THDC INDIA LIMITED

KHURJA STPP (2 X 660 MW)
TURBINE GENERATOR AND ASSOCIATED PACKAGES

CONSULTANT
NTPC LIMITED

TECHNICAL SPECIFICATION
FOR
AIR CONDITIONING SYSTEM

SPECIFICATION NO.: - PE-TS-475-553-A001 (REV0)

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

	TITLE: TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM	SPECIFICATION No: PE-TS-475-553-A001
		REV. 00
		SHEET : 1 OF 2

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SECTION – I

SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION: I	
		SUB SECTION: A	
		REV 00	DATE: AUGUST 2020
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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, 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 KHURJA STPP TURBINE GENERATOR AND ASSOCIATED PACKAGES** at village Dushahara, tehsil Khurja, distt. Bulandshehar, Uttar Pradesh.

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 AND SEISMIC DESIGN CRITERIA

SUB–SECTION – A-0

PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION

KHURJA STPP (2X660 MW)

1.00.00 BACKGROUND

THDC India Limited (Formerly Tehri Hydro Development Corporation), is a joint venture of Govt. of India & Govt. of Uttar Pradesh. THDC India Limited has been entrusted to execute a Thermal Power Project in Khurja at district Bulandshahar, Uttar Pradesh (UP) along with various other hydro projects.

THDC has placed a Consultancy order to NTPC Ltd for Pre-award to Commissioning activities (consultancy) of Khurja Coal based power project (2x660 MW).

The present proposal is to establish 2X660 MW coal based Khurja Super Thermal Power Project for the benefit of Uttar Pradesh, Rajasthan, Uttarakhand, Himachal Pradesh & Delhi.

2.00.00 CAPACITY

PRESENT PROPOSAL: 2 x 660 MW

3.00.00 MODE OF OPERATION

Base Load

4.00.00 LOCATION AND APPROACH

Khurja Super Thermal Power Project is located in Bulandshahar district of Uttar Pradesh, between 28°08'35" to 28°10'25" Northern latitude and 77°53'47" to 77°55'22" Eastern longitude. The site is situated near villages Dushhara-kherli, Jahanpur, Naiphal (Unchagaon) and Rukunpur. The district Headquarters Buland Shahar is about 32 kms. The nearest railway station Danwar on Delhi-Kolkata Section (via Aligarh) is approximately 5 km away from the project site. The nearest major railway station is Khurja at a distance of about 11 kms.

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

Distance of the project site from nearest cities

Khurja	11 kms
Aligarh	36 kms
Delhi	90 kms
Bulandshaher	32 kms

For further information, bidders are also advised to visit the project site and collect data regarding local site conditions.

CLAUSE NO.	PROJECT INFORMATION
4.03.00	**AIRPORT** The nearest commercial airport at Delhi is located at a distance of approximately 120 kms from the project site.
5.00.00	**LAND** The land requirement for the project has been estimated as 1400 Acres for Main Plant, Balance of Plant including Coal Handling Plant, Ash Disposal Area, Ash Disposal Pipeline Corridors, Construction Stores & Offices, Laydown & Fabrication Yard, and Labor Colony etc. Land has already been acquired through UPSIDC. Additional patches of required land shall be acquired.
6.00.00	**WATER** The Upper Ganga Canal passes near by the Khurja STPP. The makeup water for the project is proposed to be drawn from Upper Ganga Canal at a distance of about 13 kms. Quantity of make-up water required for 2X660MW would be about 3265 Cum/hr with ash water recirculation system and 4415 Cum/hr with once through ash water system. Make-up water is proposed to be used for condenser cooling, ash sluicing, coal dust suppression and other plant processes. Make up water shall be drawn from the canal by constructing suitable intake structures. A Raw Water Reservoir is envisaged. Govt. of UP has conveyed commitment for supply of required quantity of water for the project.

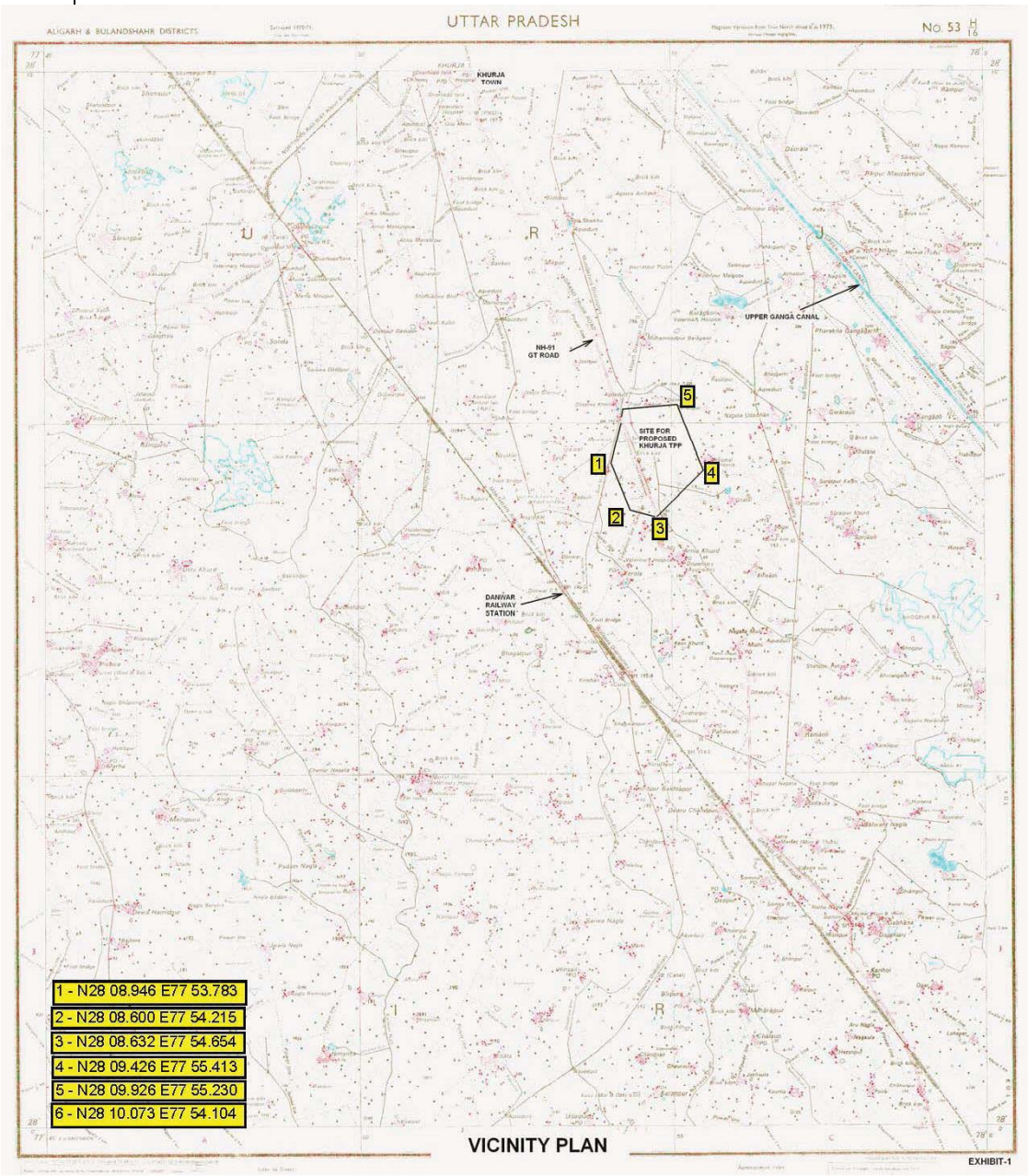
CLAUSE NO.	PROJECT INFORMATION
7.00.00	**COAL**
7.01.00	**Coal Requirement, Availability and Linkage** The daily coal requirement for 2x660 MW units shall be about 15261 tonnes based on Gross Calorific Value of 4200 Kcal/kg and 2248 Kcal/KWh unit heat rate, considering 90% plant load factor. Annual coal requirement for the plant shall be about 5.57 MTPA considering PLF of 90% and the same is proposed to be met from Amelia Coal Mine in District Singrauli, Madhya Pradesh, allotted to THDCIL by Ministry of Coal, Govt. of India. THDCIL has entered into an agreement with Nominated Authority, Ministry of Coal for the development of Amelia Coal Mine in Synchronization with the implementation of Khurja STPP. The distance between Khurja STPP plant site and Allotted Amelia Mine at Singrauli, Madhya Pradesh is around 900 Kms.
7.02.00	**Coal Transportation** The envisaged mode of coal transportation from the coal mine to the power plant is through Indian Railways**.**
7.03.00	**Coal Quality** The primary fuel for the main steam generator shall be coal. The coal quality parameters indicated in **Annexure-II** are to be considered for steam generator design.
8.00.00	**Fuel Oil** The fuel oils to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Light Diesel Oils having the characteristics & and High Speed Diesel Oil having the characteristics given at **Annexure-III & Annexure-IV** respectively.
9.00.00	**STEAM GENERATOR TECHNOLOGY** The steam generators shall be based on super critical technology, 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.
10.00.00	**FLUE GAS DESULPHURIZATION SYSTEM (FGD) & SCR:** The project is envisaged with Flue Gas Desulfurization (FGD) system and Selective Catalytic Reduction (SCR) in compliance to the notification dated 07.12.2015 by Ministry of Environment, Forest & Climate Change. The Tentative Limestone characteristic to be used for design of FGD system shall be as per the characteristic given at **Annexure-V.**

CLAUSE NO.	PROJECT INFORMATION
11.00.0	**POWER EVACUATION SYSTEM** Power Generated from each 660 MW unit would be stepped up to the evacuation voltage level through suitably rated Generator Transformer and will be evacuated through 400kV transmission systems. Associated Transmission System (ATS) of the project has already taken-up with PGCIL/CEA/UPPTCL and will be finalized soon.
12.00.00	**METEOROLOGICAL DATA** The meteorological data from nearest observatory (Aligarh) is placed at **Annexure - VI.**
13.00.00	**PLANT WATER SCHEME** The Plant water scheme is described below.
13.01.00	**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.
13.02.00	**Equipment Cooling Water (ECW) System (Unit Auxiliaries)** The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralized (DM) water 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 secondary circuit. The station auxiliaries such as Air compressors, Compressors of ash handling plant, compressor of mill reject system, FGD & SCR system etc. shall also be cooled by Demineralized (DM) water in a closed 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 Steam Generator & auxiliaries and TG & its auxiliaries.
13.03.00	**Other Miscellaneous Water Systems** CW system blow down water shall be used for the plant service water requirement, dust suppression system of coal handling plant, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, FGD system, make-up to fire water system. The service (wash water) water collected from various areas and coal handling plant shall be treated as per requirement and reused. FGD waste water shall be diverted to ash system after neutralization. The quality of clarified water & DM water is given in this sub-section at **Annexure-VII-1 & VII-2.**

CLAUSE NO.	PROJECT INFORMATION

ANNEXURE-I

VICINITY PLAN



ANNEXURE-II

COAL & ASH CHARACTERISTICS

PROPOSED COAL CHARACTERISTICS FOR KHURJA (2X660 MW)

S.No.	Characteristics (as received basis)	Range of 95 % coal supplies			Range of 5 % coal supplies
		Column - 1	Column - 2	Columr - 3	
		Design	Worst	Best	
1.0	PROXIMATE ANALYSIS				
1.1	Total Moisture (%)	12	14	11.0	11-15
1.2	Ash (%)	32	35	28	28-36
1.3	Volatile Matter (%)	24	23	25	22-26
1.4	Fixed Carbon (%)	32	28	36.0	28-36
1.5	Total (%)	100	100	100	
2.0	ULTIMATE ANALYSIS				
2.1	Carbon (%)	42.9	37.81	48.01	35.21-45.4
2.2	Hydrogen (%)	3.2	2.8	3.3	2.9-4.2
2.3	Sulphur (%)	0.4	0.6	0.3	0.52
2.4	Nitrogen(%)	1	0.58	1.2	6.86
2.5	Oxygen(%)(By difference)	8.17	8.77	7.7	0.28
2.6	Carbonates (%)	0.27	0.38	0.45	0.3
2.7	Phosphorous(%)	0.06	0.06	0.04	0.04
2.8	Total Moisture (%)	12	14	11.0	22
2.9	Ash (%)	32	35	28	39
	Total	100	100	100	
2.10	GCV (Kcal/Kg)	4200	3650	4700	3600-4800
2.11	Hard Grove Index	60	52	65	50-65
2.12	YGP (mg/kg)	70	75	70	85-70
3.0	ASH ANALYSIS				
3.1	Silica (%)	58.2	59.54	58.00	58.1-63
3.2	Alumina(%)	28	26.3	27.20	22.2-26.1
3.3	Iron Oxide (%)	6.1	6.4	7.60	8.3-11.5
3.4	Titania	1.85	1.72	1.80	0.82-1.2
3.5	Phosphoric Anhydride (%)	1.91	1.57	0.48	0.48-191
3.6	Lime (%)	1.7	3.2	3.30	1.78-3.5
3.7	Magnesia (%)	0.7	0.6	0.50	0.5-0.9
3.8	Sulphuric Anhydride (%)	0.29	0.25	0.40	0.12-0.43
3.9	Sodium Oxide (%)	0.3	0.1	0.30	0.1-0.32
3.10	Potassium oxide	0.95	0.32	0.42	0.1-0.43
	Total	100	100.00	100.00	
4.0	ASH FUSION RANGE				
	REDUCING ATMOSPHERE				
4.1	Initial Deformation Temp.(oC)	1200	1100	1150	1100 1200
4.2	Hemispherical Temp. (oC)	1400	1300	1350	1200 1400
4.3	Fusion Temperature (cC)	1400	1400	1350	1400 1450

ANNEXURE-III

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

ANNEXURE-IV

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

CLAUSE NO.

PROJECT INFORMATION

ANNEXURE-V

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

ANNEXURE-VI

METEOROLOGICAL DATA

ANNEXURE-VI

BACK

जलवायवी सारणी

CLIMATOLOGICAL TABLE

स्टेशन : अलीगढ़ STATION : Aligarh

अक्षांश LAT. 27°53' देशांतर LONG. 78°04' समुद्री तल माध्य से ऊंचाई HEIGHT ABOVE M.S.L. 187 मीटर METRES

प्रेक्षणों पर आधारित BASED ON OBSERVATIONS 1971-2000

| माह MONTH | | स्टेशन का सकल दाब STATION LEVEL PRESSURE hPa | वायु तापमान AIR TEMPERATURE | | | | | | | | | | | | | | | | | | | | वर्षा RAINFALL | | | | | | | | | | | | | | | | | | |

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : अलीगढ़
STAION : Aligarh

माह	मौसम परिघटना के साथ दिनों की संख्या							पवन की गति के साथ दिनों की संख्या (कि. मी. प्र. घं.)				पवन											मेघ								दृश्यता				
	उपरोक्त 0.3 कि.मि.या अधिक	ओले	गर्जन	धूक्षा	धूल भरी आंधी	धौर पाला	62 या अधिक	2.0-61	1-19	0	3	उ.	उ.पू.	पू.	द.पू.	द.	द.प.	प.	उ.प.	शांत	0	मेघ मात्रा (सभी मेघ) सहित दिनों की संख्या - अष्टमांश							दिन भारी मेघ मात्रा सहित दिनों की संख्या - अष्टमांश							1 कि.मी. या कम	1-4 कि.मी.	4-10 कि.मी.	10-20 कि.मी.	20 कि.मी. से अधिक
	WEATHER PHENOMENA							No. OF DAYS WITH WIND SPEED (Km. p. h.)				PERCENTAGE No. OF DAYS WIND FROM									No. OF DAYS WITH LOW CLOUD AMOUNT (ALL CLOUDS) OKTAS							No. OF DAYS WITH LOW CLOUD AMOUNT OKTAS							No. OF DAYS WITH VISIBILITY				
MONTH		HAIL	THUN DER	FOG	DUST STORM	SAND ALL	62 or more	20-61	1-19	0	N	NE	E	SE	S	SW	W	NW	CALM	0	1-2	3-5	6-7	8	FOG	0	1-2	3-5	6-7	8	FOG	UP TO 1 km	1-4 km	4-10 kms	OVER 20 kms
जनवरी JAN	I 2.1	0.1	0.2	3.0	0.0	0.0	0	0	25	6	2	14	10	16	2	11	15	9	21	20	1	2	3	5	0	20	1	2	3	5	0	3.3	6.2	16.9	4.6	0.0
	II						0	0	23	8	4	9	6	13	4	5	19	13	27	19	2	2	4	4	0	20	2	2	3	4	0	1.1	11.5	6.3	12.1	0.0
फरवरी FEB	I 2.4	0.1	0.5	1.2	0.0	0.0	0	0	23	5	3	14	8	14	2	12	15	14	18	18	2	3	3	4	0	18	1	2	3	4	0	1.9	4.8	14.5	6.8	0.0
	II						0	0	23	5	5	8	5	13	1	9	24	15	20	17	2	3	3	3	0	18	2	3	3	3	0	0.0	8.4	4.8	14.8	0.0
मार्च MAR	I 2.2	0.3	0.7	0.0	0.1	0.0	0	0	27	4	2	13	8	19	2	12	16	14	14	20	1	3	4	3	0	22	0	3	3	3	0	0.4	4.7	13.4	12.5	0.0
	II						0	0	26	5	6	8	6	11	2	10	20	22	15	17	2	4	5	3	0	19	2	3	4	3	0	0.1	6.3	6.6	18.1	0.0
अप्रैल APR	I 1.9	0.1	0.9	0.0	0.8	0.0	0	0	26	4	3	15	9	18	2	12	13	15	13	21	1	3	3	2	0	24	0	2	2	2	0	0.0	3.6	14.0	12.4	0.0
	II						0	0	27	3	8	7	6	12	4	9	13	30	11	19	2	3	4	2	0	20	2	3	3	2	0	0.0	5.5	7.0	17.4	0.0
मई MAY	I 3.2	0.1	0.9	0.0	2.3	0.0	0	0	27	4	3	12	11	13	3	12	15	16	15	23	1	2	2	3	0	25	0	2	1	3	0	0.0	5.6	15.4	9.9	0.0
	II						0	0	27	4	7	9	8	12	3	9	16	25	11	22	3	2	2	2	0	23	2	2	2	2	0	0.0	5.9	9.2	15.9	0.0
जून JUN	I 5.2	0.0	0.5	0.0	1.0	0.0	0	0	26	4	2	12	13	15	4	14	11	15	14	17	1	3	4	5	0	17	1	3	4	5	0	0.0	5.4	13.0	11.6	0.0
	II						0	0	27	3	5	14	11	15	4	13	11	18	9	15	3	3	4	5	0	16	3	3	3	5	0	0.0	5.8	8.9	15.3	0.0
जुलाई JUL	I 13.2	0.0	0.6	0.0	0.1	0.0	0	0	26	5	2	13	11	11	3	18	12	15	15	4	1	2	6	18	0	5	1	2	6	17	0	0.0	4.6	12.2	14.2	0.0
	II						0	0	26	5	5	14	14	12	4	14	10	12	15	2	2	3	8	16	0	3	2	3	7	16	0	0.0	5.3	7.7	18.0	0.0
अगस्त AUG	I 14.4	0.0	0.8	0.0	0.0	0.0	0	0	25	6	2	11	12	12	3	15	13	14	18	4	0	3	5	19	0	5	1	2	4	19	0	0.0	3.3	11.4	16.2	0.0
	II						0	0	26	5	5	14	13	10	5	14	13	9	17	2	3	3	6	17	0	2	3	3	6	17	0	0.0	5.4	7.6	18.0	0.0
सितम्बर SEP	I 7.4	0.0	0.4	0.0	0.0	0.0	0	0	24	6	2	11	13	15	3	14	13	11	18	16	1	4	3	6	0	17	1	3	3	6	0	0.0	1.4	10.2	18.4	0.0
	II						0	0	23	7	7	12	10	11	2	11	13	12	22	13	5	3	4	5	0	15	4	3	3	5	0	0.0	4.6	6.7	18.7	0.0
अक्तूबर OCT	I 1.9	0.0	0.5	0.1	0.1	0.0	0	0	20	11	4	8	10	11	3	5	11	10	38	26	1	1	1	2	0	27	0	1	1	2	0	0.1	1.6	11.7	17.7	0.0
	II						0	0	17	14	8	6	8	9	2	5	8	10	44	25	2	1	1	2	0	26	1	1	1	2	0	0.0	7.5	6.1	17.4	0.0
नवम्बर NOV	I 0.7	0.0	0.1	0.1	0.0	0.0	0	0	18	12	3	7	7	11	2	8	14	6	42	25	1	2	1	1	0	27	0	1	1	1	0	0.1	3.6	16.3	10.0	0.0
	II						0	0	12	18	6	2	4	5	1	4	11	7	60	25	1	2	1	1	0	26	1	1	1	1	0	0.0	12.2	6.6	11.2	0.0
दिसम्बर DEC	I 1.2	0.0	0.1	2.2	0.0	0.0	0	0	21	10	1	9	7	15	1	9	14	10	34	22	1	2	3	3	0	25	0	1	2	3	0	1.5	7.7	16.0	5.7	0.0
	II						0	0	17	14	3	4	3	8	1	4	11	7	60	25	1	2	3	3	0	23	1	2	3	2	0	0.0	14.6	5.9	10.4	0.0
वार्षिक योग I	55.8	0.8	6.1	6.7	4.3	0.0	0	0	287	78	2	12	10	14	2	12	13	12	23	224	11	29	38	63	0	240	7	24	32	62	0	7.3	52.6	166.8	138.4	0.0
या माध्य ANNUAL TOTAL OR MEAN II							0	0	276	89	6	9	8	11	3	9	15	15	24	202	28	33	46	56	0	220	24	27	39	55	0	1.2	91.3	83.3	189.1	0.0
वर्षों की संख्या I NUMBER OF YEARS II	29						30				30									30						30						30				

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CLAUSE NO.

PROJECT INFORMATION

ANNEXURE-VII-1

ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER

Main Plant Condenser

S.No	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as Sio2
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 -7.2
5.	Conductivity	Not more than 0.1micro mho/cm excluding the effects of free CO2

ANNEXURE-VII-2

DESIGN CLARIFIED WATER ANALYSIS

S.No	PARAMETER	UNIT	Clarified Water Analysis
			Calculated
1	pH .	-	6.8-7.3
2	Sp. Cond.	µs/cm	325
3	TDS	mg/l	230
4	Turbidity	NTU	10
5	Total hardness	mg/l As CaCO3	155
6	Calcium	mg/l As CaCO3	148.8
7	Magnesium	mg/l As CaCO3	45
8	Sodium	mg/l CaCO3	45
9	Potassium		
10	P Alkalinity	mg/l As CaCO3	-
11	M Alkalinity	mg/l As CaCO3	125.3
12	Chlorides	mg/l As as CaCO3	42
13	Sulphate	mg/l As CaCO3	71.5
14	Silica (Total)	mg/l As SiO2	21
15	Silica (Reactive)	mg/l As SiO2	20
16	Silica (Collidal)	mg/l As SiO2	1
17	TOC	mg/l	6
18	COD	mg/l	45
19	BOD	mg/l	18
20	Fe	mg/lt	-

Note: Cooling water system is expected to operate at a design minimum cycle of concentration (C.O.C) of about 5 to 5.5.

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 – B 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 : 2.0%

c) Reinforced concrete structures :1.6%

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

Appendix-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 “Vb” at ten metre above the mean ground level : 47 metre/second

b) The risk coefficient “K1” : 1.07

c) Category of terrain : Category-2

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 (Part 1).

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 (VB) obtained from modal combination is less than the base shear ($\overline{V}B$) computed using the approximate fundamental period (Ta) 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 $\overline{V}B$/ VB. However, no reduction is permitted if $\overline{V}B$ is less than VB.

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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 FOR KHURJA STPP

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

1) Peak ground horizontal acceleration (MCE) : 0.32 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 : 0.08

b) for special concentrically braced steel frames designed and detailed as per IS:800 : 0.06

c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.048

d) for RCC chimney, RCC Natural Draft Cooling Tower : 0.16

e) for Liquid retaining tanks : 0.096

f) for Steel chimney, Absorber Tower, Vessels : 0.12

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) : 0.08

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 : 0.16

Note:
g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

APPENDIX – II

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

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.040	2.240	2.032	1.600
0.050	2.450	2.222	1.750
0.060	2.660	2.413	1.900
0.070	2.870	2.604	2.050
0.080	3.080	2.794	2.200
0.090	3.290	2.985	2.350
0.100	3.500	3.175	2.500
0.105	3.500	3.175	2.500
0.110	3.500	3.175	2.500
0.115	3.500	3.175	2.500
0.120	3.500	3.175	2.500
0.125	3.500	3.175	2.500
0.130	3.500	3.175	2.500
0.135	3.500	3.175	2.500
0.140	3.500	3.175	2.500
0.145	3.500	3.175	2.500
0.150	3.500	3.175	2.500
0.200	3.500	3.175	2.500
0.220	3.500	3.175	2.500
0.230	3.500	3.175	2.500
0.240	3.500	3.175	2.500
0.300	3.500	3.175	2.500
0.350	3.500	3.175	2.500
0.400	3.500	3.175	2.500
0.450	3.500	3.175	2.500
0.500	3.500	3.175	2.500
0.550	3.500	3.175	2.500
0.600	3.173	2.879	2.267
0.650	2.929	2.657	2.092
0.700	2.720	2.467	1.943
0.750	2.539	2.303	1.813
0.800	2.380	2.159	1.700
0.850	2.240	2.032	1.600

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.900	2.116	1.919	1.511
0.950	2.004	1.818	1.432
1.000	1.904	1.727	1.360
1.050	1.813	1.645	1.295
1.100	1.731	1.570	1.236
1.150	1.656	1.502	1.183
1.200	1.587	1.439	1.133
1.250	1.523	1.382	1.088
1.300	1.465	1.329	1.046
1.350	1.410	1.279	1.007
1.400	1.360	1.234	0.971
1.450	1.313	1.191	0.938
1.500	1.269	1.151	0.907
1.550	1.228	1.114	0.877
1.600	1.190	1.080	0.850
1.650	1.154	1.047	0.824
1.700	1.120	1.016	0.800
1.750	1.088	0.987	0.777
1.800	1.058	0.960	0.756
1.850	1.029	0.934	0.735
1.900	1.002	0.909	0.716
1.950	0.976	0.886	0.697
2.000	0.952	0.864	0.680
2.050	0.929	0.843	0.663
2.100	0.907	0.822	0.648
2.150	0.886	0.803	0.633
2.200	0.865	0.785	0.618
2.250	0.846	0.768	0.604
2.300	0.828	0.751	0.591
2.350	0.810	0.735	0.579
2.400	0.793	0.720	0.567
2.450	0.777	0.705	0.555
2.500	0.762	0.691	0.544
2.550	0.747	0.677	0.533
2.600	0.732	0.664	0.523
2.650	0.718	0.652	0.513
2.700	0.705	0.640	0.504
2.800	0.680	0.617	0.486
2.850	0.668	0.606	0.477
2.900	0.657	0.596	0.469

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
2.950	0.645	0.585	0.461
3.000	0.635	0.576	0.453
3.050	0.624	0.566	0.446
3.100	0.614	0.557	0.439
3.150	0.604	0.548	0.432
3.200	0.595	0.540	0.425
3.250	0.586	0.531	0.418
3.300	0.577	0.523	0.412
3.350	0.568	0.516	0.406
3.400	0.560	0.508	0.400
3.450	0.552	0.501	0.394
3.500	0.544	0.493	0.389
3.550	0.536	0.487	0.383
3.600	0.529	0.480	0.378
3.650	0.522	0.473	0.373
3.700	0.515	0.467	0.368
3.750	0.508	0.461	0.363
3.800	0.501	0.455	0.358
3.850	0.495	0.449	0.353
3.900	0.488	0.443	0.349
3.950	0.482	0.437	0.344
4.000	0.476	0.432	0.340

SECTION: I

SUB-SECTION: C

TECHNICAL SPECIFICATION

SECTION: I

SUB-SECTION: C 1

SPECIAL TECHNICAL REQUIREMENT

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIOINING SYSTEM SPECIAL TECHNICAL REQUIREMENT	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION : I	
		Sub Section : C 1	
		REV. 00	DATE: AUGUST 2020
		SHEET-1 of 8	

1. FUNCTION

The purpose of the system is to provide Air Conditioning System for different areas of **2 x 660 MW, KHURJA STPP TURBINE GENERATOR AND ASSOCIATED PACKAGES** 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, CEP VFD Room etc.) – AC Plant-1

a) As per THDC/NTPC specification, Clause no. 1.05.00 a), of section VI, Part-B, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

b) As per THDC/NTPC specification, Clause no. 3.00.00, of section VI, Part-B, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

c) As per THDC/NTPC specification, Clause no. 1.00.00, of section VI, Part-A, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

2.2. SERVICE BUILDING - AC Plant-2

a) As per THDC/NTPC specification, Clause no. 1.05.00 b), of section VI, Part-B, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

b) As per THDC/NTPC specification, Clause no. 3.00.00, of section VI, Part-B, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

c) As per THDC/NTPC specification, Clause no. 1.00.00, of section VI, Part-A, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

Water softening plant (2x100%), common for AC plant I (i.e. Power House) & AC Plant II (i.e. Service Building) shall be provided to cater to soft water requirement of Screw Chillers of both power house area and service building. Two nos. (1W+1S) Make-up water Pumps with associated piping & valves shall be provided at outlet to softening plant for supply of water till make-up water tank of Service Building. Two no. make-up cum soft water tank for Power House's cooling towers shall be provided. Additionally, one number storage tank (if required) of required capacity for dilution of brine solution after softening plant shall also be provided. Diluted brine solution shall be led to nearest neutralizing pit through suitable pump(1W+1S), (if required). Necessary piping& supports along with accessories for the same shall be in the scope of AC System supplier.

2.3. OFFSITE CONTROL ROOMS

a) As per THDC/NTPC specification, Clause no. 1.05.00 c), of section VI, Part-B, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

b) As per THDC/NTPC specification, Clause no. 3.00.00, of section VI, Part-B, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

c) As per THDC/NTPC specification, Clause no. 1.00.00, of section VI, Part-A, Sub-Section A- 10 enclosed under Sub-Section C2A, Section I.

3. DESIGN CRITERIA

Design criteria shall be as per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 2.00.00 enclosed under-sub section C2A, section -1

4. EQUIPMENT AND SERVICES:

4.1 Vapour compression type machines:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 4.01.00 enclosed under-sub section C2A, section -1.

4.2 Chilling Unit:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 4.02.00 enclosed under-sub section C2A, section -1.

4.3 Condensing Unit -Air-Cooled (D-X type):

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 4.03.00 enclosed under-sub section C2A, section -1

4.4 Air Handling Unit (AHU):

. As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 4.04.00 enclosed under-sub section C2A, section -1

4.5 Non Ductable Split (Hi-Wall/Cassette), Ductable Split, Packaged Airconditioners:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 4.05.00 enclosed under-sub section C2A, section -1

4.6 Cooling Towers (for chilling units):

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 4.06.00 enclosed under-sub section C2A, section -1

4.7 Centrifugal Pumps:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 5.01.00 enclosed under-sub section C2A, section -1

4.8 Material of Construction for Piping & Fittings:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 5.02.00 enclosed under-sub section C2A, section -1

4.9 Valves:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 5.03.00 enclosed under-sub section C2A, section -1

4.10 Balancing / Controller Valves:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 5.03.09 enclosed under-sub section C2A, section -1

4.11 Air Filters:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 5.04.00 enclosed under-sub section C2A, section -1

4.12 Low Pressure Air Distribution System:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 6.05.00 enclosed under-sub section C2A, section -1

4.13 Diffusers, Grills & Dampers:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 6.07.00 enclosed under-sub section C2A, section -1

4.14 Thermal and Acoustic Insulation:

As per THDC/NTPC specification, section-VI, Part-B, Sub section-A-10, clause number 6.08.00 enclosed under-sub section C2A, section -1

5. LAYOUT CONSIDERATIONS:

5.1 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 15-17 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 15-18.

c) The Cooling Towers, Make-up water Storage Tank, Expansion Tank, water softening plant and soft water storage tank shall be located at 34 M level in F-G-H Bay between grid 15-17.

5.2 AC PLANT-2

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

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

6. GENERAL:

1) Basis of design of all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. drawing 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 Section I Sub-Section E, 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. However, Primary Support Structure shall be provided by BHEL.

10) Drain piping within room 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 shall be provided with thermo wells 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 drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc 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 personnel 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 dwg. / 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.

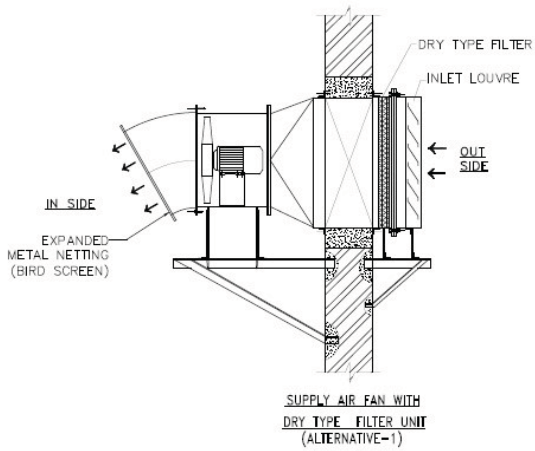
34) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.

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

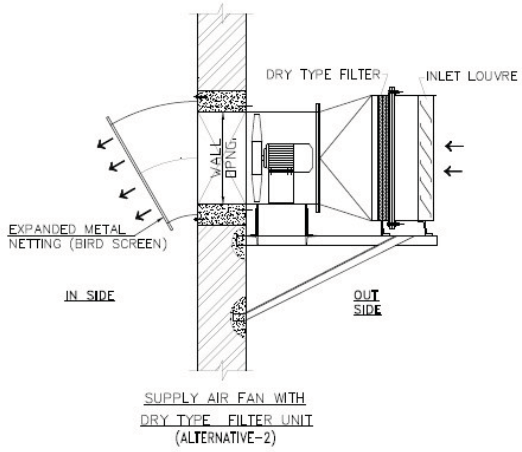
36) Training of officials, for AC system shall be provided as per customer specification.

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

.



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



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

38) All VVVFD 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. Refrigerant

and other 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.

7. 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

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 twelve (12) 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.

THDC INDIA LIMITED

(A Joint Venture of Govt. of India & Govt of U.P.)

2X660 MW KHURJA SUPER THERMAL POWER PROJECT

(TURBINE GENERATOR AND ASSOCIATES PACKAGE)

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) - 300kg 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 swiveling 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. (Refer Annexure-I)

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 start	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)	Load Chain	
i)	Type	Link type
ii)	Material	As per relevant standard
iii)	Conforms to (Std./Code)	IS: 6216 / IS 3077/IS 3019
d)	Hand Chain	
i)	Type	Link type
ii)	Material	Mild steel Grade 30
iii) :	Conform to Std.	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)	Type	Spur
ii)	Material	Alloy steel / carbon steel/ High graded cast iron
	Type of Bearing	Antifriction ball bearing / Roller
g)	Sprockets:	
	Type of bearings used	Antifriction ball bearing / Roller
i)	Method of lubrication	
	Bearings	Grease
	Gearing & Pinions	Grease
	Sprocket	Grease
h)	Brakes	
	Type	Screw and friction disc type
5.0	**Trolley and Bridge drive**	
a)	Trolley	Geared (Manually operated)
i)	Type	Mild steel (IS:2062 Grade A or B)
ii)	Material of frame	
b)	Drive Chain	Link type
i)	Type	Steel Gr.30
ii)	Material	IS : 2429 part 1 :1870
iii)	Design of drive chain	
c)	Wheel	Two in each trolley/bridge
i)	Number of pairs of wheel	Single flanged
ii)	Flange	Antifriction
iii)	Type of bearings need	As per IS 3832
iv)	Wheel material	
d)	Gears	
i)	Type	Spur / helical
ii)	Material	Cast iron/EN8
iii)	Type of bearings used	Antifriction
e)	Method of lubrication for	
i)	Bearings	Grease
ii)	General	Grease
iii)	Sprockets	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-V0-475-553-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V0-475-553-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details
3	PE-V0-475-553-A102	Schematic Circuit Diagram
4	PE-V0-475-553-A103	Mechanism Sizing Calculation
5	PE-V0-475-553-A105	O & M Manual

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-475-553-A200	Manufacturing Quality Plan

2	PE-V0-475-553-A201	GA Drawing for Chain Pulley Block with detail BOM with painting details
3	PE-V0-475-553-A202	O & M Manual

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.

ANNEXURE I: MAKES AND SUB VENDOR LIST

Package Name	Vendor Name
ELECTRIC HOIST	Alpha Services
	CONSOLIDATED HOISTS PVT LTD
	CENTURY CRANE ENGINEERS PVT. LTD.
	TECHNO INDUSTRIES
	EDDY CRANES PVT. LTD.
	Grip Engineers Pvt. Ltd.,
	TRACTEL TIRFOR INDIA PVT. LTD.
	Mangla Hoists Pvt Ltd
	BRADY & MORRIS ENGINEERING CO. LTD.
	REVA INDUSTRIES LTD.
	UNIVERSAL HOIST-O-FABRIK
CHAIN PULLEY BLOCK	UNIVERSAL HOIST-O-FABRIK
	CENTURY CRANE ENGINEERS PVT. LTD.
	BAKELITE ELECTRICAL MFG. CO. PVT. LTD.
	TRACTEL TIRFOR INDIA PVT. LTD.
	BRADY & MORRIS ENGINEERING CO. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD
	TECHNO INDUSTRIES

Note: No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the Electric hoists/CPB.

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.

	TECHNICAL SPECIFICATION **ELECTRIC HOISTS & CHAIN PULLEY BLOCKS** **2X660 MW THDC KHURJA TPS- TG & ASSOCIATES PKG**	

PAINTING SPECIFICATION

1) Painting specification for steel structures: -

Surface preparation	De greasing and Mechanical cleaning with wire brush or blasting according to SIS 055900, Grade 2 ½ .
Primer	HB Zn Phosphate - 2 coat, Minimum DFT 80 µ per coat
Finish Coat	HB MIO epoxy - 1 coat, Minimum DFT 120 µ per coat
Total DFT	260 µm

2) Painting specification for Indoor components such as motors, electrical parts etc:-

Surface preparation	Blasting according to SIS 055900, Grade 2 ½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.
Primer	Zinc phosphate epoxy - 2 coat, Total DFT 80 µm.
Finish Coat	Chlorinated rubber paint- 2 coats, Total DFT 80 µm for indoor and 100 µm for outdoor.
Total DFT	160 µm for indoor and 180 µm for outdoor

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	Light grey, shade 631 as per IS-5
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

	MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		2X660 MW THDC KHURJA TPS- TG & ASSOCIATE PKG.			
	AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
					REV	0	CONTRACT No					
					DATE	JUNE, 2020	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 THDC KHURJA TPS- TG & ASSOCIATE PKG.			
	AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
					REV	0	CONTRACT No					
					DATE	JUNE, 2020	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
1.6	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 THDC KHURJA TPS- TG & ASSOCIATE PKG.			
	AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
					REV	0	CONTRACT No					
					DATE	JUNE, 2020	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
`	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 THDC KHURJA TPS- TG & ASSOCIATE PKG.
	AS PER APPROVED VENDOR LIST	ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST
				REV	0	CONTRACT No	
				DATE	JUNE, 2020	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
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:393	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

भेल BHEL	MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **QP No.:** **REV**.:0, **Date.:** **PAGE**: 1 OF 4	**PROJECT: 2X660 MW THDC KHURJA TPS- TG & ASSOCIATE.** **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.
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	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **QP No.:** **REV**.:0, **Date.:** **PAGE**: 2 OF 4	**PROJECT: 2X660 MW THDC KHURJA TPS- TG & ASSOCIATE.** **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.		10.			11.
1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION	MA	Review	ONE SAMPLE PER HEAT		Material specification as per approved drawings.		MFR'S TC	✓	P	V	V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.
		MECHANICAL	MA	Review										
		INTERNAL DEFECTS	MA	UT	100%		ASTM A-388 REFER NOTE 1		IR	✓	P	V	V	
		NDT AFTER MACHINING	MA	DPT	100%		ASTM E-165 NO RELEVANT INDICATION		TC	✓	P	V	V	
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	

	LEGEND:	FOR CUSTOMER USE	
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SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

BHEL	MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **QP No.:** **REV**.:0, **Date.:** **PAGE**: 3 OF 4	**PROJECT: 2X660 MW THDC KHURJA TPS- TG & ASSOCIATE.** **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.		10.			11.
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	MA	HARDNESS	100%		IS:3832/ APPD DRG.	IS:3832/ APPD. DRG.	IR	✓	P	V	V	
		-SURFACE CRACK	MA	DPT	100 %		ASTM E165	NO DEFECT	IR	✓	P	V	V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT	MA	HT CHART	100%		IS 1875/IS 4367/IS 3832		IR	✓	P	V	V	
		SURFACE HARDNESS	MA	HARDNESS	10%		--DO--		IR	✓	P	V	V	
		SURFACE CRACK	MA	DPT FOR SURFACE CRACK	100%		ASTM E 165	NO DEFECT	IR	✓	P	V	V	
		DIMENSION	MA	MEASURE	10%		IS 3832		IR	✓	P	V	V	
3.0	**FINAL INSPECTION**													
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	CR	MEASUREMENT	100 %		IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V	
		ENDURANCE TYPE TEST	MA	TYPE TEST	1 PER SIZE		IS 3832	IS 3832	TC	✓	P	V	V	
		OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT.	CR	LOAD TEST	100%		-DO-	-DO-	IR	✓	P	W	V	
											P	W	V	

MANUFACTURER / CONTRACTOR SUB-CONTRACTOR SIGNATURE	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **QP No.:** **REV**.:0, **Date.:** **PAGE**: 4 OF 4	**PROJECT: 2X660 MW THDC KHURJA TPS- TG & ASSOCIATE.** **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.		10.			11.
		HEIGHT OF LIFT	MA	VISUAL	100 %		-DO-	-DO-	IR	✓	P	W	V	
		SWIVELING OF HOOK	MA	VISUAL	100%		APPROVED DRG	APPROVED DRG	IR	✓				
		EFFORT	MA	PULL ON CHAIN	100%		-DO-	-DO-	IR	✓	P	W	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.

