral part of the VFD to mitigate the reflected wave effect of harmonics.
8.00.00	**BYPASS ARRANGEMENT (OPTIONAL, IF SPECIFIED)**
8.01.00	The VFD System shall have an optional feature to run the motor under bypass arrangement for operation of Motor with VFD bypassed. During starting (under rated conditions) the motor will be switched on in VFD Mode to limit the starting current and after gaining speed, the load would be switched over to bypass mode.
8.02.00	Comprehensive motor protection scheme for protection and control for operation VFD during bypass mode shall be finalized during detailed engineering.
9.00.00	**STANDBY VFD ARRANGEMENT (OPTIONAL, IF SPECIFIED)**
9.01.00	A Common standby arrangement with auto/manual switchover shall be provided in case of failure of any VFD in a group of drives. Complete protection, interlocks & control required shall be provided in the changeover module.
10.00.00	**EFFICIENCY**
10.01.00	Efficiency (Drive only) shall be minimum 98% for both MV VFD and LV VFD. Overall efficiency (Includes the transformer if applicable) shall be minimum 96.5% for LV VFD and minimum 95 % for MV VFD at rated load and speed. Overall Efficiency evaluation shall include input transformer, harmonic filters and power factor correction (if applicable), VFD converters, cooling fans and output filter, as applicable in the system. Auxiliary controls, such as internal VFD control boards, cooling fans/pumps.
10.02.00	In absence of valid test report, a factory test shall be performed at the VFD manufacturer's facility verifying the efficiencies. Manufactures who are supplying Drive and transformer from different locations, efficiency test will be conducted separately for Drive and transformer.
11.00.00	**COOLING SYSTEM**
11.01.00	VFD manufacturer to primarily offer Air cooled Design. However in case of large ratings, liquid cooled drives may be accepted subject to employer's approval. In case of liquid cooled system, there shall be no necessity of continuous water supply system (Closed Loop System).
11.2.00	In case of Air cooled design, the VFD Cooling system shall be such that it puts minimum heat load inside the room and preferably throw the hot air outside the room with ventilation ducts. The Cooling system shall be designed in such a way that the Air Conditioning & Ventilation Air requirements are kept to minimum. The VFD Manufacturer shall furnish the data regarding heat load, air flow requirements during the detailed engineering.
11.03.00	Air cooled VFDs shall be provided with cooling fans mounted integral to the VFD/ enclosure. The VFD shall include air-flow pressure switches and temperature detectors to monitor proper operation of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure.

12.00.00	**TRANSFORMER:**	
12.01.00	Type: Outdoor Mineral oil filled ONAN type or Indoor air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.	
12.02.00	All other components, technical parameters shall be as per applicable IEC/IS.	
12.03.00	Enclosure for Dry Type Transformer (as applicable)	
	Enclosure shall be of a tested quality sheet steel of minimum thickness 2 mm & shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting.	
12.04.00	Core	Shall be High grade non-ageing cold rolled grain oriented silicon steel Laminations.
12.05.00	Winding conductor	Shall be electrolytic grade copper. Windings shall be of class F insulation or better.
.		
12.06.00	Winding temperature Indicator (WTI)	Shall be Platinum resistance type temperature detector in each limb.
12.07.00	Thermistors	Shall be embedded in each limb with alarm and trip contacts for remote annunciation.
12.08.00	Temperature rise:	For dry type transformer the winding temperature rise shall be 95 Deg. C for Class-H insulation or 70 Deg.C for Claas – F Insulation.
13.00.00	**POWER CONVERTER:**	
13.01.00	The static power converter shall consist of a line side converter for operation as a rectifier and a load side power converter for operation as a fully controller inverter. Power converter shall be fast switching, most efficient and low loss type.	
13.02.00	The converter shall be coordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation.	
13.03.00	Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.	
13.04.00	All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.	
13.05.00	The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range. If the parallel connection of semiconductor is applied, the above current rating shall not be less than 140% of the above values.	
13.06.00	All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage.	
13.07.00	The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise nor reducing its service factor due to harmonic currents generated by the inverter operation. The conversion	

	devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions / tools.
13.08.00	The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.
14.00.00	**OUTPUT FILTER (AS APPLICABLE):**
14.01.00	Output/ dv/dt filter shall be provided, if required. It shall be an integral part of the VFD system and included within the VFD enclosure. It shall inherently protect motor from high voltage dv/dt stress.
15.00.00	**DC LINK CAPACITOR (AS APPLICABLE):**
15.01.00	Capacitor shall be of self-healing film or electrolytic type having high life time. The capacitor shall be an integral part of VFD system. DC link Capacitors shall have discharge resistors which shall be capable of reducing the residual charges to zero just after the capacitor is disconnected from the supply source. The capacitor shall be suitable for high ripple currents.
16.00.00	AC/**DC Reactor (As applicable)** 1) Type: Dry type, air cored, self cooled, indoor type. Suitable for withstanding earth fault continuously. 2) Insulation: Thermal Class 155(F), temperature rise is limited to thermal class 130 (B). 3) Noise level shall not exceed value specified in NEMA TR-1.
17.00.00	**VFD PANEL REQUIREMENTS**
17.01.00	Enclosure frames and load bearing members shall be as per the Chapter B-05 and B06
17.02.00	The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.
17.03.00	All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 3X or better for MV VFD and IP: 4X or better for LV VFD as per IS/IEC 60947
17.04.00	Enclosures must be designed to avoid harmonic and inductive heating effects and to shield any outside equipment from interference, enclosing and shielding the complete to eliminate any radio frequency interference. The construction of the panel shall provide effective protection against electromagnetic emissions.
17.05.00	Each panel shall be provided with illuminating lamp, space heater with switch fuse and variable setting thermostat.
17.06.00	Proper ventilation using air filters and fans/pumps shall be provided in the panels to ensure that maximum temperature inside the cubicle is within permissible limits for reliable and continuous operation of the system.
18.00.00	**NOT USED**
19.00.00	**HT SWITCHGEAR**
19.01.00	The technical requirements of HT switchgear shall be as per chapter of HT switchgear in Part-B of Technical specifications.

20.00.00	**MOTORS**
20.01.00	VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side for motor frame size above 250 frame. However, contractor's proven practice with respect to use of insulated bearing in VFD driven motor may be accepted subject to Employer's approval.
20.02.00	Motors shall also meet the requirements mentioned in subsection for motors, relevant portions of the specifications for driven equipment and relevant IS/IEC.
20.03.00	Motor shall be suitable for operation with a solid state power supply consisting of an adjustable frequency inverter for speed control & shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
20.04.00	Motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800.
20.05.00	Drive manufacturer shall coordinate with the motor manufacturer for proper selection of the motor for the given load application and the output characteristics of the drive.
20.06.00	Other requirements of motor shall be as stipulated in technical chapter of Motors and driven equipment in Part-B of technical specifications.
21.00.00 .	**LT & HT CABLES**
21.01.00	Contractor's scope shall also include LT and HT cables suitable for VFD system and Motors.
22.00.00	**CONTROL AND PERFORMANCE REQUIREMENTS**
22.01.00	The VFD to provide an automatic current limiting feature to control motor currents during startup and provide a "soft start" torque profile for the motor load combination. Current and torque limit adjustments shall be provided to limit the maximum VFD output current and the maximum torque produced by the motor.
22.02.00	It shall be possible to vary the speed of the drive and control it in either Local or Remote mode. Local / Remote selection shall be done from VFD panel unless otherwise specified.
22.03.00	Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS. Man machine interface for (MV) VFD shall have one flat TFT monitor with keyboard (password protected) in the VFD room and a color laser printer for system alarm and monitoring located in control room. Parameter Monitoring: -Input and output voltage of Drive - Input and output current of Drive - Motor speed - Input and output power frequency of Drive - Torque -Input and Output power of Drive system (covering transformer if applicable) - Output kWhr of Drive - Transformer (if applicable) temperature for alarm & trip. - Ambient temperature - Run/stop and local/remote status displayed

22.04.00	Drive shall be equipped with a front mounted operator console panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter. Control panel shall be operable with password for changing the protection setting, safety interlock etc.
22.05.00	Operator console/Main Control Card shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another drive for start up and operation.
22.06.00	User-friendly licensed software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.
23.00.00	**PROTECTION FEATURES**
23.01.00	The system offered shall incorporate adequate protection features as per IEC 61800-4: 2002 Table-8, properly coordinated for the drive control and for motor including following: i) Converter transformer: short circuit, over current, earth fault & winding temperature high protection. ii) Incoming and outgoing line surge protection. iii) Under / over voltage protection iv) Phase loss, phase reversal, overload, negative phase sequence, locked rotor protection. v) Instantaneous Over current & Earth fault protection vi) Converter/Inverter module failure indication. vii) Over frequency/speed protection. viii) Ventilation failure indication & alarm. ix) Over temperature of VFD x) Bearing temperature protection. xi) System earth fault protection. xii) Speed reference loss protection.
23.02.00	Under VFD Bypass Mode (if applicable) all the electrical protections related to the Motor shall remain applicable.
24.00.00	**CONTROL FEATURES**
24.01.00	Following controls shall be provided as a part of the Operator Control Panel or through separate switches on the front panel door. i) Start / stop (in local/remote mode) ii) Speed control (Raise / lower)

iii) Acknowledge/Accept/ Test Push Button for annunciation

iv) Auto / Manual / Test Mode select

v) Emergency stop

vi) Trip-Remote Breaker

25.00.00 **DIAGNOSTIC FEATURES**

25.01.00 The VFD shall include a microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

25.02.00 Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available. It shall be possible to retrieve the record of events prior to tripping of the system or de-energization. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose.

26.00.00 **SERVICEABILITY / MAINTAINABILITY**

26.01.00 Power Component Accessibility: All power components in the converter sections shall be designed for rack-out accessibility for ease of maintenance and to minimize repair downtime.

26.02.00 Marking / Labeling: Sleeve type wire marker tags or other acceptable means of permanent identification shall be applied to power and control wiring. Individual labels shall be provided for all major components of the VFD system.

27.00.00 **NOT USED**

28.00.00 **TESTS**

28.01.00 **ROUTINE TESTS**

All acceptance and routine tests as envisaged in QA section shall be carried out. Charges for these shall be deemed to be included in the equipment price.

28.02.00 **TYPE TESTS**

LIST OF TYPE TESTS TO BE CONDUCTED

The following type tests shall be conducted under this contract for MV VFD

i) Overall efficiency determination of VFD system including transformer/ Harmonic filters etc at motor full load
ii) Temperature rise test
iii) Noise level
iv) Harmonics of No load current.(Input/Output)

LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

The following type test reports shall be submitted for VFD Panels'

1) VFD panels (For LV VFD used with load >= 50 KW)

i. Rated Current/ Output

ii. Temperature rise test

iii. Noise level test

iv. Power Loss Determination Test

v. Power factor measurement.

vi. Degree of Protection Test

vii. EMC Test

viii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800

2) VFD panels (For MV VFD)

i. Rated Current/ Output

ii. Current Sharing

iii. Voltage Division

iv. Power Loss Determination Test

v. Power factor measurement.

vi. Degree of Protection Test

vii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800

3) AC/DC Reactor

i. Lightning impulse test(If applicable)

ii. Heat run test

iii. Short time current test(If applicable)

iv. Noise level test

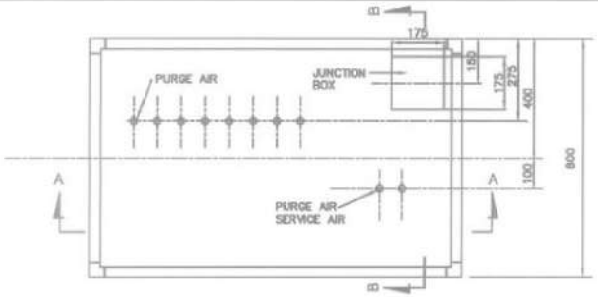
4) Transformers (for Non Integrated type)

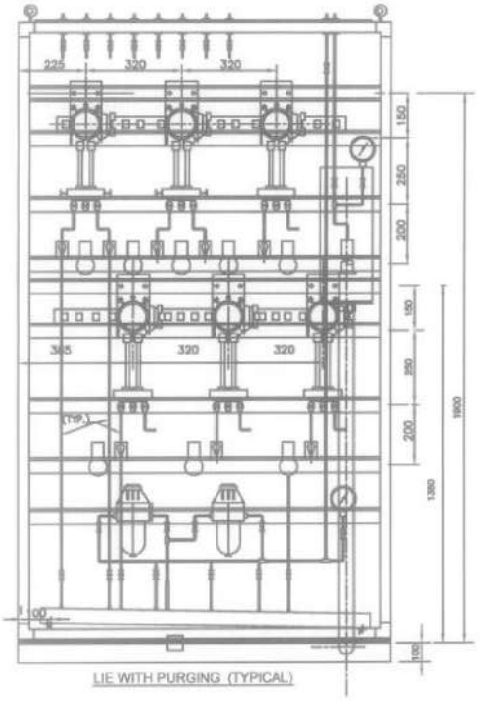
i. As per requirements mentioned in subsection for Transformer chapter in technical specifications.

PROVENESS CRITERIA

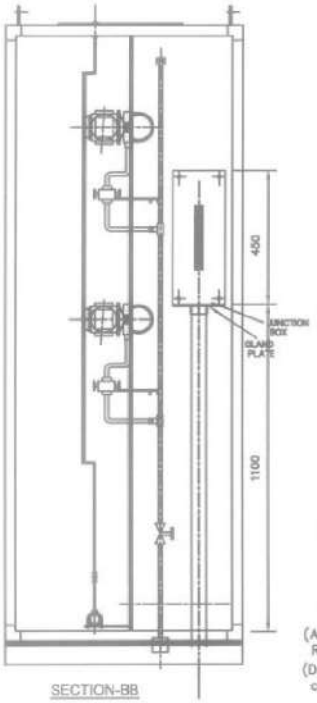
5.00.00 **INSTRUMENTS (PRIMARY & SECONDARY)**

(i)	Type of Instrument	
(ii)	Make / Model	
(iii)	Name of Power Station (Location & Address)	
(iv)	Unit Size (MW)	
(v)	Commissioning date	
	Whether above instruments have atleast one (1) year satisfactory operation in one (1) power station having unit rating of 200 MW or above.	Yes/No
(vi)	Client's certificate attached	Yes/No





LIE WITH PURGING (TYPICAL)



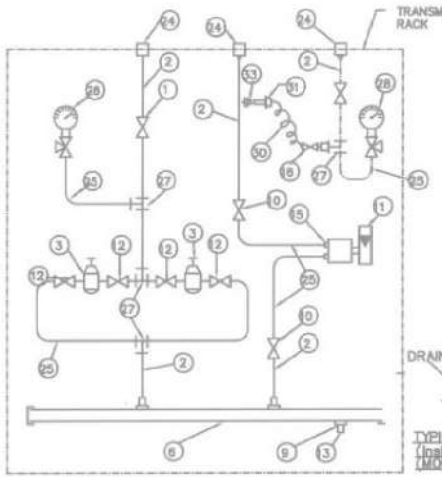
SECTION-BB

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	ISOLATION VALVE(gate/globe). SS.
2.	SEAMLESS SS PIPE.
3.	AIR FILTER REGULATOR.
6.	INST. AIR HEADER SS.
10.	COMP. NEEDLE VALVE SS.
11.	AIR PURGE SET.
12.	COMP VALVE SS.
13.	PLUG SS.
15.	TUBE SS CONNECTOR.
16.	TUBE COMP. EQUAL TEE UNION.
24.	BULKHEAD--SS SUITABLE FOR GI PIPE CONNECTION
25.	SEAMLESS TUBE SS.
27.	BRANCH TEE SS.
28.	PR. GAUGE.
30.	NYLON FLEX. HOSE BRAIDED WITH SS WIRE.
31.	HOSE BARBED CONN. SS.
33.	QUICK DISCONNECT SS (PURGE AIR CONNECTION TO INSTRUMENT SOURCE END).

LIST OF MATERIALS

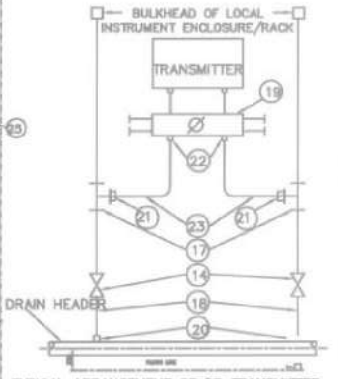
ITEM NO.	DESCRIPTION
14.	SW GLOBE VALVE.
17.	SW EQUAL TEE
18.	S.S. NIPPLE
19.	5 VALVE MANIFOLD
20.	SW HALF COUPLET CS
21.	PIPE x TUBE UNION
22.	SUITABLE ADAPTER
23.	SS TUBE



TYPICAL PURGE AIR CONNECTION INSIDE THE INST. ENCLOSURE

(APPLICABLE FOR MILL, AIR & FLUE GAS SERVICE INSTRUMENTS REQUIRING PURGE AIR)

(Drain Header of each LIE/LIR shall be connected to nearest plant drain)



TYPICAL ARRANGEMENT OF DP TRANSMITTER (Inside LIE/LIR) (MOUNTED BELOW INSTRUMENT SOURCE POINT)

FOR TENDER PURPOSE ONLY

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT (TURNKEY EPC PACKAGE)

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE, PURGING SCHEME, DP TRANSMITTER

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	GM	ARCH.	APPD	DATE
A	FIRST ISSUE										02.02.11

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SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-036	A

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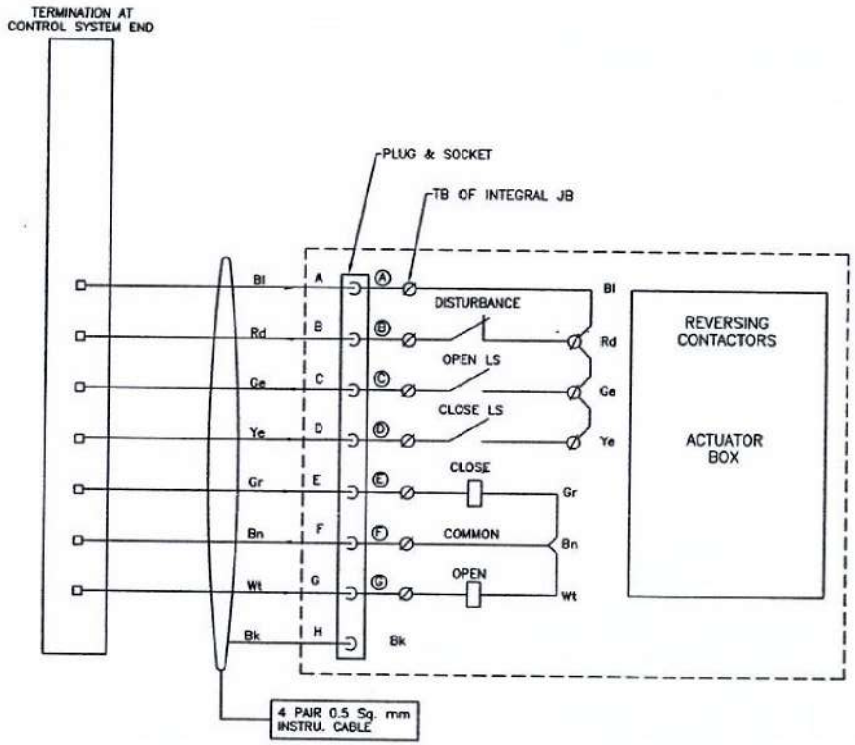

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF ACTUATORS

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										28.04.06

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SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-063	A

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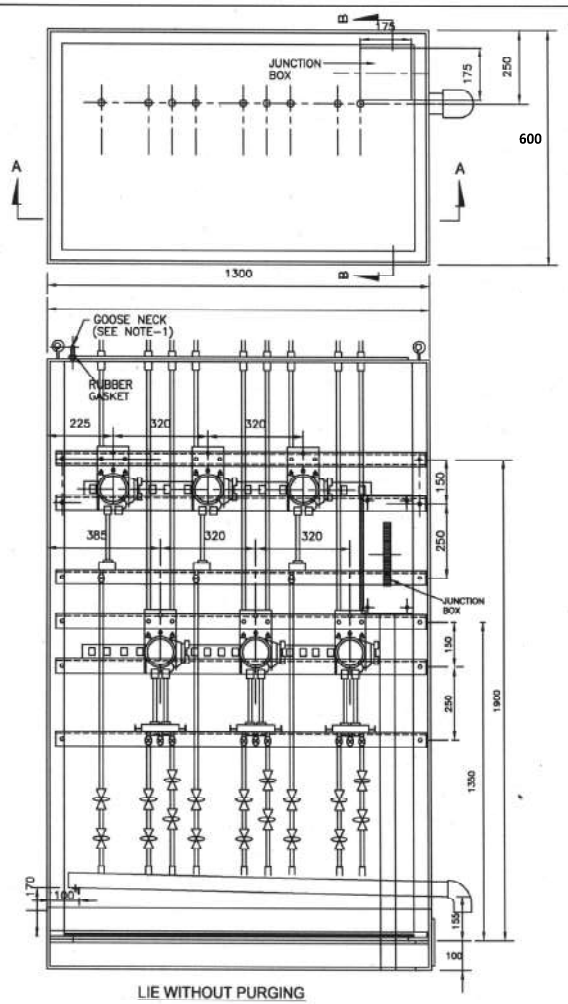
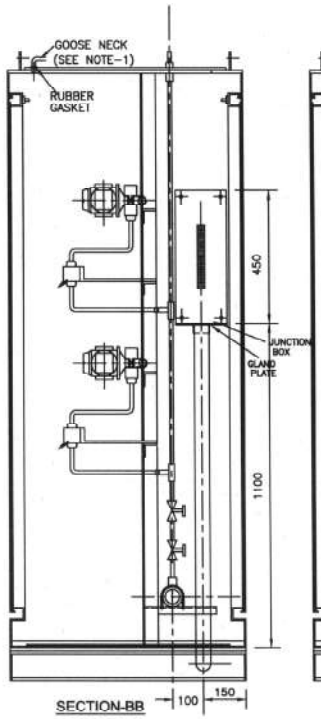
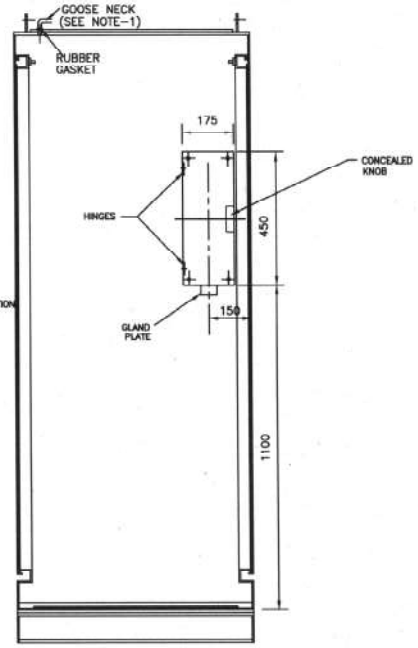


LIE WITHOUT PURGING



SECTION-BB



SIDE ELEVATION

NOTES:-

1. TO BE PROVIDED FOR LIEs USED IN STEAM & WATER APPLICATION.
2. MATERIAL OF JBs FOR LIEs SHALL BE SAME AS THAT OF LIE.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE			T.G.							21.08.12

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ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-064 SHEET 01 OF 03	B

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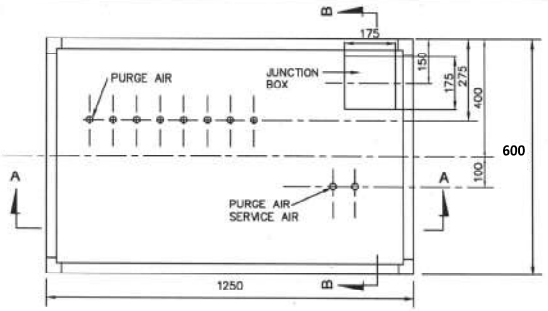
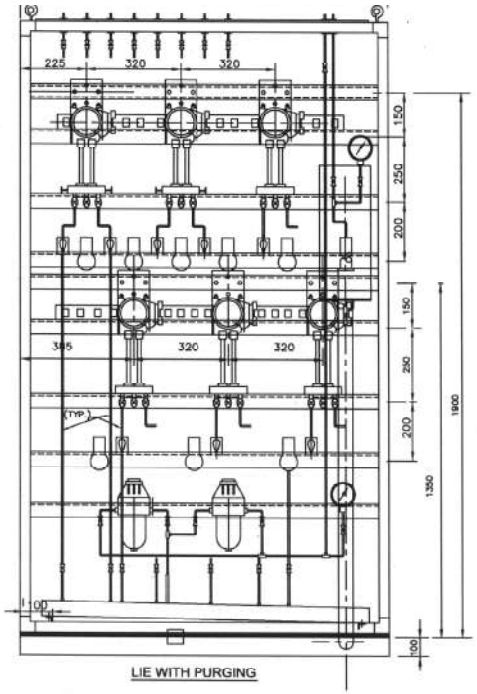
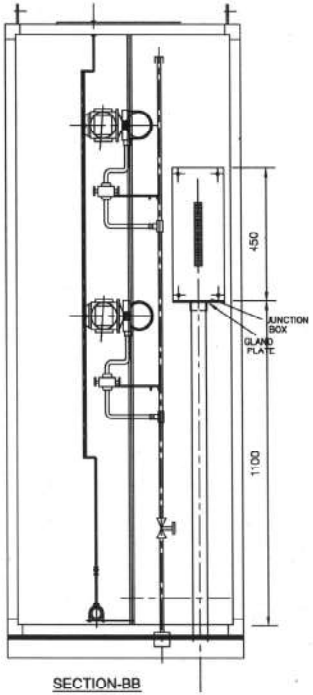




LIE WITH PURGING



SECTION-BB

NOTES:-

1. MATERIAL OF JBs FOR LIEs SHALL BE SAME AS THAT OF LIE.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			19.04.12

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NTPC — N T P C LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-064 SH- 02 OF 03	B

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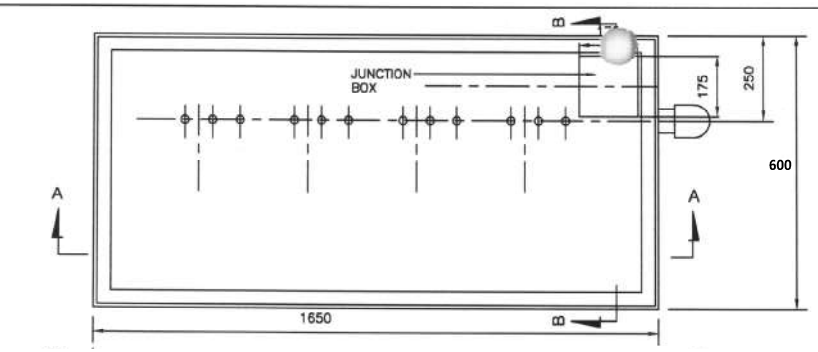
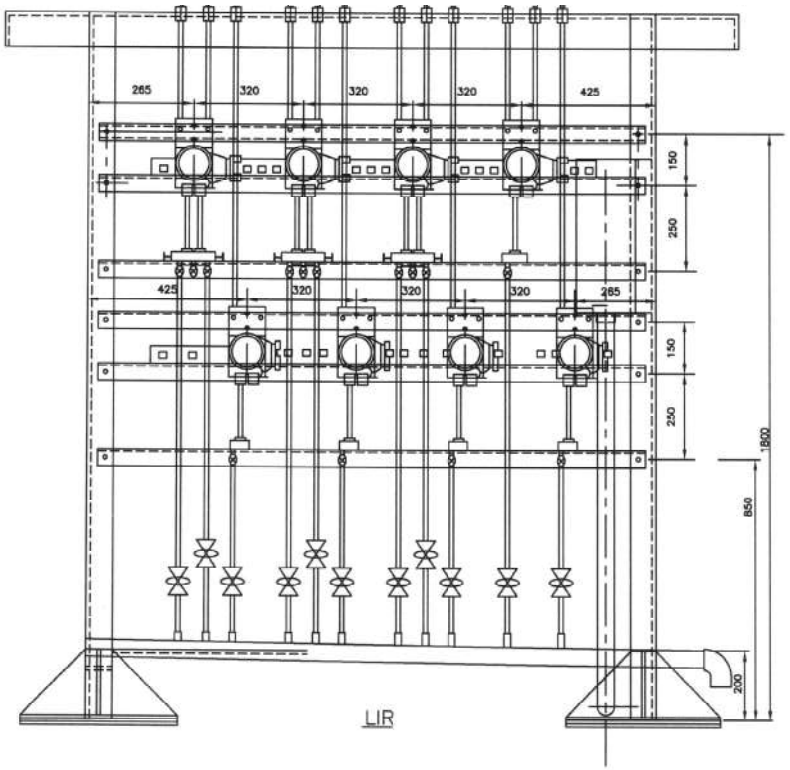
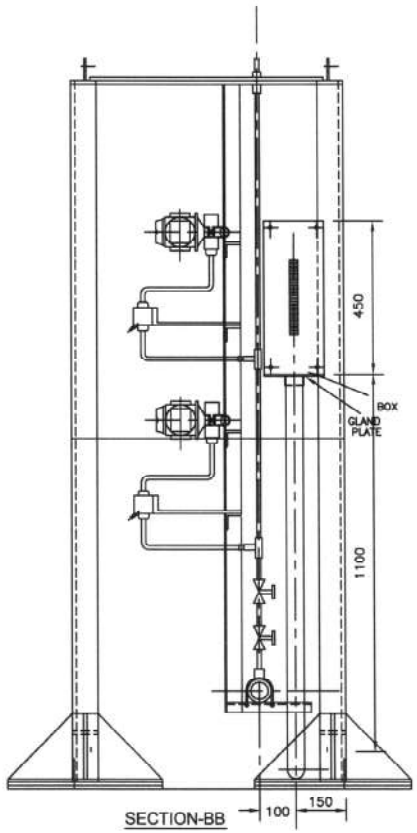




LIR



SECTION-BB

NOTE:-

1. MATERIAL OF JBs FOR LIRs SHALL BE SAME AS THAT OF LIR.

SECTION-AA
LIR WITHOUT PURGING

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ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

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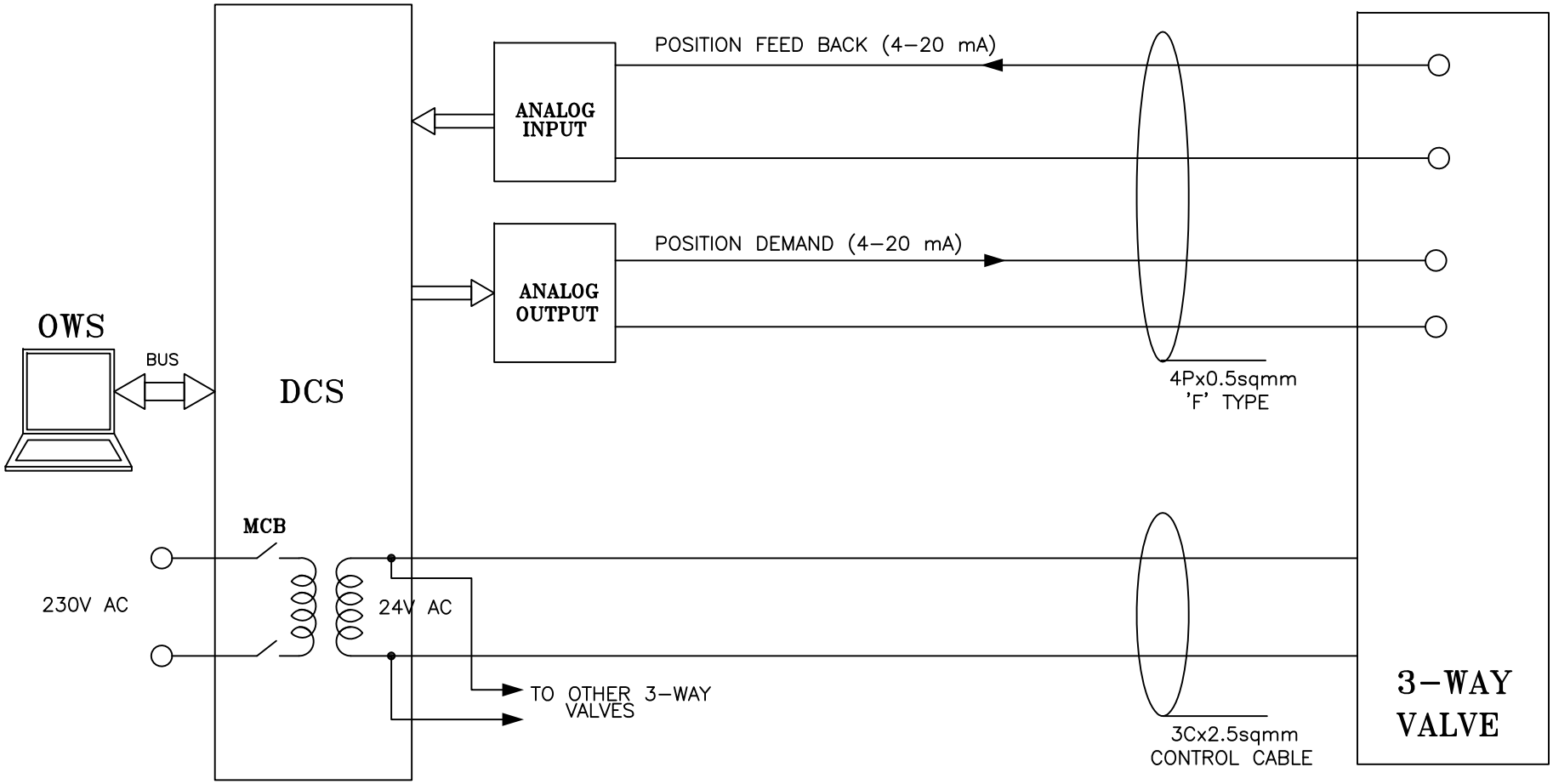
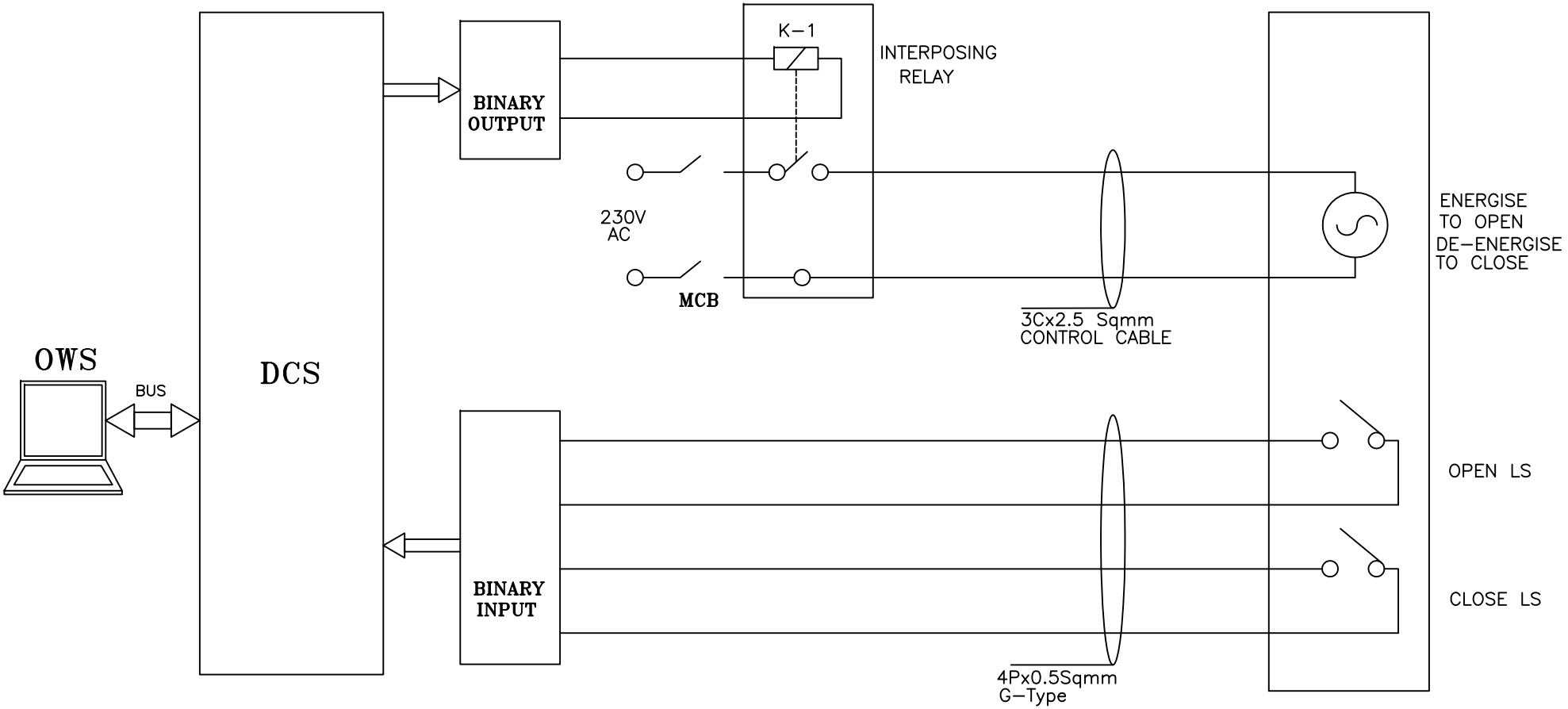
PROJECT	TITLE	SIZE	SCALE	DRG. NO.	REV. NO.
TYPICAL THERMAL POWER PROJECT	TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK	A3	N.T.S.	0000-999-POI-A-064 SH- 03 OF 03	A

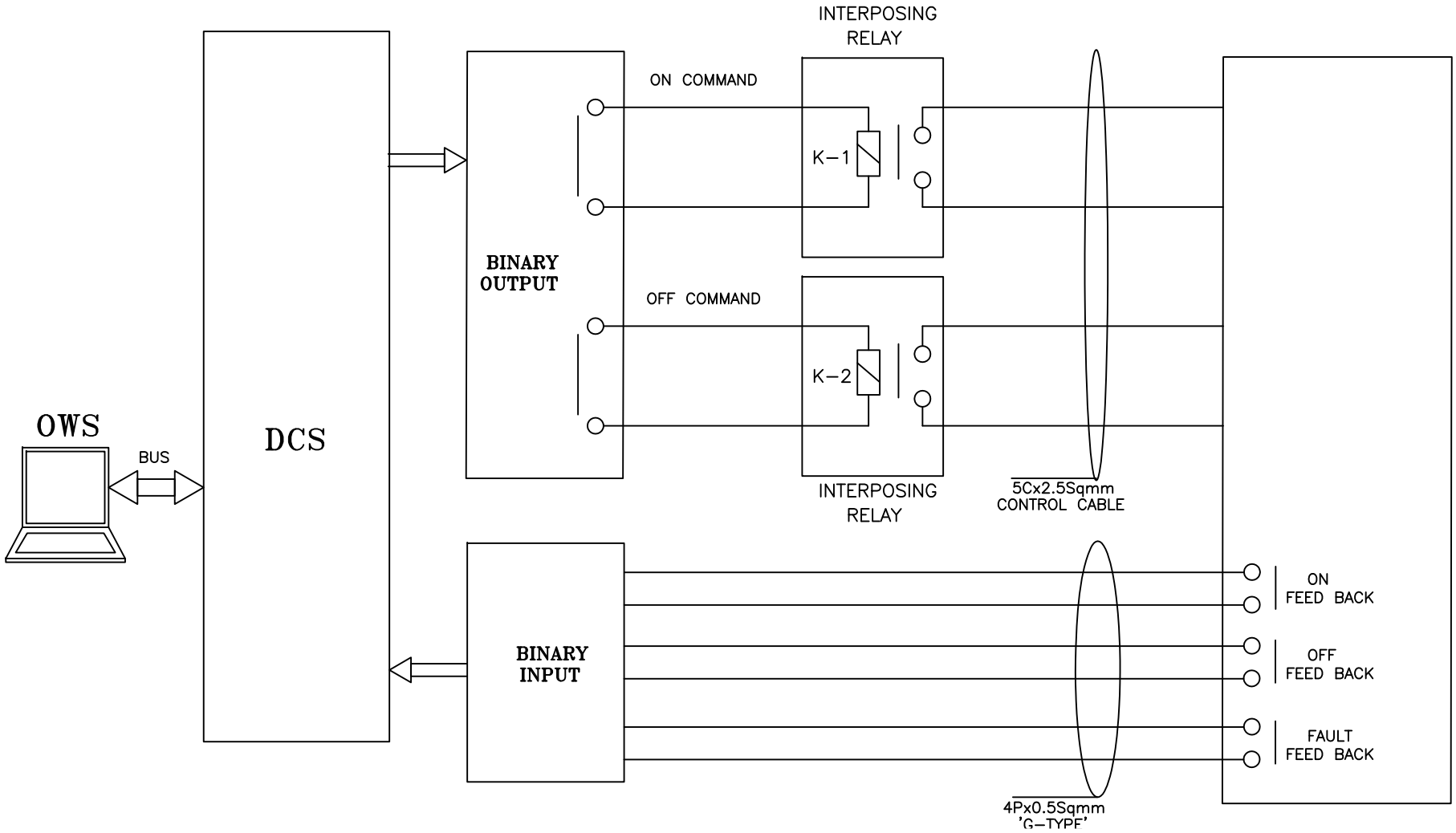
DCS INTERFACE FOR 3-WAY MIXING VALVE (MOD-AC)



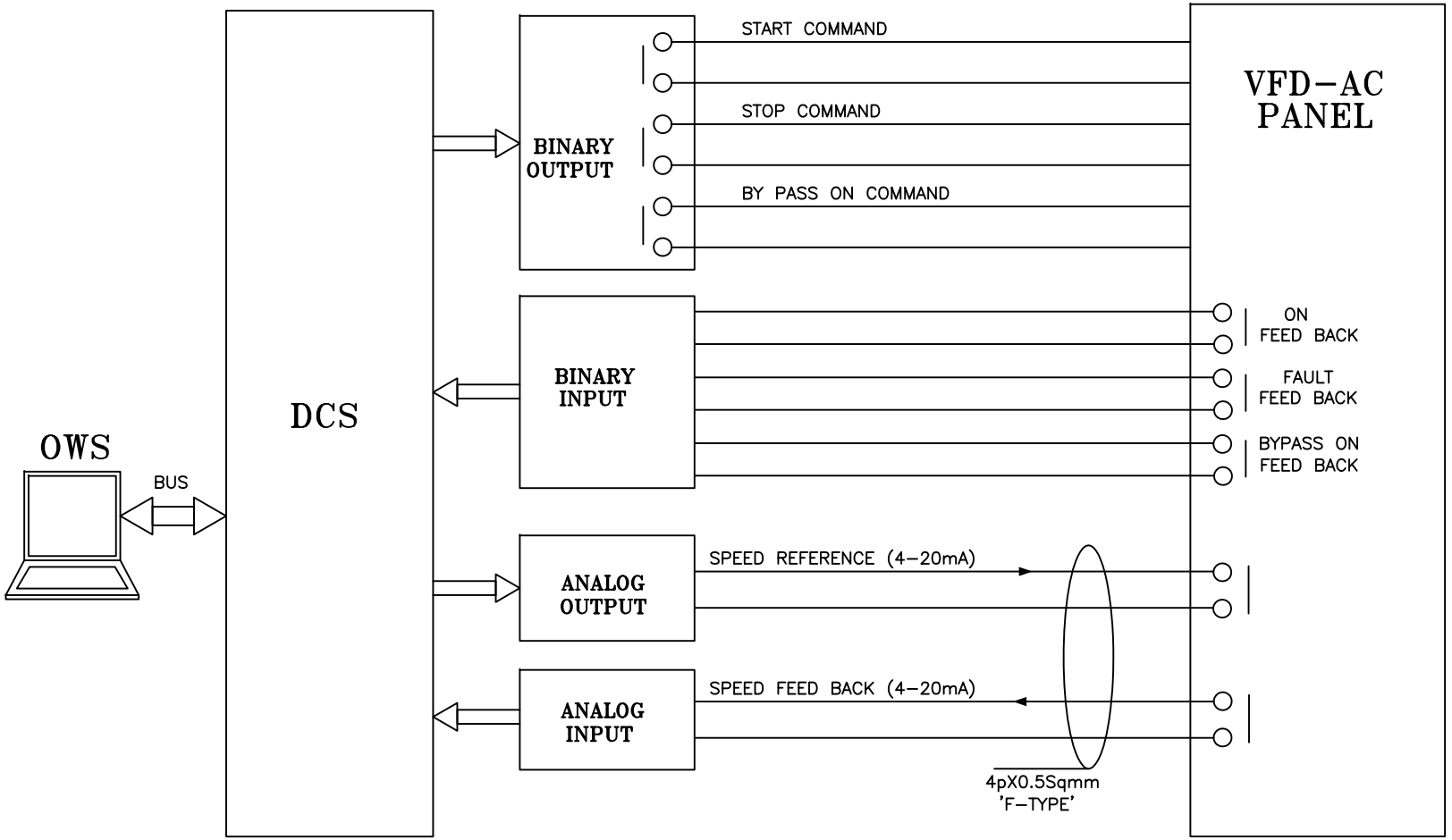
DCS INTERFACE FOR MOTORIZED OPERATED FIRE DAMPER (BID–FD)



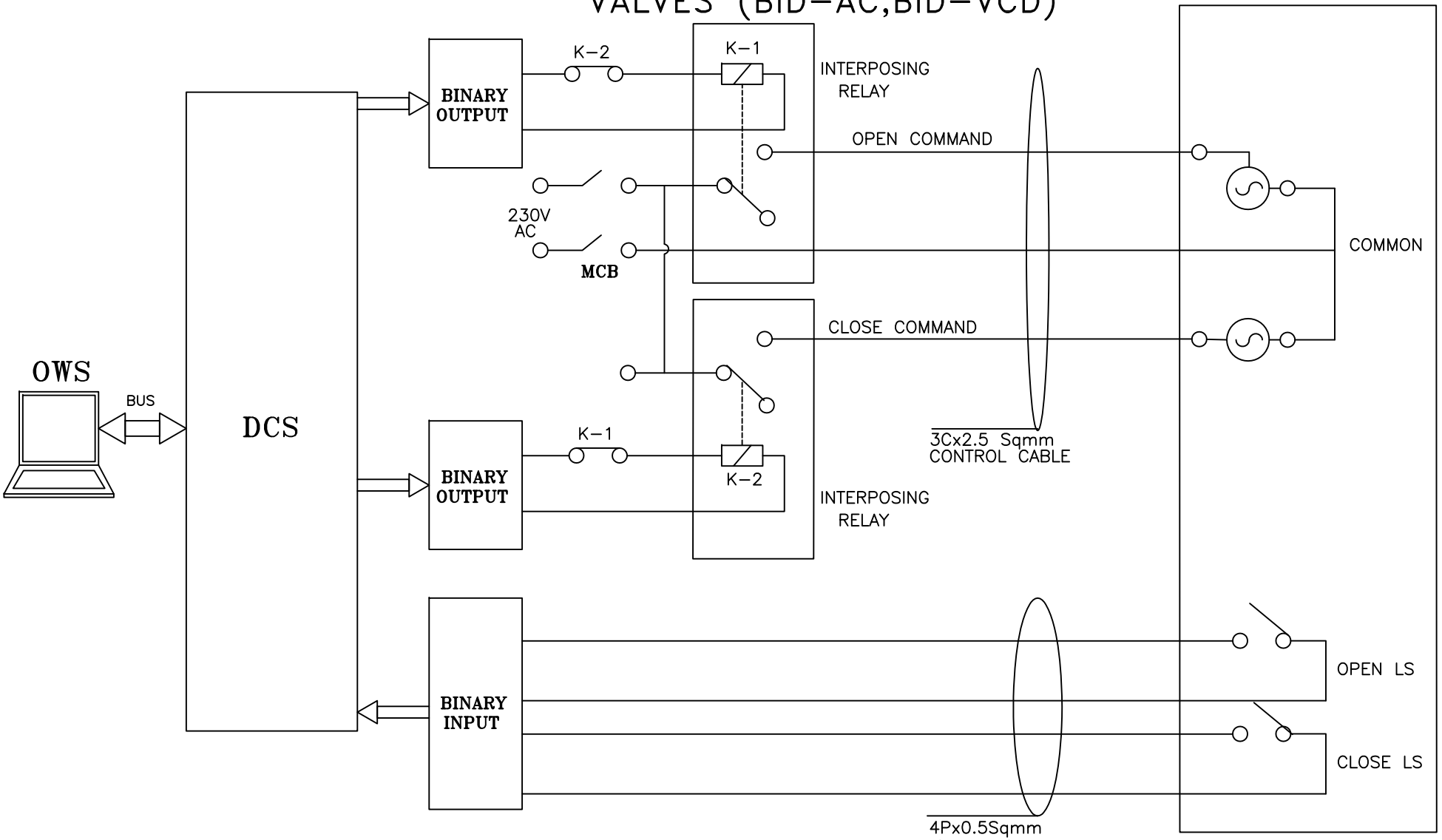
HOOK–UP DIAGRAM FOR **ACCU/SCREW CHILLER/PAC**



DCS INTERFACE FOR AHUs VFD(VFD-AC)



DCS INTERFACE FOR MOTORIZED OPERATED VALVES (BID-AC,BID-VCD)



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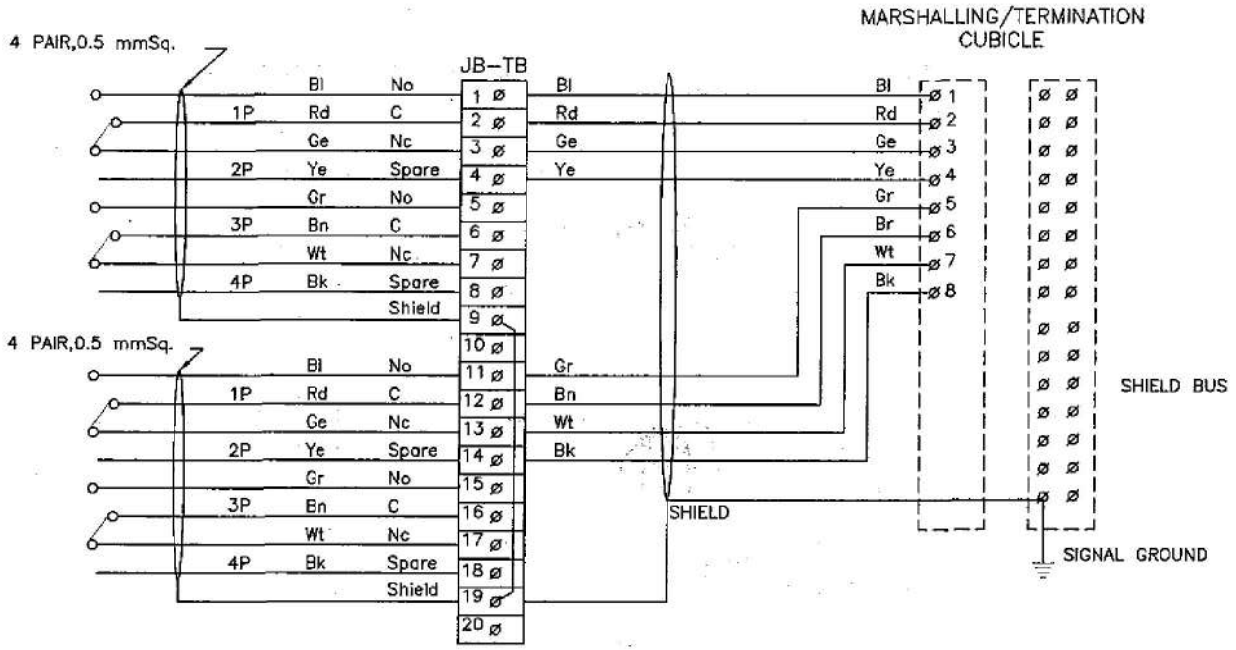

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NTPC LIMITED
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ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS/ SWGR SWITCH (COC) TERMINATION DETAILS

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

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SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 01 OF 14	A

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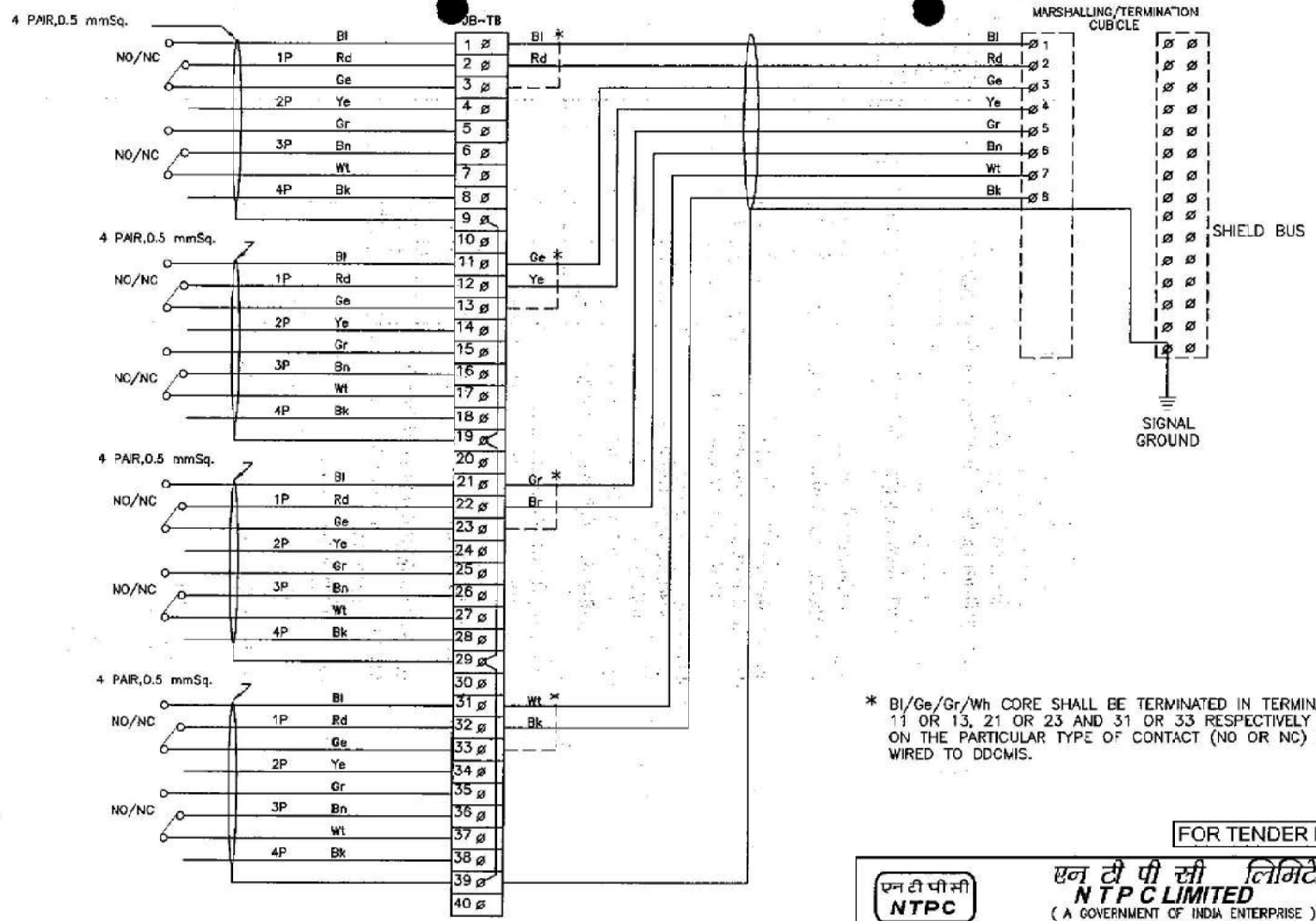

* Bl/Ge/Gr/Wh CORE SHALL BE TERMINATED IN TERMINAL 1 OR 3, 11 OR 13, 21 OR 23 AND 31 OR 33 RESPECTIVELY DEPENDING ON THE PARTICULAR TYPE OF CONTACT (NO OR NC) IS TO BE WIRED TO DDCMIS.