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

REV: 00 DATE:

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

PACKAGE: ELECTRIC HOIST FOR AC VENTILATION.
PROJECT: 2X660 MW THDC KHURJA TPS- TG & ASSOCIATE PKG.
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT.

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.

SECTION: I

SUB-SECTION: C 2

CUSTOMER SPECIFICATION

SECTION: I

SUB-SECTION: C 2A

CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT

SUB–SECTION – A-10

AIR CONDITIONG SYSTEM

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.

1.02.00 All equipments shall be located indoor unless otherwise agreed to by the Employer. The equipment and layout shall generally be in accordance with the General Layout Plant drawings.

1.03.00 Layout of all equipment and accessories shall be developed in a way to facilitate easy accessibility and maintenance of all equipments.

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

1.05.00 Areas to be air-conditioned shall be as follows:

a) Centralized air conditioning system Control Rooms, Control Equipment Rooms, UPS & battery charger room, SWAS room, Water Analysis Lab, static excitation control room (if applicable) etc. in TG building. Dedicated AHUs shall be provided for each static excitation control room and shall be placed near to it.

b) Centralized air conditioning system for Service Building: Various office areas, entrance lobbies, visitor & VIP lounge, reception area, simulator area, etc.

c) Packaged/Split air-conditioners for various auxiliary control rooms/RIO rooms and office areas of other buildings covered under Bidder's scope and as detailed out in Part-B of Technical Specification

2.00.00 DESIGN PHILOSOPHY

1. Design ambient conditions for all air conditioning system shall be as indicated below:

Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
Summer	45.0	23
Monsoon	35.8	28.3
Winter	2	0.0

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, 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 Control Room / Control Equipment Room / UPS, etc. shall be 0.45 M3/minutes/person or 1.0 air change per hour whichever is greater. However, for areas like service building, etc. quantity of fresh air shall be minimum 1.5 air changes per hour. Fresh air fan capacity shall be minimum 10% of the total CMH value of working indoor units.

5. Lighting load shall be 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 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, for service building 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 (motorized) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & 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.

14. 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.

15. 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.

16. 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 non-ductable Split (Hi-wall/Cassette) air conditioner units as per requirement.

Refer Clarification attached at end of Sub-Section C2A

17. Valves at discharge of pumps, outlet of chillers and inlet of cooling towers or any other valve in the system shall be motor operated type for remote operation of the Air conditioning system.

18. Air Conditioning system for service 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 of service building:

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

Refer Amendment attached at end of Sub-Section C2A

A. COP of the water cooled chiller:

Sl. No.	Chiller Capacity	Min COP
01.	Upto 150 TR	4.7
02.	≥ 150 TR < 300 TR	5.4
03.	≥300 TR	5.75

B. COP for air-cooled chillers:

Sl.No.	Chiller capacity	Min COP
01.	Upto 150 TR	2.9
02.	≥150 TR	3.05

18.2. Pumping System : Pumping System: Chilled water pumping system should be of variable flow type i.e. pumps should be VVVFD driven. Condenser water pumping shall be constant flow type.

18.3. Variable air flow : AHUs should be of variable flow type i.e VVVFD driven.

18.4. Refrigerant : Refrigerant should be CFC/HCFC free.

18.5 Insulation for supply and return air ducts: Supply and return ducts shall be insulated.

Refer Amendment attached at end of Sub-Section C2A

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

19.0 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.

For Point 20.0 Refer Amendment attached at end of Sub-Section C2A

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 Room] 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.

c) Service Building:

i) Screw type water chilling units: 2X100%

ii) Primary Chilled water pumps: 2X100%

iii) Secondary chilled water pumps (with VVVFD): 2X100%

iv) Condenser water pumps: 2X100%

v) Cooling Towers (with VVVFD Fan): 2X100%

vi) AHUs (with VVVFD Fan): All working & no standby.

Refer Amendment attached at end of Sub-Section C2A

d) 100% standby shall be provided for control rooms/RIO room/etc. served by ductable split/package and non-ductable split (cassette / Hi-wall) type air conditioners. No stand-by shall be provided for office areas of buildings served by split/packaged air conditioners.

Refer Amendment attached at end of Sub-Section C2A

e) Fresh air fans (no stand-by) shall be for each AHU room.

f) 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.

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		Water-cooled type. (Chillers for main plant shall 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.

CLAUSE NO.	TECHNICAL REQUIREMENTS

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 for AHU**

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.

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.
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 BALANCE EQUIPMENT SPECIFICATION

5.01.00 **Centrifugal Pumps**

a)	Type	:	Horizontal Centrifugal, Axially split type casing pump
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.

5.02.00 **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)	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).
c)	Drain piping	:	Same as (a) above & galvanized as per IS:4736.
d)	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

5.03.00 **VALVES**

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

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

CLAUSE NO.	TECHNICAL REQUIREMENTS
5.03.03	Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.
5.03.04	All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.
5.03.05	Valves shall be furnished with back seating arrangement for repacking while working under full working pressure.
5.03.06	Manual gear operators be provided for valves of size 200 NB and above.
5.03.07	All valves shall be supplied with companion flanges, nut, bolts & washers, etc.
5.03.08	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.
5.03.09	**Balancing / Controller Valves:** The valves of sizes 32 mm to 65 mm dia shall be of gun metal / cast iron construction with screwed ends. Whereas valves of sizes 75 mm and above shall be of cast iron construction with internal parts of SS 410 and EPDM / nitrile seat with flanged ends.
5.04.00	**AIR FILTERS**
5.04.01	**Pre Filter** 1) Type : Flange / Cassette 2) 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
5.04.02	**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.
5.04.03	**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 asbestos/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.

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

6.07.03 The diffusers/grills shall be of extruded Aluminum of minimum 2 mm thick with powder coating. The color of power coating shall be as per the interior Décor.

6.07.04 Supply air grills shall be of double deflection type and return air grills shall be of single deflection type.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 Service Building for optimum use of VFD driven AHUs.
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.

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.
		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	Pipe		

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
		Foam	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

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
		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 50^{o}C 0.043 at 50^{o}C	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 50^{o}C	144
Closed Cell Elastomeric Nitrile Rubber		0.036 at 20^{o}C	40 – 60
Polyurethane Foam Polyisocyanurate Foam	IS12436	0.03 at 50 ^{o}C 0.03 at 50 ^{o}C	34 $\pm$ 2 34 $\pm$ 2
Note : Insulation used for HVAC application shall be CFC/HCFC free			

CLAUSE NO.	TECHNICAL REQUIREMENTS

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 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 **FRESH AIR FANS (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.

7.00.00 PLANT CONTROL

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)" and "ESP control rooms, FGD control room & AHP 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.

Refer Amendment attached at end of Sub-Section C2A

7.02.03 Bidder shall provide Microprocessor/PLC based Control System along with Human Machine Interface System with two nos. Operator work station and one (1) no A-4 size color laser printer located at service building control room. For Service 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 and day light sensor shall be provided. CO2 sensor shall be provided in each AHU room to regulate the fresh air fan damper.

Refer Amendment attached at end of Sub-Section C2A

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 (provided by contractor) for "Main plant area", "ESP control rooms, FGD control room & AHP control room". Further these microprocessor based control panels of Chiller units shall be suitably interfaced with DDCMIS based Control panels.

Refer Amendment attached at end of Sub-Section C2A

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 fresh air fan & 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. 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 circuit and as well as with AHU motors. c) The standby condenser water pumps, fresh air fan & 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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 AC 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 and CERs, ESP control room, FGD control room 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	**PAINTING:**
8.01.00	All the Equipments shall be protected against external corrosion by providing suitable painting.
8.02.00	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.
8.03.00	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.
8.04.00	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.
8.05.00	For centrifugal fans - Casing shall have hot dip/ spray galvanization (**minimum** 60 micron DFT).

Refer Amendment attached at end of Sub-Section C2A

CLAUSE NO.	TECHNICAL REQUIREMENTS
9.00.00	**CODES & STANDARDS**
9.01.00	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.
9.02.00	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.

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

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.

Annexure –I

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 or radially 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	Graphited 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	Graphited 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	————	Compressed asbestos Fibre.

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.	

SUB–SECTION – A-10

PLANT UTILITIES

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
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), packaged/split air conditioners, fresh air fans, air distribution system (ducting, filters, valves, isolation/volume control dampers, motorized fire dampers, diffusers, grills, VAV box as applicable, etc.) along with all electrical equipment and instrumentation as required for all the buildings which are in the scope of the bidder, 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 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 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.

d) Packaged/Split air-conditioners for various auxiliary control rooms/RIO rooms and office areas of other buildings covered under Bidder’s scope and as detailed out in Part-B of Technical Specification

e) 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.

f) Supply of mandatory spares as specified.

g) 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.

h) 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 acceptable to the Employer. 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.

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

155	SECTION VI, PART-B	SUB-SECTION-A10 AIR CONDITIONING SYSTEM	3 OF 37	2.00.00 16	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 non-ductable Split (Hi-wall/Cassette) air conditioner units as per requirement.	Kindly provide the selection criteria if AC load exceed 60 TR.	For areas, where A/C load is more than 60 TR, water cooled chillers shall be provided.

AMENDMENT NO. 04 TO BIDDING DOCUMENTS (TECHNICAL SPECIFICATION)

<table>
<tr><td>55.</td><td>VI/B</td><td>A10</td><td>3 of 37</td><td>2.00.00</td><td>18.1. As per ECBC codes minimum coefficient of performance (COP) for the chiller shall be as follows (based on AHRI conditions):
……
……</td><td>DELETED</td></tr>
<tr><td>56.</td><td>VI/B</td><td>A10</td><td>4 of 37</td><td>2.00.00</td><td>18.5 Insulation for supply and return air ducts: Supply and return ducts shall be insulated.</td><td>18.5 Insulation for A/C ducts: A/C ducts shall be insulated.</td></tr>
<tr><td>57.</td><td>VI/B</td><td>A10</td><td>4 of 37</td><td>2.00.00</td><td>NIL</td><td>Following clause has been added:

20. All water cooled & air cooled chiller shall be designed with minimum COP as mentioned below:
(a) Water cooled rotary screw chillers (based on AHRI conditions):

<table><tr><th>Sl. No.</th><th>Chiller Capacity</th><th>Min COP</th></tr><tr><td>01.</td><td>Upto 150 TR</td><td>4.7</td></tr><tr><td>02.</td><td>≥ 150 TR < 300 TR</td><td>5.4</td></tr><tr><td>03.</td><td>≥300 TR</td><td>5.75</td></tr></table>(b) Air-cooled chillers (based on AHRI conditions):

<table><tr><th>Sl.No.</th><th>Chiller Capacity</th><th>Min COP</th></tr><tr><td>01.</td><td>Upto 150 TR</td><td>2.9</td></tr><tr><td>02.</td><td>≥150 TR</td><td>3.05</td></tr></table></td></tr>
</table>

AMENDMENT NO. 04 TO BIDDING DOCUMENTS (TECHNICAL SPECIFICATION)

58.	VI/B	A10	5 of 37	3.00.00	e) Fresh air fans (no stand-by) shall be for each AHU room.	e) Fresh air fans (no stand-by) shall be for each AHU room. **However, AHUs of Service Building shall be provided with modulating fresh air dampers (with filters) to regulate fresh air based on feedback from CO2 Sensors.**
59.	VI/B	A10	24 of 37	7.02.02	The basic function of the system…… ……and humidity of "CR, CER, SWAS control room, UPS and Battery Charger room, static excitation room (as applicable)" **and "ESP control rooms, FGD control room & AHP 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.	The basic function of the system…… ……and humidity of "CR, CER, SWAS control room, UPS and Battery Charger room, static excitation room (as applicable)" 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.

AMENDMENT NO. 04 TO BIDDING DOCUMENTS (TECHNICAL SPECIFICATION)

60.	VI/B	A10	24 of 37	7.02.03	**Bidder shall provide Microprocessor/PLC based Control System along with Human Machine Interface System with two nos. Operator work station and one (1) no A-4 size color laser printer located at service building control room.** For Service 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 and day light sensor shall be provided. CO2 sensor shall be provided in each AHU room to regulate the fresh air fan damper.**	For Service 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.**
61.	VI/B	A10	24 of 37	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 (provided by contractor) for "Main plant area", **"ESP control rooms, FGD control room & AHP control room"**. Further these microprocessor based control panels of Chiller units shall be suitably interfaced with DDCMIS based Control panels.	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 (provided by contractor) for "Main plant area", "**Service Building**". Further these microprocessor based control panels of Chiller units shall be suitably interfaced with DDCMIS based Control panels.

AMENDMENT NO. 04 TO BIDDING DOCUMENTS (TECHNICAL SPECIFICATION)

62.	VI/B	A10	27 of 37	7.07.00	e) Relative humidity and temperature measurement of all control rooms and CERs, **ESP control room, FGD control room** 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.	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.

AMENDMENT NO. 04 TO BIDDING DOCUMENTS (TECHNICAL SPECIFICATION)

68.	VI/B	A10	5 of 37	3.01.00, d)	100% standby shall be provided for control rooms/RIO room/etc. served by ductable split/package and non-ductable split (cassette / Hi-wall) type air conditioners. No standby shall be provided for office areas of buildings served by split/packaged air conditioners.	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 buildings served by split/packaged air conditioners.

SECTION: I

SUB-SECTION: C 2B

CUSTOMER SPECIFICATIONS
PROJECT SPECIFIC GENERAL REQUIREMENTS

PART – C

GENERAL TECHNICAL REQUIREMENT (GTR)

PART - C

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GENERAL TECHNICAL REQUIREMENTS

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 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 along with 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 contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is 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 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 Organisation 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 else where 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, equipment, and structural works 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.
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 specification .These guarantees shall supplement the general functional guarantee provisions covered under 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 Availability 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 turbine and equipments, inspection of the

steam path and the minor and major overhauls shall be specified in terms of running hours, clearly defining the spare parts and manhour 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 a contract inclusive of the scope as indicated elsewhere in the specification. 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, 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 Specification and Technical data sheet.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Annexure-I 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 thvarious 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 including various piping 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. Operation Philosophy and the control philosophy of the equipments / system covered under the scope.

viii. General Layout plan of the power station incorporating all facilities in Contractor'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.

ix. Basic layouts and cross sections of the TG building (various floor elevations), and other areas included in the scope of thebidder.

x. 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.

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

iii. Flow diagrams, Process & Instrumentation Diagrams alongwith write-up and system description.

iv. Start-up curves for turbine, 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 NTPC specifications as a base for placement of orders on their sub-vendors.

viii. Detailed design calculations for components, system/sub-system, piping etc., wherever applicable including sizing calculations for all auxiliaries like BFPs, CEPs, Heaters/ Deaerators, Condensers, vacuum pumps etc.

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

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

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

xii. 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.

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

xiv. Protection system diagrams and relay settings.

xv. Interconnection diagrams.

xvi. Cable routing plan.

xvii. 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.

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

xix. Sequence and protection interlock schemes.

xx. Type test reports and power system stability study report.

xxi. Control system configuration diagrams.

xxii. Detailed DDCMIS system manuals

xxiii. Detailed flow chart for digital control system.

xxiv. Mimic diagram layout, Assignment for other application engg.

xxv. Civil & Structural works drawings and documents for all structures, facilities, foundations, underground and overground works and super-structural works as included in the scope of the Bidder.

xxvi. Model study reports wherever applicable.

xxvii. Functional & guarantee test procedures and test reports.

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

xxix. Documentation in respect of commissioning as listed out elsewhere in this specification.

The Contractor 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 finalization and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-I. 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 atleast three (3) months prior to the commencement of erection activities of 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 tool, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection .

h) General safety procedures to followed during erection/installation.

i) Procedure for initial checking after erection.

j) Procedure for testing and acceptance norms.

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

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

m) 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. (The is 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 take 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**

(a.) 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

1. Design and performance data.

2. Process & Instrumentation diagrams.

3. Single line diagrams.

4. Sequence & Protection Interlock Schemes.

5. Alarm and trip values.

6. Performance Curves.

7. General layout plan and layout of main plant building and auxiliary buildings

8. 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.

(b.) **Project Completion Report**

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

8.03.04 **DRAWINGS**

(a.) 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-I of Part-C. The soft copies shall be uploaded by the vendors in c-folder, a web based system of NTPC ERP, for which a username and password will be alloted 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 attachements / reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

(b.) Final copies of the approved drawings alongwith requisite number of hard copies shall be submitted as per Annexure-I of Part-C.

(c.) Contractor shall prepare the model of all the facilities located in TG building (including all facilities), and any other facility located in TG building area in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams

etc. attached to the respective equipment / systems in the aforesaid 3D model.

All piping layouts, equipment layouts, floor plans, ducting layout (A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout 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 and when required by employer.. After the completion of engineering of facilities covered under this package, the corresponding complete 3D review model shall be handed over to the employer for its reference.

(d.) All documents/text information shall be in latest version of MS Office/ MS Excel/ PDF Format as applicable.

(e.) 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.

(f.) Each drawing submitted by the Contractor (including those of subvendors) 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.

(g.) 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 so as 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.

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

(j.) 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.

(k.) 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.

(l.) 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.

(m.) 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 / finalized 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.

(n.) 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.

(o.) 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 number of coppies as per **Annexure-I**.

(p.) 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.

(q.) 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.

(r.) 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 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, Centralised 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.

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 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 recommissioning,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 Engineering Co-ordination Procedure

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
8.04.01	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 :
8.04.02	All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.
8.04.03	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 subvendor along with his purchase order for subvendor'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 adequate prints of 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 three (3) 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.

8.05.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.05.01 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.

8.05.02 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.

8.06.00 **TECHNICAL CO-ORDINATION MEETING**

8.06.01 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.

8.06.02 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule.The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Employer shall then 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.

8.06.03 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.

8.06.04 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.

8.06.05 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.

8.07.00 **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.

8.07.01 **Testing of major design features:**

The major design features of the system shall be conducted 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) N/A.

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) Unified HMI for DDCMIS as indicated in IIC-01, Scope of supply & services chapter of Part-A, Section-VI.

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 w.r.t. 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) report.

8.07.02 **Demonstration of Application Engineering**

A) The 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) N/A.

B) 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 in a format to be provided by the Employer 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.

C) 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.

8.08.00 **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 which 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.

8.09.00 **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.

8.10.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

8.10.01 All the first fill and one year's topping requirements of consumables such asgreases, oil, lubricants, servo fluids / control fluids, gases (excluding H2, CO2 and N2 for Generator) and essential chemicals 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 also include supply of H2 , CO 2 and N2 as applicable for the Generator till successful commisioning of the Generator.

Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

8.10.02	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.
8.11.00	**Lubrication**
8.11.01	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.
8.12.00	**Material of Construction**
8.12.01	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.
8.13.00	**RATING PLATES, NAME PLATES & LABELS**
8.13.01	Each main and auxiliary item of plant including instruments 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.
8.13.02	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.
8.13.03	Such nameplates or labels shall be of white nonhygroscopic 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. The name plates shall be suitably fixed on both front and rear sides.
8.13.04	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.
8.13.05	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. Suitable scale shall also be provided to indicate load on support/hanger.
8.13.06	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.
8.13.07	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/cm² (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.
8.13.08	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.
8.13.09	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
8.14.00	**TOOLS AND TACKLES** The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required 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.

8.15.00 **WELDING**

8.15.01 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.

8.16.00 **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**

8.16.01 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.

8.17.00 **PROTECTION AND PRESERVATIVE SHOP COATING**

8.18.00 **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 nonmetallic protection device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground 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.

8.19.00 **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 requirement 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.
8.19.01	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.
8.19.02	All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Employer.
8.19.03	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.
8.19.04	Painting for Civil structures shall be done as specified under technical requirements on civil works in relevant part of this specifications.
9.00.00	**QUALITY ASSURANCE PROGRAMME**
9.01.00	The Contractor shall adopt suitable quality assurance programme 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. 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.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 and Data 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 controls including process, fabrication and assembly.

(h.) Control of non-conforming items and system for corrective actions and resolution of deviations.

(i.) Inspection and test procedure both for manufacture and field activities.

(j.) Control of calibration and testing of measuring testing equipment.

(k.) System for Quality Audits.

(l.) System for identification 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.) 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.

9.02.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

9.02.01 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 which shall be finalised giving due consideration to the manufacturer's standard and proven practices being followed. 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. Monthly progress reports on MQP/FQP submission/approval shall be furnished on enclosed format No. QS-01-QAI-P-02/F1.
9.02.02	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 in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
9.02.03	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.
9.02.04	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.
9.02.05	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
9.02.06	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.
9.02.07	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-QAI-P-02/F2. 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.
9.02.08	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 authorised representative for approval prior to carrying out the welding/brazing.
9.02.09	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/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.
9.02.10	Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
9.02.11	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, for other piping system ASME B31.1 or other relevant code as applicable shall be followed. 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.
9.02.12	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
9.02.13	No welding shall be carried out on cast iron components for repair.
9.02.14	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
9.02.15	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) / EN /

	Equivalent. 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. All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.
9.02.16	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-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, 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. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished on enclosed on format no. QS-01-QAI-P-02/F1. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.
9.02.17	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. With in three 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.
9.02.18	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.

9.02.19	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor'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.
9.02.20	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.
9.02.21	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
9.02.22	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
9.02.23	Environmental Stress Screening All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub - contractor should meet the following. 1) The Contractor / Sub - contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub - contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization. OR In case the Contractor / Sub - contractor do not have any established procedure to eliminate infant mortile components then two or 10% which ever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

2) Burn in Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.

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.

9.03.00 **QA DOCUMENTATION PACKAGE**

The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark.

9.03.01 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 CD-Rom may be issued not later than three weeks.

9.03.02 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

9.03.03 NOT USED.

9.03.04 NOT USED.

9.03.05 Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

9.03.06 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 3 weeks after the despatch of equipment.

9.03.07 **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/part derivatives of equipment, the complete quality document of that particular equipment to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.

9.04.00 **Project Manager's Supervision**

9.04.01 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 of Vol.I, the Contractor shall proceed to comply with the Project Manager's decision.

9.04.02 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.

9.05.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

9.05.01 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.
9.05.02	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.
9.05.03	The Contractor shall give the Project Manager/Inspector ten (10) working 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 ten (10) working 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.
9.05.04	The Project Manager or Inspector shall within ten (10) working 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.
9.05.05	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect ten (10) working days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within ten (10) working days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. 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.
9.05.06	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.
9.05.07	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.
9.05.08	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- 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.
9.05.09	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.
9.06.00	**ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME:**
9.06.01	List of items requiring Quality Plan & Sub-supplier approval. Format No. QS-01-QAI-P-01/F3-R0
9.06.02	Status of Quality Plan and Sub-supplier approval Format No. QS-01-QAI-P-02/F1-R0
9.06.03	Field Welding Schedule Format No.: QS-01-QAI-P-02/F2-R0
9.06.04	Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R0
9.06.05	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R0 The above formats are enclosed as Annexure-III to VII
10.00.00	**PRE-COMMISSIONING AND COMMISSIONING FACILITIES**
	(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 the 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.

(g.) 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.

10.02.00 **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.

In the event of test interruptions as a result of Force Majeure or Employer-Caused-Delay during Initial Operation test, where.

(i) The total cumulative interrupted time during the test is more than twenty-four (24) hours.

(ii) The total number of interruptions during the test is more than four (4).

The test shall not be deemed a successful Initial Operation Test.

The interrupted test resulting from Force Majeure or Employer-Caused-Delay shall be extended by an amount of time equal to the cumulative length of the interruptions, including time to return to steady-state operation; the test data for the period of interruptions shall be excluded from analysis; and the test data that were collected both before and after the interruptions shall be included in the analysis.

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.

(g) **Grid Restriction**

Any loss in generation in terms of power (KW) or energy (KWH) during Initial operation Test due to grid restrictions shall be treated as deemed generation. however, the total cumulative deemed generation shall not exceed 5% of the total generation during the test period failing which the test shall be extended to limit the deemed generation to 5% of the total generation.

11.00.00 **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 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, 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 specification.

12.00.00 **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 with held 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.

13.00.00 **TRAINING OF EMPLOYER'S PERSONNEL**

13.01.00 The scope of service under training of Employer's engineers shall include a training module in 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 TG and related equipments.

(b.) TG related C&I system like turbine supervisory system (TSS) etc.

(c.) DDCMIS as detailed in Part-B

(d.) Training for Electric Power Supply systems

(e.) Training for power cycle piping / critical piping

13.02.00 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 etcand shall include all the related areas like Design familiarization, training on product design features and product design softwares 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.

13.03.00 Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.

13.04.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.

13.05.00 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.

13.06.00

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 class room training.
4. A) Location of class room training for engineering shall be at Design/Engineering office.

   B) Class room training for erection/O&M shall be at location of Manufacturers' works.

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
Station C&I (Control and Instrumentation)	3.5	5.5	10
Total			

14.00.00 **SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION**

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

(a.) Working platforms should be fenced and shall have means of access.

(b.) 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.

15.00.00 **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) metre 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

(a.) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA.

(b.) Regulating drain valves in which case it shall be limited to 90 dBA-115dBA.

(c.) TG unit in which case it shall not exceed 90 dBA.

(d.) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 90 dBA.

(e) For BFP motor, the noise level shall be within the limit of 90 dBA

16.00.00 **PACKAGING AND TRANSPORTATION**

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 due to improper packing. 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.

17.00.00 **ELECTRICAL ENCLOSURE**

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 specification,

18.00.00 **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.

18.01.00 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:

a) Temperature - Degree centigrade (deg C)

b) Pressure - Kilograms per square centimetre (Kg/cm2). 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.

c) Draught - Millimetres of water column (mm wc).

d) Vacuum - Millimeters of mercury column (mm Hg) or water column (mm Wcl).

e) Flow (Gas) - Tonnes/ hour

f) Flow (Steam) - Tonnes/ hour

g) Flow (Liquid) - Tonnes / hour

h) Flow base - 760 mm Hg. 15 deg.C

i) Density - Grams per cubic centimetre.

18.02.00 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 plug-in connection at rear.

18.03.00	**NOT USED**.
19.00.00	**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.
20.00.00	**INSTRUMENT AIR SYSTEM** The instrument air supply system as supplied by the Contractor for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. shall be as per the details furnished elsewhere. 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.
21.00.00	**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 Contractor. The standard which is to be adopted, will be intimated to the Contractor. (a.) Temperature test pockets with stub and thermowell (b.) Pressure test pockets
22.00.00	**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.
22.01.00	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.
23.00.00	**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.

ANNEXURE-I

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
1.	PLANT DEFINITION MANUAL-	2 sets	4 CD-ROMs
2.	Drawings "FOR APPROVAL"		
	i) Layout drawings / P&IDs	6	2 CD - ROMs
	ii) Other drawings	2	2 CD - ROMs
3.	Drawings "FOR INFORMATION"	2	2 CD - ROMs
4.	Drawings "FINAL DRAWING"	15	4 CD-ROMs
5.	Drawings "AS BUILT "	15	4 CD-ROMs
6	DATASHEETS, DESIGN CALCULATIONS, PURCHASE SPECIFICATIONS, etc. and Other type of documents		
	i) For Approval	2	2 CD - ROMs
	ii) FINAL	15	4 CD-ROMs -
	iii) Analysis reports of equip-ments/ piping/ structures components/ systems employing software packages as detailed in the specifications	2	2 CD - ROMs
7.	Erection manual "1st Submission"	4 Sets	2 CD - ROMs
8	Erection manual "FINAL"	4 Sets	4 CD ROMs
9	Operation & Maintenance manual "1st submission"	4	2 CD - ROMs

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
10	Operation & Maintenance manual "FINAL"	4 Sets	4 CD-ROMs
11	Plant Hand Book "1st Submission"	4 Sets	2 CD ROMs
12	Plant Hand Book "FINAL"	4 Sets	4 CD ROMs
13	Commissioning and Performance Procedure manual "1st Submission"	4 Sets	2 CD-ROMs
14	Commissioning and Performance Procedure manual "FINAL"	4 Sets	4 CD ROMs
15	Performance and Functional GURANTEES TEST REPORT	4 Sets	4 CD ROMs
16	Project completion report	15	4 CD ROMs
17	QA programme including Organi-sation for implement-ation and QA systemmanual (with revision-servicing)	1	1 CD ROM
18	Vendor details in respect of pro-posed vendors including contractor's evaluation report.	1	1 CD ROM
19	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, PQR etc.		
	(i) For review/comment	2	2 CD-ROMs
	(ii) For final approval	2	2 CD ROMs

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
20	Welding Manual, HeatTreatment Manuals, Storage & preservation manuals		
	1st Submission	4 Sets	2 CD ROMs sets
	Final	4 sets	4 CD ROMs
21	QA Documentation Packagefor items / equipmentmanufactured and and despatched to site	2 sets	4 CD ROMs
22	QA Documentation Package for field activities on equipment / systems at site	2 sets	4 CD ROMS

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS

ANNEXURE-II

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 Associa-tion 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	Methods of testing for rating of forced circulation air cooling and air heating coils.
ASHRAE-52-76	Air cleaning device used in general ventilation for removing particle matter.
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	Central station AHU/Application of Central Station AHU
BS:848 (Part-1,2)	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 Guide lines 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/	National Building Code- Structural design of prefabrication and Sec.7) 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 hand book 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 polyster 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 Hand book 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	Hand book 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 AlliedWorks

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	Hand book 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

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.No.	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 :

1. **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".

2. **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.

FORMAT NO. : QS-01-QAI-P-1/F3-R0 1 / 1 Engg.Div./QA&I

ANNEXURE - IV

Project : Stage : Package : Contractor : Contractor No. :	STATUS OF ITEM REQUIRING QP & SUB-SUPPLIER APPROVAL	DOC. NO. : REV. NO. : DATE : PAGE : OF	

S.No.	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 NO. : QS-01-QAI-P-02/F1-R0 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	RFF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	

NOTES:

SIGNATURE

FORMAT NO.: QS-01-QAI-P-02/F2-R0	1/1	Engg. Div./QA&I

MFGR.s LOGO	Manufacturer's Name & Address	MANUFACTURING QUALITY PLAN ITEM SUB-SYSTEM	QP NO. : REV.NO. : DATE : PAGE : OF	PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER :

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	** 10.			11

MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER
SIGNATURE	

LEGEND : * RECORDS, IDENTIFIED WITH "TICK" ( ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION
** **M** : MANUFACTURER / SUB-SUPPLIER
C : MAIN SUPPLIER, **N** : NTPC
P : PERFORM **W** : WITNESS AND **V** : VERIFICATION, AS APPROPRIATE
CHP : NTPC SHALL IDENTIFIED IN COLUM "N" AS 'W'

FOR NTPC USE

DOC. NO. : REV.....CAT.....

REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT - QS-01-QAI-P-09/F1-R1 1/1 ENGINEERING DIV. / QA&I

	Supplier's Name & Address	FIELD QUALITY PLAN		PROJECT :
		ITEM	QP NO. :	PACKAGE :
			REV.NO. :	CONTRACT NO. :
		SUB-SYSTEM	DATE :	MAIN-SUPPLIER :
			PAGE : OF	

SL. NO.	ACTIVITY AND OPERATION	CHARACTERISTICS/INSTRUMENTS	CLASS# OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	REMARKS
1	2	3	4	5	6	7	8	9		10.

MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER	LEGEND : * RECORDS, IDENTIFIED WITH "TICK" ( ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION LEGEND TO BE USED : CLASS # : A - CRITICAL, B = MAJOR, C = MINOR; "A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY ERECTION SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)	FOR NTPC USE	DOC. NO. : REV.....CAT.....		
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT - QS-01-QAI-P-09/F2-R0 1/1 ENGINEERING DIV. / QA&I

FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

KHURJA SUPER THERMAL POWER PROJECT (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES BID DOC. NO.: THDC/RKSH/CC-9915-371	SEPARATOR

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 "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 mm Hg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser 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 furnished by the Bidder in his offer, shall be without any tolerance values 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 functional 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 calibration shall be included in the bid price.

Refer Amendment attached at end of Sub-Section C2B

(e) It is the responsibility of the contractor to perform the Performance Guarantee/Acceptance test as specified in this subsection. The performance tests will be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall only be used for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents if any as per scope from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

Refer Amendment attached at end of Sub-Section C2B

f) The Contractor shall make their system ready for the performance guarantee tests before start of initial operation.

g) The instruments to be used for process control shall also be used for PG test. Minimum number of instruments to be used for PG test has been identified in respective P&IDs with accuracy class meeting the code requirement. All instruments required for performance testing shall be of the type and accuracy required by the ASME PTC code. Prior to the start of the initial operation, the contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation, Personal computer(s), necessary server and required interface, software for on line computation of test results & report as required for PG tests shall be supplied by the contractor and shall be retained by the Employer. Separate system shall be supplied for each unit. All calibration procedures and standards shall be subjected to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

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 agreed procedure. The PG test procedure including demonstration tests shall be submitted 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. After the conductance of Performance test, the preliminary test results shall be calculated automatically by the server/software provided by the contractor. The correction curves approved by the employer shall be fed/inbuilt in the PG test program/software. Preliminary test reports shall be submitted to the Employer instantly after completing each test run. The contractor shall also submit the detailed test evaluation report of Performance test results to Employer promptly but not later than one months from the date of conductance of Performance test.

The PG test procedures shall be submitted for equipment/ system & subsystem under Contractor's scope for all Guarantees under category I, II & III as per latest International codes / standard meeting the specification requirements. The procedure shall also include correction curves, detailed activity plan of conductance of test and sample calculations.

j) The contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following:

a) Object of the test.

b) Various guaranteed parameters & tests as per contract.

c) Method of conductance of test and test code.

d) Duration of test, frequency of readings & number of test runs.

e) Method of calculation.

f) Correction curves and respective equations for graphs to be fed for the online computation

g) Instrument list consisting of range, accuracy, least count, and location of instruments along with reference approved P&IDs.

h) Scheme showing measurement points.

i) Sample calculation.

j) Acceptance criteria.

k) 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 but are achieved within the Acceptable Shortfall Limit specified at clause 1.01.02 of this subsection, Employer will accept the equipment/system/plant after levying liquidated damages as per clause 1.01.02 of this sub-section. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

(i) For Category-I Guarantees

Reject the equipment / system / plant and recover from the Contractor the payments already made

OR

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 of this sub-section shall be levied separately for

each unit. The liquidated damages shall be prorated for the fractional parts of deficiencies .The performance guarantees coming under this category are called 'Category-I' Guarantees.

(ii) For Category-II Guarantees

Reject the equipment / system/ plant 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

Reject the equipment /system / plant and recover from the Contractor the payments already made.

OR

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 guaranteed performance. These parameters/capacities shall be termed as Category-III Guarantees.

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

GUARANTEES UNDER CATEGORY - III

1.03.00 **The parameters/capabilities to be demonstrated for various systems/ equipments shall include but not be limited to the following:**

1.03.01 **Noise**

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in General Technical Requirement, Part-C Section-VI of the technical specifications.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 61672-1 and IEC-61672-2 (latest edition)

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

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 chillers for A/C system of Main Plant Area & A/C system of Service Building.

2) Guaranteed room conditions during summer for all the Air conditioned areas.

3) Parallel operation of chilled water and condenser water pumps.

3) Vibration and noise level of chillers / condensing units, centrifugal fans of AHUs and all pumps.

PART-B

QUALITY ASSURANCE

SUB–SECTION – E-10

AC & ~~VENTILATION~~ SYSTEM

CLAUSE NO.

QUALITY ASSURANCE

AIR CONDITIONING ~~AND VENTILATION~~ SYSTEM

		QA MODULE FOR AIR CONDITIONING ~~AND 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
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 :
1.01.05.01		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.
1.01.05.02		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		**FANS**
2.01.00		20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.
2.02.00		DPT of fan shafts shall be carried out after machining.
2.03.00		UT of fan shafts (diameter equal to or above 50mm) shall be carried out.
2.04.00		Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3
2.05.00		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.
2.06.00		One fan of each type and size will be performance tested as per corresponding BIS /AMCA for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.

CLAUSE NO.		QUALITY ASSURANCE
3.00.00		**AIR HANDLING UNIT**
3.01.00		For Fans refer tests as mentioned at 2.00.00
3.02.00		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.
3.03.00		All cooling coil shall be pneumatically tested and no leakage shall be permitted.
4.00.00		**CENTRIFUGAL PUMP**
4.01.00		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.
4.02.00		All rotating components of the pumps shall be dynamically balanced to ISO-1940 Gr. 6.3
4.03.00		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.
4.04.00		Standard Running Test
4.05.01		All pumps shall be tested in the manufacturer's works preferably with contract motor 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 only.
4.05.02		Noise and vibration shall be measured at shop for reference purpose only.
4.05.03		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.
4.05.04		NPSH test shall be conducted with water as the medium, if required as per approved data sheets.
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**

CLAUSE NO.		QUALITY ASSURANCE
6.01.00		Insulation material shall be tested for all mandatory tests only as per relevant code/standard.
6.02.00		Thermal conductivity tests (for thermal insulation only) shall be done once in 12 months for insulation material manufactured during 12 months period for the same density and thickness of material as applicable as per IS:3346 or equivalent standard.
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.
7.00.00		**COOLING TOWER**
7.01.00		UT of fan shaft and drive shaft (dia equal to or above 50mm) 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**
8.01.00		Pre/Fine filters shall be tested for initial and final pressure drop Vs flow 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.
10.02.00		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.
10.03.00		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.
10.05.00		Functional check of the valves for smooth opening and closing shall be done.
10.06.00		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 AC/ PAC/PEC**
11.01.00		Split/Cassette/ Window AC will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate.
11.02.00		PAC/PEC: Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard.
11.03.00		Performance test of PAC/PEC shall be carried out as per relevant standard on one unit of each type and rating at site.

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

1.01.03 **Auxiliary Power Consumption**

The unit auxiliary power consumption shall be calculated using the following relationship.

Pa = Pu + TL

Pa = Guaranteed Auxiliary Power Consumption.

Pu = Power consumed by the auxiliaries of the unit under test.

TL = Losses of the transformers supplied by bidder based on works test reports.

While guaranteeing the auxiliary power consumption the bidder shall necessarily include all continuously operating unit auxiliaries. The auxiliaries to be considered shall include but not be limited to the following :

UNIT AUXILIARIES (to be considered for calculating Pu)

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

(q) Power consumption of any other continuously operating auxiliaries for unit operation at different guarantee point loads.

(r) Air Conditioning 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 TG Building, Service Building .

Note :

1. The bidder shall furnish a list of equipments to be covered under auxilliary power consumption, which shall be subject to Employer's approval.

Refer Amendment attached at end of Sub-Section C2B

3. 50% of the total auxiliary power consumption of air-conditioning system as specified at Sl. No. (r) above shall be considered for Unit#1 & balance 50% for Unit#2.

4. Duty factor for A/C equipments of service building shall be 0.5.

SUB–SECTION – A-1

PROVENNESS

v) **Air Conditioning System**

The Bidder/ its sub-vendor 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 should have been in successful operation for at least one (1) year.

In addition, 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) number of similar type of chiller unit having a capacity of not less than 150 TR, which should have been in successful operation for at least one (1) year.

FORMAT FOR FILLING THE DETAILS OF PROVENNESS

Sub : Sub-Qualifying Requirements for the Air Conditioning System

(A) In line with the Sub-Qualifying Requirements stipulated in Clause No. 5.0 (v) of Sub-Section-A-1, Part-A of Section-VI, we/our sub-vendor hereby confirm that we/our sub-vendor have designed, supplied, erected and commissioned atleast One (1) number of Air Conditioning system having a total installed capacity of 300TR or more, which included atleast one chilling unit with a minimum capacity of 60 TR. The system have been in successful operation for atleast One (1) year. The details are give below:

S. No.	Item Description	Installation-1
1.	Name of the Client with full address, contact person(s), fax and tele no.	
2.	Name and address of the Plant	
3.	Purchase Order no. and date	
4.	Copy of purchase order enclosed	Yes/No
5.	Date of Commissioning	
6.	No. of years of successful operation prior to date of techno-commercial bid opening	
7.	Whether clients certificate is enclosed to prove that "the Air Conditioning system is in successful operation for atleast one (1) year.	Yes/No
8.	Total installed capacity of air conditioning system (should be atleast 300 TR)	..... TR
9.	Capacity of largest chilling unit in above air conditioning system (should be atleast 60 TR)	..... TR
10.	Type of installation	Industrial/ Commercial Installation
11.	The scope of Contract included	

FORMAT FOR FILLING THE DETAILS OF PROVENNESS

S. No.	Item Description	Station-I
(a)	Design	Yes/No
(b)	Supply	Yes/No
(c)	Erection	Yes/No
(d)	Commissioning	Yes/No
12.	Documentary evidence in support ofSl.No. 8 to 11 enclosed	Yes/No

(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 vapour 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 :	
1.	Name of the Client with address, name of contact person(s), tel. no. & fax no.	
2.	Purchase Order no. and date	
3.	Date of Commissioning	
4.	No. of years of successful operation	
5.	Capacity of chiller unit	..... TR
6.	Clients certificate to demonstrate successful operation of machine	Yes/No

FORMAT FOR FILLING THE DETAILS OF PROVENNESS

for atleast one (1) year.

S. No.	Item Description	Station-I
7.	Documentary evidence in support of Sl. No. 2 to 6 above enclosed	Yes/No

Date :

Place :

(Signature).....

(Printed Name).....

(Designation).....

(Common Seal).....

AMENDMENT NO. 04 TO BIDDING DOCUMENTS (TECHNICAL SPECIFICATION)

38.	VI/A	Functional Gurantee & Liquidated damage	2 of 20	1.00.01 (g)	The instruments to be used for process control shall also be used for PG test. Minimum number of instruments to be used for PG test has been identified in respective P&IDs with accuracy class meeting the code requirement. All instruments required for performance testing shall be of the type and accuracy required by the ASME PTC code. Prior to the start of the initial operation, the contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation, Personal computer(s), necessary server and required interface, software for on line computation of test results & report as required for PG tests shall be supplied by the contractor and shall be retained by the Employer.	~~The instruments to be used for process control shall also be used for PG test.~~ Minimum number of instruments to be used for PG test has been identified in respective P&IDs with accuracy class meeting the code requirement. All instruments required for performance testing shall be of the type and accuracy required by the ASME PTC code. Prior to the start of the initial operation, the contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation, Personal computer(s), necessary server and required interface, software for on line computation of test results & report as required for PG tests shall be supplied by the contractor and shall be retained by the Employer. Separate system shall be supplied for each unit. All calibration procedures and standards shall be subjected to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.
40.	VI/A	IV ,Functional Guarantee	1.00.01 /(d)	1 of 20	All costs associated with the tests including cost associated with the calibration shall be included in the bid price.	All costs associated with the tests including cost associated with the **supply,** calibration, shall be included in the bid price.

AMENDMENT NO. 04 TO BIDDING DOCUMENTS (TECHNICAL SPECIFICATION)

67.	VI/A	-	10 of 20	1.01.03	**Auxiliary Power Consumption:** **Notes:** 4. Duty factor for A/C equipments of service building shall be 0.5.	**Auxiliary Power Consumption:** **Notes:** 4. Duty factor for A/C equipments of service building shall be 0.5. **Duty factor for A/C equipments of TG building shall be 1.0** 5. Power consumption at rated duty point sl. no- (p) and (r) to be arrived at based on shop test. However, power consumption of water cooled chillers shall be based on site test.

SECTION: I

SUB-SECTION: C 2C

CUSTOMER SPECIFICATIONS
PAINTING SPECIFICATIONS

SUB–SECTION – A-7

SURFACE PREPARATION & PAINTING

KHURJA SUPER THERMAL POWER PROJECT (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES BID DOC. NO.: THDC/RKSH/CC-9915-371	SEPARATOR

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 labeled 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.
1.05.0	**SURFACE PREPARATION**
1.05.01	All surfaces to be painted shall be thoroughly cleaned of oil, grease and other foreign matter. Surfaces shall be free of moisture and contamination from chemicals and solvents.
1.05.02	The following surface 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 Phospating 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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 - Aluminium 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 based Zinc phosphate 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 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	PS 9*	1	20	-	-	-	PS9*	1	20	40	
2.	All un -insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	Design temperature < or equal to 60^{0}C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 $	35 $	155 $	
		Design temperature above 60 ^{0}C-200^{0}C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200^{0}C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH), Variable Load Hanger (VLH).		SP4*	PS19	1	40	-	-	-	PS17	1	30	70	
4.	Piping hangers/ supports (other than (3) above. (un-insulated)		SP3/SP5	PS 5	2	25	-	-	-	PS4	2	25	100	
5.	Valves													

	Cast/Forged	Design temperature < or equal to 60 degC #	SP3/SP5	PS 5	2	35	-	-	-	PS4	2	25	120	
		Design temperature above 60 degC	SP3/SP5	PS 9*	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 Deg.C, 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 for all inner parts of the hangers shall be atleast 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) LOW PRESSURE PIPING

		Surface Preparation	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)	Min. Total DFT (Microns)	
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 Colour 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.											

SECTION: I

SUB-SECTION: C 3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

47537/2020/PS-PEM-MAX

TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM (ELECTRICAL PORTION)

47537/2020/PS-PEM-MAX

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 (Annexure –I)
b) Customer specification for motors

47537/2020/PS-PEM-MAX

c) Customer cabling spec 9to be referred by vendor for their scope of work (as per electrical scope between BHEL & vendor)
d) Quality plan for motors
e) Datasheet (Annexure-I)
f) Datasheets -C
g) Electrical Load data format (Annexure –II)
h) BHEL cable listing format (Annexure –III)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: AIR CONDITIONING SYSTEM
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: KHURJA STPP (2X660 MW) TG & ASSOCIATED PKG

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC (3 Phase, 4 Wire) /240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. 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, fibre optical 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 equipments 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	

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: AIR CONDITIONING SYSTEM
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: KHURJA STPP (2X660 MW) TG & ASSOCIATED PKG

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
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 but not specified above (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.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: AIR CONDITIONING SYSTEM
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: KHURJA STPP (2X660 MW) TG & ASSOCIATED PKG

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.
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.

SUB–SECTION – B-2

MOTORS

MOTORS

1.00.00 GENERAL REQUIREMENTS

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.02.00 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.

1.03.00 Contractor shall provide fully compatible electrical system, equipment, accessories and services.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for contractors equipment and systems shall be under the contractor scope.

1.07.00 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i)	Indoor motors	-	IP 54
ii)	Outdoor motors	-	IP 55
iii)	Cable box-indoor area	-	IP 54
iv)	Cable box-Outdoor area	-	IP 55

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS/IEC:60034
2)	Single phase AC motors	:	IS/IEC:60034
3)	Crane duty motors	:	IS:3177, IS/IEC:60034
4)	DC motors/generators	:	IS/IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC: 60034-30

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 % Tolerance on efficiency value applicable as per IEC 60034. c) Crane duty motors shall be squirrel cage Induction motor as per the requirement. d) 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. e) Motors operating through variable frequency drives shall also meet the requirements mentioned in subsection for VFD.
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. 41 deg.C over inlet cooling water maximum temperature of 39 deg.C for thermal class 90 (Y) wet wound Boiler circulation pump motor.
6.00.00	**OPERATIONAL REQUIREMENTS**

CLAUSE NO.	TECHNICAL 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 full load torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
6.03.00	**Starting voltage requirement** (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 Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.
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 (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (c) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be Global Vacuum Pressure Impregnated i.e. resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15. However winding insulation for wet wound Boiler circulation pump motor shall be thermal class 90 (Y) or better. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) 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 85dB (A) except for BFP motor for which the maximum limit shall be 90 dB(A). Vibration shall be limited within the limits prescribed in IS/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 80mmX80mm 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 dial type thermometer and 2 numbers duplex platinum resistance type temperature detectors.

CLAUSE NO.	TECHNICAL REQUIREMENTS
7.08.00	Motor body shall have two earthing points on 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 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided 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 & center 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, 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	The size and number of cables (for HT and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor. (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
9.00.00	CW motor shall be designed with minimum power factor of 0.8 at design duty point.
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type

tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.

10.01.02 The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

10.01.03 In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.

10.01.04 Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED "and carried out within last ten years from the date of bid opening. These reports should be for the test 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. However if 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 the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.

10.01.05 **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.

10.01.06 **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 interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

10.02.00 **LT Motors**

10.02.01 LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for employer'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 test 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.

10.02.02 However if 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 the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.

10.02.03 **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. Over speed 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.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	**Minimum distance between centre of bottom terminal 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	385/203 (For Single core cables only)

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

SUB–SECTION – B-5

CABLING EARTHING LIGHTNING AND PROTECTION

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**CODES AND STANDARDS**
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable .

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IEC:62305	Code of Practice for the protection of building and allied structures against lightning.
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables.
BS:476	Fire tests on building materials and structures

	IEEE:80	IEEE guide for safety in AC substation grounding
	IEEE:142	Grounding of Industrial & commercial power systems
	DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
	DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
	BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
		Indian Electricity Act.
		Indian Electricity Rules.

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

2.00.00 DESIGN AND CONSTRUCTIONAL FEATURE

2.01.00 **Inter Plant Cabling**

2.01.01 Interplant cabling for main routes shall be laid along overhead trestles/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly buried cables, if essential, shall not have concentration of more than 4 cables in one route. All HT, LT and Control cables shall be armored.

2.01.02 **Transformer yard**

In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing.

2.01.03 **Trenches**

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

2.01.04 No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.

2.01.05 **Cable Vault**

The cable vault/ / cable spreader room space below the HT / LT switchgear room, Control Rooms, unit control equipment room, Programmer room, UPS, Charger & Battery Rooms, Boiler MCC room shall have **800 mm wide** and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables

Cable vaults shall be provided with adequate drainage facilities for drainage of fire water.

	Each cable vault should have at least two doors. Exit signs shall be provided near doors for personnel escape in case of emergency
2.01.06	**Boiler Area** Two separate cable routes one on each side shall be provided for each boiler unit. Cables for on set of auxiliaries such as ID, FD, PA fan & half of the coal mills shall be routed in one route & for other set of auxiliaries through other route. Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor. Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.
2.01.07	**Turbine Hall Area** a)Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.
2.01.08	**OffSite Area** In offsite pumphouses, overhead cable tray arrangement shall be followed. However cable trenches may be considered below switchgear/mcc. Trestle In fuel oil pump house, overhead cable tray arrangement shall be provided. RCC trenches provided in MCC room shall be separated from fuel oil area to avoid oil accumulation.
2.01.09	The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.
2.01.10	Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.
2.01.11	Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to: • Meet all safety requirements • Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc
3.00.00	**EQUIPMENT DESCRIPTION**
3.01.00	**Cable trays, Fittings & Accessories**
3.01.01	Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.
3.01.02	Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter.

3.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.
3.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanised as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.
3.01.05	The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1). Tolerance Class: - Coarse
3.02.00	**Support System for Cable Trays**
3.02.01	Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.
3.02.02	Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised. c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation. e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below: The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079. f. Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position. g. Support system shall be able to withstand

- weight of the cable trays
- weight of the cables (75 Kg/Metre run of each cable tray)
- Concentrated load of 75 Kg between every support span.
- Factor of safety of minimum 1.5 shall be considered.

3.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.

3.02.04 Four legged structure shall be provided wherever there is change in elevation and change in direction

3.03.04 FOR COAL, LIMESTONE AND GYPSUM HANDLING PLANT THE FOLLOWING SHALL ALSO BE APPLICABLE:

a) All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route.

b) Cable trenches shall be provided only in Switchgear/MCC rooms.

c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.

d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.

3.04.00 **Pipes, Fittings & Accessories**

3.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

3.03.02 GI Pipes shall be of medium duty as per IS: 1239

3.03.03 Duct banks shall be PVC conduits encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes and with proper sealing arrangement consisting of fire retardant sealing compound.

3.03.04 Hume pipes shall be NP3 type as per IS 458.

3.03.05 TERNE Coated Flexible Steel Conduits shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete

	with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures.
3.03.06	HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 Part-I.
3.04.00	**Junction Boxes**
3.04.01	Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:- (a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102 (b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb. (c) Class of protection shall be IP 55. (d) HV test.
3.04.02	Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.
3.05.00	**Terminations & Straight Through Joints**
3.05.01	Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter)..
3.05.02	Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall

	have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design
3.05.03	1.1 KV grade Straight Through Joint shall be of proven design.
3.06.00	**Cable glands**
3.06.01	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.
3.07.00	**Cable lugs/ferrules**
3.07.01	Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards.
3.08.00	**Trefoil clamps**
3.08.01	Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.
3.09.00	**Cable Clamps & Ties**
3.09.01	The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.
3.10.00	**Receptacles**
3.10.01	Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with RCCB/RCD of 30mA sensitivity having facility for manual testing/checking of operation of RCCB/RCD

3.12.00	**Cable Drum Lifting Jack** The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.
3.13.00	**Galvanising**
3.13.01	Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.
3.13.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified
3.14.00	**Welding**
3.14.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595
4.00.00	**INSTALLATION**
4.01.00	**Cable tray and Support System Installation**
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.

4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.
4.02.00	**Conduits/Pipes/Ducts Installation**
4.02.01	The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.
4.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.
4.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material
4.02.04	Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	**Spacing**
Upto 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm and above	3.0 M

4.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.
4.03.00	**Junction Boxes Installation**
4.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.
4.04.00	**Cable Installation**
4.04.01	Cable installation shall be carried out as per IS:1255 and other applicable standards.
4.04.02	For Cable unloading, pulling etc following guidelines shall be followed in general:

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

	cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture. b) While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.
4.04.03	Cables shall be laid on cable trays strictly in line with cable schedule . Where specific cable layouts are not shown on drawings, Contractor shall route these as directed by the Project Manager
4.04.04	Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every-one metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend. Fibre Optical cable shall be laid in trenches/trays or as decided by Employer.
4.04.05	Bending radii for cables shall be as per manufacturer's recommendations and IS:1255.
4.04.06	Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.
4.04.07	No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.
4.04.08	In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
4.04.09	Wherever few cables are branching out from main trunk route troughs shall be used.
4.04.10	Wind loading shall be considered for designing support as well Cable trays wherever required.
4.04.11	Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.
4.04.12	The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every

day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

4.04.13 **Separation**

At least 300mm clearance shall be provided between:

- HT power & LT power cables,
- LT power & LT control/instrumentation cables,

4.04.14 **Segregation**

1) Segregation means physical isolation to prevent fire jumping.

2) All cables associated with the unit shall be segregated from cables of other units.

3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

4) In switchyard, control cables of each bay shall be laid on separate racks/trays.

4.04.15 Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

No. of cores in cable	No. of spare cores
2C,3C	NIL
5C	1
7C-10C	2
14C and above	3

4.04.16 **Directly Buried Cables**

a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details.

b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

4.04.17	Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables.
4.04.18	While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.
4.05.00	**Cable Terminations & Connections**
4.05.01	The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.
4.05.02	Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.
4.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.
4.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
4.05.05	All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
5.00.00	**EARTHING SYSTEM**
5.01.00	Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts. Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All off-site areas shall be interconnected together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for

Employer's approval. Contractor shall obtain all necessary statutory approvals for the system.

5.02.00 The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects

5.03.00 The material of the earthing conductors shall be as follows :

1)	Conductors above ground level and in built up trenches.	-	Galvanized steel
2)	Conductors buried in earth	-	Mild steel
3)	Earth electrodes	-	Mild steel rod

5.04.00 The sizes of earthing conductors for various electrical equipments shall be as below:

	Equipment	Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches
a)	Main earth grid	MS rod -Min 40 mm dia. or as per actual calculation whichever is more	65 x 8mm GS flat
b)	33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	---	65 x 8mm GS flat
c)	415 V MCC/ Distribution boards / Transformers	---	50 x 6mm GS flat
d)	LT Motors above 125 KW	---	50 x 6mm GS flat
	25 KW to 125 KW	---	25 x 6mm GS flat
	1KW to 25 KW	---	25 x 3mm GS flat
	Fractional House power motor	---	8 SWG GS wire
e)	Control panel & control desk	---	25 x 3 mm GS flat
f)	Push button station / Junction Box	---	8 SWG GI wire
g)	Columns, structures, cable trays and bus ducts enclosures	---	50 x 6mm GS flat
h)	Crane, rails, rail tracks & other non-current carrying metal parts		25 x 6mm GS flat

5.05.00 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby

	earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.
5.06.00	Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground
5.07.00	Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors.
5.08.00	Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.
5.09.00	Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.
5.10.00	Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.
5.11.00	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.
5.12.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.
5.13.00	Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.
5.14.00	Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
5.15.00	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.
5.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.
5.17.00	Earth pit shall be of treated type & shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal as per IS:3043. Test links shall be

	provided with bolted arrangement alongwith each earth pit, in order to facilitate measurement of earth resistance as & when required.
5.18.00	On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.
5.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.
5.20.00	Other Requirements of Earthing System:

Standard/Code	IEEE 80, IS 3043
Earthing System	
Life expectancy	40 Years
System Fault Level	As per system requirement (B0)
Soil resistivity	Actual as per site conditions.
Min. Steel corrosion	0.12mm/year
Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.
Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.

Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.

Surface resistivity	- Gravel	3000 ohm-meter
	- Concrete	500 ohm-meter

6.00.00	**LIGHTNING PROTECTION SYSTEM**
6.01.01	Lightning protection system shall be in strict accordance with IEC:62305 .
6.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system
6.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.
6.02.00	**Down Conductors**

1. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.

2. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.

3. All joints in the down conductors shall be welded type.

4. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.

5. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm.

6. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.

7. Lightning conductors shall not pass through or run inside GI Conduits.

8. Testing link shall be made of galvanized steel of size 25x 6mm.

9. Pulser system for lightning shall not be accepted.

10. Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.

7.00.00 TESTS

7.01.01 All equipment to be supplied shall be of type tested design. During detail engineering, 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 test 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.

7.01.02 However if 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 the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

7.01.03 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.

7.01.04 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.

7.02.00 **Type Test reports shall be furnished for the following**

7.02.01 Type tests on Cable Trays support system

a) **Test 1A:**

On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 meter length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals:

i) Working load

ii) Working load + point load

iii) Off load

iv) Proof load + point load

v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

B) **Test 1B:**

Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2

Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides

a) Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.

i) Working load

ii) Working load + Point load

iii) Off load

iv) Proof load + Point load

v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

b) Test 2 B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

Test 3 : Tests on Channel Fixed on Beam/Floor

A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below

a) Test 3A : A length of steel structure shall be rigidly supported. It should be fitted on a meter length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.

b) Test 3B: With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.

c) Test 3C: With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line.

The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.

Test 4 : Channel Insert Test

A 2.5 m length of C1 channel fixed to the concrete wall/ steel structure as per actual site installation conditions. 6 nos. of 750 mm cantilever arms shall be attached to C1 channel as shown in enclosed drawing. Each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.

i) Working Load

ii) Working Load + Point Load

iii) Off Load

iv) Proof Load + Point Load

v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

Test 5 : Channel nut slip characteristics (what ever applicable)

Tests 5A1,5A2,5A3 : A length of channel C1 section 200mm long shall have fitted bracket with the two bolt fixing as shown in drawing enclosed.
With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting.

A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

Tests 5B1,5B2,5B3: The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting.

A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM.

Test 6 Weld Integrity Test

After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.

7.02.02 Cable termination kit and straight through joints should have been tested as per IS:13573 for 3.3kV grade & above.

7.03.00 **Routine/ Acceptance Tests**

7.03.01 **Routine Tests**

a) Routine tests as per specification and applicable standards shall be carried out on all requirements/items covered in the specification.

b) Physical & dimensional check on all equipments as per approved drawings/standards

.

c) HV/IR as applicable.

d) Check/measurement of thickness of paint/zinc coating/nickel-chrome plating as per specification & applicable standard.

7.03.02 **Acceptance Test**

a) Galvanising Tests as per applicable standards

b) Welding checks

c) Deflection tests on cable trays:

d) One piece each of 2.5m length of cable tray of 300mm & above shall be taken as sample from each offered lot. It shall be supported at both end & loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm.

d) Proof load tests on cable tray support system

i) Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test.

ii) Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done.

iii) Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test.
The procedure for carrying out tests at "d" above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity.

d) The above acceptance tests shall be done only on one sample from each offered lot.

8.00.00	**COMMISSIONING**
8.01.01	The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers or else required for satisfactory performance..
8.01.02	**Cables** a) Check for physical damage b) Check for insulation resistance before and after termination/jointing. c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning. d) Check of continuity of all cores of the cables. e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor. f) Check for correct polarity and phasing of cable connections. g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc. h) Check for provision of correct cable tags, core ferrules, tightness of connections.
8.02.00	**Cable trays / supports and accessories** 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories. 2) Check for continuity of cable trays over the entire route. 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports. 4) Check for earth continuity and earth connection of cable trays.
8.03.00	**Earthing and Lightning protection system** 1) Earth continuity checks. 2) Earth resistance of the complete system as well as sub-system.
8.04.00	Below Ground Earth Mat: The earthing system for plant shall be designed as per Clause No:- 3.07.00 of Sub Section B-0 of Technical Specification Section-VI, Part-B Grounding for TG and other areas or buildings covered in the specification shall be provided in accordance with IS 3043, IEC 62305, IEEE 80. Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All areas under contractor scope of supply shall be interconnected

together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system. All the columns shall be earthed by nearby risers and earthmat grid spacing shall be maximum 10 X 10 mts.. Minimum two nos of risers shall be provided for each equipment in his scope of area. Separate dedicated riser shall be provided for C&I earthing purpose and also for Lightning down conductor connection purpose. Sufficient nos of risers near the equipment shall be provided as per the system requirement.

9.00.00 **ELECTRICAL LAYOUT PHILOSOPHY**:

While developing the layout the bidder must give due consideration to the following requirements:

a) Adequate distance shall be maintained between the transformers. As basic guidelines following norms will be adhered to:

1) Transformers shall be separated from the adjacent building/structures and from each other by a minimum distance as defined below or by a fire wall of two hours of fire resisting of height at least 600 mm above bushing / pressure relief vent whichever is higher.

Oil capacity of individual transformer (in liters)	Clear separating distance (in meters)
5,000 to 10,000	8.0
10,001 to 20,000	10.0
20,001 to 30,000	12.5
Over 30,001	15.0

2) In case of auxiliary transformers having an aggregate oil capacity in excess of 2300 liters but individual oil capacity of less than 5000 liters, the maximum separating distance between transformers and surrounding building shall be at least 6M unless they are separated by fire separating walls or are protected by high velocity spray system.

3.) Rail track shall be provided in Transformer yard for movement of each transformer. The rail track in Transformer yard shall be connected with TG area rail track The Foundation top of transformer & rail top shall be at EL +/- 0.0M. Bus duct support or Transformer body shall be at least 8.0M from A-Row of TG building to clear the movement of GT/ Stator/UT/ST/UAT on rail line. Jacking pads shall be provided where the rail track changes the direction. Mooring post shall be provided on rail track for handling the transformers.

4) For each transformer a pit shall be provided all around at a distance of 1.5 m (minimum) from transformer outer edge. A sump pit shall be provided for each pit. A common oil retention pit per unit shall be provided to hold oil quantity of the largest transformer (by volume) & 10 minutes of water quantity of HVW spray system for the largest transformer. Sump pit of individual transformer shall be connected to common oil retention pit of that unit.

5) Rail track shall be provided for all outdoor transformers up to road for movement of each transformer of size more than or equal to 7.5MVA Transformer. Jacking pads shall be provided where the rail track changes the direction. Jacking pad shall also be provided at the location of installation of transformer and mooring post shall be provided on rail track for handling the transformers.

6.) The Transformer fencing shall be at 1.0 M (minimum) distance from the pit wall. The Height of fencing shall be 2.5 M (minimum) and fencing shall have personal entry gate and removable type fencing/gate for transformer withdrawal.

7) The transformer firewall, pit sizing and clearances from adjacent building/structures etc. shall be as per IS 1646/CBIP manual on Transformer

8) However, for all outdoor transformers of oil capacity less than 2000 litre, a trench of suitable size shall be provided all around at a distance of 1.0 m (minimum) from transformer outer edge. A sump pit shall be provided for each trench.

b) Layout requirements for Electrical MCC/switchgear rooms

1. Separate Switchgear Rooms shall be provided for each unit. For TG building, all HT boards shall be provided in HT switchgear room at only one floor and all LT boards shall be provided in LT switchgear room only.

2. The following clearances shall be maintained for HT Switchboard.

a.) Front Clearance

i) For one Row of Swgr. - 2.0 M (Min)

ii) For two Rows of Swgr. - 2.5 M (Min)

b.) Back Clearance - 1.5 M (Min.)

c.) Side Clearance

Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800+width of panel (including spare panels/dummy panels etc.)

3. The following clearances shall be maintained for LT Switchboard.

a.) Front Clearance

i) For one Row of Swgr - 1.5M (Min)
ii) For two Rows of Swgr - 1.5/1.75M depending upon the depth of panels etc

b.) Back Clearance
i) For single front - 1.0M (Min)
ii) For double front - 1.5M (Min)

c.) Side Clearance

Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800 mm + width of panel.

For offsite areas, HT Switchboard clearances shall be followed wherever both LT & HT switch boards are in the same MCC room.

4. Height of HT/LT Switchgear Room and Boiler MCC room

i) With Bus Duct – 4.5 m (min)
ii) Without Bus Duct – 4.0 m (min)

Further no vertical bracings shall be envisaged in HT/LT switchgear room and associated cable vault area.

5. Cable trench/Cable vault

For LT switchgear/MCC room at EL 0.0M, minimum 1400 wide x 1400 deep cable trench shall be provided to route the cables. Horizontal cable trays shall be routed in cable trenches.

c) Minimum clear working space 1200mm around the equipment

e) In buildings having MCC, minimum 2 fire door along with one rolling shutter of adequate size/capacity shall be provided.

f) The cable entry and exit from switchgear room shall be from 1.5 mtr (minimum) above FGL.

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	PROJECT:		PO NO.:	DATE:
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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	D	M	C	N	
					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

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ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI		
Reviewed by:		PRAVEEN DUTTA	Reviewed by:		RITESH KUMAR JAISWAL		

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		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

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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	-		

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Reviewed by:		PRAVEEN DUTTA	Reviewed by:		R K JAISWAL

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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	-	-	

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Approved by:			

बी एच ई एल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO :	DATE:17.04.2020
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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	-	-	

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	Sign & Date	Name		Sign & Date	Name
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Reviewed by:		PRAVEEN DUTTA	Reviewed by:		R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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Reviewed by:			
Approved by:			

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	-	-	

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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
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					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	-	-	

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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

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		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	-	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
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	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 8 OF 9

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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

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

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto 200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP55
5.0	Cooling	:	Refer Clause 5.0.of Motor customer Specification
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal box	:	50 kA for 1 sec
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Refer clause 7.0 of Motor cust. spec.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	**Refer clause 6.0 of Motor cust. spec.**
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply **(30KW & ABOVE)**	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 KW
13.0	Tests	:	As per QP/ As per clause10 of cust. Motor spec.
14.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
	c) Degree of protection	:	IP65
15.0	Paint shade	:	RAL 5012 (Blue)
16.0	Efficiency class	:	IE3

Also detailed Customer spec. for Motors is to be referred as enclosed with technical spec.

	TITLE	SPECIFICATION NO.
BHEL	LV MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE SHEET 1 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

TITLE	SPECIFICATION NO.
LV MOTOR	VOLUME II B
DATA SHEET - C	SECTION D
	REV NO. 00 DATE
	SHEET 2 OF 2

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

NAME OF VENDOR					
				REV.	
NAME	SIGNATURE	DATE	SEAL		

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.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS 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	20	21
																				ANNEXURE-II

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.	408	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	KHURJA STPP (2X660 MW) TG PKG	NAME		DATA FILLED UP ON	
	SYSTEM	VENTILATION SYSTEM	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT **ANNEXURE III**

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

47541/2020/PS-PEM-MAX

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
|	|	|	|
Cable Voltage Code (see B below)	No. of cores (e.g. 01,03,3H, 07)	Cable code (See C below)	Cable size (e.g. 035,185,2.5, 0.5)

(A) SYSTEM VOLTAGE CODES:
(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:
A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

SECTION: I

SUB-SECTION: C 4

TECHNICAL SPECIFICATION (C&I PORTION)

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

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TECHNICAL SPECIFICATION (CONTROL AND INSTRUMENTATION) FOR AIR CONDITIONING SYSTEM

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**		DESG	KKM
	JOB NO: 475		CHKD	CM
	REV. NO. 00	DATE: 16.07.2020	APPD	CM

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **AIR CONDITIONING SYSTEM**	

INDEX

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1	TITLE SHEET
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5	LIST OF DOCUMENTS/DELIVERABLES
6	MEASURING INSTRUMENTS (PRIMARY & SECONDARY)& VFD
7	INSTRUMENT STUB DETAILS
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10	SIGNAL EXCHANGE BETWEEN DRIVES & DCS
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	THDC INDIA LIMITED 2 X 660MW STPP KHURJA – TG PACKAGE	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

C&I SPECIFIC TECHNICAL REQUIREMENT

	THDC INDIA LIMITED 2 X 660MW STPP KHURJA – TG PACKAGE	
	TECHNICAL SPECIFICATION (C&I) 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 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 for main plant A/C system in addition to Main DDCMIS based Control system of A/C plant (provided by BHEL) for "Main plant area", "Service Building".

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. Electrical Actuators (as applicable) shall be Non-Intrusive type electric actuators envisaged with integral starter. 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. However, the exact protocol shall be based on finalized protocol of DCS. 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 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. 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.

14. 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.

15. 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.

16. Use of process actuated switch shall be avoided unless unavoidable.

17. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply.

18. 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.

19. 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.

20. All instruments (except PROFIBUS PA compatible transmitters) 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.

21. 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.

22. All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.

23. 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.

24. 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.

25. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.

26. Epoxy coated painting is required for all I & C Equipment & Instruments.

27. 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.

28. 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.

29. 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.

30. 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.

31. Local control panel if any required for operation shall be in bidder scope.

32. 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. 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.

33. AHUs of Service Building shall be provided with modulating fresh air dampers (with filters) to regulate fresh air based on feedback from CO2 Sensors.

34. 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.

35. LCP (If applicable) shall have the provision of command (start/stop) & feedback interface with DDCMIS.

36. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback.

37. 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.

38. VFD panels for applicable drives are in Bidders scope. Typical signal exchange with DCS has been indicated in the specification elsewhere.

39. 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.

40. 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.

41. 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.

42. Drive control philosophy/signal exchange list attached elsewhere in the specification are Tentative. Shall be finalized during detailed engineering.

43. 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.

44. 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).

45. 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.

46. Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.

47. 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.

48. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

49. 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.

50. 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.

51. For instruments which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved during detail engineering.

52. 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 .

53. All instruments should be supplied with valid calibration and test certificates provided by OEM.

54. Bidder to provide mandatory spares as per mandatory spares list. Attached elsewhere in the specification.

55. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc

56. All the instruments PG/DPG/DPT/PT etc. (as applicable) having contact with corrosive media shall be provided with chemical/diaphragm seal.

57. JB provided on the valves for manually operated valves Limit switches wherever specified.

58. Separate emergency local stop push button shall be provided for each pump, fans, compressor etc. of Air conditioning system.

59. 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.

60. 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.

61. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.

62. Number of pairs to be selected for Screen/ Control cable
F-Type: 2P/4P/8P/12P(Size : 0.5 mm2)
G-Type: 2P/4P/8P/12P(Size : 0.5 mm2)
Core Cable: 3CX2.5sqmm2/ 5CX2.5sqmm2/ 12CX1.5sqmm

63. Bidder’s presence is required for 2 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.

64. Bidder’s presence is required for 12 Man days (in two visit) at site during commissioning of DDCMIS for assistance related to process correctness. Two visit with total 12 Man days (Excluding travel time) in which one visit shall be of 6 Man days each. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder’s scope.

65. Contractor'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.

66. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.

67. 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.

68. The specifications for instruments mentioned in the specification are minimum requirements.The detail specifications shall be finalized during detail engineering.

69. Bidder to furnish electrical load/UPS load data during detailed engineering.

70. 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.

71. 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.

72. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection, JB grouping, Annunciation list, recommended control logics / write-up, SOE list, List of Instruments/devices in BHEL approved format. Plant schematic for monitoring & operation shall be available on OWS, bidder to further submit list of important signal along with applicable schematic for monitoring in DCS. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.

Note:-

1. All equipment items shall be of latest design with proven on track record.

2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

LIST OF DOCUMENTS/DELIVERABLES

	THDC INDIA LIMITED 2 X 660MW STPP KHURJA – TG PACKAGE	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-475-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-475-145-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-475-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-475-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V0-475-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-475-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-475-145-I907	FIELD JB/LIE/LIR,DRIVES TERMINATIONS	A
8	PE-V0-475-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-475-145-I909	QUALITY PLANS (INSTRUMENTS, VMS, etc.)	A
10	PE-V0-475-145-I910	INSTRUMENT HOOK-UP DRAWING	A
11	PE-V0-475-145-I911	THERMOWELL SIZING CALCULATION	A
13	PE-V0-475-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
14	PE-V0-475-145-I914	ANNUNCIATION & SOE LIST	A

NOTES:
ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCE, MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST, FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc.
SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

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GENERAL TECHNICAL REQUIREMENTS

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES**	SPECIFICATION NO.:
		VOLUME
		SUB SECTION
		REV. NO. / DATE :
		SHEET / OF

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

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SPECIFICATION FOR MEASURING INSTRUMENTS (PRIMARY & SECONDARY)& VFD

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**
1.01.00	Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with 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.
1.03.00	All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.
1.04.00	The necessary root valves, impulse piping, drain cocks, gauge-isolating cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.
1.05.00	All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor).
1.06.00	For coastal areas, all instruments shall be provided with durable epoxy/ polyurethane coating for housings and all exposed surfaces of the instruments.
1.07.00	The instruments which are proposed to be used for PG test as indicated in the tender P&IDs shall meet the minimum requirements specified in ASME PTC or subsequent clauses in this chapter whichever is better.

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.

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.

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).

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.

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

11.01.00	**Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.**

S No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output

	2	Accuracy	± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc. +0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2. ± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc.
	3.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm2.
	4	Turn down	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm2
		(Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).	
	5	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating
	6.	Electrical connection	½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible
	7.	Process connection	½" NPT (F)
	8.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.
		Overpressure	150% of max operating pressure
	9	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications. -The valve manifold shall be non-integral type. -For hazardous area, enclosure as described in NEC article 5.

10.	Mounting	2 inch pipe mounting with Enclosure/Rack/Canopy.
11.	Diagnostics & display	Self-Indicating feature and digital display on transmitter

Notes

- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc.
- LVDT type is not acceptable.
- 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.

11.02.00 Temperature Transmitter

11.02.01 Single Input /Dual Input Temperature transmitter

Temperature transmitter shall be provided which shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C.

Following specifications are applicable for dual input/single input temperature transmitter.

S No.	Features	Essential/Minimum Requirements
1.	Output	FOUNDATION fieldbus /PROFIBUS PA
2.	Input	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types
3.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating
4.	Electrical connection	½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible
5.	Diagnostics & display	Self-Indicating feature and digital display on transmitter
6.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.

7.	Mounting	2 inch pipe mounting with Canopy.
8.	Accessories	As required by service and operating condition.
9.	Composite Accuracy	(Refer note 2)

RTD =<0.25% of 0-250 deg C span

T/C-K type =<0.2% of 0-600 deg C span

CJC accuracy (for thermocouples) shall be =< 1 deg C

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.
2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed.
3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., 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. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.
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.

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	Die-cast aluminium	Die-cast aluminium	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.

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.

VFD

VARIABLE FREQUENCY DRIVES

1.00.00 **GENERAL**

The Design, manufacture, erection, testing and performance of items and services provided under this specification shall comply with the latest edition including all applicable official amendments and revisions as on date of award of the following standards. In case of conflict between this specification and code (IS Code, standards, etc.) referred herein, the former shall prevail. All work shall be carried out as per the following codes and standards.

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	IEC 60034-18-41 &42, IEC60034 / NEMA 30 & 31,
Contactor/Switches/Fuses etc.	IEC:60947, IS: 13947
Harmonics & EM compatibility	IEEE:519/IEC: 61000
VFD	IEC: 60034/ IEC: 61800

Equipment complying with other internationally accepted standards will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision amendments and revision in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

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 auxiliary AC voltage supply arrangement shall have 11/6.6/3.3kV and 415V systems (as applicable). It shall be designed to limit voltage variations as given below under worst operating condition: 1. 11kV/ 3.3 kV/ 6.6 KV : +/- 6% 2. 415V : +/- 10% Note: The Voltage level mentioned above is the Nominal Voltage available at the input of the VFD System from the MCC/ Switchgear/transformer, based on the system requirement/Availability. 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. For drives less than 100 KW Six (6) pulse can be offered meeting all other requirements.
5.03.00	The system shall be fully digital, PLC/Microprocessor based, energy efficient, and shall provide very high reliability, high power factor, low harmonic distortion and low vibration and wear and noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance.
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. All the Motors which are to be driven by VFDs will be of Inverter duty type. 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 shall be minimum 96.5% for LV VFD and minimum 94 % 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	The VFD shall be designed to operate indoor under temperature range of 0 deg C to 50 deg C and relative humidity of 95 %(at 40 deg C).
11.02.00	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).
11.03.00	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.
11.04.00	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 natural 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.
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:	Winding temperature rise shall be as per applicable IEC.

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 fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material. In case dry type transformer is provided inside VFD panels, the enclosure and in its frame thickness shall be same as indicated in this para.
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	**PAINTING**
	Paint shade shall be as follows
	a) VFD transformer reactor enclosure : RAL 5012 (Blue), legend in black letter
	b) Motors : RAL 5012 (Blue)
	c) VFD Panels : Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012)
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.

20.02.00	Motors shall also meet the requirements mentioned in subsection for motors 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 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	**STORAGE AND PRESERVATION**
27.01.00	The Contractor shall be responsible for the storage and preservation of all the equipments to be supplied under the VFD System, till the time of successful installation and commissioning. The equipment should be suitable for storage for long periods before installation. Contractor should take adequate measures to ensure that no damage happens to the VFD System due to storage and preservation.
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**
28.02.01	The Contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.
28.02.02	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days' notice shall be given by the Contractor. The Contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
28.02.03	In case the Contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the

	specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contractor.
28.02.04	Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test 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. However if 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 the case of type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
28.03.00	**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)
28.04.00	**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)** 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 (In case of non integrated type)

i. As per requirements mentioned in subsection for Transformer chapter in technical specifications.