FOR TENDER PURPOSE ONLY

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
SWITCH TERMINATION DETAILS
NO/NC

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

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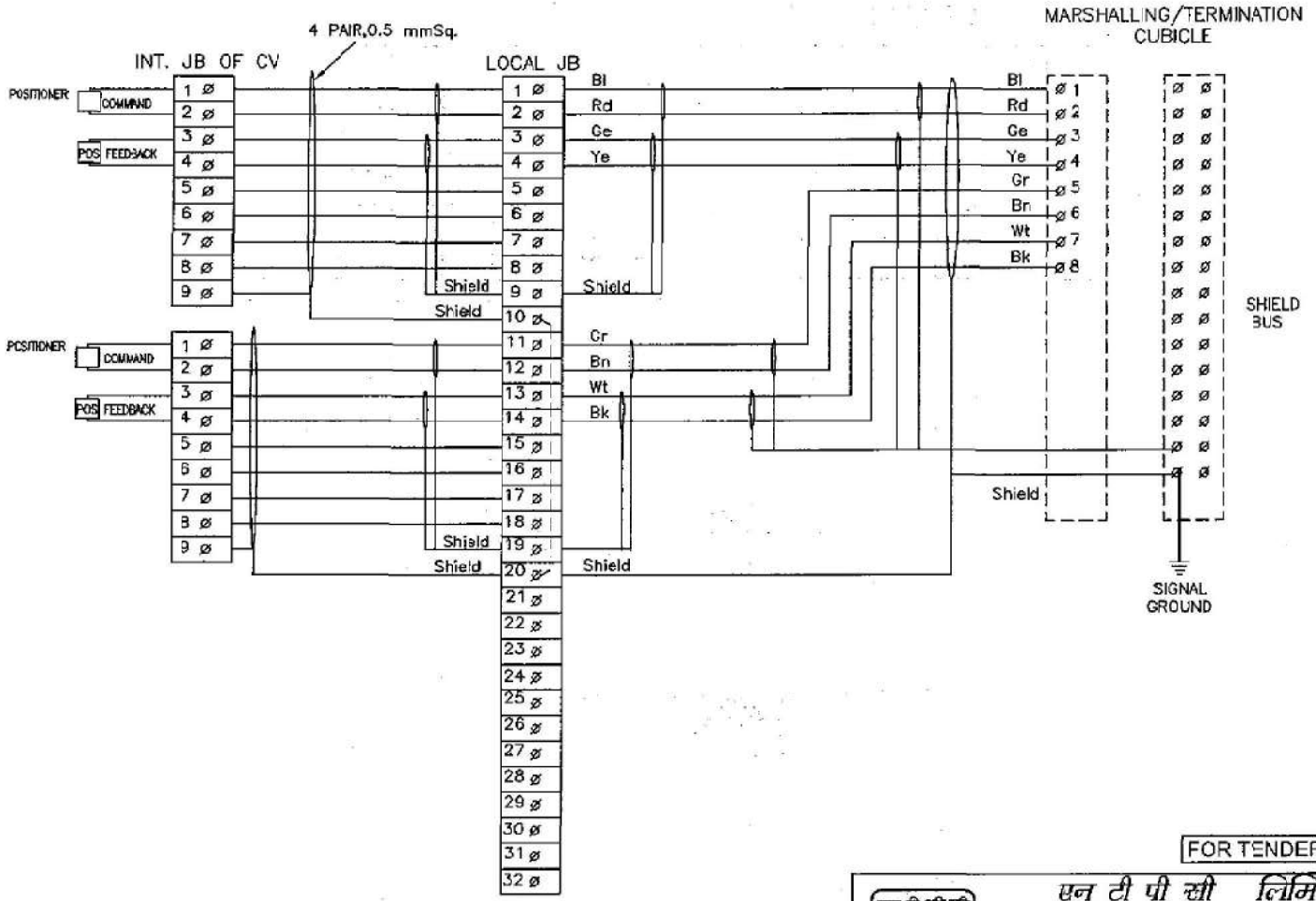
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 02 OF 14	A



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ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS CONTROL VALVE

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 03 OF 14	A

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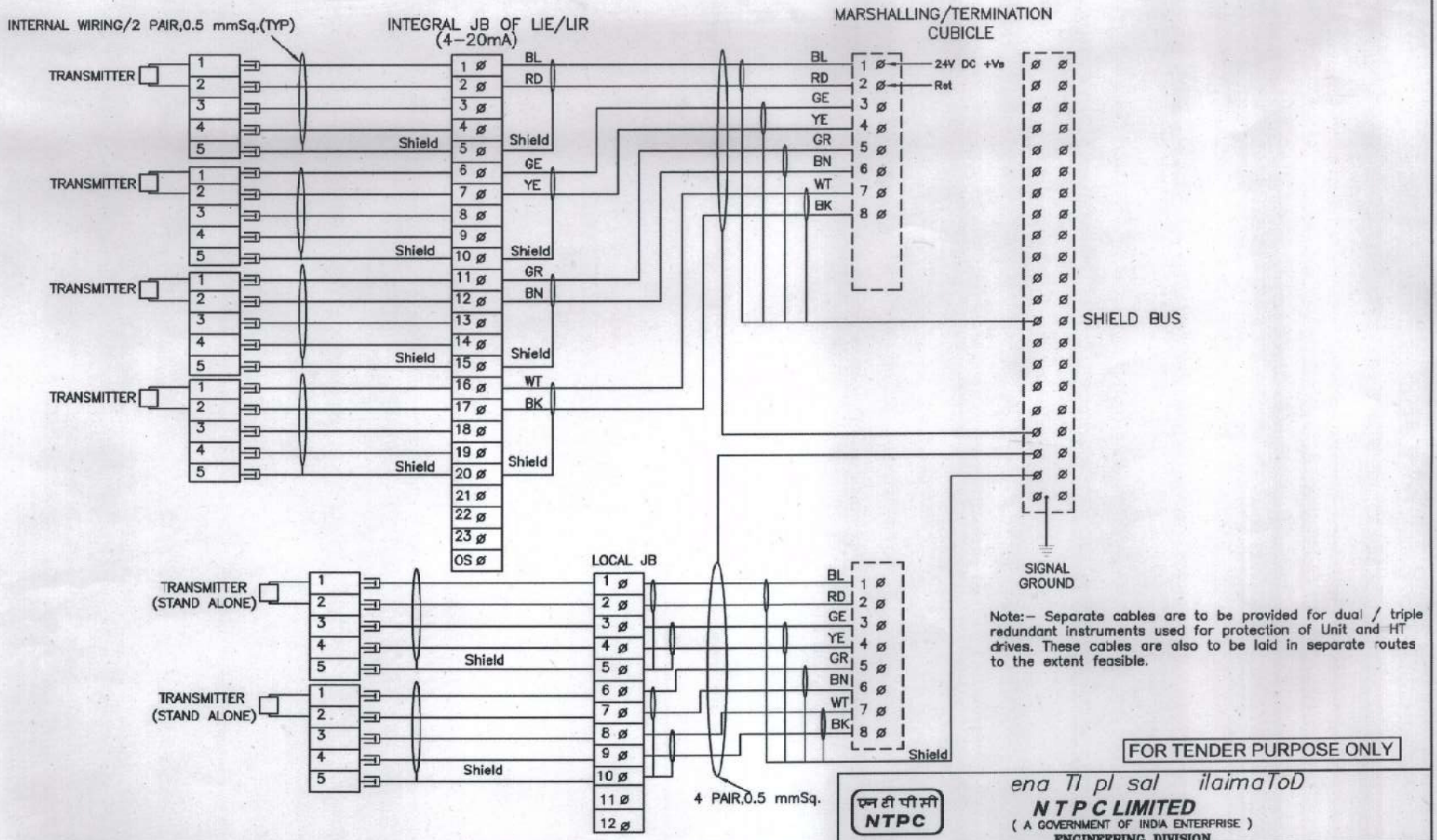

Note:– Separate cables are to be provided for dual / triple redundant instruments used for protection of Unit and HT drives. These cables are also to be laid in separate routes to the extent feasible.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
C	NOTE REGARDING CABLE IS ADDED.										10.12.13
B	INTERNAL WIRING FOR LIE/LIR MOUNTED SHOWN WIRING OF STAND ALONE TXTR SHOWN										10.12.06
A	FIRST ISSUE										12.1.05
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS 4-20mA

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 04 OF 14	C

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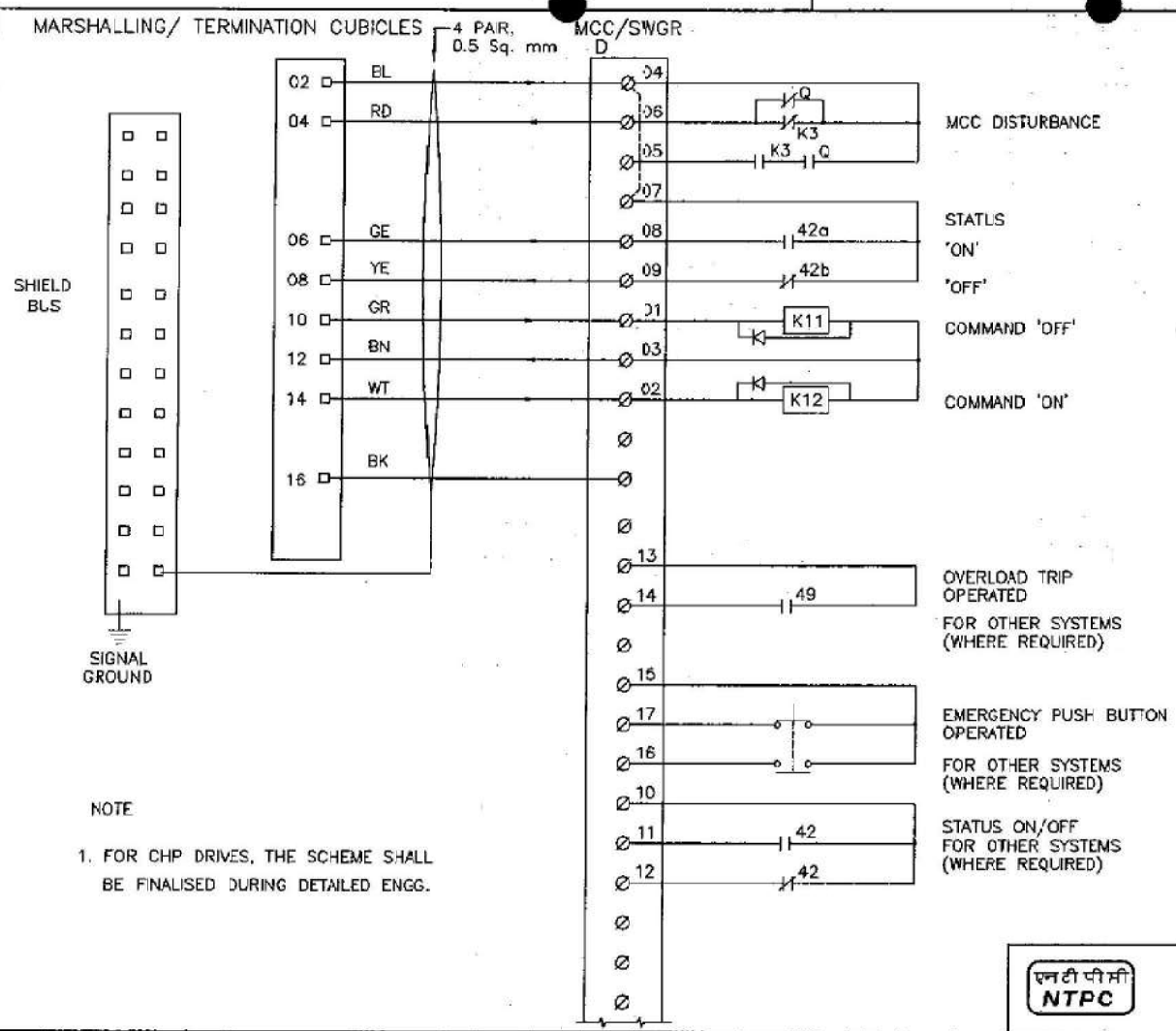

NOTE

1. FOR CHP DRIVES, THE SCHEME SHALL BE FINALISED DURING DETAILED ENGG.

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ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(LT MOTORS)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

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SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 05 OF 14	A

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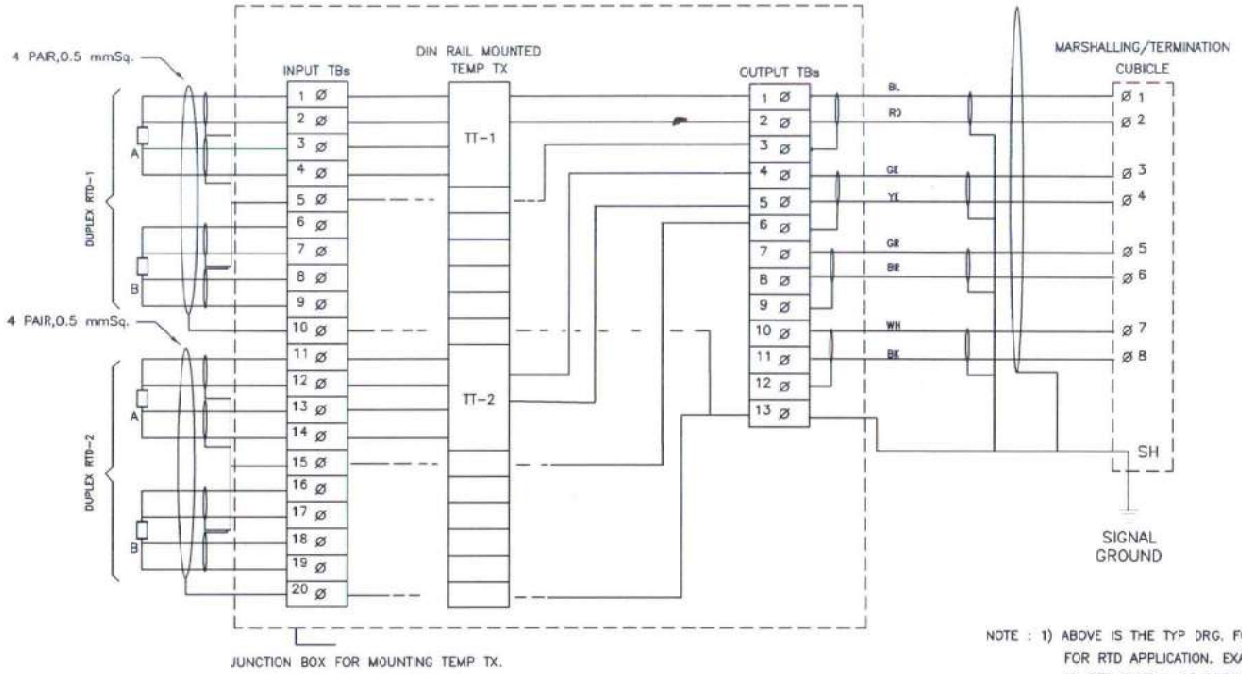

NOTE : 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTERS FOR RTD APPLICATION. EXACT TYPE OF TEMP TRANSMITTER SHALL BE AS PER PART-A OF SPECIFICATION.
2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

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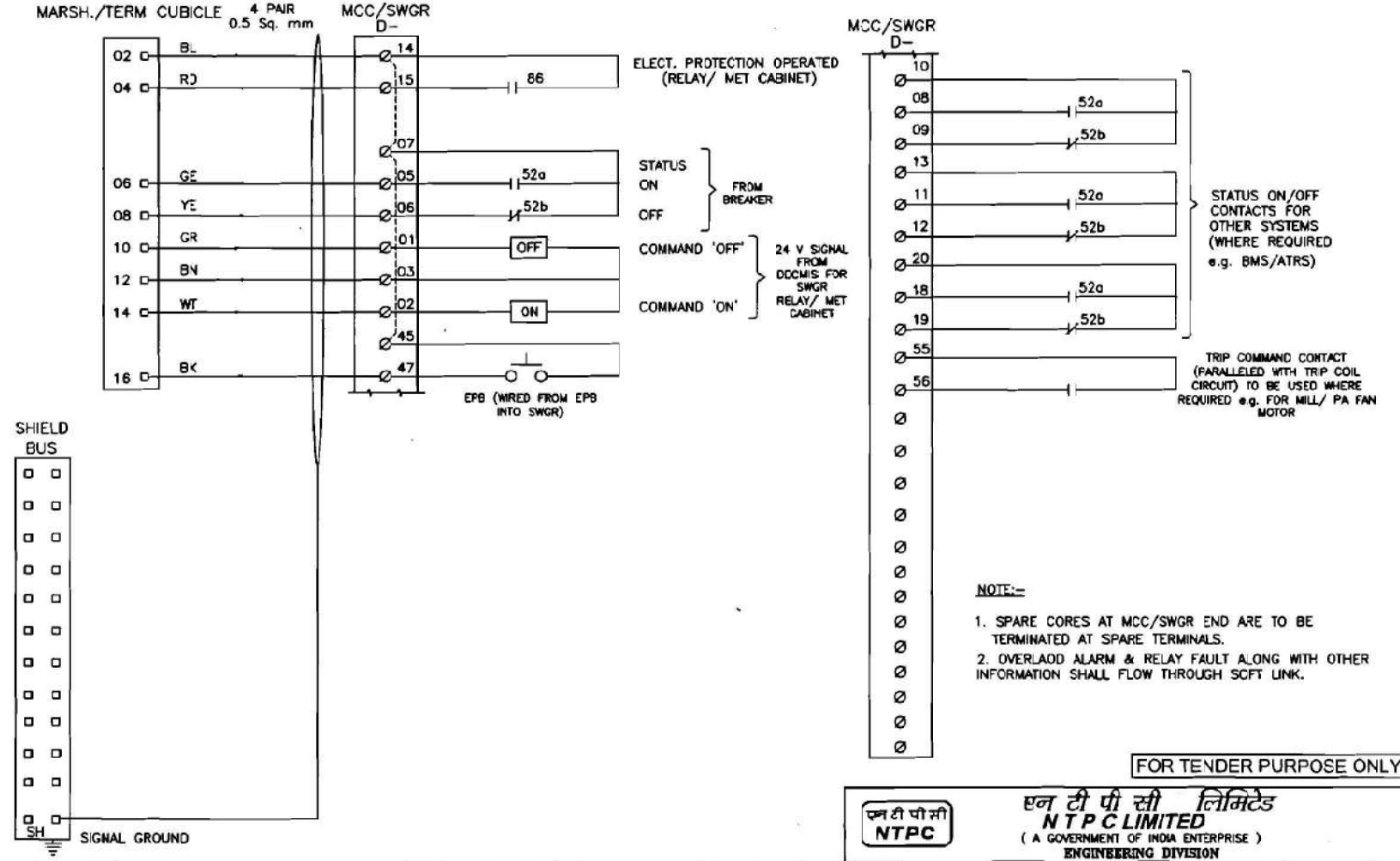
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS INJBs

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 06 OF 14	C



NOTE:-

1. SPARE CORES AT MCC/SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. OVERLAOD ALARM & RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.

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ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (HT MOTORS)

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	C	C&I	ARCH.	APPD	DATE
B	Revised for Numerical relay based SWGR									14.02.08

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SIZE	SCALE	ORG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 07 OF 14	B

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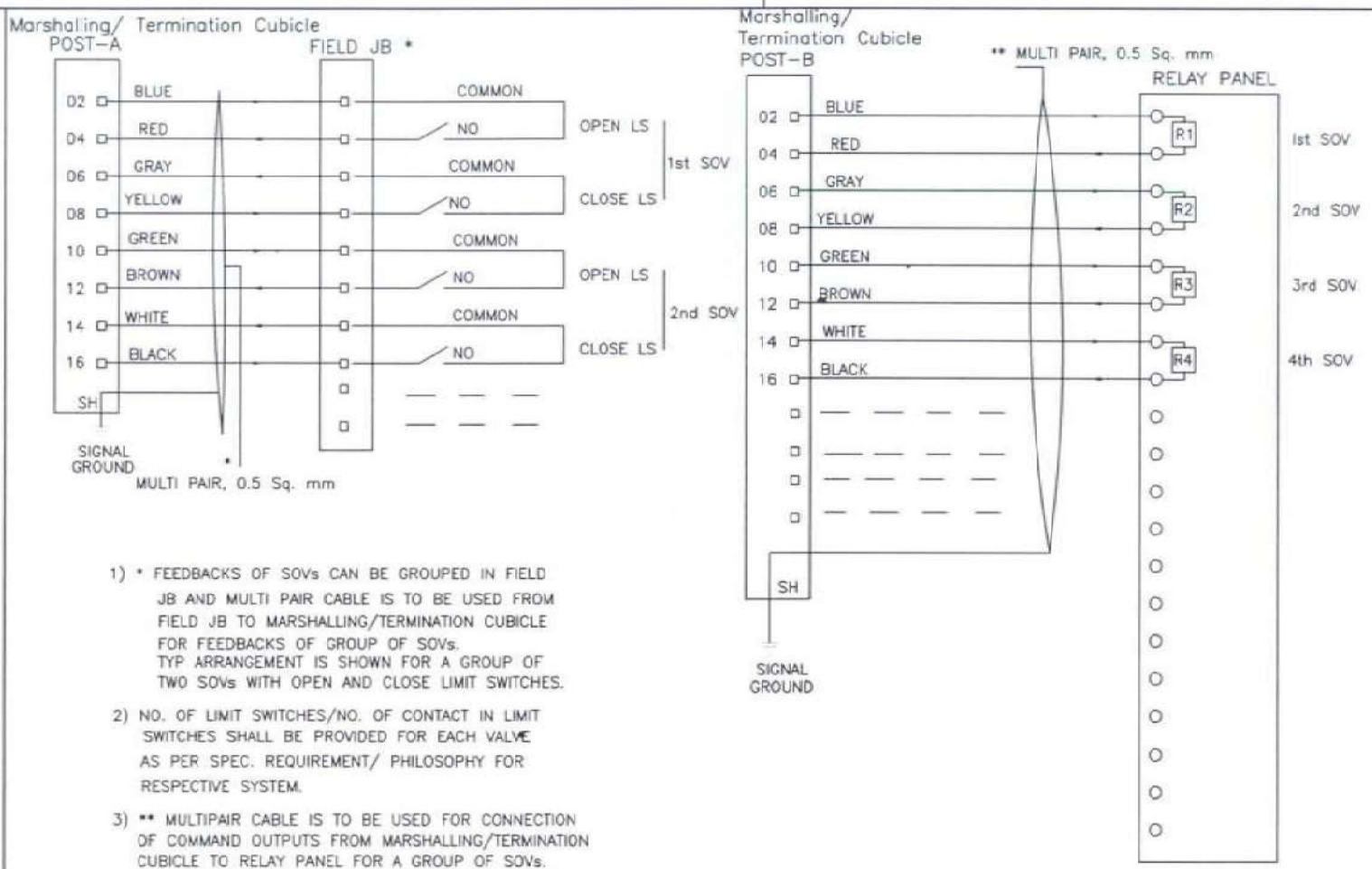

1) * FEEDBACKS OF SOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF SOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO SOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF SOVs.

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नेशनल थर्मल पावर कारपोरेशन लिमिटेड
National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(SINGLE COIL SOLENOID)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	FIRST ISSUE										30.10.02

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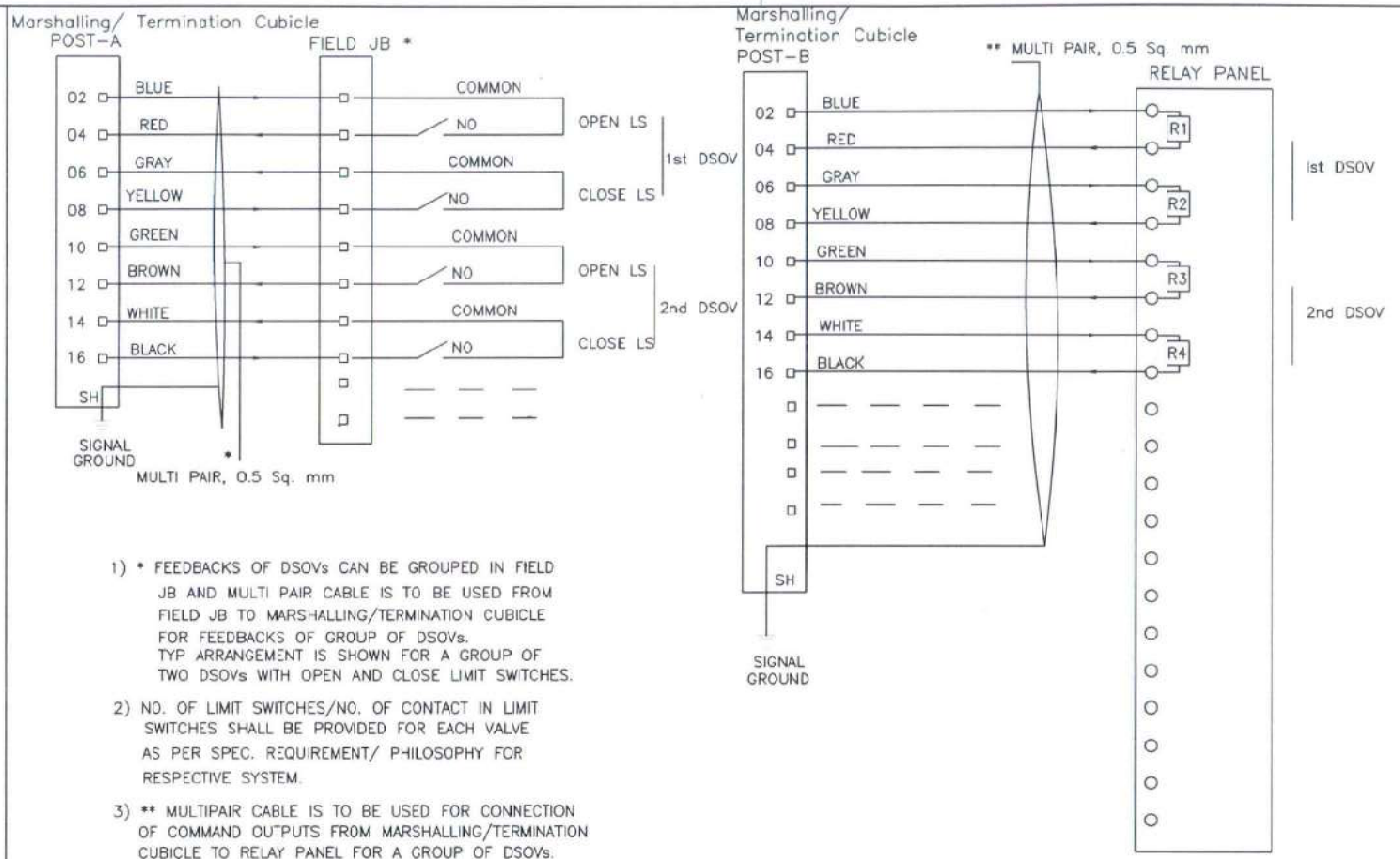
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 08 OF 14	C



1) * FEEDBACKS OF DSOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF DSOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO DSOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF DSOVs.

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ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	FIRST ISSUE										30.10.02

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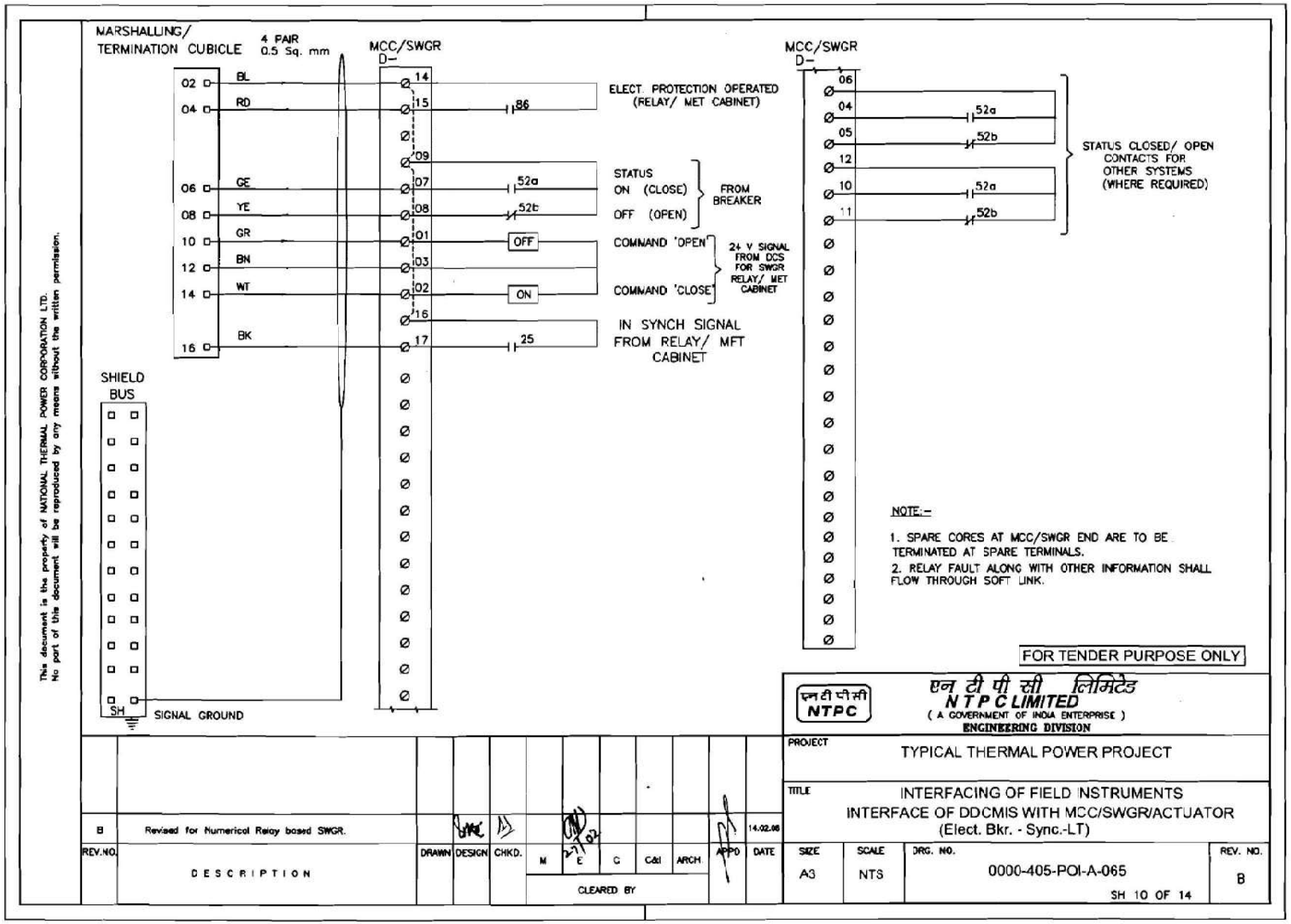
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(DOUBLE COIL SOLENOID)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 09 OF 14	C


MARSHALLING/
TERMINATION CUBICLE
4 PAIR
0.5 Sq. mm
MCC/SWGR
D–
02 BL
04 RD
06 GE
08 YE
10 GR
12 BN
14 WT
16 BK
14
15
09
07
08
01
03
02
16
17
86
52a
52b
OFF
ON
25
ELECT. PROTECTION OPERATED
(RELAY/ MET CABINET)
STATUS
ON (CLOSE)
OFF (OPEN)
FROM BREAKER
COMMAND 'OPEN'
COMMAND 'CLOSE'
24 V SIGNAL FROM DCS FOR SWGR RELAY/ MET CABINET
IN SYNCH SIGNAL FROM RELAY/ MFT CABINET
SHIELD BUS
SH
SIGNAL GROUND
MCC/SWGR
D–
06
04
05
12
10
11
52a
52b
STATUS CLOSED/ OPEN CONTACTS FOR OTHER SYSTEMS (WHERE REQUIRED)
NOTE:–
1. SPARE CORES AT MCC/SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.
FOR TENDER PURPOSE ONLY
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(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(Elect. Bkr. - Sync.-LT)
SIZE A3
SCALE NTS
DRG. NO. 0000-405-POI-A-065
SH 10 OF 14
REV. NO. B
B
Revised for Numerical Relay based SWGR.
14.02.06
REV.NO.
DESCRIPTION
DRAWN
DESIGN
CHKD.
M
E
C
Cdl
ARCH
APPD
DATE
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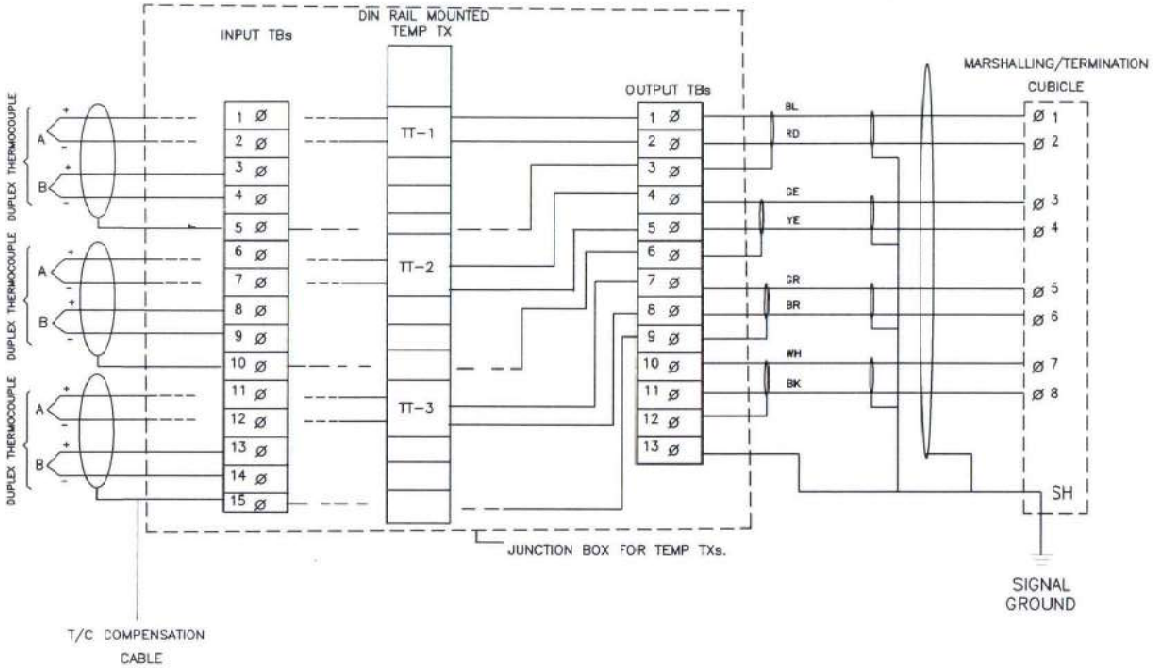

NOTE: 1) ABOVE S THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTER FOR T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.

2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

3) AFTER GLANDING OF T/C CABLES ON JB, THE CABLE PAIR OF FIRST ELEMENT WILL BE DIRECTLY CONNECTED TO TT AND FOR CABLE PAIR OF SECOND ELEMENT LOOP SHALL BE KEPT, BEFORE TERMINATION AT INPUT TBs FOR FUTURE USE.

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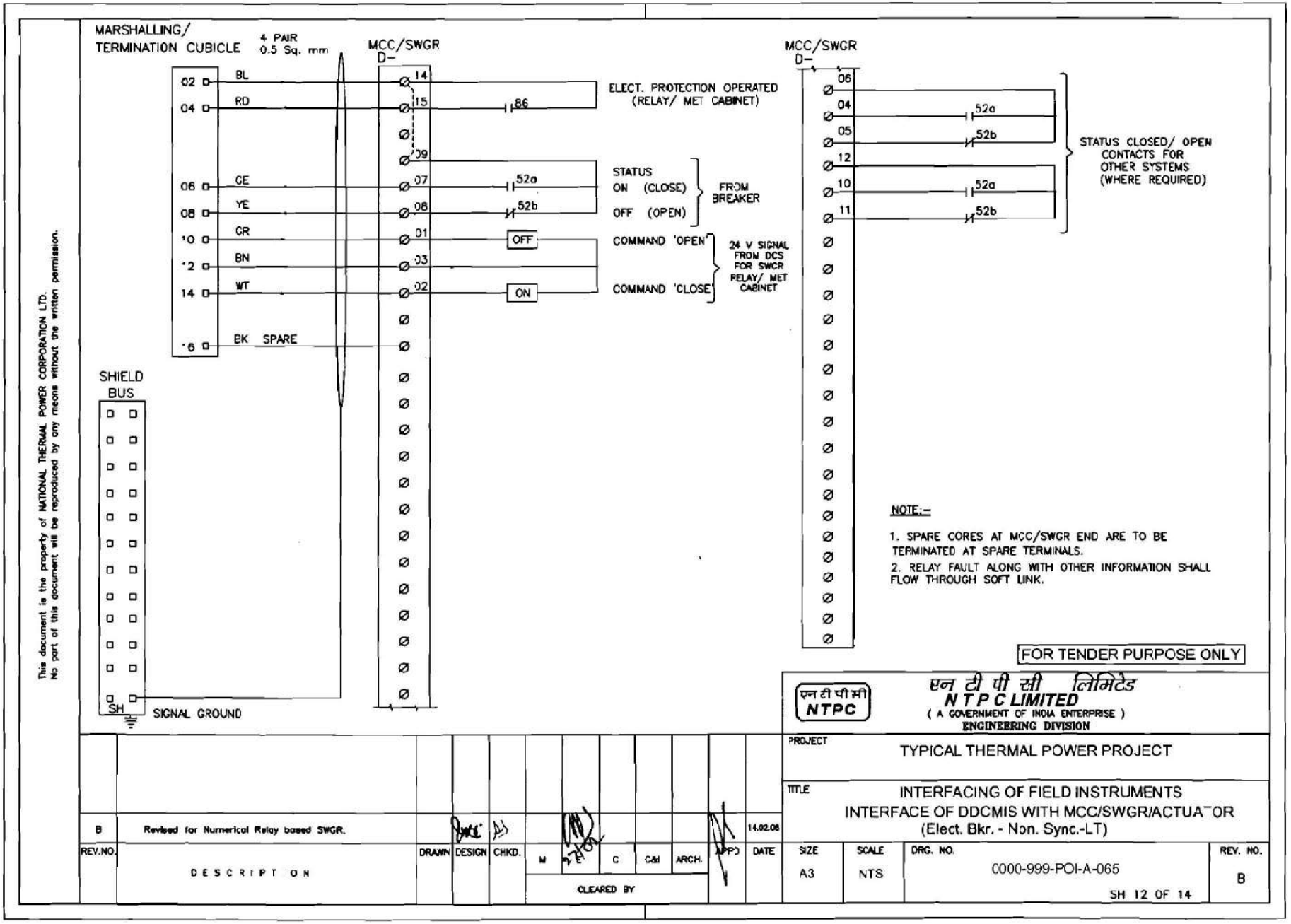
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

CLEARED BY

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
TYPICAL T/C CONNECTION WITH TEMP TXs IN JBs

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 11 OF 14	C


MARSHALLING/
TERMINATION CUBICLE
4 PAIR
0.5 Sq. mm
MCC/SWGR
D-
02 BL
04 RD
06 GE
08 YE
10 GR
12 BN
14 WT
16 BK SPARE
14
15
09
07
08
01
03
02
86
52a
52b
OFF
ON
ELECT. PROTECTION OPERATED
(RELAY/ MET CABINET)
STATUS
ON (CLOSE)
OFF (OPEN)
FROM BREAKER
COMMAND 'OPEN'
COMMAND 'CLOSE'
24 V SIGNAL FROM DCS FOR SWGR RELAY/ MET CABINET
MCC/SWGR
D-
06
04
05
12
10
11
52a
52b
STATUS CLOSED/ OPEN CONTACTS FOR OTHER SYSTEMS (WHERE REQUIRED)
SHIELD
BUS
SH
SIGNAL GROUND
NOTE:-
1. SPARE CORES AT MCC/SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.
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(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(Elect. Bkr. - Non. Sync.-LT)
B
Revised for Numerical Relay based SWGR.
14.02.08
REV.NO.
DESCRIPTION
DRAWN
DESIGN
CHKD.
M
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C
C&I
ARCH.
APPD
DATE
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SIZE
A3
SCALE
NTS
DRG. NO.
C000-999-POI-A-065
SH 12 OF 14
REV. NO.
B
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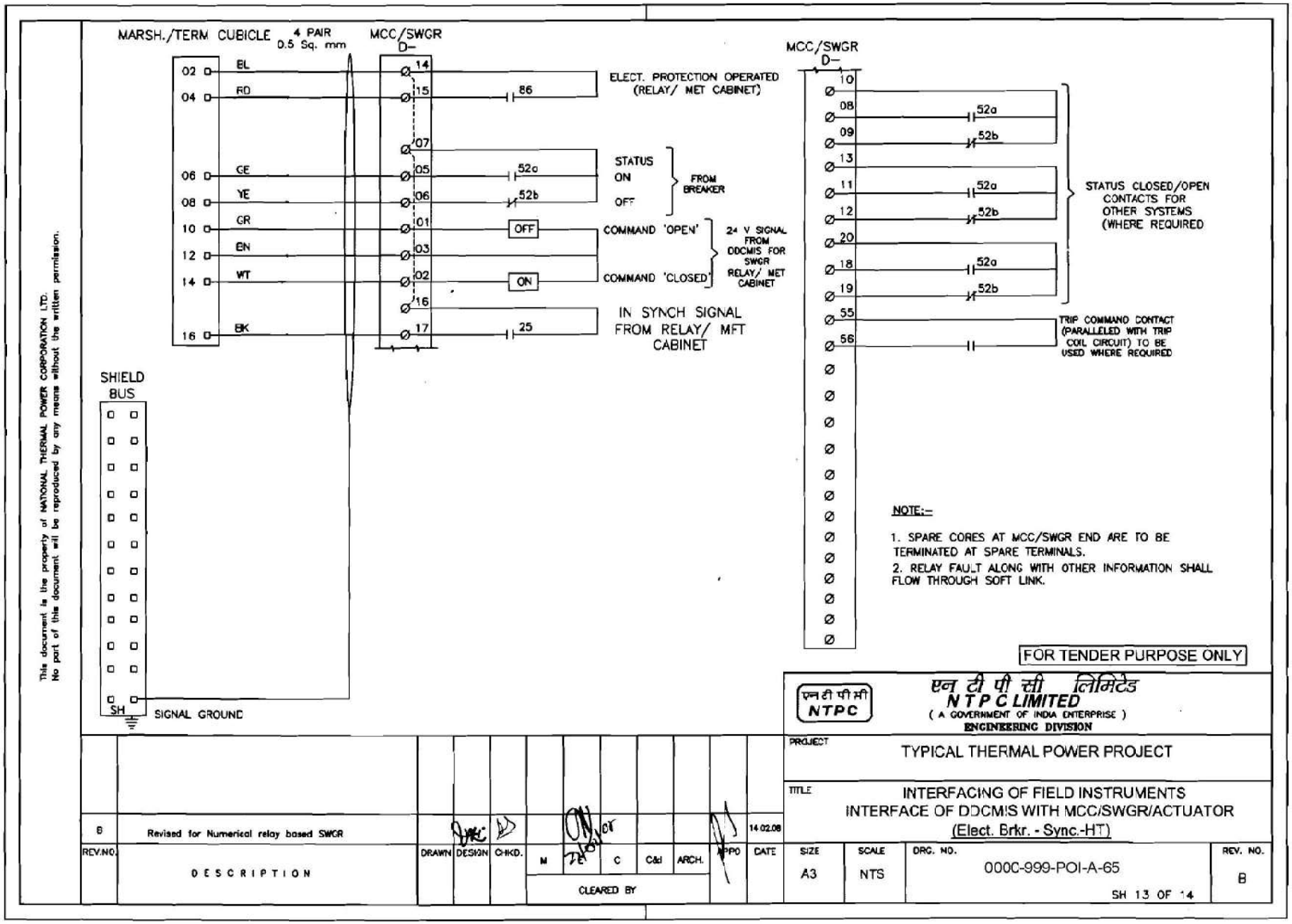

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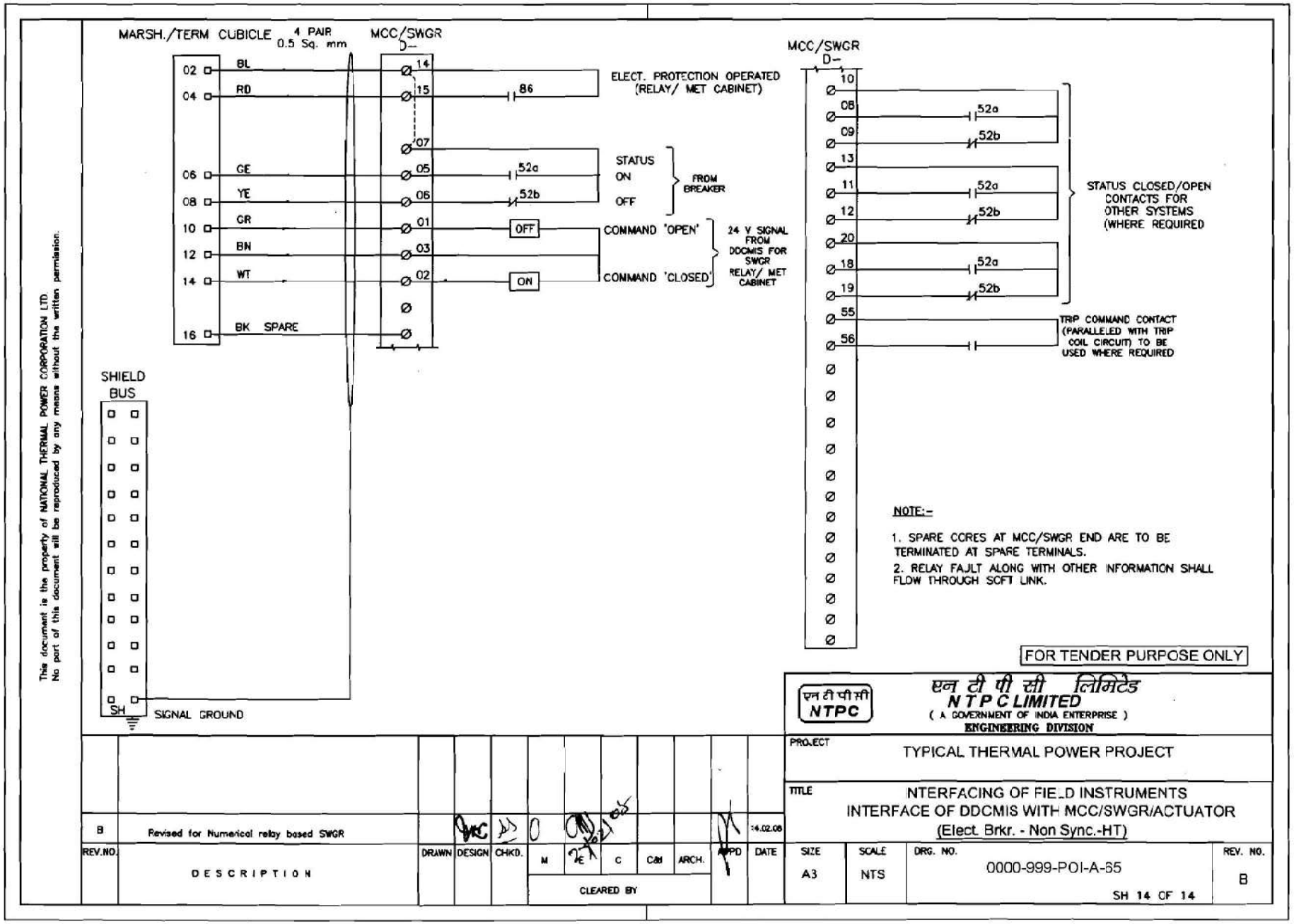

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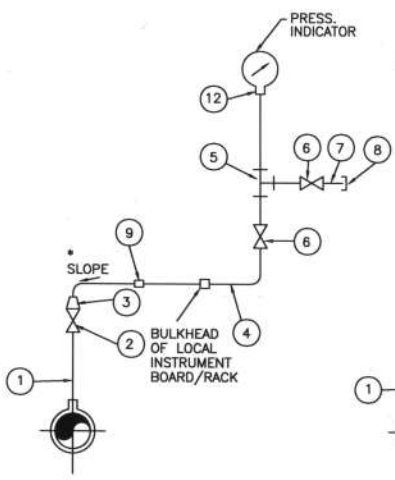
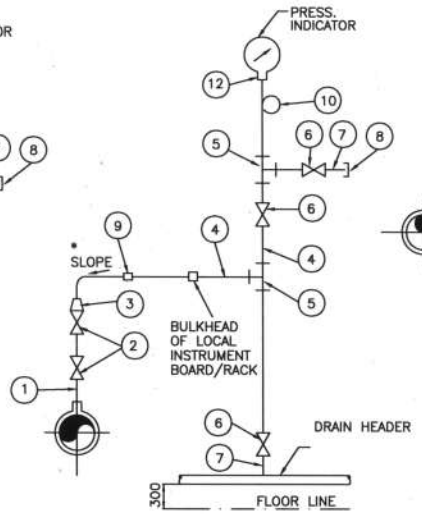
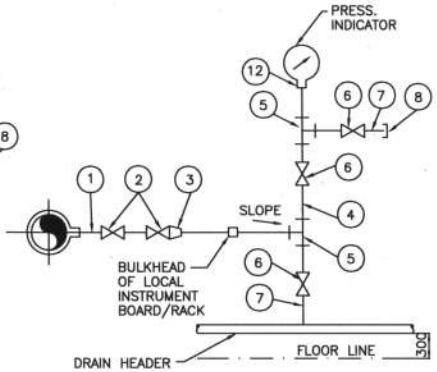


ELEVATION
INST./ SERVICE AIR



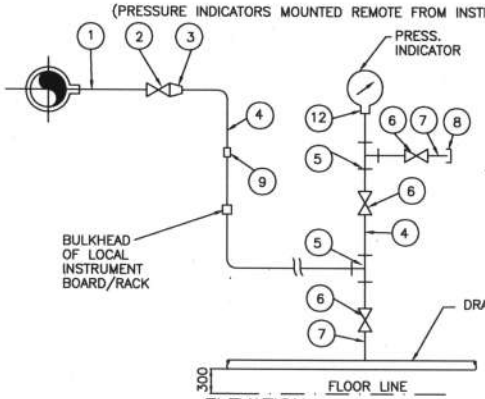
ELEVATION
STEAM SERVICE

(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)



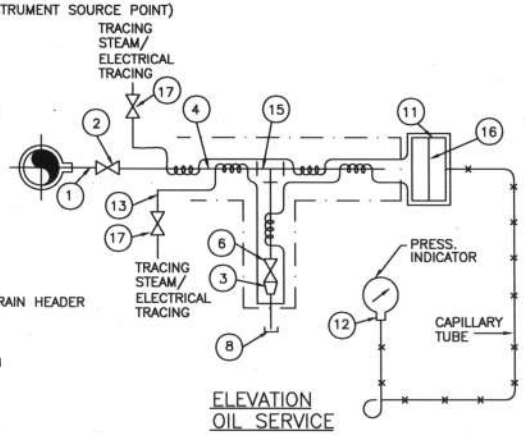
ELEVATION
LIQUID SOURCE

(GAUGE MOUNTED ABOVE INSTRUMENT SOURCE POINT)



ELEVATION
LIQUID SOURCE

(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)



ELEVATION
OIL SERVICE

(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2" , 3/4" , 1" NPS SCH 40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	1/2"/3/4"/1' SW GLOBE VALVE/GATE VALVE
3.	3/4" / 1" x 1/2" SW REDUCING INSERT
4.	1/2" / 3/4" PIPE
5.	1/2" / 3/4" SW EQUAL TEE
6.	1/2" / 3/4" SW GLOBE VALVE.
7.	1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.
8.	1/2" / 3/4" NPT(F) CAP.
9.	1/2" / 3/4" PIPE UNION.
10.	6" SS SYPHON
11.	1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.
12.	SUITABLE ADAPTER.
13.	1/4" CHROME MOLY STEEL TUBE.
14.	
15.	1"/3/4" SW EQUAL TEE.
16.	DIAPHRAGM(WAFER ELEMENT)
17.	ISOLATION VALVE 316 SS,1/4"SW

NOTES:-

1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE & NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFIRM TO ANSI-B.16-11.
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTINGS SHALL BE OF 3/4" NB SIZE.
5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON A CHANNEL OR FRAME OR A RACK..
6. * SLOPE APPROX. 50 MM / METRE.

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ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G.	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
		CLEARED BY						C&I			

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-022	A

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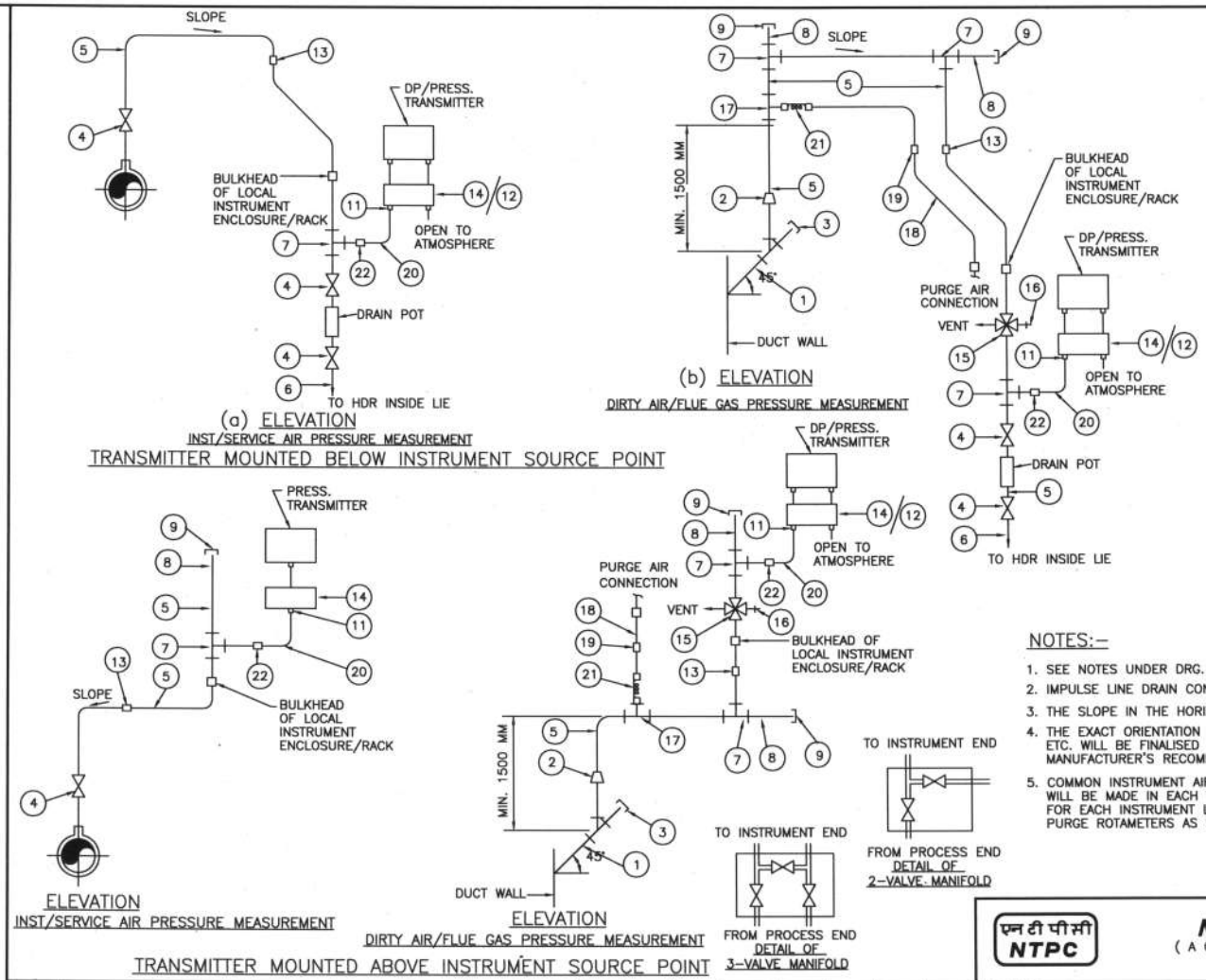

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42 X 405 MM M.S. BLACK PIPE
2.	M42x2 TO 3/4" REDUCING INSERT
3.	M42x2(F) M.S.CAP
4.	3/4" SW GLOBE VALVE/GATE VALVE
5.	3/4" NPS PIPE
6.	3/4" NPS SW 3/4" NPT(M) CS/AS NIPPLE
7.	3/4" SW EQUAL TEE
8.	3/4" NPS SCH 80 CARBON/ALLOY STEEL NIPPLE
9.	3/4" NPT(F) CS/AS CAP
10.	3/4" SW CS/AS EQUAL CROSS
11.	1/2" TUBE ADOPTER
12.	3 VALVE MANIFOLD
13.	3/4" PIPE UNION
14.	2 VALVE MANIFOLD
15.	3/4" SW 4 WAY VALVE
16.	QUICK DISCONECT FITTING
17.	3/4"SWx1/2"SW BRANCH TEE
18.	1/2" NB SEAMLESS GI PIPE
19.	1/2" NPT (F) GI FITTING
20.	SS TUBE
21.	FLEXIBLE HOSE WITH ONE END SOCKET WELDED (PIPE SIDE) & OTHER END WITH SUITABLE FITTINGS.
22.	3/4" x 1/2" S.S. TUBE UNION

NOTES:-

1. SEE NOTES UNDER DRG. NO.0000-999-POI-A-022.
2. IMPULSE LINE DRAIN CONNECTIONS SHALL BE DONE AS PER TECHNICAL SPECIFICATIONS
3. THE SLOPE IN THE HORIZONTAL OF THE IMPULSE PIPE SHALL BE APPROX. 50 mm/mtr.
4. THE EXACT ORIENTATION OF THE TRANSMITTERS WITH RESPECT TO VALVE MANIFOLDS ETC. WILL BE FINALISED DURING DETAILED ENGINEERING KEEPING IN VIEW THE MANUFACTURER'S RECOMMENDATIONS.
5. COMMON INSTRUMENT AIR HEADER (1"NB) USING REDUNDANT AIR FILTER REGULATORS WILL BE MADE IN EACH TRANSMITTER ENCLOSURE REQUIRING PURGE AIR. PURGE AIR FOR EACH INSTRUMENT LINE SHALL BE TAPPED FROM THIS HEADER USING INDIVIDUAL PURGE ROTAMETERS AS SHOWN IN DRG. NO. 0000-999-POI-A-034 TYPICALLY.

FOR TENDER PURPOSE ONLY

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

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N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM
(PRESSURE MEASUREMENT USING PRESS / DP TRANSMITTERS
(INST./SERVICE, DIRTY AIR/FLUE GAS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-023	A

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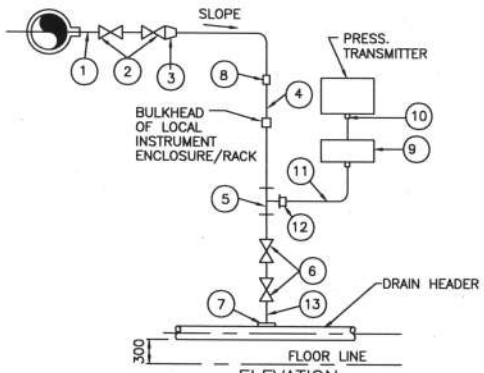
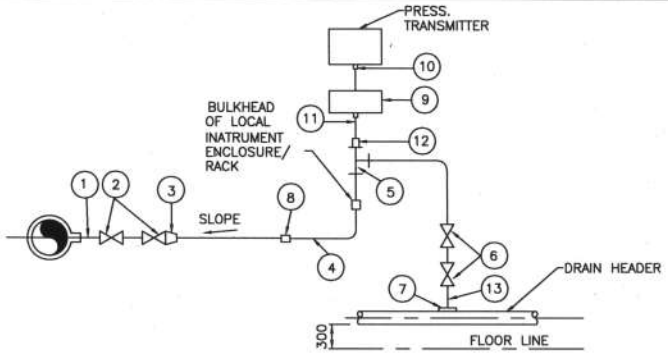


ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



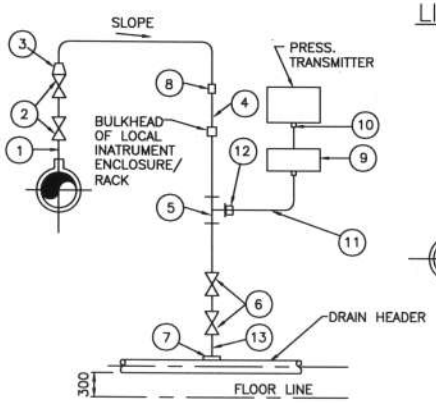
ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIQUID PRESSURE MEASUREMENT

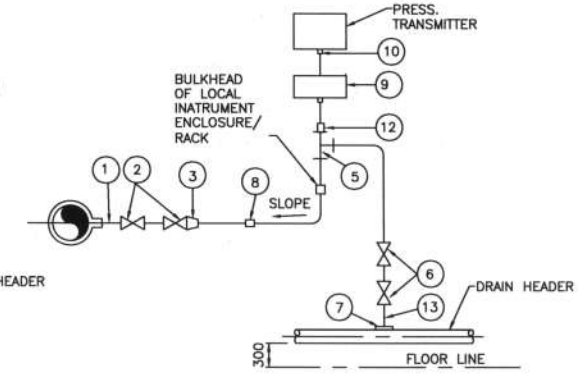
LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2"/ 3/4"/1"NPS SCH. 80/160/XXS/P91 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	3/4"/1" SW GLOBE VALVE.
3.	3/4"/1" TO 1/2" REDUCING INSERT
4.	1/2" NPS PIPE
5.	1/2" SW EQUAL TEE
6.	1/2"SW GLOBE VALVE
7.	1/2"NPS SCH. 80/160 SWx1/2"CS/AS COUPLER
8.	1/2" PIPE UNION
9.	2/3 VALVE MANIFOLD (FOR DETAIL SEE DRAWING NO.0000-102-POI-A-023.
10.	SUITABLE ADAPTER
11.	SS TUBE
12.	1/2" PIPE x 1/2"TUBE UNION
13.	1/2"NPS SCH. 80/160 SWx1/2" NPT(M) CS/AS NIPPLE



ELEVATION

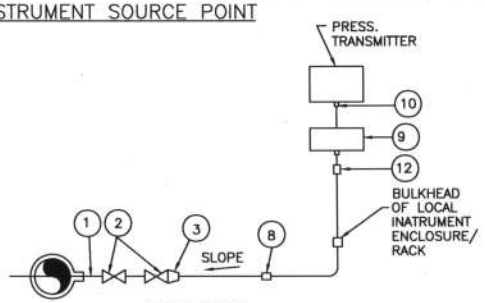
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

STEAM PRESSURE MEASUREMENT



ELEVATION

VACCUM PRESSURE MEASUREMENT

NOTES:-

1. SAME NOTES UNDER DRG. NO. 0000-999-POI-A-023.
2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

FOR TENDER PURPOSE ONLY

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ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-025	A

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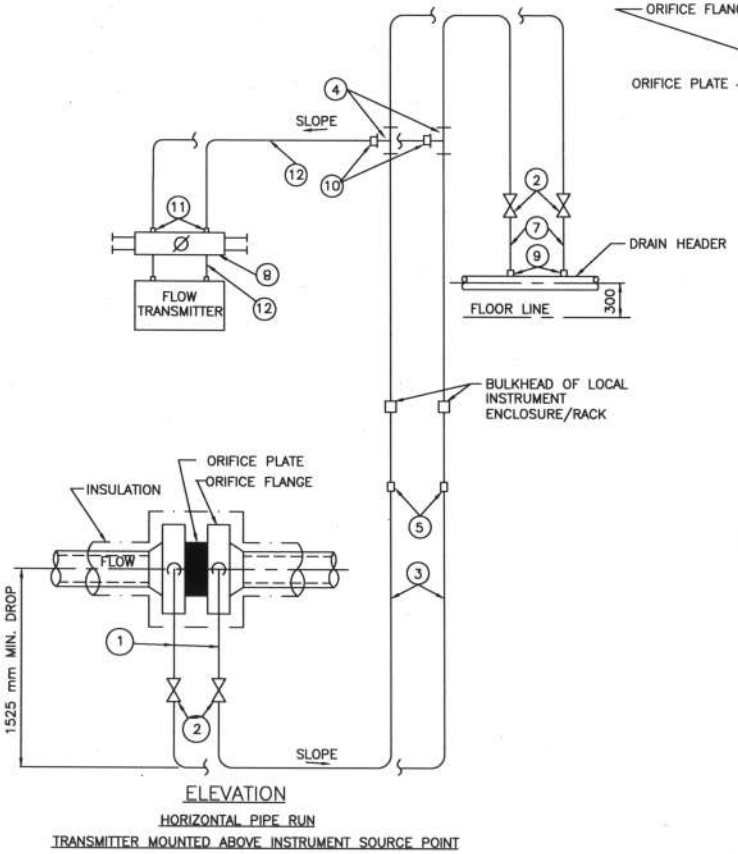
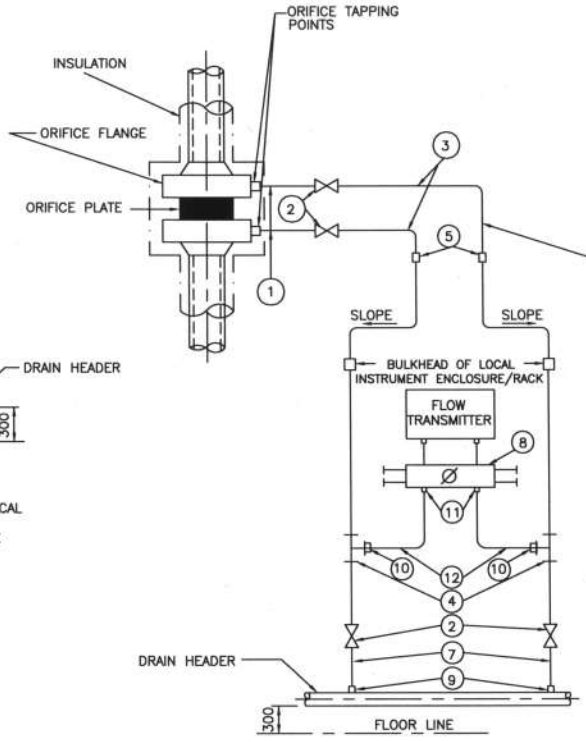


ELEVATION

HORIZONTAL PIPE RUN

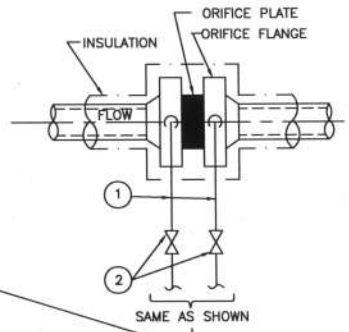
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



ELEVATION

VERTICAL PIPE RUN

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

HORIZONTAL PIPE RUN

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2"NPS SCH. 80 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE WITH NECESSARY ATTACHMENT TO FLANGE OF ORIFICE
2.	1/2"SW GLOBE VALVE.
3.	1/2" NPS PIPE
4.	1/2" SW EQUAL TEE
5.	1/2" PIPE UNION
6.	–
7.	1/2"NPS SCH. 80 SWx1/2"NPT (M) S.S. NIPPLE
8.	5 VALVE MANIFOLD FOR DETAIL REFER DRAWING NO.0000-102-POI-A-026.
9.	1/2" T SW HALF COUPLET
10.	1/2" PIPE x 1/2" TUBE UNION
11.	SUITABLE ADAPTER
12.	SS TUBE

NOTES:–

1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM
FLOW MEASUREMENT (USING ORIFICE PLATES)
CONDENSATE & SERVICE WATER

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-027	A

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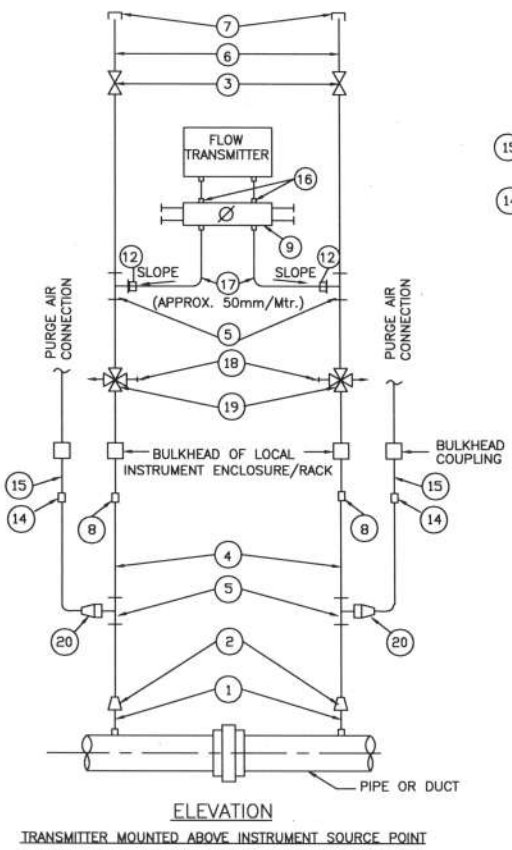
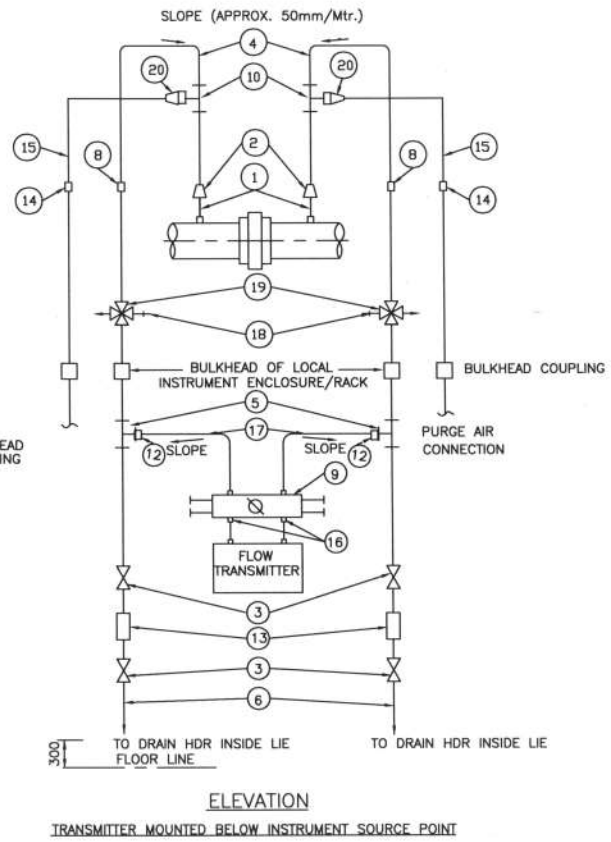


ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42x4.05mm M.S. BLACK PIPE.
2.	M 42x2 TO 3/4"SW REDUCING INSERT.
3.	3/4" SW GLOBE VALVE.
4.	3/4" PIPE.
5.	3/4" SW EQUAL TEE.
6.	3/4" SCH. 80 SWx3/4" NPT (M) CS/AS NIPPLE
7.	3/4" NPT (F) CAP.
8.	3/4" PIPE UNION.
9.	5 VALVE MANIFOLD FOR DETAIL REFER DRAWING NO.0000-102-POI-A-026.
10.	3/4" SW EQUAL TEE.
11.	3/4" SW GATE VALVE.
12.	3/4" PIPE x 1/2" TUBE UNION
13.	DRAIN POT.
14.	1/2" GI FITTING
15.	1/2" NB GI PIPE
16.	SUITABLE ADAPTER
17.	SS TUBE
18.	QUICK DISCONNECT FITTINGS.
19.	3/4" SW 4 WAY VALVE.
20.	3/4" x1/2" REDUCER.

NOTES:-

1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

FOR TENDER PURPOSE ONLY

AIR/GAS FLOW MEASUREMENT USING HEAD TYPE PRIMARY ELEMENT

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G. C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
		CLEARED BY									

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (FLOW MEASUREMENT AIR/GAS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-028	B

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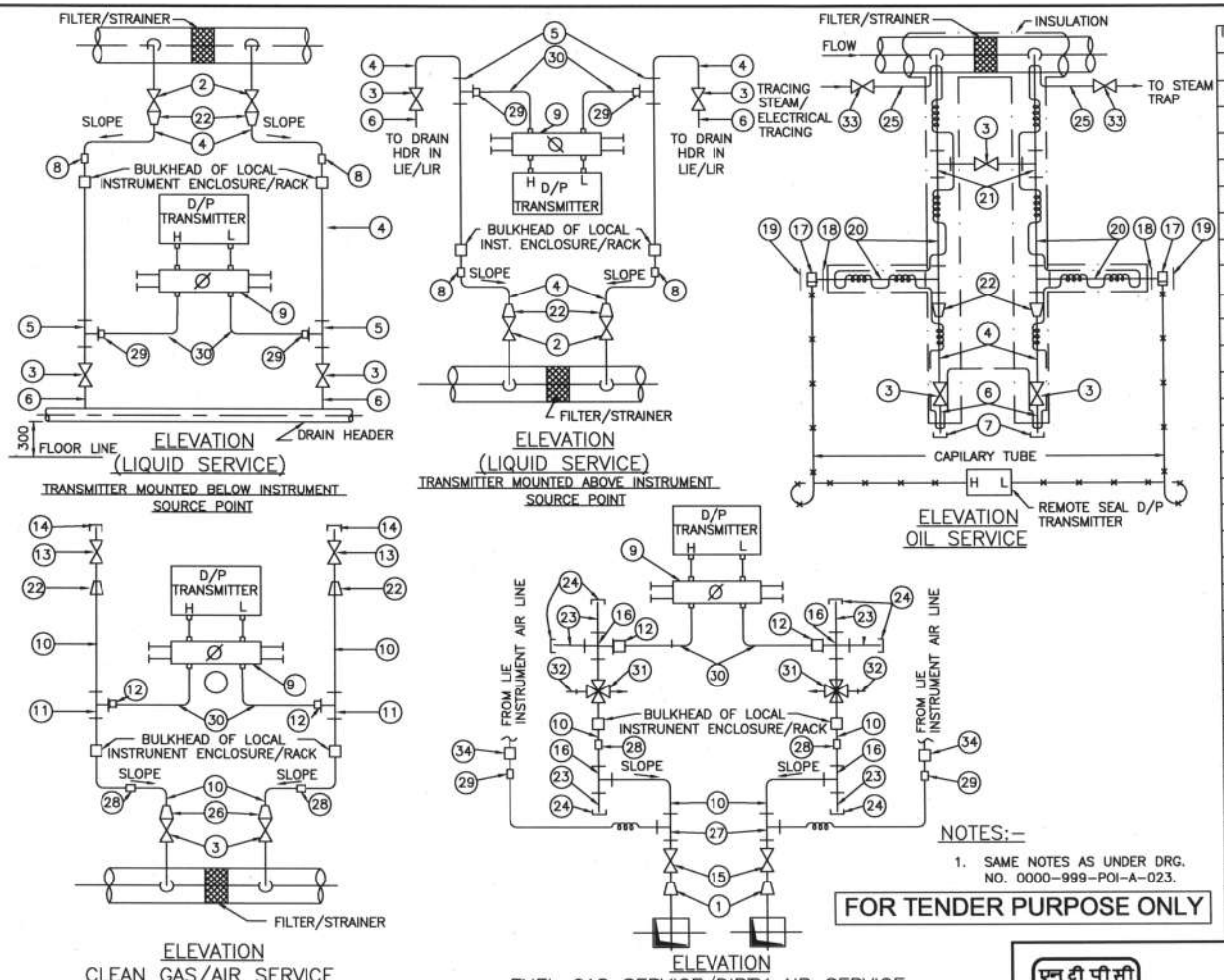

ELEVATION
(LIQUID SERVICE)
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

ELEVATION
(LIQUID SERVICE)
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

ELEVATION
OIL SERVICE

ELEVATION
CLEAN GAS/AIR SERVICE
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
DIFFERENTIAL PRESSURE MEASUREMENT

ELEVATION
FUEL GAS SERVICE/DIRTY AIR SERVICE

NOTES:-

1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

FOR TENDER PURPOSE ONLY

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42x2 TO 3/4" SW REDUCING INSERT.
2.	3/4" SW GLOBE VALVE.
3.	1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4"/1" IN GAS/AIR APPLICATION
4.	1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" NPS SW x 1/2" NPT (M) NIPPLE.
7.	1/2" NPT (F) CAP.
8.	1/2" PIPE x 1/2" PIPE UNION.
9.	5 VALVE MANIFOLD (FOR DETAIL REFER DRAWING NO.0000-999-POI-A-026.
10.	3/4" SCH 80 CARBON/ALLOY STEEL PIPE.
11.	3/4"/1/2" SW EQUAL TEE.
12.	3/4"x1/2" TUBE UNION.
13.	1/2" SCREWED GLOBE VALVE.
14.	1/2" NPT (M) PLUG.
15.	3/4" SW GATE VALVE.
16.	3/4" SW EQUAL CROSS.
17.	WAFER ELEMENT FOR USE WITH 3"ANSI R.F. VALVE.
18.	3"BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE.
19.	3" BLIND FLANGE.
20.	1"NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.
21.	1" SW EQUAL TEE.
22.	3/4" x 1/2"SW REDUCING INSERT.
23.	3/4" SW x 3/4" NPT (M) CS/AS NIPPLE
24.	3/4" NPT (F) CS/AS CAP.
25.	1/4" NPS ALLOY STEEL PIPE.
26.	1" x 3/4" SW REDUCING INSERT.
27.	3/4" SW x 1/2" PSW BRANCH TEE.
28.	3/4" PIPE UNION
29.	1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE.
30.	SS TUBE
31.	3/4" SW 4 WAY VALVE.
32.	QUICK DISCONNECT FITTINGS.
33.	1/4" SW ISOLATION VALVE 316SS
34.	1/2" x 1/2" SS PIPE UNION.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

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PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS.MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-030	A

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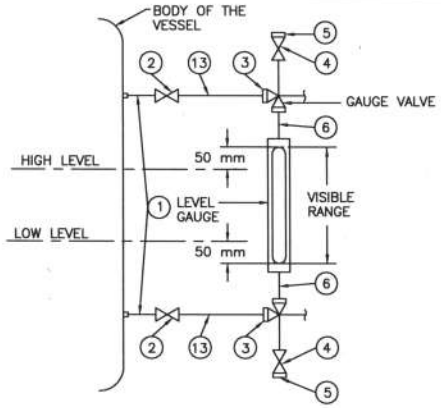
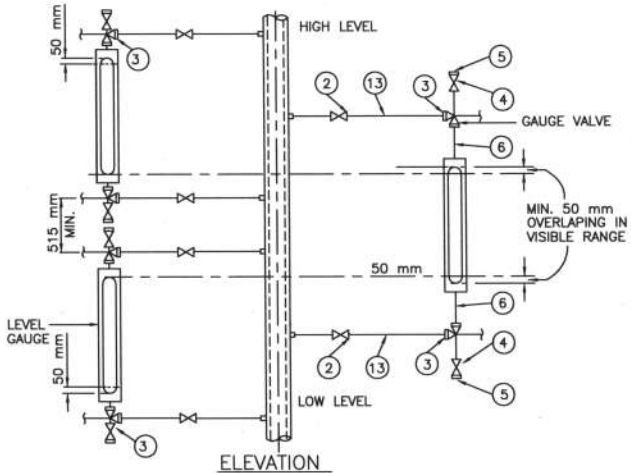


ELEVATION

LOCAL LEVEL INDICATION USING GAUGE GLASS

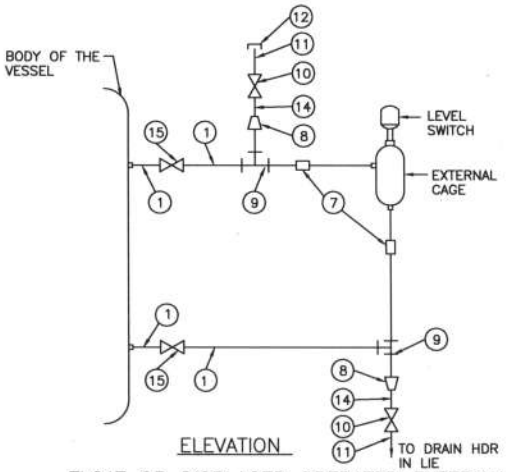


ELEVATION

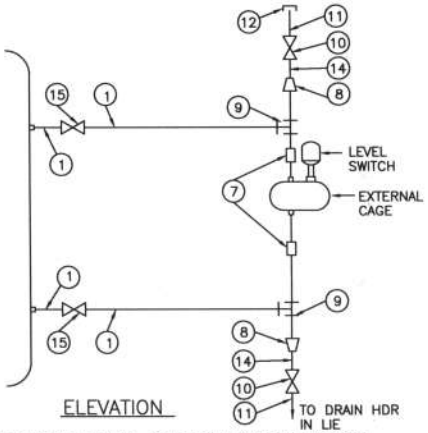
LOCAL LEVEL INDICATION USING MULTIPLE GAUGES
FOR INCREASED RANGE NOT COVERED IN A SINGLE UNIT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	3/4"/1" NPS SCH.40/80/160/P91 (AS PER PROCESS REQUIREMENT) CARBON /ALLOY STEEL PIPE.
2.	3/4" SW GLOBE VALVE.
3.	3/4" SW UNION.
4.	3/4" NPT GLOBE VALVE.
5.	3/4" NPT (M) CAP.
6.	3/4" NPT (F) UNION CONNECTION.
7.	1" SW EQUAL UNION.
8.	1" x 1/2" SW REDUCING INSERT.
9.	1" SW EQUAL TEE.
10.	1/2" SW GLOBE VALVE.
11.	1/2" NPS SWx1/2" NPT(M) CS/AS NIPPLE.
12.	1/2" NPT (F) CAP
13.	3/4"x1/2" NPS SCH.40/80 CS/AS PIPE.
14.	1/2" NPS SCH.80/160 CS/AS NIPPLE.
15.	1" SW GLOBE VALVE.



ELEVATION



ELEVATION

FLOAT OR DISPLACER OPERATED EXTERNAL CAGE TYPE LEVEL SWITCH INSTALLATION

NOTES:-

1. FOR LEVEL GAUGE 3/4" AND FOR LEVEL SWITCH 1" PROCESS CONNECTION SHALL BE PROVIDED.
2. NOTES UNDER DRG. NO. 0000-999-POI-A-023 (WHICHEVER ARE RELEVENT).

FOR TENDER PURPOSE ONLY

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N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE & SWITCHES)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12
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SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-031	A

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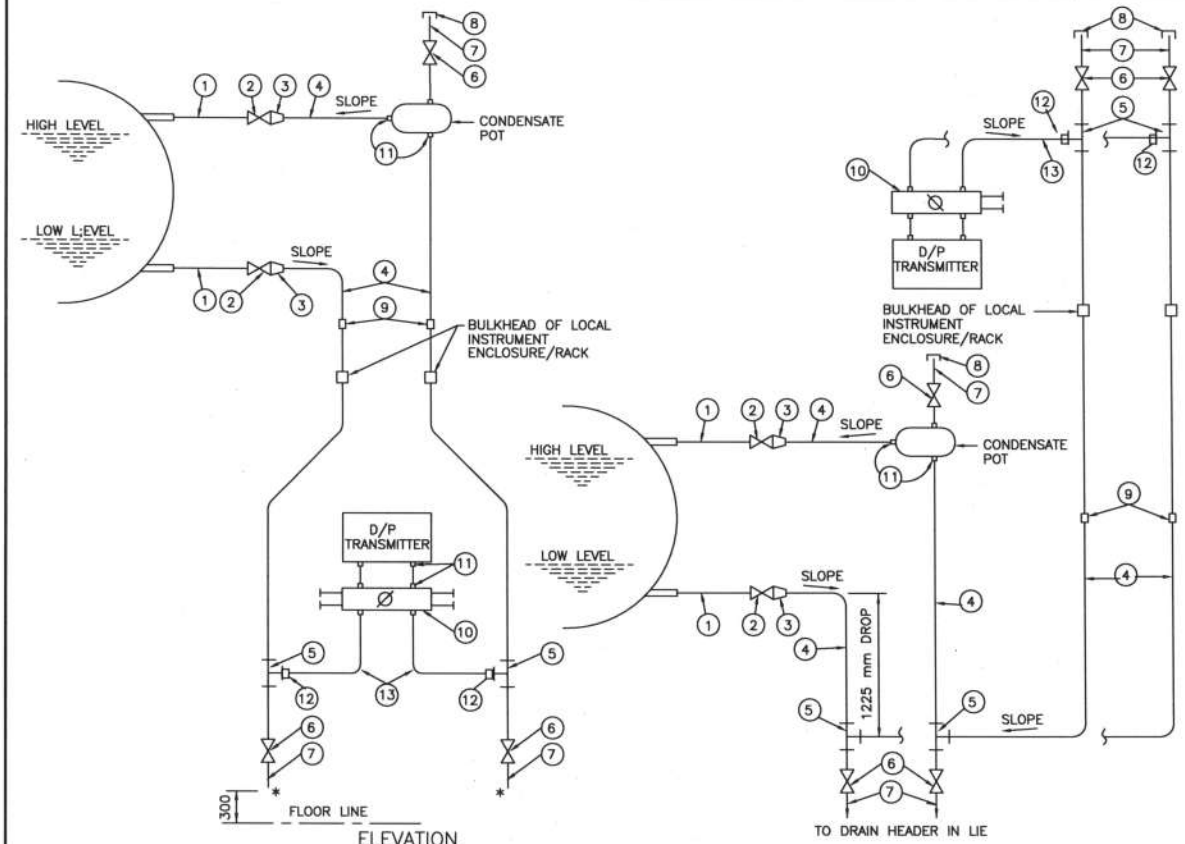

ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1" NPS SCH.40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) CARBON /ALLOY STEEL PIPE.
2.	1" SW GLOBE VALVE.
3.	3/4"/1" TO 1/2" REDUCING INSERT.
4.	1/2" NPS SCH.80/160/XXS(AS PER PROCESS REQ.)CS/AS PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" SW GLOBE VALVE.
7.	1/2" NPS SWx1/2" NPT(M) CS/AS NIPPLE.
8.	1/2 NPT (F) CAP.
9.	1/2" PIPE UNION.
10.	5-VALVE MANIFOLD (FOR DETAILS REF. DRG. NO.0000-999-POI-A-026.
11.	SUITABLE ADAPTER.
12.	1/2" PIPE x 1/2" TUBE UNION.
13.	S.S. TUBE.

NOTES:-

1. SAME NOTES AS UNDER DRG. NO.0000-999-POI-A-023. (WHICHEVER ARE RELEVENT).

* TO DRAIN HEADER IN LIE/LIR.

FOR TENDER PURPOSE ONLY

LEVEL MEASUREMENT OF CLEAR NON-VISCOUS OR NON-CORROSIVE LIQUID IN CLOSED VESSEL WITH CONDENSABLE ATMOSPHERE USING D/P TRANSMITTER

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT USING D/P TRANSMITTERS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-032 SH 1 OF 2	A

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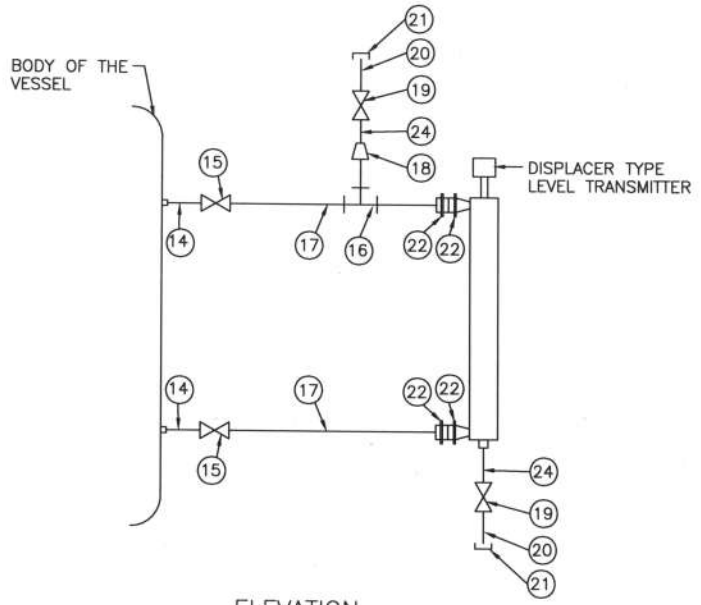

ELEVATION

DISPLACER TYPE LEVEL TRANSMITTER WITH SIDE CONNECTION

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	2" NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) VESSEL NOZZLE.
15.	2" SW GLOBE VALVE.
16.	2" SW EQUAL TEE.
17.	2" NPS SCH. 40/80 CS/AS PIPE
18.	2" x 3/4" SW REDUCING INSERT.
19.	3/4" SW GLOBE VALVE
20.	3/4" NPS SW x 3/4" NPT (M) CS/AS NIPPLE.
21.	3/4" NPT (F) CAP.
22.	2" ANSI 300 lbs RAISED PHASE WELD NECK FLANGE.
23.	2" ANSI FLANGE OF LEVEL TRANSMITTER.
24.	3/4" NPS SCH. 40/80 PIPE.

NOTES:–

1. SAME NOTES AS UNDER DRG. NO.0000–999–POI–A–023 (WHICHEVER ARE RELEVENT).

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12
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N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT USING DISPLACER TYPE TRANSMITTERS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-032 SH 2 OF 2	A

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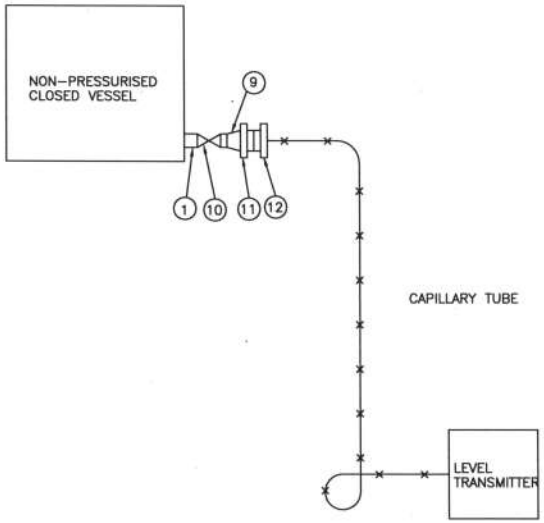
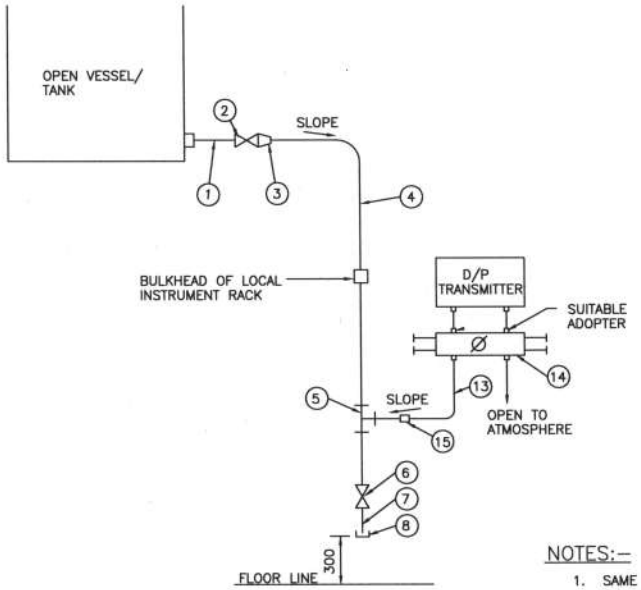


ELEVATION

LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID IN CLOSED VESSEL USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER WITH REMOTE SEAL



ELEVATION

LEVEL MEASUREMENT OF CLEAN LIQUID IN AN OPEN VESSEL USING D/P TRANSMITTER

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	3/4"/ 1" NPS 40/80 PIPE.
2.	3/4" SW GLOBE VALVE.
3.	3/4"/ 1/2" SW REDUCING INSERT.
4.	1/2" NPS SCH. 40/80 PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" SW GLOBE VALVE.
7.	1/2" NPS SWx1/2" NPT(M) NIPPLE.
8.	1/2" NPT (F) CAP.
9.	3/4" TO 4" EXPANDER.
10.	3/4" BUTT WELDED GATE VALVE.
11.	4" ANSI 300 lbs R.F. WELD NECK FLANGE.
12.	4"ANSI MATCHING FLANGE WITH FLUSH DIAPHRAGM OF LEVEL TRANSMITTER
13.	SS TUBE.
14.	3–VALVE MANIFOLD (FOR DETAIL REF. DRG. NO. 0000–999–POI–A–023.
15.	1/2" PIPE x 1/2" TUBE UNION.

NOTES:–

1. SAME NOTES UNDER DRG. NO. 0000–999–POI–A–023.
2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

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PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT-OPEN VESSEL)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-033	A

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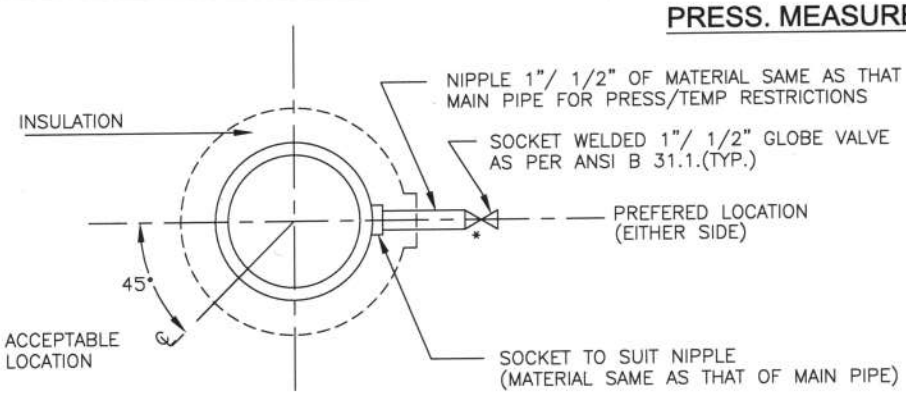
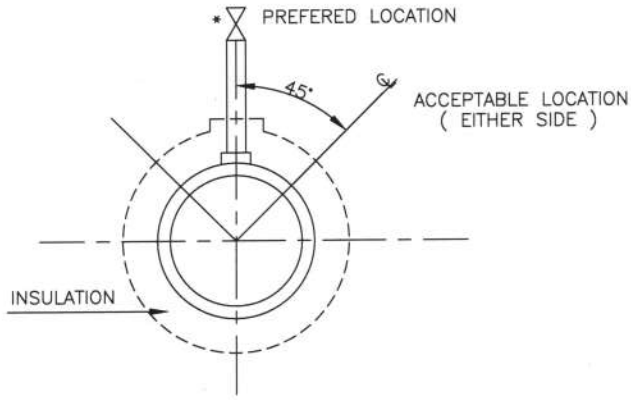
PRESS. MEASUREMENT

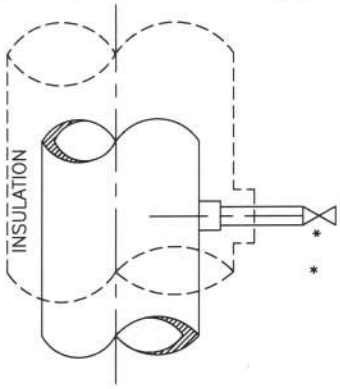


ELEVATION
LIQUID SERVICE



ELEVATION
STEAM SERVICE

PRESSURE CONNECTION ON HORIZONTAL PIPE



* USE DOUBLE ISOLATION VALVES FOR PRESSURE EQUAL TO OR EXCEEDING 40 Kg/Cm2.

ELEVATION
LIQUID OR STEAM SERVICE

PRESSURE CONNECTIONS ON VERTICAL PIPES

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								T.G.		21.08.15			
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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE		
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NTPC LIMITED
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ENGINEERING DIVISION

PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-1 Of 14	A

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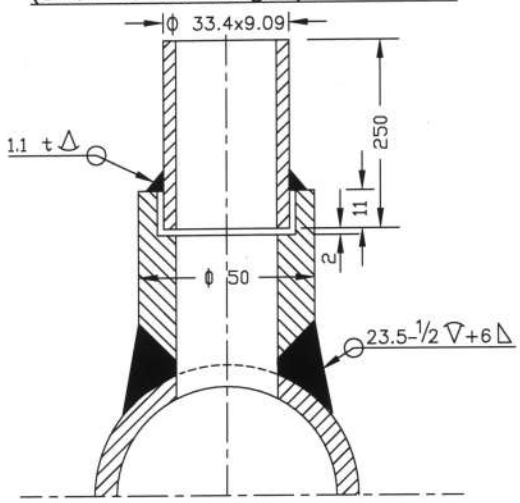
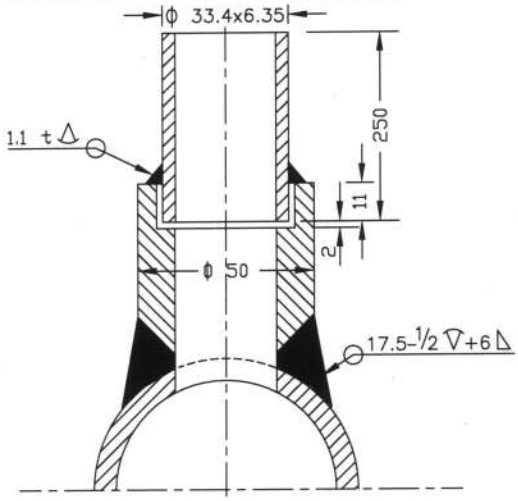
PRESSURE MEASUREMENT

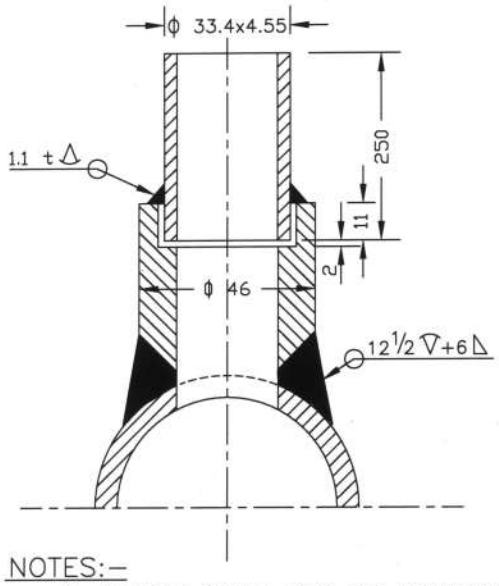
(SYSTEM PR.>40Kg/Sq Cm CL 9000)



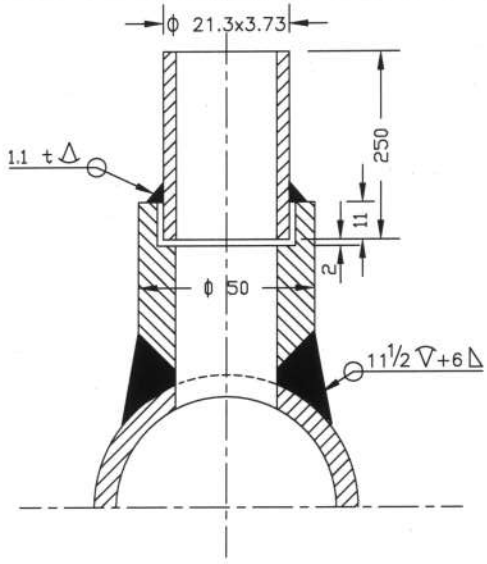
(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(SYSTEM PR. <40Kg/Sq cm Nb 25 CL 3000)



(SYSTEM PR. <40Kg/Sq cm Nb 15 CL 3000)



NOTES:–

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = >40 Kg/Cm2.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

FOR TENDER PURPOSE ONLY

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.06.18

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PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh–2 Of 14	A

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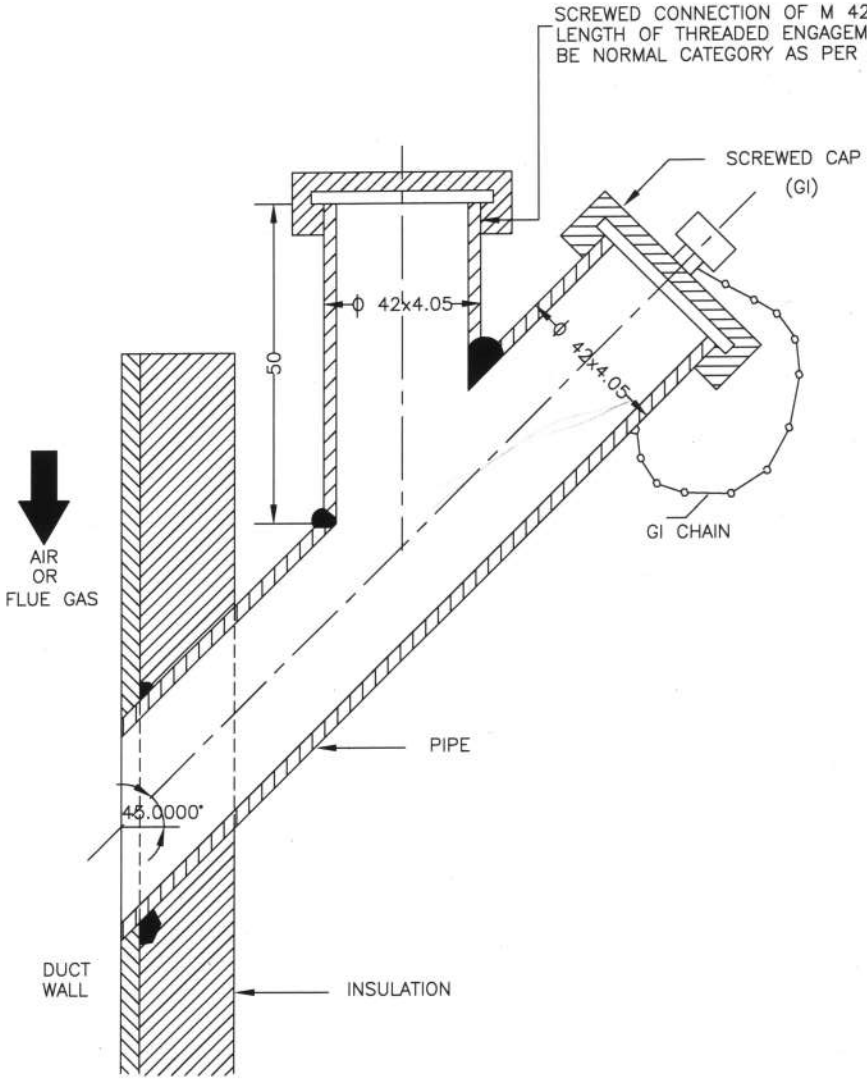
PRESS. MEASUREMENT



NOTES:–

1. THIS TYPE OF PRESSURE CONNECTON SHALL BE PROVIDED FOR PRESSURE MEASUREMENTS IN AIR AND FLUE GAS DUCT/FURNACE.
2. DIMENSIONS ARE INDICATIVE ONLY.

FOR TENDER PURPOSE ONLY

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	T.G.	ARCH.	APPD.	DATE
A	FIRST ISSUE											21.06.13
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PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-3 Of 14	A

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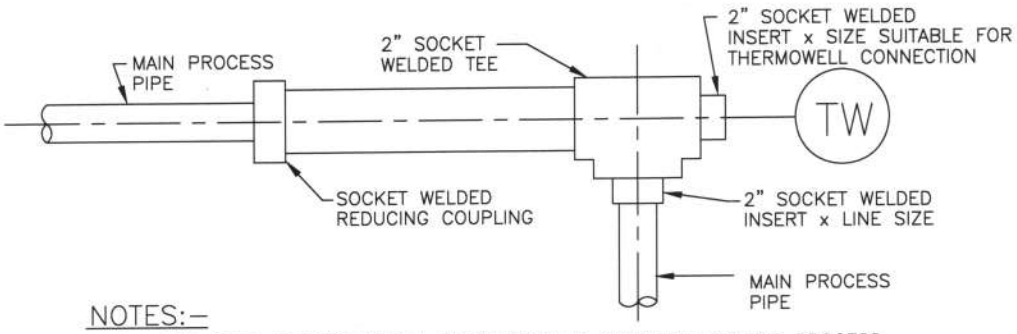
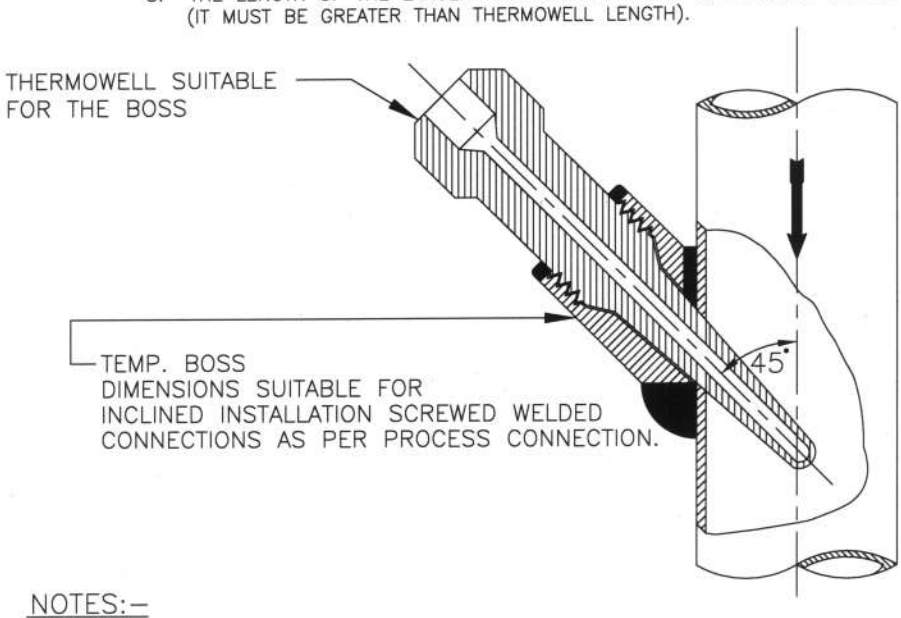
TEMP. MEASUREMENT



NOTES:–

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR THE PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150mm (IT MUST BE GREATER THAN THERMOWELL LENGTH).



NOTES:–

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL).

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			31.08.15
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NTPC — N T P C LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT	TYPICALTHERMAL POWER PROJECT (SG PACKAGE)
TITLE	INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999/102-POI-A-035 Sh–4 Of 14	A

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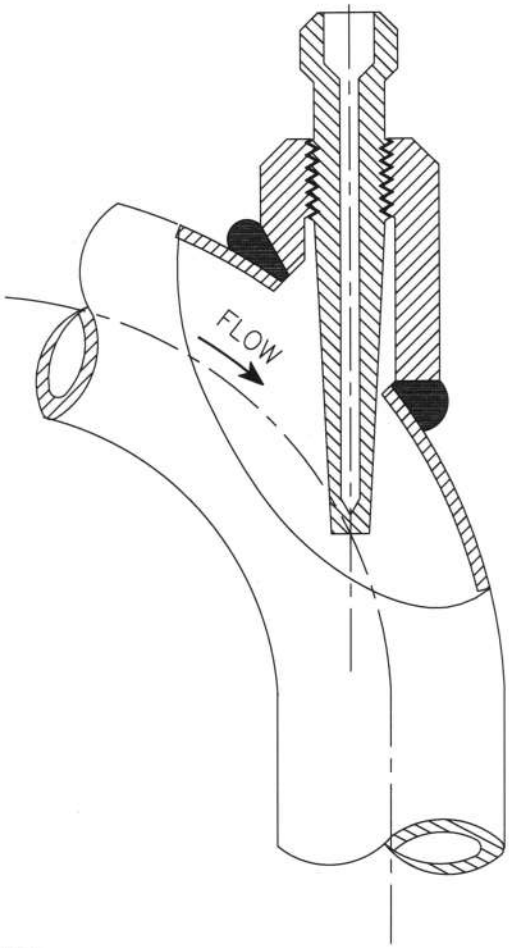

NOTES:–

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE MAY BE USED FOR LIQUID SERVICES. ONLY STEAM SERVICES EXPANDER SECTION MAY BE USED IN VERTICAL PLAN.

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A	FIRST ISSUE										21.06.12

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PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh–5 Of 14	A

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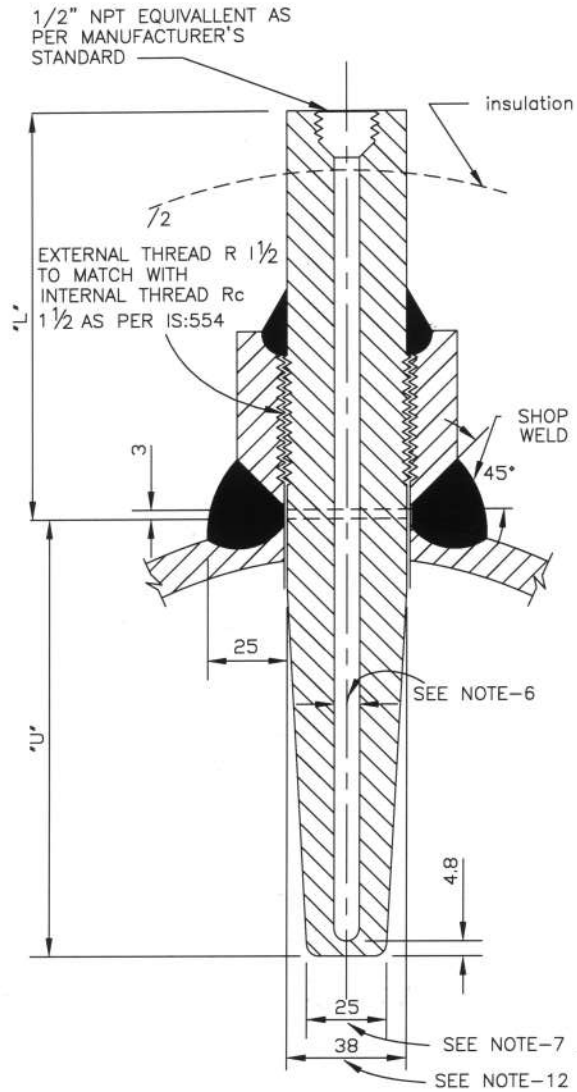

NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE PROCESS PRESS EQUAL/ABOVE 40 Kg/Cm2(g).
2. THE MATERIAL OF THE BOSS SHOULD BE SIMILAR TO THAT OF PIPING MATERIAL OF SPECIFICATION.
3. ALL WELD TO BE TESTED IN ACCORDANCE WITH APPLICABLE CODES BY MANUFACTURER.
4. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
5. THERMOWELL SHALL BE DRILLED BARSTOCK TYPE.
6. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME,PTC-19.3.
7. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS.AND TEMP.,AS PER ASME,PTC-19.3.
8. THE TYPE OF TAPERED THERMOWELL SHALL BE USED FOR LIQUID VELO-CITIES UP TO 92M.P.S.(300F.T.P.S.).
9. THERMOWELL WITH THE INSULATION LAG EXTENSIONS SHALL BE USED WHEREVER APPLICABLE.
10. ACTIVITIES TO BE COMPLETED AT THE SHOP. WELD THE BOSS ON THE PIPE AND DRILL THE HOLE IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE BOSS. PROVIDE INTERNAL THREAD AS PER IS:554 TO MATCH WITH THE THERMO-WELL EXTERNAL THREAD.
11. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
12. WIILL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER RC 1 1/2
13. THE "U" & "L" DIMENSIONS SHALL BE BE SELECTED BASED ON PARTICULAR APPLICATION AND THE SAME SHALL BE SUBJECT TO OWNER'S APPROVAL DURING DETAILED ENGINEERING.
14. ALL DIMENSIONS ARE INDICATIVE ONLY.

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G. C&I	ARCH.	APPD.	DATE
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PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-6 Of 14	A

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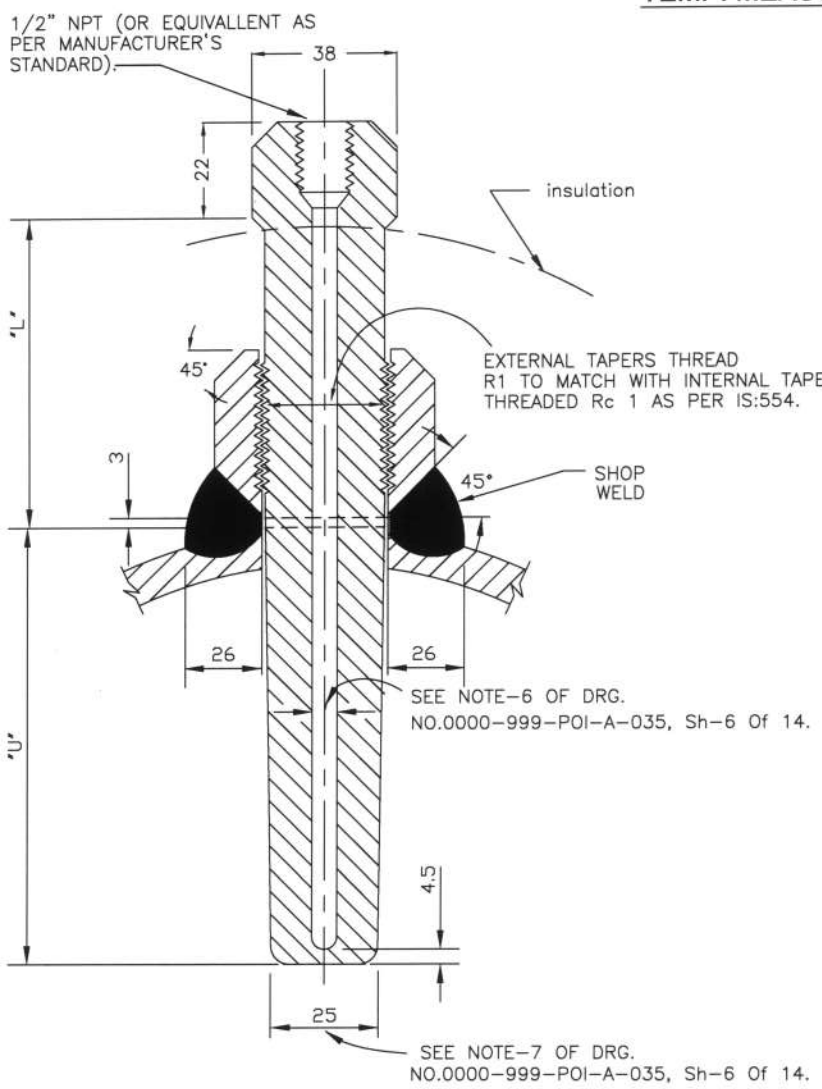
TEMP. MEASUREMENT



NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESSURE/TEMPERATURE BELOW 40 Kg/Cm2(g)/400°C
2. FOR PRESSURE TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. PIPES HAVING PROBABILITY OF PROLONGED VIBRATION SEAL WELDING MAY BE DONE ALL AROUND AFTER TIGHTENING THERMOWELL WITHIN THE BOSS.
4. SEE NOTES-2 TO 14 OF DRG. NO. 0000-999-POI-A-035, Sh-6 Of 14.

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G. C&I	ARCH.	APPD.	DATE
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PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-7 Of 14	A

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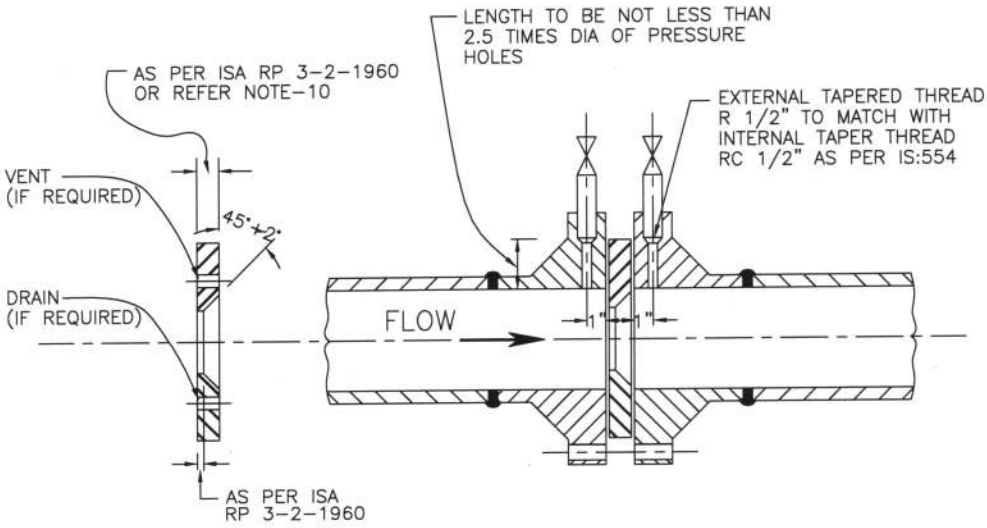
FLOW MEASUREMENT



NOTES:-

1. ORIFICE PLATE MOUNTED BETWEEN FLANGES WITH FLANGE TAPPING (AS SHOWN ABOVE) SHOULD BE LIMITED TO PIPE SIZES OF 2" OR LARGER.
2. ORIFICE PLATE SHALL BE MOUNTED BETWEEN PIPING FLANGES WITH THE SHARP EDGE FACING UPSTREAM SUCH THAT CENTRE OF THE CONCENTRIC ORIFICE SHOULD BE WITHIN 0.79 mm (1/32") OF THE AXIS OF THE PIPE.
3. TWO GASKETS SHALL BE INSERTED BETWEEN THE PLATE AND THE FLANGES AND INSIDE DIAMETER OF THE GASKETS SHOULD BE ATLEAST 1.5 mm (1/16") GREATER THAN THE INSIDE DIAMETER OF THE PIPE SO THAT THEY DO NOT PROTRUDE INTO THE PIPE.
4. PIPING FLANGES SHALL BE ANSI WELD NECK, RAISED FACE TYPE. THE FLANGE IS TO BE ALIGNED WITH THE FACE PERPENDICULAR TO THE FLOW AXIS.
5. BIDDER TO SUPPLY ORIFICE PLATE SPECIAL TYPE (HAVING PRESS. CONNECTIONS) OF FLANGES ALONG WITH GASKETS, NIPPLES AND SOURCE VALVES.
6. ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE TAKEN FROM SIDES FOR LIQUID AND STEAM SERVICE AND FROM TOP FOR DRY GAS SERVICE. FOR PROCESS LIQUIDS INSTALLATION OF PRESSURE TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW THE HORIZONTAL IN SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED.
7. THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm (1/16") OF THE DISTANCE SPECIFIED.
8. MAXIMUM DIAMETER OF PRESS. CONNECTION HOLES SHALL BE AS PER RECOMMENDATIONS OF ASME PTC 19.5. THE DIAMETER OF THE HOLE SHOULD REMAIN THE SAME FOR A DISTANCE NOT LESS THAN 2.5 TIMES OF THE DIAMETER BEFORE EXPANDING INTO THE PRESSURE PIPE.
9. THERE MUST BE NO BURRS WIRE EDGES OR OTHER IRREGULARTIES ALONG THE EDGE OF THE HOLE AND IT MUST BE SQUARE AND ROUNDED SLIGHTLY (1/64" RADIUS).
10. ORIFICE PLATE SHOULD BE FLAT WITHIN 0.02 mm (0.001") AND THE SURFACE ROUGHNESS SHOULD NOT EXCEED 20 MICRO INCH. THE THICKNESS OF THE ORIFICE PLATE SHOULD BE AS PER EN ISO 5167:2003.
11. FOR HORIZONTAL PIPE RUN DRAIN HOLES IN ORIFICE PLATES ARE AT THE BOTTOM (APPROX. TANGENT TO INSIDE DIA OF PIPE) FOR STEAM OR GAS SERVICE. VENT HOLES SHOULD BE LOCATED ON UPPER SIDE FOR INCOMPRESSIBLE FLUID.
12. ORIFICE PLATE SHOULD BE OF 316 SS (ASTM A167-54 GRADE-II).
13. RECOMMENDED MINIMUM LENGTHS OF STRAIGHT PIPE PRECEDING AND FOLLOWING ORIFICES SHALL BE AS PER EN ISO 5167:2003.
14. THREE PAIRS OF PRESSURE TAPS SHALL BE PROVIDED WITH NIPPLES OF REQUIRED LENGTH AND SOURCE VALVES AND THE UN-USED TAPS ARE PLUGGED.
15. THE INTERNAL TAPERED CONNECTION WITHIN THE FLANGE FOR PRESSURE TAPS SHOULD BE RC 1/2" AND THE NIPPLE SHOULD ALSO OF EXTERNAL THREADED R 1/2" AS PER IS:554. THE LENGTH OF THREADED ENGAGEMENT SHALL BE AS PER ABOVE STANDARD.

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
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A	FIRST ISSUE							T.G.			31.08.12

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PROJECT	TYPICALTHERMAL POWER PROJECT
TITLE	INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-12 Of 14	A

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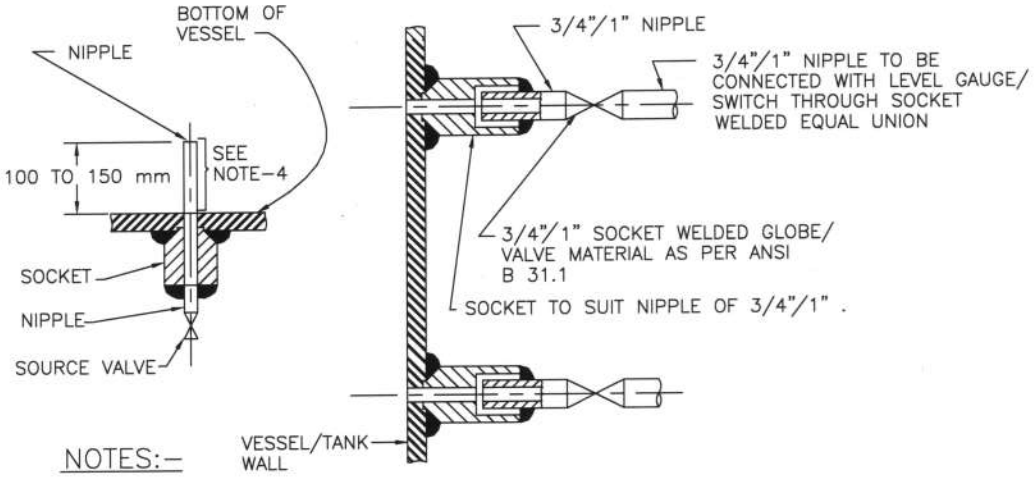
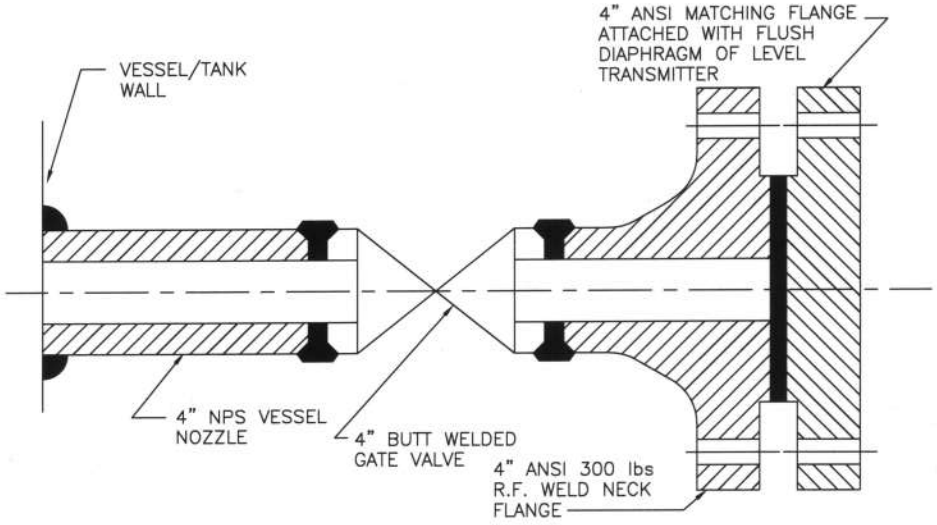
LEVEL MEASUREMENT



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL CAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY BIDDER.

FOR TENDER PURPOSE ONLY

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			01.06.12

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NTPC — N T P C LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-13 Of 14	A

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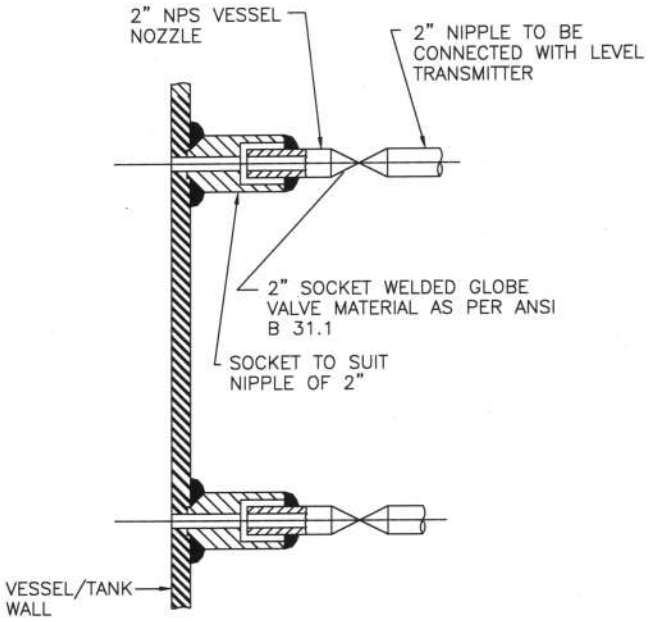
LEVEL MEASUREMENT



NOTES:–

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR DISPLACER TYPE LEVEL TRANSMITTER.
2. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
3. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.