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

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INSTRUMENT STUB DETAILS

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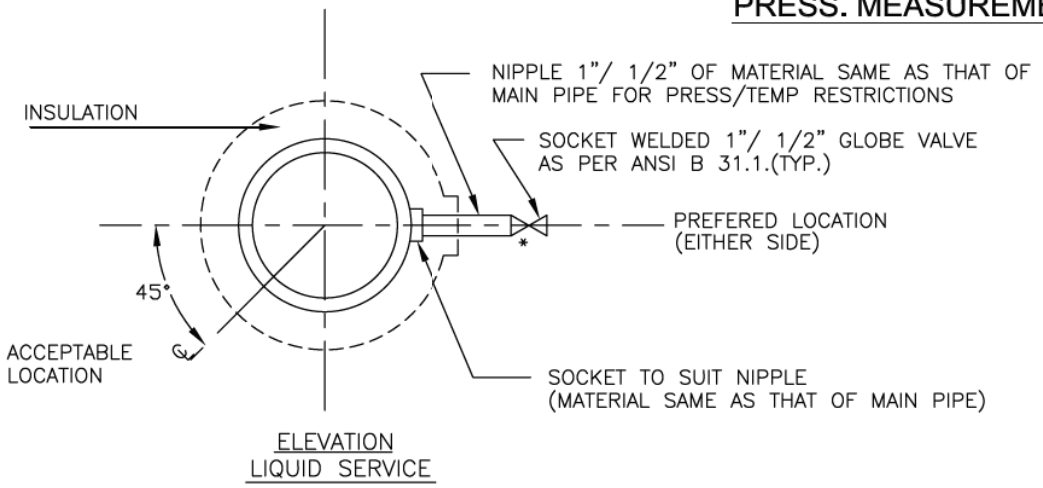
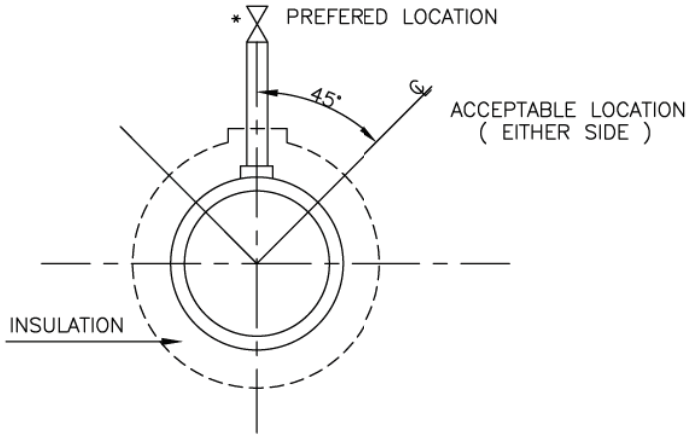
PRESS. MEASUREMENT

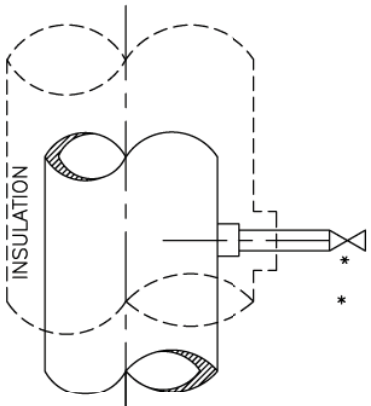


ELEVATION
LIQUID SERVICE



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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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

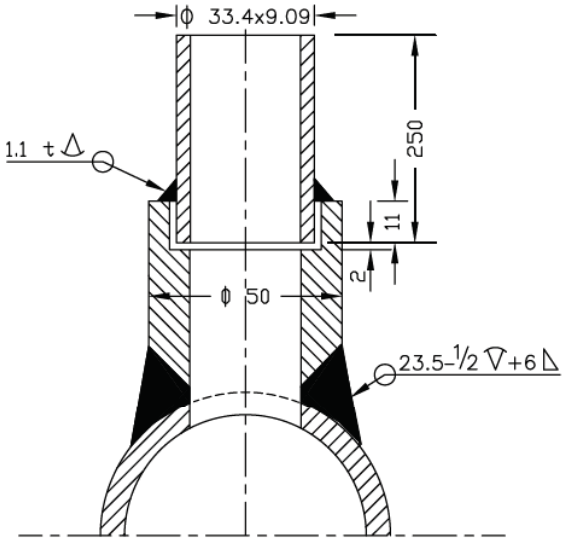
PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

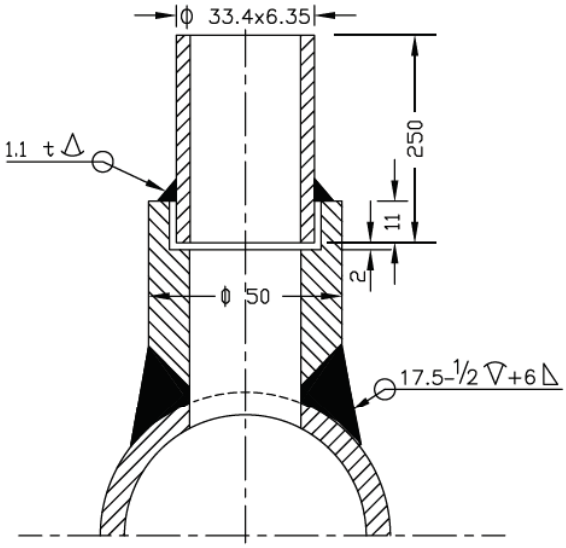
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-1 Of 14	A

PRESSURE MEASUREMENT

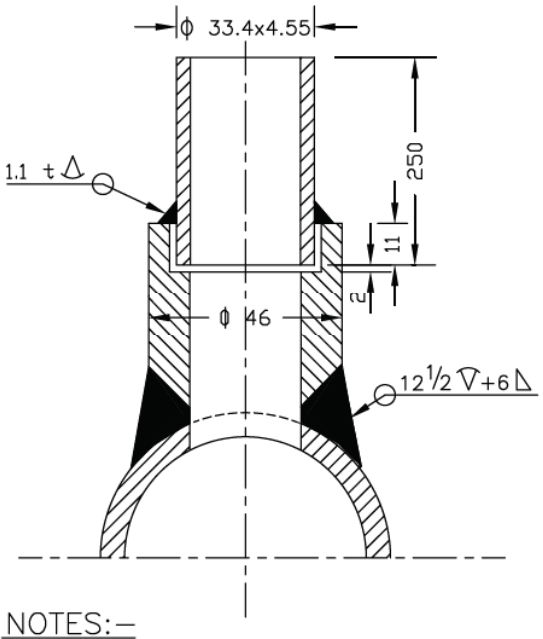
(SYSTEM PR.>40Kg/Sq Cm CL 9000)



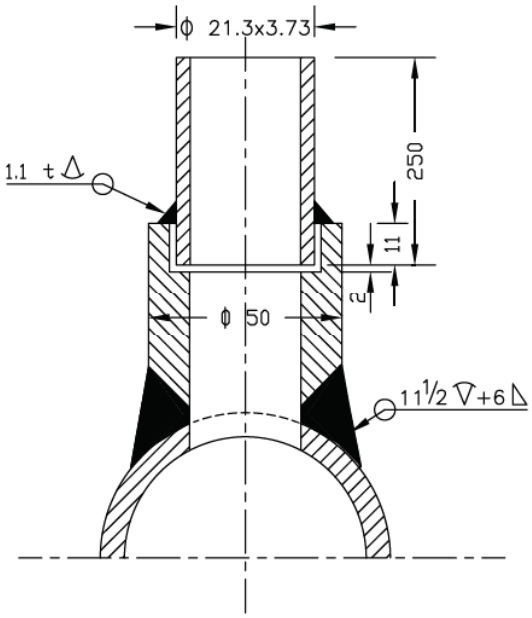
(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(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 CONNECTON 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.

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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-2 Of 14	A

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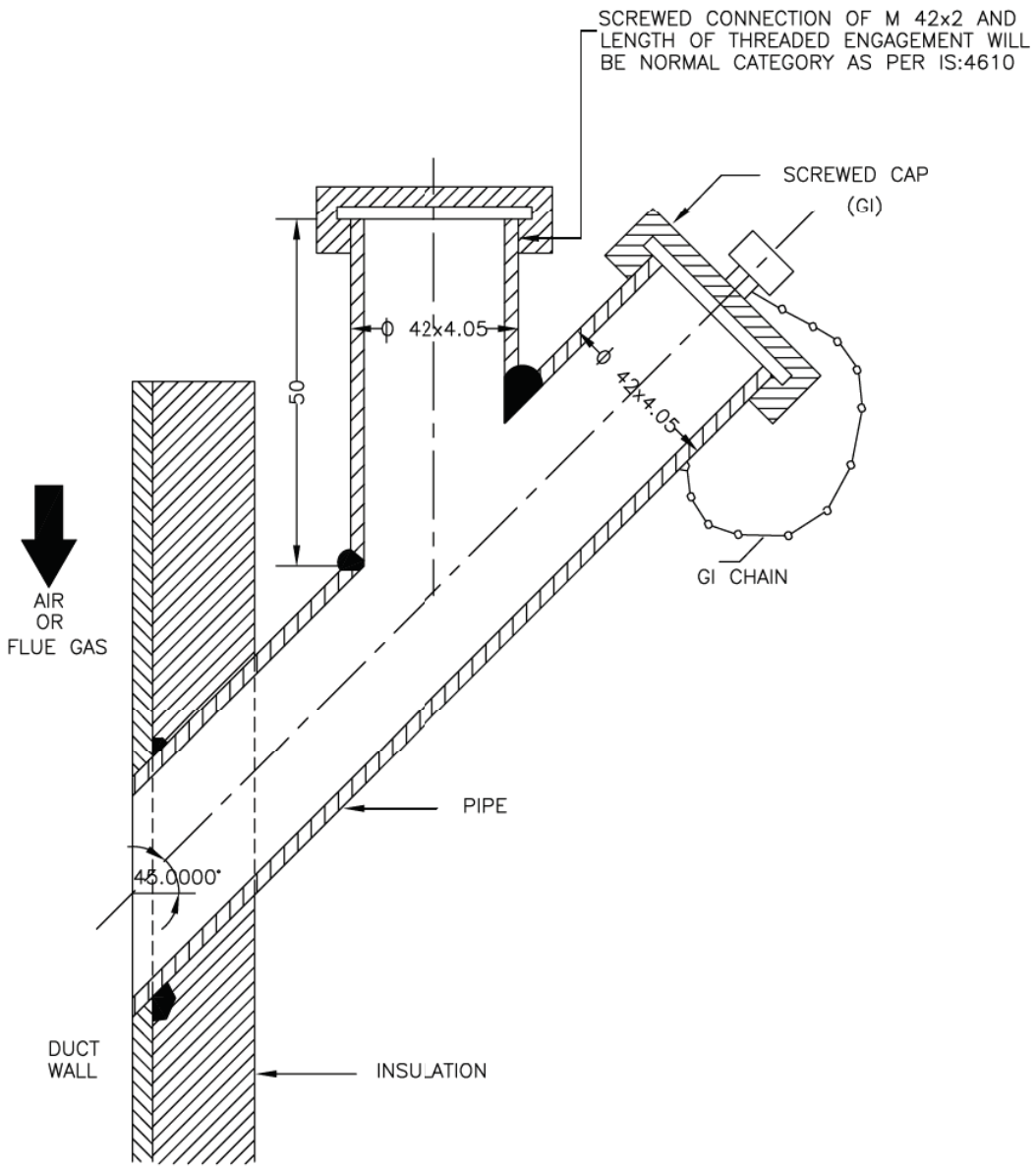
PRESS. MEASUREMENT



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.

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A	FIRST ISSUE							T.G.			21.08.12
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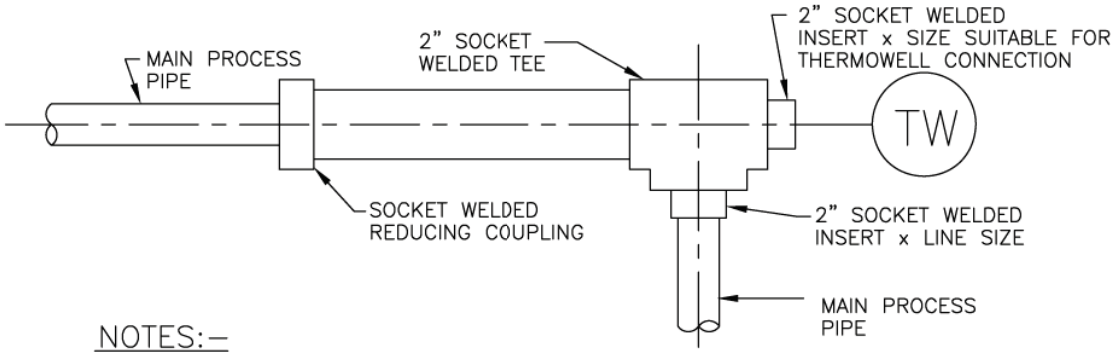
PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

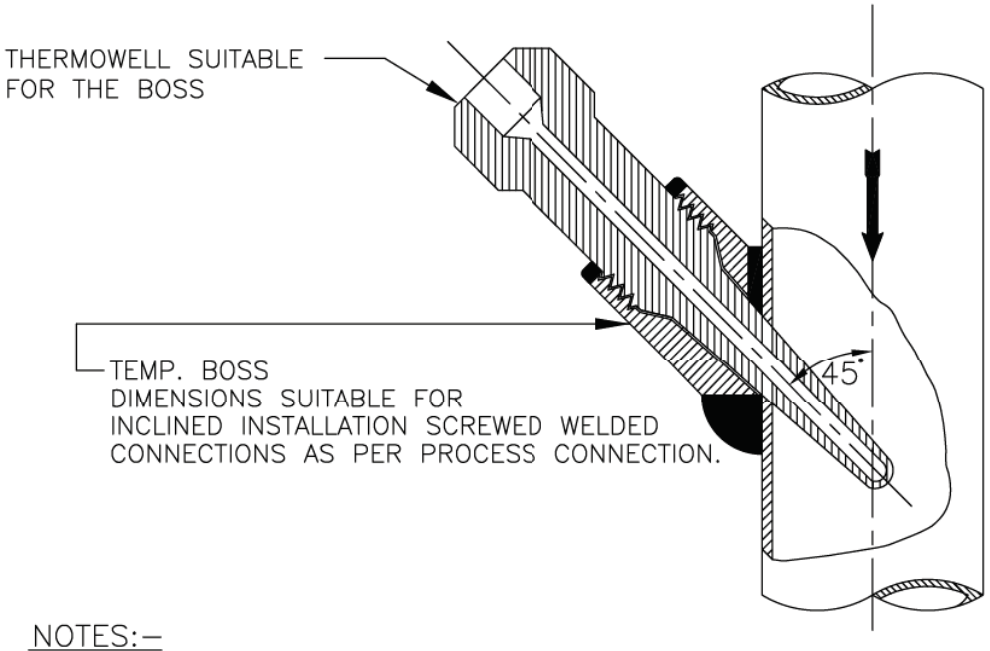
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh–3 Of 14	A

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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A	FIRST ISSUE							T.G.			21.08.12

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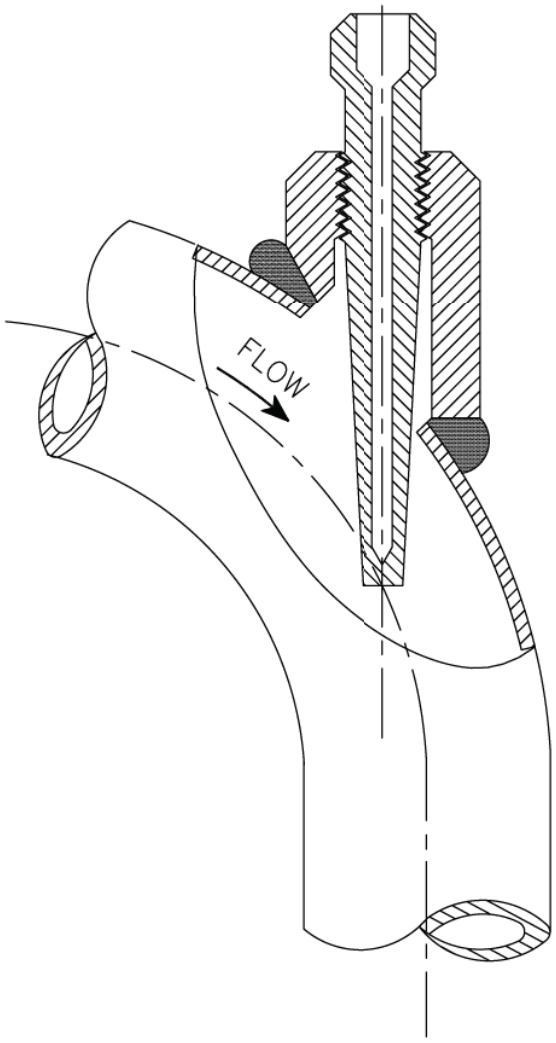
PROJECT: TYPICALTHERMAL POWER PROJECT (SG PACKAGE)

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

TEMP. MEASUREMENT



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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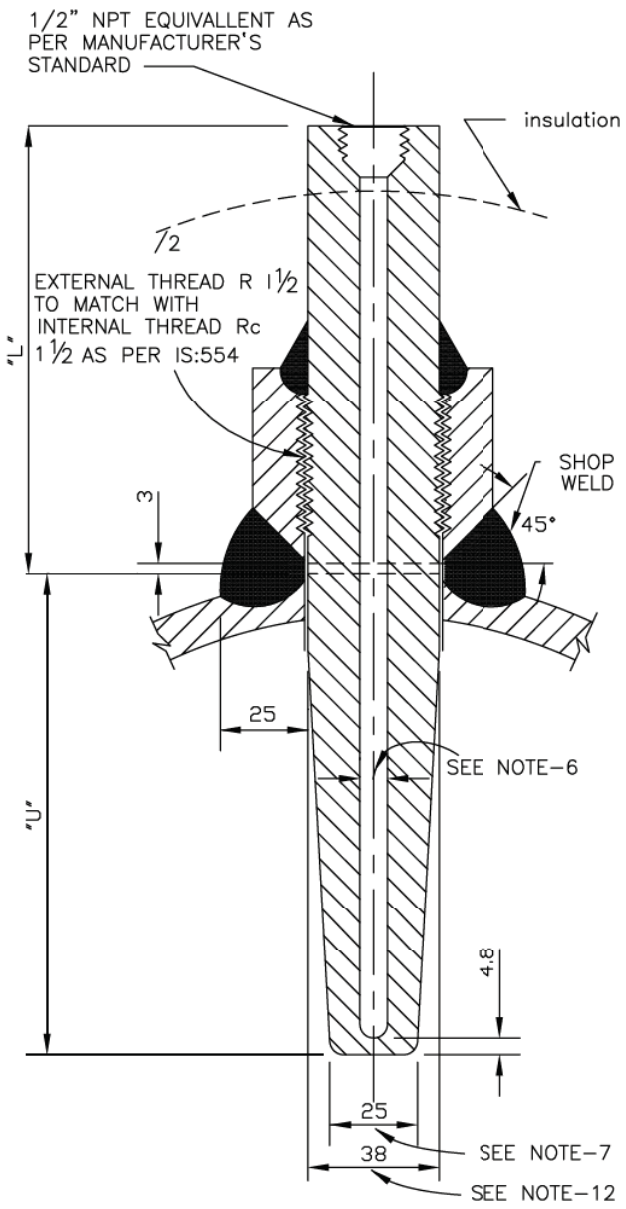
PROJECT: TYPICALTHERMAL POWER PROJECT

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

47541/2020/PS-PEM-MAX

TEMP. MEASUREMENT



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 1½
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	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.08.12
					CLEARED BY						

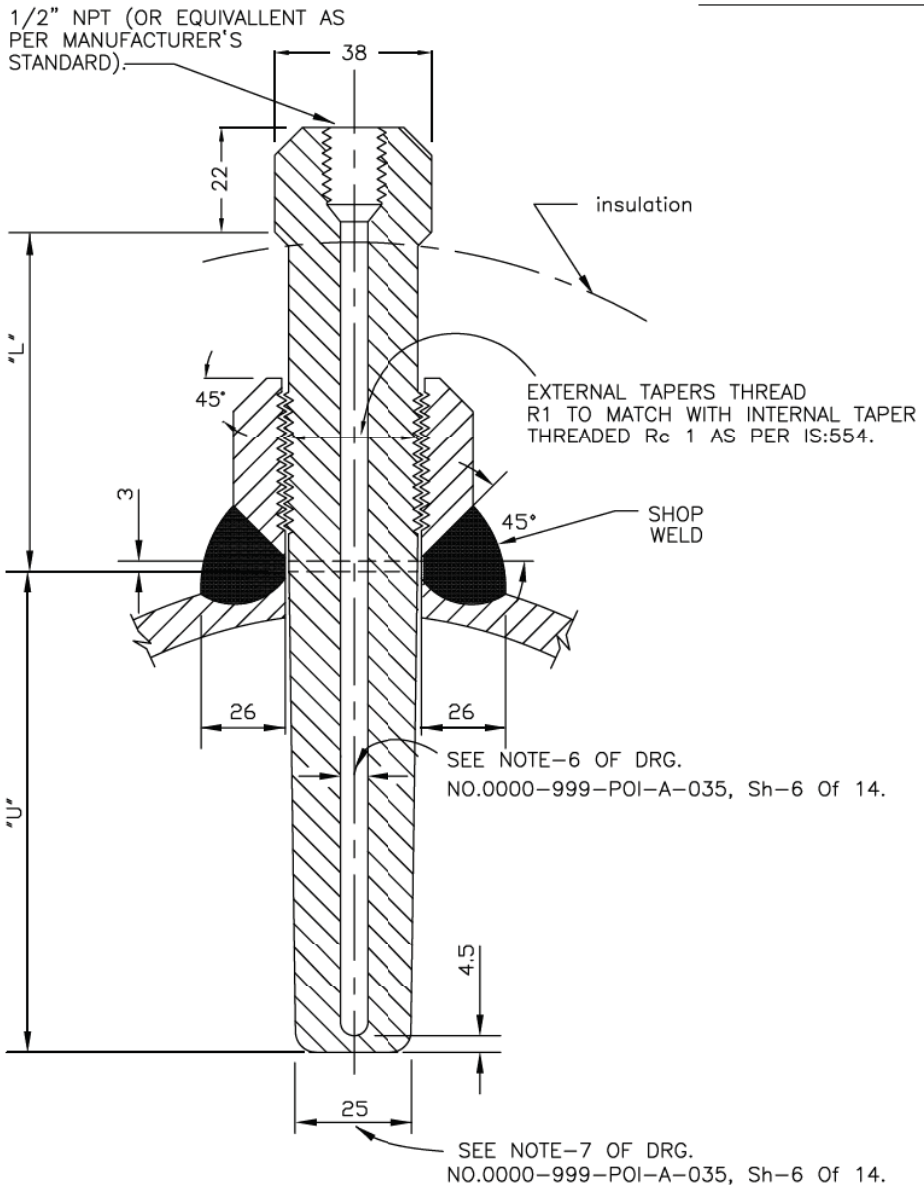
एन टी पी सी NTPC **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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-6 Of 14	A

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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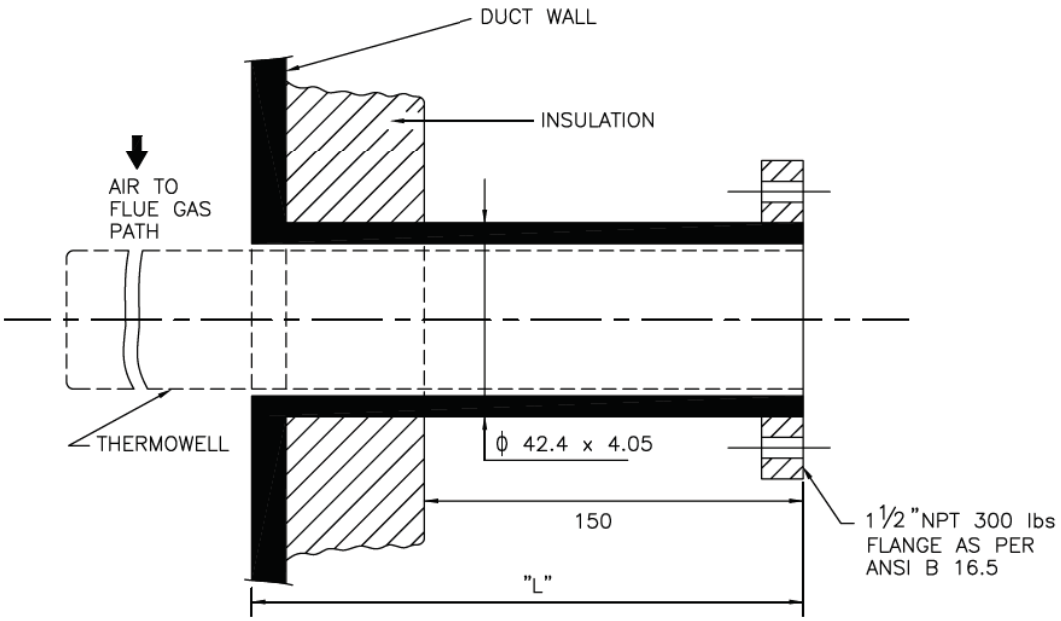
TEMP. MEASUREMENT



NOTES:–

1. THIS TYPE OF TEMPERATURE CONNECTIONS SHALL BE PROVIDED FOR TEMPERATURE MEASUREMENT IN AIR AND FLUE GAS DUCT.
2. MATERIAL OF THERMOWELL SHALL BE OF 316SS.
3. EXTERNAL CONNECTION SHALL BE OF SLIP ON FLANGED TYPE AND THERMOWELL DESIGN SHALL BE AS PER ASME.PTC–19.3 (REFER NOTES 9&10 OF DRG.NO. 0000–999–POI–A–035, Sh–6 Of 14).
4. BIDDER TO SUPPLY AND INSTALL THE COUNTER FLANGED AND THERMOWELL (ALONG WITH TEMP. ELEMENT).
5. ALL DIMENSIONS ARE INDICATIVE ONLY.

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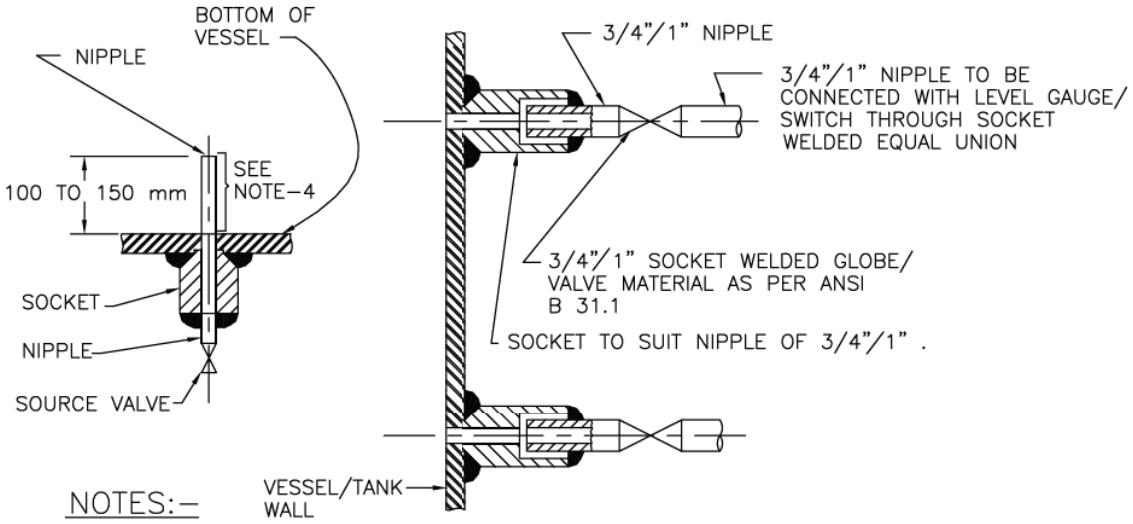
TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

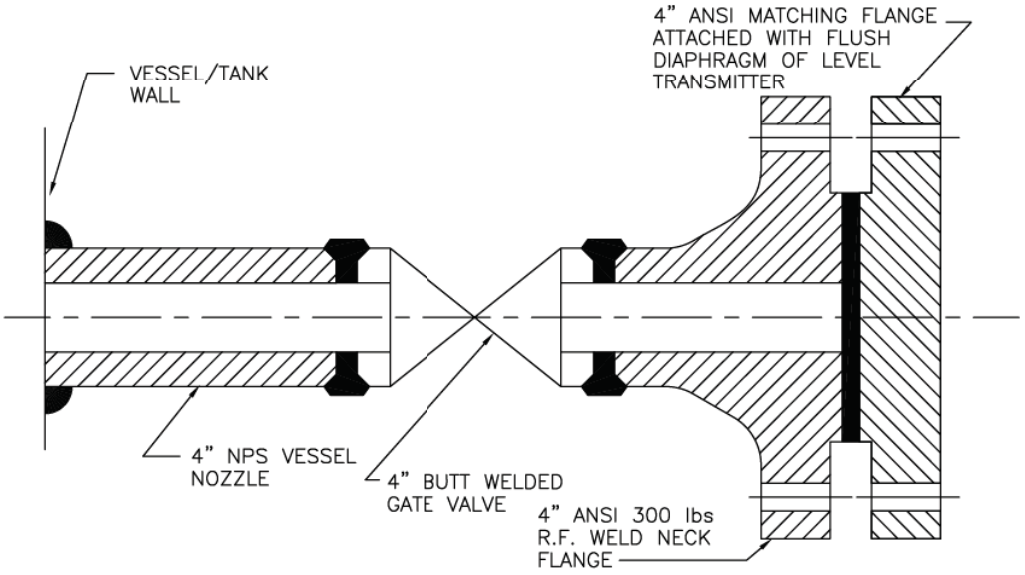
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh–8 Of 14	A

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.

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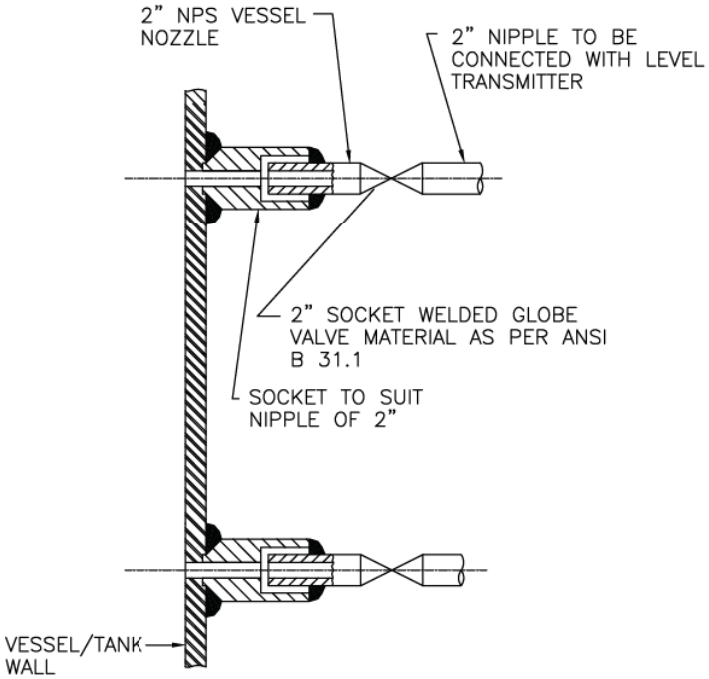
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-13 Of 14	A

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.

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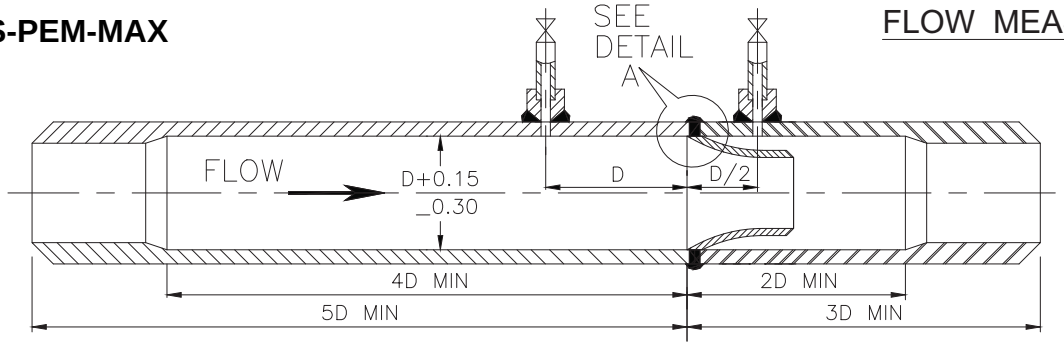
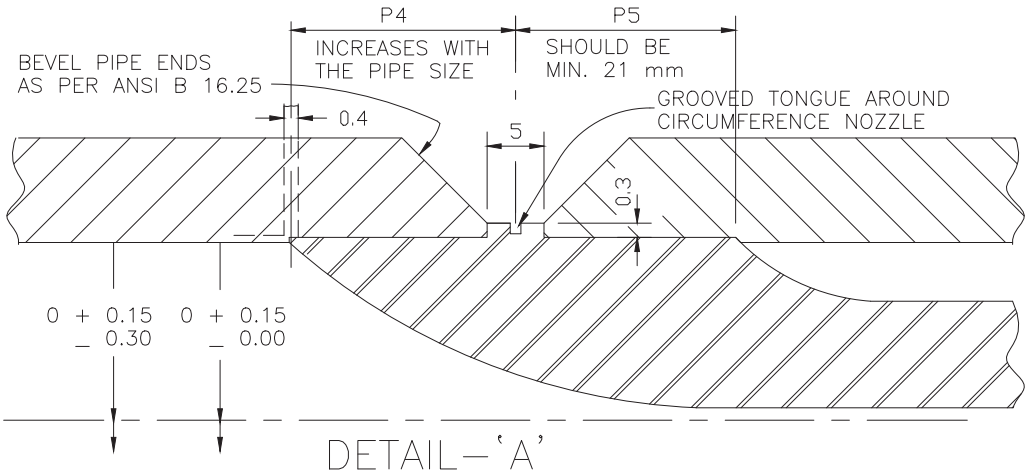
TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-14 Of 14	A

FLOW MEASUREMENT





DETAIL–'A'

NOTES:–

1. COMPLETE FLOW NOZZLE BRANCH ASSEMBLY ALONG WITH NIPPLES AND SOURCE ISOLATION VALVES SHALL BE SUPPLIED BY THE BIDDER. THE BIDDER ALSO TO INSTALL FLOW NOZZLE WITHIN THE MACHINED BRANCH, PRESSURE STUBS ON THE BRANCH PIPE (FOR ORIENTATION OF PRESSURE TAP REF. NOTE–3) ALONG WITH NIPPLE AND SOURCE ISOLATION VALVES.
2. THE MACHINING OF BRANCH PIPE SHOULD BE DONE AFTER PRESSURE CONNECTIONS HAVE BEEN WELDED TO PIPE AND ALSO EXTEND FOR ATLEAST 4D IN THE INLET SECTION, 2D IN THE OUTLET SECTION, MEASURED FROM THE INLET FACE OF FLOW NOZZLE. TOTAL BRANCH PIPE ASSEMBLY SHOULD BE ATLEAST A LENGTH OF 8D/5D IN THE INLET SECTION AND 3D IN THE OUTLET SECTION, MEASURED FROM THE INLET FACE OF THE FLOW NOZZLE AS SHOWN ABOVE.
3. ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE LOCATED ON SIDES OF THE PIPE FOR LIQUID AND STEAM SERVICE AND ON THE TOP FOR DRY GAS SERVICE FOR PROCESS LIQUIDS, INSTALLATION OF PRESS. TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW HORIZONTAL FOR SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED.
4. THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm(1/16") OF DISTANCE SPECIFIED AND NUMBER OF PAIRS OF PRESSURE TAPS TO BE PROVIDED WILL BE AS PER FLOW MEASUREMENT DATA SHEET.
5. PRESSURE TAPS SHOULD BE DRILLED RADIALLY WITH RESPECT TO PIPE AND THIS DRILLING SHOULD BE DONE AFTER ANY COUPLING FOR ATTACHING THE PRESSURE TUBING HAS BEEN WELDED TO THE PIPE. THE HOLE WHERE IT BREAKS THROUGH THE INNER SURFACE OF THE PIPE MUST BE FREE OF BURRS OR WIRE EDGE AND CORNER OF EDGE HOLE LEFT ROUNDED VERY SLIGHTLY (1/64" RADIOUS).
6. RECOMMENDED MAXIMUM DIAMETERS OF PRESSURE TAP HOLES IN THE BRANCH PIPES WILL BE AS PER EN ISO 5167:2003. THE DIAMETER FOR HOLE SHOULD REMAIN SAME FOR DISTANCE NOT LESS THAN 2.5 TIME OF DIA FROM THE INNER SURFACE OF THE PIPE.
7. FLOW NOZZLE SHALL BE CENTRED IN THE PIPE WITHIN 0.8 mm (1/32") OF THE PIPE AXIS. INSIDE DIAMETER MEASURED AT FOUR POINTS AT ANY CROSS SECTION SHALL NOT DIFFER BY MORE THAN 1%.
8. BRANCH PIPE SHALL BE AS PER MAIN PIPING MATERIAL SPECIFICATION. INTERNAL SURFACE OF BORED SECTIONS MUST BE SMOOTH AND STRAIGHT, FREE FROM SCALES, PITS, BURRS OR ANY IRREGULARTIES.
9. FLOW NOZZLE MATERIAL SHALL BE 316 SS AND THE DESIGN AS PER ASME.
10. MAXIMUM UPSTREAM AND DOWN STREAM STRAIGHT LENGTH REQUIRED FROM INLET FACE OF FLOW NOZZLE SHALL BE AS PER EN ISO 5167:2003.

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CLIENT **THDC INDIA LIMITED**
(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT TYPICALTHERMAL POWER PROJECT (TG PACKAGE)

TITLE INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-110-POI-A-035 360 Sh–11 Of 14	A

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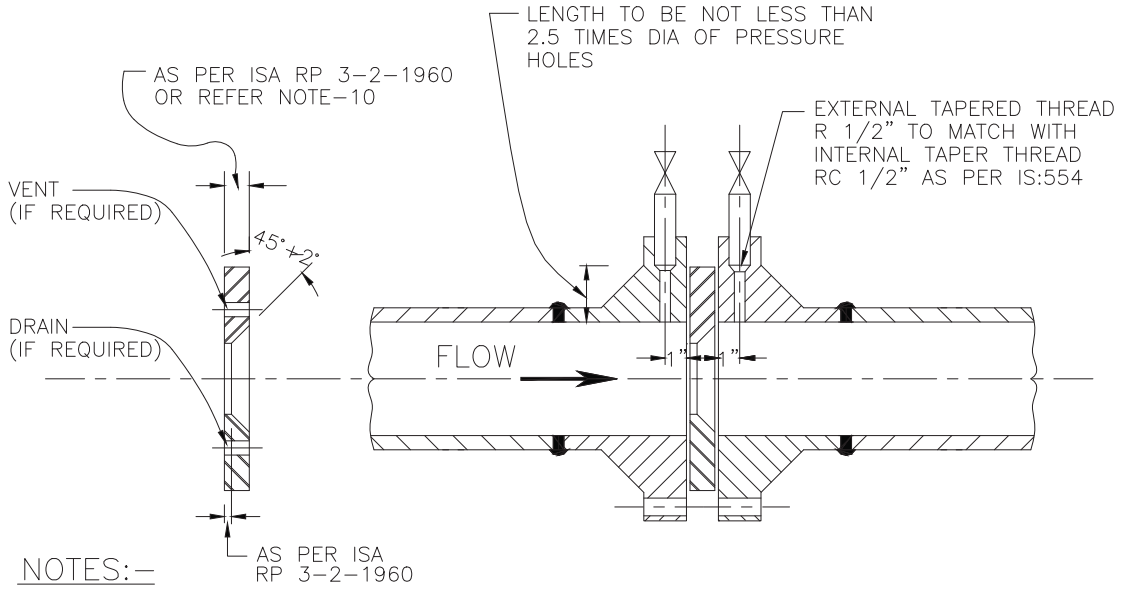
FLOW MEASUREMENT



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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ENGINEERING DIVISION

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE										26.04.06

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PROJECT: TYPICALTHERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-110-POI-A-035 361 Sh-12 Of 14	A

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

`

MOTORISED VALVE ACTUATOR SPECIFICATION

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**GENERAL:**
1.01.00	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.
1.02.00	This sub-section of specification is applicable for following types of electric actuators:
1.02.02	**Electric actuators for valves/ dampers/ gates (other than covered in 1.02.01):** These actuators shall be Non-Intrusive type electric actuators. The interface of these actuators with DDCMIS shall be of two types viz with Fieldbus interface. The common requirements of both these type of actuators are specified at clause 2.00.00, specific requirements of Non-Intrusive hardwired actuators are specified at clause 3.00.00 and specific requirements of Non-Intrusive fieldbus actuators are specified at clause 4.00.00. The applications where these two types of actuators are to be provided is specified in Part-A of Technical Specifications.
2.00.00	**COMMON REQUIREMENTS FOR NON INTRUSIVE ELECTRIC ACTUATORS**
2.01.00	**TYPE:**
2.01.01	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.
2.01.02	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.
2.02.00	**RATING:** (a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire & 50HZ +/-5%. (b) 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.
2.03.00	**CONSTRUCTION:** (a) Enclosure: Totally enclosed weatherproof, minimum IP-68 degree of protection. (b) Manual Wheel: Shall disengage automatically during motor operation.

2.04.00 MOTOR:

(a) Type :

Squirrel cage induction motor suitable for Direct On Line (DOL)starting.

(b) Enclosure:

Totally enclosed, self-ventilated.

(c) Insulation

Class F. Temperature rise 70 Deg C. over 50 Deg C ambient.

(d) Bearings:

Double shielded, grease lubricated antifriction.

(e) Earth Terminals:

Two

(f) 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.

2.05.00 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.

2.06.00 LOCAL OPERATION:

It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.

2.07.00 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.

2.08.00 WIRING:

Suitable voltage grade copper wire.

2.09.00 TERMINAL BLOCK:

For power cables, the grade of TBs shall be minimum 650V.

2.10.00 ACCESSORIES:

All required accessories (if applicable) for calibration / settings/ configuration of various parameters of actuator shall be provided. For quantities, please refer Part A of technical specifications.

2.11.00	**SIL CERTIFICATION:** All actuators shall be certified for SIL 2 or better.
4.00.00	**SPECIFIC REQUIREMENTS FOR NON INTRUSIVE FIELDBUS ACTUATORS**
4.01.00	**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 Foundation Fieldbus/ Profibus compatible. However the exact protocol shall be based on finalized protocol of DDCMIS. 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. (c) Open/close command termination logic shall be suitably built inside actuator.

CLAUSE NO.	TECHNICAL REQUIREMENTS
4.02.00	**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.

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

PROCESS CONNECTION, PIPING & LOCAL CONTROL PANEL

PROCESS CONNECTION AND PIPING

1.00.00 **PROCESS CONNECTION PIPING**

1.01.00 The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section on as required basis for the connection of all instruments and control equipments of entire plant.

1.01.01 **IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS**

1.01.02 All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The material of the impulse pipe shall be same as that of main process pipe or equivalent. The size of impulse pipe shall be ½" for Steam & Water Application and ¾" for Air & Flue Gas applications. 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

Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm^2 or Temp>280 ^{o}C. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.

1.01.03 The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:

Manifold	Application/Measurement
2 Valve	Pressure measurements using pressure transmitters/pressure switches
3 Valve	Pressure measurements using differential pressure transmitter/ switches
5 Valve	Differential Pressure, Flow and Level Measurements

For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .

2.00.00 **AIR SUPPLY PIPING**

2.01.01 All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.

2.02.00 Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.

2.03.00 The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines

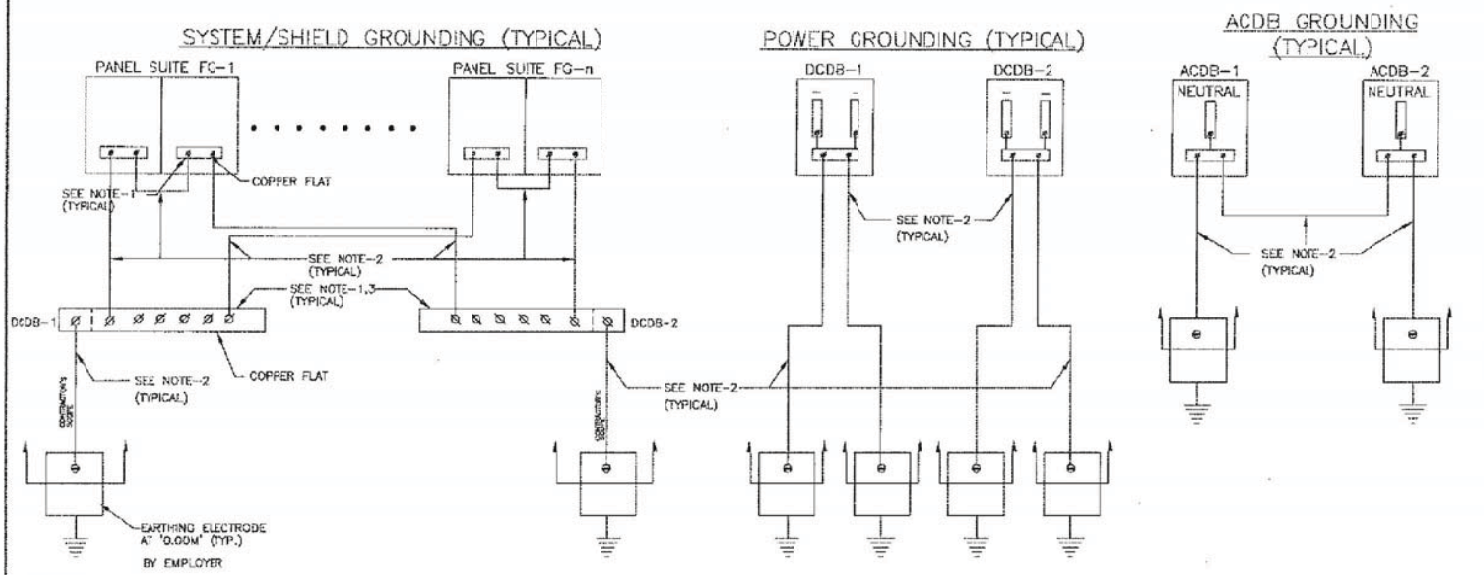
	shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports.
2.04.00	The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location.
2.05.00	All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.
2.06.00	Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering.
3.00.00	**INSTALLATION AND ROUTING**
3.01.01	All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe form the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided. Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes.
4.00.00	**SHOP AND SITE TESTS**
4.01.01	The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-IIIE-04 (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.
4.01.02	Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.
5.00.00	**LOCAL INSTRUMENT ENCLOSURE AND RACKS** All transmitters, switches etc. in Boiler Turbine Generator measurements (except for all fuel oil applications) shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas like Turbine/Generator area. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor.

	The GA of LIR shall be similar to LIE except for front/rear doors and side panels. . The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. 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. Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided. Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.
5.01.00	ENCLOSURE / RACKS FOR DUAL/SINGLE I/P TEMPERATURE TRANSMITTERS All Dual/Single Input temperature transmitters in Boiler Turbine Generator measurements shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant like boiler area, etc. and (ii) Racks in case of covered areas like Turbine/Generator area. Integral JB shall be provided with each Enclosure and Rack. The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance. Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55. Enclosure and Racks shall be free standing type. Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.
5.02.00	Local Control Panels: Local control panels shall be designed as per IP class 65 or better. These local panels shall be suitably placed taking care of safety of the operating personnel and Instruments. For Hot and dusty environment / process (e.g. Mill reject, Ash hoppers etc), panels shall be placed at least 5mtrs away from the process.

7.00.00 **Painting Color scheme for Impulse Piping:**

Sl. 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	Aluminium		Signal Red	537	3001
4.	Air Steam Mixture	Aluminium		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.



NOTES:-

1. SUPPLY, ERECTION, TERMINATION OF CABLES, FLATS ETC. REQUIRED FOR PROPER GROUNDING OF CONTRACTOR's CONTROL SYSTEM, SYSTEM CABINETS, POWER SUPPLY CABINETS ETC. ARE IN THE SCOPE OF CONTRACTOR.
2. CABLE IN CONTRACTOR'S SCOPE.
3. TO BE LOCATED IN DCDB.
4. EXACT LOCATION, ARRANGEMENTS OF FLATS ETC. SHALL BE AS FINALISED WITH CONTRACTOR. DURING DETAILED ENGINEERING.
5. CABINET BODY, CABNET BOTTOM PLATE, CABINET DOORS ARE TO BE CONNECTED TO PANEL EARTH FLAT COPPER CABLE BY CONTRACTOR.

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N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENTATION CABLING DIAGRAM
GROUNDING SCHEME FOR CABINETS / PANELS / POWER SUPPLY

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.I.S.	0000-999-PO-A-019A SH-1 OF 2	A

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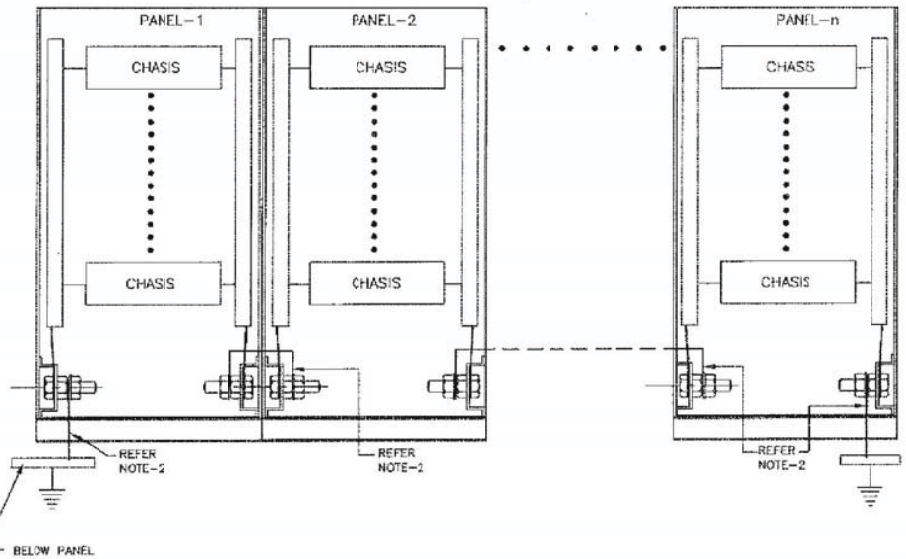
GROUNDING FOR EACH ROW OF PANELS (TYPICAL)



NOTES:–

1. SUPPLY, ERECTION, TERMINATION OF CABLES, FLATS ETC. REQUIRED FOR PROPER GROUNDING OF CONTRACTOR's CONTROL SYSTEM, SYSTEM CABINETS, POWER SUPPLY CABINETS ETC. ARE IN THE SCOPE OF CONTRACTOR.
2. CABLE IN CONTRACTOR'S SCOPE.
3. TO BE LOCATED IN DCDB.
4. EXACT LOCATION, ARRANGEMENTS OF FLATS ETC. SHALL BE AS FINALISED WITH CONTRACTOR. DURING DETAILED ENGINEERING.
5. CABINET BODY, CABINET BOTTOM PLATE, CABINET DOORS ARE TO BE CONNECTED TO PANEL EARTH FLAT COPPER CABLE BY CONTRACTOR.

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N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

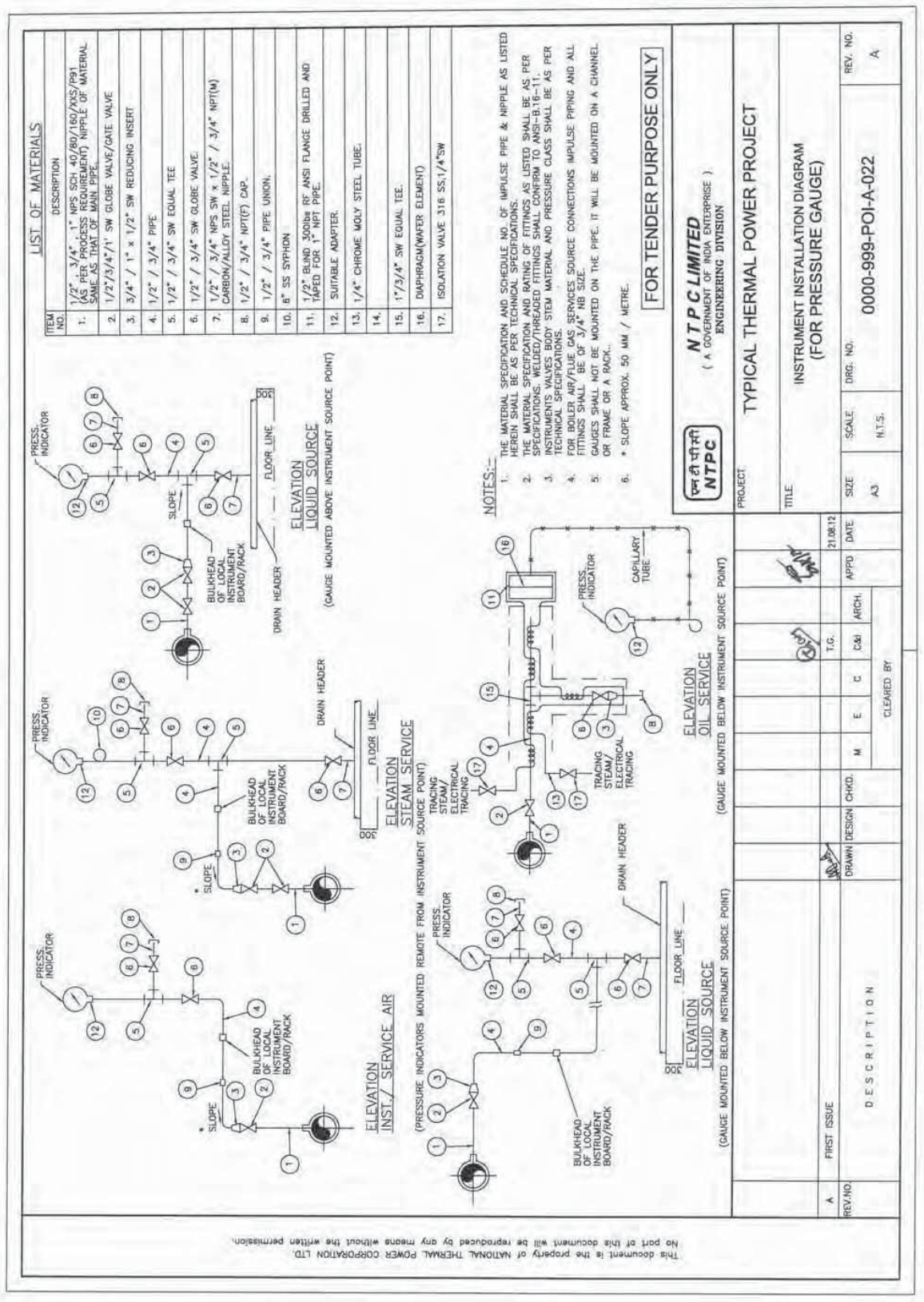
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.8.12

CLEARED BY

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENTATION CABLING DIAGRAM
GROUNDING SCHEME FOR CABINETS / PANELS / POWER SUPPLY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-019A SH–2 OF 2	A


LIST OF MATERIALS
ITEM NO.
DESCRIPTION
1. 1/2" 3/4" 1" NPS SCH 40/80/160/XXS/PB1 (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. 8" 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.
ELEVATION INST./ SERVICE AIR
(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)
ELEVATION STEAM SERVICE
ELEVATION LIQUID SOURCE
(GAUGE MOUNTED ABOVE INSTRUMENT SOURCE POINT)
ELEVATION OIL SERVICE
(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)
PRESS. INDICATOR
BULKHEAD OF LOCAL INSTRUMENT BOARD/RACK
DRAIN HEADER
FLOOR LINE
TRACING STEAM/ ELECTRICAL TRACING
CAPILLARY TUBE
SLOPE
FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT: TYPICAL THERMAL POWER PROJECT
TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)
SIZE: A3
SCALE: N.T.S.
DRG. NO. 0000-999-POI-A-022
REV. NO. A
REV.NO. DESCRIPTION DRAWN DESIGN CHKD. M E C T.G. C&I ARCH. APPD DATE
A FIRST ISSUE 21.08.12
CLEARED BY
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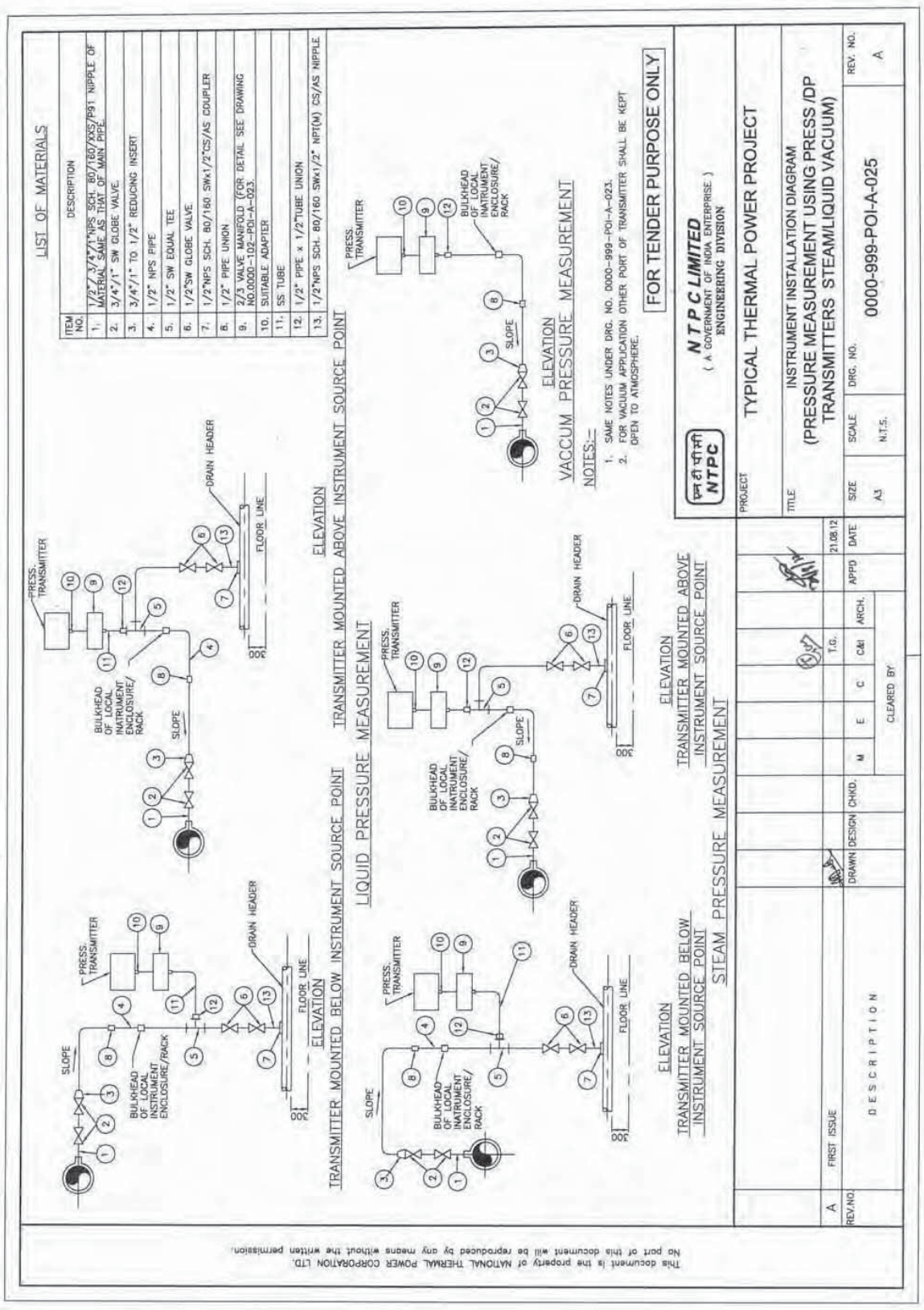
LIST OF MATERIALS
ITEM NO. | DESCRIPTION
1. 1/2"/ 3/4"/1"NPS SCH. 80/160/XXS/P91 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE
2. 3/4"/1" SW GLOBE VALVE.
3. 3/4"/1" TO 1/2" REDUCING INSERT
4. 1/2" NPS PIPE
5. 1/2" SW EQUAL TEE
6. 1/2"SW GLOBE VALVE.
7. 1/2"NPS SCH. 80/160 SWx1/2"CS/AS COUPLER
8. 1/2" 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
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
LIQUID PRESSURE MEASUREMENT
ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
LIQUID PRESSURE MEASUREMENT
ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
STEAM PRESSURE MEASUREMENT
ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
STEAM PRESSURE MEASUREMENT
ELEVATION
VACCUM PRESSURE MEASUREMENT
PRESS. TRANSMITTER
BULKHEAD OF LOCAL INATRUMENT ENCLOSURE/ RACK
DRAIN HEADER
FLOOR LINE
SLOPE
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
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT: TYPICAL THERMAL POWER PROJECT
TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)
SIZE: A3
SCALE: N.T.S.
DRG. NO.: 0000-999-POI-A-025
REV. NO.: A
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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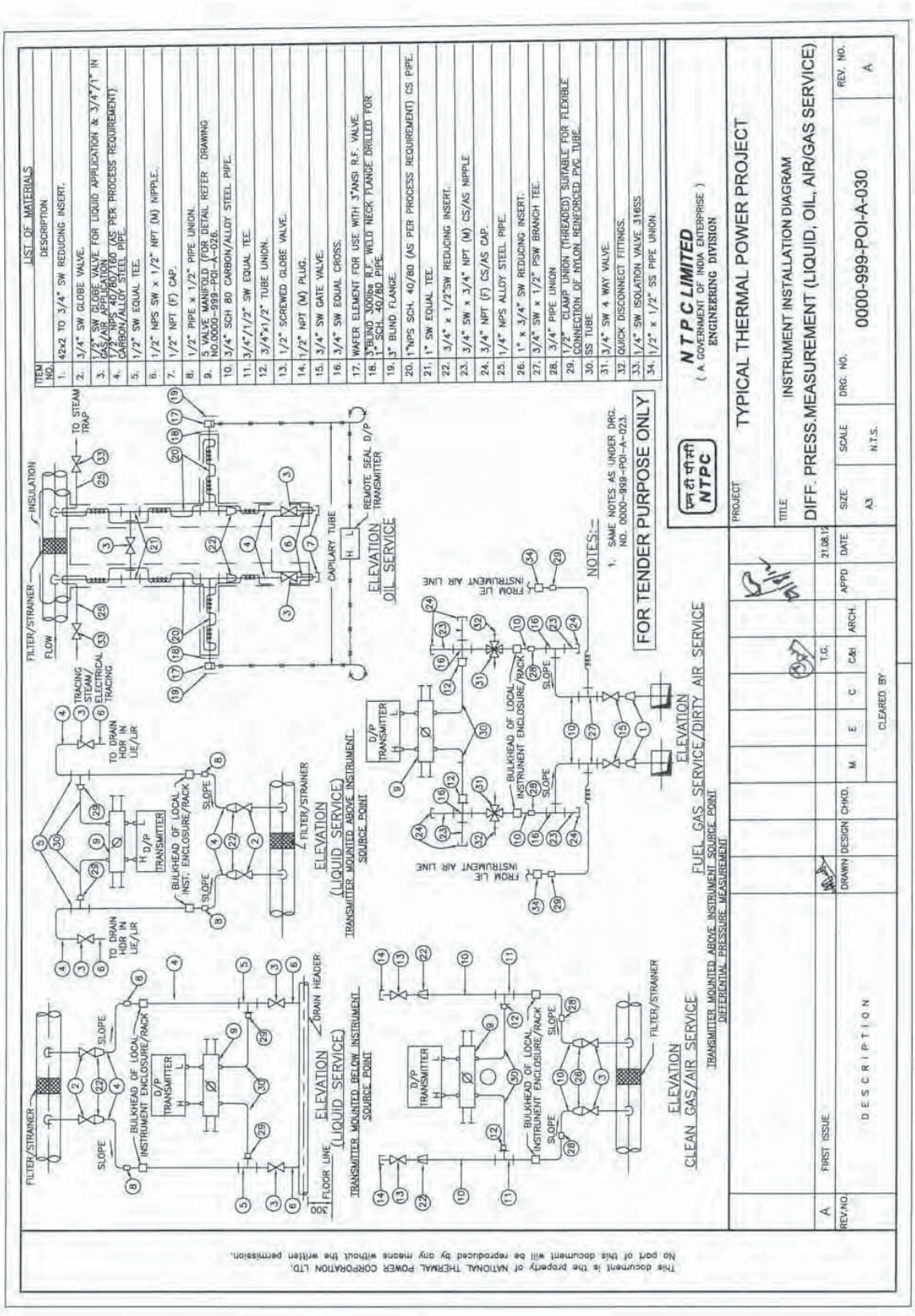
47541/2020/PS-PEM-MAX



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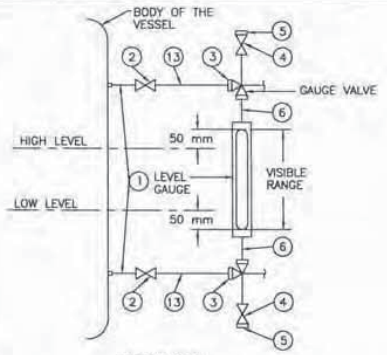
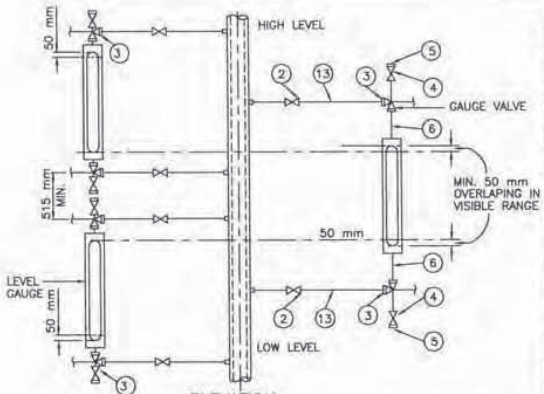


ELEVATION

LOCAL LEVEL INDICATION USING GAUGE GLASS

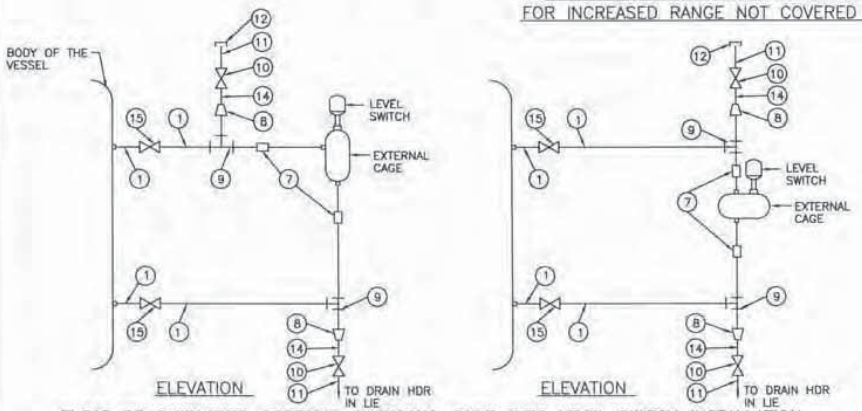


ELEVATION

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

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-031	A

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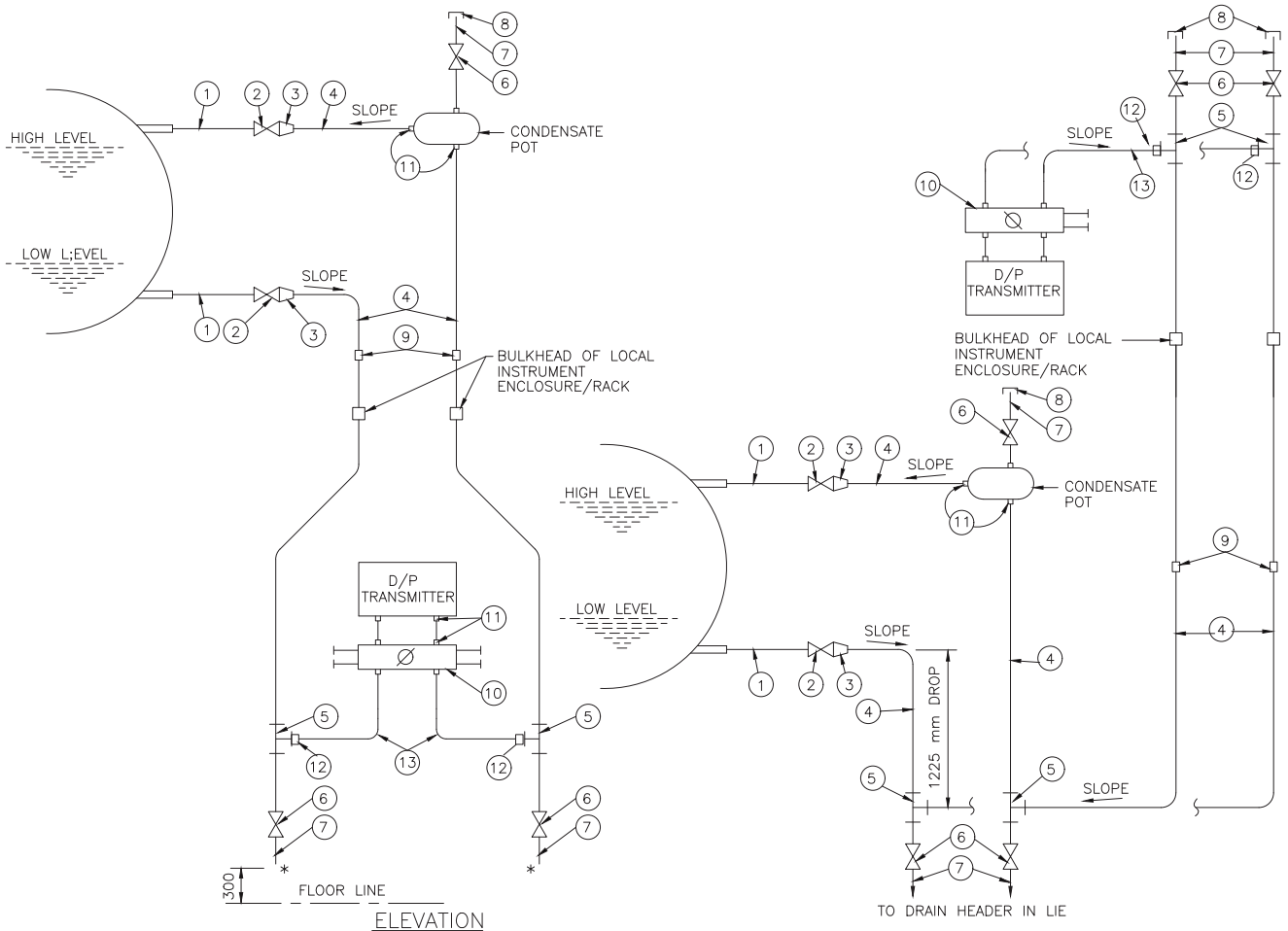

LIST OF MATERIALS

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

CLIENT **THDC INDIA LIMITED**
(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT USING D/P TRANSMITTERS)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										26.04.06

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-110-POI-A-032 SH 1 OF 2	A

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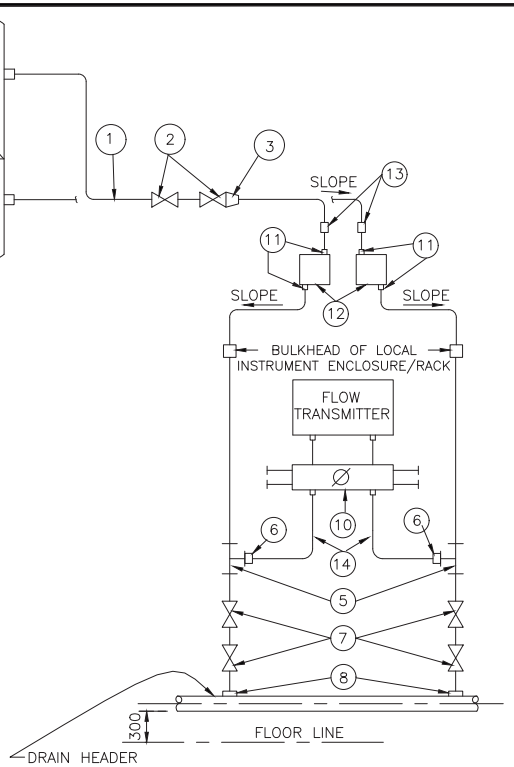
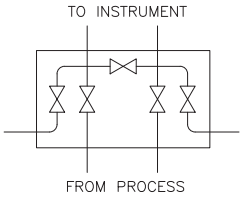
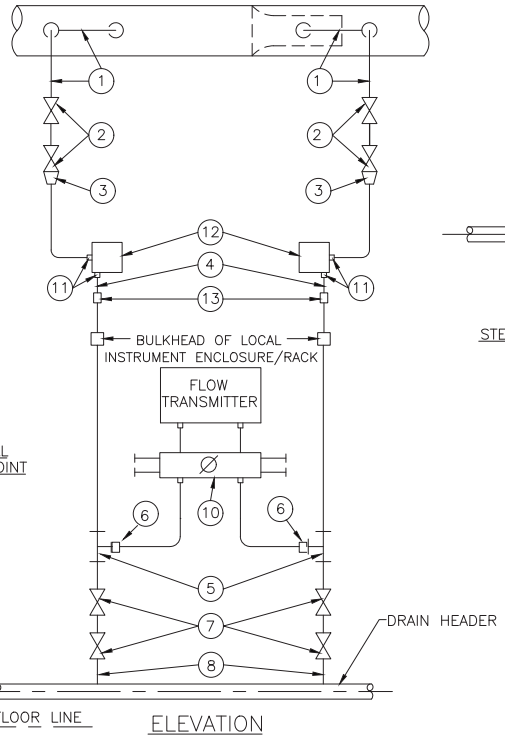


ELEVATION

FEED/ATTEMPERATION WATER FLOW MEASUREMENT IN VERTICAL PIPE–TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

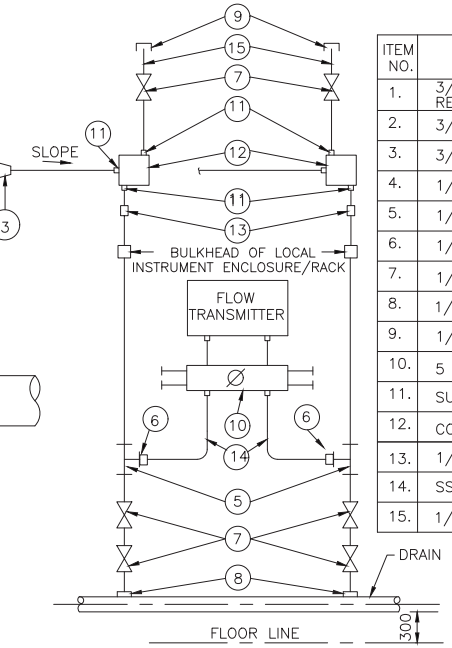


DETAIL OF 5 VALVE MANIFOLD
(ITEM NO. 10)



ELEVATION

FEED/ATTEMPERATION WATER FLOW MEASUREMENT IN HORIZONTAL PIPE–TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

STEAM FLOW MEASUREMENT IN VERTICAL PIPES

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	3/4" /1"NPS SCH. 80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) 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" PIPE x 1/2" TUBE UNION
7.	1/2" SW GLOBE VALVE.
8.	1/2"NPS SCH. 80/160 SWx1/2" SW CS/AS COUPLER
9.	1/2" NPT (F) CAP
10.	5 VALVE MANIFOLD
11.	SUITABLE ADAPTER
12.	CONDENSATE POT (RESERVOIR)
13.	1/2" PIPE UNION
14.	SS TUBE
15.	1/2"NPS SCH. 80/160 SWx1/2" NPT (M) CS/AS NIPPLE

NOTES:–

1. SAME NOTES UNDER DRG. NO. 0000–999–POI–A–023.
2. CONDENSATE POTS SHALL BE PROVIDED FOR ALL STEAM SERVICES.
3. FOR WATER SERVICES CONDENSATE POTS SHALL BE PROVIDED ONLY IN THOSE CASES WHERE TEMP. > 120°C

FOR TENDER PURPOSE ONLY

CLIENT **THDC INDIA LIMITED**
(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT
एनटीपीसी NTPC
N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT INSTALLATION DIAGRAM
FLOW MEASUREMENT (USING FLOW NOZZLES)
STEAM & FEEDWATER

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										06.04.06

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-110-POI-A-026	A

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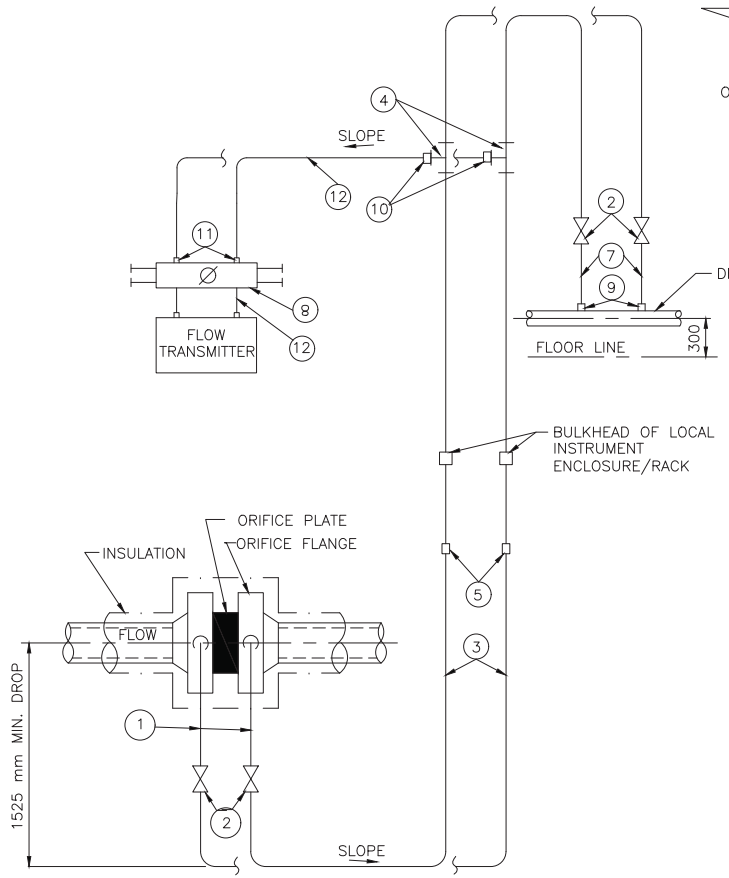
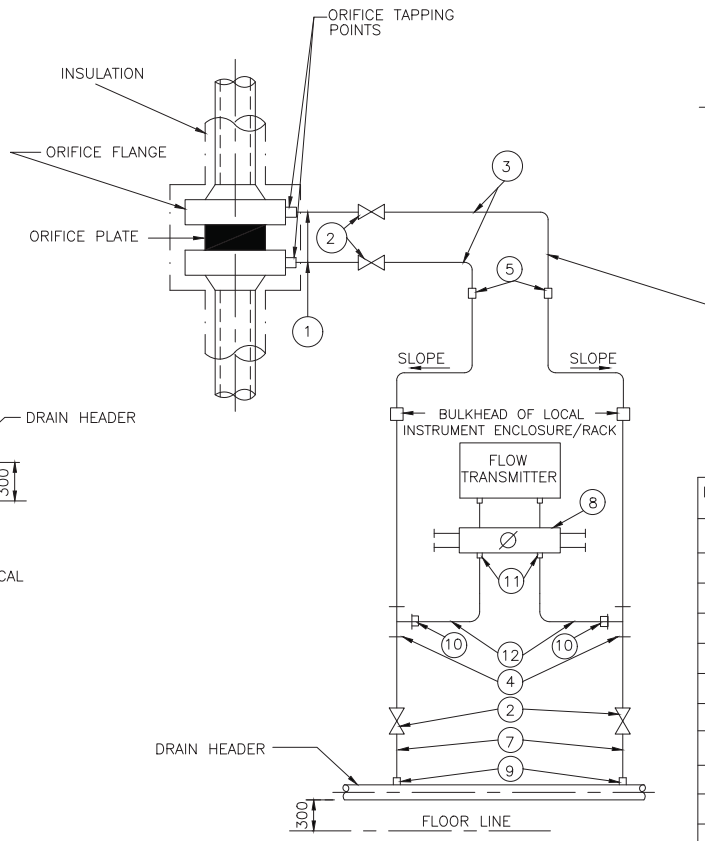


ELEVATION

HORIZONTAL PIPE RUN

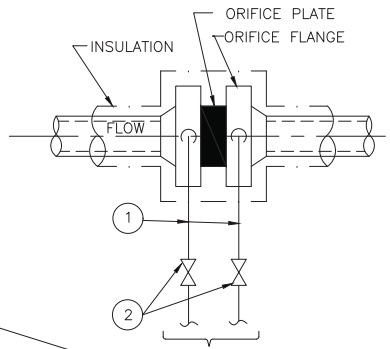
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



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

FOR TENDER PURPOSE ONLY

NOTES:–

1. SAME NOTES AS UNDER DRG. NO. 0000–999–POI–A–023.

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										26.04.06
					CLEARED BY						

CLIENT **THDC INDIA LIMITED**
(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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.	0000-110-POI-A-027	A

10.00.00	**CONTROL CABINETS / PANELS**
10.01.00	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition as specified in Sub-section-basic Design criteria (Part-B, Section-VI) and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.
10.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.□ mm thick CRCA steel sheet or as per supplier□s standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.
10.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than □00 mm, double doors shall be provided.
10.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than □5-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.□ mm. The finish colors for exterior and interior surfaces shall conform to following shades□ (a.) Exterior□ As per RAL 9002 (End panel sides RAL 5012), to be finali□ed during detailed engineering. (b.) Interior□ Same as above.
10.01.05	Paint films which show sags, checks or other imperfections shall not be acceptable.
10.01.0□	As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.
10.01.07	Refer Subsection Basic Design Criteria, Part B, and Section VI for grounding requirements.
10.01.0□	The mimic shall be configured on the OWS and it shall be possible to control, monitor and operate the plant from the same.
10.01.09	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section I□ST CABLE of this specification.