FOR TENDER PURPOSE ONLY

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.06.12
					CLEARED BY						

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PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-14 Of 14	A

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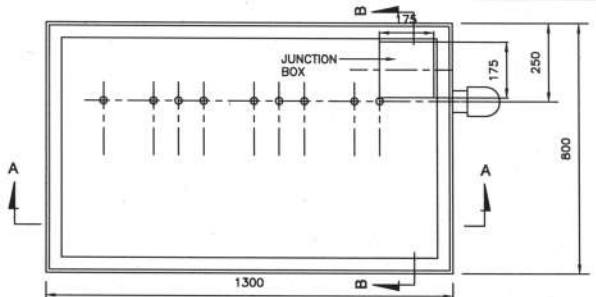
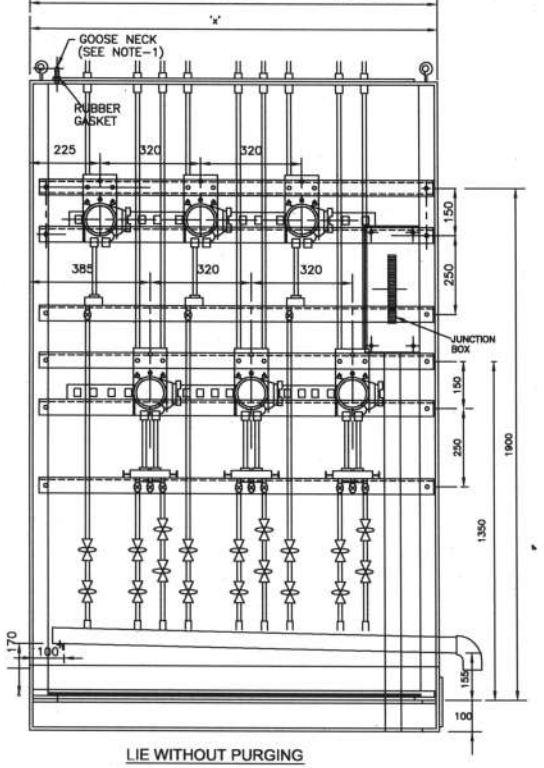
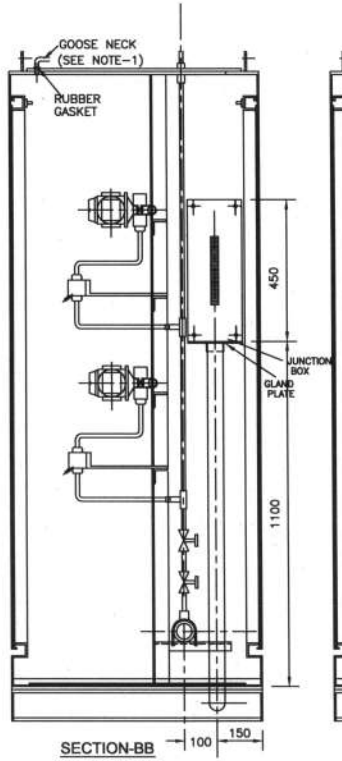
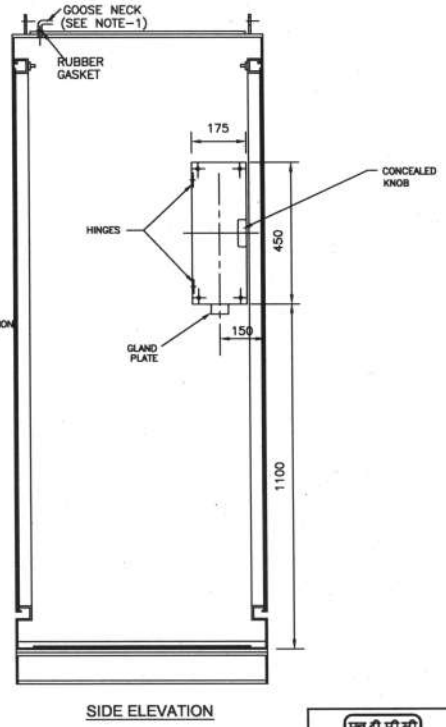




LIE WITHOUT PURGING



SECTION-BB



SIDE ELEVATION

LIE TYPE	MAX. NO. OF TRANSMITTERS	DIMENSION 'X' (mm)
A	6	1250
B	4	930
C	2	630

NOTES:–

1. TO BE PROVIDED FOR LIEs USED IN STEAM & WATER APPLICATION.
2. MATERIAL OF JBs FOR LIEs SHALL BE SAME AS THAT OF LIE.

FOR TENDER PURPOSE ONLY

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12
					CLEARED BY						

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-064 SHEET 01 OF 03	B

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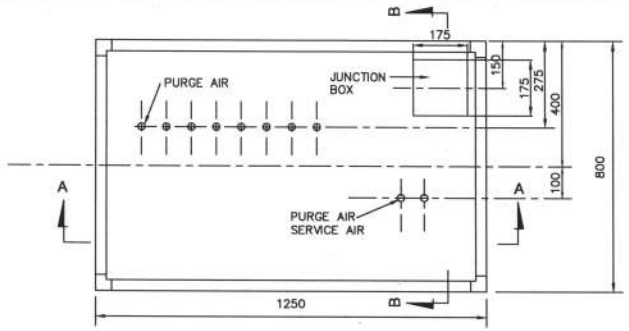
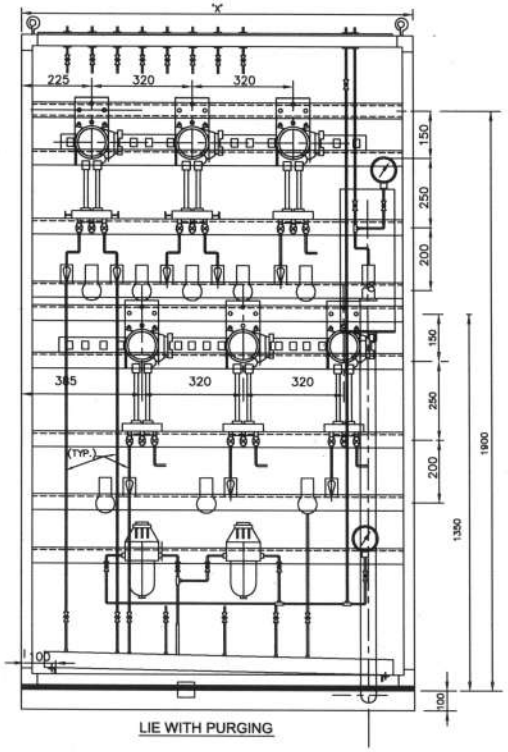
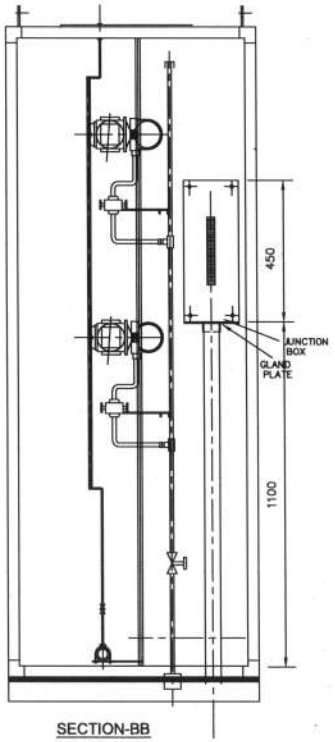




LIE WITH PURGING



SECTION-BB

LIE TYPE	MAX. NO. OF TRANSMITTERS	DIMENSION 'X' (mm)
A	6	1300
B	4	980
C	2	680

NOTES:-

1. MATERIAL OF JBs FOR LIEs SHALL BE SAME AS THAT OF LIE.

FOR TENDER PURPOSE ONLY

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			19.04.12

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ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-064 SH- 02 OF 03	B

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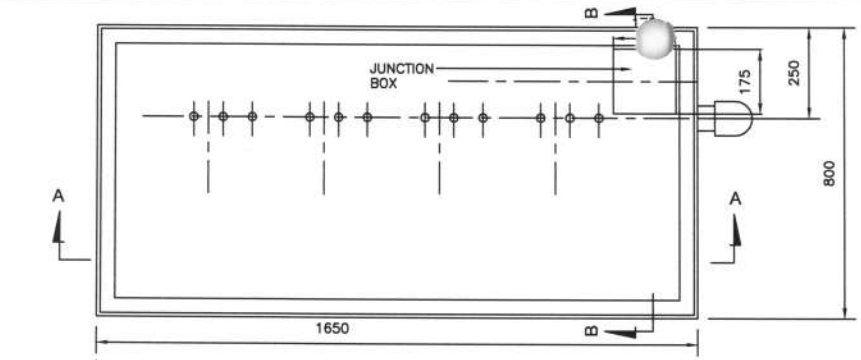
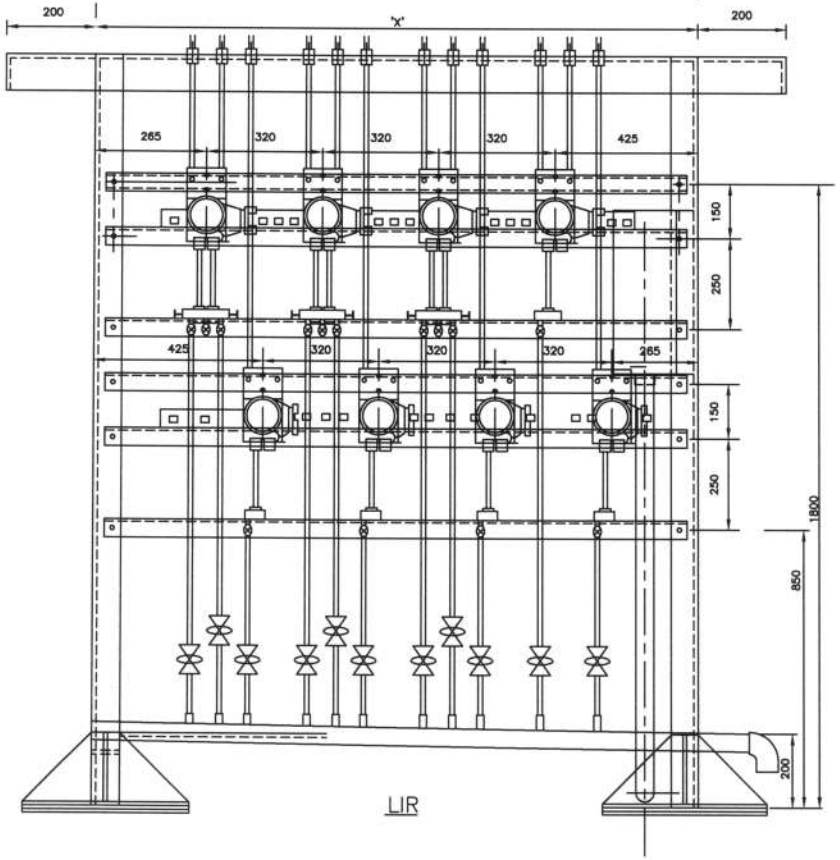
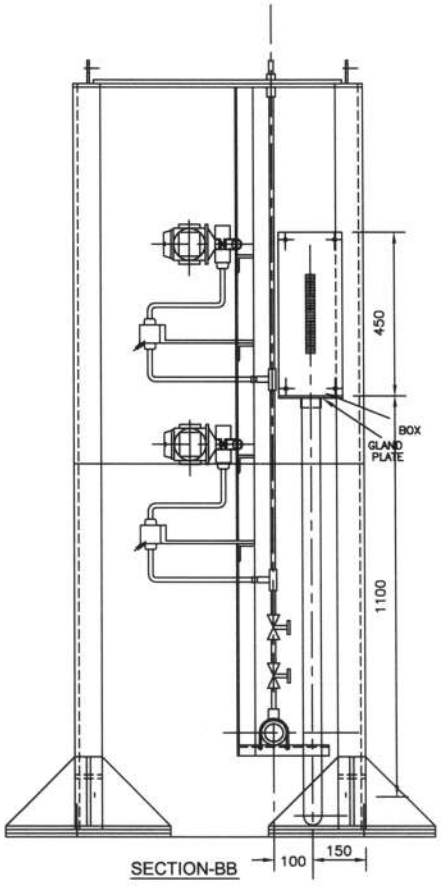


LIR TYPE	MAX. NO. OF TRANSMITTERS	DIMENSION 'X' (mm)
A	8	1650
B	6	1330
C	4	1010



LIR



SECTION-BB

NOTE:–

1. MATERIAL OF JBs FOR LIRs SHALL BE SAME AS THAT OF LIR.

SECTION-AA
LIR WITHOUT PURGING

FOR TENDER PURPOSE ONLY

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

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SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-064	A

SH - 03 OF 03

LOCAL CONTROL PANEL

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

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

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

3.1.7 The class of protection shall be in accordance with IP-55 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2 Hazardous Area Panel Requirement

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

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

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

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

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

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

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

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

3.3.3 Relays

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

3.3.4 Timers

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

3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

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

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

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

3.3.7 Ammeters

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

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

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

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

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

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due

to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

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

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

QUALITY ASSURANCE

MEASURING INSTRUMENTS **Page- 1/2**

Item Components Sub System Assembly	Attributes Characteristics								
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (As applicable [illegible])	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-60770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
7. Transducer (IS-14570)	Y	Y	Y	Y	Y	Y			
8. Thermocouples (IEC – 584 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
9. RTD(IS-2848)	Y	Y	Y	Y	Y	Y			
10. Thermowell	Y		Y				Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

Note: **1)** This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

MEASURING INSTRUMENTS **Page- 2/2**

Item Components Sub System Assembly	Attributes Characteristics												
	GA, Dimensions, Paint Thickness (R)	Make, Model, Type, Rating ,BOM(R)	Process / Electrical connection (R)	Calibration/Functional (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	HV/ IR Test (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)	Integral Testing of complete System
11. Orifice plate(BS-1042)	Y	Y	Y	Y*	Y	Y**	Y**			Y	Y**	Y	
12. Flow nozzle(BS-1042)	Y	Y	Y	Y*	Y	Y	Y			Y	Y	Y	
13. Impact head type element	Y	Y	Y					Y				Y	
14. Electronics Water Level Indicator (EWLI)	Y	Y	Y		Y		Y		Y	Y	Y	Y	Y
15. Flue Gas & Ambient Air Analysers	Y	Y	Y	Y					Y				Y
16- SWAS System with Analyser & Chiller#	Y	Y	Y	Y			Y		Y	Y	Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.
** As applicable
#Vaccuminasation test of chiller assembly

Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

POWER SUPPLY FOR C&I SYSTEMS (UPS/BATTERY/BATTERY CHARGER/ACDB/DCDB)

ITEMS \ TESTS	Visual/dimension/rating/ Paint Adhesion/ Thickness (R)	General arrangement/BOM/make of components /Mimic ®	Efficiency ,regulation(R)	Input voltage variation (A)	Out put voltage and frequency adj. range(A)	Preliminary light load test(R)	Load transfer retransfer test (R) *	AC input failure and return test (R)	Parallel operation and current division(R)	Relative harmonic content(R)	Restart with PRI A.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard &specification (R)&(A)
UPS/CONVERTER (IEC-146 PT-4)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VOLTAGE STABILISER	Y	Y	Y	Y	Y					Y		Y				Y	
LEAD ACID BATTERY (PLANTE)-IS-1652																	Y
Ni-CD BATTERY(IS-10918/IEC-623)																	Y
ACDB/DCDB	Y	Y														Y	Y
BATTERY CHARGER	Y	Y	Y	Y	Y				Y					Y	Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded.

Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

INSTRUMENTATION CABLE

TESTS / ITEMS	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y			Y			Y								
Insulation(VDE-207)				Y	Y	Y	Y						Y		Y
Pairing/Twisting				Y	Y		Y								
Shielding				Y			Y			Y					
Drain wire	Y			Y			Y		Y	Y					
Inner Sheath				Y	Y	Y	Y					Y	Y		
Outer Sheath				Y	Y	Y	Y					Y	Y		
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)				Y			Y								

Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.

Note : ® - Routine Test A - Acceptance Test Y - Test Applicable

Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)
- ** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk (As applicable)

\+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

CONTROL VALVE ACTUATORS AND ACCESSORIES.

TESTS / ITEMS	MAKE,MODEL, TAG (R)	DIMENSION®	SURFACE FINISH®	HEAT TREATMENT®	MATERIAL TEST CERTIFICATES®	IBR CERTIFICATES®	HYDRAULIC TEST , SEAT LEAKAGE ®	UT/RADIOGRAPHY FOR >900 LB RATING®	MPI/DP®	PRESSURE RESISTANCE®	TIMING OPEN/CLOSE®	LINEARITY/HYSTERISIS®	FUNCTIONAL TEST, REVIEW FOR MAKE AND TC OF ACCESSORIES®
CONTROL VALVE AND ACTUATOR													
OVERALL	Y	Y	Y			Y	Y				Y	Y	Y
BODY		Y	Y	Y	Y			Y	Y	Y			
BONNET		Y	Y	Y	Y								
TRIM		Y			Y			Y*					
PNEUMATIC ACTUATOR	Y	Y								Y			
ELECTRO PNEUMATIC POSITIONER	Y												Y

R- ROUTINE TEST A - ACCEPTANCE TEST Y - TEST APPLICABLE

Y* - UT ON SPINDLE DIA >= 40 MM.

NOTE : 1) THIS IS AN INDICATIVE LIST OF TESTS/CHECKS. THE MANUFACTURE IS TO FURNISH A DETAILED QUALITY PLAN INDICATING HIS PRACTICE & PROCEDURE ALONG WITH RELEVANT SUPPORTING DOCUMENTS DURING QP FINALISATION FOR ALL ITEM.

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes Characteristics / ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Local/ Remote (Open-Stop-Close) Operation®	Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR with Integral Starter , Non-Intrusive Electrical Actuator (EN15714-2)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.

- SIL 2 certificate if applicable

® - Routine Test (A) - Acceptance Test Y - Test applicable

Process, Connection & piping FOR C&I SYSTEMS

TESTS / ITEMS	Visual & Dimensions ®	GA, BOM, Layout of component & construction feature, Paint Shade/thickness ®	Flattening,flaring,hydrotest,hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydrulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y*		Y		Y	Y							
Gauge Board	Y	Y		Y		Y		Y		Y	Y			
Impulse pipes and tubes	Y		Y			Y						Y		
Socket weld fittings ANSI B-16.11	Y					Y						Y		Y
Compression fittings	Y					Y					Y	Y	Y	
Instrument valves & Valve manifolds	Y					Y					Y	Y		
Copper tubings ASTM B75	Y					Y								Y

*-applicable for painted junction boxes.

Note: R-Routine Test A- Acceptance Test Y – Test applicable

Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

VFD MODULE				
ATTRIBUTES / CHARACTERISTICS ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY	Visual & Dimensional checks	Make / Type / Rating etc.	Final Inspection as ISS / IEC	Remarks
HT Breaker (IEC 56)	Y	Y	Y	
DC Reactor	Y	Y		
Transformer	Y	Y		For details refer table for LT Indoor Transformer & Auxiliary Transformer
Motor	Y	Y		For details refer separate table for Motor
VFD Panel	Y	Y		For details refer table for VFD Panel

Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalisation.

2) Make of all major Bought Out Items will be subject to NTPC approval.

VFD PANEL

Attributes Characteristics / Item Components Sub System Assembly	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	IS:6005 ,Seven tank process	Paint finish/ shade/thickness	Mountings / BOM/ Make, Completeness	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Final testing as per Relevant IS/IEC
Sheet Steel (IS-513)		Y	Y	Y										
Aluminum / Copper Bus-bar(IS-5082/IS-613/IS-1987)	Y	Y	Y	Y										
Support Insulator (BS-2782/IEC-660/IS-10912)	Y	Y	Y	Y										
Control / Selector Switch(IS-6875)					Y	Y	Y							
Contactor/ MCB(IS-13947)					Y	Y	Y							
O/L Protection relays(IS-3231)					Y		Y							
C.T /V.T/ Indicating Meter(IS-2705/3156/1248)					Y	Y	Y							
Fuse/ Fuse carrier(IS-13703)					Y	Y	Y							
Terminals/lugs/pvc wires(IS-13947//IS-694)	Y			Y	Y	Y	Y							
Timers(IS-3231)					Y	Y	Y							
Push Button/ Lamp/ (IS-6875)					Y	Y	Y							
Control Transformer (IS-12021)					Y	Y	Y							
Mimic, Annunciater					Y		Y							
GASKET(IS-11149)		Y	Y	Y	Y		Y							
Fabrication								Y						
Pretreatment & Painting									Y	Y				
VFD panel										Y	Y	Y	Y	Y

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. All major Bought Out Items will be subject to NTPC approval.

3.00.00 **TYPE TEST REQUIREMENT FOR OTHER C&I SYSTEMS**

Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
1	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
2	Instrumentation Cables Twisted & Shielded*				
	-Conductor	Resistance test	VDE-0815	No	Yes
		Diameter test	IS-10810	No	Yes
		Tin Coating test (Persul-phate test)	IS-8130	No	Yes
	-Insulation	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
	-Inner sheath***	Loss of mass	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Cold bend/ cold impact test	VDE 0472	No	Yes

		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
	-Outer sheath	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
		Colour fastness to water	IS-5831	No	Yes
		Cold bend/ cold impact test	VDE-0472	No	Yes
		Oxygen index test	ASTMD-2863	No	Yes
		Smoke Density Test	ASTMD-2843	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-fillers	Oxygen index test	ASTMD-2863	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-AL-MYLAR shield	Continuity test		No	Yes
		Shield		No	Yes

	thickness			
	Overlap test		No	Yes
-Over all cable	Flammability Test	IEEE 383	No	Yes
	Swedish Chimney Test	SEN 4241475	No	Yes
	Noise interference	IEEE Trans-actions	No	Yes
	Dimensional checks	IS 10810	No	Yes
	Cross talk	VDE-0472	No	Yes
	Mutual capacitance	VDE-0472	No	Yes
	HV test	VDE-0815	No	Yes
	Drain wire continuity		No	Yes

* 1.0 All cables to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last Ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.0 In case the Contractor is not able to submit report of the type test(s) conducted within last Ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests either in an independent laboratory or at manufacturer's works in presence of Owner's representative under this contract free of cost to the Owner and submit the reports for approval.

**These tests shall be carried out as per VDE0207 Part 6 & ASTMD-2116 for TEFLON insulated & outer sheathed cables

***Applicable for armoured cables only

3 DC Power Supply System (Applicable for each model and rating)

1)The Type Test reports for offered rectifier module and the controller module irrespective of the rectifier bank shall be acceptable

		Surge Withstand Capability(SWC)	(ANSI / IEEE C37.90.1)or (IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-4-18).	No		Yes
		Dry Heat Test	IEC-60068-2-2 or equivalent	No		Yes
		Damp Heat test	IEC-60068-2-30 or IEC-60068-2-78 or equivalent	No		Yes
		Vibration test	IEC-60068-2-6 or equivalent	No		Yes
		Electrostatic discharge test	IEC 61000-4-2 or equivalent	No		Yes
		Radio frequency immunity test	IEC-61000-4-6 or equivalent	No		Yes
		Electromagnetic field immunity	IEC 61000-4-3 or equivalent	No		Yes
		Degree of Protection	IS-13947 or equivalent	No		Yes
4	Battery ##	As per standard (col 4)	IS-10918 (Ni-Cd Batteries)	No		Yes
			IS-1652 (Lead Acid Plante Batteries)	No		

5 UPS (Applicable for each model and rating)

1) Type Test reports of same series of UPS with similar PCB's cards and controllers as the target UPS system shall be acceptable.

2) For Dry heat, Damp heat and vibration, the tests conducted on individual PCB's shall be acceptable.

		Surge Withstand Capability(SWC)	(ANSI / IEEE C37.90.1)or (IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-	No		Yes

			4-18).		
		Dry Heat Test	IEC-60068-2-2 or equivalent	No	Yes
		Damp Heat test	IEC-60068-2-30 or IEC-60068-2-78 or equivalent	No	Yes
		Vibration test	IEC-60068-2-6 or equivalent	No	Yes
		Electrostatic discharge test	IEC 61000-4-2 or equivalent	No	Yes
		Radio frequency immunity test	IEC-61000-4-6 or equivalent	No	Yes
		Electromagnetic field immunity	IEC 61000-4-3 or equivalent	No	Yes
		Degree of protection test	IS-13947	No	Yes
		Fuse Clearing Capability	Approved procedure	No	Yes
		Short Circuit current capability	IEC 60146-2	No	Yes
6	Public Address System				
	IP based PA system components	As per Standard	IEC 60268-16	No	Yes
7	Control Valves	CV test	ISA 75.02& 75.11	No	Yes
8	Flow Nozzle Orifice plates	Calibration	ASME PTC BS 1042	No	Yes

The contractor shall submit for Employers approval the reports of all the type test as per latest IS-10918 carried out within last ten years from the date of Bid opening and the test(s) should have been either conducted at an independent laboratory or in presence of owner's representative. The complete type test reports shall be for any rating of Battery in a particular group based on plate dimensions being manufactured by supplier.

Note:

Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

Temperature Measurements

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.
3. Temperature measuremnet by electrical Resistance thermometers - IS:2806.
4. Thermometer - element - Platinum resistance - IS:2848.

Pressure Measurements

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).

   b) Electonic transmitters BS:6447.
2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.
3. Process operated switch devices (Pr. Switch) BS-6134.

Flow Measurements

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

Electronic Measuring Instrument & Control Hardware/ Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.
2. Safety requirements for electrical and electronic measuring and controling instrument - ANSI C 39.5 - 1974.
3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).

5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.

6. Printed circuit boards - IPC TM - 650, IEC 326 C.

7. General requirement 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 C 73 - 1973 (Supplement ANSI C 73 a - 1980).

11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).

12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.

13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.

14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.

15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.

17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.

18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.

19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.

20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.

21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.

22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.
2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).
2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).
3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

Apparatus, enclosures and installation practices in hazardous area

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.
2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.
3. Instrinsically safe apparatus - NFPA 493 1978.
4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.
5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.
3. Water and steam in power cycle - ASME PTC 19.11.
4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.
2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472
3. Damp heat cycling test - IS:2106

4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.
2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.
3. Turbine water damage prevention - ASME TDP-1-1980.
4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.
2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.
3. Surge withstand capability test - ANSI C 37.90 1 -1989.
4. Performance testing of UPS - IEC 146.
5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.
6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.
7. Printed Circuit Board - IPC TM 650, IEC 326C.
8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.
2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.
3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).
4. Codes for pressure piping - ANSI B 31.1
5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.
2. Seamless carbon steel pipe ASTM - A - 106.
3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.
4. Material for socket welded fittings - ASTM - A - 105.
5. Seamless ferritic alloy steep pipe - ASTM - A - 335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.
7. Composition bronze of ounce metal castings - ASTM - B - 62.
8. Seamless Copper tube, bright annealed - ASTM - B - 168.
9. Seamless copper tube - ASTM - B - 75.
10. Dimension of fittings - ANSI - B - 16.11.
11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.
2. Material of socketweld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI - B - 16.11.
4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.
2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.
3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorugh 2/83.
4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).
5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.
6. Rules for Testing insulated cables and flexible cables : VVDE - 0472
7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)

8.0	**Control & Instrumentation**	
(I)	**Air-Conditioning System**	
8.1	Electronic Transmitters	
8.1.1	Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.)	5 Nos. of each type and model
8.2	Temperature elements	
8.2.1	RTD's*	5 Nos.
8.2.2	Thermo well (if applicable) * (With head assembly, terminal block and nipple)	2 Nos.
8.3	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, and differential temperature, level switch Devices.	2 Nos. of each type and model
8.4	Relative Humidity Sensors	1 No.
8.5	Geyserstat	1 No.
8.6	Local Humidity/Temperature indicators	2 Nos. each
9.0	**Variable Frequency Derive (VFD)**	
9.1	Complete VFD derive	1 No of each type & rating
9.2	Complete Converter & Inverter unit	1 No of each type & rating

9.3	Set of Cards	1 No of each type & rating
9.4	Set of fuses	2 Nos of each type & rating
9.5	Input & Output Chokes (If applicable)	1 Set

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS

STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING PLANT

1. GENERAL

1.1 This specification covers the design, manufacture, testing at Manufacturer's works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the central air conditioning plant, as specified hereinafter.

2. CODES & STANDARDS

2.1 The design, manufacture and performance of air conditioning equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Nothing in this specification shall be construed to relieve the tenderer of this responsibility. In particular the equipment shall conform to the latest editions of the following standards.

2.1.1	IS-660	:	Safety code for Mechanical Refrigeration.
2.1.2	ARI 520-90	:	Standard for Positive Displacement Refrigerant compressors and condensing units.
2.1.3	IS-5111	:	Code of Practice of Measurement for Testing Refrigeration compressors.
2.1.4	ASHRAE/23-93	:	Method of Testing for Rating Positive Displacement Refrigerant compressors and condensing units.
2.1.5	ARI-450:		Standard for water-cooled Refrigerant condensers, Remote Type.
2.1.6	ASME (Section VIII)	:	Unfired pressure Vessels Code.
2.1.7	IS-2825	:	-do-
2.1.8	IS-4503	:	Shell and tube type heat exchangers.
2.1.9	ASHRAE/22-92	:	Method of Testing for rating of Water Cooled refrigerant condensers.
2.1.10	IS-659	:	Safety code for Air conditioning.
2.1.11	IS-2379	:	Color Code for Identification of pipe lines.
2.1.12	TEMA	:	Standards of Tubular Exchanger manufacturers Association.
2.1.13	IS-1239 (Part-I)	:	Seamless steel tubes (Up to & including 168.2 mm OD.).
2.1.14	IS-3589	:	For piping above 168.2mm to 2032mm Outside Diameter.
2.1.15	IS-778	:	Valves up to 50 MM.
2.1.16	IS-780	:	Valves 50 MM to 300 MM.
2.1.17	ASHRAE 24	:	Method of Testing for Rating liquid coolers.

2.1.18 ARI-480: Standard for refrigerant cooled liquid coolers-Remote type.

3. DESIGN & CONSTRUCTION REQUIREMENTS

3.1 The components of Central air conditioning plant comprising compressor, chiller refrigerant piping, valves and fittings etc. Shall be as given in Data sheet A. The type of all accessories, controls and instrumentation shall also be as indicated in data sheet A.

3.2 The various equipments supplied under this specification shall be fully compatible with each other & capable of operating as fully balanced integrated system to deliver the specified output under design conditions.

4. TESTING AND INSPECTION

(Refer standard quality plan)

4.1 Hydrostatic, Volumetric and refrigerant leak tests etc. shall be carried out at manufacturers works before dispatch of equipment in accordance with the applicable codes and standards.

Following minimum tests amongst others shall be conducted.

4.1.1 Material analysis, testing and identification (Data sheet/ Drg. Shall clearly indicate the specification, grade, class and Heat treatment condition of material for which TC will be furnished)

4.1.2 Hydrostatic pressure test of all pressure parts.(Testing pressure shall be clearly indicated for each component/ subassembly/ assembly)

4.1.3 Static and Dynamic balancing test of rotating parts at rated and over speed and to determine vibration & noise level.(Grade of balancing, type- whether dynamic or single plane balancing for components/ subassembly/ assembly shall be clearly indicated in data sheet/ approved drg.. Permissible vibration (velocity and displacement –peak to peak and noise level in dB(A) to be indicated in Data Sheet/Approved Drg.)

4.1.4 Radiography & magna-flux examination of materials & welds.(Components to be subjected to NDT with applicable, procedures and acceptance norms to be clearly indicated in Data sheet/ approved drg. If in a component only certain areas are to be subjected to NDT same shall be clearly brought out else it will be understood that the entire component is subject to NDT)

4.1.5 Ultrasonic test of castings & forgings.(Procedure and acceptance norms with areas subject to NDT to be clearly indicated in Quality Plan).

4.1.6 Performance test including determination of capacity, efficiency & characteristics etc.(Applicable standard, Acceptance norms, Procedure for test (if not covered in applicable standard),performance characteristics with applicable tolerances and drive to be used during shop test to be clearly indicated in Quality Plan). Performance data to be indicated in Approved Drg./ Data Sheet)

4.1.7 Functional checks and adjustments of controls & instrumentation. (Functional checks required to be clearly indicated with extent of check and applicable standard in approved check list / Quality plan. Class of instruments / tolerances and performance data to be incorporated in Approved Data Sheet / Drg.)

4.1.8 Checking of working clearances.(desired working clearances to be indicated in approved Drg.)

4.1.9 Examination after selective opening up after testing.(basis/ reasons for selective opening up, areas to be examined and parameters to be checked to be brought out in Quality Plan)

4.2 TESTS AT SITE

Tests to prove guaranteed performance of the air conditioning plant, shall also be carried out at site after proper installation. The site test shall include performance testing (as per FQP) of equipment for 72 continuous hours each in all three seasons i.e. Summer, Winter and Monsoon. Unless specified elsewhere. All instruments, tools etc. as may be required to carry out site tests shall be arranged by the tenderer.

5. PERFORMANCE GUARANTEE

5.1 Each equipment of air conditioning system shall be guaranteed for its rated capacity under the specified site conditions.

5.2 If the shop/site performance tests indicate failure of equipment to meet specified requirement, it would be tenderer's responsibility to carry out required alterations at no extra cost to purchaser. Tests shall be repeated after carrying out the modifications to demonstrate the performance.

5.3 The air conditioning plant before being taken over by purchaser shall be subjected to running test for a minimum period of one week during which all readings shall be recorded. Any deficiencies noted during this period, shall be rectified by the tenderer /at no extra cost to purchaser. These running tests shall be in addition to the seasonal performance test specified under clause 4.2. The inside design conditions shall be guaranteed throughout the year.

6. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

6.1

6.2 Drawings including equipment layout, foundation & loading details etc. for civil works for the entire plant. These drawings must cover sufficient details so that design of civil works can be completed.

6.3 Inspection, operation & Maintenance Manuals.

6.4 Manuals for method of testing & calibration of all instruments.

6.5 Equipment description giving complete design calculations, basis of design, selection criteria etc.

6.6 Schematic piping diagrams.

6.7 Layout of piping.

6.8 Electrical drawings.

6.9 Test Certificates.

6.10 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

DESCRIPTION		DATA
1.	**GENERAL**	
1.1	Type of AC plant	: Chilled Water Type.
1.2	Plant configuration/capacity.	: Refer to Section-C of Specific Technical Requirements.
1.3	Location of AC plant rooms	: As per Tender drawings.
1.4		
1.5	Electrical work scope: -	
	i) MCC for AC plant	: By Others
	ii) Power cables / Control cables.	: By Others
	iii) Drives	: By Bidder.
	iv) Whether separate alarm/annunciation Panel/control panels required	: Yes (By bidder), Refer to Section-C of Specific Technical Requirements.
	v) Termination of cabling & earthling at Equipment end.	: By Bidder for bidder supplied equipment.
2.	**REFRIGERATION COMPRESSOR**	
2.1.	Type	: SCREW CHILLE
2.2.	Nos. (working + standby)	: Refer to Section-C of Specific Technical Requirements.
2.3.	Type of capacity control	: Automatic.
2.4.	Type of drive	: Direct driven.
2.5.	Restart after tripping	: Manual.
2.6.	Type of start	: As per manufacturing standard.
2.7.	Shaft Seal	: Mechanical shaft seal.
2.8.	Purge Recovery unit	: As per manufacturing standard.
2.9.	Type of lubrication	: As per manufacturing standard.
2.10.	Refrigerant used	: Environment friendly HCFC, (CFC is not acceptable)

3. DESIGN REQUIREMENTS

3.1.	Minimum capacity at Design conditions	: Refer to Section-C of Specific Technical Requirements.
3.2.	Capacity control	: Microprocessor based Control Panel sheet metal panel, located on each Compressor/chiller unit including protection devices
3.3.	Vibration isolator	:Neoprene rubber pads/Equivalent approved to suit chiller package.
3.4.	Type of foundation	: Floating / As per manufacturing standard

4.0 CONDENSER

4.1	Type	: Horizontal shell & tube type water-cooled
4.2	Number required	: One no. for each machine.
4.3	Design requirements	
4.3.1	Fluid	: Refrigerant (Shell side) Water (tube side)
4.3.2	Cooling Water Quantity	: To suit requirement.
4.3.3	Capacity of condensers	: To match compressor & to provide at least 2°C sub cooling.
4.3.4	Cooling water inlet temp.	: Refer to Section-C of Specific Technical Requirements.
4.3.5	Leaving Water Differential.	: Refer to Section-C of Specific Technical Requirements.
4.3.6	Max. flow velocity through tubes.	: 2.5 m/sec.
4.3.7	Design fouling factor	: 0.0002 (MKS Unit)
4.3.8	Maximum pressure drop.	: 0.6 Kg/cm2 (g)
4.3.9	Tube wall Thickness	: Not less than 18 SWG
4.4	Materials of construction	
	i/ Shell	: M.S. Plate fusion welded.
	ii/ Tube	: Integrally bonded Seamless copper

iii/ Head ends : Cast Iron.

iv/ Tube sheet material : Steel

v/ Baffle plate : Steel.

4.5 Accessories required

i/ Purge & drain connections with valves. : Yes

ii/ Relief valves : Yes

iii/ Liquid line shut off valve. : Yes

iv/ Isolating valves on water side. : Yes

v/ Flow switch : Yes (interlocked with control of individual refrigeration system)

vi/ Pressure/temperature gauges at inlet/outlet : Yes

vii/ Descaling tee : Yes

viii/Charging valve : Yes

ix/ MS supporting frame work : Yes

viii/Cooling thermostat : Yes

ix/ MS supporting frame work. : Yes

5.0 **CHILLER** (Applicable for chilled water type plant only.)

5.1 Type : Horizontal shell & tube flooded type

5.2 Number required/standby : One no. for each chiller package.

5.3 Design requirements

5.3.1 Fluid to be cooled : Water

5.3.2 Water flow rate (Inside tube) : To suit requirement.

5.3.3 Water inlet temperature : 12 ^{o}C approx.

5.3.4 Water outlet temperature : 7 ^{o}C approx.

5.3.5 Super heating of refrigerant material : By at least 3 deg. C.

5.3.6 Insulation /thickness/finish : As per the manufacture standard.

5.3.7 Design fouling factor : 0.00010(MKS Unit)

5.3.8 Maximum pressure drop. : 0.6 Kg/cm2 (g)

5.3.9 Tube wall Thickness : Not less than 22 SWG.

5.4 Materials of construction

i/ Shell : M.S. Plate fusion welded.

ii/ Tube : Integrally Seamless copper (internally Corrugated)

iii/ Head ends : Cast Iron.

iv/ Tube sheet material : Steel.

v/ Baffle plate : Steel.

5.5 Accessories required

i/ Purge & drain : Yes

ii/ Gate valves at water inlet/outlet. : Yes

iii/ Flow switch : Yes

iv/ Pressure/temperature gauges at inlet/outlet : Yes

v/ Anti-freeze thermostat : Yes

vi/ Thermostatic expansion valves : Yes

vii/ Pilot solenoid valve : Yes

viii/ Cooling thermostat : Yes

ix/ MS supporting frame work. : Yes

Note :-

The system shall also incorporate:

1) Auto operation of chilling plant for operation of the whole AC system.

2) A Central Control Panel with fault annunciators with provision for remote extension besides local control kiosks.

3) Water Chiller package shall be skid-mounted unit with microprocessor based control panel complete with all accessories and controls are assembled at manufacturing works on single unit.

4) Screw chiller shall be suitable for 415V $\pm$ 10 %/50 Hz $\pm$ 3%/3 phase operation with voltage & frequency variation as specified with built in starter etc.

5) Only supply feeders shall be provided for chillers.

STANDARD TECHNICAL SPECIFICATION
FOR
AIR HANDLING UNITS

1. GENERAL

1.1 This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

2. CODES AND STANDARDS

2.1 The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:

2.1.1 IS-659 : Safety code for air conditioning

2.1.2 IS-660 : Safety code for mechanical refrigeration

2.1.3 ASHRAE: Method of testing forced circulation air-cooling and air heating coils. standard 33

2.1.4 ARI 41 : Standard for forced circulation air cooling and air heating coils.

2.1.5 ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.

2.1.6 AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

3. CONSTRUCTION FEATURES

3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m^3 density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

3.2 Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (<=1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6

mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.

3.3 DX or chilled water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The chilled water/hot water coils shall have suitable (standardize class, size, threading) drain and vent connections.

3.4 The filters in the filter section shall be provided as detailed in data sheet A.

3.5 Humidifier shall be Pan type/as specified in the specification.

Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A.

Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.

3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room.Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized

3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.

The AHU shall be provided with 18 G SS drain pan.

4. **TESTING AND INSPECTION AT MANUFACTURERS WORKS:**

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection.

4.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

4.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

4.3 Shaft: Mechanical and chemical.

4.4 Motors (of approved make): Routine TC.

4.5 Workmanship and dimensional check as per manufacturing drg. and approved Drgs.

4.6 Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.

4.7 Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).

4.8 Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

4.9 Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.

4.10 Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group-K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

5. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

5.1

5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.

5.3 Inspection, operation & Maintenance Manuals.

5.4 Equipment description giving complete design calculations, basis of design, selection criteria etc.

5.5 Test Certificates.

5.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

5.7 Performance Test Certificates.

	DESCRIPTION	DATA
1.	Nos. required/working	: Refer to Section-C of Specific technical requirement.
2.	Location	: Refer to Section-C of Specific technical requirement.
3.	Service/type	: Air Conditioning /Double skin.
4.	Fan type	: Centrifugal (forward/backward curve Blade) limit load.
	a) Capacity	: To Suit as per calculation.
	b) Static pressure	: To suit but not less than 60 mm wc for AHU's Micro-V filters.
	c) Discharge direction	: To suit layout.
	d) Motor	: By Bidder,
	e) Local push button station (Start/Stop)	: By Others
	f) Motor location	: Inside AHU Casing.
	g) Drive	: Belt, pulley, belt guard.
5.	Face and Bypass Damper	: Required (Opposed blade type) DX AHU's having
6.	Cooling coil	
	a) Duty sensible heat	: To suit as per calculations
	b) Duty latent heat	: -do-
	c) Type of coil	: Chilled Water/DX/Hot Water.
	d) No. of rows	: To suit but not less than four (4)
	e) Material of tube /Thickness	: Seamless Copper to ASTME-75/Equivalent.
	f) Material of fins	: Aluminium to SAE-1100-/1145-0
	g) Number of fins	: Not greater than 5 per cm (13 per inch).
	h) Max. face velocity	: 2.5 m/sec.
	i) Air flow quantity	: To suit as per tender drawings/documents.
7.	3 - way motorised mixing valve with thermostat.	: Required with thermostat & actuator for chilled water system for each AHU.

8.	Damper at discharge	: Manually operated at discharge of each AHU outlet.
	a) Material of construction	: Mild Steel, galvanised.
9.	Filters (Pre-filters)	
	a) Type & thickness	: Dry panel type/ 50 mm
	b) Filter area.	: To suit as per velocity requirements. "V" - Bank.
	c) Filter efficiency	: Average arrestance efficiency of 65-80 %
	d) Press drop (Clean)	: Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty.
10.	Humidification section	: As per the System requirement.
	a) Type	: Pan type, unless otherwise specified.
	b) Operation	: Automatic with Humidification.
11.	Fresh air arrangement	: Required.
	a) Fresh air fan	: Tube axial flow fans with motor.
	b) Accessories	: i) Inlet cone with Bird screen. : ii) Dry panel pre-filters, : iii) High efficiency filters for control room areas. : iv) Volume Control Dampers, : v) Supports etc.
12.	Vibration isolator required.	: Yes
13.	Type of vibration isolator.	: Neoprene ribbed Rubber for AHU's.
14.	Any other requirement	: i) In addition to dry panel filters on AHU, High efficiency filters(average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all control room and allied areas. : ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat.
15.	Instrument & controls	: Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.)
16.	Insulation of drain piping	: Lot.

STANDARD TECHNICAL SPECIFICATION
FOR
COOLING TOWER

1. GENERAL

1.1 this standard specification covers the design, manufacture assembly, inspection & testing at manufacturer's works, suitable painting & packing, delivery, erection & commissioning at site of all materials and equipments for mechanical induced draught cooling tower complete with all accessories as specified hereinafter.

2. CODES & STANDARDS

2.1 the design, manufacture, inspection & testing and performance of the cooling tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American standards and codes of practice. the latest editions of the following standards & publications shall be followed in particular:

2.1.1 Cooling tower institute USA bulletin ATP-10S: Acceptance test procedure for industrial water-cooling tower.

2.1.2 PTC-23 ASME performance test code for Atmospheric water-cooling equipment.

2.1.3 In case of any conflict between the above codes & standards and-this specification, the later shall prevail.

3. DESIGN REQUIREMENTS

3.1 the cooling tower shall be designed for continuous operation to cool not less than design flow of water from specified inlet temperature to the outlet temperature at a design ambient wet bulb temperature as indicated under data sheet a.

3.2 all the components shall be capable of safe, proper and continuous operation at all cooling water flows upto & including those specified under data sheet a & shall be designed with regard to case of maintenance, repair, cleaning & inspection.

3.3 the cooling tower shall be of induced draught cross flow or counter flow type and with multiple cells (if specified in data sheet a.) the cooling tower shall be suitable for handling the fluid and also for achieving the specified parameter as per data sheet a. the cooling tower shall be designed such that the drift losses & evaporation losses are minimum.

4. CONSTRUCTIONAL FEATURES

4.1 CASING & LOUVERS

4.1.1 The cooling tower casing shall be made of FRP/as specified in data sheet A. The louvers shall be made of FRP/as specified. Louvers, if provided, shall be designed for air entry to the tower with low velocity for minimum pressure drop & less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards. Air intake shall be all along the base circumference of the casing & hotdip galvanised expanded metal mesh shall be provided to protect the air intake.

4.2 FILL

4.2.1 Cooling tower fills shall be made of noncombustible PVC/as specified in data sheet A. The design & arrangement of the fills shall be so as to expose maximum air/water surface with minimum pressure drop.

4.3 Drift Eliminators

4.3.1 Multi-pass drift eliminators with minimum two pass zig-zag path shall be provided so to minimise the drift losses.

4.3.2 In case of FRP cooling tower the drift eliminators shall be of multi-blade rotary type.

4.4 Fans & Accessories

4.4.1 The fans shall be multiple blade, low speed, high efficiency axial flow type located above the top deck level of the cooling tower. Fan rotating assembly shall be statically & dynamically balanced. The fan blades shall be preferably adjustable in stand still condition for propeller action. The fan shall be either directly mounted on the shaft of a totally enclosed weather proof motor or shall be suitable for V-belt drive.

4.4.2 The rating of drive motor shall have at least 15% margin over maximum fan power consumption. The design & construction of the drive motor shall be in accordance with enclosed specification for LVAC motors.

4.5 Water basin

4.5.1 The material of construction of water basin shall be FRP or RCC as specified in data sheet A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity for safe operation of AC plant.

4.6 Hot water distribution system

4.6.1 Manually operated flow control valves shall be provided in hot water distribution piping such that each cooling tower can be isolated without affecting the operation of other cells.

4.6.2 The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzles shall be made of brass /SS 304/316/316L (brass shall be as per manufacturer's standard) unless specified in data sheet A:

4.6.3 In case of FRP tower water shall be distributed over the fill by means of a multiple area fail safe rotary sprinkler made of PVC pipes fitted on a aluminium alloy (as per manufacturers standard) rotary head and mounted on sealed ball bearings (make) .

4.7 Access

4.7.1 A stair case paddle ladder (as per manufacturer's standard) shall be provided external to the cooling tower at one end of each tower along with stairways hand rails etc give safe & convenient access to the top deck from ground level.

4.8 Painting

4.8.1 The cooling towers shall be painted with suitable anti-corrosive paint as per approval of purchaser. All galvanized external surfaces shall be painted to match colouring scheme. Before painting galvanized surfaces -etch primer to be applied.

5. SHOP INSPECTION & TESTING

5.1 Compliance certificates for nozzles (Or rotary sprinkler), piping, fill material, drift eliminator, louvers components etc.

5.2 Certificate of conformance for all other material components.

5.3 Balancing report for Static & dynamic balancing of fan assembly.

6. TESTS AT SITE

6.1 Hydrostatic testing of complete hot water distribution piping at site.

7. PERFORMANCE GUARANTEE

7.1 The cooling tower shall be guaranteed to meet the performance requirements as specified & when tested in accordance with ATP-105.

7.2 The vendor shall furnish performance curves for the cooling tower showing variations in performance from design duty point with change in approach to wet bulb temperature, cooling range, water loading of cooling tower.

8. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

8.1 General arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works included showing extent of platforms, walkways, handrails, access doors, staircase etc. and the limits of scope of supply of electrical works.

8.2 General arrangement and sectional assembly drawings pertaining to the following components of the cooling tower:

i) Tower fill with supporting arrangement.
ii) Drift eliminator installation and details.
iii) Complete hot water distribution system including flow regulating valves, distribution basin/pipes and nozzles etc.

8.3 Cooling tower performance curves showing WBT Vs cold-water temperature for design cooling range, 90% cooling range and 110% cooling range at 100%, 90%, and 110% design flow.

8.4 Performance curves of cooling tower fans.

8.5 Test procedure along with details of tests to be conducted for the offered cooling tower.

8.6 Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.

8.7 Operation and maintenance instructions.

A. **GENERAL DATA**

1)	Service	: Cooling of condenser water of AC plant.
2)	Type	: Fibreglass reinforced plastic construction induced draught.
3)	Quantity	: Refer to Section-C of Specific Technical Requirements.
4)	Place of installation	: Refer to Section-C of Specific Technical Requirements.

B. **DESIGN DATA**

1)	Capacity at specified conditions.	: To suit the system requirement.
2)	Water flow rate	: To suit the system requirement.
3)	Design wet bulb temperature	: 25 Deg. C.
4)	Hot water inlet temperature	: To suit requirement.
5)	Cooled water temperature	: To suit requirement.
6)	Depth of sump Tank	: As per manufacturer's standard.

C. **MATERIAL**

1)	Sump tank & Casing	: FRP
2)	Louvers	: FRP/PVC/Aluminium.
3)	Type of fill	: Non-combustible PVC/Eq.
4)	Nozzles	: Brass with chrome plating/polypropylene.
5)	Ladder	: Hot dip galvanized steel ladder for each tower.
6)	Bird screen	: 25 mm square made of GI/SS wire mesh of 16 gauge.
7)	Fan impeller	: Cast Aluminium Alloy/FRP propeller type and multi-blade aerofoil construction with adjustable pitch..
8)	Supporting structure	: MS with spray galvanization of epoxy painting.
9)	Strainer	: Plant strainer made of GI/SS wire mesh of 16 gauge.

D. ACCESSORIES

1)	Make up connection	: Yes.

2)	Quick fill connection	: Yes.
3)	Overflow & drain & blow down connection	: Yes.
4)	Access door in louvers/fan deck	: Yes (if applicable).
5)	Supports & supporting structure for mounting	: Yes.
6)	Level switch	: Yes.
7)	Rain protection for motor	: Yes (suitable Canopy by Bidder)
E.	ELECTRICAL DATA	
i)	Power supply	: 415 V± 10%/50 Hz ± 3%/3 phase.
ii)	Motor	: As per specification attached.
F.	INSPECTION & TESTING	: As per approved quality plan.

STANDARD TECHNICAL SPECIFICATION
FOR
LOW PRESSURE AIR DISTRIBUTION SYSTEM

1. GENERAL

1.1 This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

2. CODES AND STANDARDS

2.1 The design, construction and performance of complete system shall conform to all currently applicable stuatues, regulations, safety codes in the locality where the equipment are to installed

2.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

a) IS: 655 - Specifications for metal air ducts.

b) IS:277 - Specifications for galvanised steel sheets.

c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

3.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Section-C of Specific Technical Requirements.

3.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

4. CONSTRUCTION/FABRICATION

4.1 The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.2 **RECTANGULAR DUCTS**

4.2.1

S.No.	Max Side	Sheet Thickness	Type of transverse	Bracings

		(mm) GI	(mm) Al	Joint connections	
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None
b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.

4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.

4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:

a) Upto 1000mm - 6 mm dia GI bolts
b) 1001 to 1500 - 8 mm dia GI bolts
c) 1501 and above - 10mm dia GI bolts

4.2.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.

4.2.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.

4.3 **ROUND DUCTS**

4.3.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.3.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.3.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.4 **DUCT SUPPORTS**

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in

direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

4.5 **FLEXIBLE CONNECTIONS**

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.6 **TRANSFORMATIONS AND BREACHES**

All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

4.7 **CAULKING**

Wherever duct passes through wall, the opening between masonary and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.8 **EASEMENT**

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

4.9 **ACCESS DOORS**

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.10 **DAMPERS AND SPLITTERS**

4.10.1 Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

4.10.2 FIRE DAMPERS

Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal

sensor or fusible link type.

4.10.3 VANES

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

4.10.4 FLASHING

For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

4.11 **DIFFUSERS AND GRILLS**

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

4.12 **PLENUMS AND RA BOXING**

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonary construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box ~~shall be~~ fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

4.13 **ACCOUSTIC LINING**

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

4.14 **PAINTING**

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

4.15 **THERMAL INSULATION**

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

5. INSPECTION AND TESTING

5.1 **INSPECTION & TESTING DURING FABRICATION**

5.1.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

5.1.3 Check for dimensions & mass as per latest IS-277.

5.1.4 Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5 Bend test & wrapping test as per IS-277.

5.1.6 Zinc coating test on samples as per IS-6745.

5.2 **INSPECTION & TESTING AT SITE.**

5.2.1 The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.

5.2.2 After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.

6. BALANCING

6.1.1 The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit

6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.

7. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.

7.2 Test certificates in line with scope of inspection.

7.3 Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.

Description		Data
1.	General (List of areas)	: As per Specification/Tender drawing.
2.	GSS Duct Work	
	a) Type	: GSS as per IS: 277 (Zinc coating as per Section-C of Specific Technical Requirements.)
	b) Size	: As per Section-C of Specific Technical Requirements and bill of quantity.
3.	Acoustic lining	: Up to 5m length from AHU Outlet.
4.	Special painting	: Galvanised.
5.	Thermal Insulation	: Required in supply air duct in AC entire length.
6.	Diffusers (Circular/Square) 300 mm size 350 mm size 450 mm size 550 mm size 600 mm size Any other size	: Bidder to estimate as per drawings./specification. All grille frame and louvers shall be manufactured of at least 16 SWG Aluminium
7.	SA grilles (for each size)	: To suit air flow as per System requirements / Tender Drawings.
8.	RA grilles (for each size)	: -do-

NOTE:

1. Duct sheet thickness shall be as per IS-655
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-C.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.

8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

STANDARD TECHNICAL SPECIFICATION
FOR
CENTRIFUGAL PUMPS

1. GENERAL

1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's or his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

2. CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.

2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.

2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.

2.1.4 BS - 599 : Method of testing Pumps.

2.1.5 PTC - '6' : Centrifugal Pumps Power test code

2.1.6 API - 610

2.1.7 Hydraulic Institute Standards of USA

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineering shall be final and binding.

3. DESIGN REQUIREMENTS

3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.

3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..

3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.

3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

4. CONSTRUCTION FEATURES:

4.1 **PUMP CASING**

4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.

4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.

4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610

4.2 **IMPELLER**

4.2.1 Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.

4.3 **WEARING RING**

4.3.1 Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend

beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

4.4 **SHAFT**

4.4.1 Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runway speed.

4.5 **BEARING**

4.5.1 Bearings and hydraulic devices**,** of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

4.6 **STUFFING BOX**

4.6.1 Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.

4.7 **SHAFT COUPLING**

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 **BASE PLATE AND SOLE PLATE**

4.8.1 Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 **PRIME MOVER**

4.9.1 The drive motor selected shall conform to the requirements of the enclosed motor specifications.

4.10 **LIFTING ARRANGEMENT**

4.10.1 Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..

5. PERFORMANCE REQUIREMENTS

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6. DRIVE RATING

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.

6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7. SCOPE OF INSPECTION AND TESTING

7.1 **CASTING**

7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers

unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.

7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.

7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.

7.1.4 Verification of Heat treatment charts (as applicable)

7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.1.6 Surface finish of Steel castings shall meet MSS SP-55.

7.2 **FORGING**

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.3 **FABRICATED ITEMS**

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.

7.4 **IN PROCESS INSPECTION AND TESTING**

7.4.1 Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness)

as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable

a) Cracks, flakes, seams and laps

b) Defects giving indications longer than that from a 4mm equivalent flaw.

c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.

d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

7.5 **PERFORMANCE TEST**

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked.

a) Capacity V/s Head

b) Capacity V/s Power absorbed by pump

c) Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.

7.5.2 NPSH test in case specifically mentioned elsewhere.

7.5.3 Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.

7.5.4 Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 **TEST AT SITE**

7.6.1 The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

7.7 **PERFORMANCE GUARANTEE**

7.7.1 The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head

8. **CLEANING, PROTECTION , PAINTING & PACKING**

8.1 Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.

9. DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:

a) Foundation base plate and sole plate details as applicable

b) Civil foundation and anchor bolts details and loading data

c) Minimum submergence required for the pump (if applicable)

9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.

9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.

9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.

9.5 Experience list about the supply and successful operation of similar pumps for similar application.

9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.

9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.

9.8 Data sheet-B with all the particulars filled in.

10. MANUFACTURERS NAME AND TAG. PLATES

10.1 Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English:

a) Manufacturer's name and trade mark.

b) Design Capacity and Head.

c) Design.

d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

11. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

11.1 Certified GA drawings of pump motor assembly weights, crane.

11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes.

11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.

11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.

11.5 Material and other test certificates as required by the application clauses of this specification.

11.6 Motor speed torque curves super imposed on pump speed torque curves.

11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.

11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.

DESCRIPTION		DATA
1.	Designation	: Condenser water and Chilled Water pumps for AC plant.
2.	Type	: Horizontal, Centrifugal pump or vertical split type casing pump .
3.	Quantity	: Refer to section-C of Specific Technical Requirements
4.	Installation	: On floating type foundation.
5.	Fluid to be handled	: Water
6.	Temperature of fluid	: To suit.
7.	Capacity M3/hr and TDH at rated	: To suit system requirements but head shall not be less than 25 MWC.
8.	Duty	: Continuous (24 hours / day)
9.	Suction condition	: Flooded
10.	Type of drive	: Direct
11.	Prime Mover	: LV AC motor
12.	Maximum speed	: 1500 RPM
13.	Type of lubrication	: Grease Lubrication
14.	Material	
	a) Impeller	: Bronze to Grade IS: 318 Grade 2
	b) Pump shaft	: EN - 8 / Equivalent (Approved).
	c) Casing	: CAST IRON TO IS: 210 Grade - 260.
	d) Wearing ring	: Bronze to Grade IS:318 GR-2, Renewable type.
	e) Shaft Sleeve	: -do-
	f) Base plate	: Cast Iron to Grade FG-200 IS-210/M.S. fabricated.
	g) Bolt and nuts.	: MS
	h) Stuffing Box gland/bush case.	: Deep Bronze packing to be renewable with

i) Stuffing box Packing. : Flexible Graphite or PTFE (Asbestos shall not be used)

j) Pump motor coupling. : Flexible.

15. **ACCESSORIES REQUIRED:-**

The following accessories shall be provided by the bidder for each pump:

a) Suction & Discharge pressure gauges. : Yes.

b) Vent connection : Yes.

c) Drain piping up to common drain point in plant room. : Yes

d) Companion flanges. : Yes

e) Common base plate. : Yes.

f) Suction strainer. : Yes

g) Isolating valve : Yes

h) NRV at pump outlet at inlet/outlet : Yes

i) Any special requirements : The Chilled Water pumps shall be suitably insulated as per spec.

j) Inspection & Testing : As per specification enclosed elsewhere.

STANDARD TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT

1 GENERAL

1.1 This specification covers the design, manufacture, inspection and testing at the manufacturer's works and suitable packing delivery and testing of the packaged air conditioning unit.

2 CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following standards:

2.1.1 I.S.660 : Safety code for Mechanical Refrigeration.

2.1.2 I.S.5111 : Code of practice for measurement, and testing of refrigerant compressor.

2.1.3 I.S.659 : Safety code for air conditioning.

2.1.4 I.S.2494 : V Belt for industrial purpose.

2.1.5 I.S.3142 : V grooved pullies for V Belts.

2.1.6 I.S.4503 : Shell and tube type heat exchanger.

2.1.7 ARI 210 : Standard for/unitary air conditioning equipment

2.1.8 ARI 270 : Standard for application installation and servicing of unitary equipment.

2.1.9 ASHRAE-37 : Standard methods of testing for rating unitary air conditioning and heat pump / equipment.

2.1.10 ANSI-B9-1 : Safety code for mechanical refrigeration.

3 DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1 Compressor

The compressor shall be hermatic or semi-hermatic or screw rotary type or scroll type. The same shall be suitable for R410A/R407C/R134A refrigerant. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessable with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.

3.2 **CONDENSING UNIT**

Shell and tube type water cooled condenser or air cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with

multipass heads and shall be fitted with the following:

3.2.1 Hot gas inlet and liquid outlet connection with shut off valve for liquid.

3.2.2 Drain plug, air vent and test valve.

3.2.3 Water inlet and outlet connection with thermowell and suitable cocks respectively.

3.2.4 Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)

3.2.5 Any other accessory as recommended by the manufacturer for proper functioning of the equipment.

3.3 AIR HANDLING FAN

The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.

3.4 FILTERS

Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).

3.5 COOLING COIL

The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).

3.6 CONTROLS

All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere.

The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable

3.7 REFRIGERANT PIPING

The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with FREON gas and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.

3.8 CABINET

All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint . Painting shall be as per manufacturers std unless specified otherwise in data sheet 'A'. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.

The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts.

All the electric wires within the cabinet shall run in flexible conduits and carry identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.

3.9 **OTHER ACCESSORIES**

Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads.

4 CONTROL AND INTERLOCK REQUIREMENTS

The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc.

The interlocking requirement shall be as indicated below:

4.1 The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch.

4.2 The compressor shall not start unless the evaporator fan is started.

4.3 The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan.

4.4 Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat

4.5 A humidifying package, if specified in data sheet A, shall be controlled by humidistat.

5 TEST AND INPSECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

5.1.4 Visual and Free running test of the packaged unit on test bed.

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

5.1.7 NOISE LEVEL- <=85 dB(A).

5.1.8 Other tests as per approved qualities plan/scope of inspection.

5.2 Inspection and Testing at Site

5.2.1 Performance testing of the packaged unit for 72 hours in summer / monsoon & 24 hours in winter. Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating.

The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data.

5.2.1.1 Condenser inlet and outlet pressure and temperature

5.2.1.2 Entering and leaving air temperature of the cooling coil air filters.

5.2.1.3 Motor current for the compressor and blower.

5.2.1.4 Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters.

Room temperature (Dry & wet bulb)

5.2.1.5 Test to ensure all controls and safety instruments are working properly.

During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected.

All tools and instruments required for the above testing will be provided by the vendor.

6 PAINTING:

The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.

7 GUARANTEES

The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained.

The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.

8 NAME PLATES

Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final technical data as per Data Sheet-B

9.2 G.A. and interior view of packaged unit

9.3 Electrical wiring diagram

9.4 Catalogues for all controls

9.5 O & M Manual

9.6 Erection Manual

DESCRIPTION		DATA
1)	Capacity of the unit at operating conditions.	: As specified
2)	Numbers required	: Refer to Section-C of Specific Technical Requirements
3)	Designation of the unit	: Package AC Unit
4)	Whether air cooled/water cooled	: Refer to Section-C of Specific Technical Requirements
5)	The plant shall be suitable for maximum- - ambient temp.	: Refer outdoor design condition as specified.
6)	Whether a plenum Chamber required	: Units shall be connected to fresh air ducts.
	OR	
	Whether to be connected duct system.	: Yes.
7)	Whether Humidifier required for humidity- -control.	: Refer to Section-C of Specific Technical Requirements
8)	Whether strip heaters required for winter heating.	: Refer to Section-C of Specific Technical Requirements
9)	Whether strip heater required for Humidity control.	: Refer to Section-C of Specific Technical Requirements
10)	Final painting colour shade stage.	: Subject to approval / during detail engineering
11)	Whether fan static pressure is to be designed for filters arrangement shown.	: Yes.
12)	Installation supporting structure/ drain piping, insulation.	: Required. Drain piping with insulation up to the nearest drain point.
13)	Controls & Instruments	: Yes (Lot)
14)	Isolation Switch	: Yes

STANDARD TECHNICAL SPECIFICATION FOR AIR FILTER

1. GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system.

2. CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3. GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1 POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency Em (%) shall be >/= 80 as per BS EN - 779.

3.2 DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency Em (%) of >/= 95 as per BS EN - 779.

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be >/= 90.

However oil wetted air filters shall have Average Efficiency Em (%) >/= 90 as per BS EN - 779..

3.4 AUTOMATIC CLEANING FILTERS

This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endles steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gladge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

3.5 ABSOLUTE FILTERS

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctyphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

3.6 WATER REPELLANT NYLON FILTERS

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

4. INSPECTION & TESTING

The scope of inspection for air filters shall be as below:

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing of type tests on one per type per size air filters for the following properties.

a) Gravimetric efficiency.

b) Pressure drop in clean & dirty (choked - %age to be specified) condition.

c) Efficiency as per BS EN - 779.

4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).

5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

5.1 GA Drawing.

5.2 Drawing showing material/construction detail

5.3 Installation and\service manual

5.4 Rating curves/charts

5.5 Test certificates

5.6 Elect. diagrams (when automatic cleaning type)

DESCRIPTION		DATA
1)	**General**	
1.1	Service	: Air Conditioning.
1.2	Location	: Central Air conditioning plant, & package AC plant, fresh air fan system. Also for split AC.
1.3	Nos.	: Refer Section 'C' of Specification.
1.4	Total air flow/type	: Refer Section 'C' of Specification.
1.5	Temperature	: As per project information.
1.6	Relative Humidity	: 100%
1.7	Gas Composition	: Atmospheric Air (Dusty) as prevalent in power Station.
1.8	Filter Media	: Synthetic non-woven
1.9	Efficiency	: Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80-90 % for fine filters.
1.10	Allowable pressue drop	: 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters). 12 mm in clean condition for fine filters.
1.11	Frame Work	: 18 G, GSS.
1.12	Mounting	: Ladder Type M.S Angles (galvanised)
1.13	Size	: 600 x 600 mm

Note:-

1) Face velocity of air across the filters shall not exceed 2.5 m/sec.

STANDARD TECHNICAL SPECIFICATION FOR THERMAL INSULATION FOR COLD SURFACES

1. SCOPE

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

2. CODES & STANDARDS

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

IS:3069: GLOSSARY OF TERMS & SYMBOLS & UNITS RELATING TO THERMAL INSULATION

materials.

2.1 IS:4671: Expanded polystyrene for thermal insulation purposes.

2.2 IS:3677: Mineral wool for thermal insulation.

2.3 IS:8183: Resin bonded mineral wool.

3. DESIGN REQUIREMENTS

3.1 The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.

3.2 The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.

3.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1 The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.

4.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.3 Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.

4.4 Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with

bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.5 In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.

5. VAPOR SEALING & INSULATION FINISH

The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-

5.1 FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

5.1.1 A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.

5.1.2 The surface shall then be wrapped with 20mm (3/4"_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.

5.1.3 12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

5.2 FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.

5.2.1 The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:

5.2.2 The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.

5.2.3 12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.

5.3 FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH

5.3.1 The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.

5.3.2 The polythene shall be covered with 24 gauge GI/aluminum sheet

5.3.3 25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.

5.4 FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND

For ducts & piping exposed to atmosphere, the finish shall be as follows:

5.4.1 A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.

5.4.2 The surface shall then be wrapped with 20mm (32/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 223 SWG GI lacing wire.

5.4.3 12.5mm thick (1/*2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.

5.4.4 3 mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.

6. INSULATION OF PUMPS & VALVES

6.1 For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

6.2 The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.

7. INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

7.1 All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer's works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8. PAINTING

8.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final version of data sheet 'B' incorporating changes if any along with design data.

9.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following:-

a) Thermal conductivity test.

b) Sound absorption coefficient test.

c) Corrosion test.

d) Sulphur content, moisture content, shot content, moisture absorption etc.

e) Compressive strength & cross breaking strength test.

9.3 Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.

9.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work.