BHEL	**SPECIFICATION FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS –999- 145 –054A
		VOLUME II B
		SECTION D
		REV. NO. 03 / DATE : 16-09-2013
		SHEET 1 OF 6

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

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

a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
e) IS-8828:1996 : Circuit breaker for household and similar installations.
f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
g) ISA-18.1:1979 : Annunciator Sequences and Specification
h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others

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-42 unless otherwise specified

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 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 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 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
Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

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4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

FORM NO. PEM-6666-0

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5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet
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
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.

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **AIR CONDITIONING SYSTEM**	

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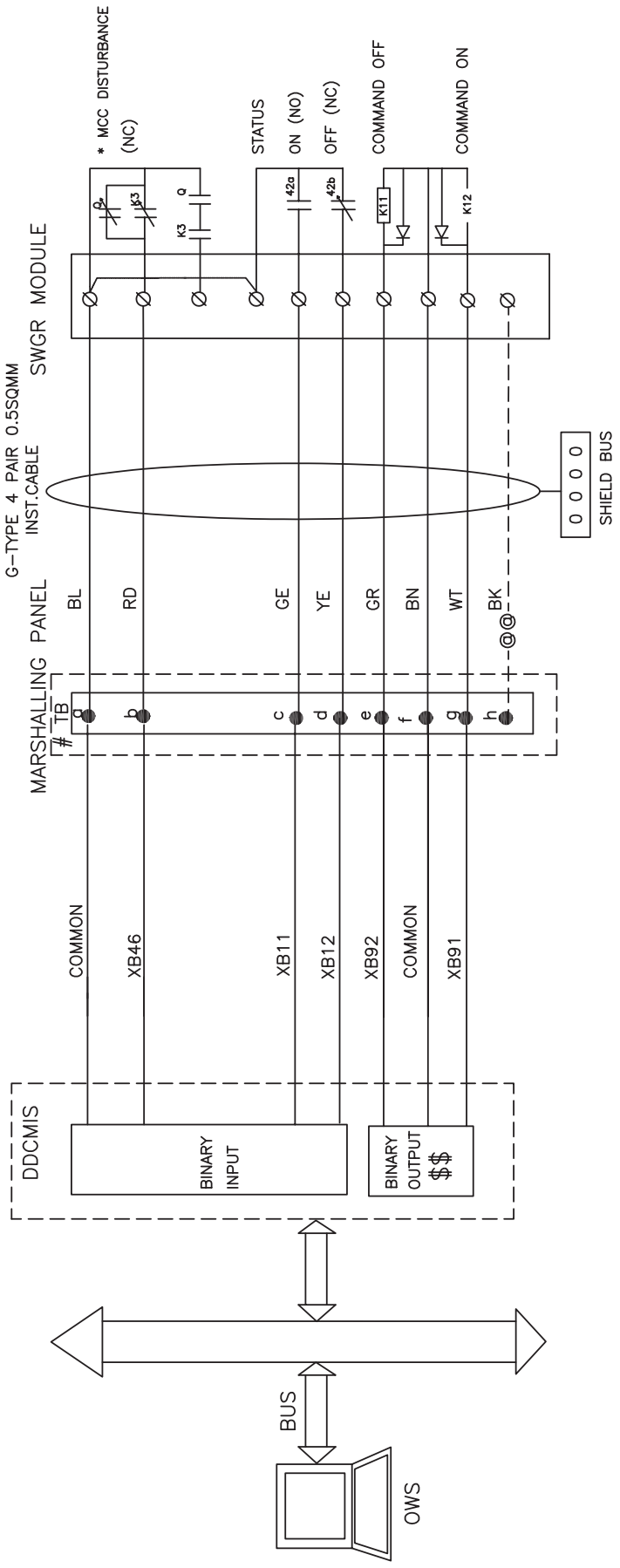
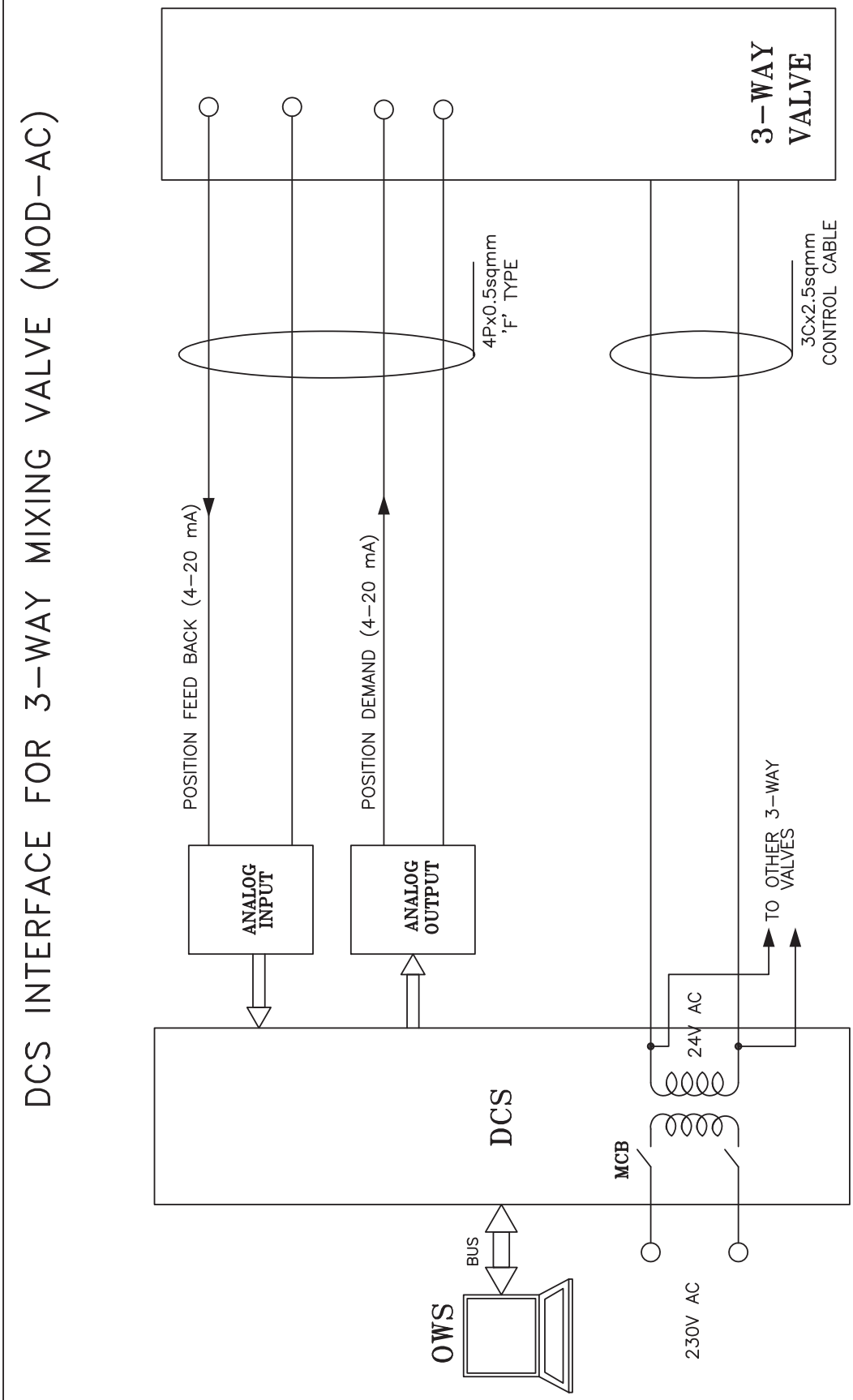
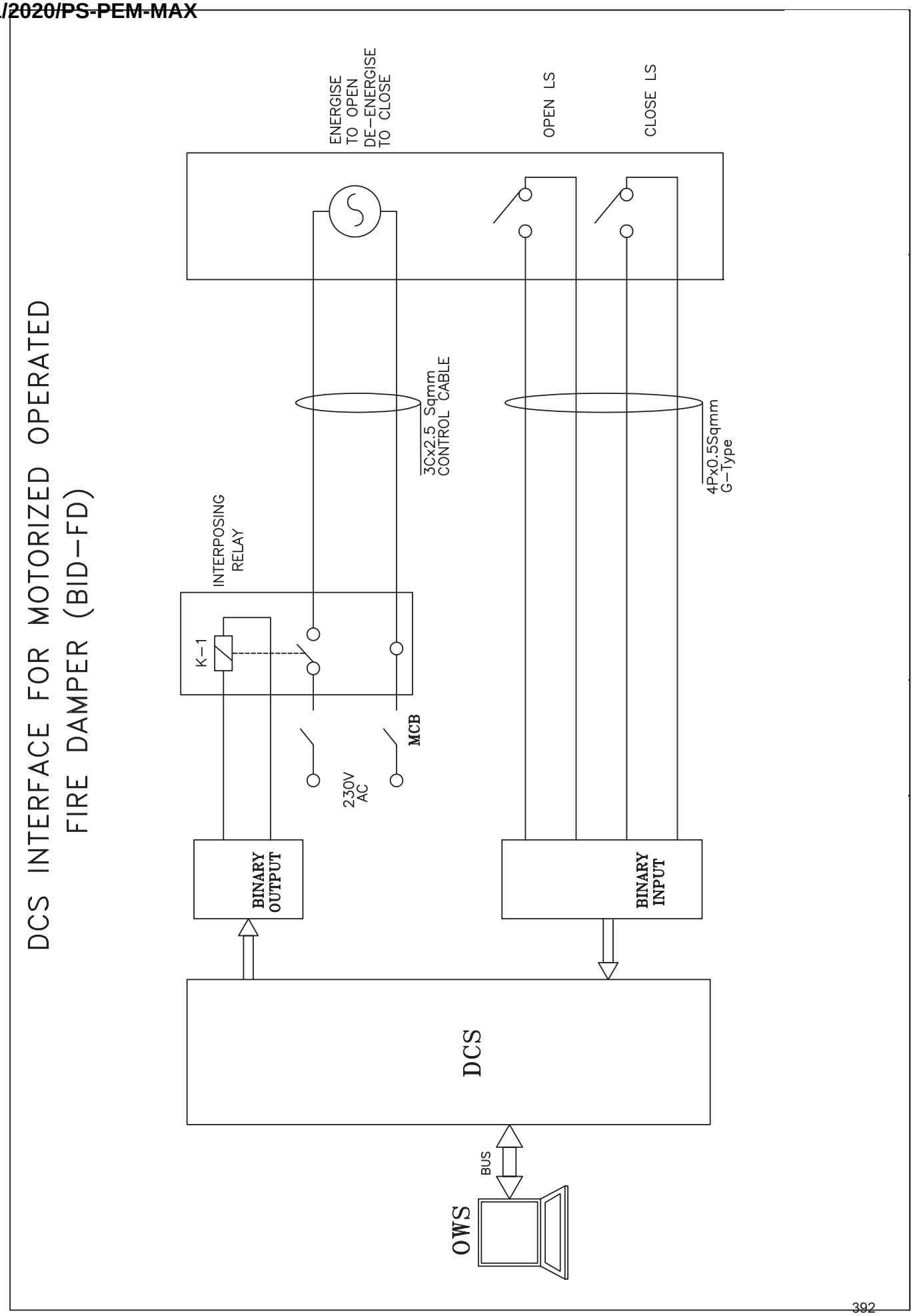
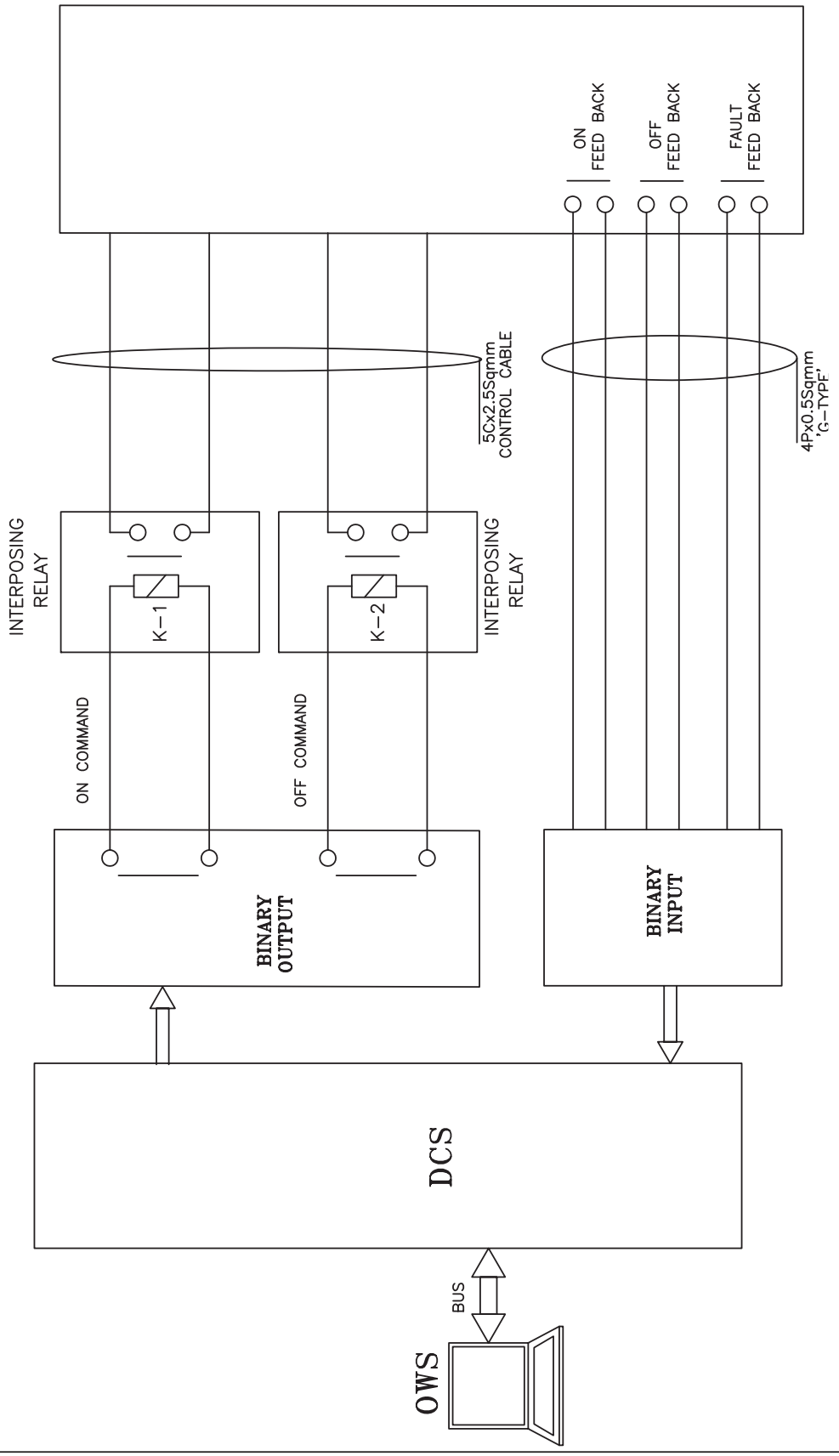
SIGNAL EXCHANGE BETWEEN DRIVES AND DCS

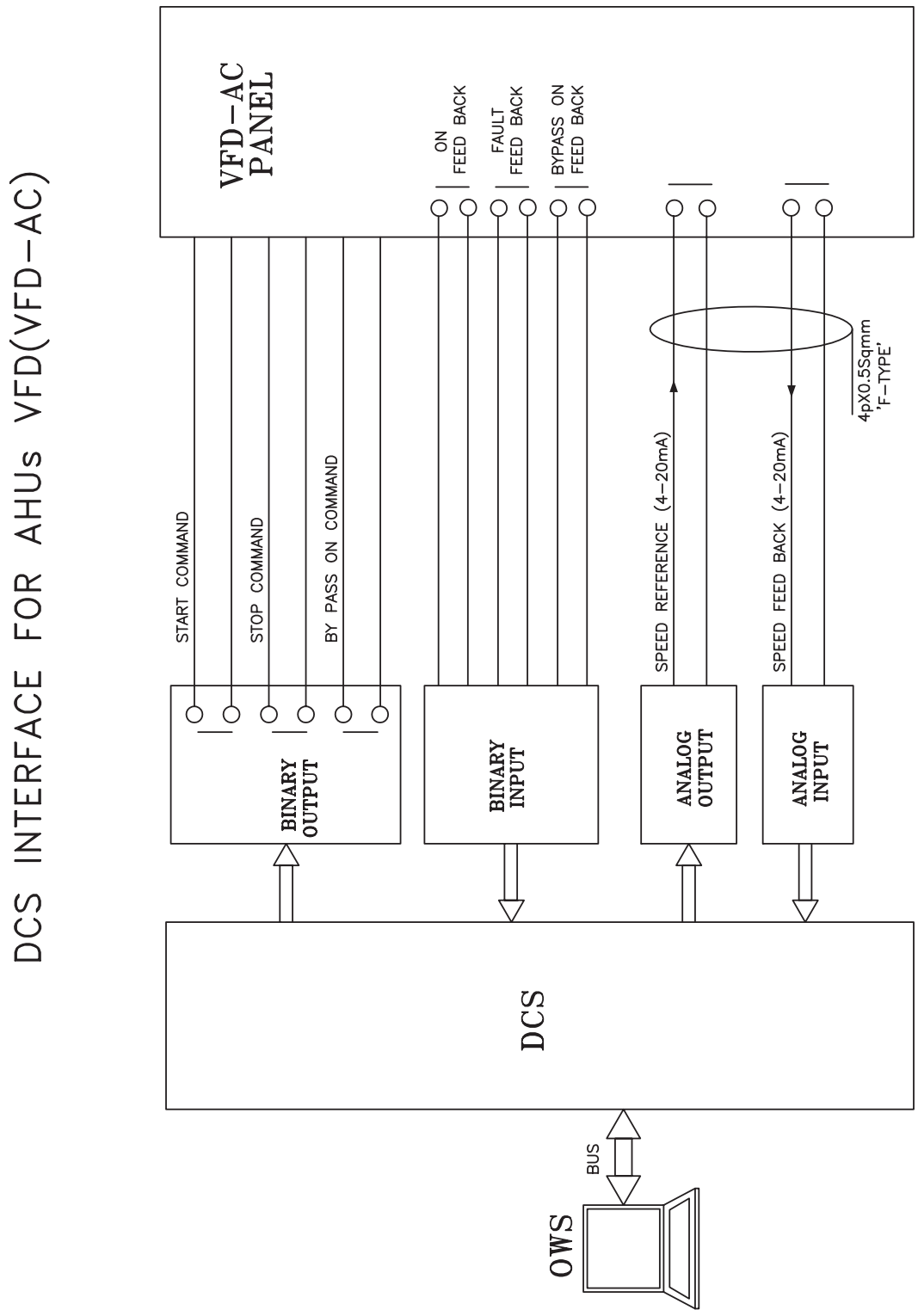

DDCMIS INTERFACE WITH LT MCC (LT)
* MCC DISTURBANCE
(NC)
STATUS
ON (NO)
OFF (NC)
COMMAND OFF
COMMAND ON
K3
K11
K12
42a
42b
SWGR MODULE
G-TYPE 4 PAIR 0.5SQMM
INST.CABLE
SHIELD BUS
MARSHALLING PANEL
T# TB
BL
RD
GE
YE
GR
BN
WT
BK
COMMON
XB46
XB11
XB12
XB92
COMMON
XB91
DDCMIS
BINARY INPUT
BINARY OUTPUT
BUS
OWS

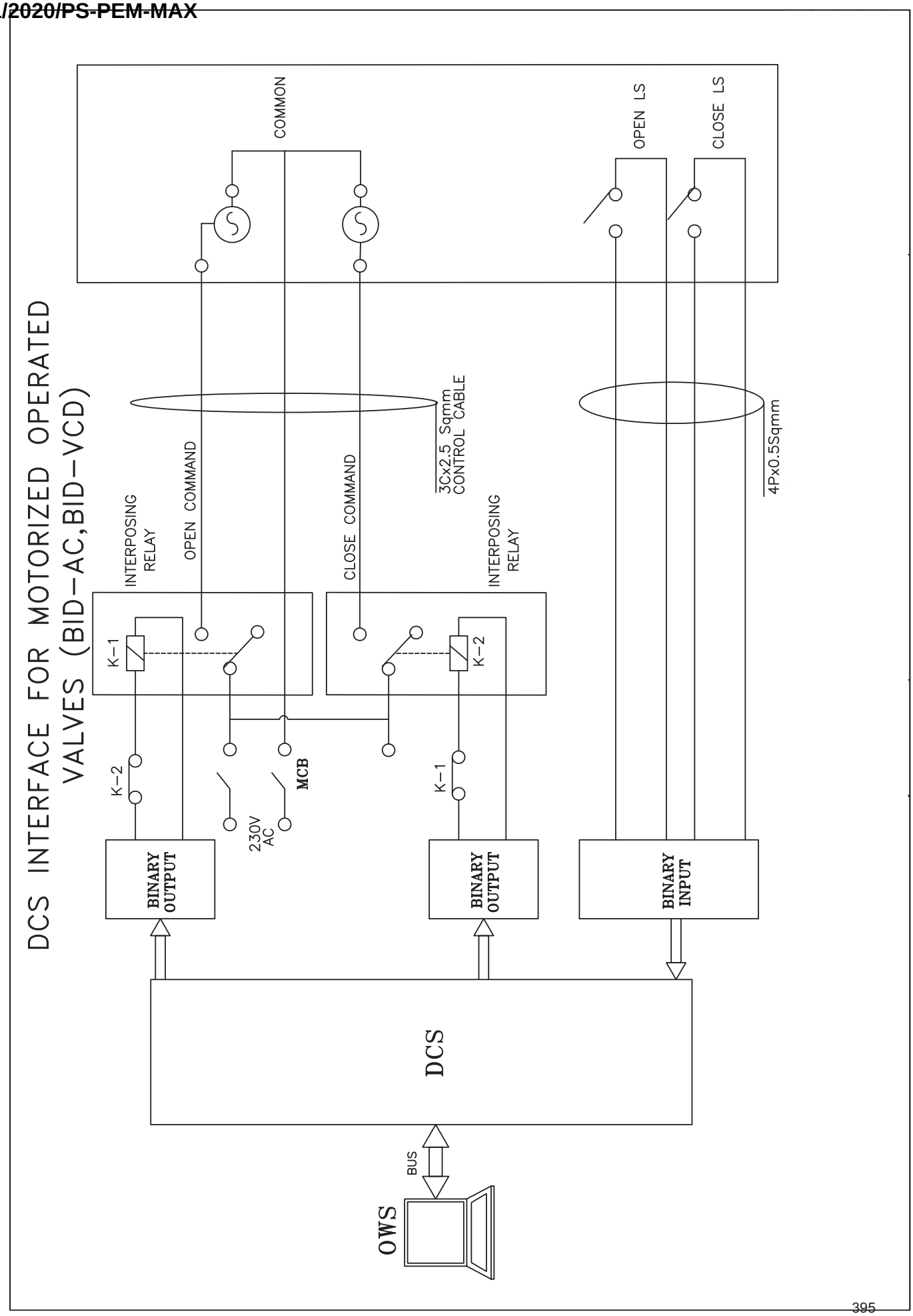

DCS INTERFACE FOR 3-WAY MIXING VALVE (MOD-AC)
3-WAY VALVE
4Px0.5sqmm 'F' TYPE
3Cx2.5sqmm CONTROL CABLE
POSITION FEED BACK (4-20 mA)
POSITION DEMAND (4-20 mA)
ANALOG INPUT
ANALOG OUTPUT
TO OTHER 3-WAY VALVES
24V AC
DCS
MCB
BUS
OWS
230V AC


DCS INTERFACE FOR MOTORIZED OPERATED
FIRE DAMPER (BID-FD)
ENERGISE
TO OPEN
DE-ENERGISE
TO CLOSE
OPEN LS
CLOSE LS
3Cx2.5 Sqmm
CONTROL CABLE
4Px0.5Sqmm
G-Type
INTERPOSING
RELAY
K-1
MCB
230V
AC
BINARY
OUTPUT
BINARY
INPUT
DCS
BUS
OWS

HOOK–UP DIAGRAM FOR **ACCU/SCREW CHILLER/PAC**




DCS INTERFACE FOR AHUs VFD(VFD-AC)
VFD-AC PANEL
ON FEED BACK
FAULT FEED BACK
BYPASS ON FEED BACK
START COMMAND
STOP COMMAND
BY PASS ON COMMAND
SPEED REFERENCE (4-20mA)
SPEED FEED BACK (4-20mA)
4pX0.5Sqmm 'F-TYPE'
BINARY OUTPUT
BINARY INPUT
ANALOG OUTPUT
ANALOG INPUT
DCS
BUS
OWS


DCS INTERFACE FOR MOTORIZED OPERATED VALVES (BID-AC,BID-VCD)
COMMON
OPEN LS
CLOSE LS
3Cx2.5 Sqmm CONTROL CABLE
4Px0.5Sqmm
OPEN COMMAND
CLOSE COMMAND
INTERPOSING RELAY
INTERPOSING RELAY
K-1
K-2
K-2
K-1
MCB
230V AC
BINARY OUTPUT
BINARY OUTPUT
BINARY INPUT
DCS
BUS
OWS

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **AIR CONDITIONING SYSTEM**	

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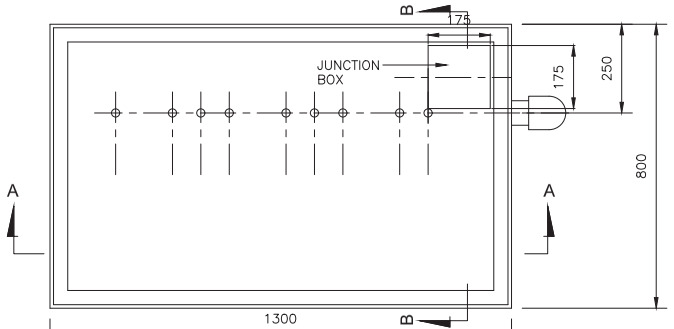
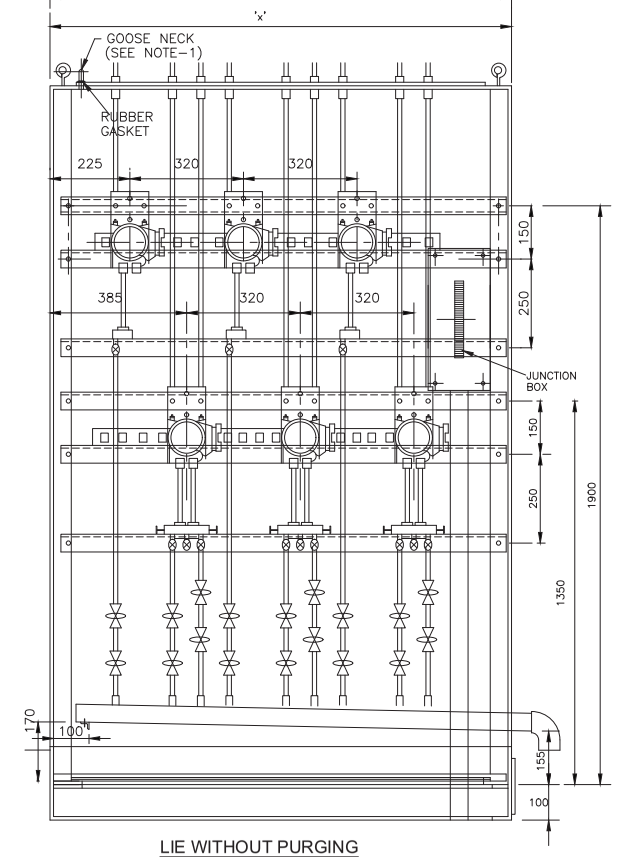
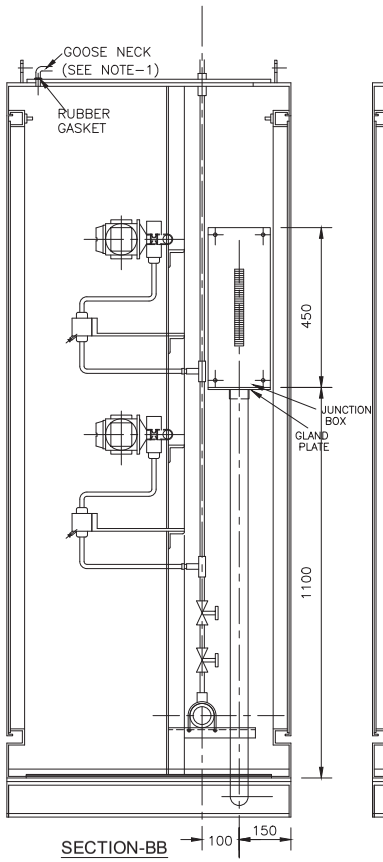
DRIVE AND INSTRUMENT INTERFACE DIAGRAM

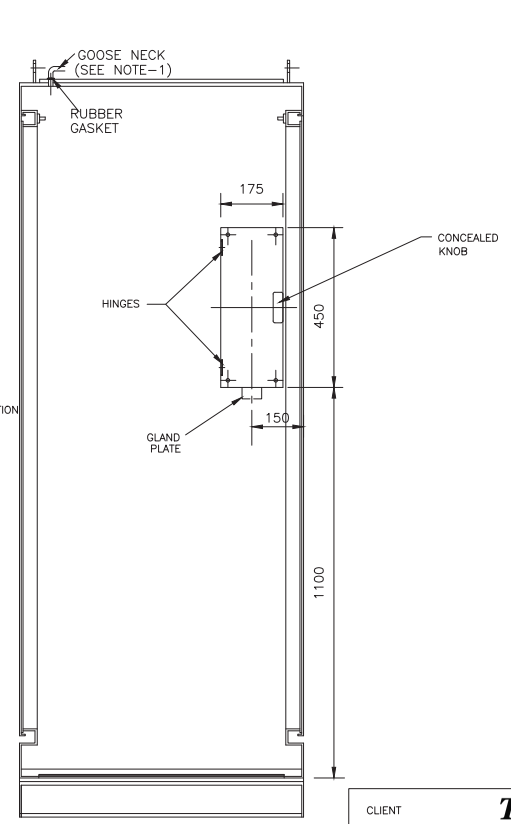




LIE WITHOUT PURGING



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.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										26.04.06

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(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT
SG,TG, BOP PACKAGE

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-064	A

SHEET 01 OF 03

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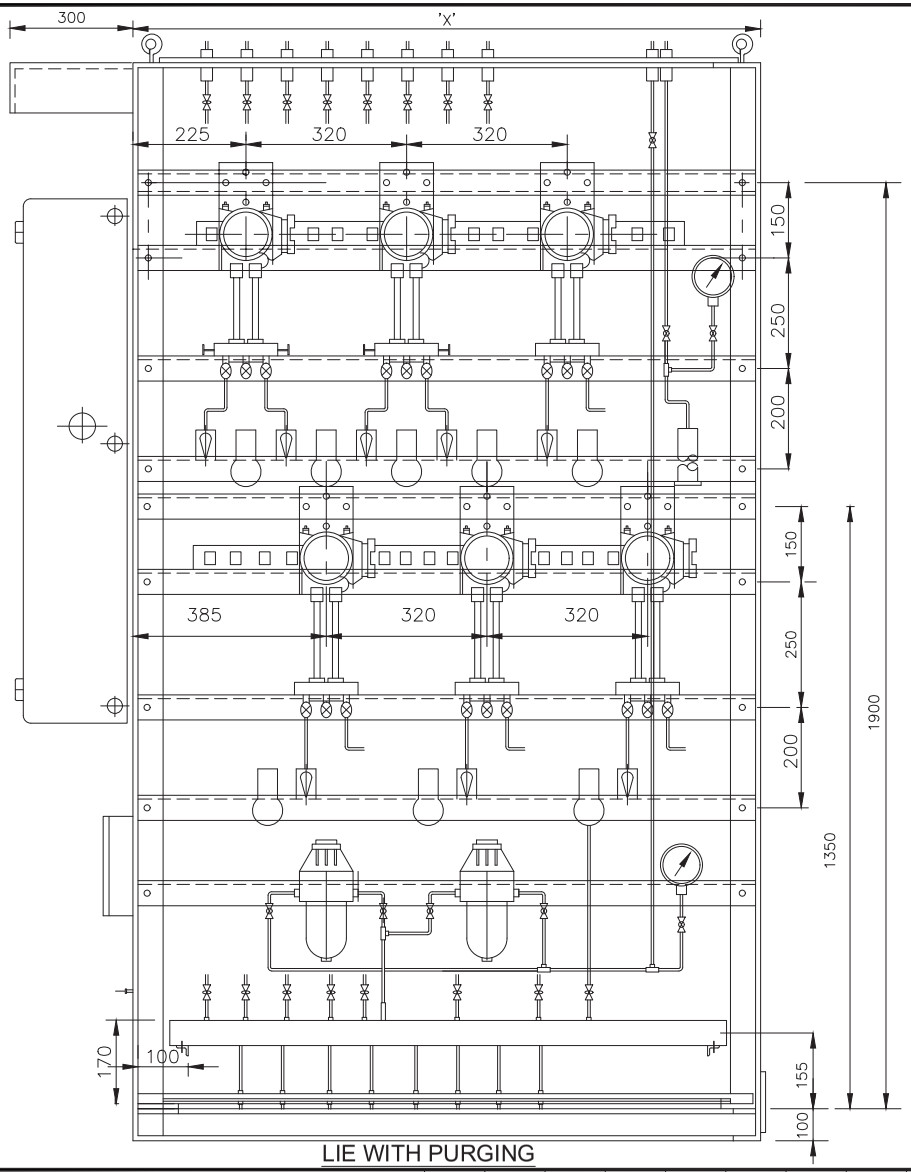

LIE WITH PURGING

LIR TYPE	MAX. NO. OF TRANSMITTERS	DIMENSION 'X' (mm)
A	6	1250
B	4	930

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(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT
SG,TG,BOP PACKAGE

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
D	FIRST ISSUE										22.08.02

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SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-064 SH– 02 OF 03	D

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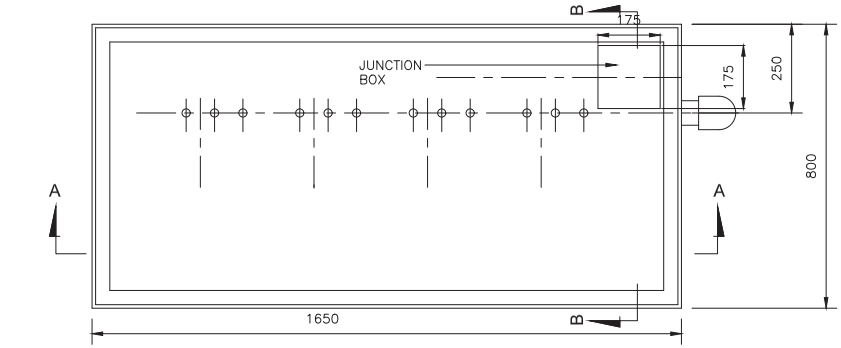
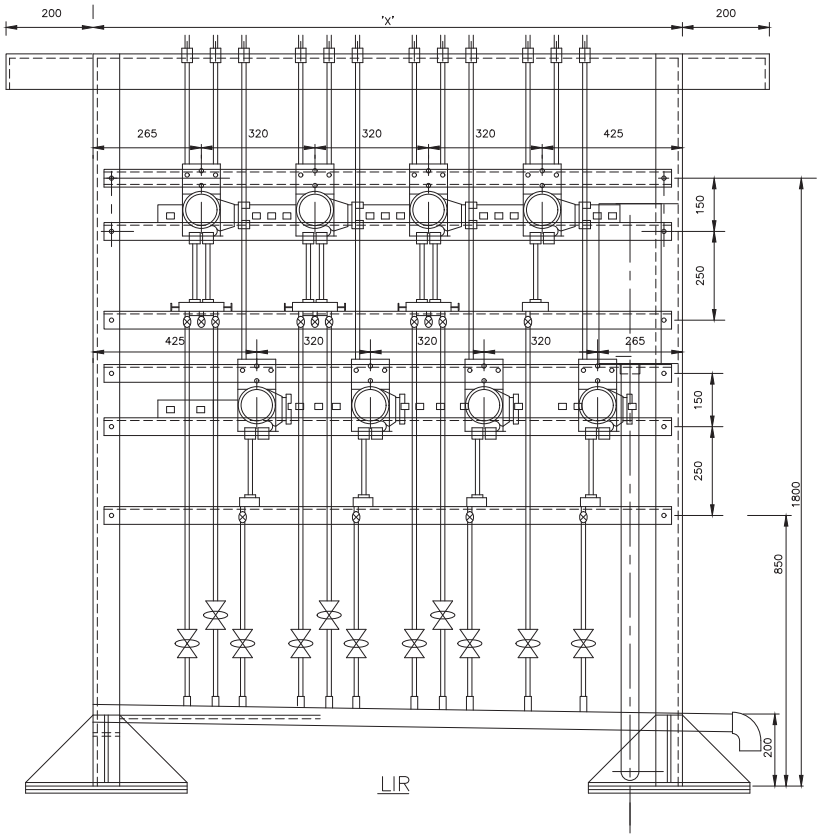
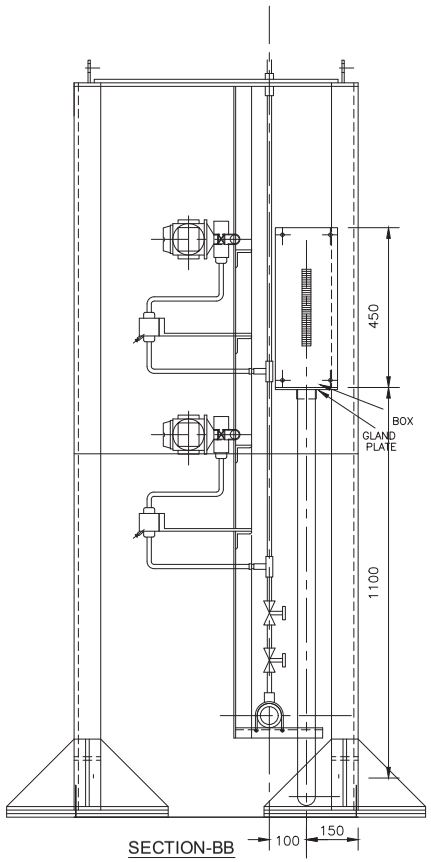


LIR TYPE	MAX. NO. OF TRANSMITTERS	DIMENSION 'X' (mm)
A	8	1650
B	6	1330
C	4	1010



LIR



SECTION-BB

SECTION-AA
LIR WITHOUT PURGING

NOTE:–

1. MATERIAL OF JBs FOR LIRs SHALL BE SAME AS THAT OF LIR.

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PROJECT: TYPICAL THERMAL POWER PROJECT
SG,TG, BOP PACKAGE

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-064 SH– 03 OF 03	A

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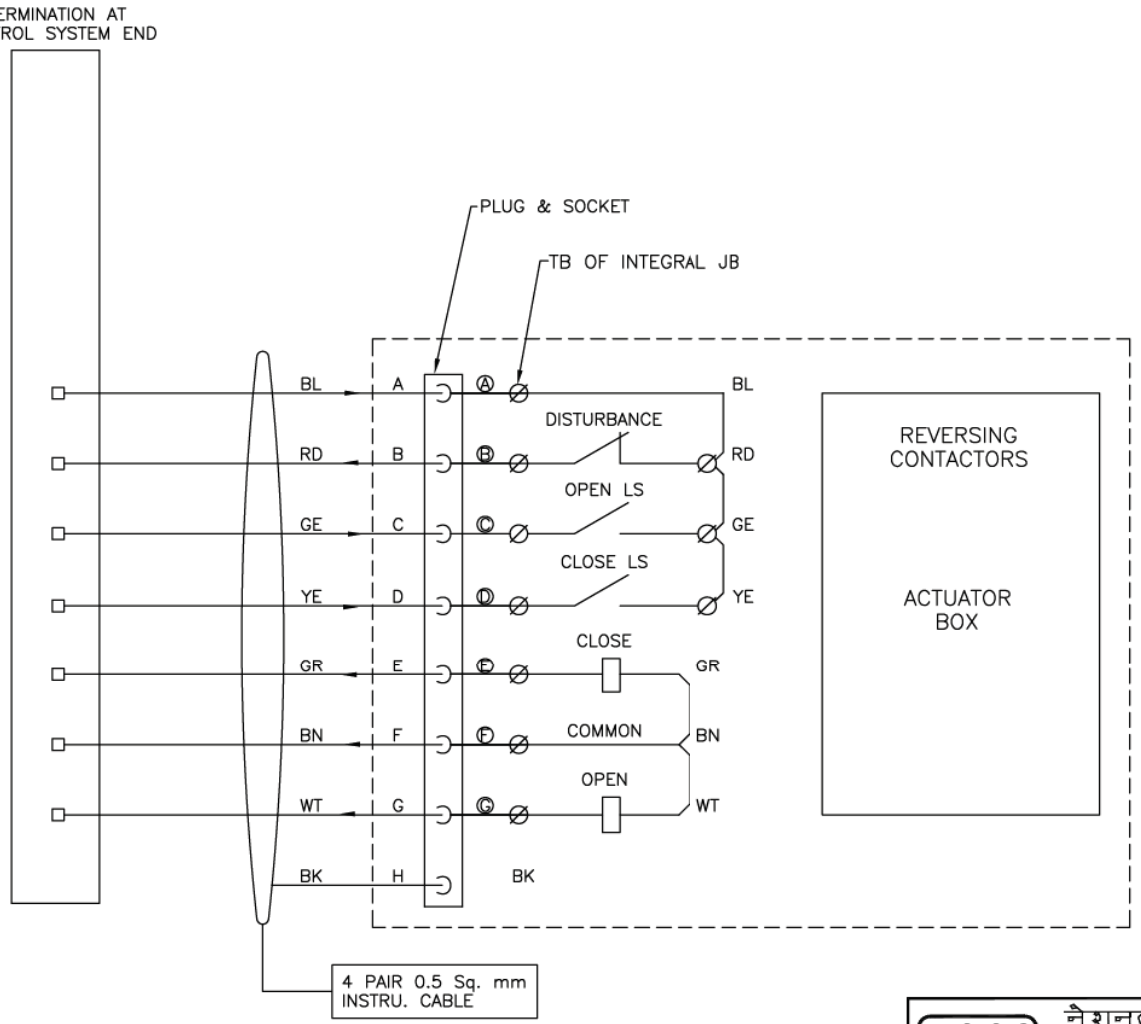

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नेशनल थर्मल पावर कारपोरेशन लिमिटेड
National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF ACTUATORS

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
D	FIRST ISSUE										21.08.12

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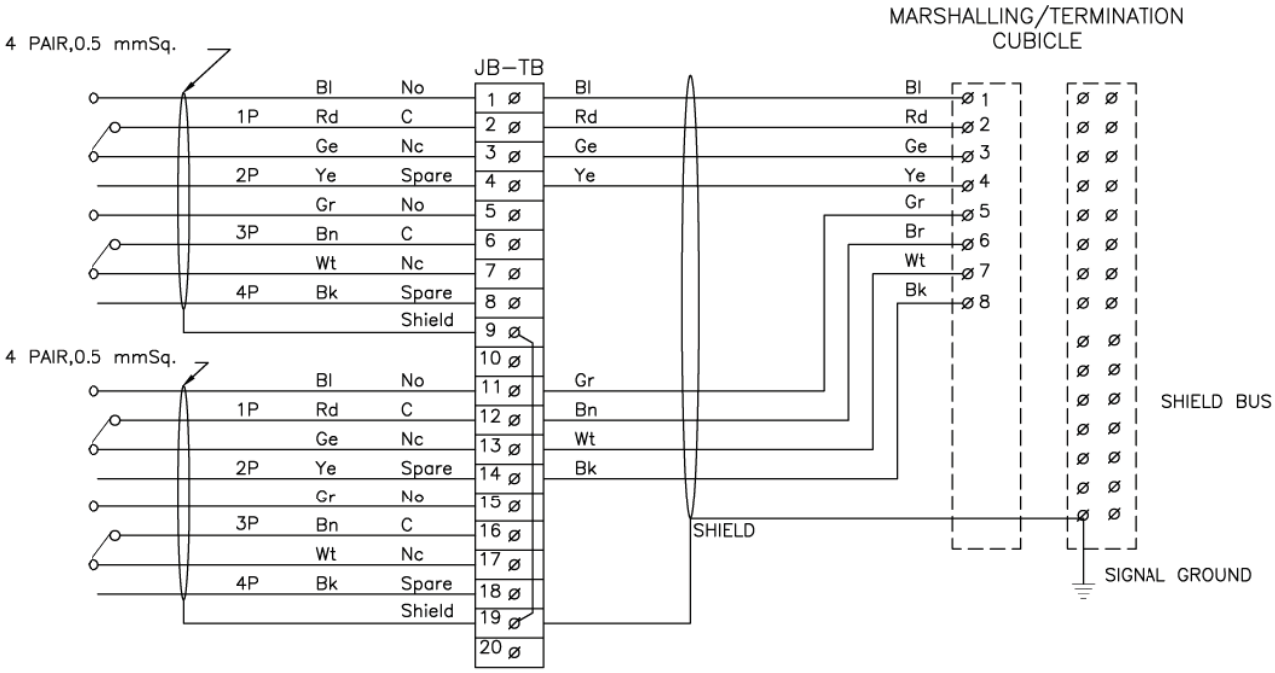
SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-063	D



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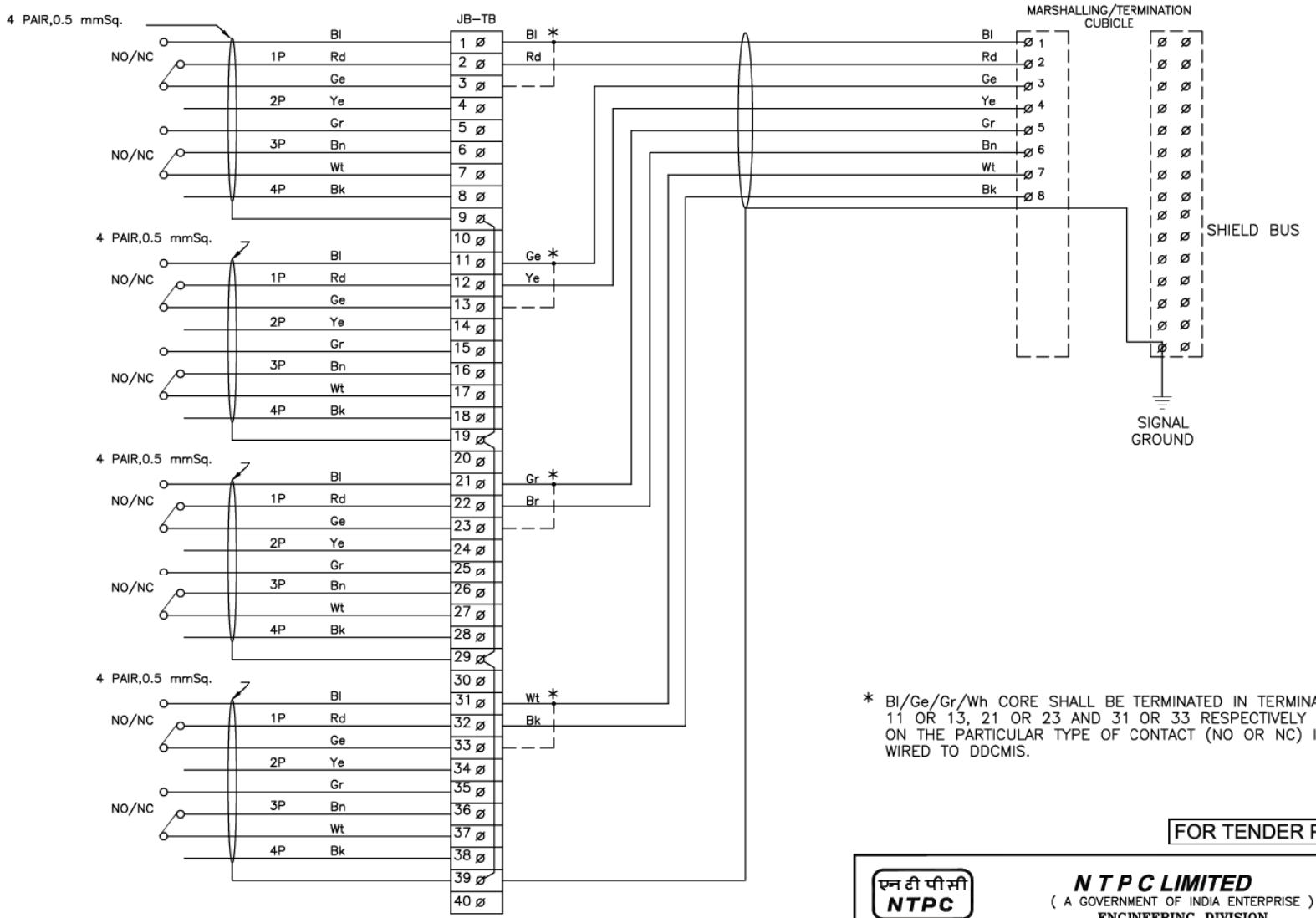
N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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										21.08.12
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 01 OF 15	A



* 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.

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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										21.08.12
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
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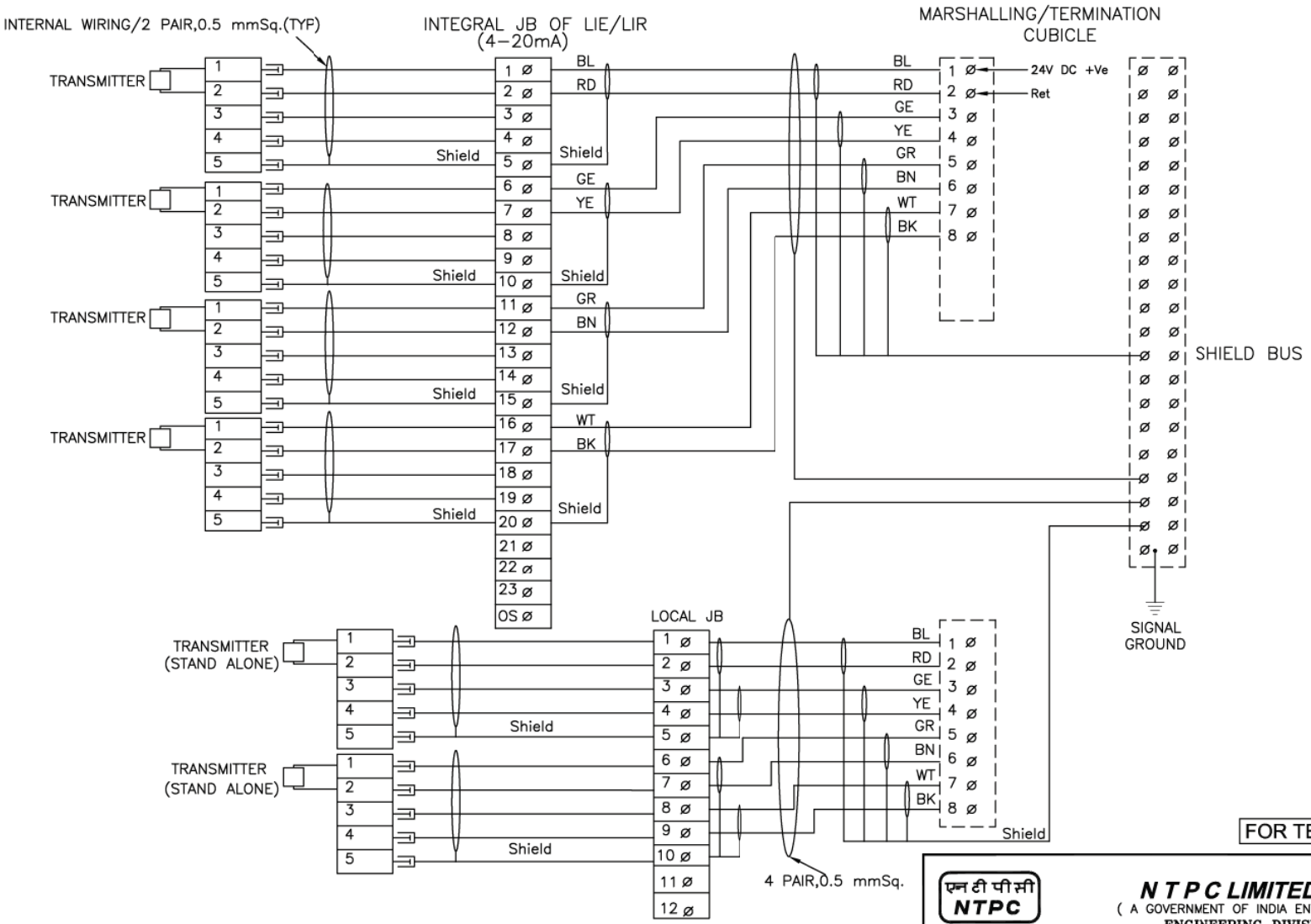

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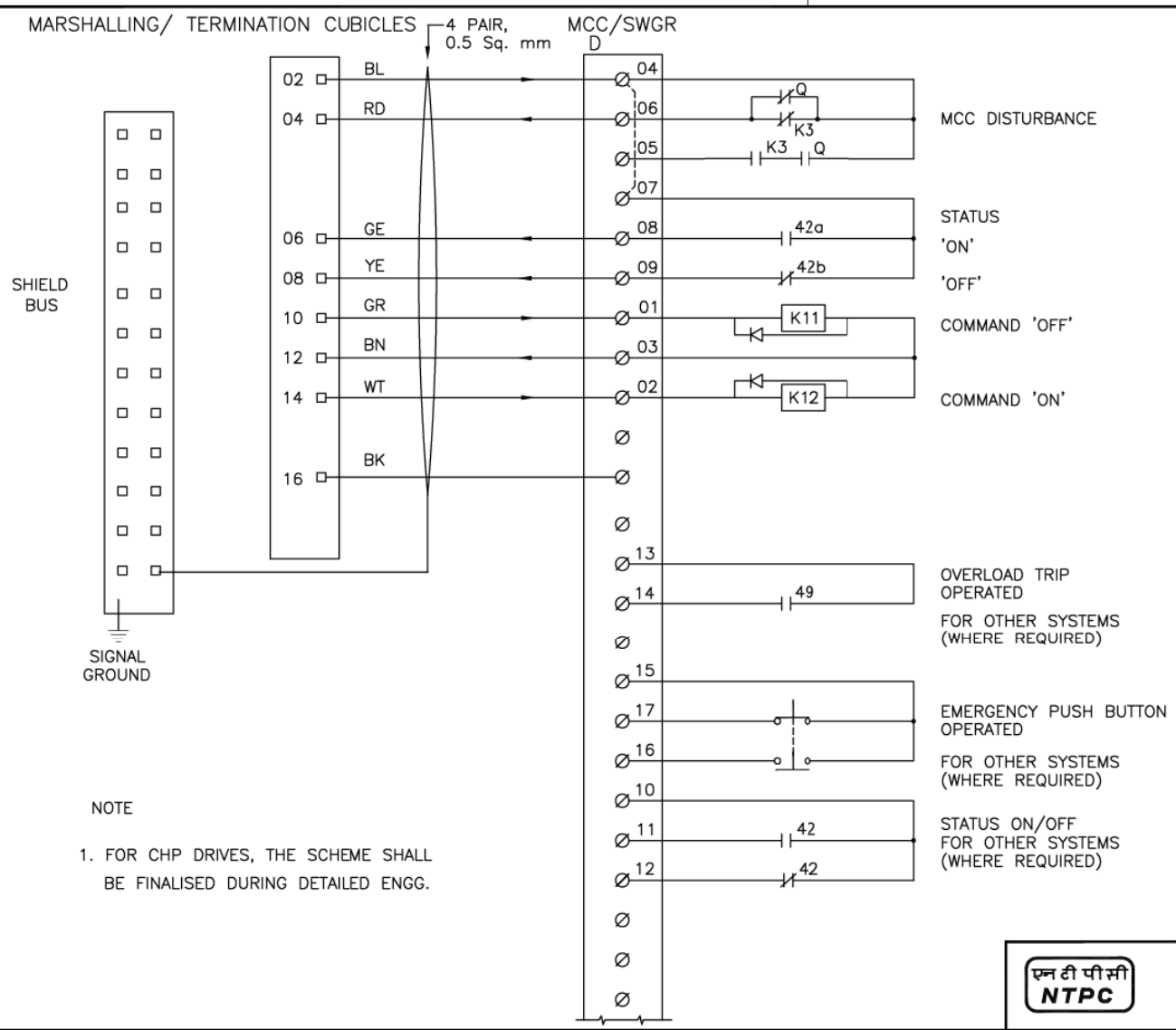
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS 4-20mA

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	INTERNAL WIRING FOR LIE/LIR MOUNTED SHOWN WIRING OF STAND ALONE TXTR SHOWN										21.08.12
A	FIRST ISSUE										12.1.05
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 04 OF 15	B



NOTE

1. FOR CHP DRIVES, THE SCHEME SHALL BE FINALISED DURING DETAILED ENGG.

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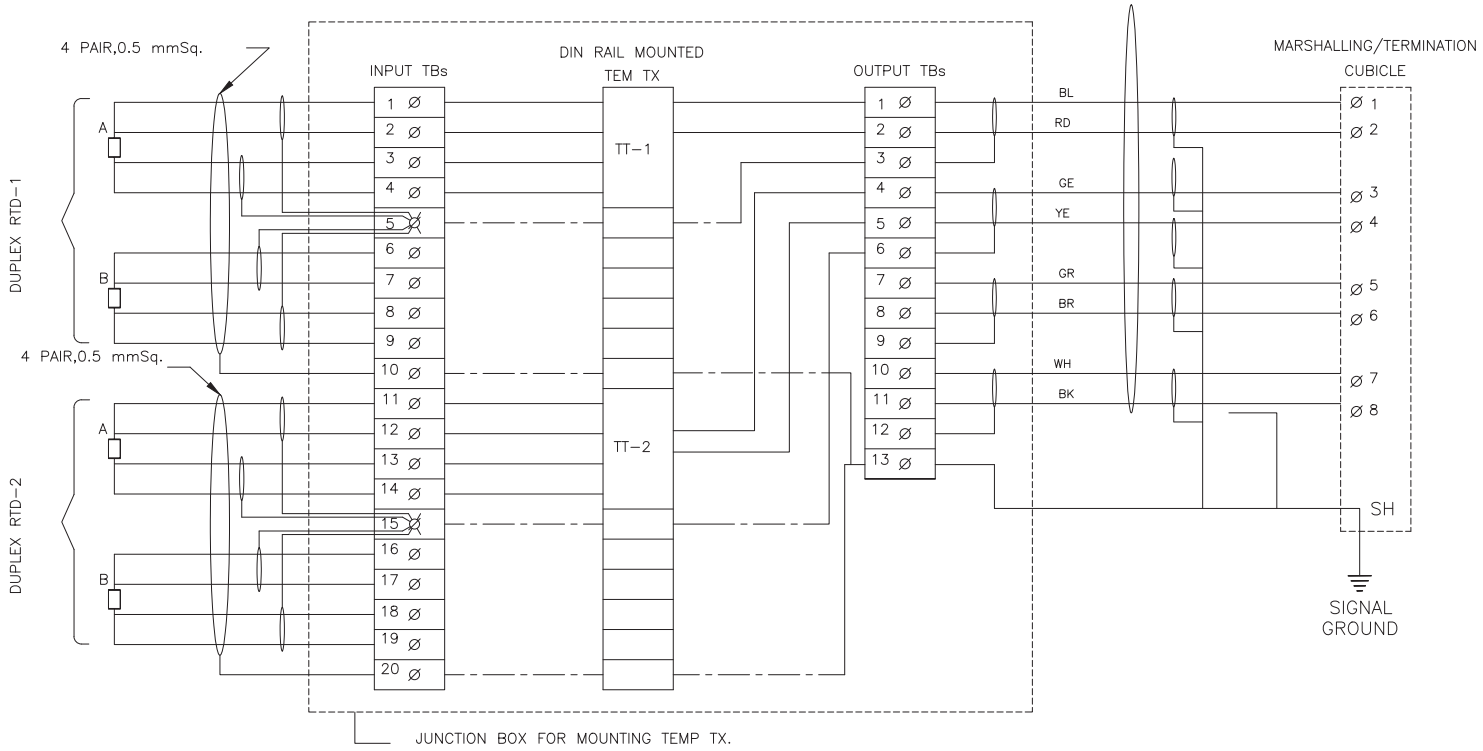
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(LT MOTORS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 05 OF 15	A



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. FOR DUAL INPUT TRANSMITTER, BOTH ELEMENTS SHALL BE TERMINATED TO TT.
2. THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISTED DURING DETAILED ENGG. STAGE.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	CLEARED BY M	E	C	C&I	ARCH.	APPD	DATE
C	UPDATED										30.12.16
A	FIRST ISSUE										29.04.06

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CONSULTANT **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS INJBs

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 06 OF 14	C

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	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **AIR CONDITIONING SYSTEM**	

`

INSTRUMENTATION CABLE, CABLE TERMINATION PHILOSOPHY & JUNCTION BOXES

2.00.00 SPECIFICATION OF INSTRUMENTATION CABLE

2.01.00 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.

S. No.	Property	Requirement
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 c.Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath.	
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.	Ovality at any cross-section	Not more than 1.0 mm
8.	CAGE-CLAMP suitability	To be provided
9.	Color	The outer sheath shall be of blue color.
10.	Others	Repaired cables shall not be acceptable.

2.02.00 **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
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

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
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 (i.e. extruded FEP)
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 or Numbered binder tape to be provided on each pair
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			
Individual pair shielding	No		To be provided for F-type cable	No
Minimum thickness of Individual pair shielding	No		0.028mm (28 micron)	No

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
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 shield	N.A.		Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper	N.A.
Drain wire provided for 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.

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Maximum Acid gas generation by weight as per IEC-60754-1	20%			N.A.
Maximum Smoke Density Rating as per ASTMD-2843	60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			N.A.
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 type 100 nF/km for G-type	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.

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
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 (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to entire 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

3.07.00 Penetration of water resistance and impact resistance shall be as per IEC standard.

4.00.00 SPCIFICATION OF CONTROL & POWER SUPPLY CABLES

Refer Electrical sub-sections

5.00.00 INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.

TABLE A: CABLE TERMINATION TO BE FOLLOWED

Application		Type Of Termination		Type Of Cable
FROM (A)	**TO (B)**	**END A**	**END B**	
Valves/dampers drives (Integral Junction box)	Marshalling / Marshalling – cum Termination Cubicle / local group JB	Plug in connector	Post mount cage clamp type.	G
Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G
RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F
Thermocouple	Local junction box / CJC box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A, B, C*
Other Field mounted Instrument	Local JB / Group JB	Plug in connector	Cage clamp (Rail mount) type.	F,G
RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F
Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A, B, C*

Application		Type Of Termination		Type Of Cable
FROM (A)	TO (B)	END A	END B	
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR	Marshalling / Marshalling – cum Termination Cubicle	Cage clamp (Rail mount) type.	Cage clamp (Post mounted) type.	F,G
Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp (Post mounted) type.	Plug-in connector / other system as per Mfr.'s Standard	Internal wiring
Marshalling/ Termination System Cabinets	UCD mounted equipments	Cage clamp (Post mounted) type.	Plug in connector / Cage clamp type (rail mounted).	F,G (with plug-in connector at one end)
DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard

Notes

1 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables which shall be as per manufacturer's standard.

2 For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.

3 * For high temperature applications only.

4 For Cable type and cable termination scheme for the instruments/ equipment that are connected to Steam Turbine and Generator (STG) control system defined at Part A, sub section IIC, clause no. 2.03.01 (a) (ii) above and hydrogen generation plant auxiliaries system, Contractor's standard and proven practice is also acceptable. However, for termination of instrumentation cable at marshalling cabinets/DCS panel end, cage-clamp termination shall be offered. For power and control cable termination, Contractor's standard and proven practice would be acceptable.

6.00.00	**TERMINAL BLOCKS**
6.01.00	All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.
6.02.00	All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc.
6.03.00	The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.
6.04.00	For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.

6.05.00	The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
7.00.00	**INTERNAL PANELS/ SYSTEM CABINETS WIRING**
7.01.00	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.
7.02.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.
7.03.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.
7.04.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.
7.05.00	All the special tools as may be required for solder less connections shall be provided by Bidder.
7.06.00	Wire sizes to be utilised for internal wiring.

(i)	Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system.	0.5 Sq.mm.
(ii)	Power supply and internal illumination.	2.5Sq.mm. minimum (shall be as per load requirement.)

10.00.00	**FIELD MOUNTED LOCAL JUNCTION BOXES**		
	(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	Screwed at all four corners for door. Door gasket shall be of synthetic rubber.

	(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply.
	(v)	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.
	(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
	(vii)	Grounding	To be provided.
	(viii)	Color	RAL 7035

Note : For solenoid valve box, the material for the enclosure shall be of steel plate (SS304) with minimum 2 mm thick frame and minimum 2 mm thick steel (SS-304) sheet. Provision of individual isolation for each solenoid shall be provided inside the box. Minimum 100 mm space between the solenoids shall be ensured for ease of access and maintenance. All other specifications shall be as per above.

11.00.00 CONDUITS

11.01.00 Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant terne coated steel with , water leak, fire and rust proof protected for the areas of Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's .

And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided. The temperature rating of flexible conduit shall be suitable for actual application.

11.02.00 All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.

11.03.00 Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.

11.04.00 Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.

11.05.00 Conduits shall be securely fastened to all boxes and cabinets.

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

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QUALITY ASSURANCE

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) Page- 1/2									
TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	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. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. 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 (PRIMARY AND SECONDARY) Page- 2/2

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **			Y	Y **	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y *	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Analysers	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*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.												
** If applicable												

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.

PROCESS CONNECTION & PIPING

TESTS / ITEMS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	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 Y Y	Y												
Local instruments racks Y Y Y Y	Y Y	Y Y Y	Y Y	Y Y													
Junction Box Y Y Y Y* Y Y Y																	
Gauge Board Y Y Y Y Y Y Y Y	Y																
Impulse pipes and tubes Y Y Y	Y	Y															
Socket weld fittings ANSI B-16.11	Y	Y Y		Y Y													
Compression fittings Y Y Y	Y Y	Y															
Instrument valves & Valve manifolds	Y	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.

CLAUSE NO.

QUALITY ASSURANCE

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.

CLAUSE NO.

QUALITY ASSURNACE & INSPECTION

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	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions

2) 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.

® - Routine Test (A) - Acceptance Test Y - Test applicable

CONTROL DESK, LVS PANEL, PLC PANEL, SMOKE DETECTOR, FIRE ALARM & CONTROL SYSTEM

ITEMS \ TESTS	Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade/Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ osaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element ,	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
1. Control Desk	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
2. LVS Panel	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y
3. Annunciation, Control, PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
4.Smoke Detectors (UL-268,EN-54 PT-7), Heat Detectors(UL-521/EN 54 PT-5) Annunciation/ Control Panel (UL -864, EN-54, PT-2)															Y

Note: 1) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents.

- *Applicable for PLC
- Y - Test Applicable , ® - Routine Test (A) - Acceptance Test

CLAUSE NO.

QUALITY ASSURANCE

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.

[20150424]

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-1056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 1 OF 9

SL. 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 M	6 C/N	7	8	9	D	M	C	N	
	RAW MATERIAL													
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		2. Bend Test	CR	Mech. test	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		3. Surface finish	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Waviness	MA	Visual	100%	10%	Manufacturing Standard	No Waviness	Inspection Report	√	P/W	---		
		5. Thickness	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		6. Mill marking	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Sample	IS:2062	IS:2062	Test Certificate	√	P/W	---		
		2. Surface Defects	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		3. Straightness	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Mill marking	MA	Visual	100%	10%	IS:2062	IS:2062	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign &.Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/2/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 2 OF 9

SL. 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	D	**			
					M	C/N					M	C	N	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		2. IR and HV	MA	Electrical	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	 10% 10% 10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		4. Type / Routine Test Certificates	MA	Verification	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays	1. Verification at make and Type	CR	Visual	Sample	Sample	Approved Drg/Datasheet	Approved Drg/Datasheet	Test Certificate	√	P/W			
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		3. Operation / Functional check	CR	Electrical	Sample+ 100% @	Sample+ 10% @	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			+ for relay & contactors only

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 3 OF 9

SL. 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	
	Timers, Space Heaters, Thermostat, Indicating meters etc.	4. I.R.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		6. Calibration	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W	V		
		7. Pick up / Drop off Voltage	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		2. Surface defects	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
	IN PROCESS INSPECTION													

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 4 OF 9

SL. 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	
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Surface defects after bending	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W			
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Deburring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
	ASSEMBLY													
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Alignment	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Welding Quality	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Surface defects	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/2/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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Approved by:			

बीएच ई एल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
		PROJECT:		PO NO.: --	DATE: --
		ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 5 OF 9

SL. 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	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Periodic	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		3. Dipping / Removal Time	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		4. Surface quality after every dip	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		5. Primer after phosphating	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		7. Paint first coat	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/4/2020	CHETAN MALIK	Checked by:	14/04/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/4/2020	RK RAINA	Reviewed by:	14/4/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 6 OF 9

SL. 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	D	**			
					M	C/N					M	C	N	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Ferrule numbers	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Colour of wiring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		5. Size of Conductor	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
11.	Component Mounting	1. Correct components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Fixing	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/2/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 7 OF 9

SL. 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 M	6 C/N	7	8	9	D	M	C	N	
	FINAL TESTING													
12.	Final Inspection	1. Workmanship	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		3. Components identification Marking / Name plates	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		5. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		6. Door functioning	MA	Functional	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		7. Paint Shade	CR	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 8 OF 9

SL. 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	D	**			
					M	C/N					M	C	N	
		8. Paint Thickness	CR	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		9. Workmanship of Gaskets	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		10. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		11. Wire Termination	MA	Pulling manually	Sample	Sample	-----	Firm termination	Inspection Report	√	P/W	W		
		12. Continuity	MA	Electrical	100%	10%	-----	Continuity OK	Inspection Report	√	P/W	W		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	Sample	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	√	P/W	V		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 9 OF 9

SL. 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	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		2. Instrument Calibration	CR	Electrical	10%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		3. Temperature rise	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

NOTES:

1. Customer's specification for painting shall be included in the technical specification. In the absence of Customer's spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
2. Copies of all TC's (Test Certificates) for components shall be submitted to BHEL for verification and acceptance.
3. BHEL reserves the right to conduct repeat tests, if required.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, **D**: DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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Reviewed by:			
Approved by:			

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

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TYPE TEST REQUIREMENT

1.00.00	**TYPE TEST REQUIREMENTS**
1.01.00	General Requirements
1.01.01	The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. If the bidder proposes a different standard/code from that indicated at table 3.00.00, same is acceptable provided the equivalence of the proposed standard is established by the bidder. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard. (a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests. (b) For the rest, submission of type test results and certificate shall be acceptable provided. i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. ii. There has been no change in the components from the offered equipment & tested equipment. iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening. (c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.
1.01.02	As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.
1.01.03	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
1.01.04	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.
1.01.05	The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.

CLAUSE NO.	TECHNICAL REQUIREMENTS

2.00.00 **SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS**

2.01.00 The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems shall be as indicated below:

i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test.

ii) Dry Heat test as per IEC-68-2-2 or equivalent.

iii) Damp Heat test as per IEC-68-2-3 or equivalent.

iv) Vibration test as per IEC-68-2-6 or equivalent.

v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent.

vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent.

vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent.

Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.

3.00.00 **TYPE TEST REQUIREMENT FOR 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	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	No
2	Transducers	As per standard (col 4)	IEC-60688,IS12784	No	No
3	Thermocouple	Degree of protection test	IS-13947	No	No
4	RTD	As per standard (col 4)	IEC-60751	No	No
5	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	No
6	E/P converter	As per standard (col 4)	Mfr. standard	No	No
7	Dust emission monitor	Degree of protection test	IS-13947	No	No
8	Instrumentation Cables Twisted & Shielded*				
	-Conductor	Resistance test	VDE-0815	No	No
		Diameter test	IS-10810	No	No
		Tin Coating test (Persul-phate test)	IS-8130	No	No
	-Insulation	Loss of mass	VDE 0472	No	No
		Ageing in air ovens**	VDE 0472	No	No
		Tensile strength and	VDE 0472	No	No

		elongation test before and after ageing**			
		Heat shock	VDE 0472	No	No
		Hot deformation	VDE 0472	No	No
		Shrinkage	VDE 0472	No	No
		Bleeding & blooming	IS-10810	No	No
	-Inner sheath***	Loss of mass	VDE 0472	No	No
		Heat shock	VDE 0472	No	No
		Cold bend/ cold impact test	VDE 0472	No	No
		Hot deformation	VDE 0472	No	No
		Shrinkage	VDE 0472	No	No
	-Outer sheath	Loss of mass	VDE 0472	No	No
		Ageing in air ovens**	VDE 0472	No	No
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	No
		Heat shock	VDE 0472	No	No
		Hot deformation	VDE 0472	No	No
		Shrinkage	VDE 0472	No	No
		Bleeding & blooming	IS-10810	No	No
		Colour fastness to water	IS-5831	No	No
		Cold bend/ cold impact test	VDE-0472	No	No

		Oxygen index test	ASTMD-2863	No	No
		Smoke Density Test	ASTMD-2843	No	No
		Acid gas generation test	IEC-60754-1	No	No
	-fillers	Oxygen index test	ASTMD-2863	No	No
		Acid gas generation test	IEC-60754-1	No	No
	-AL-MYLAR shield	Continuity test		No	No
		Shield thickness		No	No
		Overlap test		No	No
	-Over all cable	Flammability Test	IEEE 383	No	No
		Swedish Chimney Test	SEN 4241475	No	No
		Noise interference	IEEE Trans-actions	No	No
		Dimensional checks	IS 10810	No	No
		Cross talk	VDE-0472	No	No
		Mutual capacitance	VDE-0472	No	No
		HV test	VDE-0815	No	No
		Drain wire continuity		No	No

* 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

9 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 37.90.1, IEEE-472,EN 61000-4-12	No	No
Dry Heat Test	IEC-68-2-2 or equivalent	No	No
Damp Heat test	IEC-68-2-3 or equivalent	No	No
Vibration test	IEC68-2-6 or equivalent	No	No
Electrostatic discharge test	EN 61000-4-2 orr equivalent	No	No
Radio frequency immunity test	EN-61000-4-3 orr equivalent	No	No
Electromagnetic field immunity	EN 61000-4-3 orr equivalent	No	No
Degree of Protection	IS-13947 or equivalent	No	No

10	Battery ##	As per standard (col 4)	IS-10918 (Ni-Cd Batteries)	No	No
			IS-1652 (Lead Acid Plante Batteries)	No	No
11	NOT APPLICABLE				
12	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 37.90.1, IEEE-472,EN 61000-4-12	No	No
	Dry Heat Test	IEC-68-2-2 or equivalent	No	No
	Damp Heat test	IEC-68-2-3 or equivalent	No	No
	Vibration test	IEC68-2-6 or equivalent	No	No
	Electrostatic discharge test	EN 61000-4-2 orr equivalent	No	No
	Radio frequency immunity test	EN-61000-4-3 orr equivalent	No	No
	Electromagnetic field immunity	EN 61000-4-3 orr equivalent	No	No
	Degree of protection test	IS-13947	No	No
	Fuse Clearing Capability	Approved procedure	No	No
	Short Circuit current capability	IEC 60146-2	No	No
13	Voltage Stabilisers	Over Load Test	Approved procedure	No	No

		Temp rise test without redundant fans	Approved procedure	No	No
14	Public Address System				
	IP based PA system components	As per Standard	IEC 60268-16	No	Yes
15	LIE / LIR	Degree of protection test	IS-13947	No	No
16	Flue gas analyzers	Degree of protection test	IS-13947	No	No
17	Master Clock	Functional test	As per approved procedure	No	No
18	CJC Box	Degree Of protection test	IS-13947	No	No
19	Junction Box	Degree Of protection Test	IS-13947	No	No
20	OPC Data Access Server, Data Exchange Server & Historical Data Access Server	OPC Compliance Testing		No	No (Self certification is also acceptable)
21	Conductivity Type Level Switch	Degree of protection test	IS-2147	No	No
22	Local Gauges	Degree of protection test	IS-2147	No	No
23	Process actuated Switches	Degree of protection test	IS-2147	No	No
24	Control Valves	CV test	ISA 75.02& 75.11	No	No
25	PLCs	As per standard (Col	IEC 1131	No	No

			4)				
26	Flow Orifice Venturi	Nozzle plates,	Calibration	ASME PTC BS 1042	No		No

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 / owners 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.

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

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MANDATORY SPARE LIST

6.0	**Electrical Actuators**	
6.1	Actuators	10% or 1 No. of each type, model and rating, whichever is more.
6.2	Motor for Centrifugal fan for air washer unit	1 No of each rating
6.3	**Variable Frequency Derive (VFD)**	
6.3.1	Complete VFD derive	1 No of each type & rating
6.3.2	Complete Converter & Inverter unit	1 No of each type & rating
6.3.3	Set of Cards	1 No of each type & rating
6.3.4	Set of fuses	2 Nos of each type & rating
6.3.5	Input & Output Chokes (If applicable)	1 Set
7.0	**Control & Instrumentation**	
i)	Air-Conditioning System	
7.1	Electronic Transmitters	

7.1.1	Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.)	5% or 1 No. of each type and model whichever is more. (to be divided into various ranges in proportion to main population)
7.2	Temperature elements	
7.2.1	RTD's*	5% or 1 No. which ever is more **
7.2.2	Thermo well * (With head assembly, terminal block and nipple)	5% or 1 No. which ever is more ** ** (to be divided into various insertion lengths in proportion to main population)
7.3	All types of Local Indicators	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main population of all make, model and type)
7.4	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, and differential temperature, level switch Devices.	5% or 1No. of each type and model whichever is more.
7.5	Relative Humidity Sensors	2 Nos.
7.6	Geyserstat	2 Nos.
7.7	Local Humidity/Temperature indicators	2 Nos. each
8.0	Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)	
8.1	Valves	10% or 1 No. of each type, class, size and model whichever is more.
8.2	2 way, 3way, 5way valve manifolds	10% or 1 No. of each type, class, size and model whichever is more.
8.3	Fittings	10% or 1 No. of each type, class, size and model whichever is more.

Note: Wherever “set” is indicated, it shall mean complete replacement for one main equipment.