9.5 Instructions on maintenance of insulation work.

Insulation Material

Insulation	Code	Thermal Conductivity MW/cm ^{0}C	Density Kg/m^3
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 ^{0}C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 ^{0}C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 ^{0}C	At least 15

Type of Insulation

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded roll Mineral Wool (IS:8183)		25
ii)	Refrigerant Piping	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
iii)	AHU drain pipe	a) Expanded Polystyrene	Pipe Section	25
		or		
		b) Mineral Wool	Pipe Section	25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene	Slabs	25
		or		
		b) Mineral Wool	Slabs	25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
vi)	Chiller	a) Expanded Polystyrene	Slabs	100
		or		
		b) Mineral Wool	Slabs	100
vii)	Chilled Water Pumps	a) Expanded Polystyrene	Slabs	50
		or		
		b) Mineral Wool	Slabs	50
viii)	Expansion tank with pipe	a) Expanded Polystyrene	Slabs/Pipe Section	50
		or		
		b) Mineral Wool	Slabs/Pipe Section	50

SECTION-I
SUB SECTION -E

LIST OF MAKES OF SUB-VENDOR ITEMS

LIST OF APPROVED MAKES

LIST OF APPROVED MAKES

S. N. क्र.सं.	Item / मद	QP/ Insp. Cat. क्यूपी/ निरी. श्रेणी.	QP No. / क्यूपी. सं.	QP Sub. Schedule क्यूपी उप.अनुसूचि	Proposed sub-supplier/ प्रस्तावित उप आपूर्तिकर्ता	Place/ स्थान	Sub-suppliers approval status / category उप आपूर्तिकर्ता के अनुमोदन की स्थिति /श्रेणी (NOTE-1)	Sub-supplier Details submission schedule/ उप आपूर्तिकर्ता के विवरण प्रस्तुतीकरण की सूची	Remarks/ टिप्पणी	Applicable Systems
3	FAN- AXIAL TYPE > = 5KW				CB DOCTOR VENTILLATOR PVT LTD	AHMEDABAD	A		up to 50000 CMH	WTP,CT.AC&VENTILATION,CHP,LHP&GHP,AHP
					HOWDEN SOLYVENT FLAKT INDIA PVT LTD,	CHENNAI	A		up to 125000 CMH	
					C DOCTOR &CO PVT LTD	KOLKATA	A		up to 50000 CMH	
					KRUGER VENTILATION INDUSTRIES (I) PVT LTD	SHAHPUR, THANE	A		Up to 6000 CMH	

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		I			NADI AIRTECHNICS PVT LTD	CHENNAI	A		Up to 15000 CMH	
					ADVANCE VENTILATION PVT LTD	KUNDALI. SONEPAT	A		up to 40000 CMH	
					SK SYSTEMS PVT LTD	KUNDALI PHASE-II, SONEPAT, HARYANA	A		up to 50000 CMH	
					ALMONAROD (P) LIMITED	CHENNAI	A		Up to 14000 CMH	
5	PIPES & FITTINGS-GRP	I			EPP COMPOSITES PVT LTD	RAJKOT			UP TO 900MM	WTP,CT
					GRAPHITE INDIA	NASIK			UP TO 1000MM	
					SHRIRAM SEPL COMPOSITES LTD	CHENNAI			UP TO 1100MM	
					BALAJI FIBER REINFORCE PVT LIMITED	VADODARA			UP TO 650MM	
					MEGHA FIBRE GLASS INDUSTRIES PVT LTD	MEDAK			UP TO 900MM	

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7	PUMPS- HORIZONTAL & VERTICAL CENTRIFUGAL -UP TO 300KW	(UP TO 60 KW CAT-II , ABOVE 60 KW CAT-I)			KIRLOSKAR BROTHERS LTD	KIRLOSKARWADI	A			WTP,CW, CPU,FDPS,CHP, LHP &GHP,AC & VENTILATION,MUW, AHP
					WILO MATHER & PLATT	PUNE	A			
					WILO MATHER & PLATT	KOLHAPUR	A			
					SAM TURBO	COIMBATORE	A		FLOW UP TO 1500 CUM/HR AND POWER RATING UP TO 425 KW	
					FLOWMORE LTD	GHAZIABAD	A			
					BEST AND CROMPTON	CHENNAI	A			
					JYOTI LTD	VADODARA	A			
					WPIL	GHAZIABAD	A			
					KISHORE PUMPS	PUNE	A		UPTO 500M3/HR ONLY RUBBERLINED PUMPS ALSO	
					GRUNDFOS PUMPS INDIA PVT LTD	CHENNAI	A		HORIZONTAL UP TO 30 KW ONLY AND VERTICAL UP TO 45 KW ONLY (FOR	
					SINTECH PRECISION	GHAZIABAD	A		HORIZONTAL UP TO 400 KW MOTOR RATING AND VERTICAL UP TO 30 KW MOTOR RATING	
					KSB	PUNE	A			
					KSB	NASHIK	A			
					FLOWSERVE INDIA CONTROLS PVT LTD	COIMBATORE	A		HOIZONTAL CENTRIFUGAL PUMP UP TO 75 KW ONLY	
					SU MOTOR	MUMBAI	A		HORIZONATL UPTO 500M3/HR ONLY RUBBERLINED PUMPS AND VERTICAL CENTRIFUGAL PUMPS UP TO 100CMH ONLY	
					BHARAT PUMPS AND COMPRESSORS	NAINI	A		FLOW UP TO 2200 M3/HR AND HEAD UP TO 60 MWC	
8	PUMPS -VT -UP TO 300KW	I			FLOWMORE LTD	GHAZIABAD	A			WTP, CW
					KIRLOSKAR BROTHERS LIMITED	KIRLOSKARWADI	A			
					WPIL LTD	KOLKATA	A			
					WPIL LTD	GHAZIABAD	A			
					JYOTI LTD	VADODARA	A			
					XYLEM WATER SOLUTIONS INDIA PVT LTD	VADODARA	A			
					FLOWSERVE INDIA CONTROLS PVT LTD	COIMBATORE	A		UP TO 1025 KW	
					SINTECH PRECISION	GHAZIABAD	A			
					WILO MATHER & PLATT	PUNE	A			

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9.A	VALVE-DUAL PLATE CHECK > 600MM OR CLASS > 300 (VALVE- DUAL PLATE CHECK UP TO 600MM & CLASS 300: CAT-II & MAIN CONTRACTOR APPROVED SOURCES)	I			ADVANCE VALVE PVT LTD	GR. NOIDA	A		DUAL PLATE CHECK VALVES CI UPTO 1000 NB CLASS 125, DUPLEX SS UP TO 600NB CLASS 600.	WTP,CW, CPU,FDPS,CAS,LP PIPING
					LEADER VALVES	JALANDHAR	A		UP TO 900MM CLASS 150 , SS 200NB CLASS#300	
					R & D MULTIPLE	VALSAD	A		CI/ CS UP TO 800NB PN 10	
9.B	VALVE-BALL > 100 MM OR CLASS > 800; (VALVE- BALL UP TO 100 MM & CLASS 800:CAT-II & MAIN CONTRACTOR APPROVED SOURCES)	I			TRILLIUM FLOW	HUBLI	A		SS BALL VALVES UP TO 500MM AND CLASS #600, CS BALL VALVES UP TO 250 MM AND CLASS# 900, CS/ SS BALL VALVES UP TO 100 MM AND CLASS # 1500.	WTP, CPU,FDPS,CAS,FOH,CHP, LHP&GHP,AHP
					MICRO FINISH VALVES PVT. LTD.	HUBLI	A		400NB CLASS#600 AND UP TO 600NB CLASS#300	
					FLOW CHEM INDUSTRIES	KALOL	A		100NB CLASS#600,200NB CLASS#300, 50 NB CLASS#800	
					L&T VALVES LIMITED	COIMBATORE	A		UPTO 150NB, CLASS #150/300, AND UPTO 50NB, CLASS #800	
					PRECISSION ENGG CO VALVES PVT LTD	NASIK	A		FCS UP TO 50NB CLASS 800, CCS UP TO 400NB CLASS 150.	
					BELGAUM AQUA VALVE PVT LTD	BELGAON	A		FCS UP TO 50NB CLASS 800, CCS UP TO 200NB CLASS 150.	
					G M ENGINEERING PRIVATE LTD	RAJKOT	A		UP T0 400 NB AND CLASS #600	
9.C	VALVE-BUTTERFLY > 600MM OR CLASS>150 (VALVE-BUTTERFLY UP TO 600MM & CLASS 150::CAT-II & MAIN CONTRACTOR APPROVED SOURCES)	I			INTERVALVE POONAWALA LTD	PUNE	A		SGI / CI / D2 1400MM PN10, SGI / CI 1000MM PN16,CS/SS 500MM PN16, SS 400MM CLASS#300, MS FABRICATED UPTO 2000NB	WTP, CW,CT,CPU,FDPS,CAS, AC& VENTILATION, MUW,CHP, LHP&GHP,LP PIPING,AHP
					TRILLIUM FLOW	HUBLI	A		CI/ DI BUTTERFLY VALVE UP TO 1000MM AND PN16 AND UP TO 1800MM AND PN10,CCS UP TO 1050MM CLASS 150 AND UP TO 1800MM AND PN16 SS - UP TO 400NB PN-16 ,FABRICATED 800MM CLASS#150.	
					PENTAIR VALVES	HALOL	A		FOR SS UP TO 500 NB PN-10, CI- UP TO 900NB PN-10, UP TO 500NB PN-16, 450MM CLASS#300., MS FABRICATED UPTO 2800NB, PN6.	
					FOURES ENGINEERING	BANGALORE	A		CAST SGI/CI/ MS FABRICATED- UP TO 1200 PN-10, UP TO 350 PN-16 ,2400 MM	
					KIRLOSKAR BROTHERS LTD	KONDHAPURI	A		CAST SGI/CI/CS 1400 MM PN16 , SS 300 MM PN16 , 1800MM CLASS 150, MS FABRICATED 900 NB PN40,MS FABRICATED 2800NB, PN6.	
					R & D MULTIPLE	VALSAD	A		CAST SGI/CI/MS FABRICATED- UP TO 1800 MM PN-10/CLASS # 75, ,1100MM PN25,1400MM CLASS#150 ,MS FABRICATED	
					ADVANCE VALVES PVT LTD	GREATER NOIDA	A		METAL SEATED, TRIPLE ECCENTRIC, SS BFV OF SIZE UPTO 100NB, AND PRESSURE RATING UPTO CLASS #300.	
					BRAY CONTROLS INDIA PVT. LTD	KANCHIPURAM	A		UPTO 450 MM AND CLASS#600	
					INSTRUMENTATION LTD.	PALAKKAD	A		UPTO 2200NB CLASS # 75	
					HAWA ENGINEERS	AHMEDABAD	A		CI/ CS & FABRICATED UPTO 1200MM, CLASS #150, SS UPTO 250MM, CLASS#150	
					CRANE PROCESS FLOW	SATARA	A		UP TO 900MM PN10	

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					L & T VALVES LIMITED	COIMBATORE	A		UP TO 900MM CLASS 150	
					DEMBLA VALVES	THANE	A		UP TO 2200MM CLASS#75	
9.D	VALVE-CONVENTIONAL GATE / GLOBE / CHECK > 600NB OR CLASS > 300	II			LEADER VALVES	JALANDHAR	A		CS GATE 600MM CLASS#600, SS GLOBE 600MM CLASS#600, CS CHECK 600MM AND CLASS#600	WTP, CW,CT,CPU,FDPS,CAS, AC& VENTILATION, MUW,CHP, LHP&GHP,LP PIPING,AHP
					HAWA ENGINEERS	AHMEDABAD	A		FCS / FSS 50 NB CLASS 800.	
					FOURES ENGINEERINGS	THANE	A		400NB CLASS 600 AND 50NB CLASS 800.	
					BHEL IVP	GOINDWAL	A		GATE UP TO 300 NB CLASS 600. GLOBE 250 NB CLASS 400, CHECK 150NB CLASS 600.	
					HITECH ENGG PVT LTD	AHEMDABAD	A		50 NB CLASS 800.	
					KSB PUMPS LTD	COIMBATORE	A		300NB CLASS 2500.	
					NITON VALVES INDIA PVT LTD	NAVI MUMBAI / AURANGABAD	A		CS GATE 900 NB CLASS 600, CHECK 300 NB CLASS 600.	
					L&T VALVES LIMITED	COIMBATORE			650 MM CLASS 600, 50 NB CLASS 800.	
					TRILLIUM FLOW	HUBLI	A		CONVENTIONAL CCS GATE / GLOBE / CHECK VALVES UP TO 600MM AND CLASS # 1500, CSS GATE/ GLOBE/ CHECK VALVES UP TO 200MM AND CLASS # 600, FCS GATE / GLOBE / CHECK VALVES UP TO 50MM AND CLASS # 2500.	
9.E	VALVE- DIAPHGRAGM TYPE	I			CRANE PROCESS FLOW	SATARA	A		UP TO 300NB PN10	WTP,CPU
					WEIR BDK	HUBLI	A		UPTO 250 NB - PN 10, 350MM PN6	
					PROCON ENGINEERS	MUMBAI	A		UPTO 200 NB AND PN 10/CLASS #150	
9.F	VALVE-PLUG > 100 MM OR CLASS > 800(VALVE-PLUG UP TO 100 MM & CLASS 800:CAT-II & MAIN CONTRACTOR APPROVED SOURCES)	I			TRILLIUM FLOW	HUBLI	A		SOFT SEATED 400MM AND CLASS #150, 300NB CLASS#300	WTP,CPU,CHP, LHP&GHP, FOH,AHP
					XOMOX SANMAR	TRICHY	A		UP TO 600MM AND CLASS#300	
					FLOWSERVE INDIA CONTROLS	CHENNAI	A		METALLIC SEATED 400NB CLASS#150, 300NB CLASS #300, 50NB CLASS #800	
10	PUMP -SUBMERSIBLE>= 30KW	I			KSB	NASHIK	A		130 KW	WTP,CT, CPU,CHP, LHP&GHP, FOH,AHP.LP PIPING,FDPS
					KIRLOSKAR BROTHERS LTD	KIRLOSKARWADI	A			
					AQUA MACHINERY	AHMEDABAD	A		UP TO 235 KW	
					WPIL	GHAZIABAD	A			

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26	CENTRIFUGAL FAN (≥ 5KW) MOTOR FROM NTPC ACCEPTED SOURCE	I			MARATHON ELECTRIC MOTOR(I) LTD	KOLKATA	A		UP TO 50000 CMH	AC& VENTILATION, CHP, LHP&GHP,,AHP
					HOWDEN SOLYVENT FLAKT INDIA PVT LTD,	CHENNAI	A		UP TO 200000 CMH	
					ALMONAROD (P) LIMITED	CHENNAI	A		UP TO 60000 CMH	
					PATEL AIRFLOW	VATWA, AHMEDABAD	A		UP TO 250000 CMH	
					CB DOCTOR VENTILATOR PVT LTD	AHMEDABAD	A		UP TO 150000 CMH	
					WOLTER VENTILATORS INDIA (P) LTD	BHIWADI,	A		UP TO 200000 CMH	
					C DOCTOR &CO PVT LTD	KOLKATA	A		UP TO 250000 CMH	
					SUVIDHA AIR ENGINEERS	AHMEDABAD	A		UP TO 190000 CMH	

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					SUBURBAN INDUSTRIAL WORKS PVT. LTD	KOLKATA	A		UP TO 100000 CMH	
					KRUGER VENTILATION INDUSTRIES (I) PVT LTD	THANE	A		UP TO 90000 CMH	
					SOLYVENT FLAKT	KOLKATA	A		UP TO 200000 CMH	
					ADVANCE VENTILATION PVT LTD	SONEPAT	A		UP TO 250000 CMH	
					SK SYSTEMS PVT LTD	SONEPAT	A		UP TO 250000 CMH	
34	SCREW CHILLER	II			KIRLOSKAR CHILLER	PUNE	A		UP TO 350TR	AC& VENTILATION
					DAIKIN	NEEMRANA	A		UP TO 185 TR	

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					BLUE STAR (COMPRESSOR FROM HANBEL-TAIWAN)	WADA	A		SCREW CHILLER UP TO 282TR	

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4	PIPES-MS- (BLACK/ GI) AS PER IS:1239 & IS:3589 UPTO 1000 NB	II			(BIS MARKED, MANUFACTURERS WITH VALID BIS LICENSE)					WTP,CW,CT,CPU,FDPS,AC&VENTILATION,CHP,LHP&GHP,AHP
26	PIPE-SS ASTM A 312	II			MAIN CONTRACTOR's APPROVED SOURCES					
27	PIPE-CS SEAMLESS ASTM A 106	II			MAIN CONTRACTOR's APPROVED SOURCES					
Note-1	Items for which Sub-QR is enviisaged, vendors are accepted subject to Sub-QR clearance from NTPC Engg.									
A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list along with the condition of approval, if any./ इन मदों के लिए प्रस्तावित वेंडर एनटीपीसी को स्वीकार्य है। अनुमोदन की शर्त, , यदि कोई हो, के साथ-साथ पत्र "क" में इंगित किया जाए ।										
DR – For these items "Detailed required" for NTPC review. To be identified with letter "DR" in the list. एनटीपीसी द्वारा इन मदों की समीक्षा के लिए "विस्तृत ब्यौरे की आवश्यकता" होगी। सूची में "DR" पत्र में इंगित किया जाना चाहिए।										
QP / INSPECTION CATEGORY:										
CAT-I / श्रेणी- I: For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC. इन मदों के लिए गुणवत्ता योजनाओं को एनटीपीसी द्वारा अनुमोदित किया जाता है और एनटीपीसी द्वारा अंतिम स्वीकृति भौतिक निरीक्षण के दौरान उपलब्ध गवाह										
CAT-II / श्रेणी- II: For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP. इन मदों के लिए गुणवत्ता योजनाओं को एनटीपीसी द्वारा अनुमोदित किया										
CAT-III/ श्रेणी-III : For these items Quality control to be exercised as per Main contractor Quality Assurance System. The final acceptance by NTPC shall be on the basis of Certificate of Conformance (COC) by Main Contractor.										
UNITS/WORKS इकाईयां / कार्य: Place of manufacturing/ निर्माण का स्थान Place of Main Supplier of multi units/works/बहु- इकाइयों / कार्यों के मुख्य सप्लाइर का स्थान.										
FORMAT NO./ प्रारूप सं: QS-01-QAI-P-1B/F1-R0						Engg. Div. / QA&I				

एनटीपीसी NTPC	Project/ परियोजना : Talcher - III Package/ पैकेज : TALCHER III EPC PACKAGE Supplier/ आपूर्तिकर्ता: Contract No./ अनुबंध सं.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL क्वालिटी प्लान तथा सब –वेंडर के अनुमोदन सहित मदों की सूची SUB-SYSTEM उप-प्रणाली: ELECTRICAL	Doc. No./ दस्तावेज सं.: REVISION NO : 01 DATE/ तिथि : 03.02.2022

S. N. क्र.सं	Item / मद	QP/ Insp. Cat. क्यूपी/ निरी. श्रेणी.	QP No. / क्यूपी. सं.	QP Sub. Schedule क्यूपी उप.अनुसूचि	Proposed sub-supplier/ प्रस्तावित उप आपूर्तिकर्ता	Place/ स्थान	Sub-suppliers approval status / category उप आपूर्तिकर्ता के अनुमोदन की स्थिति /श्रेणी	Sub-supplier Details sub sch/ उप आपूर्तिकर्ता के विवरण प्रस्तुतीकरण की सूची	Remarks/ टिप्पणी
	132 KV cable termination & straight through								
					Powergear	Chennai / Bangalore	A		
					KGS Engg.	Chennai	A		
36	LT MOTOR	CAT I							
					ABB	FARIDABAD	A		UPTO 55KW
					ABB	BANGALORE	A		
					JYOTI LTD.	VADODARA	A		
					TIPM	JAPAN	A		UPTO 15 KW (NON FLAME PROOF)
					HYOSUNG	SOUTH KOREA	A		
					WEG	BRAZIL	A		
					HYUNDAI	SOUTH KOREA	A		
					LHP	SOLAPUR	A		
					CGL	AHMEDNAGAR	A		RQP, FOR FLAME PROOF MOTOR
		Refer Note 7			TMEIC	JAPAN (NAGASAKHI)	A		
					NGEF	BANGALORE	A		UPTO 15 KW
					BHARAT BIJLEE	MUMBAI	A		RQP, FOR FLAME PROOF ALSO
					KEC	BANGALORE/ HUBLI*	A		*UPTO 90KW, RQP, FOR FLAME PROOF ALSO

एनटीपीसी NTPC	Project/ परियोजना : Talcher - III Package/ पैकेज : TALCHER III EPC PACKAGE Supplier/ आपूर्तिकर्ता: Contract No./ अनुबंध सं.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL क्वालिटी प्लान तथा सब –वेंडर के अनुमोदन सहित मदों की सूची SUB-SYSTEM उप-प्रणाली: ELECTRICAL	Doc. No./ दस्तावेज सं.: REVISION NO : 01 DATE/ तिथि : 03.02.2022

S. N. क्र.सं	Item / मद	QP/ Insp. Cat. क्यूपी/ निरी. श्रेणी.	QP No. / क्यूपी. सं.	QP Sub. Schedule क्यूपी उप.अनुसूचि	Proposed sub-supplier/ प्रस्तावित उप आपूर्तिकर्ता	Place/ स्थान	Sub-suppliers approval status / category उप आपूर्तिकर्ता के अनुमोदन की स्थिति /श्रेणी	Sub-supplier Details sub sch/ उप आपूर्तिकर्ता के विवरण प्रस्तुतीकरण की सूची	Remarks/ टिप्पणी
36.1	**DC Motor**	**CAT I**							
					CGL	MANDIDEEP	A		
37	**LT VFD Control Panel**	**CAT I**							
					Powertech	Sonepat	A		Upto 55 KW with following conditions: i) VFD from Schneider- France, upto 415V, 50KW. ii) Enclosure & bought out items shall be from NTPC acceptable makes & iii) Engineering support for integration will be provided by Schneider / Authorized integrator of Schneider
					DANFOSS	Oragadam	A		(upto 690V, 1200kW), VFD drives with VFD sourced from Danfoss-Denmark / USA and Panel sourced from Rittal
					YASAKAWA	Japan	A		VFD from Yasakawa- Japan, Upto 415V, 132KW
					ROCKWELL AUTOMATION	SAHIBABAD	A		VFD from Rockwell(Allen Bradley)- USA, (Upto 415 V, 600 KW)
					ABB	BANGALURU	A		VFD from ABB-Finland, Upto 690V, 750 KW
					SIEMENS	NASIK	A		VFD from SIEMENS- Germany, Upto 690V,900KW
					VACON	BANGALORE	A		VFD(NXP model) from VACON Finland, upto 400KW,415V and upto 900KW, 690V

एनटीपीसी NTPC	Project/ परियोजना : Talcher - III Package/ पैकेज : TALCHER III EPC PACKAGE Supplier/ आपूर्तिकर्ता: Contract No./ अनुबंध सं.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL क्वालिटी प्लान तथा सब –वेंडर के अनुमोदन सहित मदों की सूची SUB-SYSTEM उप-प्रणाली: ELECTRICAL	Doc. No./ दस्तावेज सं.: REVISION NO : 01 DATE/ तिथि : 03.02.2022

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NOTES:

Note - 1 : Vendors to submit project specific documents as per Sub-QR requirements in case the Vendor is approved under collaboration agreement.

Note - 2: Vendors under 'A' are approved and accepted by NTPC with/without conditions in the past. Similar conditions as the case may be for the vendor shall be applicable for this project and tied up in the quality plan.

Note - 3: Main contractor approved sub vendors are acceptable those are evaluated / assesesed as per Main contractor Quality Management System for vendor approval. Main contractor to inform the finaly selected vendor to NTPC as soon as PO is placed for these items. In case of sub-QR Note-1 is also applicable.

Note - 4 : BOI shall be reviewed and finalised during MQP approval for items/systems where ever applicable.

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S. N. क्र.सं	Item / मद	QP/ Insp. Cat. क्यूपी/ निरी. श्रेणी.	QP No. / क्यूपी. सं.	QP Sub. Schedule क्यूपी उप.अनुसूचि	Proposed sub-supplier/ प्रस्तावित उप आपूर्तिकर्ता	Place/ स्थान	Sub-suppliers approval status / category उप आपूर्तिकर्ता के अनुमोदन की स्थिति /श्रेणी	Sub-supplier Details sub sch/ उप आपूर्तिकर्ता के विवरण प्रस्तुतीकरण की सूची	Remarks/ टिप्पणी

Note - 5: Category of inspection for LT Cables:

	For Total Contract Quantity per Size	*Category Of Inspection*
	For cable total quantity ≤ 2.5 KM	Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years
	For cable total quantity above 2.5 km & up to ≤ 10 km per size/type	Cat-II for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years
	For cable total quantity above 10 km per size/type	Cat-I

Note - 6: Category of inspection for Cable Trays & Cable Tray Flexible Support System:

	For Total Contract Quantity per Size	*Category of Inspection*
	For cable total quantity ≤ 2.5 KM	Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years
	For cable total quantity above 2.5 km & up to ≤ 10 km per size/type	Cat-II for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years
	For cable total quantity above 10 km per size/type	Cat-I

Note - 7:

i) For Motors less than 50 KW: CAT-III. Acceptance of Motor less than 50 KW is based on COC of the Manufacturer and the Main Contractor confirming as follows: "It is hereby confirmed that the above mentioned motor / motors was / were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA / KW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing / data sheets".

ii) For Motors 50 KW and less than 75 KW : CAT- II. Acceptance of Motor is based on NTPC review of Routine Test inspection report as per **IS: 12615** / applicable standards duly witnessed by main contractor along with COC of the Manufacturer and the Main Contractor confirming as follows: "It is hereby confirmed that the above mentioned motor / motors was / were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA / KW, temp. rise, distance between centre of stud & gland plate, space heater and tested in accordance with approved drawing / data sheets".

iii) For Motors 75 KW & above : CAT- I . AS PER NTPC APPROVED QUALITY PLAN (To be submitted seperately for NTPC review & approval).

Note - 8:

NTPC approved Galvanizers:

	1. M / s M J Engg,Delhi	7. M / s National Galvanizer, Kolkata	13. M / s Gurpreet Galvanizer, Hyderabad	19. Unitech Fabricators & Galvanizers- Hoogly
	2. M / s A.V. Engg, Kolkata	8. M / s Unistar Galvanizer, Kolkata	14. M / s Sigma, Mumbai	
	3. M / s Inar Profiles, Vishakapatnam	9. M / s B.P. Project. Kolkata	15. M / s Radhakrishnan Shetty, Chennai	
	4. M / s Anand Udyog, Mumbai	10. M / s Bajaj Pune	16. Karamtara Mumbai	
	5. M / s Techno Engg,Chandigarh	11. M / s Electrocare Industries, Mumbai	17. Poona Galvanizers Pune	
	6. M / S Steelite Engg, Mumbai	12. M / s B.G. Shirke, Pune	18. Neha Galvanizer-Kolkata	

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S. N. क्र.सं	Item / मद	QP/ Insp. Cat. क्यूपी/ निरी. श्रेणी.	QP No. / क्यूपी. सं.	QP Sub. Schedule क्यूपी उप.अनुसूचि	Proposed sub-supplier/ प्रस्तावित उप आपूर्तिकर्ता	Place/ स्थान	Sub-suppliers approval status / category उप आपूर्तिकर्ता के अनुमोदन की स्थिति /श्रेणी	Sub-supplier Details sub sch/ उप आपूर्तिकर्ता के विवरण प्रस्तुतीकरण की सूची	Remarks/ टिप्पणी

Note - 9: Relevant certificates shall be submitted for NTPC approval.Approval conditions attached to above identified vendors, as applicable shall be adhered to.

Note - 10 : Indigenous sub-vendors for Annexure-I items are acceptable subject to meeting the MLC (Minimum Local Content} in line with latest MOP order.

LEGENDS / संकेतिका

SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY /प्रणाली आपूर्तिकर्ता / सब –वेंडर की स्वीकृति की स्थिति की श्रेणी **(SHALL BE FILLED BY NTPC** एनटीपीसी द्वारा भरा जाएगा**)**

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list along with the condition of approval, if any./ इन मदों के लिए प्रस्तावित वेंडर एनटीपीसी को स्वीकार्य है। अनुमोदन की शर्त, , यदि कोई हो, के साथ-साथ पत्र "क" में इंगित किया जाए ।

DR – For these items "Detailed required" for NTPC review. To be identified with letter "DR" in the list. एनटीपीसी द्वारा इन मदों की समीक्षा के लिए "विस्तृत ब्यौरे की आवश्यकता" होगी। सूची में **"DR"** पत्र में इंगित किया जाना चाहिए।

QP/INSPN CATEGORY: क्यूपी / निरीक्षण की श्रेणी:

CAT-I / श्रेणी- **I: For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.** इन मदों के लिए गुणवत्ता योजनाओं को एनटीपीसी द्वारा अनुमोदित किया जाता है और एनटीपीसी द्वारा अंतिम स्वीकृति भौतिक निरीक्षण के दौरान उपलब्ध गवाह के आधार पर दी जाएगी।

CAT-II / श्रेणी- **II: For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.** इन मदों के लिए गुणवत्ता योजनाओं को एनटीपीसी द्वारा अनुमोदित किया जाता है। हालाँकि एनटीपीसी द्वारा कोई भौतिक निरीक्षण नहीं किया जाएगा। एनटीपीसी द्वारा अंतिम स्वीकृति अनुमोदित क्यूपी के अनुसार दस्तावेजों की समीक्षा के आधार पर दी जाएगी।

CAT-III/ श्रेणी-**III : For these items Quality control to be exercised as per Main contractor Quality Assurance System. The final acceptance by NTPC shall be on the basis of Certificate of Conformance (COC) by Main Contractor.**

UNITS/WORKS इकाईयां / कार्य: **Place of manufacturing/** निर्माण का स्थान **Place of Main Supplier of multi units/works/**बहु- इकाइयों / कार्यों के मुख्य सप्लाइर का स्थान.

: Control measure of item covered in quality plan of main item.

एनटीपीसी NTPC एक महारत्न कम्पनी	PROJECT : Talcher-III (2X660MW) PACKAGE : EPC PACKAGES CONTRACTOR: CONTRACT NO :	LIST OF C&I ITEMS REQUIRING QUALITY PLAN AND SUB SUPPLIER APPROVAL	REVISION NO : 00 DATE :04.02.2022

Sr No	Item Description	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status (Note-1)	SS Detail Sub.SCH	SS Approval SCH	Remark
											analyser
12	Electrical Actuators										
12-A	Electrical Actuator (With gear box if applicable)										
		II				Antrieb Technik Pvt Ltd	Chennai	A			For low torque applications only
		II				Auma	Bengaluru	A			
		II				Limitorque	Faridabad	A			Model no L120,SMB,LY series, Gear Box T, HBC Series
		II				Rotork	Bengaluru	A			For low torque app (Up to 1000 Nm)
		II				Rotork Controls (India) Private Ltd	Chennai	A			For low torque app (Up to 1000 Nm) & High torque 4000 to 7000 Nm With integral starter for non critical applications

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Sr No	Item Description	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status (Note-1)	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				Auma	Germany	A			
		III				Limitorque	USA	A			
		III				Rotork	UK	A			For low torque app (Up to 1000 Nm)
		III				Nippon gear	Japan	A			
		III				Drehmo GMBH	Germany	A			C Matic Series (DMC/DMCR)
12-B	Electrical Actuator- Non-Intrusive (With gear box if applicable)										
		I				Auma India Pvt Ltd	Bengaluru	A			Also acceptable for Field Bus based applicable
		III				Flowserve	USA	A			Also acceptable for Field Bus based applicable
		III				Bernard Controls	France	A			
12-C	Electrical actuator for ID/FD/PA Blade pitch ,IGV &SCOOP										
		III				Harold Beck & Sons Inc	USA	A			
		III				SIPOS Aktrorik GmbH	Germany	A			
13	Electronics Transmitter (Pressure , DP and DP based Flow/Level)										
13-A	Electronics Transmitter (Pressure , DP and DP based Flow/Level)										
		III				ABB Ltd	Bengaluru	A			2600T & critical item from ABB Italy/ Their approved source;
		III				Emerson Process Management Ltd	Pawane	A			
		III				Siemens Ltd	Thane	A			Model:-SITRANS P
		III				Honeywell Automation India Ltd	Pune	A			
		III				Baldota Control and Equipment Pvt Ltd	Navi Mumbai	A			PT & DPT of LD 301 Series (SMAR)
		III				Yokogawa India Limited	Bengaluru	A			EJA-E 110,430,530 SERIES & all raw material and BOI under knocked down condotion (sensor assembly as a single unit) shall be sourced from M/S Yokogawa Japan
		III				M/s Endress + Hauser India Automation Instrument Pvt Ltd	Aurangabad	A			
		III				Emerson (Rosemount)	USA	A			
		III				Yokogawa	Japan	A			
		III				ABB	Germany / Italy	A			2600T & critical item from ABB Italy/ Their approved source;
		III				Siemens	France	A			Sitrans P DSIII Series
		III				Fuji Electric	France	A			FCX -AIII SERIES
		III				Fuji	Japan	A			
13-B	Electronics Transmitter -Field Bus Based (Pressure , DP and DP based Flow/Level)										
		I				ABB India Ltd	Bengaluru	A			One no of Transmitter will be sent at DDCMIS supplier for function testing of field bus communication with DDCMIS during FAT

एनटीपीसी NTPC एक महारत्न कम्पनी	PROJECT : Talcher-III (2X660MW) PACKAGE : EPC PACKAGES CONTRACTOR: CONTRACT NO :					LIST OF C&I ITEMS REQUIRING QUALITY PLAN AND SUB SUPPLIER APPROVAL				REVISION NO : 00 DATE :04.02.2022
Sr No	**Item Description**	**QP Inspection Category**	**QP No**	**QP submission SCH**	**QP approval SCH**	**Proposed Sub Supplier**	**Country**	**SS Approval_Status (Note-1)**	**SS Detail Sub.SCH**	**SS Approval SCH**	**Remark**
		I				SWAN	Hyderabad	A			1. Conductivity analyser, pH analyser and Temperature Transmitter will be of M/s ABB, UK make . 2. TSS analyser will be of M/s Daeyoon, South Korea make . 3. Oil in water analyser will be of M/s TriOs, Germany make. 4. Online BOD/COD analyser will be of M/s Shimadzu, Japan make . 5. Flow meter will be of M/s Khrone Marshall, Maharashtra make. 6. Data Aquisition System will be procured from Knowledge Lens, Karnataka.
15	Fiber optic cable										
		Note-3				U M Cables Ltd	Silvassa (Daman)	A			
		Note-3				KEC International Ltd	Mysore	A			
		Note-3				Apar Industries Limited	Valsad (Gujrat)	A			
		Note-3				HFCL	Goa	A			
		Note-3				Aksh Fibre	Bhiwadi (Raj)	A			
		Note-3				Finolex Cable Ltd	Goa	A			
		Note-3				Birla Cable Limited	Rewa	A			
		Note-3				R&M	Switzerland	A			
		Note-3				Molex	UK	A			
		Note-3				Corning	USA	A			

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Sr No	Item Description	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status (Note-1)	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				Durag GmbH	Germany	A			D-VTA-201
29	Instrument Cables (F,G & T/C Cables)										

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Sr No	Item Description	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status (Note-1)	SS Detail Sub.SCH	SS Approval SCH	Remark
		Note-2				Goyolene Fibers (India) Pvt Ltd	Silvassa	A			F&G Type Cable
		Note-2				Temsens Instruments Ind Pvt Ltd	Udaipur	A			
		Note-2				Havells India	Alwar	A			F Type Cable
		Note-2				Paramount Communication Ltd	Khuskhera	A			
		Note-2				Polycab	Daman	A			
		Note-2				Delton	Faridabad	A			
		Note-2				KEI	Bhiwadi (Raj)	A			
		Note-2				Elkey Telelinks	Faridabad	A			
		Note-2				CORDS	Kaharani	A			
		Note-2				CORDS	Bhiwadi	A			
		Note-2				Nicco	Kolkata	A			
		Note-2				Universal Cable	Satna	A			
		Note-2				Thermocables	Hyderabad /Mahboobnagar	A			
		Note-2				Gupta Power Inftrastructure Ltd.	Khurdha	A			
		Note-2				CMI	Faridabad	A			
		Note-2				Advance Cables Pvt Ltd	Bengaluru	A			F&G Type Cable
		Note-2				Gemscab Industries Ltd	Bhiwadi (Raj)	A			F&G Type Cable
		Note-2				Apar Industries Limited	Valsad	A			F&G Type Cable
		Note-2				Suyog Electricals Ltd	Halol (Gujrat)	A			
		Note-2				Special Cables Pvt Ltd	Rudrapur	A			
		Note-2				T C Communication	Ghaziabad	A			
		Note-2				TEW & C	USA	A			
		Note-2				Habia cables	Sweden	A			
		Note-2				Kerpen cables	Germany	A			
		Note-2				Lapp cables	Germany	A			
		Note-2				Thermo elecrta Bv	Netherland	A			
		I				Planner System Inc	USA	A			
32	Level switch- Conductivity type										
		II				Raman Instruments (System integrator of Delta Morbey/ Emerson Mobrey /Solartron -Mobrey)	Delhi	A			1.M/S Emerson (Morbey) UK system 2.Pl refer Note-07
		II				HI Tech System & services Ltd (System Integrator of Levelstate systems Ltd ,UK)	Kolkata	A			1. M/S Levekstate UK System .Vessel from M/s Hi Tech 2.Pl refer Note-07
		II				BHEL	Trichurapalli	A			
		III				Emerson -Mobrey (Solartron mobrey)	UK	A			
		III				Levelstate Systems Ltd	UK	A			

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		III				Yarway	USA	A			
33	Local Instrument Enclosure/Rack										
		I				Pyrotech Electronics Pvt. Ltd	Udaipur	A			BOI from LOA approved sources
		I				Sajas electrical	Trichurapalli (Tamilnadu)	A			BOI from LOA approved sources
		I				Prammen	Puddukottai (Tamilnadu)	A			BOI from LOA approved sources
		I				Chemin C&I Pvt Limited	Puducherry	A			1- BOI from LOA approved sources 2.Fabrication at M/s LUFT tech India 3- Painting at M/s Supreame Coater & Fabricator

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		III				Commend International GMBH	Austria	A			

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Sr No	**Item Description**	**QP Inspection Category**	**QP No**	**QP submission SCH**	**QP approval SCH**	**Proposed Sub Supplier**	**Country**	**SS Approval_Status (Note-1)**	**SS Detail Sub.SCH**	**SS Approval SCH**	**Remark**
		II				Shin Hwa Engineering Co. Ltd	S.Korea	A			
39	Radar type level transmitter										
		III				Limaco	Russia	A			High Frequency Type
		III				Emerson Process Management Ltd	Pawane	A			For M/s Emerson Singapore make
		III				Endress & Houser	Aurangabad	A			
		III				SIEMENS	Canada	A			
		III				B M Technology	Italy	A			For Non Contact type
		III				Magnetrol	Belgium	A			
		III				ABB	USA	A			K-Tech Brand
		III				Endress & Houser	Germany	A			
		III				Saab Rosemeount	Sweden	A			
		III				Emerson Process Management	Singapore	A			Rosemount 3300 series for GW Radar & 5600 Series for Non-Contact type
		III				Endress & Houser	Germany	A			
		III				Vega Grieshaber KG	Germany	A			
40	Short Term Fire Proof cable										
		III				nVent Solutions limited	UK	A			
		III				Wrexham Mineral	UK	A			
		III				KME	Italy	A			

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41	SWAS (Sampling Handling System and Dry Panel)										
		I				Emerson Process Management Ltd	Navi Mumbai	A			Analysers and Other BOI Componets from LOA agreed source
		I				Forbes Marshall	Pune	A			Analysers and Other BOI Componets from LOA agreed source
		I				SEPL	Pune	A			Analysers and Other BOI Componets from LOA agreed source
43	Temp Transmitter										
43-A	Temp Transmitter										
		III				Endress & Houser	Aurangabad	A			
		III				Emerson Process Management Ltd	Pawane	A			For M/s Emerson Singapore make
		III				Yokogawa	Bengaluru	A			Make Yokogawa japan and caliberation at Yokogawa Banglore

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		III				ABB	Bengaluru	A			For M/s ABB Germany make
		III				WIKA Instruments India Pvt Ltd	Pune	A			For M/s WIKA Germany make Model no T-32
		III				Honeywell Automation India Ltd	Pune	A			
		III				Yokogawa	Japan	A			
		III				Moore	USA	A			
		III				M System co Ltd	Japan	A			Model No-B3HU-0
		III				Emerson	U.S.A/Singapore/ Germany	A			
		III				ABB	Germany	A			
		III				Emerson Process Management	Germany	A			
43-B	Temp Transmitter -Field Bus based Single/Dual Input										
		I				ABB India Ltd	Bengaluru	A			One no of TT will be available at DCS supplier for function testing of field bus communication with DCS during FAT
	Turbine supervisiory Instruments along with										
		III				Teledyne	USA	A			
46	Ultrasonic type level Transmitter										
		III				EIP Enviro	Noida	A			1-Ultrasonic level Tx shall be BM Technology Italy make 2-Required mounting arrangement , Testing, Calibration shall be carried out at M/s EIP Works.
		III				E & H	Aurangabad	A			
		III				Emerson Process Management Ltd	Pawane	A			Complete Intrument Transmitter & Probe to be procured from Mobrey UK , only intergration & configuration at Pawane works
		III				BM Technology	Italy	A			
		III				Siemens Miltronics	Canada	A			
		III				Nivelco Process Control	Hungary	A			
		III				E & H	Germany	A			
		III				HAWK Measurement PTY Ltd	Australia	A			

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50	Field Bus Cable/ Profibus Cable- PA & DP type										
		I				LAPP India Pvt Ltd	Bangalore	A			
51	Field bus components (Field bus modules ,segment protector ,surge protector & SS JB)										
		III				Phoenix Contact Inc	USA	A			Materiall will be allowed to dispatch from the vendor works as CAT-III item ,however all material except SS junction box will be available at DDCMIS supplier works for functional testing .
		III				Pepperl + Fuchs Pte Ltd	Singapore	A			Materiall will be allowed to dispatch from the vendor works as CAT-III item ,however all material will be available at DDCMIS supplier works for functional testing .

Main Contractor approved sources (Note-12)

MC-4	Anemometer	III				Main Contractor Approved Sources					
MC-11	Conduits /Pipe (GI)	III				Main Contractor Approved Sources					
MC-12	Conduits lead coated (Flexible)	III				Main Contractor Approved Sources					

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MC-13	Copper tubing/Brass connectors	III				Main Contractor Approved Sources					
MC-15	Coupling /Interposing Relays	III				Main Contractor Approved Sources					
MC-18	Digital Indicators	III				Main Contractor Approved Sources					
MC-19	Dust Sensor	III				Main Contractor Approved Sources					
MC-20	Dew point sensor/meter (H2)	III				Main Contractor Approved Sources					
MC-21	Flow Gauge	III				Main Contractor Approved Sources					
MC-22	Flow Indicator cum Totaliser	III				Main Contractor Approved Sources					
MC-23	Flow Switch	III				Main Contractor Approved Sources					
MC-24	FRP Junction Box	III				Main Contractor Approved Sources					
MC-28	Hand Held Calibrator	III				Main Contractor Approved Sources					
MC-29	Hart Management System	III				Main Contractor Approved Sources					
MC-30	Humidistat / Thermostat / Gyserstat / Airstat	III				Main Contractor Approved Sources					
MC-31	Instant Corrosion Rate Monitor & Portable Corrosion Meter	III				Main Contractor Approved Sources					
MC-32	Impact head type flow element	III				Main Contractor Approved Sources					
MC-33	Instrument Tube Fittings (Air)	III				Main Contractor Approved Sources					
MC-34	Instrument Valve	III				Main Contractor Approved Sources					
MC-35	IR Detector	III				Main Contractor Approved Sources					
MC-36	KVM Switch/Matrix KVM Switch	III				Main Contractor Approved Sources					
MC-37	Level gauge (Transperent & Reflex, Tubular type)	III				Main Contractor Approved Sources					
MC-38	Level Indicator (Float & Board type)	III				Main Contractor Approved Sources					
MC-39	Level switch - Float/Displacer Type	III				Main Contractor Approved Sources					
MC-40	Level Switch (RF Type)	III				Main Contractor Approved Sources					
MC-41	Level switch capacitance type	III				Main Contractor Approved Sources					
MC-42	Limit Switch	III				Main Contractor Approved Sources					
MC-43	Maintenance and Calibration Equpiment	III				Main Contractor Approved Sources					
MC-44	Mini UPS-Type C configuration	III				Main Contractor Approved Sources					
MC-45	Orifice plate assembly	III				Main Contractor Approved Sources					
MC-46	On line carbon in Ash analyser	III				Main Contractor Approved Sources					
MC-47	Pitot Tube	III				Main Contractor Approved Sources					
MC-48	Pr./Vaccum./DP Gauges	III				Main Contractor Approved Sources					
MC-49	Press, DP, Vaccum Switch	III				Main Contractor Approved Sources					
MC-50	Printer (Dot Matrix/Inkjet / Laser)	III				Main Contractor Approved Sources					
MC-51	Psycrometer	III				Main Contractor Approved Sources					
MC-52	Pulse jet Controller	III				Main Contractor Approved Sources					
MC-53	Pulse Valve	III				Main Contractor Approved Sources					
MC-54	Residual Chlorine Analyser	III				Main Contractor Approved Sources					
MC-55	Rotameter	III				Main Contractor Approved Sources					
MC-56	Reverse Rotation Indicator	III				Main Contractor Approved Sources					
MC-57	Synchronising Relay	III				Main Contractor Approved Sources					
MC-58	Synchroscope	III				Main Contractor Approved Sources					
MC-59	Semaphore Indicators	III				Main Contractor Approved Sources					
MC-60	Sight Flow Indicator	III				Main Contractor Approved Sources					
MC-61	Smart Positioner	III				Main Contractor Approved Sources					
MC-62	Socket Weld Fittings	III				Main Contractor Approved Sources					
MC-63	Solenoid Valve	III				Main Contractor Approved Sources					

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MC-64	Solid Mass Flow Meter	III				Main Contractor Approved Sources					
MC-65	Terminal Block (Cage and Clamp type)	III				Main Contractor Approved Sources					
MC-66	Temperature cum Humidity Indicator	III				Main Contractor Approved Sources					
MC-67	Temperature Element(Thermocouple , RTD & Thermowell)	III				Main Contractor Approved Sources					
MC-68	Temperature Gauge(With Thermowell)	III				Main Contractor Approved Sources					
MC-69	Temperature Switch	III				Main Contractor Approved Sources					
MC-70	Transducer	III				Main Contractor Approved Sources					
MC-71	Tube thicknes Meter	III				Main Contractor Approved Sources					
MC-72	Voltmeter/ Watterhour Meter	III				Main Contractor Approved Sources					
MC-73	Valve manifolds	III				Main Contractor Approved Sources					
MC-74	Electric to Pneumatic Converter	III				Main Contractor Approved Sources					
MC-75	Network components	III				Main Contractor Approved Sources					
MC-76	Isolator	III				Main Contractor Approved Sources					
MC-77	ORP Monitor /Analyser	III				Main Contractor Approved Sources					
MC-78	Ultrasonic Type Flow Transmitter	III				Main Contractor Approved Sources					
MC-79	Chlorine Leak detector	III				Main Contractor Approved Sources					
MC-80	Density Meter	III				Main Contractor Approved Sources					
MC-81	Electro Magenetic Flow meter	III				Main Contractor Approved Sources					
MC-82	Postive dispalcement Type Flow Meter	III				Main Contractor Approved Sources					
MC-83	Level Scanner (3 D)for Solid Application	III				Main Contractor Approved Sources					
MC-84	Mosaic tiles /Console items	III				Main Contractor Approved Sources					
MC-85	Electrical Control Panel (UCP/Backup)	III				Main Contractor Approved Sources					
MC-86	Electrical Indicating Instruments (Mosaic Compatible)	III				Main Contractor Approved Sources					
MC-87	OWS/EWS/Server	III				Main Contractor Approved Sources					
MC-88	Bio Matrix Reader	III				Main Contractor Approved Sources					
MC-89	ANPR	III				Main Contractor Approved Sources					
MC-90	UVSS	III				Main Contractor Approved Sources					
MC-91	Comd & Control System	III				Main Contractor Approved Sources					
MC-92	Access & Controller Software	III				Main Contractor Approved Sources					
MC-93	IR LED based Illuminator	III				Main Contractor Approved Sources					
MC-94	ATB Bolloard	III				Main Contractor Approved Sources					
MC-95	Boom Barrier	III				Main Contractor Approved Sources					
MC-96	Touchless biomatric recorder	III				Main Contractor Approved Sources					
MC-97	GPS Sensor based Vehicle Monitoring system	III				Main Contractor Approved Sources					
MC-98	10mp digital camera with tripod for photo capture	III				Main Contractor Approved Sources					
MC-99	2D GIS map application	III				Main Contractor Approved Sources					
MC-100	Audible alarm device	III				Main Contractor Approved Sources					
MC-101	CameraPoles	III				Main Contractor Approved Sources					
MC-102	Card Reader	III				Main Contractor Approved Sources					
MC-103	Door Frame Metal Detector -DFMD	III				Main Contractor Approved Sources					
MC-104	Door sensor	III				Main Contractor Approved Sources					
MC-105	Egress Switch	III				Main Contractor Approved Sources					
MC-106	EM LOCK	III				Main Contractor Approved Sources					
MC-107	Emergency exit / door override switch	III				Main Contractor Approved Sources					
MC-108	Emergency Siren /Hooter	III				Main Contractor Approved Sources					
MC-109	Flap barrier	III				Main Contractor Approved Sources					
MC-110	Flash Lights for covering perimeter area for clear view from PTZ in night time	III				Main Contractor Approved Sources					
MC-111	Geo fencing	III				Main Contractor Approved Sources					
MC-112	Glass Break switch at Emergency Exit	III				Main Contractor Approved Sources					
MC-113	Guard tour	III				Main Contractor Approved Sources					

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MC-114	Half Height Turnstile	III				Main Contractor Approved Sources					
MC-115	Handheld Walkie - Talkie	III				Main Contractor Approved Sources					
MC-116	HHMD	III				Main Contractor Approved Sources					
MC-117	Long Range RFID Reader	III				Main Contractor Approved Sources					
MC-118	Monitors 24 Inch Full HD	III				Main Contractor Approved Sources					
MC-119	Network Panel	III				Main Contractor Approved Sources					
MC-120	Optical Time Domain Reflector-meter (OTDR) with all accessories	III				Main Contractor Approved Sources					
MC-121	Panic Button with Audible Alarm	III				Main Contractor Approved Sources					
MC-122	Panic button/SOS button supportin SIP protocol	III				Main Contractor Approved Sources					
MC-123	RFID based Stickers	III				Main Contractor Approved Sources					
MC-124	Sliding Gate	III				Main Contractor Approved Sources					
MC-125	SMS gateway	III				Main Contractor Approved Sources					
MC-126	Storage Device (SAN/NAS/DAS) of 100 TB each	III				Main Contractor Approved Sources					
MC-127	Traffic Light	III				Main Contractor Approved Sources					
MC-128	Turnstile - half height	III				Main Contractor Approved Sources					
MC-129	SPIKE BARRIER	III				Main Contractor Approved Sources					
MC-130	CHAIN LINK FENCE	III				Main Contractor Approved Sources					
MC-131	X-ray Baggage Scanner	III				Main Contractor Approved Sources					
MC-132	Static Radio Set	III				Main Contractor Approved Sources					

LEGENDS :

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY

A - For those items proposed vendor is acceptable to Customer. To be indicated with letter "A" in the list alognwith the condition of approval, if any.

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by Customer and final acceptance will be on physical inspection witness by Customer

CAT - II : For those items the Quality Plans are approved by Customer. However no physical inspection shall be done by Customer. The final acceptance by Customer shall be on the basis of review of documents.

CAT - III :For these items Quality control to be exercised as per Main contractor Quality Assurance System. The final acceptance by NTPC shall be on the basis of Certificate of Conformance (COC) by Main Contractor.

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units/works.

NOTE - 1 : A: Vendors to submit project specific documents as per Sub-QR requirements in case the Vendor is approved under collaboration agreement.
B: In case approved sub vendor is offering product with latest model/series apart from earlier approved, vendors to submit project specific documents as per Sub-QR requirements.

NOTE - 2 : For Insrument cable <= 1 KM inspection category CAT - III, For > 1 KM to <= 10 KM Inspecton category CAT - II COC & FOR> 10 KM Inspection category CAT-I

NOTE -3 : For Fiber Optic cable <=10KM inspection category CAT - III & for > 10KM Inspection category CAT-II

NOTE-4 : Batteries for UPS <= 10 KVA and batteries for intelligent battery charger 24 V DC <= 40 Amp inspection category CAT-III & for Batteries for UPS> 10KVA and batteries for intelligent battery charger 24 V DC > 40 Amp rating

NOTE-5 UPS <= 10 KVA rating inspection category CAT-III & for > 10KVA rating inspection category CAT-I

NOTE - 7 - EMPTY CABINETS, COMPUTERS, SIGNAL ISOLATOR/ MULTIPLIER and TB SHALL ALSO BE ACCEPTABLE FROM OWNER ACCPETED IN QP. IF THE TOTAL INTEGRATED PANEL AND FAT IS CONDUCTED INDEGENEOUSLY

NOTE-8 : For the C & I instrumnts mounted on the skid of the main item or supplied as a integral part of the main item, instrument to be supplied as per proven practice of the manufacturer meeting the Customer technical specification

NOTE-9- This item is a bought out componenet of main equipments like DDCMIS ,PLC,TSI,CCTV ,PA system etc

NOTE-10- For these controlled items, vendor shall be proposed for owner accpetance with-in the agreed contract schedule of the package

NOTE-11 - Major Bought-Out-Items are to be procured from LOA approved sources & the same shall be finalized during the finalization of Manufacturing Quality Plan . MQP shall be duly vetted by OEM with their project specific authorisation letter .

NOTE-12 : Main contractor apporved sub vendors are acceptable those are evaluated / assesesed as per Main contractor Quality Management System for vendor approval. Main contractor to inform the finaly selected vendor to NTPC as soon as PO is placed for these items. In case of sub-QR Note-1 is also applicable.

SECTION-I
SUB SECTION -E

INDICATIVE LIST OF MAKES OF SUB-VENDOR ITEMS

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORBTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIRE(FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	As per Electrical spec.
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA /AEROCELL
14	BALANCING VALVE	ADVANCE
15	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
16	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG/SAMSON CONTROLS PVT. LTD/INSTRUMENTATION LTD./ Koso India Private Limited,

18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19	MOTORIZED BUTTERFLY VALVE	ANERGY / ADVANCE / BELIMO / JOHNSON / HONEYWELL / SIEMENS
20	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
21	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
22	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
25	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28	RELIEF / PURGE VALVE	BRASSOMATIC
29	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32	FLOW SWITCH	As per approved make list
33	FLOW METER	As per approved make list
34	RH SENSOR/TEMP SENSOR	As per approved make list
35	PLC BASED PANEL	NA
36	OWS / PC	NA
37	PRINTER	NA
38	UPS	NA
39	FIBRE OPTIC CABLE	As per approved make list
40	ANNUNCIATOR FOR PANEL	NA
41	METERING PUMP	SHAPO TOOLS / VK PUMPS
42	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
43	PRESSURE TRANSMITTER	As per approved make list
44	TEMPERATURE TRANSMITTER	As per approved make list
45	ROTAMETER	As per approved make list
46	BATTERY CHARGER	NA

47	BATTERY (NI -Cd)	NA
NOTE		
	NOTES: 1. THE APPROVED SUB VENDOR LIST IS ATTACHED ABOVE 2. IF ANY ITEMS ARE NOT COVERED IN APPROVED LIST, INDICATIVE SUB VENDOR LIST CAN BE REFFERED ABOVE 3.INDICATIVE SUB VENDOR LIST 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. 4. THE INSECTION CATEGORY HAS BEEN INDICATED IN APPROVED SUB VENDOR LIST 5. FOR ITEMS WHICH ARE NOT COVERED IN APPROVED SUB VENDOR LIST 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. 6. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-1,C-3, C-4 & C-5 FOR HANDLING RELATED EQUIPMENT ,ELECTRICAL AND C&I LIST OF MAKE.	

ANNEXURE-II

MANDATORY SPARE LIST

(REFER SUGGESTIVE PRICE FORMAT)

SECTION-I

SUB SECTION E

ANNEXURE-III

PAINTING & COLOUR SCHEME
(PLEASE REFER SECTION C2-C)

ANNEXURE-IV

LIST OF TOOLS & TACKLES

(REFER SUGGESTIVE PRICE FORMAT)

SECTION-I

SUB-SECTION-E

ANNEXURE-V

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE (COVERED UNDER SUB-SECTION C2-B)

SECTION-I

SUB-SECTION-E

ANNEXURE-VI

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

SL	BHEL DRG NO.	NTPC DRG NO.	DRAWING TITLE	APP CAT	SCH WEEK (FROM DATE OF LOI)
1	PE-V0-497-553-A501	4540-001-147-PVM-B-059	STANDARD DRAWING FOR DUCT FABRICATION & SUPPORTING RRANGEMENT	AA	2
2	PE-V0-497-553-A503	4540-001-147-PVM-B-061	GA DRAWING OF EXPANSION TANKS / MAKE UP TANK / STORAGE TANK FOR AIR-CONDITIONING SYSTEM	AA	10
3	PE-V0-497-553-A504	4540-001-147-PVM-B-062	GA OF AIR TERMINALS LIKE SUPPLY / RETURN AIR DIFFUSER / GRILL, NRD, VCD ETC.	AA	10
4	PE-V0-497-553-A507	4540-001-147-PVM-F-007	A/C PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL ALONGWITH PIPING LAYOUT FOR SERVICE BUILDING	AA	3
5	PE-V0-497-553-A513	4540-001-147-PVM-F-008	AHU ROOM LAYOUT WITH FOUNDATION DETAIL FOR VARIOUS FLOORS OF SERVICE BUILDING ALONGWITH CHILLED WATER PIPING LAYOUT	AA	3
6	PE-V0-497-553-A509	4540-001-147-PVM-F-009	A/C PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL ALONGWITH PIPING LAYOUT FOR ADMIN BUILDING	AA	3
7	PE-V0-497-553-A514	4540-001-147-PVM-F-010	AHU ROOM LAYOUT WITH FOUNDATION DETAIL FOR VARIOUS FLOORS OF ADMIN BUILDING ALONGWITH CHILLED WATER PIPING LAYOUT	AA	3
8	PE-V0-497-553-A508	4540-001-147-PVM-F-011	A/C EQUIPMENT LAYOUT WITH FOUNDATION DETAILS FOR WATER SYSTEM CONTROL BUILDING	AA	3
9	PE-V0-497-553-A532	4540-001-147-PVM-F-013	A/C EQUIPMENT LAYOUT WITH FOUNDATION DETAILS FOR CANTEEN	AA	3

10	PE-V0-497-553-A516	4540-001-147-PVM-F-014	A/C DUCT LAYOUT FOR MAIN POWER HOUSE AT EL 8.5 M & 17 M AND 0.0M	A	3
11*	PE-V0-497-553-A505	4540-001-147-PVM-F-015	A/C PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL ALONGWITH PIPING LAYOUT FOR MAIN POWER HOUSE	AA	3
12*	PE-V0-497-553-A506	4540-001-147-PVM-F-064	A/C PLANT ROOM LAYOUT WITH COMPLETE FOUNDATION DETAIL ALONGWITH PIPING LAYOUT COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM	AA	3
13*	PE-V0-497-553-A537	4540-001-147-PVM-F-067	AHU ROOM LAYOUT WITH FOUNDATION DETAIL FOR MAIN POWER HOUSE	AA	3
14*	PE-V0-497-553-A538	4540-001-147-PVM-F-068	CHILLED WATER PIPING LAYOUT DRAWING FROM A/C PLANT ROOM TO VARIOUS AHU ROOMS FOR MAIN PLANT	AA	3
15	PE-V0-497-553-A517	4540-001-147-PVM-F-071	A/C DUCT LAYOUT DRAWING COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM	AA	3
16	PE-V0-497-553-A518	4540-001-147-PVM-F-072	A/C DUCT LAYOUT DRAWING FOR VARIOUS FLOORS OF SERVICE BUILDING	AA	3
17	PE-V0-497-553-A519	4540-001-147-PVM-F-073	A/C DUCT LAYOUT DRAWING FOR VARIOUS FLOORS OF ADMIN BUILDING	AA	3
18	PE-V0-497-553-A520	4540-001-147-PVM-F-074	A/C DUCT LAYOUT DRAWING FOR WATER SYSTEM CONTROL BUILDING	AA	4
19	PE-V0-497-553-A536	4540-001-147-PVM-F-076	A/C DUCT LAYOUT DRAWING FOR CANTEEN	AA	4
20	PE-V0-497-553-A527	4540-001-147-PVM-H-080	SPLIT AC SCHEDULE	AA	10
21*	PE-V0-497-553-A719	4540-001-147-PVM-W-102	WRITE UP & CONTROL PHILOSOPHY FOR A/C SYSTEM FOR MAIN PLANT, A/C COMMON FOR ESP, FGD, ASH HANDLING CONTROL ROOM & VFD ROOM, SERVICE BUILDING,ADMIN BUILDING, WATER SYSTEM CONTROL BUILDING, GIS SWITCHYARD CONTROL BUILDING, CANTEEN,	A	11

			ETC.		
22*	PE-V0-497-553-A523	4540-001-147-PVM-L-076	P & I DIAGRAM FOR A/C SYSTEM FOR MAIN POWER HOUSE	A	5
23*	PE-V0-497-553-A524	4540-001-147-PVM-L-077	P & I DIAGRAM FOR A/C SYSTEM COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM	A	5
24*	PE-V0-497-553-A525	4540-001-147-PVM-L-078	P & I DIAGRAM FOR A/C SYSTEM FOR SERVICE BUILDING	A	5
25*	PE-V0-497-553-A526	4540-001-147-PVM-L-079	P & I DIAGRAM FOR A/C SYSTEM FOR ADMIN BUILDING	A	5
26*	PE-V0-497-553-A529	4540-001-147-PVM-L-080	P & I DIAGRAM FOR A/C SYSTEM FOR WATER SYSTEM CONTROL BUILDING, GIS SWITCHYARD CONTROL BUILDING, CANTEEN	A	5
27*	PE-V0-497-553-A101	4540-001-147-PVM-U-001	DESIGN PHILOSOPY, HEAT LOAD CALCULATION FOR A/C SYSTEM FOR MAIN POWER HOUSE, ESP/AHP/FGD BUILDINGS	A	1
28*	PE-V0-497-553-A103	4540-001-147-PVM-U-003	DESIGN PHILOSOPY, HEAT LOAD CALCULATION FOR A/C SYSTEM OF SERVICE BUILDING, ADMINISTRATIVE BUILDING, CANTEEN	A	1
29*	PE-V0-497-553-A104	4540-001-147-PVM-U-005	DESIGN PHILOSOPY, HEAT LOAD CALCULATION FOR A/C SYSTEM OF WATER SYSTEM CONTROL BUILDING AND GIS SWITCHYARD CONTROL BUILDING	A	1
30*	PE-V0-497-553-A107	4540-001-147-PVM-U-007	PRESSURE DROP CALCULATION OF CONDENSER WATER PIPING AND CHILLED WATER PIPING FOR MAIN PLANT A/C SYSTEM	AA	1

31*	PE-V0-497-553-A108	4540-001-147-PVM-U-008	PRESSURE DROP CALCULATION OF CONDENSER WATER PIPING AND CHILLED WATER PIPING FOR A/C SYSTEM OF SERVICE BUILDING	AA	1
32*	PE-V0-497-553-A114	4540-001-147-PVM-U-014	PRESSURE DROP CALCULATION OF CHILLED WATER PIPING FOR AC SYSTEM COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM	AA	1
33	PE-V0-497-553-A109	4540-001-147-PVM-U-006	PRESSURE DROP CALCULATION OF CONDENSER WATER PIPING AND CHILLED WATER PIPING FOR A/C SYSTEM OF ADMIN BUILDING	AA	1
34	PE-V0-497-553-A902	4540-001-147-PVM-X-129	OPERATION & MAINTENANCE MANUAL	A	10
35*	PE-V0-497-553-A223	4540-001-147-PVM-Y-031	TECHNICAL DATA SHEET & G/A DRAWING OF WATER COOLED SCREW CHILLERS FOR MAIN PLANT A/C SYSTEM , AHP/ESP/FGD A/C SYSTEM, SERVICE BUILDING & ADMIN BUILDING	AA	8
36*	PE-V0-497-553-A224	4540-001-147-PVM-Y-032	TECHNICAL DATA SHEETS & G/A/DRAWING OF COOLING TOWERS	AA	4
37*	PE-V0-434-553-201	4540-001-110-PEM-PVE-Y-348	TECHNICAL DATA SHEET, GA DRAWING AND PERFORMANCE CURVES OF MOTOR FOR PUMPS, COOLING TOWER & CENTRIFUGAL FAN	AA	10
38*	PE-V0-497-553-A225	4540-001-147-PVM-Y-033	TECHNICAL DATA SHEET & GA DRAWING FOR CONDENSER WATER PUMPS AND CHILLED WATER PUMPS	AA	10
39*	PE-V0-497-553-A227	4540-001-147-PVM-Y-035	TECHNICAL DATA SHEET OF AHU WITH COLING COIL AND CENTRIFUGAL FANS FOR AIR HANDLING UNITS	AA	10
40*	PE-V0-497-553-A226	4540-001-147-PVM-Y-034	TECHNICAL DATA SHEET OF D-X UNITS WATER SYSTEM CONTROL BUILDING, GIS SWITCHYARD CONTROL BUILDING, CANTEEN BUILDING	AA	10
41	PE-V0-497-553-A228	4540-001-147-PVM-Y-036	TECHNICAL DATA SHEET & G/A/ DRAWING FOR HEATER PACKAGE	AA	10

42	PE-V0-497-553-A245	4540-001-147-PVM-Y-037	TECHNICAL DATA SHEET & G/A/ DRAWING OF PAN HUMIDIFIER	AA	8
43	PE-V0-497-553-A230	4540-001-147-PVM-Y-038	TECHNICAL DATA SHEET & G/A/ DRAWING OF FRESH AIR FAN	AA	10
44*	PE-V0-497-553-A231	4540-001-147-PVM-Y-039	TECHNICAL DATA SHEET FOR HI-WALL TYPE SPLIT AIR CONDITIONER	AA	10
45*	PE-V0-497-553-A246	4540-001-147-PVM-Y-040	TECHNICAL DATA SHEET FOR CASSETTE TYPE AIR CONDITIONER	AA	10
46	PE-V0-497-553-A234	4540-001-147-PVM-Y-042	TECHNICAL DATA SHEET FOR Y-STRAINERS	AA	10
47	PE-V0-497-553-A235	4540-001-147-PVM-Y-043	TECHNICAL DATA SHEET & G/A/DRWG/ FOR CAST IRON VALVES(GATE VALVE,CHECK VALVE, GLOBE VALVE,BUTTER FLY VALVE (MANUAL)	AA	6
48	PE-V0-497-553-A237	4540-001-147-PVM-Y-045	TECHNICAL DATA SHEET & GA FOR BUTTER FLY VALVE (MOTORISED)	AA	7
49	PE-V0-497-553-A238	4540-001-147-PVM-Y-046	TECHNICAL DATA SHEET & GA FOR 3-WAY & 2 WAY MIXING VALVE	AA	10
50	PE-V0-497-553-A239	4540-001-147-PVM-Y-047	TECHNICAL DATA SHEET& G/A/DRWG/ FOR BALANCING VALVE	AA	7
51	PE-V0-497-553-A240	4540-001-147-PVM-Y-048	TECHNICAL DATA SHEET FOR THERMAL & ACCOUSTIC INSULATION FOR DUCTING/PIPES	AA	10
52	PE-V0-497-553-A241	4540-001-147-PVM-Y-049	TECHNICAL DATA SHEET & G/A/ DRAWING OF PRE-FILTER,FINE FILTER,HEPA FILTER&WATER REPELLANT FILTER	AA	9
53	PE-V0-497-553-A242	4540-001-147-PVM-Y-050	TECHNICAL DATA SHEET & G/A/ DRAWING OF FIRE DAMPER WITH ACTUATOR	AA	10
54	PE-V0-497-553-A243	4540-001-147-PVM-Y-051	TECHNICAL DATA SHEET OF G/I SHEET	AA	8
55	PE-V0-497-553-A244	4540-001-147-PVM-Y-052	TECHNICAL DATA SHEET OF PIPES	AA	8
56	PE-V0-497-553-A001	4540-001-147-QVM-Q-220	MQP Axial fan	E	10
57	PE-V0-497-553-A002	4540-001-147-QVM-Q-221	MQP Balancing Valves	A	10
58	PE-V0-497-553-A003	4540-001-147-QVM-Q-222	MQP Butterfly Valves	A	10

59*	PE-V0-497-553-A004	4540-001-147-QVM-Q-223	MQP Centrifugal fan	E	10
60	PE-V0-497-553-A005	4540-001-147-QVM-Q-224	MQP Conventional Gate/Globe Valve/ Check Valve (Size >600 NB or Rating Pr Class > 300	E	10
61*	PE-V0-497-553-A006	4540-001-147-QVM-Q-225	MQP Horizonatal Centrifugal Pumps	E	10
62	PE-V0-497-553-A007	4540-001-147-QVM-Q-226	MQP MS ERW Pipe (Black/GI)	E	10
63	PE-V0-497-553-A008	4540-001-147-QVM-Q-227	MQP Pipe-CS/SS seamless	A	10
64*	PE-V0-497-553-A009	4540-001-147-QVM-Q-228	MQP Screw Chiller	A	10
65	PE-V0-497-553-A010	4540-001-147-QVM-Q-229	MQP VRF	A	10
66*	PE-V0-497-553-A201	BHEL INTERNAL DOC	TECHNICAL DATA SHEET, GA DRAWING AND PERFORMANCE CURVES OF MOTOR FOR PUMPS, COOLING TOWER & CENTRIFUGAL FAN	AA	12
67	PE-V0-497-553-A706	BHEL INTERNAL DOC	LIST OF INSTRUMENTS / INSTRUMENT SCHEDULE FOR MAIN PLANT / COMMON A/C FOR ESP, FGD, ASH HANDLING CONTROL ROOM & VFD ROOM/SERVICE BUILDING / ADMINISTRATIVE BUILDING / WATER SYSTEM CONTRO BUILDING / CANTEEN BUILDING	AA	12
68	PE-V0-497-553-A707	BHEL INTERNAL DOC	CABLE INTER CONNECTION SCHEDULE FOR MAIN PLANT / COMMON A/C FOR ESP, FGD, ASH HANDLING CONTROL ROOM & VFD ROOM / SERVICE BUILDING / ADMINISTRATIVE BUILDING / WATER SYSTEM CONTRO BUILDING / CANTEEN BUILDING	AA	12
69	PE-V0-497-553-A716	BHEL INTERNAL DOC	DRIVE LIST FOR MAIN PLANT / A/C COMMON FOR ESP, FGD, ASH HANDLING CONTROL ROOM & VFD ROOM / SERVICE BUILDING / ADMINISTRATIVE BUILDING / WATER SYSTEM CONTRO BUILDING / CANTEEN BUILDING	AA	12
70	PE-V0-497-553-A717	BHEL INTERNAL DOC	I/O LIST FOR MAIN PLANT / A/C COMMON FOR ESP, FGD, ASH HANDLING CONTROL ROOM & VFD ROOM / SERVICE BUILDING / ADMINISTRATIVE BUILDING / WATER SYSTEM CONTRO BUILDING / CANTEEN BUILDING	AA	12

71	PE-V0-497-553-A711	BHEL INTERNAL DOC	LOGIC DRAWING FOR MAIN PLANT / A/C COMMON FOR ESP, FGD, ASH HANDLING CONTROL ROOM & VFD ROOM / SERVICE BUILDING / ADMINISTRATIVE BUILDING / AUDITORIUM / WATER SYSTEM CONTRO BUILDING / IT BUILDING / CANTEEN / ACC CONTROL ROOM ETC.	AA	12
72	PE-V0-497-553-A203	BHEL INTERNAL DOC	TECHNICAL DATA SHEET FOR TEMPERATURE GAUGE , PRESSURE GAUGE AND LEVEL GAUGE	AA	12
73	PE-V0-497-553-A207	BHEL INTERNAL DOC	TECHNICAL DATA SHEET FOR TEMP SENSOR/ELEMENT, TEMPERATURE CUM HUMIDITY INDICATOR WITH SENSOR, HUMIDITY SENSOR	AA	12
74	PE-V0-497-553-A208	BHEL INTERNAL DOC	TECHNICAL DATA SHEET FOR PRESSURE TRANSMITTER & TYPE TEST REPORT FOR PRESSURE TRANSMITTER	AA	12
75	PE-V0-497-553-A209	BHEL INTERNAL DOC	TECHNICAL DATA SHEET FOR LEVEL TRANSMITTER & TYPE TEST REPORT FOR LEVEL TRANSMITTER	AA	12
76	PE-V0-497-553-A210	BHEL INTERNAL DOC	TECHNICAL DATA SHEET FOR TEMPERATURE TRANSMITTER & TYPE TEST REPORT FOR TEMP TRANSMITTER	AA	12
77	PE-V0-497-553-A211	BHEL INTERNAL DOC	TECHNICAL DATA SHEET FOR LEVEL SWITCH, FLOW SWITCH & DIFFERENTIAL PRESSURE SWITCH	AA	12
78	PE-V0-497-553-A215	BHEL INTERNAL DOC	TECHNICAL DATA SHEET FOR GEYSERSTAT & AIRSTAT	AA	12
79	PE-V0-497-553-A220	BHEL INTERNAL DOC	TECHNICAL DATASHEET & GA , TYPE TEST OF JUNCTION BOX	AA	12
80	PE-V0-497-553-A515	BHEL INTERNAL DOC	A/C DUCT LAYOUT ALONG WITH AHU LAYOUT FOR UPS AND SWAS ROOM OF MAIN POWER HOUSE	AA	3
81	PE-V0-497-553-A522	BHEL INTERNAL DOC	VALVE SCHEDULE	AA	12
82	PE-V0-497-553-A901	BHEL INTERNAL DOC	PG TEST PROCEDURE	A	15
83*	PE-V0-497-553-A202	BHEL INTERNAL DOC	TECHNICAL DATA SHEET FOR VFD	AA	16
84	PE-V0-497-553-A247	BHEL INTERNAL DOC	TDS AND GA OF WATER SOFTENING PLANT	AA	10

85	PE-V0-497-553-A248	BHEL INTERNAL DOC	TDS AND GA OF VARIABLE AIR VOLUME (VAV) ALONGWITH OCCUPANCY SENSORS	AA	12
86	PE-V0-497-553-A249	BHEL INTERNAL DOC	TDS AND GA OF ELECTRIC HOIST FOR AC SYSTEM	AA	12
87	PE-V0-497-553-A250	BHEL INTERNAL DOC	TDS AND GA OF CHAIN PULLEY BLOCK FOR AC SYSTEM	AA	12

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.: -

    a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

    b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

    c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

    d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

    e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

    f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

    g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

    h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

    i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

    j) Bidder to follow the following the drawing submission schedule:

    k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

n) Drawing/Documents listed above and marked as "*" under S. no. column shall be treated as basic Drawing/Documents.

SECTION-I

SUB-SECTION-E

ANNEXURE-VII

FORMAT FOR OPERATION AND 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 &				

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
	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				
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 equipments 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 equipments.				
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				

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
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., 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**				

SECTION-I

SUB-SECTION-E

ANNEXURE-VIII

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

- a) GENERAL STORAGE REQUIREMENTS
- b) GENERAL PRESERVATION REQUIREMENTS
- c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

A. GENERAL STORAGE REQUIREMENTS

1) To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2) The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3) The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4) Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5) Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
6) Vendor shall compulsory make covered storage shed of minimum size of 15 feet x 15 feet for storage of valuable electrical/electronic items/instruments etc.
7) Vendor shall compulsory make office of size 10 feet x 10 feet for site engineer/staff along with facility of computer/laptop/printer for protocol preparation and submission to BHEL.
8) Alternately vendor can provide container of suitable size for sr no-06 and 07 purpose.
9) Vendor shall deploy one number Safety officer and one number Quality engineer during total E&C period. Failure for above BHEL shall deploy it and appropriate charges shall be deducted from

vendor due payments.

10. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks, preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

11. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.

2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.

3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.

4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings

5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.

6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.

7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.

8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment

a. Rust preventive fluid (RPF)

b. Rust protective paints

c. Tarpaulin covers, in case of outdoor storage

d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

- Ingress of moisture and corrosion damages.

  Damage to protective coating.

- Open ends in pipes, vessels and equipment –
  - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

- In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
- Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere**. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.

ii **Semi-closed storage**. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.

iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

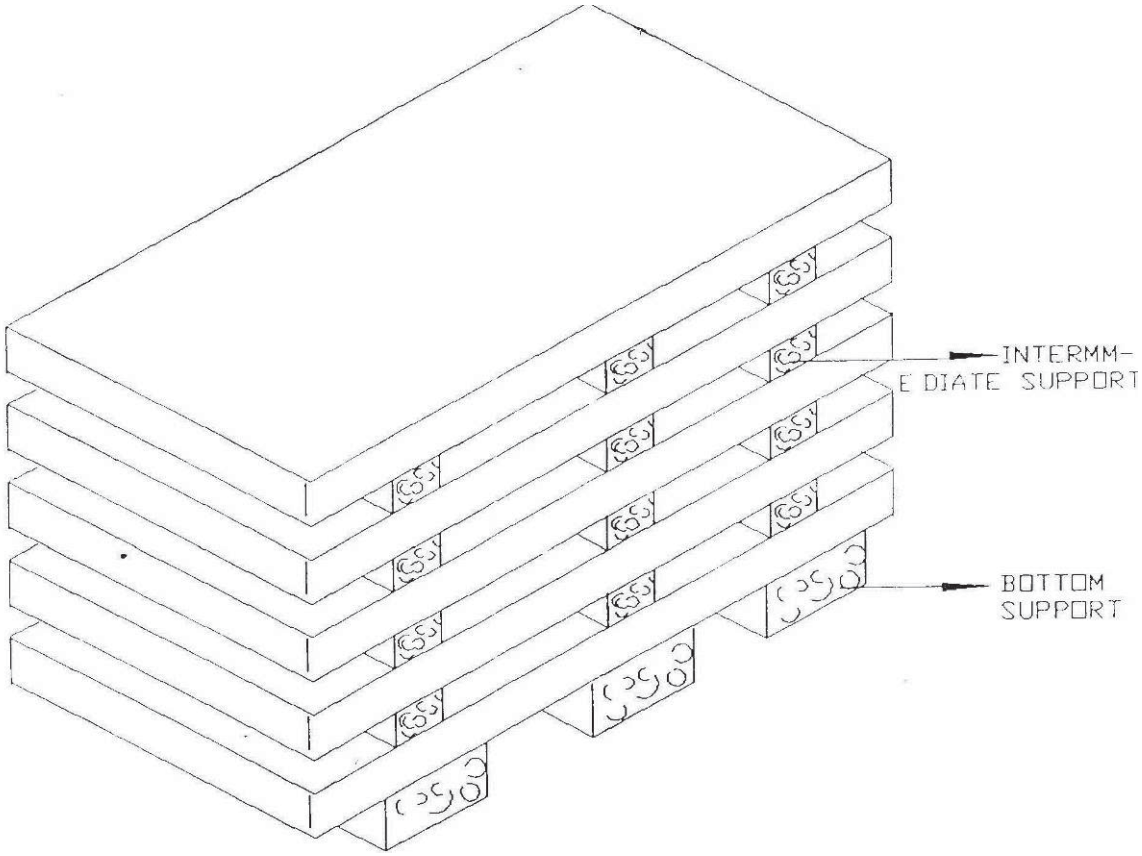

Figure – 1 – PLATE STACKING ARRANGEMENT

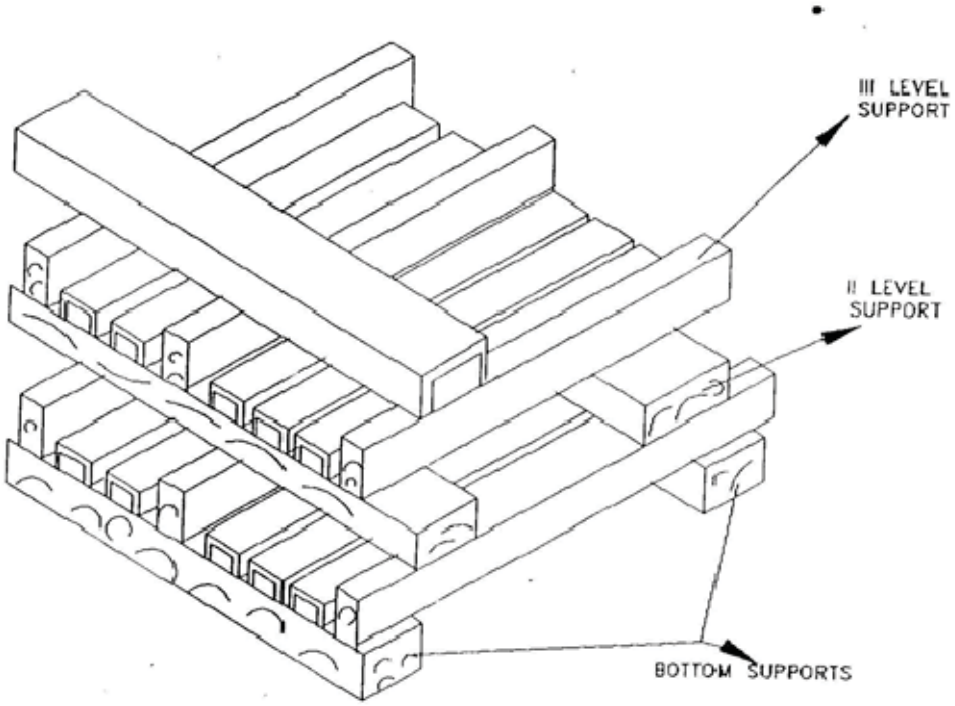

Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-I

SUB-SECTION-E

ANNEXURE-IX

PACKING PROCEDURE

(REFER SUB-SECTION C2-B)

SECTION-I

SUB-SECTION-E

ANNEXURE-X

CUSTOMER SPECIFICATION
ERECTION CONDITIONS OF CONTRACT

41.04.02 The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.

41.05.00 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

42.00.00 UNFAVOURABLE WORKING CONDITIONS

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavorable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

43.00.00 PROTECTION OF MONUMENTS AND REFERENCE POINTS

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be performed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

44.00.00 WORK & SAFETY REGULATIONS

44.01.00 General

i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.

ii) The Contractor shall follow NTPC Safety Rules as specified in SCC with respect to safety in construction & erection.

iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge.

iv) The contractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to

employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents to Engineer I/c for approval as per the format of Safety plan as annexed at Annexure - III.

v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.

vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard.

vii) The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.

viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.

ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NTPC safety documents as stated above.

x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured.

The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 0f The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health records shall be maintained accordingly and to be submitted to Engineer I/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c).

xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction

sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.

44.01.01 **Emergency Action Plan**

The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.

44.01.02 **Scaffolding**

The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.

44.01.03 **Opening**

The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.

44.01.04 **Explosives**

The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.

44.02.00 **Fencing of Machinery**

The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.

The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.

44.03.00 **Carrying of Excessive Weight by a Worker**

The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.

44.04.00 **Dangerous and Harmful Gases / Equipment**

The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.

The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.

44.05.00 **Overhead Protection**

The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

44.06.00 **Working at Heights**

All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.

Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.

Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.

Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (fall arrestors) for climbing/getting down through ladders to prevent fall from height.

44.07.00 **Handling of Hazardous Chemicals**

The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained

by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.

Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule.

Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.

The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.

The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.

44.08.00 **Eye Protection**

The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.

44.09.00 **Excavation**

The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides.

Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.

44.10.00 **Electrical Hazards**

The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules.

The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.

The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools.

The contractor should also ensure that all temporary electrical installations at the

construction works are provided with earth leakage circuit breakers.

44.11.00 **Vehicular Traffic**

The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.

44.12.00 **Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc.**

The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.

44.13.00 **Excessive Noise, Vibration**

The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000. Generally for brownfield projects background noise is in the range of 58-60 DB, however it shall be responsibility of contractor to collect and measure the latest noise data at site.

44.14.00 **Electrical Installations**

44.14.01 The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment.

Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall

i) Satisfy the Engineer I/C that the appliance is in good working condition;

ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances;

iii) Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected.

The Engineer I/C will not grant permission to connect until he is satisfied that:

The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

iv) No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.

v) The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrica

installation.

he installations are provided with suitable ELCBs and RCCBs wherever required.

44.15.00 **Safety Organisation**

44.15.01 The contractor shall employ full time safety officer(s) as per requirement stipulated in NTPC Safety Rules, exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub-contractor shall also be considered as the contractor's employees/workmen for the above purpose.

44.15.02 The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.

44.16.00 **Reporting of Accident and Investigation**

In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.

44.17.00 **Right to stop Work**

44.17.01 The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.

44.17.02 The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (l)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.

44.18.00 **Fire Protection**

The contractor shall provide sufficient fire extinguishers at place /s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment.

44.19.00 **Penalties**

I If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c shall have the right to regulate the payment in accordance with provisions of SCC. Further such defaulting worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.

II If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has

(1) not complied with keeping adequate PPEs in stock or

(2) defaulted in providing PPEs to his workmen

(3) not followed statutory requirements / NTPC safety rules

(4) been issued warning notice/s by NTPC head of the project on non observance of safety norms

(5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident.

The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by NTPC. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evaluation of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.

44.20.00 The Contractor will make available minimum quantity of all safety equipments and safety PPEs of required specifications as per suggestive list included bidding documents as a part of "List of minimum T & P". Further Contractor will ensure availabilitty of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.

44.21.00 The Contractor shall abide by the following during Construction and Erection activities:

I. Chain pulley block shall not be used for loads more than 2 (Two) tonne.

II. Hydra shall not be used for material transport.

III. Cage shall necessarily be provided to Monkey ladders of height more than 4 m.

IV. Fencing shall be provided to all Electrical Distribution boards and transformers etc.

44.22.00 Contractor shall ensure following regarding implementation of Safety:

a) Two Tier Safety Monitoring System:
Separate Safety Consultancy contract shall be awarded by NTPC for assisting and guiding overall Plant Safety during Construction. The safety consultant shall induct and engage manpower required as per specific requirements of project.
For Construction safety, Contractor shall engage certified safety team in consultation with NTPC Safety team /safety Consultant for each package/area.

b) Risk level of different area of plant shall be evaluated by NTPC Safety & Safety consultant. Based on the severity of risk level, total project area shall be categorized into different safety zones and each zone will be identified with different color coding.

c) Dedicated Project Safety Manager of Safety Consultant will be deployed. Contratcor to deploy area/ system wise safety representative for each system/ area of project e.g. SG area, TG Main Power House area and similarly in other BOP Systems.

d) The Safety Officer can stop work of any contractor if safety rules are violated.

e) There should also be safety clearance in Quarterly RA bills in addition to the clearances being presently taken from HR and Quality dept.

f) PPEs, scaffoldings, safety nets, testing tools etc. should be monitored by NTPC Safety Manager to control and maintain the uniformity of Quality for Safety equipment/ PPEs.

g) There should be 24/7 Safety Control room equipped with IP Camera, AI Input alarms and proper communication system for monitoring safety. All CCTV footage shall be available to control room. Drone based safety monitoring shall be done during day. The safety control room shall be operated & managed by NTPC through safety consultant.

h) Safety management plan for the Project must be submitted for approval before start of work.

i) In line with the Project Planning, Safety planning will be done jointly by Project Team and Consultants.

j) Availability of Fire Tender shall be ensured by contractor before start of construction work.

k) **Number of Safety Stewarts**: Each area (e.g. SG, TG, etc.) should have minimum 5 safety Stewarts from Main Agency and 5 from the sub agency.

l)	Contractor should provide scaffolding material, pipes, clamps, boards and scaffolding of standard quality.
m)	Uses of Safety net, Fire blankets and fall arrester shall be adequate.
n)	Construction Elevators shall be used during erection phase.
o)	Material transport through Hydra shall be avoided.
p)	Good Quality and new PPEs and tools and machinery shall be used.
q)	All Agency /Sub Agency will deploy Safety manpower after getting approval from Head of safety Consultant.
r)	Contractor Safety officer shall take approval of JSA /HIRA of each area from Safety consultant. Before Start of work in a particular area, concerned Safety consultant clearance is must.
s)	Inspect the site to ensure it is a hazard-free environment & promotes safe practices at the job site.
t)	Verifies that injury logs and reports are completed and submitted to NTPC.
u)	Receives reports from and responds to orders issued by NTPC and Labor inspectors.
v)	Serve as primary contact for project site incident and injury notification, investigation, and follow-up.
w)	Organize and maintain necessary project safety documentation.
x)	Training Setup to be created for giving basic education of Safety to workers.
y)	Safety Park and work simulation facility to be created at site.
z)	Health Check Up facility of workers.
aa)	Vendor Safety circle (with max 25 nos person) and monthly safety award to be created.
bb)	24/7 first aid center (common for all agency) and expenditure on contribution basis which is decided by NTPC safety department.
45.00.00	**FOREIGN PERSONNEL**
45.01.00	The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.
45.02.00	Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.
45.03.00	No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.

SECTION-I

SUB-SECTION-E

ANNEXURE-XI

E-LEARNING MODULE
(REFER GENERAL TECHNICAL REQUIREMENTS CLAUSE NO. 8.03.05)

SECTION II

SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

1.01.00 Inspection and Tests during Manufacture.

1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.

1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

1.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.

For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.

1.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to dispatch from place of manufacture.

1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the

Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 Performance Tests at Site

1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

1.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required

QAP FORMAT

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: SYSTEM :

VENDOR : ITEM :

SL NO	COMPONENT /OPERATION OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYPE /METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

Legend: 1. BHEL 2. Vendor 3. Sub-Vendor

QP No	CQS/SQP/31	Signature	Date				
	Rev		Name				
Page No	1 of 1		Party	Customer/Consultant		Bhel	Vendor

SUB -QR FORMAT FOR CHILLER

(B) We further declare that the chillers to be suppplied under the package shall be sourced from manufacturer M/s..... who has manufactured and supplied atleast One (1) no. of similar type of chiller unit having a capacity of not less than 150 TR and have been in successful operation for atleast One (1) year.

Chillers proposed to be supplied under this package would be sourced from following manufacturers. Experience details of the manufacturers are given below:

(a)	Type of vapor compression type chilling unit offered	Screw compressor
(b)	Name and Address of Manu-facturer from whom the above equipment is sourced	
(c)	For the above type of chiller Experience details of the Manufacturer is as follows :	

Sl.No.	Item Description	Plant No.1
1.	Name of the Client with address, name of contact person(s), tel. no. & fax no.	**Confirmed that chiller for this project shall be procured as per sub QR requirement and all details shall be provided as per required format.**
2.	Purchase Order no. and date	
3.	Date of Commissioning	
4.	No. of years of successful operation	
5.	Capacity of chiller unit	..... TR

Signature of authorized signatory.....

Sl.No.	Item Description	Plant No.1
6.	Clients certificate to demonstrate successful operation of machine for at least one (01) year.	Yes/No
7.	Documentary evidence in support of above enclosed	Yes/No

Date :

Place :

(Signature).....

(Printed Name).....

(Designation).....

(Common Seal).....

Signature of authorized signatory.....

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

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Un priced format for AC package
4. Deviation schedule /No deviation certificate in attached format ‘Deviation sheet (Cost of withdrawal)’.
5. Pre bid clarification schedule.

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

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

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & 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. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

   For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) 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.

o) 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.

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

DEVIATION SHEET (COST OF WITHDRAWAL)
(Refer GCC and Unpriced schedule for cost of withdrawal format)

2x660 MW TALCHER TPP MAIN PLANT

AIR CONDITIONING SYSTEM

GUARANTEED POWER CONSUMPTION FIGURES

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
1	2	3A	3B	4	5	6=3Ax4x5
1.0	**ACP-1 COMMON CONTROL ROOM FOR UNIT# 1&2 OF MAIN CONTROL ROOM AREAS, (AC PLANT - 1)**					
1.1	Water Cooled Screw Compressor motor	2	1		1	
1.2	Condenser water pump	2	1		1	
1.3	Chilled water pump	2	1		1	
1.4	AHU at 25.5 m	3	1		1	
1.5	AHU AT 8.5 m	2	1		1	
2.0	**ACP-2 COMMON FOR ESP CUM FGD CONTRL ROOM UNIT-1 & 2, ASH HANDLING CONTROL ROOM**					
2.1	Water Cooled Screw Compressor motor for WATER cooled chiller	2	1		1	
2.2	Condenser water pump	2	1		1	
2.3	Chilled water pump	2	1		1	
2.4	AHU In AHU Room For ESP Cum FGD Control Room For Unit-1	2	2		1	
2.5	AHU In AHU Room For ESP Cum FGD Control Room For Unit-2	2	2		1	
2.6	AHU In AHU Room For AHP MCC cum C/R Room & LHP GHP MCC Room	1	1		1	
2.7	AHU In AHU Room For AHP Classifier MCC	1	1		1	
2.7	AHU In AHU Room For AHP CHP Bunker MCC	1	1		1	
2.8	AHU For AHP Silo AHP MCC	1	1		1	
3.0	**ACP-3 FOR SERVICE BUILDING**					
3.1	Water cooled Screw Compressor motor	2	0		0.5	
3.2	Condensor Water Pump	2	0		0.5	
3.3	Primary Chilled Water Pump	2	0		0.5	
3.4	Secondary Chilled Water Pump	2	0		0.5	
3.5	AHU In AHU Room At Ground Floor Of Service Bldg.	2	0		0.5	

3.6	AHU In AHU Room At First Floor Of Service Bldg.	2	0		0.5	
3.7	AHU In AHU Room At Second Floor Of Service Bldg.	2	0		0.5	
3.8	AHU In AHU Room At Third Floor Of Service Bldg.	2	0		0.5	
3.9	AHU In AHU Room At Fourth Floor Of Service Bldg.	2	0		0.5	
4.0	**ACP-4 FOR ADMIN BUILDING**					
4.1	Water cooled Screw Compressor motor	2	0		0.5	
4.2	Condensor Water Pump	2	0		0.5	
4.3	Primary Chilled Water Pump	2	0		0.5	
4.4	Secondary Chilled Water Pump	2	0		0.5	
4.5	AHU In AHU Room At Ground Floor Of Admin Bldg.	2	0		0.5	
4.6	AHU In AHU Room At First Floor Of Admin Bldg.	2	0		0.5	
4.7	AHU In AHU Room At Second Floor Of Admin Bldg.	2	0		0.5	
4.8	AHU In AHU Room At Third Floor Of Admin Bldg.	2	0		0.5	
5.0	**ACP-5 FOR WATER SYSTEM CONTROL ROOM BUILDING**					
5.1	Air cooled condensing unit	1	1		1	
5.2	DX AHU	1	1		1	
6.0	**ACP-6 FOR CEP VFD UNIT #1**					
6.1	Air cooled condensing unit	1	1		1	
6.2	DX AHU	1	1		1	
7.0	**ACP-7 FOR CANTEEN BUILDING**					
7.1	Air cooled condensing unit	2	0		0.5	
7.2	DX AHU	2	0		0.5	
					TOTAL(kW)	

Note:	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 1150 kW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ USD 5195 per kW of additional power over EPC. Bidder’s guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ USD 5195 per KW shall be levied on vendor.

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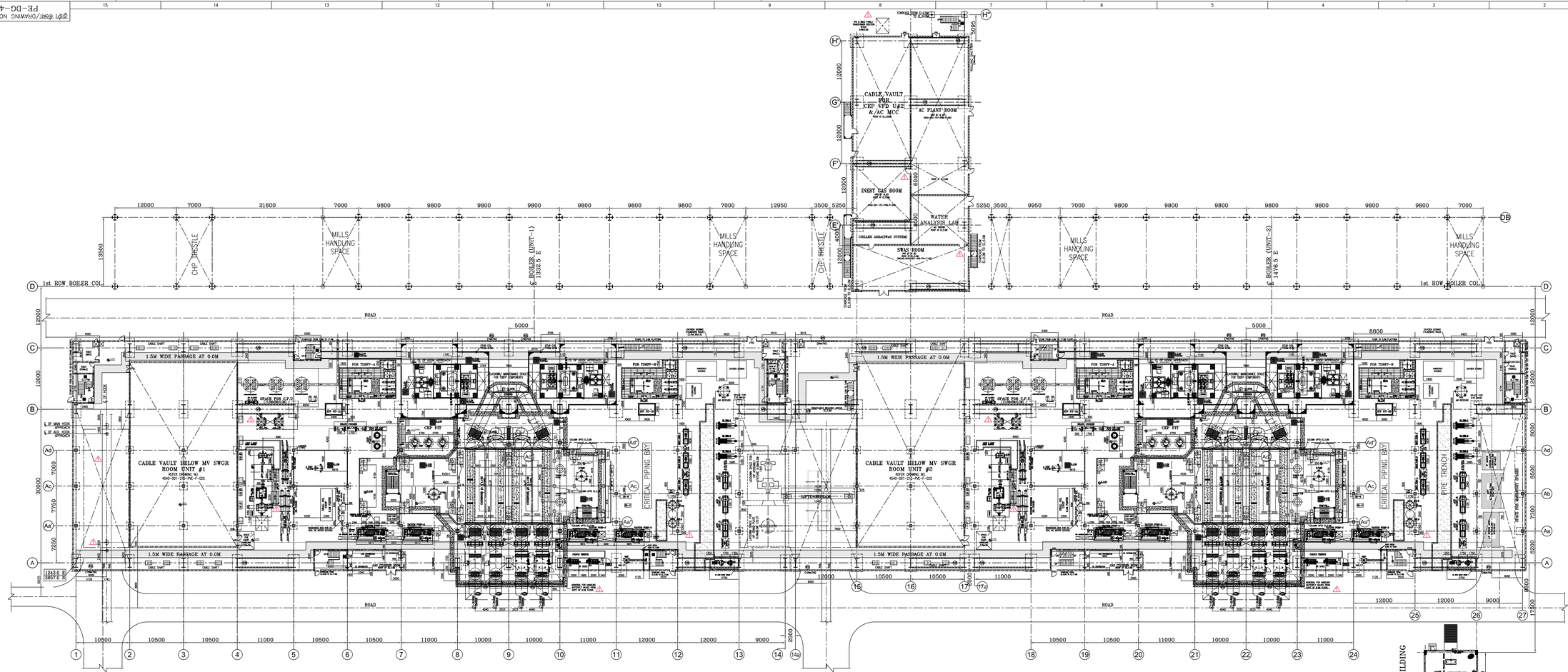
it must not be used directly or indirectly in any way detrimental to the interest of the company./इसका प्रयोग प्रत्यक्ष या अप्रत्यक्ष रूप से ऐसे किसी तरीके से नहीं किया जाएगा जो कंपनी के हित के प्रतिकूल हो।

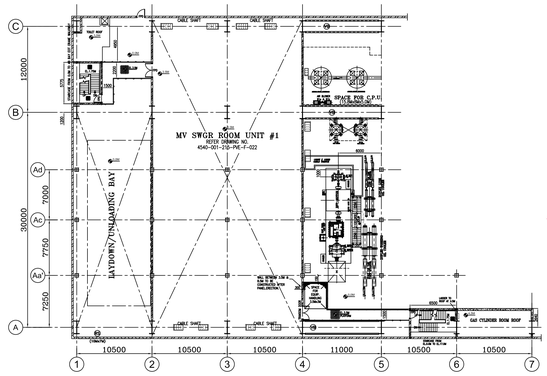
NORTH



PLAN AT EL.0.0M

⚠ SPACE FOR FORMANDATORY SPARES AT 0M:–

1. IP INNER CASING LOWER HALF
2. HP TURBINE
3. LP ROTOR ASSEMBLY

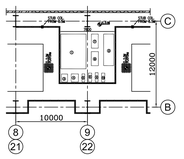


PLAN AT EL.3.5M

DETAIL OF LAYDOWN SPACE FOR TDBFP COMPONENTS

S.No.	DESCRIPTION	LENGTH	BREADTH	HEIGHT
01	MAXIMUM OF OUTER CASING + EXH. HOOD	3510	4850	4090
02	ROTOR	4400	1400	1400
03	FRONT BEARING PEDESTAL(UP)	860	1100	370
04	REAR BEARING HOUSING(UP)	1000	1120	520
05	GUIDE BLADE CARRIER–I (UP)	390	1130	520
06	GUIDE BLADE CARRIER–I (LP)	390	1300	620
07	GUIDE BLADE CARRIER–II (UP)	960	1970	990
08	GUIDE BLADE CARRIER–II (LP)	990	1970	990
09	STEAM CHAMBER (UP)	440	1240	620
10	STEAM CHAMBER (LP)	440	1240	620

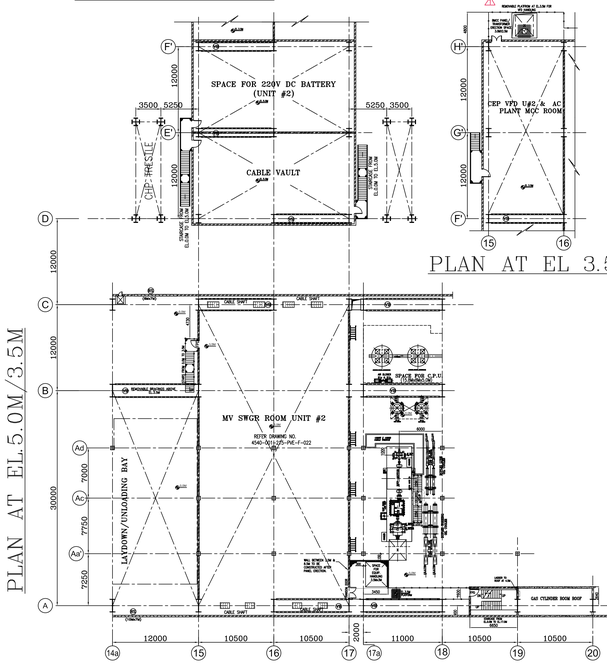
⚠



NOTES:–

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR ELEVATION AS ±0.00M WHICH CORRESPONDS TO RL (+) 71.50M.
3. EQUIPMENTS & FACILITIES OF BOI'S SHOWN ARE SUGGESTIVE ONLY & UPDATED ACCORDINGLY AS ORDERED.
4. LUBE OIL PIPING BETWEEN COOLERS AND MDBFP TO BE ROUTED BELOW WALKOVER PLATFORM.

PROGRESS DRAWING 01:20.02.2023



PLAN AT EL.5.0M/3.5M

⚠ REFERENCE DRAWINGS:–

1.	TG EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	4540–001–110–PVM–F–050
2.	TG EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	4540–001–110–PVM–F–051
3.	TG EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY	4540–001–110–PVM–F–052
4.	CROSS SECTION OF TG BUILDING	4540–001–110–PVM–F–053
5.	CONDENSER GA	4540–001–110–PVM–B–084
6	FOUNDATION PLAN – TG	4540–001–315–PVC–U–1679
7.	GA OF GLAND STEAM CONDENSER	4540–001–110–PWM–B–034
8	FOUNDATION DETAILS OF GEN. AUXILIARY EQUIPMENTS	01500001981
9.	LAYDOWN SPACE FOR STEAM TURBINE COMPONENTS	4540–001–110–PWM–F–068
10.	GENERAL ARRANGEMENT & FOUNDATION OF CEP SET	4540–001–110–QWM–Q–002
11.	GENERAL ARRANGEMENT OF DRAIN COOLER	4540–001–110–PWM–U–016A
12.	GA & FOUNDATION OF VACUUM PUMP	4540–001–110–QWM–Q–169
13.	TDBFP – FOUNDATION GA & LOADING DETAILS	4540–001–315–PVC–U–0335
14.	GA OF TDBFP SET	4540–001–110–PWM–B–044
15.	TDBFP – AUXILIARY EQUIPMENT FOUNDATION GA & LOADING	—
16.	FOUNDATION ARRANGEMENT OF MDBFP SET	4540–001–315–PVC–C–0339A
17.	GA OF MDBFP SET	4540–001–110–PWM–B–044A
18.	GA OF F/T–A	4540–001–110–PWM–B–089
19.	GA OF F/T–B	4540–001–110–PWM–B–090
20.	GA OF UNIT F/T	4540–001–110–PWM–B–091
21.	GA OF LEAKAGE TANK/DIRTY OIL TANK & PUMP	4540–001–110–PWM–B–017
22.	GA OF WASTE OIL TANK	4540–001–110–PWM–B–118B
23.	CPU SERVICE VESSEL AREA LAYOUT	— (BOI)
24.	GA AND FOUNDATION OF MDBFP HYD. COUPLING COOLERS	4540–001–110–PWM–B–047
25.	TURBINE JB AND LIST & LAYOUT	—
26.	GA OF TG PHEs	4540–001–110–PWM–Y–065 (BOI)
27.	GA OF TG DMCW & ACW PUMPS	4540–001–110–PWM–B–087 (BOI)
28.	GA OF ACW SELF CLEANING STRAINERS	4540–001–110–PWM–Y–067 (BOI)
29.	GENERAL ARRANGEMENT OF DRIP PUMPS	4540–001–110–QWM–Q–003
30.	GA OF CSC	4540–001–110–PWM–B–034
31.	GA OF DRAIN COOLER	4540–001–110–QWM–Q–187
32.	GA & ASSY. OF CLEAN OIL TANK	4540–001–110–PWM–B–004
33.	GA & ASSY. OF DIRTY OIL TANK	4540–001–110–PWM–B–005
34.	ARRGT. & ASSY. OF OIL UNLOADING VESSEL	4540–001–110–PWM–B–006
35.	GA OF AIR RECEIVER	4540–001–102–PWM–Y–021 (BOI)
36.	GAS CYLINDER ROOM LAYOUT	4540–001–110–PWM–F–070
37.	OXYGEN & AMMONIA DOSING SYSTEM	4540–001–102–PWI–Y–003
		4540–001–102–PWM–B–004 (BOI)

LEGEND:–

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

NOTE:– SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

कार्य संख्या/JOB NO.	497
स्थिति/STATUS	CONTRACT
मुद्रण स्केल मीटर में/PRINT SCALE IN METRE	0 2 4 6 8 10 20 30 40 50

ग्राहक ड्राॅग संख्या/CUSTOMER DRAWING NO. 4540–001–110–PVM–F–049

ग्राहक/CUSTOMER: एन टी पी सी लिमिटेड N T P C LIMITED

एन टी पी सी/NTPC

परियोजना/PROJECT: 2X660 मेगावाट तालचर थर्मल पावर परियोजना चरण–III
2X660MW TALCHER THERMAL POWER PROJECT STAGE–III

भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD
पावर सेक्टर/POWER SECTOR
परियोजना अभियांत्रिकी प्रबंधन PROJECT ENGINEERING MANAGEMENT
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

DEPT CODE: M

	नाम/NAME	हस्ताक्षर/SIGNATURE	दिनांक/DATE
परियोजना/DSN	DK/MK	Sd/–	20.10.2022
डीएम/एमजी/DCM	DK/MK	Sd/–	20.10.2022
चीफ/CHD	KK	Sd/–	20.10.2022
अप्रूवेड/APPD	BKA	Sd/–	20.10.2022

	DATE	चीफ/CHD	अप्रूवेड/APPD
2	20.06.23	DK	KK	BKA
1	28.12.22	MK	Sd/– KK	Sd/– BKA

1. DRG. REVISED INLINE WITH NTPC COMMENTS.
2. REVISION MARKED ⚠

1. DRG. REVISED INLINE WITH NTPC COMMENTS RCVD. LETTER NO. CC–ENG2–4540–001–110–PVM–F–049 RCVD. DTD. 04/11/2022 & DISCUSSION ON TALCHER SITE DTD.24.11.2022.
2. REVISION MARKED ⚠

शीर्षक/TITLE: TG EQUIPMENT PLAN AT GROUND FLOOR

यमपीएल/MPL	सिविल/CIVIL	इलेक्ट्रिकल/ELEC	सी&सं/C&I	एमएसई/MSE	मेक्स/MAX

डिपार्ट/DEPT. SIGN / दिनांक/DATE

स्केल – SCALE– 1:300

ड्राईंग संख्या / DRAWING NO. PE–DG–497–100–M003

शीट/SHEET 1 OF 1 पुनरीक्षण/REV. 02

ELECTRONIC FILE NAME : 497_100_M0_03_04_05_06_07_R01b.dwg

फॉर्मेट/फाइव AO FORMAT SIZE AO

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It must not be used directly or indirectly in any way detrimental to the interest of the company./इसे सीधे अथवा अन्य प्रकार से कंपनी के हित के प्रतिकूल नहीं होना चाहिए

ELECTRONIC FILE NAME : 497_100_MO_03_04_05_06_07_R01a.dwg

ड्राईंग संख्या/DRAWING NO. PE-DG-497-100-M004

फर्स्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION

सभी माप मि॰ मी॰ मे है/ALL DIMENSIONS ARE IN MM

NORTH

PLAN AT EL.8.5M

1st ROW BOILER COL

CHP TRESTLE

MILLS HANDLING SPACE

℄ BOILER (UNIT-1) 1332.5 E

℄ BOILER (UNIT-2) 1476.5 E

ARU ROOM FOR CEPs VFD AT 8.5M (UNIT #2)
DRG.NO.4540-001-405-PVE-F-007

SPACE FOR UPS PANEL & BATTERY AT 8.5M (UNIT #2)
DRG.NO.4540-001-405-PVE-F-007

SPACE FOR UPS PANEL & BATTERY CHARGER (AC AREA) AT 8.5M (UNIT #1&2)
DRG.NO.4540-001-405-PVE-F-007

CER (AC AREA) AT 8.5M (UNIT #1)

CER (AC AREA) AT 8.5M (UNIT #2)

CABLE SHAFT

1.5M WIDE PASSAGE AT 8.5M

CABLE VAULT BELOW LV SWGR ROOM UNIT #1
ROTER DRAWING NO.
4540-001-215-PVE-F-029

CABLE VAULT BELOW LV SWGR ROOM UNIT #2
ROTER DRAWING NO.
4540-001-215-PVE-F-029

OPENING FOR MDBFP

OIL ROOM

SPACE FOR HEATER HANDLING

PLAN AT EL.12.0M

LV SWGR ROOM UNIT #1
ROTER DRAWING NO.
4540-001-215-PVE-F-023

OPENING FOR MDBFP

PLAN AT EL.12.0M/13.5M

CABLE VAULT

CABLE VAULT

LV SWGR ROOM UNIT #2
ROTER DRAWING NO.
4540-001-215-PVE-F-023

OPENING FOR MDBFP

PROGRESS DRAWING
01.20.02.2023

NOTES:–

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR ELEVATION AS ±0.00M WHICH CORRESPONDS TO RL (+) 71.50M.

REFERENCE DRAWING:–

1.	TG EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	4540-001-110-PVM-F-049
2.	TG EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	4540-001-110-PVM-F-051
3.	TG EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY	4540-001-110-PVM-F-052
4.	CROSS SECTION OF TG BUILDING	4540-001-110-PVM-F-053
5.	CONDENSER ASSEMBLY (GENERAL ARRANGEMENT)	4540-001-110-PVM-B-084
6.	GENERATOR OUTLINE	4540-001-110-PVE-V-150E
7.	OIL ROOM ARRANGEMENT	4540-001-110-PVM-B-118
8.	FOUNDATION DETAILS OF GEN. AUXILIARY EQUIPMENTS	01500001981
9.	LP BYPASS VALVE ARRANGEMENT (PLAN)	---
10.	GENERAL ARRANGEMENT OF LP HEATER No.–1	4540-001-110-PVM-B-032E
11.	GENERAL ARRANGEMENT OF LP HEATER No.–2	4540-001-110-PVM-B-032E
12.	GENERAL ARRANGEMENT OF LP HEATER No.–3	4540-001-110-PVM-B-032A
13.	GENERAL ARRANGEMENT OF LP HEATER No.–4	4540-001-110-PVM-B-032B
14.	GENERAL ARRANGEMENT OF LP HEATER No.–5	4540-001-110-PVM-B-032C
15.	GENERAL ARRANGEMENT OF HP HEATER No.–7A	4540-001-110-PVM-B-033A
17.	GENERAL ARRANGEMENT OF HP HEATER No.–7B	4540-001-110-PVM-B-033A
18.	OIL CANAL DETAILS	0000-001-315-PVC-C-0046
19.	TURBINE JB AND LIST & LAYOUT	---
20.	LAYOUT OF IPB (MAIN, DELTA & TAP–OFF RUN) FOR UNIT–1 & 2	4540-001-207-PVE-B-004
21.	STRUCTURE AND FOUNDATION LAYOUT OF IPB FOR UNIT–1 & 2	4540-001-207-PVE-V-017
22.	FOUNDATION DETAILS OF HPSU (LPBPV)	4540-001-110-PVI-T-026
23.	TG DECK	4540-001-315-PVC-C-0309B

LEGEND:–

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

| | | |

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NORTH

PLAN AT EL.17.0M

SPACE FOR 220V DC BATTERY ROOM (UNIT #1)

PROGRAMMER ROOM (UNIT #1&2)
SHIFT INCHARGE ROOM
C&I ENGINEER ROOM &
CONFERENCE ROOM

OFFSITE CONTROL ROOM

CENTRAL CONTROL ROOM
DRG.NO.4540-001-405-PVI-F-002

CER

MILLS HANDLING SPACE

CHP TRESTLE

℄ BOILER (UNIT-1) 13382.5 E

℄ BOILER (UNIT-2) 14476.5 E

3.0M WIDE PASSAGE AT 17.0M

1.5M WIDE PASSAGE AT 17.0M

OPENING FOR LPH HANDLING

OPENING FOR MDBFP HANDLING

OPENING FOR HEATER HANDLING

SPACE FOR LAYDOWN

OIL CANAL TOP EL170 M

AIR WASHER (1A)
AIR WASHER (1B)
AIR WASHER (1C)
AIR WASHER (1D)
AIR WASHER (1E)
AIR WASHER (2A)
AIR WASHER (2B)
AIR WASHER (2C)
AIR WASHER (2D)
AIR WASHER (2E)

SPACE FOR MANDATORY SPARES AT 17M:-

1. IP INNER CASING UPPER HALF
2. EXCITER
3. IP ROTOR
4. BFPDT ROTOR
5. GENERATOR ROTOR
6. BFP MOTOR.

AIR WASHER (A)

LAYDOWN SPACE FOR TURBINE & GENERATOR COMPONENTS

AIR WASHER (D)

LAYDOWN SPACE FOR TURBINE & GENERATOR COMPONENTS

PROGRESS DRAWING DT:20.02.2023

DETAIL OF LAY-DOWN SPACE FOR TG COMPONENTS.

Sl.No	DESCRIPTION	WT. IN (T)	AREA M x M
(01)	ASSEMBLY OF GUIDE BLADE CARRIER (UPPER PART LEFT)	4.43	4.2x2.3
(02)	ASSEMBLY OF GUIDE BLADE CARRIER (UPPER PART RIGHT)	4.43	4.2x2.3
(03)	ASSEMBLY OF GUIDE BLADE CARRIER (UPPER PART LEFT)	4.43	4.2x2.3
(04)	ASSEMBLY OF GUIDE BLADE CARRIER (UPPER PART RIGHT)	4.43	4.2x2.3
(05)	IP OUTER CASING (U/H)	42	5.6x4.2
(06)	LP INNER CASING (U/H) 2NOS.	20	4.0x4.3
(07)	LP SHAFT 2NOS.	56.6	6.7x3.2
(08)	LP OUTER CASING 2NOS.	30	6.0x8.35
(09)	HP OUTER CASING - EXHAUST PART	27	3.4x5.3
(10)	IP SHAFT	32	5.9x1.7
(11)	HP INNER CASING (U/H)	18	3.4x2.0
(12)	CROSS OVER PIPE (PART-1)	32	12.0x3.1
(13)	CROSS OVER PIPE (PART-2)	22	6.5x3.0
(14)	LIFTING BEAM	8	8.5x3
(15)	IP INNER CASING (L/H)	40	3.55x3.5
(16)	LPSSC (U/H) (TC) 2 NOS.	0.8	1.85x1.85
(17)	LPSSC (U/H) (GC) 2 NOS.	0.8	1.85x1.85
(18)	IP INNER CASING (U/H)	34	3.5x3.2
(19)	HP INNER CASING (L/H)	18	3.4x2.0
(20)	HP SHAFT	20	5.5x1.5
(21)	LP BYPASS CONTROL VALVE ACTUATOR 2NOS.	0.5	2x0.7
(22)	OVERLOAD CONTROL VALVE	0.8	1.5x0.6
(23)	OVERLOAD CONTROL VALVE ACTUATOR	0.8	1.5x0.6
(24)	IP CONTROL VALVE ACTUATOR 2NOS.	1.6	2.0x0.7
(25)	HP STOP VALVE ACTUATOR 2NOS.	1.5	1.7x0.9
(26)	HP CONTROL VALVE 2NOS.	3	2.3x1.1
(27)	HP CONTROL VALVE ACTUATOR 2NOS.	2	1.7x1
(28)	IP CONTROL VALVE 2NOS.	6.5	3.0x1.3
(29)	HP STOP VALVE 2NOS.	4.5	2.5x1.3
(30)	LP BYPASS CONTROL VALVE 2NOS.	2.5	2.0x2.0
(31)	IP STOP VALVE ACTUATOR 2NOS.	1.4	2.1x0.7
(32)	IP STOP VALVE 2NOS.	7	2.1x1.7
(33)	PEDESTAL COVER - HP FRONT	0.6	1.344x0.62
(34)	PEDESTAL COVER - HP-IP	1	1.45x0.79
(35)	PEDESTAL COVER - IP-LP	1.4	1.6x1.215
(36)	PEDESTAL COVER - LP-GEN	1.4	1.6x1.215
(37)	PEDESTAL COVER - LP-LP	1.4	1.32x1.53
(38)	H2 COOLERS 2NOS.	5	5.0x2.2
(39)	END SHIELD (DS) 2NOS. (U/H) & (L/H)	8/9	3.6x1.2
(40)	END SHIELD (TS) 2NOS. (U/H) & (L/H)	8/9	3.6x1.2
(41)	EXCITER	35	5.65x2.01
(42)	BEARING SHELLS 4NOS.	0.5	0.5x0.8
(43)	EXCITER HOUSING	3.5	4.6x4.3
(44)	H2 COOLER HOUSING	21	5.0x4.4
(45)	GENERATOR ROTOR WITH BASE FRAME	86	14.140x1.79
(46)	LP BYPASS STOP VALVE 2NOS.	2.5	2.0x2.0
(47)	LP BYPASS STOP VALVE ACTUATOR 2NOS.	0.5	2x0.7

DETAIL OF Air Washer Layout AT 17.0M FLOOR UNIT-1

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -1A	A Row grid 2-3	0 Mtr floor, Mezzanine floor, Operating Floor,HT Switch Gear & its Cable vault, LT Switch Gear & its Cable vault of Unit 1
02	Air Washer -1B	A Row grid 6-7	
03	Air Washer -1C	A Row grid 7-8	
04	Air Washer -1D	A Row grid 10-11	
05	Air Washer -1E	A Row grid 12-13	

DETAIL OF Air Washer Layout AT 17.0M FLOOR UNIT-2

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -2A	A Row grid 15-16	0 Mtr floor, Mezzanine floor, Operating Floor,HT Switch Gear & its Cable vault, LT Switch Gear & its Cable vault of Unit 2
02	Air Washer -2B	A Row grid 19-20	
03	Air Washer -2C	A Row grid 20-21	
04	Air Washer -2D	A Row grid 23-24	
05	Air Washer -2E	A Row grid 25-26	

NOTES:-

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR ELEVATION AS ±0.00M WHICH CORRESPONDS TO RL (+) 71.50M.

REFERENCE DRAWING:-

1.	TG EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	4540-001-110-PVM-F-049
2.	TG EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	4640-001-110-PVM-F-050
3.	TG EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY	4540-001-110-PVM-F-052
4.	CROSS SECTION OF TG BUILDING	4540-001-110-PVM-F-053
5.	GENERAL ARRANGEMENT OF HP HEATER No.-8A	4540-110-110-PVM-B-033C
6.	GENERAL ARRANGEMENT OF HP HEATER No.-8B	4540-110-110-PVM-B-033C
7.	GENERAL ARRANGEMENT OF HP HEATER No.-9A	4540-110-110-PVM-B-033E
8.	GENERAL ARRANGEMENT OF HP HEATER No.-9B	4540-110-110-PVM-B-033E
9.	FOUNDATION PLAN - TG	4540-001-315-PVC-C-0308
11.	OIL CANAL DETAILS	0000-001-315-PVC-C-0046
12.	FOUNDATION DETAILS FOR GENERATOR AUXILIARY EQUIPMENTS	01500001981
13.	LAYDOWN SPACE FOR STEAM TURBINE COMPONENTS	4540-001-110-PVM-F-068
14.	OIL ROOM ARRANGEMENT	4540-001-110-PVM-B-118
15.	LP BYPASS VALVE ARRANGEMENT (PLAN)	4540-001-110-PVM-Y-064
16.	COR/ CER/ COMPUTER ROOM LAYOUT	4540-001-405-PVI-F-002
17.	TURBINE JB AND LIST & LAYOUT	--

LEGEND:-

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

NOTE:- SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

कार्य संख्या-JOB NO. 497

स्थिति STATUS CONTRACT

मूल स्केल मीटर में PRINT SCALE IN METRE 0.2 0.4 0.8 1.0 20 30 40 50

ग्राहक ड्राईंग संख्या CUSTOMER DRAWING NO. 4540-001-110-PVM-F-051

ग्राहक/CUSTOMER एन टी पी सी लिमिटेड N T P C LIMITED

परियोजना PROJECT 2X660 मेगावाट तालचर थर्मल पावर परियोजना चरण-III
2X660MW TALCHER THERMAL POWER PROJECT STAGE-III

भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD
पावर सेक्टर/POWER SECTOR
परियोजना अभियांत्रिकी प्रबंधन PROJECT ENGINEERING MANAGEMENT
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

	NAME	SIGNATURE	DATE
तैयारकर्ता/DRN	DK/MK	Sd/-	20.10.2022
डिजाइनकर्ता/DSGN	DK/MK	Sd/-	20.10.2022
जाँचकर्ता/CHD	KK	Sd/-	20.10.2022
अनुमोदनकर्ता/APPD	BKA	Sd/-	20.10.2022

DEPT'L CODE M

REV.	DATE	DRAWN	CHD	APPD
1	10.01.23	MK	KK	BKA
2	20.02.23	DK	KK	BKA

1. DRG. REVISED INLINE WITH NTPC COMMENTS.
2. REVISION MARKED ⚠

1. DRG. REVISED INLINE WITH NTPC COMMENTS RCVD. LETTER NO. CC-ENGG-4540-001-110-PVM-F-051 RCVD. DTD. 04/11/2022 & DISCUSSION ON TALCHER SITE DTD.24.11.2022.
2. REVISION MARKED ⚠

शीर्षक/TITLE TG EQUIPMENT PLAN AT OPERATING FLOOR

एमपीएल MPL	सिविल CIVIL	इलेक्ट्रिकल ELEC	सी&आई C&I	एमएसई MSE	मैक्स MAX

डिभाग DEPT. | स्केल – SCALE– 1:275 | इंजीनियर SIGN | दिनांक DATE

ड्राईंग संख्या/ DRAWING NO. PE-DG-497-100-M005

शीट SHEET 1 OF 1 | पुनरीक्षण REV. 01

फॉर्मेट-साइज़ A0 FORMAT SIZE A0

ELECTRONIC FILE NAME : 497-100_MO_03_04_05_06_07_R01a.dwg

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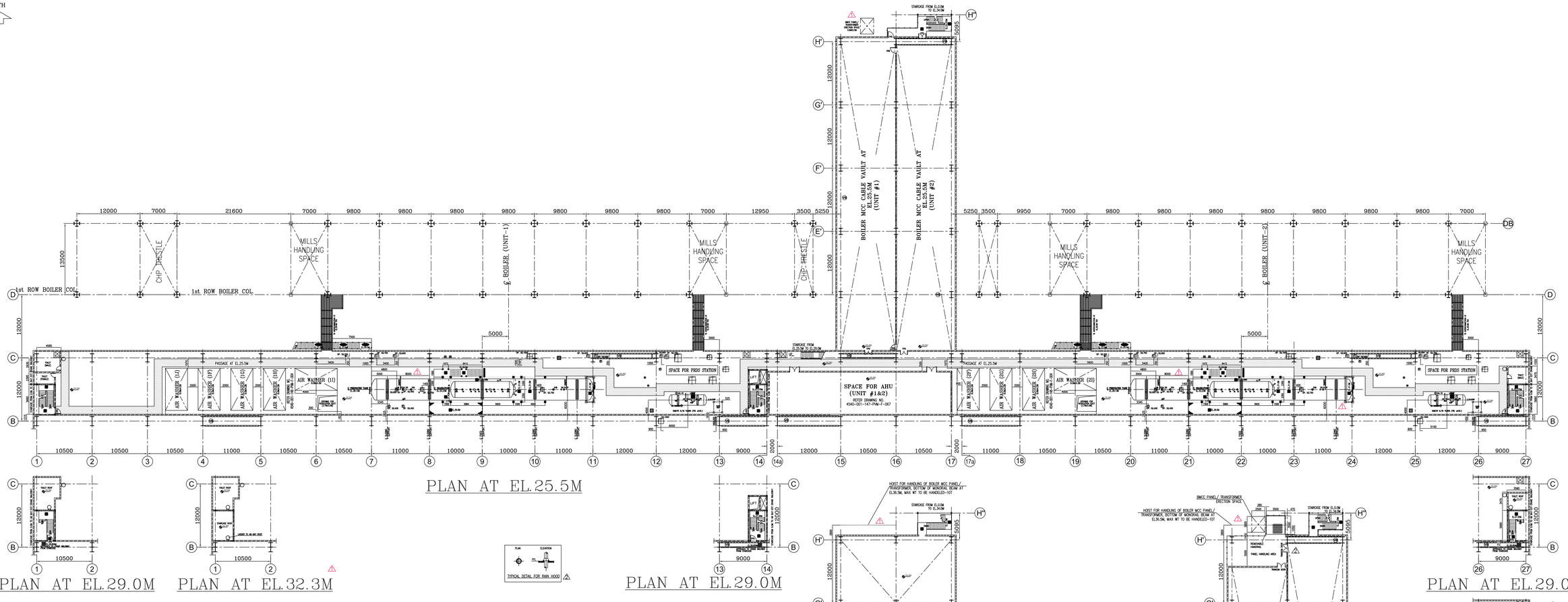
it must not be used directly or indirectly in any way detrimental to the interest of the company./इसका उपयोग प्रत्यक्ष अथवा अप्रत्यक्ष रूप से कंपनी के हितों के प्रतिकूल नहीं होना चाहिये

ELECTRONIC FILE NAME : 497-100_MO_03_04_05_06_07_R01o.dwg

ड्राफ्ट शीट/DRAWING NO. PE-DG-497-100-M006

फर्स्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION — सभी माप मि॰ मी॰ मे है/ALL DIMENSIONS ARE IN MM

NORTH



PLAN AT EL.25.5M

PLAN AT EL.29.0M

PLAN AT EL.32.3M

PLAN AT EL.29.0M

PLAN AT EL.32.3M

PLAN AT EL.34.0/37.5M(TOS)

PLAN AT EL.29.0M

TYPICAL DETAIL FOR RAIN HOOD

DETAIL OF Air Washer Layout AT 25.5 M FLOOR UNIT-1

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -1J	BC Bay grid 3-4	0 Mtr floor, Mezzanine floor, Operating Floor of Unit 1
02	Air Washer -1F	BC Bay grid 4-5	
03	Air Washer -1G	BC Bay grid 4-5	
04	Air Washer -1H	BC Bay grid 5-6	
05	Air Washer -1I	BC Bay grid 5-6-7	

DETAIL OF Air Washer Layout AT 25.5 M FLOOR UNIT-2

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -2F	BC Bay grid 17-18	0 Mtr floor, Mezzanine floor, Operating Floor of Unit 1
02	Air Washer -2G	BC Bay grid 17a-18	
03	Air Washer -2H	BC Bay grid 18-19	
04	Air Washer -2I	BC Bay grid 18-19-20	

DETAIL OF Air Washer Layout AT 34.0 M FLOOR UNIT-1

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -1a	CD Bay grid 15-16	Boiler MCC & its Cable vault, CCR cable vault, UPS cable vault of Unit 1

DETAIL OF Air Washer Layout AT 34.0 M FLOOR UNIT-2

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -2a	CD Bay grid 16-17	Boiler MCC & its Cable vault, CCR cable vault, UPS cable vault of Unit 2
02	Air Washer -2J	BC Bay grid16-17	

LEGEND:-

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

NOTES:-

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR ELEVATION AS ±0.00M WHICH CORRESPONDS TO RL (+) 71.50M.

REFERENCE DRAWING:-

1. TG EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	4540-001-110-PVM-F-049
2. TG EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	4540-001-110-PVM-F-050
3. TG EQUIPMENT LAYOUT PLAN AT OPEARATING FLOOR	4540-001-110-PVM-F-051
4. CROSS SECTION OF TG BUILDING	4540-001-110-PVM-F-053
5. GA OF SPRAY CUM TRAY DEAERATOR	4540-001-110-PVM-B-040
6. DEAERATOR PLATFORM ASSEMBLY	---
7. GA OF DMCW TANK FOR TG AUXILIARIES	4540-001-110-PVM-B-007
8. GA OF NaOH DOSING SKID	4540-001-110-PVM-B-085 (BOI)

PROGRESS DRAWING DT:20.02.2023

NOTE:- SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

कार्य संख्या-JOB NO. 497
स्थिति STATUS CONTRACT
मुद्रण स्केल मीटर में PRINT SCALE IN METRE
0.2 0.4 0.8 1.0 2.0 3.0 5.0 6.0 8.0 10

ग्राहक ड्राईंग संख्या CUSTOMER DRAWING NO. 4540-001-110-PVM-F-052

ग्राहक/CUSTOMER एन टी पी सी लिमिटेड N T P C LIMITED

परियोजना PROJECT 2X660 मेगावाट तालचर थर्मल पावर परियोजना चरण-III
2X660MW TALCHER THERMAL POWER PROJECT STAGE-III

भारत हैवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD
पावर सेक्टर/POWER SECTOR
परियोजना अभियांत्रिकी प्रबंधन PROJECT ENGINEERING MANAGEMENT
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

	नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
तैयारकर्ता/DSN	DK/MK	Sd/-	20.10.2022
डिजाइनकर्ता/DESN	DK/MK	Sd/-	20.10.2022
जाँचकर्ता/CHD	KK	Sd/-	20.10.2022
अनुमोदनकर्ता/APPD	BKA	Sd/-	20.10.2022

DEPT CODE M

REV.	DATE	ALTD	CHD	APPD
1	09.01.23	MK	KK	BKA
2	20.02.23	DK	KK	BKA

1. DRG. REVISED INLINE WITH NTPC COMMENTS RCVD. LETTER NO. CC-ENGG-4540-001-110-PVM-F-052 RCVD. DTD. 04/11/2022 & DISCUSSION ON TALCHER SITE DTD.24.11.2022.
2. REVISION MARKED

शीर्षक/TITLE TG EQUIPMENT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY

एमपीएल MPL	सिविल CIVIL	इलेक्ट्रिकल ELEC	सी&आई C&I	एमएसई MSE	मैक्स MAX	डिज़ाइन DEPT.	स्केल SCALE	1:275

ड्राईंग संख्या/ DRAWING NO. PE-DG-497-100-M006

शीट SHEET 1 OF 1 पुनरीक्षण REV. 01

फॉर्मेट-साइज़ AO FORMAT SIZE AO

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it must not be used directly or indirectly in any way detrimental to the interest of the company./इसका उपयोग प्रत्यक्ष या अप्रत्यक्ष रूप से किसी भी प्रकार से कंपनी के हितों के प्रतिकूल नहीं होना चाहिए

ELECTRONIC FILE NAME : 497_100_M0_03_04_05_06_07_R01a.dwg

ड्राइंग संख्या/DRAWING NO. PE-DG-497-100-M007

फर्स्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION | सभी माप मि॰ मी॰ मे है/ALL DIMENSIONS ARE IN MM

LEGEND:–

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

NOTES:–

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR ELEVATION AS ±0.00M WHICH CORRESPONDS TO RL (+) 71.50M.

REFERENCE DRAWING:–

1.	TG EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	4540-001-110-PVM-F-049
2.	TG EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	4540-001-110-PVM-F-050
3.	TG EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	4540-001-110-PVM-F-051
4.	TG EQUIPMENT LAYOUT PLAN AT DEAERATOR FLOOR	4540-001-110-PVM-F-052

PROGRESS DRAWING DT:20.02.2023

REV.	DATE	ALTD	CHD	APPD
2	20.02.23	DK	KK	BKA
1	09.01.23	MK	KK	BKA

1. DRG. REVISED INLINE WITH NTPC COMMENTS.
2. REVISION MARKED

1. DRG. REVISED INLINE WITH NTPC COMMENTS RCVD. LETTER NO. CC-ENGG-4540-001-110-PVM-F-053 RCVD. DTD. 04/11/2022 & DISCUSSION ON TALCHER SITE DTD.24.11.2022.
2. REVISION MARKED

NOTE:– SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

कार्य संख्या/JOB NO. 497

स्थिति/STATUS CONTRACT

मुद्रण स्केल मीटर में/PRINT SCALE IN METRE

0 2 4 6 8 10 20 30 40 50

ग्राहक ड्राइंग संख्या/CUSTOMER DRAWING NO. 4540-001-110-PVM-F-053

ग्राहक/CUSTOMER एन टी पी सी लिमिटेड N T P C LIMITED

परियोजना/PROJECT 2X660 मेगावाट तालचर थर्मल पावर परियोजना चरण–III
2X660MW TALCHER THERMAL POWER PROJECT STAGE–III

भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD
पावर सेक्टर/POWER SECTOR
परियोजना अभियांत्रिकी प्रबंधन
PROJECT ENGINEERING MANAGEMENT
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

	नाम/NAME	हस्ताक्षर/SIGNATURE	दिनांक/DATE
तैयारकर्ता/DSN	DK/MK	Sd/–	20.10.2022
डीजाइनकर्ता/DSGN	DK/MK	Sd/–	20.10.2022
जाँचकर्ता/CHD	KK	Sd/–	20.10.2022
अनुमोदनकर्ता/APPD	BKA	Sd/–	20.10.2022

DEPT'S CODE M

शीर्षक/TITLE

CROSS SECTION OF TG BUILDING

उपकरण/MPL	सिविल/CIVIL	इलेक्ट्रिकल/ELEC	सी एण्ड आई/C&I	एमएसई/MSE	मैक्स/MAX

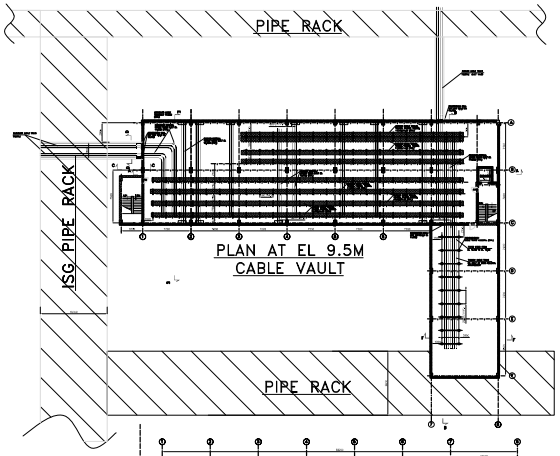
डिपार्ट/DEPT. | स्केल – SCALE– 1:75

ड्राइंग संख्या/DRAWING NO. PE-DG-497-100-M007

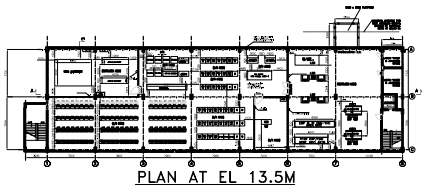
हस्ताक्षर/SIGN | दिनांक/DATE

शीट/SHEET 1 OF 1 | पुनरीक्षण/REV. 01

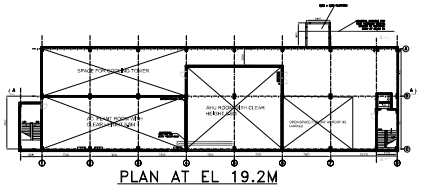
फॉर्मेट/साइज़ A0 FORMAT/SIZE A0



PLAN AT EL 9.5M
CABLE VAULT

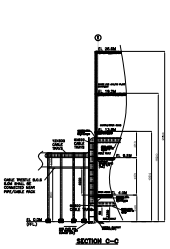


PLAN AT EL 13.5M



PLAN AT EL 19.2M

SPACE FOR AHU/AC EQUIPMENT

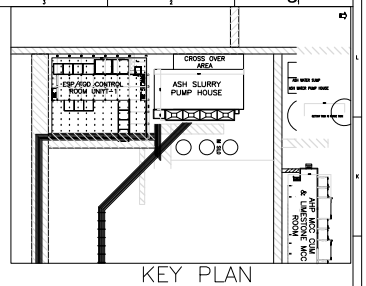


SECTION G-G

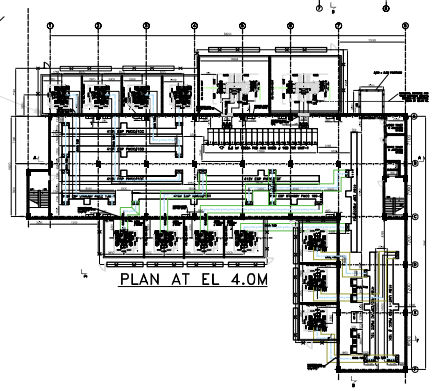
LEGEND

- OPERATING FRONT OF THE PANEL
- BRICK WALL
- FIRE BARRIER WALL
- VERTICAL CABLE TRAYS
- CABLE TRAYS
- DOUBLE LEAF DOOR 1500W X 2500H
- SINGLE LEAF DOOR
- SINGLE LEAF FIRE PROOF DOOR
- CABLE DUCT BANK WITH PULL PIT
- FENCING
- REMOVABLE FENCING
- MOORING POST
- EYE WASH
- RCC STRUCTURE

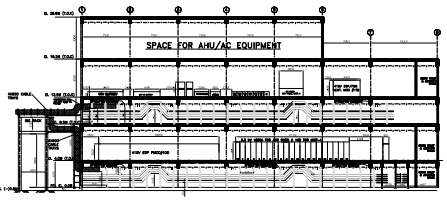
NORTH



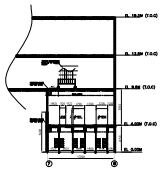
KEY PLAN



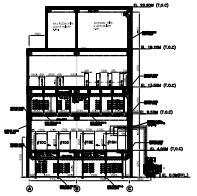
PLAN AT EL 4.0M



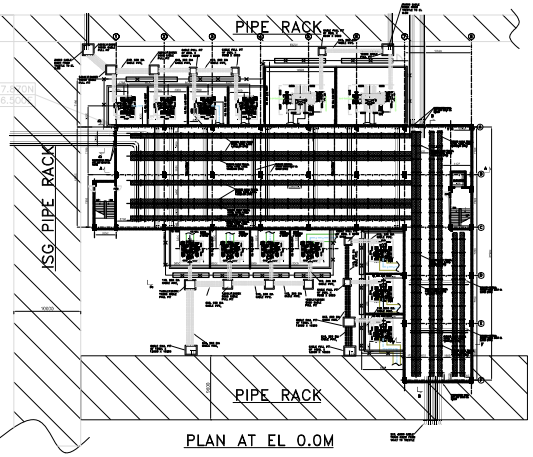
SECTION A–A FGL (–)0.5M



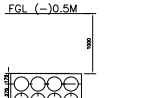
SECTION F–F



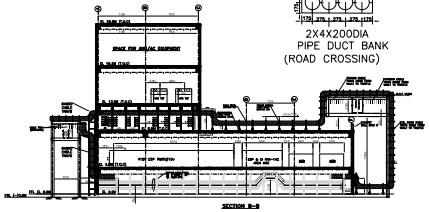
SECTION E–E



PLAN AT EL 0.0M



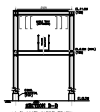
2X4X200DIA
PIPE DUCT BANK
(ROAD CROSSING)

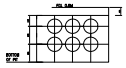


SECTION B–B

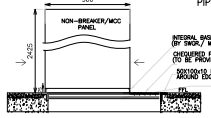
2X2X200DIA
PIPE DUCT BANK

1X2X200DIA
PIPE DUCT BANK

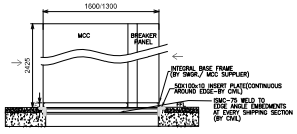




2X3X200DIA
PIPE DUCT BANK



TYPICAL FIXING ARRGT. FOR NON-BREAKER/MCC PANEL
(FLOOR CUTOUT INDICATIVE)



TYPICAL FIXING ARRGT. FOR BREAKER/MCC PANEL
(FLOOR CUTOUT INDICATIVE)

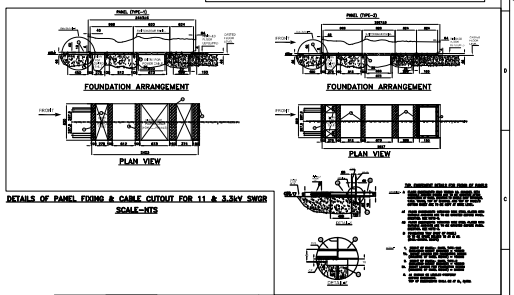
REFERENCE DRAWINGS :

S. NO.	TITLE	DRAWING NO.	SOURCE AGENCY
1.	PLOT PLAN	4540-001-301-POC-F-001	PEM/ MPL
2.	ELECTRICAL SINGLE LINE DIAGRAM	4540-001-299-PVE-P-058-01	PEM/ ELECT

NOTES :

1. ALL ELEVATIONS ARE WITH RESPECT TO MAIN POWER HOUSE BUILDING GROUND FLOOR LEVEL AS EL.(±)0.00 M. CORRESPONDS TO RL(+)71.50M.
2. ALL DIMENSIONS ARE IN MM AND ELEVATIONS IN METRES UNLESS STATED OTHERWISE.
3. THE LT PANEL DIMENSIONS INDICATED IN DRAWING ARE TENTATIVE AND ARE SHOWN FOR DEVELOPING CONCEPTUAL LAYOUT.
4. THIS DRAWING IS TO BE REFERRED FOR DETAILS OF ELECTRICAL EQUIPMENT AND CABLING LAYOUT ONLY. LAYOUT SHOWN FOR FACILITIES SUCH AS AC & VENTILATION SYSTEM IS INDICATIVE & FOR INTERFACE PURPOSE. FOR EXACT LAYOUT OF OTHER SYSTEMS, RELEVANT DISCIPLINE DRAWINGS SHALL BE REFERRED.
5. ALL AREAS SHOWN IN THIS DRAWING ARE NON A/C UNLESS STATED OTHERWISE.
6. BOTTOM MOST/OUTERMOST TRAY OF ALL RUNS SHALL BE PERFORATED TYPE.
7. BOTH SWITCHGEAR ROOM & CABLE VAULT ROOM SHALL BE VENTILATED.
8. DOORS IN CABLE VAULT SHALL BE FIRE PROOF.
9. FIRE BARRIER WALLS WILL BE 200 MM THICK CONCRETE AS PER CIVIL DETAILING; AND WILL PROJECT MINIMUM 600 MM BEYOND THE OIL CONTAINING PART OF THE TRANSFORMER.
10. SUITABLE GRADE FLOOR MATTING FOR PREVENTION OF SHOCKS SHALL BE PROVIDED IN THE SWITCHGEAR ROOM.
11. FOLLOWING CIVIL DETAILS FROM Pt. a to d SHALL BE DECIDED SEPARATELY BY CIVIL.
    a) SOAK PIT INVERT LEVEL OF TRANSFORMERS, FOUNDATIONS FOR TRANSFORMERS/ RAIL TRACKS/ RADIATORS/ COOLERS AS PER TRANSFORMER FOUNDATION PLANS AND OTHER PIPE SUPPORT ARRANGEMENT. INVERT LEVEL OF SOAK PIT SHALL BE FIXED IN LINE WITH TRANSFORMER OIL QUANTITY AND QUANTITY OF WATER SPRAY (TO BE INDICATED SEPARATELY BY FIRE FIGHTING SYSTEM ENGINEER).
    b) DRAINAGE SYSTEM FROM SOAK PITS OF INDIVIDUAL TRANSFORMERS TO COMMON OIL WATER SEPARATOR PIT/ BURNT-OIL PIT
    c) MOORING POSTS
    d) FENCING DETAILS.

"We confirm that this document meets all the contract requirements including safety and statuary requirements and facilitate ease of operation and maintenance. In case any deviation is found, the Contractor shall carry out all required changes/ modifications without any cost implications to NTPC. In addition, Penalty on account of noncompliance of contract specification as deemed fit by the Employer shall be recovered.



DETAILS OF PANEL FIXING & CABLE CUTOUT FOR 11 & 3.3kV SWGR
SCALE–NTS

CUSTOMER DRAWING NO.	4540-001-215-PVE-P-027	
NTPC	एन टी पी सी लिमिटेड N T P C LIMITED	
JOB NO. 497	PROJECT 2X660 मेगावाट तलचर थर्मल पावर परियोजना चरण-III 2X660MW TALCHER THERMAL POWER PROJECT STAGE-III	
STATUS CONTRACT	BHARAT HEAVY ELECTRICALS LTD पावर सेक्टर/POWER SECTOR PROJECT ENGINEERING MANAGEMENT नोएडा (उ.प्र.)/NOIDA (U.P.)	E
TITLE	ELECTRICAL EQUIPMENT AND CABLING LAYOUT IN ESP CUM FGD CONTROL ROOM BUILDING (UNIT-1)	
DRAWING NO.	PE-DG-497-100-E008	
SHEET	1 OF 1	

MUNDABASTI AREA
LOW HEIGHT PLANTATION
EXISTING OVERHEAD WATER TANK
SPACE FOR RESERVOIR (11 ACRES)
2 NO. 800NB M/U WATER PIPE
2 NO. 1200NB M/U WATER OUTLET PIPE
1 NO. 700NB M/U WATER INLET PIPE
CHP, CHEM. MCC HOUSE
SPACE FOR CONSTRUCTION STORE & WORKSHOP
SPACE FOR BATCHING PLANT (2400 SqM)
600NB, RW TO ASH SUMP
RL(+)71M
PARADE GROUND
GATE (NTPC)
CISF BARRACKS
LAND BELONGS TO KUKUDULA SCHOOL (3 ACRE)
SPACE FOR LAYDOWN AND PRE-ASSEMBLY (25000 SqM)
GATE-5
GATE-6
WT-6
WT-5
WT-4
WT-3
WT-2
WT-1
ADDITIONAL COAL STOCK AREA (36m x 270m)
270 m (L) x 50 m(W) x 10.5 m (H)
270 m (L) x 50 m(W) x 10.5 m (H)
SPACE FOR LAYDOWN & PRE-ASSEMBLY (30700 SqM)
SPACE FOR LAYDOWN & PRE-ASSEMBLY (60MxSSM)
SPACE FOR TMT STORAGE (9300 SqM)
SPACE FOR ETP (85Mx115M)
SPACE FOR BATCHING PLANT (3100 SqM)
SPACE FOR T/S & PLANT (NTPC)
SPACE FOR CO2 CAPTURE (NTPC)
METHANOL PRODUCTION CO2 CAPTURE 15,000 SQ.M (NTPC)
HYDROGEN REQUIREMENT CO2 CAPTURE 35,000 SQ.M (NTPC)
ASH SLURRY PIPELINE ROUTING
ASH SLURRY PIPE CORRIDOR
PIPE CONVEYOR FOR COAL-2
EXISTING POWER HOUSE
SWITCHYARD
JAGANNATHPUR VILLAGE
ADDITIONAL LAND REQUIRED FOR RAIL, TP AND TRACK HOPPER IN THIS PORTION
LAND AREA REQUIRED BY RAILWAYS
RAILWAY LINE
ANAND BAZAR
TOWARDS MAIN ROAD
MATERIAL GATE (TEMP. FOR 2ND PHASE)
TALCHER PH STATION PLATFORM
EXIST.LOC.NO-07
TYPE-BURUBURI (132 KV D/C) LINE
EXIST.LOC.NO-06
TO CUTTACK
DIVERSION OF ROAD
FLYOVER UNDER CONSTRUCTION
TOWNSHIP PHASE-II
U.G.T
SERVICE APARTMENT
B-TYPE
C-TYPE
H.O.D BUNGLOW
GREEN
SWIMMING POOL
GROUND WATER RESERVOIR
HOSPITAL
EARTHEN DRAIN
EARTHEN SLOPE
GUEST HOUSE
EXECUTIVE CLUB
TOWNSHIP MAIN GATE COMPLEX
PARKING AREA
ADMN. BLDG.
GATE COMPLEX GATE-1
GATE-2
GATE-3
GATE-4
GATE-7
TEMP. GATE
EXISTING NEW CONSTRUCTION OFFICE COMPLEX
EXISTING GUEST HOUSE
EXISTING SEWAGE TREATMENT PLANT
TRUCK PARKING AREA
FENCING
EXISTING WATER TANK
TEMPORARY STORE (NTPC)
PERMANENT STORE (NTPC)
OPEN YARD (500 SQM) (NTPC)
CONSTRUCTION OFFICE (NTPC)
FGD AREA (NTPC)
STP FOR T/S & PLANT (NTPC)
TOWN WELL
TRUCK PARKING
MATERIAL ENTRY
NANDRI NALLA
DIVERSION OF ROAD
TRANSMISSION LINE CORRIDOR
400 KV TRANSMISSION LINE CORRIDOR
TYPE-MERAMANDALI 220 KV LINE
TYPE-CHAINPAL-ST.I 132 KV D/C LINE
TYPE-CHAINPAL-ST.I 132 KV S/C LINE
EXIST.LOC.NO-04
EXIST.LOC.NO-05
EXIST.LOC.NO-03
EXIST.LOC.NO-02
EXIST.LOC.NO-08
EXIST.LOC.NO-09
EXIST.LOC.NO-10
EXIST.LOC.NO-11
EXIST.LOC.NO-12
EXIST.LOC.NO-13
EXIST.LOC.NO-14
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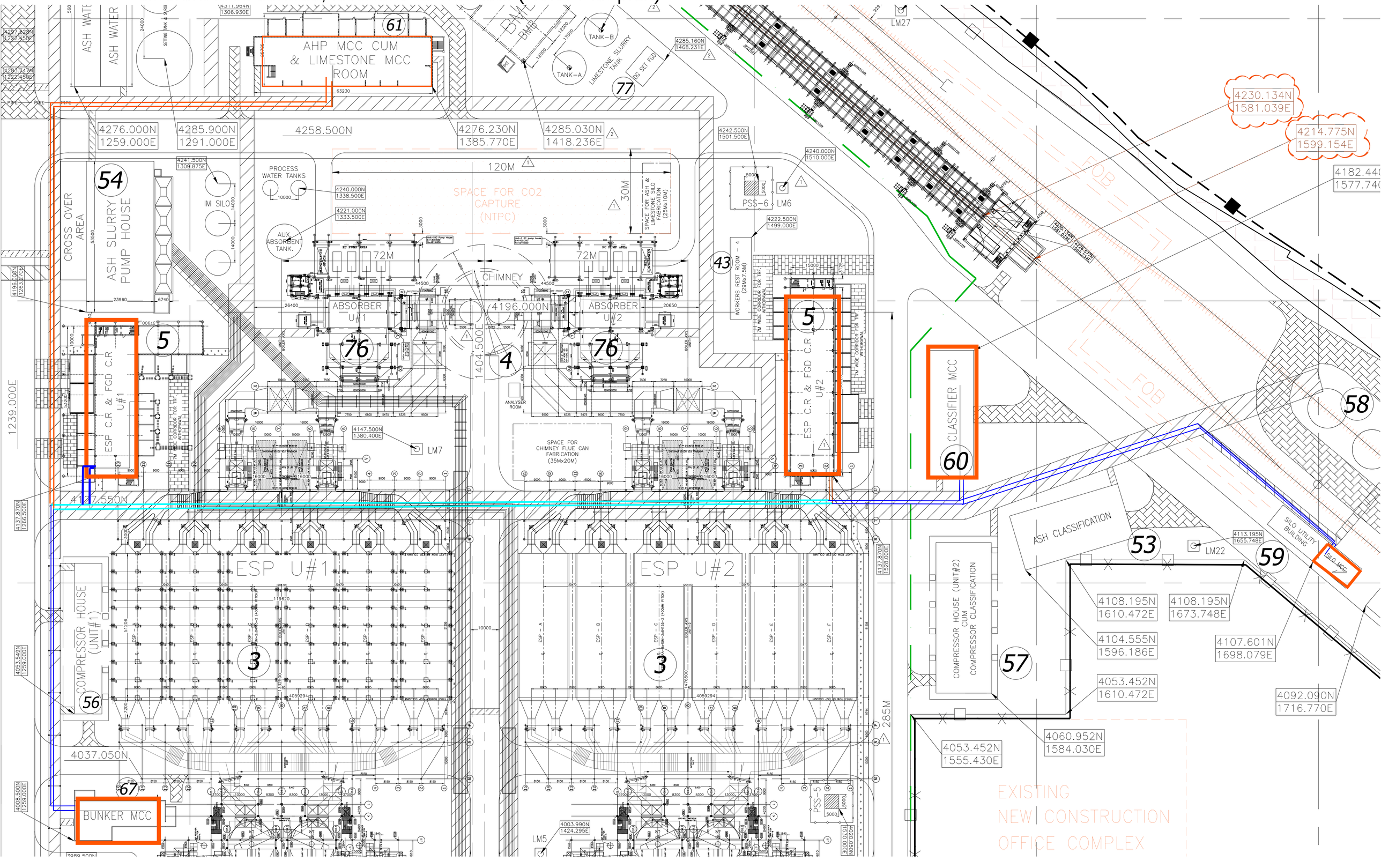
EXIST.LOC.NO-40
EXIST.LOC.NO-41
EXIST.LOC.NO-42
EXIST.LOC.NO-43
EXIST.LOC.NO-44
EXIST.LOC.NO-45
EXIST.LOC.NO-46
EXIST.LOC.NO-47

Indicative Routing of Insulated Chilled Water piping from AC Plant -2, located in ESP Control Room & FGD Control Room Unit-1 to different load centres, locations as marked. (Refer Plot plan)



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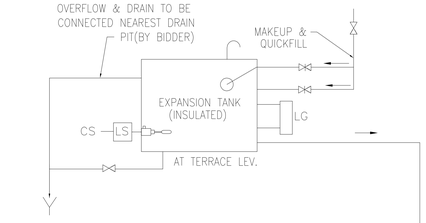
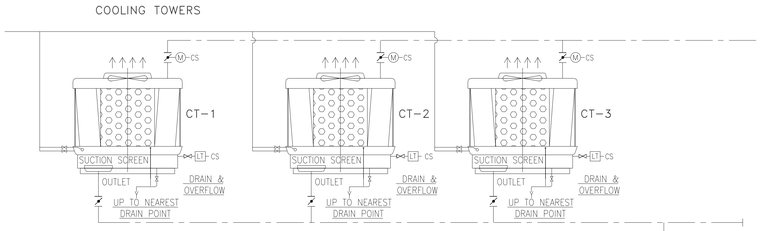
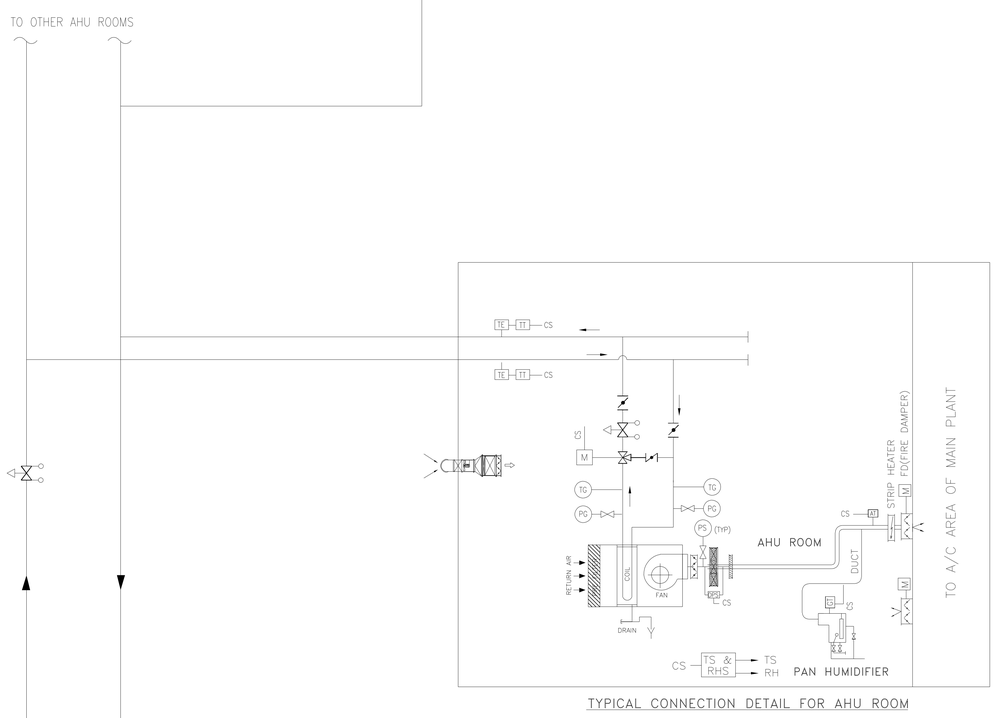




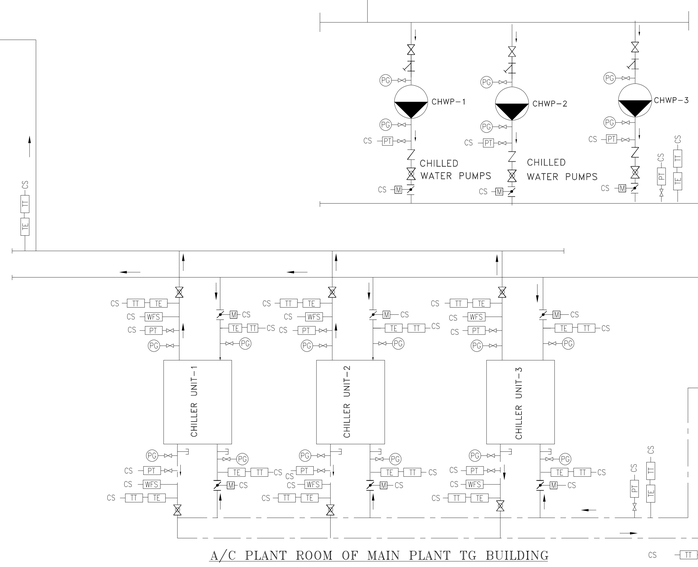
CHILLED WATER PUMP DETAIL	
NAME	QTY
CHWP-1 TO 3	3 NOS(2W+1S/B)

CONDENSER WATER PUMP DETAIL	
NAME	QTY
COND.WP-1 TO 3	3 NOS(2W+1S/B)

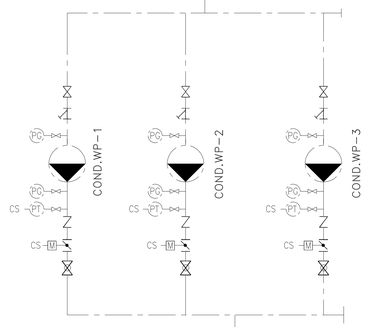
COOLING TOWER DETAILS	
NAME	QTY
CT-1 TO 3	3 NOS(2W+1S/B)



TYPICAL CONNECTION DETAIL FOR AHU ROOM



A/C PLANT ROOM OF MAIN PLANT TG BUILDING



CONDENSER WATER PUMPS

CS	CONTROL SYSTEM
TE	TEMPERATURE TRANSMITTER)
	CH.WATER SUPPLY & RETURN PIPE
	COND.WATER SUPPLY & RETURN PIPE
	OPEN DRAIN PIT
	ATMOSPHERIC VENT
	DESCALING CONNECTION
	STRIP HEATER
M	FRESH AIR FAN WITH PRE FILTER & FINE FILTER
	CENTRIFUGAL FAN
	PUMP
	PAN HUMIDIFIER WITH 25NB GATE VAVE(3 NOS EACH),1 NO EACH FLOAT VALVE, M-I/P/Q.FILL & DRAIN CON.
TG	TEMPARATURE GAUGE
LG	LEVEL GAUGE
LT-CS	LEVEL TRANSMITER
LS-CS	LEVEL SWITCH
GT-CS	GEYSER STAT
AT-CS	AIR STAT
DPS-CS	DIFFERENTIAL PRESSURE SWITCH
WFS-CS	WATER FLOW SWITCH
CS-TS RH	RH SENSOR &TEMP.SENSOR
TE-CS	TEMPARATURE ELEMENT(SENSOR)
PT-CS	PRESSURE TRANSMITTER
PG	PRESSORE GAUGE
	HEPA FILTER
	FINE FILTER
	PRE FILTER
FD-M	ML TYPE FIRE DAMPER(MOTORISED)
VCD	VOLUME CONTROL DAMPER (ML TYPE)
NRD	NON RETURN DAMPER (ML TYPE)
	FLOW CONTROL VALVE
	GATE VALVE
	FLOAT VALVE
M	MOTORIZED GLOBE VALVE(INCHING TYPE)
	BALANCING VALVE
M	2 WAY VALVE (MODULATING WITH ACTUATOR)
	GLOBE VALVE
	CHECK VALVE
	'Y' STRAINER
M	BUTTERFLY VALVE(MOTORISED)
	BUTTERFLY VALVE
LEGEND	DESCRIPTION

NOTE:

1) CAPACITY OF ALL THE A/C EQUIPMENTS SHALL BE FINALISED DURING DETAILED ENGINEERING BASED ON HEAT LOAD CALCULATION.
2) SIZE OF PIPES, VALVES ETC SHALL BE FINALIZED DURING DETAILED ENGINEERING
3) NUMBER OF AHU AND AHU CAPACITY SHALL BE FINALIZED DURING DETAILED ENGINEERING BASED ON THE FINALIZED ARCHITECTURAL DRAWINGS.
4) CHILLED WATER PUMPS, PIPING, VALVES,EXPANSION TANK, AHU-DRAIN ETC. SHALL BE INSULATED AS PER SPECIFICATION.
5) ALL PIPING & VALVES OF SIZE 40 NB & BELOW SHALL BE PROVIDED AS PER SYSTEM REQUIREMENT BY THE BIDDER.
6) FOR FLOW BALANCING, BALANCING VALVE AND ORIFICE PLATE SHALL BE PROVIDED BY BIDDER AS PER SYSTEM REQUIREMENT.
7) 1X100% CAPACITY FRESH AIR FAN SHALL BE PROVIDED IN EACH AHU ROOM
8) TEMPERATURE SENSOR (TS) & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDED IN EACH AHU ROOM.
9) AIR RELEASE VALVES AS PER SYSTEM REQUIREMENT SHALL BE PROVIDED AT SUITABLE LOCATIONS.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
					CLEARED BY					

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NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: **TALCHER SUPER THERMAL POWER PROJECT**
STAGE-III (2x660MW)

TITLE: SCHEMATIC DIAGRAM FOR A/C SYSTEM FOR MAIN PLANT TG BULDING

SIZE	SCALE	DRG.NO.	REV.
A1	NTS	4540-001-POM-A-054	00

CAD FILE NAME : 4540-001-POM-A-054

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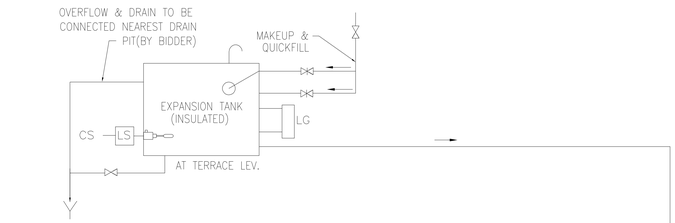
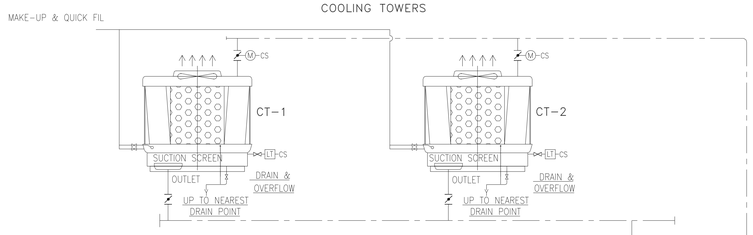


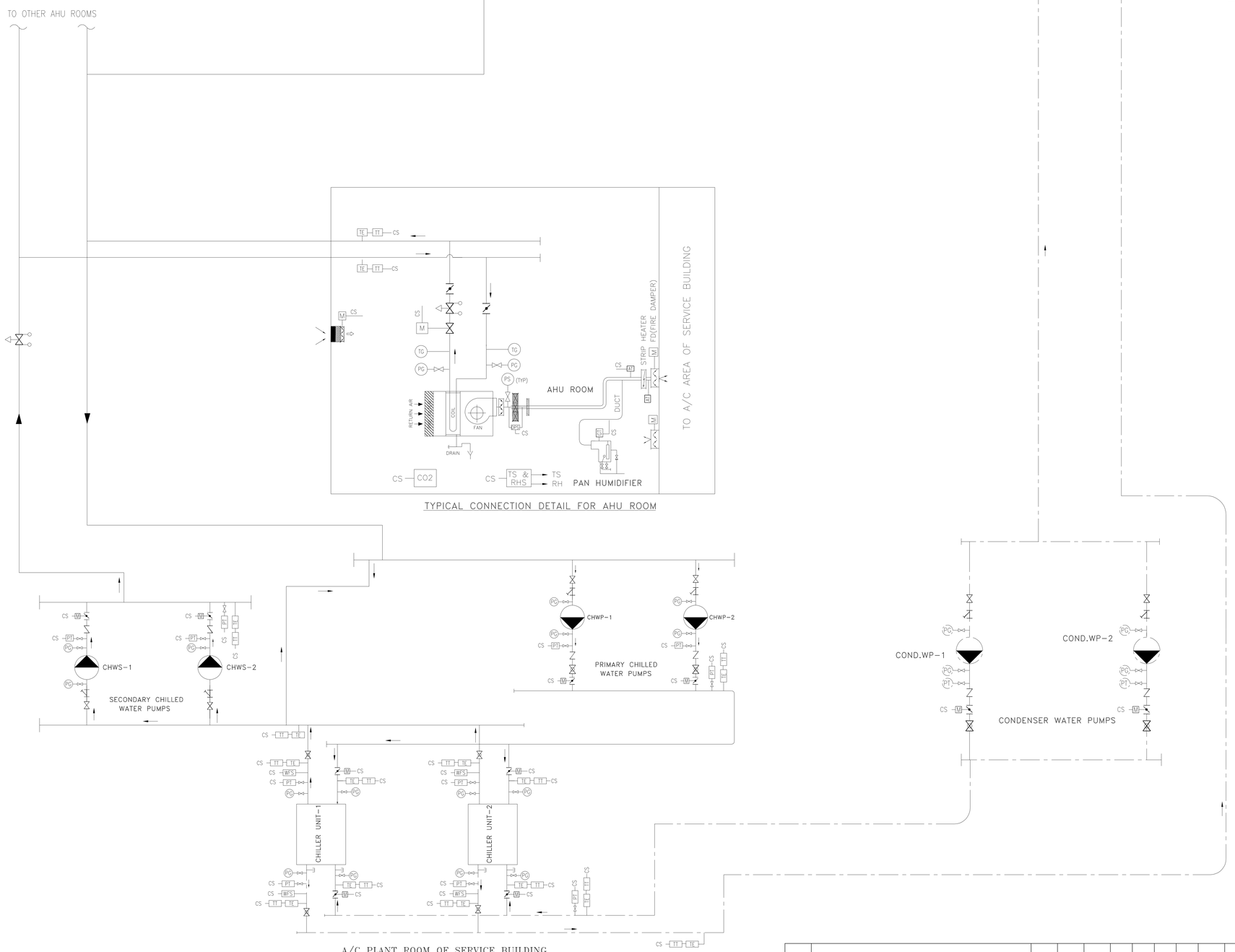


PRIMARY CHILLED WATER PUMP DETAIL	
NAME	QTY
CHWP-1 TO 2	2 NOS(1W+1S/B)

SECONDARY CHILLED WATER PUMP DETAIL	
NAME	QTY
CHWS-1 TO 2	2 NOS(1W+1S/B)

CONDENSER WATER PUMP DETAIL	
NAME	QTY
COND.WP-1 TO 2	2 NOS(1W+1S/B)

COOLING TOWER DETAILS	
NAME	QTY
CT-1 TO 2	2 NOS(1W+1S/B)



TYPICAL CONNECTION DETAIL FOR AHU ROOM

A/C PLANT ROOM OF SERVICE BUILDING

CS	CONTROL SYSTEM
TE	TEMPERATURE TRANSMITTER)
	CH.WATER SUPPLY & RETURN PIPE
	COND.WATER SUPPLY & RETURN PIPE
	OPEN DRAIN PIT
	ATMOSPHERIC VENT
	DESCALING CONNECTION
	STRIP HEATER
	FRESH AIR FAN WITH PRE FILTER & FINE FILTER
	CENTRIFUGAL FAN
	PUMP
	PAN HUMIDIFIER WITH 25NB GATE VAVE(3 NOS EACH),1 NO EACH FLOAT VALVE, M-UP/Q.FILL & DRAIN CON.
TG	TEMPARATURE GAUGE
LG	LEVEL GAUGE
LT-CS	LEVEL TRANSMITER
LS-CS	LEVEL SWITCH
GT-CS	GEYSER STAT
AT-CS	AIR STAT
DPS-CS	DIFFERENTIAL PRESSURE SWITCH
WFS-CS	WATER FLOW SWITCH
CS TS RH RHS TS RH	RH SENSOR &TEMP.SENSOR
TE-CS	TEMPARATURE ELEMENT(SENSOR)
PT-CS	PRESSURE TRANSMITTER
PG	PRESSORE GAUGE
	HEPA FILTER
	FINE FILTER
	PRE FILTER
FD M	ML TYPE FIRE DAMPER(MOTORISED)
VCD	VOLUME CONTROL DAMPER (ML TYPE)
NRD	NON RETURN DAMPER (ML TYPE)
	FLOW CONTROL VALVE
	GATE VALVE
	FLOAT VALVE
M	MOTORIZED GLOBE VALVE(INCHING TYPE)
	BALANCING VALVE
M	2 WAY VALVE (MODULATING WITH ACTUATOR)
	GLOBE VALVE
	CHECK VALVE
	'Y' STRAINER
M	BUTTERFLY VALVE(MOTORISED)
	BUTTERFLY VALVE
LEGEND	DESCRIPTION

NOTE:

1) CAPACITY OF ALL THE A/C EQUIPMENTS SHALL BE FINALISED DURING DETAILED ENGINEERING BASED ON HEAT LOAD CALCULATION.
2) SIZE OF PIPES, VALVES ETC SHALL BE FINALIZED DURING DETAILED ENGINEERING
3) NUMBER OF AHU AND AHU CAPACITY SHALL BE FINALIZED DURING DETAILED ENGINEERING BASED ON THE FINALIZED ARCHITECTURAL DRAWINGS.
4) VARIABLE AIR VOLUME BOX (VAV) SHALL BE PROVIDED FOR OPTIMUM USE OF AHU THROUGH VVVFD. NUMBERS OF VAV BOX SHALL BE FINALIZED DURING DETAILED ENGINEERING. VAV BOX SHALL BE REGULATED BY TEMPERATURE SENSOR & OCCUPANCY SENSOR PROVIDED IN RESPECTIVE ROOMS.
5) SECONDARY CHILLED WATER PUMPS, COOLING TOWER FANS, AHU SHALL BE VVVFD
6) CHILLED WATER PUMPS, PIPING, VALVES,EXPANSION TANK, AHU-DRAIN ETC. SHALL BE INSULATED AS PER SPECIFICATION.
7) ALL PIPING & VALVES OF SIZE 40 NB & BELOW SHALL BE PROVIDED AS PER SYSTEM REQUIREMENT BY THE BIDDER.
8) FOR FLOW BALANCING, BALANCING VALVE AND ORIFICE PLATE SHALL BE PROVIDED BY BIDDER AS PER SYSTEM REQUIREMENT.
9) FRESH AIR DAMPERS WITH FILTERS SHALL BE PROVIDED IN EACH AHU ROOM.
10) ONE NO CO2 SENSOR SHALL BE PROVIDED IN EACH AHU ROOM.
11) TEMPERATURE SENSOR (TS) & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDED IN EACH AHU ROOM.
12) AIR RELEASE VALVES AS PER SYSTEM REQUIREMENT SHALL BE PROVIDED AT SUITABLE LOCATIONS.
13) ALL WATER PIPES SHALL BE AS PER TECHNICAL SPECIFICATION.
14) THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
					CLEARED BY					

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NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: **TALCHER THERMAL POWER PROJECT**
STAGE – III (2x660MW)

TITLE: SCHEMATIC DIAGRAM FOR A/C SYSTEM FOR SERVICE BUILDING

SIZE	SCALE	DRG.NO.	REV.
A1	NTS	4540-001-POM-A-056	00

CAD FILE NAME : 4540-001-POM-A-056

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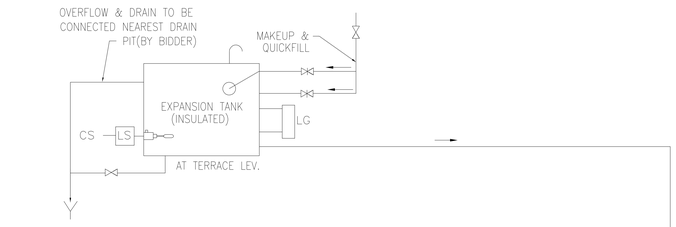
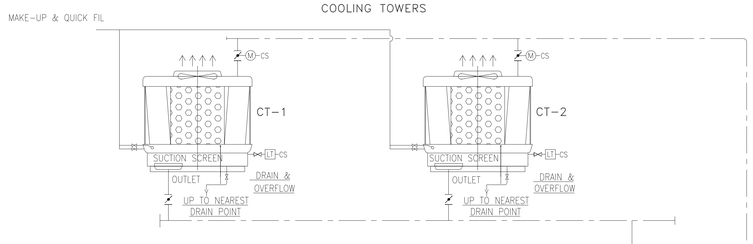


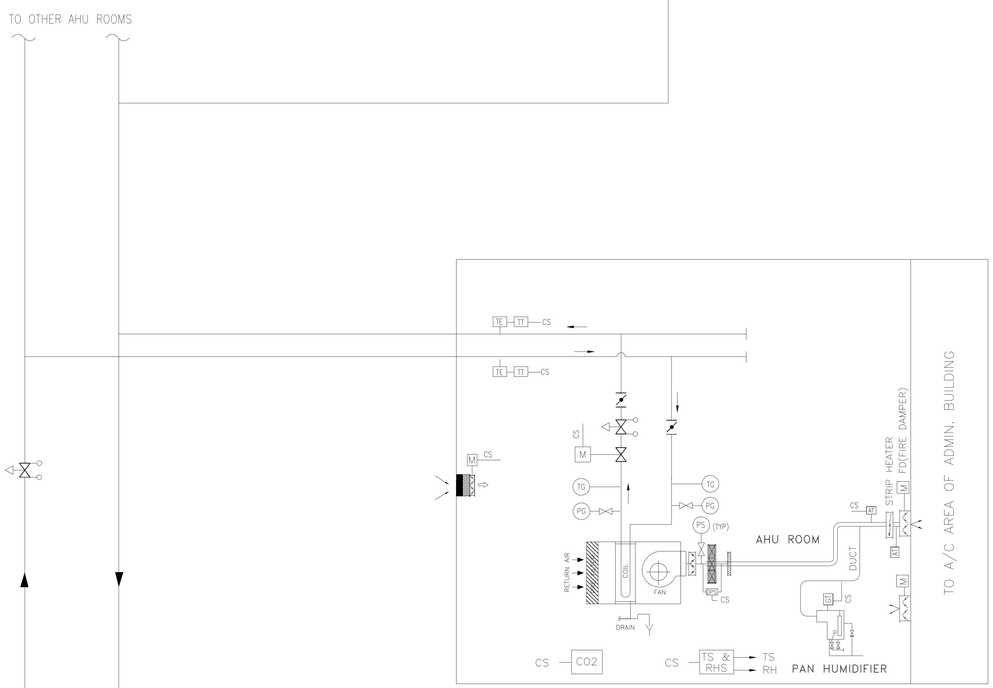


PRIMARY CHILLED WATER PUMP DETAIL	
NAME	QTY
CHWP-1 TO 2	2 NOS(1W+1S/B)

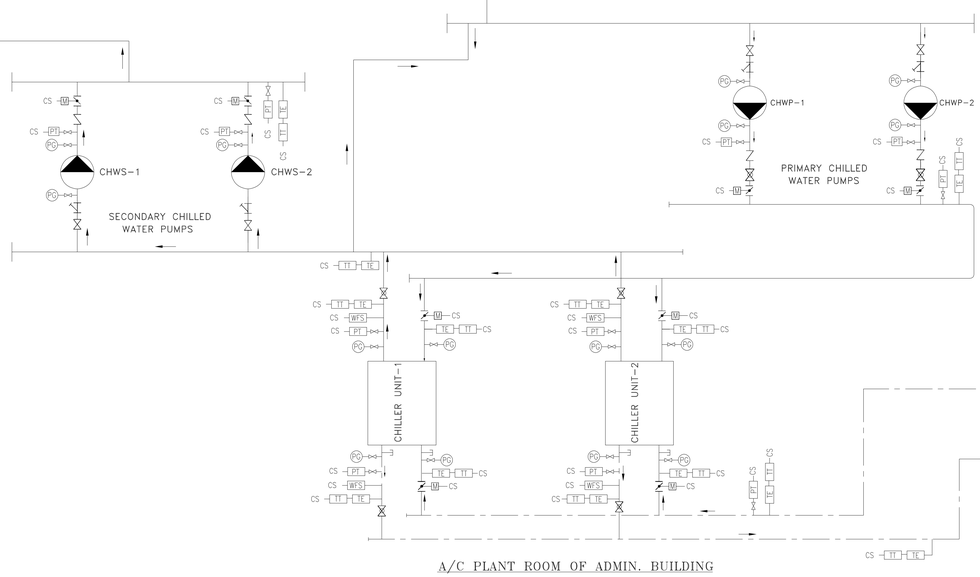
SECONDARY CHILLED WATER PUMP DETAIL	
NAME	QTY
CHWS-1 TO 2	2 NOS(1W+1S/B)

CONDENSER WATER PUMP DETAIL	
NAME	QTY
COND.WP-1 TO 2	2 NOS(1W+1S/B)

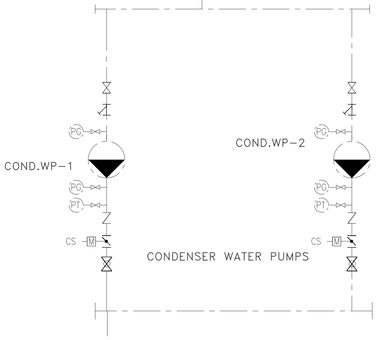
COOLING TOWER DETAILS	
NAME	QTY
CT-1 TO 2	2 NOS(1W+1S/B)



TYPICAL CONNECTION DETAIL FOR AHU ROOM



A/C PLANT ROOM OF ADMIN. BUILDING



CS	CONTROL SYSTEM
TE	TEMPERATURE TRANSMITTER)
	CH.WATER SUPPLY & RETURN PIPE
	COND.WATER SUPPLY & RETURN PIPE
	OPEN DRAIN PIT
	ATMOSPHERIC VENT
	DESCALING CONNECTION
	STRIP HEATER
	FRESH AIR FAN WITH PRE FILTER & FINE FILTER
	CENTRIFUGAL FAN
	PUMP
	PAN HUMIDIFIER WITH 25NB GATE VAVE(3 NOS EACH),1 NO EACH FLOAT VALVE, M-UP/D.FILL & DRAIN CON.
TG	TEMPARATURE GAUGE
LG	LEVEL GAUGE
LT—CS	LEVEL TRANSMITER
LS—CS	LEVEL SWITCH
GT—CS	GEYSER STAT
AT—CS	AIR STAT
DPS—CS	DIFFERENTIAL PRESSURE SWITCH
WFS—CS	WATER FLOW SWITCH
CS — TS RH	RH SENSOR &TEMP.SENSOR
TE—CS	TEMPARATURE ELEMENT(SENSOR)
PT—CS	PRESSURE TRANSMITTER
PG	PRESSORE GAUGE
	HEPA FILTER
	FINE FILTER
	PRE FILTER
FD — M	ML TYPE FIRE DAMPER(MOTORISED)
VCD	VOLUME CONTROL DAMPER (ML TYPE)
NRD	NON RETURN DAMPER (ML TYPE)
	FLOW CONTROL VALVE
	GATE VALVE
	FLOAT VALVE
M	MOTORIZED GLOBE VALVE(INCHING TYPE)
	BALANCING VALVE
M	2 WAY VALVE (MODULATING WITH ACTUATOR)
	GLOBE VALVE
	CHECK VALVE
	'Y' STRAINER
M	BUTTERFLY VALVE(MOTORISED)
	BUTTERFLY VALVE
LEGEND	DESCRIPTION

NOTE:

1) CAPACITY OF ALL THE A/C EQUIPMENTS SHALL BE FINALISED DURING DETAILED ENGINEERING BASED ON HEAT LOAD CALCULATION.
2) SIZE OF PIPES, VALVES ETC SHALL BE FINALIZED DURING DETAILED ENGINEERING
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8) FOR FLOW BALANCING, BALANCING VALVE AND ORIFICE PLATE SHALL BE PROVIDED BY BIDDER AS PER SYSTEM REQUIREMENT.
9) FRESH AIR DAMPERS WITH FILTERS SHALL BE PROVIDED IN EACH AHU ROOM.
10) ONE NO CO2 SENSOR SHALL BE PROVIDED IN EACH AHU ROOM.
11) TEMPERATURE SENSOR (TS) & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDED IN EACH AHU ROOM.
12) AIR RELEASE VALVES AS PER SYSTEM REQUIREMENT SHALL BE PROVIDED AT SUITABLE LOCATIONS.
13) ALL WATER PIPES SHALL BE AS PER TECHNICAL SPECIFICATION.
14) THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
					CLEARED BY					

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NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: **TALCHER THERMAL POWER PROJECT**
STAGE – III (2x660MW)

TITLE: SCHEMATIC DIAGRAM FOR A/C SYSTEM FOR ADMIN. BUILDING

SIZE	SCALE	DRG.NO.	REV.
A1	NTS	4540-001-POM-A-057	00

CAD FILE NAME : 4540-001-POM-A-057

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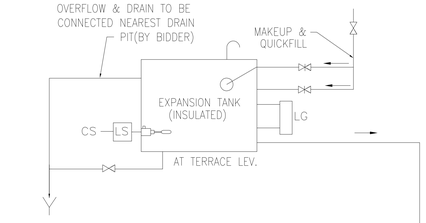
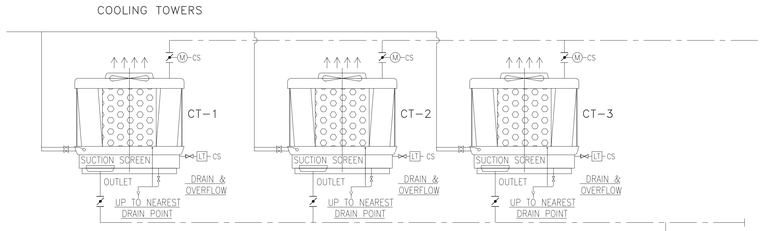
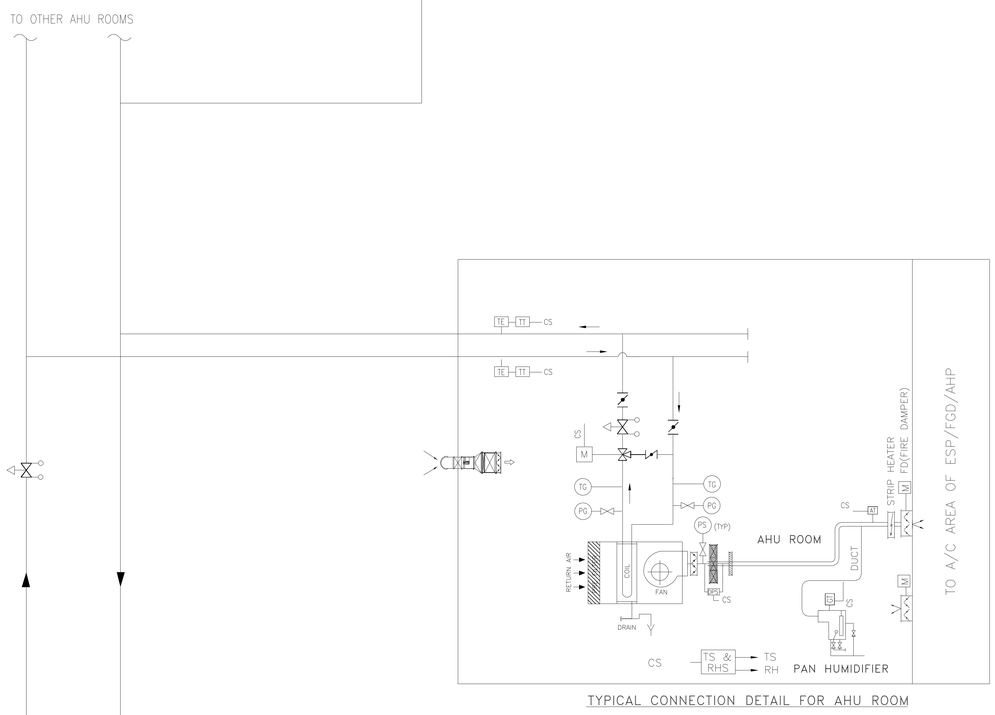




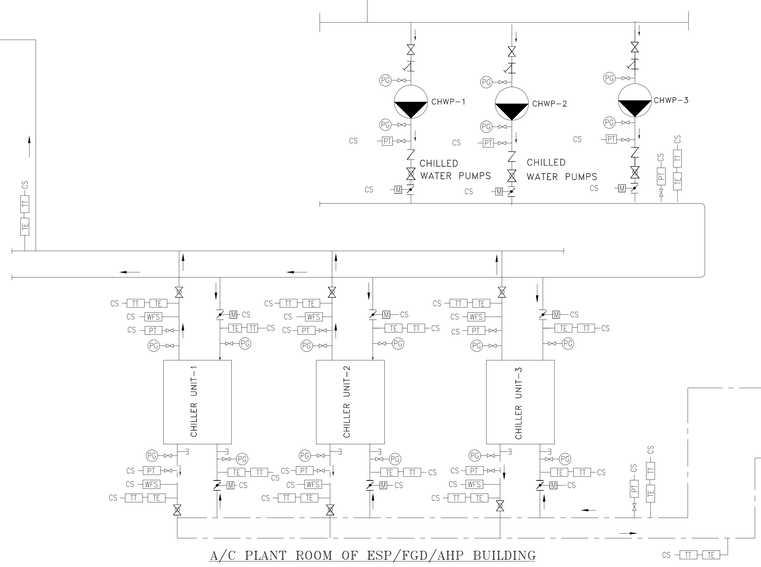
CHILLED WATER PUMP DETAIL	
NAME	QTY
CHWP-1 TO 3	3 NOS(2W+1S/B)

CONDENSER WATER PUMP DETAIL	
NAME	QTY
COND.WP-1 TO 3	3 NOS(2W+1S/B)

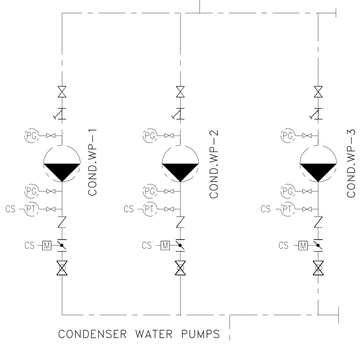
COOLING TOWER DETAILS	
NAME	QTY
CT-1 TO 3	3 NOS(2W+1S/B)



TYPICAL CONNECTION DETAIL FOR AHU ROOM



A/C PLANT ROOM OF ESP/FGD/AHP BUILDING



CONDENSER WATER PUMPS

CS	CONTROL SYSTEM
TE	TEMPERATURE TRANSMITTER)
	CH.WATER SUPPLY & RETURN PIPE
	COND.WATER SUPPLY & RETURN PIPE
	OPEN DRAIN PIT
	ATMOSPHERIC VENT
	DESCALING CONNECTION
	STRIP HEATER
	FRESH AIR FAN WITH PRE FILTER & FINE FILTER
	CENTRIFUGAL FAN
	PUMP
	PAN HUMIDIFIER WITH 25NB GATE VAVE(3 NOS EACH),1 NO EACH FLOAT VALVE, M-I/P/D.FILL & DRAIN CON.
TG	TEMPARATURE GAUGE
LG	LEVEL GAUGE
LT-CS	LEVEL TRANSMITER
LS-CS	LEVEL SWITCH
GT-CS	GEYSER STAT
AT-CS	AIR STAT
DPS-CS	DIFFERENTIAL PRESSURE SWITCH
WFS-CS	WATER FLOW SWITCH
CS TS RH TS RH	RH SENSOR &TEMP.SENSOR
TE-CS	TEMPARATURE ELEMENT(SENSOR)
PT-CS	PRESSURE TRANSMITTER
PG	PRESSORE GAUGE
	HEPA FILTER
	FINE FILTER
	PRE FILTER
FD M	ML TYPE FIRE DAMPER(MOTORISED)
VCD	VOLUME CONTROL DAMPER (ML TYPE)
NRD	NON RETURN DAMPER (ML TYPE)
	FLOW CONTROL VALVE
	GATE VALVE
	FLOAT VALVE
M	MOTORIZED GLOBE VALVE(INCHING TYPE)
	BALANCING VALVE
M	2 WAY VALVE (MODULATING WITH ACTUATOR)
	GLOBE VALVE
	CHECK VALVE
	'Y' STRAINER
M	BUTTERFLY VALVE(MOTORISED)
	BUTTERFLY VALVE
LEGEND	DESCRIPTION

NOTE:

1) CAPACITY OF ALL THE A/C EQUIPMENTS SHALL BE FINALIZED DURING DETAILED ENGINEERING BASED ON HEAT LOAD CALCULATION.
2) SIZE OF PIPES, VALVES ETC SHALL BE FINALIZED DURING DETAILED ENGINEERING
3) NUMBER OF AHU AND AHU CAPACITY SHALL BE FINALIZED DURING DETAILED ENGINEERING BASED ON THE FINALIZED ARCHITECTURAL DRAWINGS.
4) CHILLED WATER PUMPS, PIPING, VALVES,EXPANSION TANK, AHU-DRAIN ETC. SHALL BE INSULATED AS PER SPECIFICATION.
5) ALL PIPING & VALVES OF SIZE 40 NB & BELOW SHALL BE PROVIDED AS PER SYSTEM REQUIREMENT BY THE BIDDER.
6) FOR FLOW BALANCING, BALANCING VALVE AND ORIFICE PLATE SHALL BE PROVIDED BY BIDDER AS PER SYSTEM REQUIREMENT.
7) 1X100% CAPACITY FRESH AIR FAN SHALL BE PROVIDED IN EACH AHU ROOM
8) TEMPERATURE SENSOR (TS) & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDED IN EACH AHU ROOM.
9) AIR RELEASE VALVES AS PER SYSTEM REQUIREMENT SHALL BE PROVIDED AT SUITABLE LOCATIONS.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
					CLEARED BY					

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NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: **TALCHER SUPER THERMAL POWER PROJECT**
STAGE-III (2x660MW)

TITLE: SCHEMATIC DIAGRAM FOR A/C SYSTEM FOR ESP/FGD/AHP BUILDING

SIZE	SCALE	DRG.NO.	REV.
A1	NTS	4540-001-POM-A-055	00

CAD FILE NAME : 4540-001-POM-A-055

85 M^3/hr

REFER P&ID OF PLANT WATER SYSTEM:

150 NB

HVAC MAKE-UP (Clarified water) FOR HVAC MAKE-UP DISTRIBUTION AT VARIOUS PLACES AND TERMINAL POINT AS SHOWN IN DRG.

100 NB

50 NB

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-1 25 NB → TO PACKAGE AIR WASHER-1 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-2 25 NB → TO PACKAGE AIR WASHER-2 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-3 25 NB → TO PACKAGE AIR WASHER-3 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-4 25 NB → TO PACKAGE AIR WASHER-4 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-5 25 NB → TO PACKAGE AIR WASHER-5 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-6 25 NB → TO PACKAGE AIR WASHER-6 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-7 25 NB → TO PACKAGE AIR WASHER-7 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (Along A-Row).

50 NB

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-8 25 NB → TO PACKAGE AIR WASHER-8 MAKE-UP UNIT - 2
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-9 25 NB → TO PACKAGE AIR WASHER-9 MAKE-UP UNIT - 2
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-10 25 NB → TO PACKAGE AIR WASHER-10 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
5 m^3/hr HVAC-11 40 NB → (SERVICE BLDG.) PAN HUMIDIFIER
For AC SYSTEM, NEAR MAKE-UP WATER TANK NEAR AC SYSTEM COOLING TOWER at Terrace floor.
PEM MSE/MPL
LOCATION : (AT ROOF/TERRACE LEVEL of Service Building)

100 NB

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-12 25 NB → TO PACKAGE AIR WASHER-11 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-13 25 NB → TO PACKAGE AIR WASHER-12 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-14 25 NB → TO PACKAGE AIR WASHER-13 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-15 25 NB → TO PACKAGE AIR WASHER-14 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-16 25 NB → TO PACKAGE AIR WASHER-15 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-17 25 NB → TO PACKAGE AIR WASHER-16 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-18 25 NB → TO PACKAGE AIR WASHER-17 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-19 25 NB → TO PACKAGE AIR WASHER-18 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-20 25 NB → TO PACKAGE AIR WASHER-19 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
2.5 m^3/hr HVAC-21 25 NB → TO PACKAGE AIR WASHER-20 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
1.25 m^3/hr HVAC-22 25 NB → TO PACKAGE AIR WASHER-21 MAKE-UP UNIT - 1.
PEM MSE/MPL
LOCATION: (At roof of D-E-F BAY).

VENTILATION SYSTEM VENDOR
1.25 m^3/hr HVAC-23 25 NB → TO PACKAGE AIR WASHER-22 MAKE-UP UNIT - 2.
PEM MSE/MPL
LOCATION: (At roof of D-E-F BAY).

AC-VENDOR
9 m^3/hr HVAC-24 50 NB → (COMMON FOR UNIT-1 & 2) PAN HUMIDIFIER
For AC SYSTEM, NEAR MAKE-UP WATER TANK NEAR AC SYSTEM COOLING TOWER at roof of D-E-F bay.
PEM MSE/MPL
LOCATION: (At roof of D-E-F BAY).

NOTE:–

1. BHEL TO PROVIDE HVAC MAKE-UP WATER PIPING/FITTINGS UP TO THE TERMINAL POINT AS SHOWN IN DRG.
2. HVAC MAKE-UP WATER PIPING INCLUDING FITTINGS SHALL BE TERMINATED WITHIN THE RANGE OF 5 METER DISTANCE FROM MAKE-UP WATER TANK / AIR-WASHER BY BHEL (LP PIPING VENDOR'S SCOPE) FURTHER PIPING SHALL BE DONE BY RESPECTIVE PLANT SUPPLIER AS MARKED IN THIS DRG.
3. HVAC MAKE-UP WATER PRESSURE AT EACH TERMINAL POINT SHALL BE MAINTAINED 0.5 kg/cm2.
4. HVAC - SYSTEM MAKE-UP WATER PIPING FROM TERMINAL POINT TO MAKE-UP WATER TANK, COOLING TOWER, EXPANSION TANK & PAN HUMIDIFIER ETC. SHALL BE IN SYSTEM VENDOR SCOPE.
5. MAKE-UP WATER REQUIREMENT IS CONTINUOUS/INTERMITTENT AS MENTIONED.
6. MATERIAL OF PIPE SHALL BE CARBON STEEL.
7. FOR PIPE OD AND THICKNESS, PLEASE REFER TABLE BELOW.

VENTILATION SYSTEM VENDOR
PEM MSE/MPL
50 NB
10 m^3/hr HVAC-25
Two Nos. UAF of ESP cum FGD building Terrace UNIT - 1.
LOCATION: (IN ESP cum FGD BUILDING TERRACE LEVEL)

AC - VENDOR
25 NB HVAC-33 → FOR AC SYSTEM COOLING TOWER at ESP Control Building Unit-1 Terrace.
LOCATION: (AT ROOF OF ESP CONTROL ROOM IN AHU ROOM OF UNIT 1.) common FGD and ESP control room

AC - VENDOR
intermittent 25 NB → TO HUMIDIFIER OF ESP AHU UNIT - 1,

AC - VENDOR
25 NB → TO HUMIDIFIER OF ESP AHU UNIT - 2,

VENTILATION SYSTEM VENDOR
4 m^3/hr HVAC-26 40 NB
Two Nos. UAF of ESP cum FGD building Terrace UNIT - 2.
PEM MSE/MPL
LOCATION: (IN ESP cum FGD BUILDING TERRACE LEVEL)

AC-VENDOR
40 NB
PEM MSE/MPL
4 m^3/hr HVAC-27 → PAN HUMIDIFIER (ADMIN. BLDG.)
NEAR AC SYSTEM COOLING TOWER at Terrace floor.
LOCATION : (AT ROOF/TERRACE LEVEL of Admin Building)

AC-VENDOR
intermittent 25 NB HVAC-28 → TO HUMIDIFIER OF AHP-MCC
PEM MSE/MPL
LOCATION: (AT GROUND FLOOR AT AHP MCC)

AC-VENDOR
intermittent 25 NB HVAC-29 → TO HUMIDIFIER OF CLASSIFIER MCC
PEM MSE/MPL
LOCATION: (AT GROUND FLOOR OF CLASSIFIER MCC)

AC-VENDOR
intermittent 25 NB HVAC-30 → TO HUMIDIFIER OF SILO MCC
PEM MSE/MPL
LOCATION: (AT GROUND FLOOR OF SILO MCC)

AC-VENDOR
intermittent 25 NB HVAC-31 → TO CHP BUNKER-MCC
PEM MSE/MPL
LOCATION: (AT GROUND FLOOR OF BUNKER MCC)

AC-VENDOR
from service water line
intermittent 25 NB HVAC-32 → TO HUMIDIFIER OF CANTEEN AHU
PEM MSE/MPL
LOCATION: (AT GROUND FLOOR IN AHU ROOM OF CANTEEN BUILDING)

AC-VENDOR
from service water line
25 NB HVAC-33 → TO HUMIDIFIER OF WATER SYSTEM CONTROL ROOM AHU
PEM MSE/MPL
LOCATION: (AT GROUND FLOOR IN AHU ROOM OF WATER SYSTEM CONTROL BUILDING)

AC-VENDOR
from service water line
25 NB HVAC-34 → TO HUMIDIFIER OF CEP VFD UNIT 1 CONTROL ROOM AHU
PEM MSE/MPL
LOCATION: (AT FIRST FLOOR IN AHU ROOM OF CEP VFD UNIT 1 CONTROL BUILDING)

PIPE SIZE - CARBON STEEL
Design pressure - 12 Kg/sq. cm
Design temperature - 60 deg. C

NB	OD (mm) MAX	THICKNESS (mm)
150	165	5.4
125	140	5.4
100	114	5.4
50	60.8	4.5
40	48.8	4
25	34.2	4

CUSTOMER : NATIONAL THERMAL POWER CORPORATION (NTPC)

JOB No. : 497

2X660 MW TALCHER STPP (EPC)

STATUS CONTRACT

DISTRIBUTION:

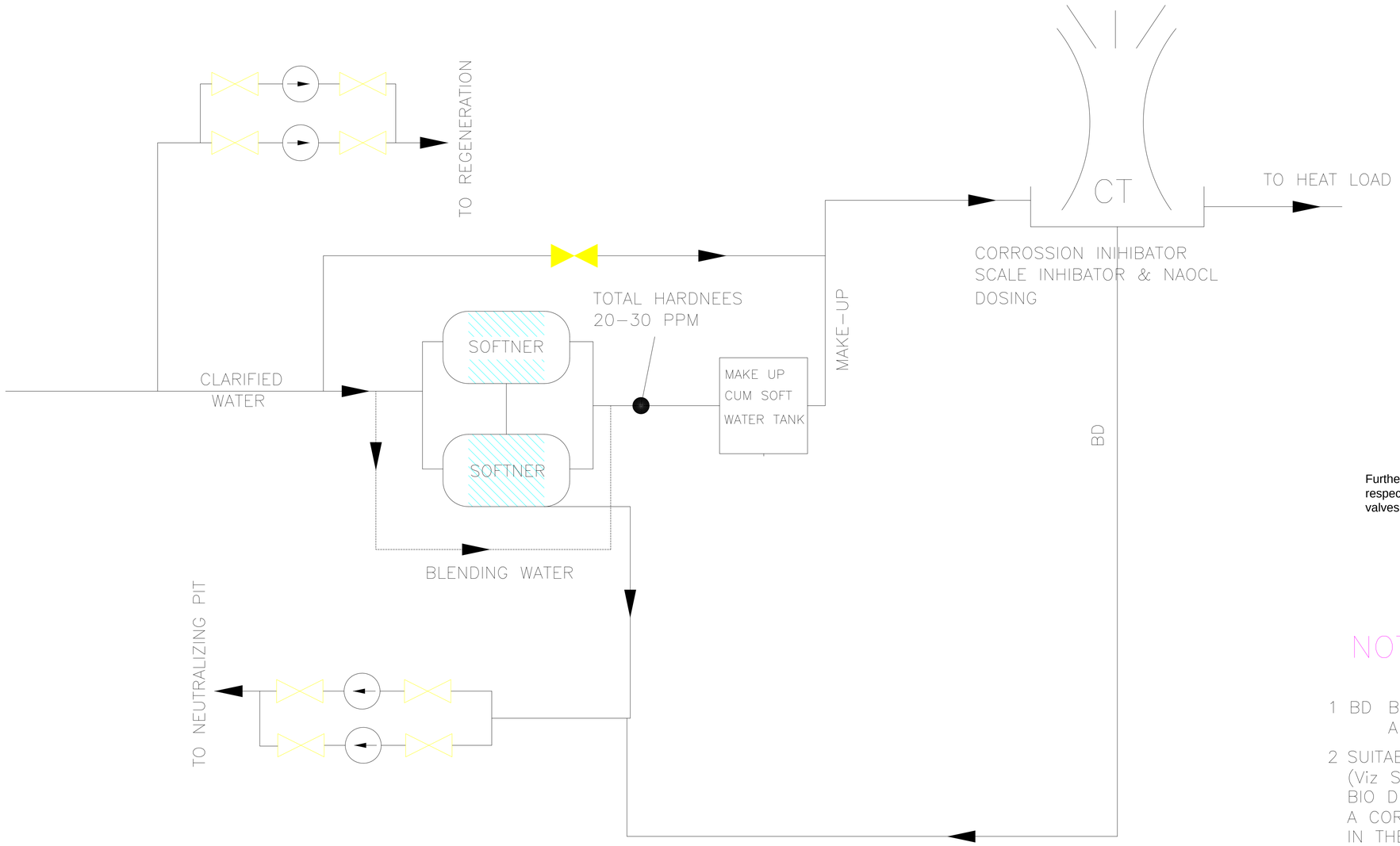
REV.	DATE	DRAWN	CHD	APPD
0	28.04.22	SKG	MKS	LJ
01	05.05.22			
02	28.07.22			

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BLDG. PLOT NO. 25, SECTOR-16A, NOIDA

TITLE: SCHEMATIC DAIAGRAM FOR HVAC MAKE UP

MPL	C	MSE	I	MAX	E	DEPT.	SCALE- N.T.S	DRG. NO. PE-DG-497-553-A001.
						SIGN		
						DATE		SHEET 1 OF 1 REV 0

SIZE-A1



SKID MOUNTED PREFABRICATED AND PRE–ASSEMBLED SOFTENING PLANT

Further, redundancy of instruments shall be governed by respective clause of C&I specification and instrument and valves indicated are bare minimum requirement.

NOTES FOR SOFTENING PLANT:

1 BD BLOW DOWN TO BE CONTROLLED TO ENSURE A CYCLE OF CONCENTRATION OF 02

2 SUITABLE COOLING WATER TREATMENT PROGRAM (Viz SCALE INHIBITOR/ CORROSION INHIBITOR/ BIO DISPERSANT ETC.) MUST TO DOSED TO MAINTAIN A CORROSION AND SCALE FREE WATER CHEMISTRY IN THE COOLING WATER CIRCUIT.

3 REQUIRED INSTRUMENTATION SHALL BE PROVIDED INLINE WITH MAIN PLANT

TYPICAL SCHEME FOR WASP

ड्राईंग संख्या/DRAWING NO. PE-DG-497-610-C001

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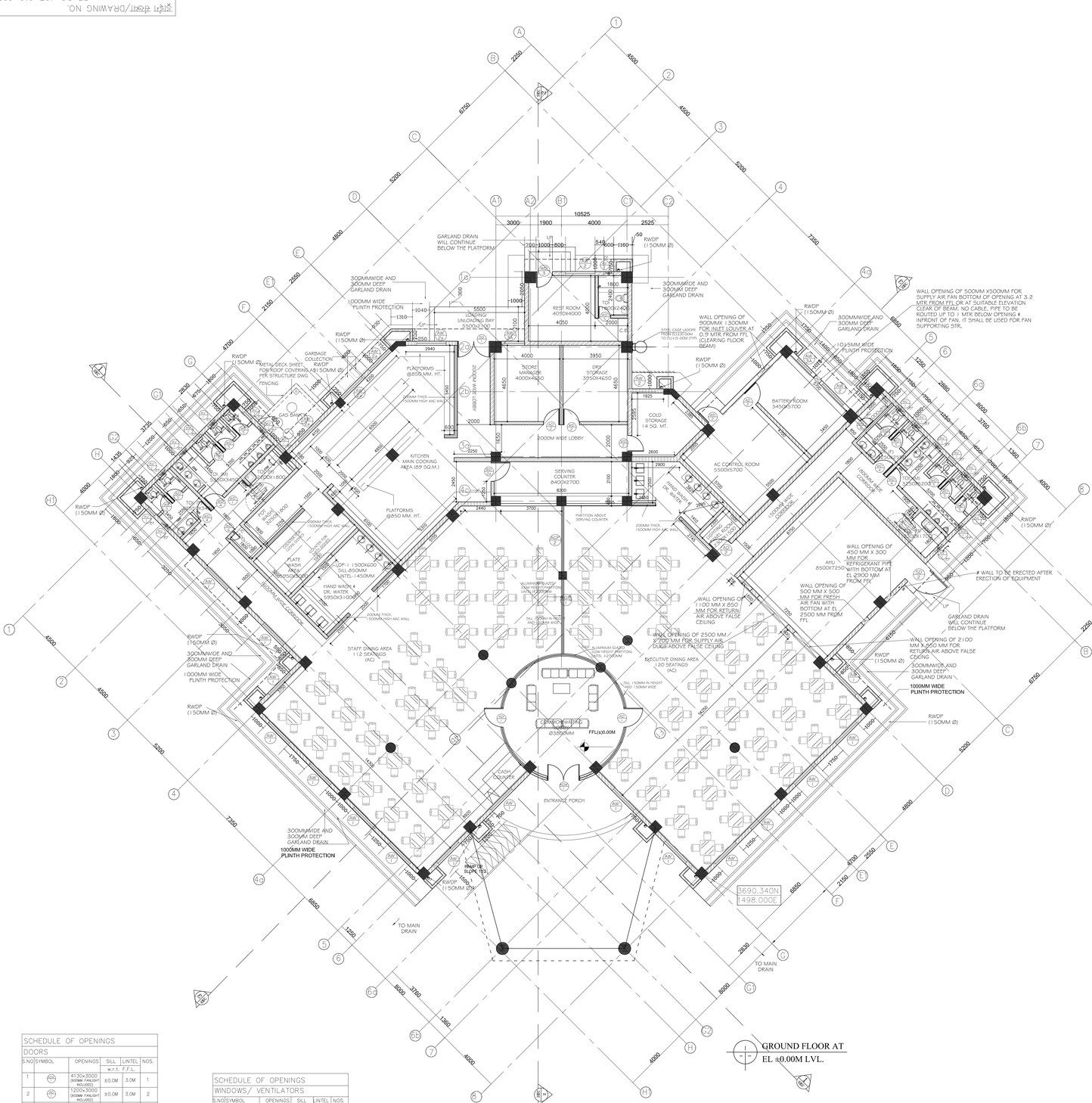
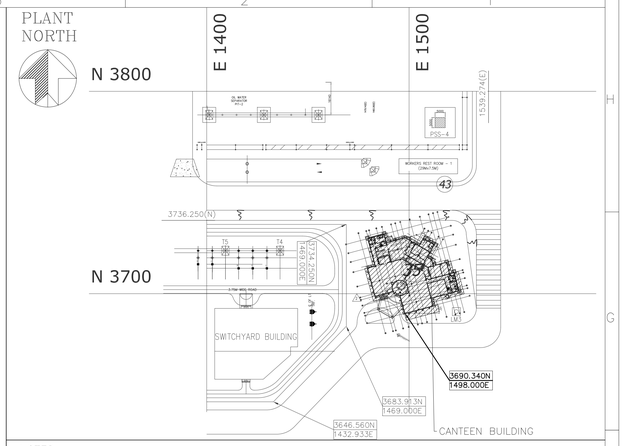


NOTE:– CANTEEN BLDG. IS AT EL (–)2.000M/RL(+)69.5M.
FINISHED GROUND LEVEL(FGL) OUTSIDE BLDG. IS AT EL (–)2.500M/RL(+)69.00M.



SCHEDULE OF FINISHES		
FLOORING	A	CEMENT CONCRETE WITH METALLIC HARDENER TOPPING
	B	VITRIFIED CERAMIC TILES
	C	MARBLE STONE / GRANITE STONE
	D	HEAVY DUTY DUST PRESSED CERAMIC TILES AND GRANITE STONE IN ONE PIECE FOR WASH BASIN PLATFORM
	E	20 MM THICK POLISHED MARBLE STONE /GRANITE STONE AS/PATTERN
	F	GRANITE STONE/ VITRIFIED CERAMIC TILES IN COMBINATION
	G	HEAVY DUTY DUST PRESSED CERAMIC TILE
	H	PAVERS INTERLOCKING CEMENT CONCRETE BLOCKS
	I	ACID, ALKALI RESISTANT TILE
SKIRTING	J	VITRIFIED CERAMIC TILES SKIRTING
	K	CEMENT CONCRETE SKIRTING
	L	POLISHED GRANITE STONE AT SKIRTING & AT THE TOP SURFACE OF CILL OF THE ALUMINIUM PARTITIONS
	M	HEAVY DUTY DUST PRESSED CERAMIC TILE
	N	POLISHED GRANITE STONE AT SKIRTING & AT THE TOP SURFACE OF CILL OF THE ALUMINIUM PARTITIONS
DADO	O	DESIGNER CERAMIC WALL TILES DADO UPTO 2.1M HEIGHT AND ACRYLIC DISTEMPER FOR BALANCE AREA HEIGHT
	P	DESIGNER CERAMIC TILES UPTO 1.2M AND TEXTURED PAINT FOR BALANCE HEIGHT AND GLASS MOSAIC TILES FOR MURALS & FOR INTERIOR FINISH IN COMBINATION
	R	MARBLE STONE/GRANITE STONE UP TO 1.2M HEIGHT & TEXTURED PAINT
	S	ACID, ALKALI RESISTANT TILE 1.2M HEIGHT
FALSE CEILING/ PAINTING	1	ACRYLIC DISTEMPER
	2	TEXTURED PAINT/ ACRYLIC EMULSION PAINT
	3	ACRYLIC EMULSION PAINT
	4	MINERAL FIBER BOARD FALSE CEILING AS PER APPROVED SAMPLE
	5	GYPSUM BOARD FALSE CEILING AS PER APPROVED SAMPLE
	6	CALCIUM SILICATE FALSE CEILING
	7	METAL FALSE CEILING
	8	ALUMINIUM FALSE CEILING
	9	CHEMICAL RESISTANT PAINT

NOTES:–

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH CONTRACT TERMS AND CONDITIONS, TECHNICAL SPECIFICATIONS AND SCHEDULE OF ITEMS.
2. ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METERS UNLESS STATED OTHERWISE.
3. ALL ELEVATIONS ARE REFERRED TO THE FINISHED FLOOR LEVEL OF POWER HOUSE BUILDING AS EL(±) 0.00 M WHICH CORRESPONDS TO RL(+)71.50 M. FINISHED FLOOR LEVEL OF CANTEEN BLDG. IS AT EL (–)2.000M/RL(+)69.5M. FINISHED GROUND LEVEL(FGL) OUTSIDE BLDG. IS AT EL (–)2.500M/RL(+)69.00M
4. FOR OTHER NOTES AND STD. DETAILS REF. DRG. PE-DG-497-600-C001 (NTPC DRG NO.4540-001-315-PVC-C-0151A)
5. SAMPLES OF FINISHING ITEMS SHALL BE APPROVED BY EOC/ARCHITECT BEFORE ORDERING IN BULK.
6. ALL WINDOWS/ VENTILATORS SHALL BE IN THE CENTRE OF GRID LINE UNLESS STATED OTHERWISE.

PLASTER:–

1. OUTER FACE (ROUGH SIDE) OF ALL BRICK WALL SHALL HAVE 18THK. & INNER FACE (SMOOTH SIDE) OF ALL WALLS SHALL HAVE 12THK. CEMENT SAND PLASTER (1:6).
2. CEILING OF CABLE VAULT, METAL DECK, ABOVE FALSE CEILING NOT TO BE PLASTERED.
3. CEILING PLASTER 6MM THICK CEMENT SAND PLASTER (1:4).

ENGINEERING REFERENCE DRAWINGS :–

1. PE-DG-497-100-M001 – PLOT PLAN

ARCHITECTURE DRAWINGS :–

PE-DG-497-610-C001/4540-001-301-PVC-C-0751 – CANTEEN BUILDING – ARCHITECTURAL PLANS & FINISH SCHEDULE
PE-DG-497-610-C002/4540-001-301-PVC-C-0752 – CANTEEN BUILDING – ARCHITECTURAL ELEVATIONS
PE-DG-497-610-C003/4540-001-301-PVC-C-0754 – CANTEEN BUILDING – TOILET DETAILS
PE-DG-497-610-C004/4540-001-301-PVC-C-0754A– CANTEEN BUILDING – DOOR & WINDOW DETAILS
PE-DG-497-610-C005/4540-001-301-PVC-C-0755C– CANTEEN BUILDING – REFLECTED FALSE CEILING PLAN
PE-DG-497-610-C008/4540-001-301-PVC-C-0753 – CANTEEN BUILDING – ARCHITECTURAL SECTIONS

STRUCTURAL REFERENCE DRAWINGS :–

PE-DG-497-610-C006/4540-001-301-PVC-C-0756 – CANTEEN BUILDING – GA & RC DETAIL OF FOUNDATION & COLUMNS
PE-DG-497-610-C009/4540-001-301-PVC-C-0757C – CANTEEN BUILDING – GA & RC DETAIL OF PLINTH & TIE BEAMS
PE-DG-497-610-C011/4540-001-301-PVC-C-0760A – CANTEEN BUILDING – GA & RC DETAILS OF ROOF
PE-DG-497-610-C012/4540-001-301-PVC-C-0757B – CANTEEN BUILDING – GA & RC DETAILS OF GRADE SLAB

LEGENDS :–

CONCRETE HATCH
EL(+)X.XXX – LEVEL TAG
–BRICK WALL
– TILE DROP
℄ – CENTER LINE
TOC – TOP OF CONCRETE
EF – EXHAUST FAN
TOCP – TOP OF CHEQUERED PLATE
EL – ELEVATION
TOP – TOP OF PARAPET
FFL – FINISHED FLOOR LEVEL
UNO – UNLESS NOTED OTHERWISE
TYP – TYPICAL
UGP – UPVC GLAZED PARTITION

SCHEDULE OF OPENINGS						
DOORS						
S.NO	SYMBOL	OPENINGS	SILL w.r.t. F.F.L.	LINTEL w.r.t. F.F.L.	NOS.
1	AW	4130x3000 (600MM FANLIGHT INCLUDED)	±0.0M	3.0M	1
2	AW	1200x3000 (600MM FANLIGHT INCLUDED)	±0.0M	3.0M	2
3	AW	1000x2400	±0.0M	3.0M	3
4	AW	2000x3000	±0.0M	3.0M	1
5	AW	1500x2400	±0.0M	2.4M	1
6	AW	1200x2400	±0.0M	2.4M	2
7	AW	1200x2400	±0.0M	2.4M	3
8	AW	1000x2400	±0.0M	2.4M	1
9	AW	900x2400	±0.0M	2.4M	4
10	AW	800x2400	±0.0M	2.4M	11
11	AW	600x1800	+0.30M	2.1M	2

SCHEDULE OF OPENINGS						
WINDOWS/ VENTILATORS						
S.NO	SYMBOL	OPENINGS	SILL w.r.t. F.F.L.	LINTEL w.r.t. F.F.L.	NOS.
1	AW	1800x2400	+0.60M	3.0M	20
2	AW	1800x2100	+0.90M	3.0M	3
3	AW	1800x1800	+1.20M	3.0M	4
4	AW	1200x2400	+0.60M	3.0M	–
5	AW	1200x2100	+0.90M	3.0M	2
6	AW	1200x2400	+0.60M	3.0M	–
7	AW	850x2400	+0.60M	3.0M	–
8	AW	600x750	+1.8M	2.55M	18
9	EF	330MM Ø	2.865M CENTER LINE		18
10	AW	900x600	+0.30M	+0.90M	6

FINISHING SCHEDULE							
INTERNAL FINISHING SCHEDULE– GROUND FLOOR							
AREA	FLOORING	WALL			CEILING		REMARKS
		SKIRTING	DADO	PAINTING	FALSE CEILING	PAINTING	
WAITING AREA	C	L	Q	—	4/6	—	
AHU ROOM	A	K	—	1	—	1	
TOILETS	B	—	P	1	R	—	
AC CONTROL	A	K	—	1	—	1	
BATTERY ROOM	1	—	S	9	—	9	
REST ROOM	B	—	—	S	6	—	
STORE MANAGER	B	J	—	S	6	—	
COLD STORE	A	K	—	1	—	1	
DRY STORE	A	K	—	1	—	1	
KITCHEN AND PREPARATION AREA	D	—	P	1	—	1	
POT WASH	D	—	P	1	—	1	
PLATE WASH	D	—	P	1	—	1	
HAND WASH	B	—	P	1	4/5	—	
SERVING COUNTER	B	—	P	1	4/5	—	
STAFF SEATING AREA	F	—	Q	2	4/5	1	FALSE CEILING AS PER APPROVED PATTERN/DRAWING.
EXECUTIVE SEATING AREA	F	—	Q	2	4/5	1	
EXTERNAL FINISHING SCHEDULE							
PORCH AREA	PAVERS INTERLOCKING CEMENT CONCRETE BLOCKS						
EXTERNAL FINISH	RESIN BONDED GRANULAR TEXTURE PAINT AND PREMIUM ACRYLIC SMOOTH EXTERIOR PAINT ON WALLS AND PROJECTION AS PER APPROVED COLOUR			PREMIUM ACRYLIC SMOOTH EXTERIOR PAINT OF APPROVED COLOUR IN SOFFIT OF PROJECTIONS			
NOTE:							

LEGEND:

- 250 MM THICK AAC BLOCK FULL HEIGHT WALL
- 200 MM THICK AAC BLOCK WALL HEIGHT UPTO FALSE CEILING /SLAB
- 150 MM AAC BLOCK (PARTITION)WALL HEIGHT UPTO 2200MM.
- 200 MM THICK AAC BLOCK WALL HEIGHT UPTO 1500MM

SPECIAL NOTE:

BHEL HEREBY CONFIRMS THAT THIS DRAWING MEETS ALL THE CONTRACT REQUIREMENTS INCLUDING SAFETY & STATUTORY REQUIREMENTS & FACILITATE EASE OF OPERATION & MAINTENANCE. IN CASE ANY DEVIATION IS FOUND, THE CONTRACTOR SHALL CARRY OUT ALL REQUIRED CHANGES/ MODIFICATIONS WITHOUT ANY COST IMPLICATIONS TO NTPC.

ALL ELECTRICAL AND VENTILATION CUTOUT & OPENING DETAILS SHALL BE REFERRED FROM RESPECTIVE DRAWINGS BEFORE EXECUTION.

BHEL- PROJECT ENGINEERING MANAGEMENT(CIVIL)		
THIS DRAWING MARKED (✓) IS RELEASED FOR		
☑ COMMENTS/APPROVAL	☐ FABRICATION	
☐ PLANNING	☐ INFORMATION	
☐ CONSTRUCTION	☐ AS BUILT DRAWING	
Before proceeding with construction please scan the QR code to know the latest revision.		
STAMP ALL PREVIOUS REVISION AS SUPERSEDED		
ISSUED BY		
NAME	AMIT RAWAL	
SIGNATURE	-Sd-	
DATE	06.03.2023	

NOTE:– SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

ग्राहक ड्राइंग संख्या CUSTOMER DRAWING NO.	4540-001-301-PVC-C-0751
कार्य संख्या- JOB NO.	497
स्थिति STATUS	CONTRACT
मुद्रण स्केल मीटर में PRINT SCALE IN METRE	0 2 4 6 8 10 20 30 40 50

ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
परियोजना PROJECT	2X660 मेगावाट तालचर थर्मल पावर परियोजना चरण–III 2X660MW TALCHER THERMAL POWER PROJECT STAGE–III
	भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD पावर सेक्टर/POWER SECTOR परियोजना अभियांत्रिकी प्रबंधन PROJECT ENGINEERING MANAGEMENT नोएडा (उ॰प्र॰)/NOIDA (U.P.)

DEPT CODE		नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
C	तैयारकर्ता/DRN	JASBEER	--sd--	02.03.2023
	डिजाइनकर्ता/DESN	AR	--sd--	02.03.2023
	जांचकर्ता /CHD	AB	--sd--	02.03.2023
	अनुमोदनकर्ता /APPD	TMS RAO	--sd--	02.03.2023

शीर्षक/TITLE	CANTEEN BUILDING ARCHITECTURAL PLANS & FINISH SCHEDULE

एमपीएल MPL	सिविल CIVIL	इलेक्ट्रिकल ELEC	सीएंडआई C&I	एमएसई MSE	मेक्स MAX	विभाग DEPT.	स्केल – SCALE–	ड्राइंग संख्या/ DRAWING NO.
						हस्ताक्षर SIGN दिनांक DATE		PE-DG-497-610-C001
							शीट SHEET 1 OF 2	पुनरीक्षण REV. 0

पुनरीक्षण REV.	दिनांक DATE	परीक्षितकर्ता ALTD	जांचकर्ता CHD	अनुमोदनकर्ता APPD

पुनरीक्षण REV.	दिनांक DATE	परीक्षितकर्ता ALTD	जांचकर्ता CHD	अनुमोदनकर्ता APPD
R0b	06.03.2023	JASBEER	AR/AB	TMS RAO
DRAWING UPDATED AFTER INTERFACE OBSERVATIONS RECEIVED FROM PEM MAUX ON DATED 18.02.2023,PEM MPL ON DATED 20.02.2023				

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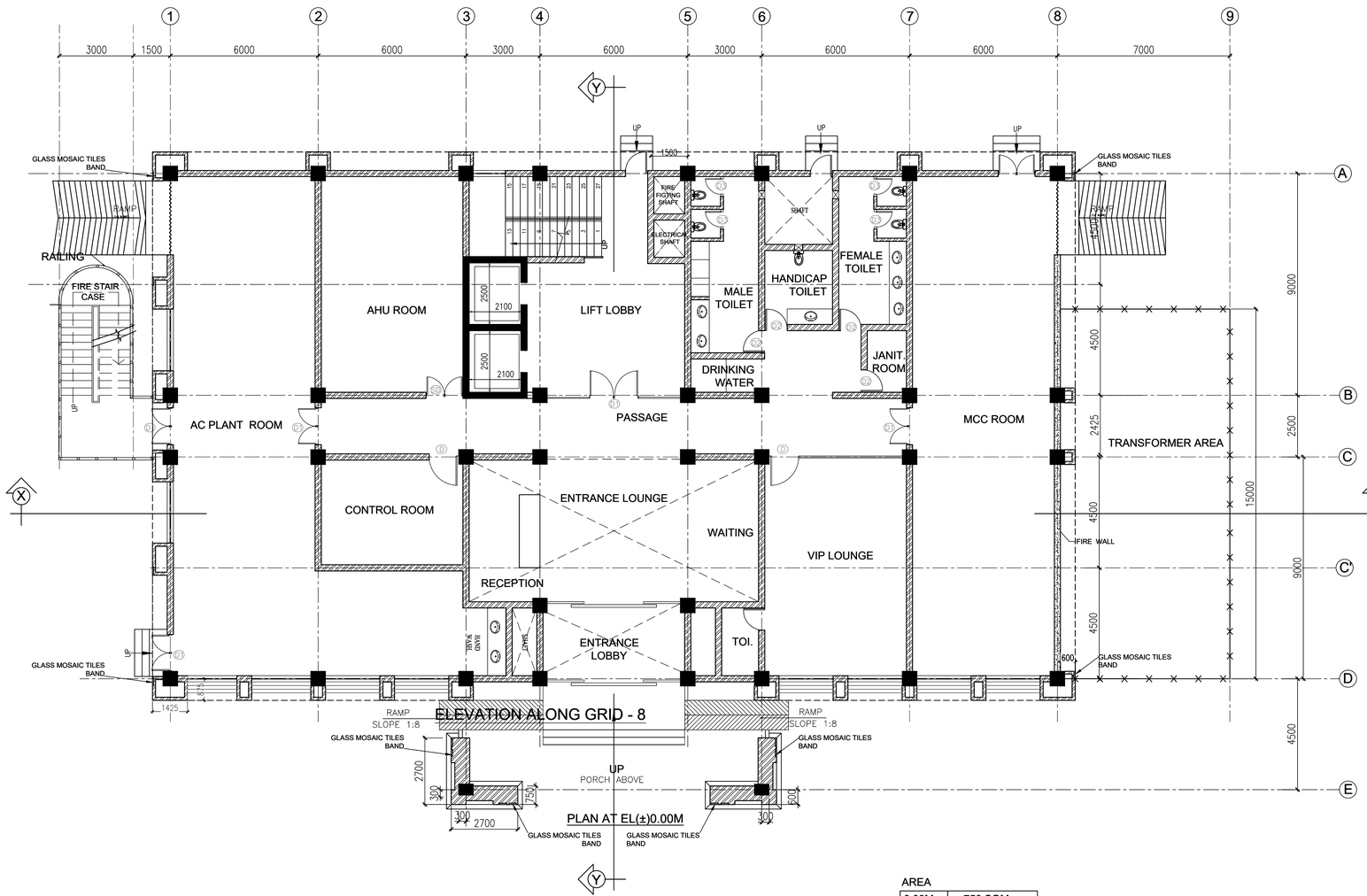

NOTES:

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
2. THESE DRAWINGS ARE FOR TENDER PURPOSE ONLY, DETAILED ARCHITECTURAL DRAWINGS SHALL BE PREPARED AND SUBMITTED BY THE BIDDER DURING DETAILED ENGINEERING STAGE FOR OWNER'S APPROVAL AND WORK SHALL BE EXECUTED THEREAFTER.

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AREA

0.00M	750 SQM.
6.00M	730 SQM.
10.50M	730 SQM.
15.00M	625 SQM.
TOTAL AREA - 2840 SQM.	

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FOR TENDER PURPOSE ONLY										20.01.22

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NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
(ENGINEERING DIVISION)

PROJECT: TALCHER SUPER THERMAL POWER PROJECT
STAGE-III (2X660 MW)

TITLE: ADMINISTRATIVE BUILDING
FLOOR AT EL(+)0.00M

SIZE	SCALE	DRG. NO.	REV. NO.
		4540-999-POC-A-017-SH-1	00

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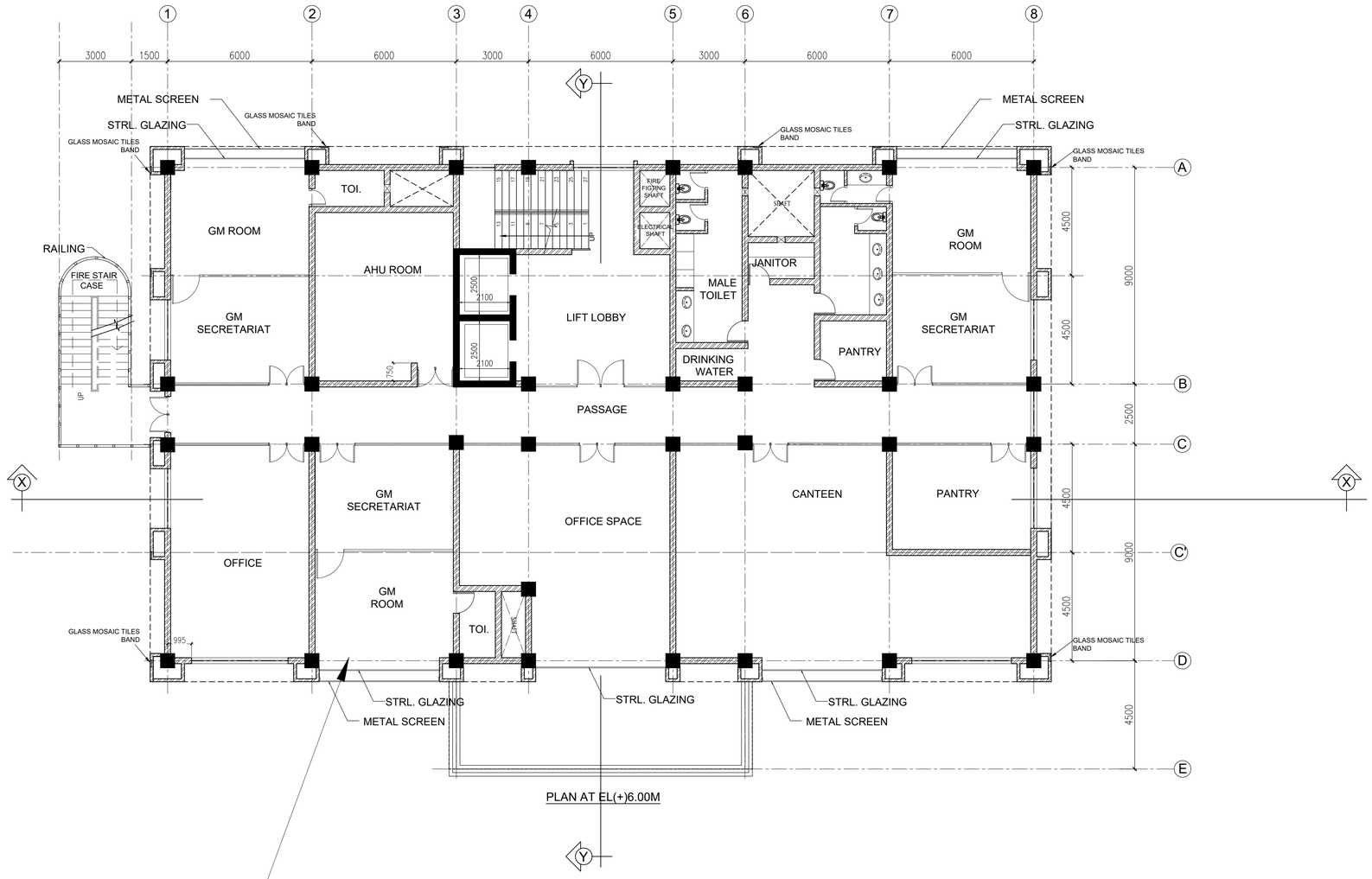

PLAN AT EL(+)6.00M

NOTES:

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HOW IT WILL LOOK FROM INSIDE THE BUILDING

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FOR TENDER PURPOSE ONLY										20.01.22

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(ENGINEERING DIVISION)

PROJECT: TALCHER SUPER THERMAL POWER PROJECT
STAGE-III (2X660 MW)

TITLE: ADMINISTRATIVE BUILDING
FLOOR AT EL(+)6.00M

SIZE	SCALE	DRG. NO.	REV. NO.
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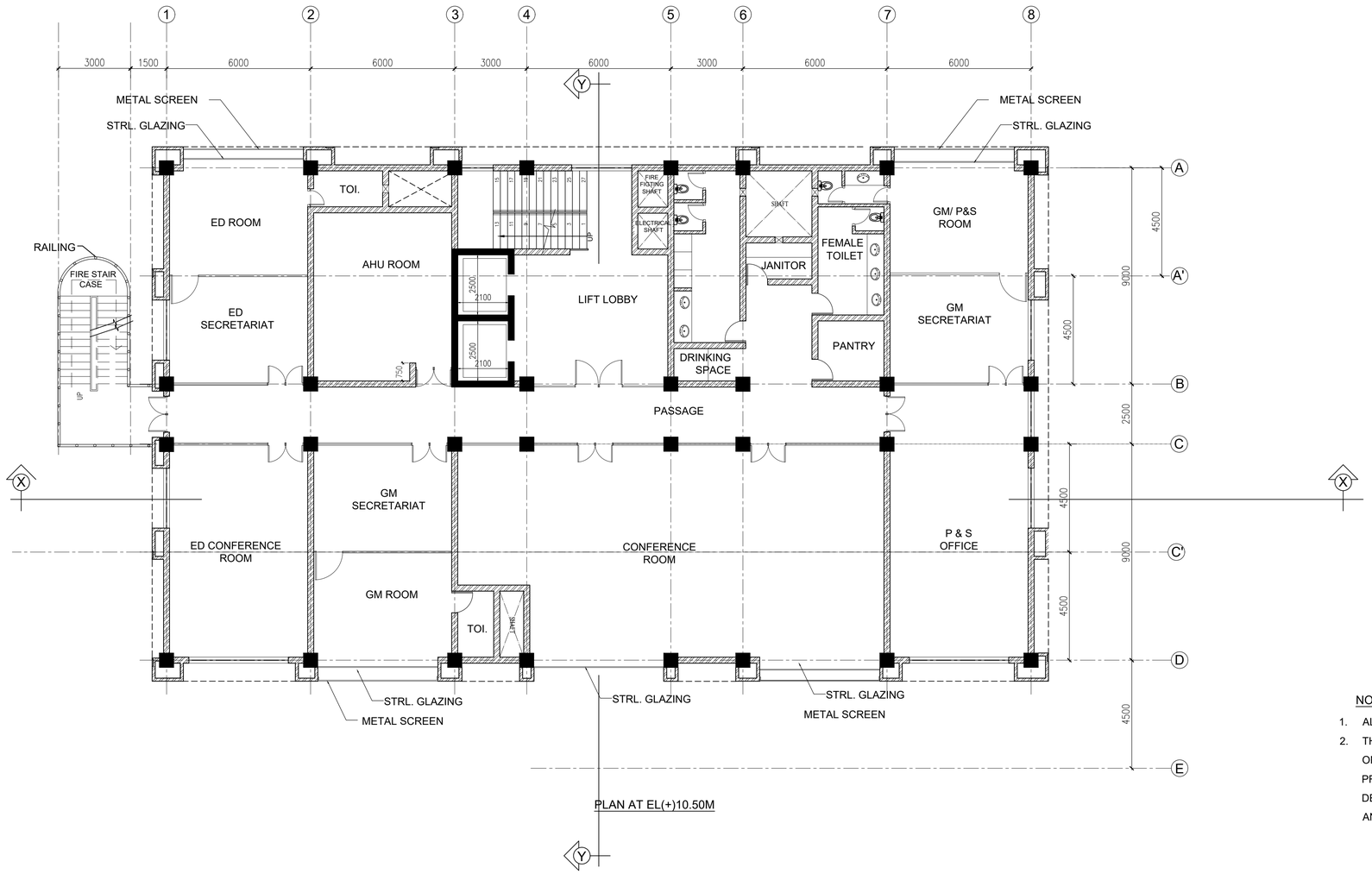

PLAN AT EL(+)10.50M

NOTES:

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(ENGINEERING DIVISION)

PROJECT: TALCHER SUPER THERMAL POWER PROJECT
STAGE-III (2X660 MW)

TITLE: ADMINISTRATIVE BUILDING
FLOOR AT EL(+)10.50M

SIZE	SCALE	DRG. NO.	REV. NO.
		4540-999-POC-A-017-SH-3	00

CAD FILE NAME:- 4540-999-POC-A-017-SH-3

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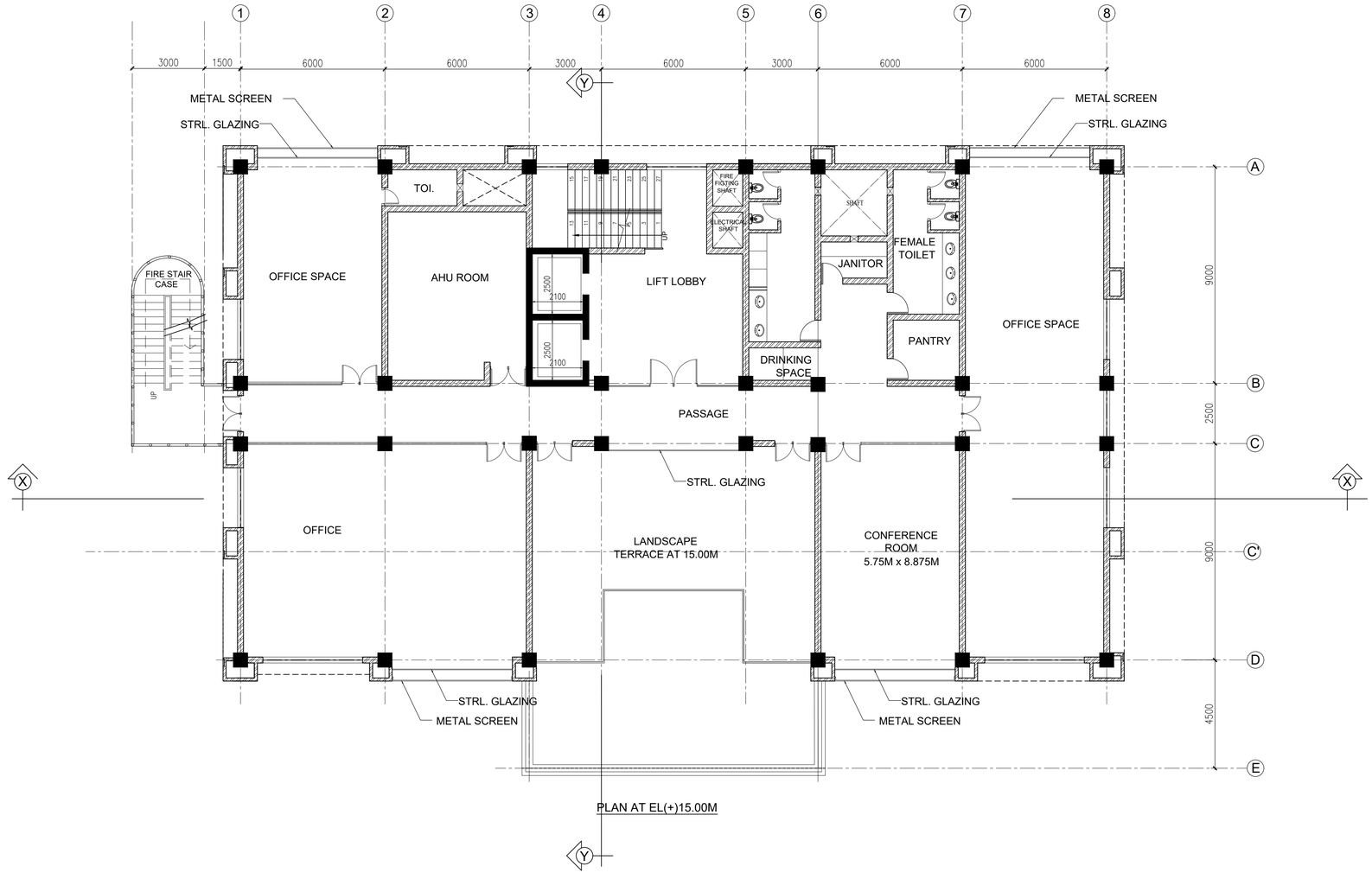

PLAN AT EL(+)15.00M

NOTES:

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(ENGINEERING DIVISION)

PROJECT: TALCHER SUPER THERMAL POWER PROJECT
STAGE-III (2X660 MW)

TITLE: ADMINISTRATIVE BUILDING
FLOOR AT EL(+)15.00M

SIZE	SCALE	DRG. NO.	REV. NO.
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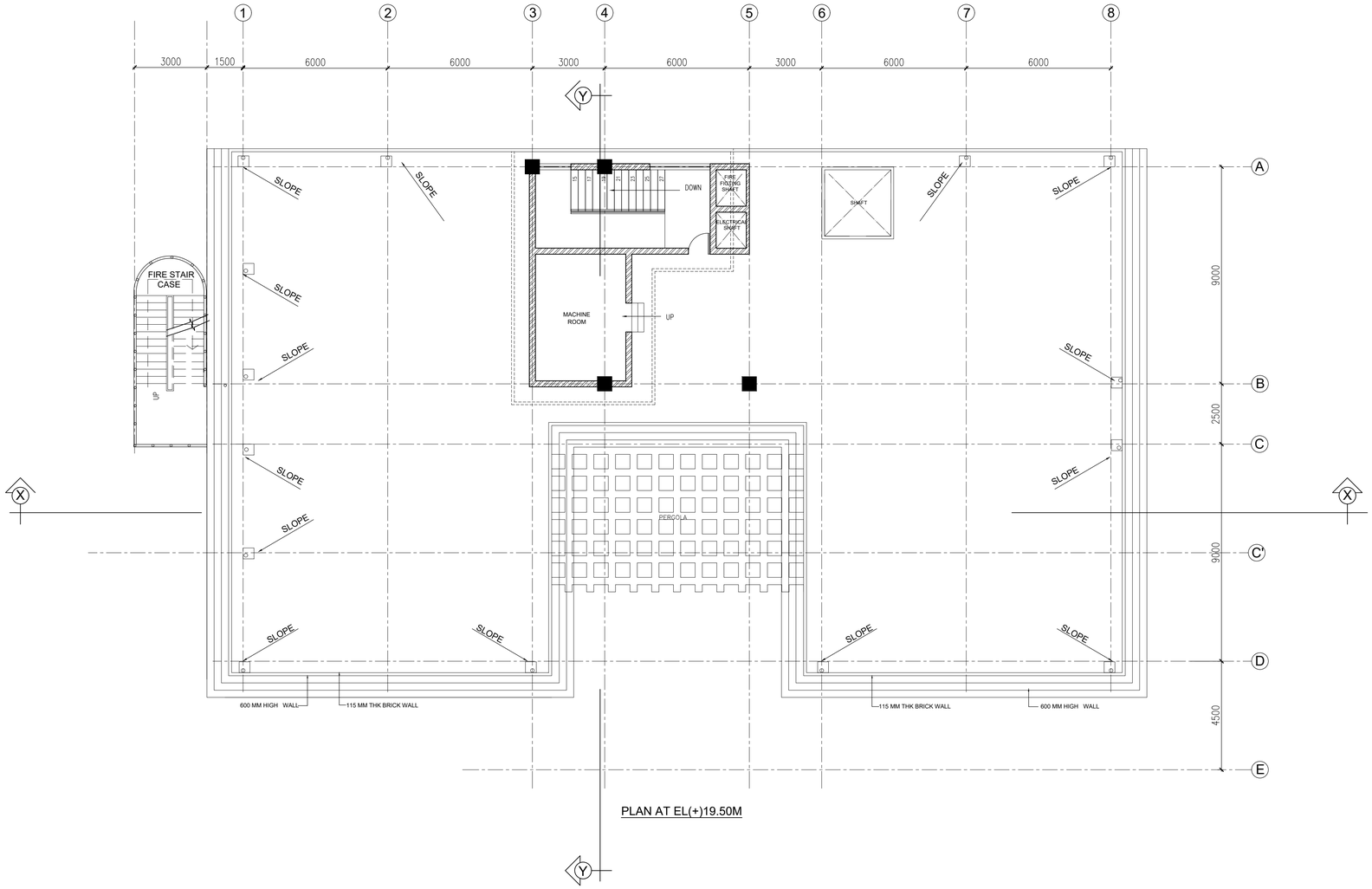
REV. NO. A



PLAN AT EL(+)19.50M

NOTES:

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(ENGINEERING DIVISION)

PROJECT: TALCHER SUPER THERMAL POWER PROJECT
STAGE-III (2X660 MW)

TITLE: ADMINISTRATIVE BUILDING
FLOOR AT EL(+)24.00M

SIZE	SCALE	DRG. NO.	REV. NO.
		4540-999-POC-A-017-SH-5	00

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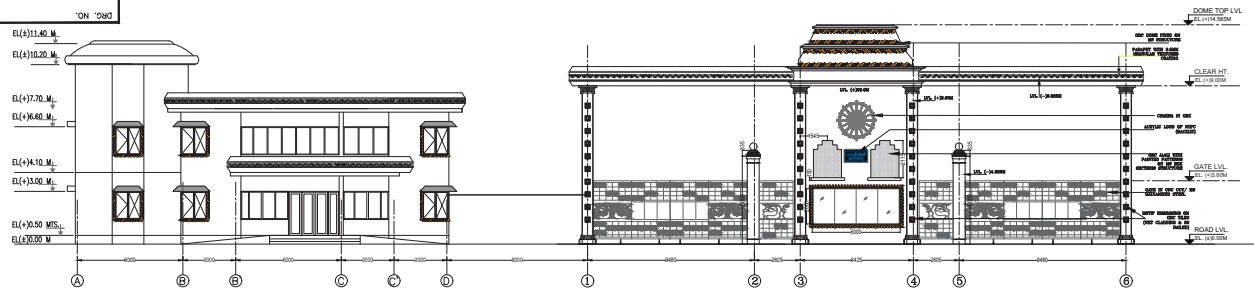
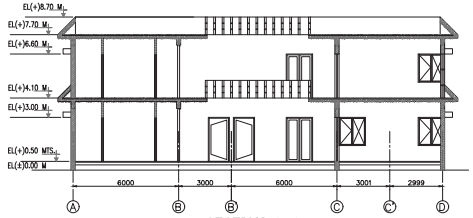
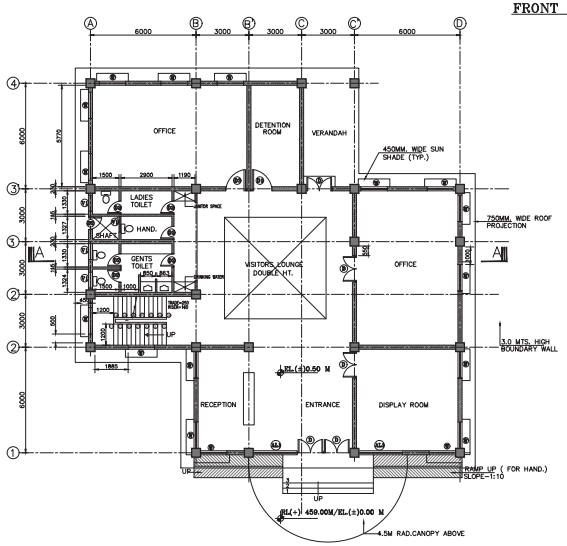


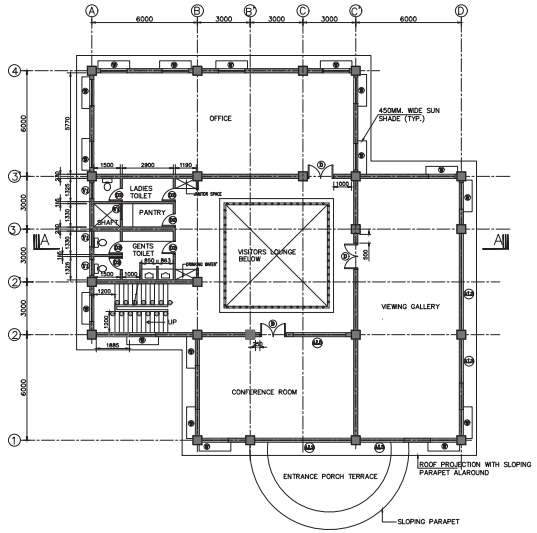
FRONT ELEVATION



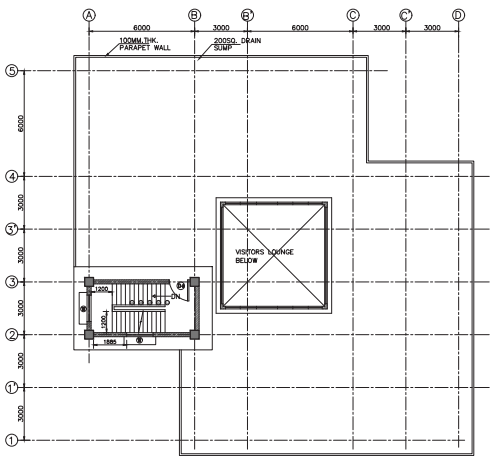
SECTION A-A



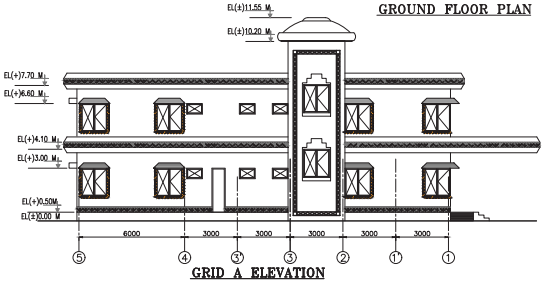
GROUND FLOOR PLAN



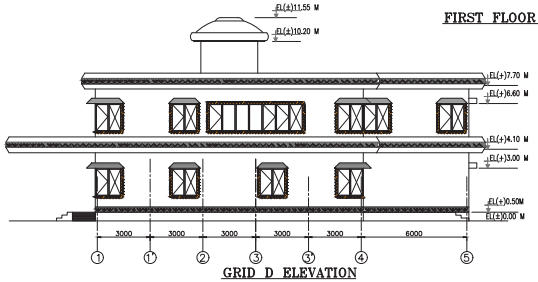
FIRST FLOOR PLAN



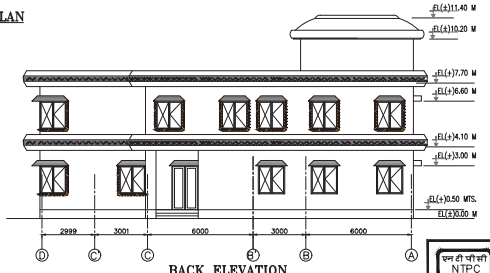
TERRACE PLAN



GRID A ELEVATION



GRID D ELEVATION



BACK ELEVATION

NOTES:

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00	RELEASED FOR TENDER PURPOSE	ARCHI	DK								21.01.22
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NTPC Limited
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(ENGINEERING DIVISION)

PROJECT: TALCHER SUPER THERMAL POWER PROJECT
STAGE-III (2X660 MW)

TITLE: GATE COMPLEX AND CISF BUILDING
FLOOR PLAN, ELEVATIONS & SECTION

SIZE	SCALE	DRG. NO.	REV. NO.
		4540-999-POC-A-018-SH-2	00