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR AIR CONDITIONING SYSTEM	

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SUB VENDOR LIST

PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY)

Sl No	Package Name	Supplier Name	Supplier Communication Address
1	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,
2	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
3	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
4	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone-9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
5	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de
6	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
7	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
8	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com
9	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
10	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
11	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone-24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
12	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
13	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com

14	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
15	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
16	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
17	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
18	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
19	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
20	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
21	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
22	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
23	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
24	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
25	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in
26	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
27	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
28	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com

29	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
30	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
31	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
32	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com
33	TEMP. ELEMENT	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
34	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com
35	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
36	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
37	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in
38	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
39	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
40	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
41	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com
42	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,
43	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com

44	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
45	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
46	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
47	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
48	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,
49	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
50	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
51	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
52	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
53	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
54	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
55	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
56	TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
57	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
58	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com

59	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
60	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
61	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
62	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone-9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
63	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com
64	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
65	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
66	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
67	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
68	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
69	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
70	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone-022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
71	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone-+919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in

72	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
73	LEVEL SWITCH-CAPACITANCE TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone-9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
74	LEVEL SWITCH-CAPACITANCE TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
75	LEVEL SWITCH-CAPACITANCE TYPE	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in
76	LEVEL SWITCH-CAPACITANCE TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
77	LEVEL SWITCH-CAPACITANCE TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
78	LEVEL SWITCH-CONDUTIVITY TYPE	Sapcon Instrument Pvt Ltd.	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com
79	LEVEL SWITCH-CONDUTIVITY TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
80	LEVEL SWITCH-CONDUTIVITY TYPE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
81	LEVEL SWITCH-CONDUTIVITY TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
82	LEVEL SWITCH-CONDUTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA Phone- 033-22290045 Pincode : 700016 Email : sandeep@hitech.in
83	LEVEL SWITCH-CONDUTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.	Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com
84	LEVEL SWITCH-CONDUTIVITY TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone-+919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
85	LEVEL SWITCH-CONDUTIVITY TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,

86	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
87	LEVEL SWITCH-FLOAT TYPE	D.K. INSTRUMENTS PVT.LTD.	N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@vsnl.net
88	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
89	LEVEL SWITCH-FLOAT TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone-9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
90	LEVEL SWITCH-FLOAT TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
91	LEVEL SWITCH-FLOAT TYPE	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone-9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
92	LEVEL SWITCH-FLOAT TYPE	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
93	LEVEL SWITCH-FLOAT TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
94	LEVEL SWITCH-FLOAT TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone-+919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
95	LEVEL SWITCH-FLOAT TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
96	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
97	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
98	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone-022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
99	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com

100	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
101	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com
102	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
103	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
104	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
105	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
106	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
107	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
108	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
109	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,

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

	THDC INDIA LIMITED **2 X 660MW STPP KHURJA – TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **AIR CONDITIONING SYSTEM**	

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KKS NUMBERING PHILOSOPHY

DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

1) Refer the P&ID sheets.

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level

CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- *Equipment Code – AA*

		N1	N2 N3
Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*1*	*51 to 99*
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99

NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

ii) Field Instruments

Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ……. Where system code is same.

.FOR INSTRUMENTS KKS 6th AND 7th PLACE VALUE OF KKS CODE SHALL BE CHANGED FOR CORRESPONDING EQUIPMENT AS FOLLOWS:-
1.FOR PRESSURE -CP
2.FOR TEMPERATURE/GT/AT/TEMP SENSOR-CT
3.FOR LEVEL-CL
4.FOR FLOW-CF
5.R.H.SENSOR-CM
FOR INSTRUMENTS 8th,9th AND 10th PLACE VALUE OF KKS CODE SHALL BE CHANGED FOR CORRESPONDING EQUIPMENT AS FOLLOWS:-
1.FOR PRESSURE/TEMPERATURE/LEVEL TRANSMITTER-011
2.FOR PRESSURE/TEMPERATURE/LEVEL GAUGE-511
3.FOR PRESSURE/TEMPERATURE/LEVEL SWITCH-111

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FORMAT FOR LIST OF PT, DPT AND GUIDED WAVE RADAR (GWR) TYPE

Position	Field Name	Type	Description
1	**KKS_CODE**	**Text**	This column contains the KKS code of instrument. This should be same as indicated in the P&ID/Instrument schedule and Process I/O list.
2	**DESCRIPTION**	**Text**	This column contains Description of application for which instrument is being used.
3	**PARAMETER**	**Text**	This columns contains Process parameter measured by the Instrument e.g. GAUGE PRESS, ABS PRESS, DIFF PRESS, LEVEL, FLOW.
4	**TYPE OF TRANSMITTER**	**Text**	PT / DPT / GWR
5	**MEDIUM**	**Text**	This column contains the MEDIUM of measured process e.g. CONDENSATE, FEED WATER, DM WATER, STEAM, WATER, SLURRY, AIR, FLUE GAS, HFO, LDO etc.
6	**SCOPE OF SUPPLY**	**Text**	This column contains the scope of supply for Instruments e.g. STN C&I If Instrument Is to be supplied under Station C&I Package or SG If Instrument Is to be supplied under SG Package or TG If Instrument Is to be suplied under TG Package .
7	**PROCESS_RANGE**	**Alpha-numeric**	This column contains the range (along with unit of measurement) of parameter being measured by instrument e.g. 0-100 T/HR, (-1)-5 KG/CM2, (-1)-(-5) KG/CM2. Format should be same as given in example.
8	**DP RANGE (FOR LEVEL, FLOW)**	**Alpha-numeric**	This column contains the DP range (along with unit) corresponding to flow or level measurement and applicable where DP type transmitter is being used for flow or level measurement.
9	**OPR VALUE**	**Alpha-numeric**	This column contains the normal operating value of the process being measured.
10	**P_MAX**	**Alpha-numeric**	This column contains the maximum operating pressure of the process medium along with engineering unit. For DP type of transmitters, maximum operating pressure of high pressure side are to be indicated. Caution :- Pipe design pressure may not be same as process maximum operating pressure. Please keep this in view while filling this details.
11	**T_MAX**	**Alpha-numeric**	This column contains the maximum value of operating temp along with engineering unit.
12	**PROCESS END CONNECTION DETAILS**	**Alpha-numeric**	This column contains the tapping details of process end to which instrument should be compatible. This information shall have to be filled in line with corresponding process tapping drawing/ isometric drawing/ fabrication drawing.
13	**SPECIAL_REMARK**	**Text**	This column contains any additional requirement for the Instrument e.g. Requirement for DIAPHRAGM SEAL, requirement for hazardous area application (hydrogen, chlorine).
14	**REF_DOC_NO**	**Alpha-numeric**	This column contains the document number along with revision number of PID or Instrument schedule In which the Instrument and related proces parameters are shown.
15	**QTY PER UNIT**	**numric**	This column Indicates the per unit quantity of that Instrument.
16	**TOTAL QTY**	**numric**	This column Indicates the total quantity of that Instrument for the STATION.
17	**REV_REMARK**	**Text**	This column contains name of the columns In which changes are done w.r.t. last revision.
18	**REV_NUMBER**	**numric**	This column Indicates the progressive Revision number e.g. 0, 1, 2. Any change done should be marked with correct revision detail for Identification.
19	**REV_CODE**	**Text**	Write A for data chages In any column, B If Instruemnt Is added In this revision and C If Insturment Is to be deleted (Please do not remove row, only write C In the revision code).

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: FORMAT FOR LIST OF PT, DPT AND GUIDED WAVE RADAR (GWR) TYPE

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
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FORMAT FOR LIST OF TEMPERATURE ELEMENTS AND TEMPERATURE TRANSMITTERS

Position	Field Name	Type	Description
1	KKS_CODE	Text	This column contains the KKS code of instrument. This should be same as indicated in the P&ID/Instrument schedule and Process I/O list.
2	DESCRIPTION		This column contains Description of application for which temp element is being used.
3	PARAMETER	Text	This column contains Process parameter measured by the Instrument e.g TEMP
4	TYPE OF TE	Text	This column contains type of TEMP ELEMENT i.e. Pt100, K TYPE T/C, R TYPE T/C etc.
5	SCOPE OF SUPPLY	Text	This column contains the scope of supply for TEMP ELEMENT & TRANSMITTER e.g. STN C&I if TE+TT is to be supplied under Station C&I Package or SG if TE+TT is to be suplied under SG Package or TG if TE+TT is to be suplied under TG Package .
6	TYPE OF TT	Text	This column indicates type of TEMP TRANSMITTER i.e. DIN RAIL, HEAD MOUNTED, DUAL INPUT, FIELD BUS.
7	MEDIUM	Text	This column contains the MEDIUM of measured process e.g. CONDENSATE, FEED WATER, DM WATER, STEAM, WATER, SLURRY, AIR, FLUE GAS, HFO, LDO, etc.
8	PROCESS_RANGE	Alpha-numeric	This column contains the range (along with unit of measurement) of parameter being measured by instrument e.g. 0-100 DEGC, (-10)-100 DEGC. Format should be same as given in example.
9	OPR VALUE	Alpha-numeric	This column contains the normal operating value of the parameter being measured.
10	P_MAX	Alpha-numeric	This column contains the maximum operating pressure of the process medium along with engineering unit. For DP type of transmitters, maximum operating pressure of high pressure side are to be indicated. Caution :- Pipe design pressure may not be same as process maximum operating pressure. Please keep this in view while filling this details.
11	T_MAX	Alpha-numeric	This column contains the maximum value of operating temp along with engineering unit.
12	VELOCITY_MAX	Alpha-numeric	This column contains the maximum value of Process velocity along with enginering unit.
13	LINE SIZE	Alpha-numeric	This column indicates the Size of Line/pipe in which temp element is to be fitted. Format shall be like Pipe OD x Pipe thickness.
14	LINE INSULATION THICKNESS	Alpha-numeric	This column indicates the thickness of insulation provided on the process line in which temp element is to be fitted.
15	THERMOWELL MATERIAL	Alpha-numeric	This column contains material of thermowell.
16	IBR CERTIFICATION	Text	Y means IBR certification is required. BLANK means same is not applicable.
17	PROCESS END CONNECTION DETAILS	Alpha-numeric	This column contains the tapping details of process end to which instrument/ thermowell should be compatible. This information shall have to be filled in line with corresponding process tapping drawing/ isometric drawing/ fabrication drawing.
18	TT JB DETAILS	Alpha-numeric	DUAL INPUT TT and DIN Rail type TT shall be mounted in the junction boxes. There will be separate type of JB for Dual input TT and Din Rail type TT. The grouping details of TTs in a junction box are to be indicated in this column for these two types of TTs. Format can be e.g. For TTs of SG area :- TT JB numenclature can be SG-TTJB1, SG-TTJB2 etc. or For TTs of TG area :- TT JB numenclature can be TG-TTJB1, TG-TTJB2 etc..
19	SPECIAL_REMARK	Text	This column contains any additional requirment for the Instrument.
20	QTY/UNIT	numric	This column indicates the per unit quantity of that instrument.
21	TOTAL QTY	numric	This column indicates the total quantity of that instrument for the STATION.
23	REF_DOC_NO	Alpha-numeric	This column contains the document number along with revision number of PID or Instrument schedule in which the Instrument and related proces parameters are shown.
24	REV_REMARK	Text	This column contains name of the columns in which changes are done w.r.t. last revision.
25	REV_NUMBER	numric	This column indicates the progressive Revision number e.g. 0, 1, 2. Any change done should be marked with correct revision detail for identification by vender.
26	REV_CODE	Text	Write A for data chages in any field, B if instruemnt is added in this revision and C if insturment is to be deleted (Please do not remove row, only write C in the revision code).

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: FORMAT FOR LIST OF TEMPERATURE ELEMENTS AND TEMPERATURE TRANSMITTERS

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FORMAT FOR LIST OF DRIVES

Position	Field Name	Type	Description
1	ID	Alpha-numeric	This column indicates the unique identification number of that drive assigned by package engineer e.g. for first drive pertaining to SG area, this number will be SG-D-1 or for first drive pertaining to TG area, this number will be TG-D-1.
2	KKS_CODE	Text	This column contains the KKS code of DRIVE including UNIT/COMMON prefix. Prefix for any unitised Drive will be 10 for UNIT-1, 20 for UNIT-2, 30 for UNIT-3. For any common drive prefix will be 00. This should be same as indicated in the P&ID or other relevant document of equipment or process supplier .
3	TAG	Text	This column indicates the alternate tag number (if any) for that drive beside KKS_CODE as indicated in the P&ID/other document.
4	DESCRIPTION	Text	This column contains Description Of Drive. Pl keep drive description limited to 24 characters.
5	DRIVE_TYPE	Text	This column indicates the Type of Drive e.g. HT, LT etc..
6	O_C	Text	O for OLCS (ON/OFF, OPEN/CLOSE) drives and C for CLCS (Regulating) drives
7	AREA	Text	This column indicates the process area or Major equipment.
8	PACKAGE	Text	This column indicates the corresponding package name of the drive/equipment e.g. STN C&I, SG, TG, AHP, CHP, DM, PT, CT, CW
9	DDCMIS_NAME	Text	This column contrains the control scope of drives. Write STN C&I for Station-C&I DDCMIS, SG for SG DDCMIS, TG for TG DDCMIS etc
10	PROCESS_BLOCK_STREAM	Text	This column will indicate the process block applicable for that drive e.g. For STN C&I DDCMIS : Secondary air (SA), Steam & Water (SW), Primary air (PA), BOP-TG (TG), Electrical (ELECT). Further for STN C&I DDCMIS In order to maintain stream wise process redundancy, stream information will also be indicated along with process block information e.g.FD fan A and B belongs to process block SA In Unit DDCMIS, so PROCESS_BLOCK_STREAM for FD FAN A will be SA-A and same for FD FAN B will be SA-B.
11	FG	Number	This column indicates the Functional Group number e.g. FG01, FG02, FG101, FG301. This will be assigned by DDCMIS supplier based on PROCESS_BLOCK_STREAM (column 10) Information. Not required to be filled by SG/TG Vendor.
12	RIO	Text	This column contains the NAME of the Remote IO (if applicable) for that drives. Not required to be filled by SG/TG Vendor.
13	EQUP_GR	Text	This column contains the information of groups defined for I/O allocation within one FG/controller. I/Os for Drives defined under one EQUP GR can be assigned in same input or output cards within the FG/RIO. However I/Os for drives belonging to different EQUP GR should be allocated to separate I/O cards.
14	SOLENOID_GR	Text	Applicable only for solenoid operated valves (SOV, DSOV). This column contains the information of specific group of solenoids powered from one common feeder and one isolation / monitoring.
15	O/P_REDUNDANCY	Yes/No	Y indicates that redundant O/Ps (from two different O/P modules or from redundant type of O/P modules) are to be considered for these drives.
16	UCD_PB_ DETAIL	Alpha-numeric	This column indicates the detail of push button station on the control desk (located in CR) for that drive e.g. 2PB+3L, 3PB+3L, 2PB+4L etc.
17	SYNCH	Yes/No	This column is applicable for Electrical breakers only. Y indicates drive is SYNCH type. Blank means not applicable.
18	REMOTE_OPRN	Yes/No	N indicates that remote operation for that drive from OWS/LVS has to be inhibited. BLANK means remote operation from OWS/LVS is allowed.
19	MODULE_TYPE	Text	This field is applicable for LT motors, HT motors and electrical breakers. This indicates the type of MCC/SWGR module for that drive. Not required to be filled by SG/TG Vendor.
20	MODULE_NO	Text	This field is applicable for LT motors, HT motors and electrical breakers. This indicates the module number of MCC/SWGR module for that drive. Not required to be filled by SG/TG Vendor.
21	SPECIAL_REMARK	Text	This field indicates the special remark/requirement, if any, for that drive. Following are to be compulsorily included (as applicable) in this column. 1) Solenoid coil voltage and solenoid VA/Wattage for solenoid type of drives e.g. Solenoid coil is 24VDC/8W or Solenoid coil is 240V AC/10VA etc. Further if solenoid coil voltage is other than 24V DC, the powering scheme of such solenoids should be specifically furnished.
22	REF_DOC_NO	Alpha-numeric	This column contains the document number (including rev number) of PID or schedule in which the drive is shown.
23	REV_REMARK	Text	This column contains name of the columns in which changes are done w.r.t. last revision.
24	REV_NUMBER	numeric	This column indicates the progressive Revision number e.g. 0, 1, 2. Any change done should be marked with correct revision detail for identification by vender.
25	REV_CODE	Text	Write A for data changes in any column, B If drive is added in this revision and C If drive is to be deleted (Please do not remove row, only write C in the revision code).

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PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: FORMAT FOR LIST OF DRIVES

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FORMAT FOR PROCESS IO LIST

Position	Field Name	Type	Description
1	ID	Alpha-numeric	This column indicates the unique identification number of that signal assigned by package engineer e.g. for first signal pertaining to TG area, this number will be TG-P-1. Similarly for first signal of DM area, this number will be DM-P-1. Please note that no additional sr. no. column is required.
2	KKS_CODE	Text	This column contains the KKS code of the signal including UNIT/COMMON prefix. Prefix for any unitised signal will be 10 for UNIT-1, 20 for UNIT-2, 30 for UNIT-3. For any common signal prefix will be 00.
3	TAG	Text	This column indicates the alternate tag number (if any) for that signal beside KKS_CODE as indicated in the P&ID/other document.
4	DESCRIPTION	Text	This column contains Description Of SIGNAL. Pl keep description limited to 24 characters.
5	STATUS	Text	This column is applicable for digital signals only and indicates the Status of the process value e.g. HIGH, LOW, ADEQ, NRML etc.
6	RECORD_TYPE	Text	Write DI for Digital Inputs, DISOE for SOE inputs, DO for Digital Outputs, AI for Analog Inputs and AO for Analog Outputs.
7	IO_TYPE	Text	Write DI[DRY] for potential free contact Inputs with contact interrogation voltage from DDCMIS, DI[24V DC] for 24V DC digital inputs which do not require any contact interrogation voltage from DDCMIS, AI[4-20] for analog inputs which is to be loop powered from DDCMIS, AI[4-20]LIVE for analog inputs which are having their own power supply and are not to be loop powered from DDCMIS and Galvanic isolation is required, AI[4-20]HART for analog inputs with HART information, DO[DRY] for potential free contact type digital output, DO[24V DC] for 24V DC digital output, AO[4-20] for 4-20 mA analog output, AO[4-20]LIVE for 4-20mA analog output for which Galvanic Isolation is required.
8	NO_NC	Text	This column is applicable for DI[DRY] IO_type only. Write NO, NC, NO of COC, NC of COC in this column. Please note that COC signals are to be listed as two signals in the I/O list.
9	O_I_C	Text	O for signals being used in the OLCS, C for signals being used in CLCS and I for signals being used only for alarm/information
10	AREA	Text	This column indicates the process area or Major equipment related to that drive e.g. for discharge and suction valves of MDBFP-A, Area can be MDBFP-A. Area should be filled in such a way that if DDCMIS supplier wants to divides one PROCESS_BLOCK in two or more functional group / controller, area wise signals distribution can be possible. Area In Drive list and Process IO should be matching.
11	EQUP_GR	Text	This column contains the information of groups defined for I/O allocation within one FG/controller. I/Os defined under one EQUP GR can be assigned in same input or output cards within the FG/RIO. However I/Os belonging to different EQUP GR should be allocated to separate I/O cards. If this field is blank, such I/Os can be assigned to any of the relevant card within the FG/RIO. In case of triple / dual measurements, the vender shall try to allocate these signals to same channel number of three /two (for triple or dual measurement) different I/O modules. Unique nos. for TR and DR series with in each BLOCK/RIO shall be maintained.
12	PACKAGE	Text	This column indicates the corresponding package name related to signal e.g. TG, SG, AHP, CHP, DM, PT, CT, CW
13	DDCMIS_NAME	Text	This column contains the name of DDCMIS where this signal is to be connected. Write STN C&I for Station-C&I DDCMIS, SG for SG DDCMIS, TG for TG DDCMIS etc
14	PROCESS_BLOCK_STREAM	Text	This column will indicate the process block applicable for that signal e.g. For STN C&I DDCMIS : Secondary air (SA), Steam & Water (SW), Primary air (PA), BOP-TG (TG), Electrical (ELECT). Further for STN C&I DDCMIS In order to maintain stream wise process redundancy, stream information will also be indicated along with process block information e.g.FD fan A and B belongs to process block SA In Unit DDCMIS, so PROCESS_BLOCK_STREAM for FD FAN A will be SA-A and same for FD FAN B will be SA-B.
15	FG	Number	This column indicates the Functional Group number e.g. FG01, FG02, FG101, FG301. This will be assigned by DDCMIS supplier based on PROCESS_BLOCK_STREAM information. Not required to be filled by SG/TG Vendor.
16	RIO	Text	This column contains the NAME of the Remote IO (if applicable) for that signal. Not required to be filled by SG/TG Vendor.
17	SOURCE	Text	This field indicates the source of the signal e.g. MCC, SWGR, ACTR, FIELD JB, LIE-JB, LIR-JB, FIELD, LCP, UCD etc. For output signals same is DDCMIS, DDCMIS RLY PNL.
18	DESTINATION	Text	This field indicates the destination of the signal. For input signals destination is DDCMIS. For output signals destination may be MCC, SWGR, ACTR, FIELD JB, FIELD, DDCMIS, LCP, UCD etc.
19	ALM	Text	write Y for signals which are directly (without any logical operation) being used for alarm e.g. If a pressure switch contact is being used for alarm directly, Indicate Y In this column. However If a pressure switch signal with some time delay is being used for alarm, same should be covered in the logic and shall be called logic generated alarm.
20	PARAMETER	Text	This column is applicable mainly for analog signals and indicates the process parameter corresponding to analog signal. Write GAUGE PRESS, ABS PRESS, DIFF PRESS, LEVEL, FLOW, TEMP, CURRENT, VOLTAGE, MW, MVAR , PF (for power factor) according to measurement.
21	INST_TYPE	Text	This column indicates the basic instrument type from where signal is generated e.g. PT for gauge pressure & absolute pressure measurement, DPT for diff press as well as for flow & level measurement by using DPT, GWR for level measurement by guided wave radar type LT, ULTRA-LT & ULTRA-FT for level & flow measurement respectively by ultrasonic transmitters, pt100+TT for temp measurement by pt100 RTD along with temp transmitter, K TYPE T/C+TT for temp measurement by K type T/C along with temp transmitter, R TYPE T/C+TT for temp measurement by R type T/C along with temp transmitter, PS for pressure switch, DPS for switch, TS for temp switch, FS for flow switch, LS for level switch, DPM for dew point meter, CM for conductivity meter/Tx, ANALYSER for H2 purity & any of SWAS/ Flue gas/ DM plant/PT plant analyser except conductivity & moisture analyser. Write SE i.e signal exchange for signals which are being used for hardwired signal exchange between two systems e.g. SG control system and Station-C&I control syste
22	PROCESS_RANGE	Alpha-numeric	This column is applicable for analog Inputs. This column contains the range (along with unit of measurement) for the process parameter corresponding to analog signal e.g. 0-100 T/HR, (-1)-5 KG/CM2, (-1)-(-5) KG/CM2, 0-100 DEGC. Range of analog signals are to be indicated along with Engineering unit for analog point configuration in the DDCMIS.
23	INST_SCOPE	Text	This column primarily indicates the scope of instrument supply. Write STN C&I in this column for instruments which are to be supplied in Station C&I Package or For Instruments which are not under scope of Station C&I, write SG C&I/TG C&I.
24	REF_DOC_NO	Alpha-numeric	This column contains the document number along with revision number of PID or schedule/list/logic/write up In which source of signal is indicated.
25	SPECIAL_REMARK	Text	This field indicates the special remark/requirement If any for that I/O. Following are to be compulsorily included (as applicable) In this column. 1) For DO[DRY] type signals, the contact interrogation voltage (circuit voltage where DDCMIS/relay contact will be used) is to be indicated. 2) For signal exchanges within same DDCMIS, please write "SIGNAL EXCHANGE WITHIN SYSTEM". For signal exchange with other DDCMIS systems, write "SIGNAL EXCHANGE BETWEEN UNIT DDCMIS AND SG OR TG ETC.".
26	REV_REMARK	Text	This column contains name of the columns in which changes are done w.r.t. last revision.
27	REV_NUMBER	numeric	This column indicates the progressive Revision number e.g. 0, 1, 2. Any change done should be marked with correct revision detail for identification by vender.
28	REV_CODE	Text	Write A for data changes In any column, B If Instrument is added In this revision and C If Instrument is to be deleted (Please do not remove row for Instrument to be deleted, only write C In the revision code).

FOR TENDER PURPOSE ONLY

एन टी पी सी लिमिटेड
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
					CLEARED BY						
A	FIRST ISSUE	BG	BG	MJ							25.1.11

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: FORMAT FOR PROCESS IO LIST

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-G-002 SH 05 OF 08	A

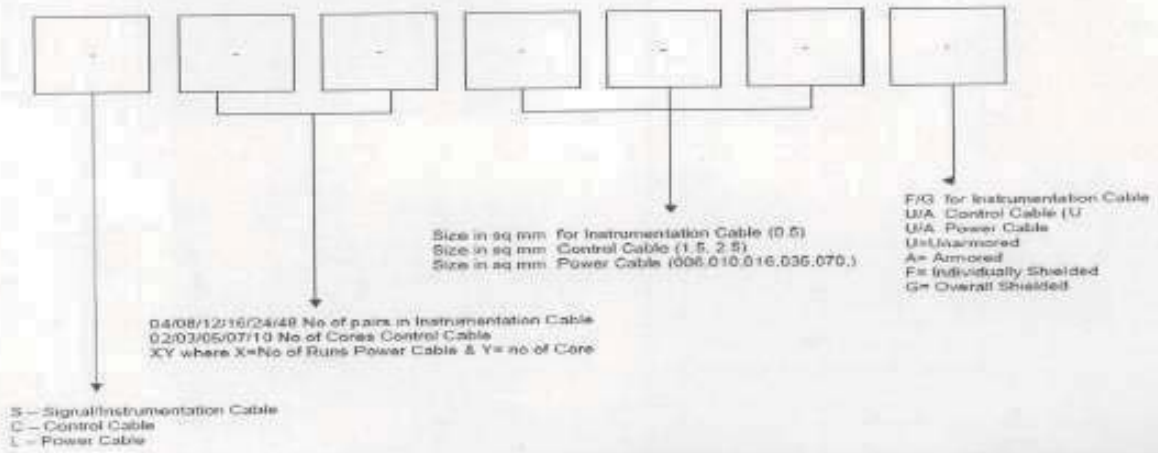
CABLE LIST FORMAT:-												
NTPC CABLE NO.	NTPC CABLE CODE	UNIT NO.	FROM DESCRIPTION	FROM_LOCATION	TO DESCRIPTION	TO_LOCATION	CABLE SCOPE	SEPARATE PATH	NTPC CABLE NO.			

DRAWING FOR TENDER PURPOSE ONLY

CABLE LIST FORMAT DETAILS :

NTPC CABLE ID	MEANINGFUL ALPHANUMERIC ID SHALL BE ASSIGNED.IT SHALL BE LIMITED TO 7 CHARACTERS
NTPC CABLE CODE	THIS COLUMN SHALL CONTAIN 7 CHARACTER NTPC CABLE CODE(AS PER CABLE CODING GUIDELINES FURNISHED BELOW)
UNIT NO	UNIT NO. OF THE PLANT e.g. 01 MAY BE FILLED FOR UNIT NO.1
FROM DESCRIPTION	DESCRIPTION OF THE SOURCE FROM WHICH CABLE IS RUN
FROM_LOCATION	X,Y,Z COORDINATES OF THE SOURCE FROM WHICH CABLE IS RUN
TO DESCRIPTION	DESCRIPTION OF THE DESTINATION WHERE THE CABLE TERMINATES
TO_LOCATION	X,Y,Z COORDINATES OF THE DESTINATION WHERE THE CABLE TERMINATES
CABLE SCOPE	SCOPE OF SUPPLY AND LAYING OF THE CABLE e.g FOR CABLES IN ABFPL SCOPE "ABFPL" MAY BE FILLED IN THIS COLUMN
SEPARATE PATH	IF A CABLE IS TO BE ROUTED THROUGH A SEPARATE PATH W.R.T ANOTHER CABLE,THEN "YES"IS TO BE MENTIONED IN THIS COLUMN.TWO OR MORE CABLES WHICH ARE TO BE ROUTED THROUGH SEPARATE PATH W.R.T EACH OTHER SHOULD HAVE SAME NTPC CABLE ID WITH SUFFIXES AS,B,C ADDED AT THE END OF THE NTPC CABLE ID.

CABLE CODING PHILOSOPHY



SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATION

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.

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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.

5.2 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.

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6. DRAWINGS / DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

6.1 Final version of all drawings & data submitted with the along with technical schedules enclosed in Volume III.

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 Installation & erection manual.

6.5 Manuals for method of testing & calibration of all instruments.

6.6 Equipment description giving complete design calculations, basis of design, selection criteria etc.

6.7 Schematic piping diagrams.

6.8 Layout of piping.

6.9 Electrical drawings.

6.10 Test Certificates.

6.11 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

6.12 Vendor shall also provide soft copy of each drawing in AutoCAD format.

6.13 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

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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	Type of lifting facility provided.	: Electric hoist / Chain Pulley block with monorail (by Bidder)
1.5	Electrical work scope: -	
	i) MCC for AC plant	: By Others (Refer Electrical scope matrix)
	ii) Power cables / Control cables.	: By Others (Refer Electrical scope matrix)
	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. (Refer Electrical scope matrix)
2.	**REFRIGERATION COMPRESSOR**	
2.1.	Type	: SCREW CHILLE/VAM
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	: Latest 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.

47541/2020/PS-PEM-MAX

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SECTION-D

AIR HANDLING UNITS

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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.

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5. DRAWINGS / DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.

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 Installation and erection manual.

5.5 Equipment description giving complete design calculations, basis of design, selection criteria etc.

5.6 Test Certificates.

5.7 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

5.8 Performance Test Certificates.

5.9 Vendor shall also provide soft copy of each drawing in AutoCAD format.

5.10 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

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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 (Refer Electrical scope matrix)
	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.

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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, fire damper : 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.

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SECTION-D

COOLING TOWER

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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.

3.4 Water Equalizer line shall be provided for all the cooling towers.

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 & hot dip 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 minimize 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 weatherproof 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.

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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.

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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 Installation & Erection manual and Operation and maintenance instructions.

8.8 Vendor shall also provide soft copy of each drawing in AutoCAD format.

8.9 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

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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	: 28.5 Deg.
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).

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5) Supports & supporting structure for mounting : Yes.

6) Level switch : Yes.

7) Rain protection for motor : Yes (suitable Canopy by Bidder)

8) Water equalizer line : Yes

E. ELECTRICAL DATA

i) Power supply : 415 V$\pm$ 10%/50 Hz $\pm$ 3%/3 phase.

ii) Motor : As per specification attached.

F. INSPECTION & TESTING : As per approved quality plan.

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SECTION-D

CENTRIFUGAL PUMPS

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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..

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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.

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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-A 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.

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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 & Erection Manual and operation & maintenance manual.

11.9 Other drawings and data, if necessary.

11.10 Vendor shall also provide soft copy of each drawing in AutoCAD format.

11.11 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

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	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 30 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	: Deep Bronze packing to be renewable with case.
	i) Stuffing box Packing.	: Flexible Graphite or PTFE (Asbestos shall not be used)
	j) Pump motor coupling.	: Flexible.

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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.

	TECHNICAL SPECIFICATION PACKAGE AIR CONDITIONING UNIT	SPECIFICATION NO.PES-553-05	
		VOLUME II B	
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SECTION-D

PACKAGE AIR CONDITIONING UNIT

	TECHNICAL SPECIFICATION PACKAGE CONDITIONING UNIT	SPECIFICATION NO.PES-553-05
		VOLUME II B
		SECTION D
		REV. 03 / DATE:20.03.2020
		SHEET 2 OF 6

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 CFC free environment friendly latest refrigerrant e.g. R407C etc. 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 REFRIGERENT 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-A

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

9.7 Vendor shall also provide soft copy of each drawing in AutoCAD format.

9.8 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PES-553-05
PACKAGE AIR -CONDITIONING UNIT	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 01 / DATE 20.03.2020
	SHEET 1 OF 1

	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
15)	Electrical feeder requirement	: To be provided by Vendor

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO.PES-553-06	
		VOLUME II B	
		SECTION D	
		REV. 03	DATE: 20.03.2020
		SHEET 1 OF 4	

SECTION-D

AIR FILTER

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO.PES-553-06	
		VOLUME II B	
		SECTION D	
		REV. 03	DATE: 20.03.202
		SHEET 2 OF 4	

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).

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO.PES-553-06	
		VOLUME II B	
		SECTION D	
		REV. 03	DATE: 20.03.202
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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 & erection manual and Operation and maintenance/service manual

5.4 Rating curves/charts

5.5 Test certificates

5.6 Elect. diagrams (when automatic cleaning type)

5.7 Vendor shall also provide soft copy of each drawing in AutoCAD format.

5.8 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PES-553-06	
AIR FILTER	VOLUME II-B	
DATA SHEET - A	SECTION D	
	REV 01	DATE 20.03.2020
	SHEET 1 OF 1	

DESCRIPTION		**DATA**
1)	**General**	
1.1	Service	: Air Conditioning.
1.2	Location .	: Central Air conditioning plant, Precision & 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 and for absolute filters velocity shall not exceed 1.5 m/sec.

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07	
		VOLUME II B	
		SECTION D	
		REV. 03	DATE: 20.03.2020
		SHEET 1 OF 7	

SECTION-D

LOW PRESSURE AIR DISTRIBUTION SYSTEM

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
		VOLUME II B
		SECTION D
		REV. 03 / DATE: 20.03.2020
		SHEET 2 OF 7

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 Details shall be as under.

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
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 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.

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07	
		VOLUME II B	
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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**.**

7.4 Installation instruction manual and air balancing manual.

7.5 Duct air leaking test procedure/smoke test procedure.

7.6 Vendor shall also provide soft copy of each drawing in AutoCAD format.

7.7 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

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LOW PRESSURE AIR DISTRIBUTION SYSTEM	VOLUME II-B
DATA SHEET - A	SECTION D
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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.

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SECTION-D

THERMAL INSULATION FOR COLD SURFACES

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
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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 :-

2.1 IS:3069 : Glossary of terms & symbols & units relating to thermal insulation materials.

2.2 IS:4671 : Expanded polystyrene for thermal insulation purposes.

2.3 IS:3677 : Mineral wool for thermal insulation.

2.4 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 should 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.

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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.

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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.

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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 erection and maintenance of insulation work.

9.6 Vendor shall also provide soft copy of each drawing in AutoCAD format.

9.7 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE

INSULATION

DATA SHEET - A

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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
Al foiled face Nitrile rubber / XLPE	EN12667	0.037 at 20 ^{0}C	At least 140

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)	Roll/slab	25
		Or AI foiled face Nitrile rubber/XLPE	Roll/slab	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

Insulation shall be fire retardant class.

SECTION: I

SUB-SECTION: E

ANNEXURE: I

LIST OF MAKES OF SUB-VENDOR ITEMS

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SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
3	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
4	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIRE(FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
5	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
6	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
7	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
8	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP
9	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
10	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
11	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA /AEROCELL
12	BALANCING VALVE	ADVANCE
13	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
14	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
15	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,
16	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
17	MOTORIZED BUTTERFLY VALVE	ANERGY / ADVANCE / BELIMO / JOHNSON / HONEYWELL / SIEMENS

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18	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
19	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
20	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
21	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
22	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
23	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
24	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
25	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
26	RELIEF / PURGE VALVE	BRASSOMATIC
27	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
28	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
29	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
30	PRESSURE GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST P. LTD. / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/ PRECISION MASS PRODUCTS PVT. LTD. / BOSE PANDA INSTT. PVT. LTD
31	TEMPERATURE GAUGE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GOA THERMOSTATIC/ GAUGE BOURDON/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
32	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
33	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS PRODUCTS/ MITTAL REFRIGERATION
34	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
35	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V.

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		AUTOMATE/ SIEMENS
36	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ FLOW TECH/ NIVO CONTROLS/ PUNE TECHTROL/ SAPCON/ BAUMER TECHNOLOGIES/ GIC/ SBEM
37	TRANSMITTERS	TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V AUTOMATION & INST / FISHER-ROSEMOUNT/ SIEMENS/ TATA HONEYWELL/ PUNE TECHTROL/ NIVO CONTROLS/ PANAM ENGINEERS/ EMERSON/ MOORE INDUSTRIES/ TOSHINIWAL INDUSTRIES/ YOKOGAWA/ E&H/ ABB
38	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS ANAND/ SCIENTIFIC DEVICES/ BK EQUIPMENTS/ INSTRUMENTATION ENGINEERS
39	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
40	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST & ELECTRONICS / TOSHNIWAL/ GOA INSTRUMENTS/ GAUGE BOURDON/ TECHNO INSTRUMENTS/ TEMPSENS INSTRUMENTS/ THERMAL INSTRUMENTS/ TM TECHNOMATIC/ BAUMER TECHNOLOGIES
41	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
42	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
43	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
44	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
45	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
46	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
47	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
48	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
49	METERING PUMP	SHAPO TOOLS / VK PUMPS
50	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
51	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
52	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V.

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		AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
53	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL
54	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
55	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT
NOTE		

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

2. 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.

3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C2A C-3, C-4 FOR HANDLING, ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.

SECTION: I

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ANNEXURE: II

MANDATORY SPARE LIST

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM MANDATORY SPARE LIST	SPECIFICATION No: PE-TS-475-553-A001	
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LIST OF MANDATORY SPARES

NAME OF PROJECT:		2 X 660 MW KHURJA STPP TURBINE GENERATOR AND ASSOCIATED PACKAGES
NAME OF PACKAGE:		AIR CONDITIONING SYSTEMS
TECHNICAL SPECIFICATION NO.:		PE-TS-475-553-A001
S. NO.	DISCRIPTION	QUANTITY
1	**Screw Compressor Chilling Machine for each type/rating / model(If supplied for the project)**	
1.1	Oil filter - O ring	1 Set
1.2	Refrigerant filter	1 Set
1.3	Master solenoid valve	1 No.
1.4	Master solenoid valve coil	1 Set
2	**Pumps (For Each Model)**	
2.1	Pump Bearing	1 Set
2.2	Pump Motor Bearing	1 Set
2.3	Shaft Sleeve	2 set
3	**Air handling unit (for each model)**	
3.1	V-belts for AHU Blower	2 Sets
3.2	AHU Blower bearing	1 Set
3.3	Blower motor bearing	1 Set
3.4	Filters at suction and discharge of all AHUs	25% of installed population
4	**Cooling Tower (for each model)**	
4.1	Nozzles for cooling towers	20 Nos.
4.2	Float valve assembly	1 No.
4.3	Fan Bearings	1 Set
4.4	Motor bearings	1 Set
5.0	**Electrical Actuators**	
5.1	Actuators	10% or 1 No. of each type, model and rating, whichever is more.
5.3	**Variable Frequency Derive (VFD)**	
5.3.1	Complete VFD derive	1 No of each type & rating
5.3.2	Complete Converter & Inverter unit	1 No of each type & rating
5.3.3	Set of Cards	1 No of each type & rating
5.3.4	Set of fuses	2 Nos of each type & rating
5.3.5	Input & Output Chokes (If applicable)	1 Set
6	**Control & Instrumentation**	
i)	Air-Conditioning System	
6.1	Electronic Transmitters	

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6.1.1	Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.)	5% or 1 No. of each type and model whichever is more. (to be divided into various ranges in proportion to main population)
6.2	Temperature elements	
6.2.1	RTD's*	5% or 1 No. whichever is more **
6.2.2	Thermo well * (With head assembly, terminal block and nipple)	5% or 1 No. whichever is more ** ** (to be divided into various insertion lengths in proportion to main population)
6.3	All types of Local Indicators	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main population of all make, model and type)
6.4	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, and differential temperature, level switch Devices.	5% or 1No. of each type and model whichever is more.
6.5	Relative Humidity Sensors	2 Nos.
6.6	Geyserstat	2 Nos.
6.7	Local Humidity/Temperature indicators	2 Nos. each
7	**Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)**	
7.1	Valves	10% or 1 No. of each type, class, size and model whichever is more.
7.2	2 way, 3way, 5way valve manifolds	10% or 1 No. of each type, class, size and model whichever is more.
7.3	Fittings	10% or 1 No. of each type, class, size and model whichever is more.

Notes

a) Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidder's scope of supply.

b) Wherever "set" is indicated, it shall mean complete replacement for one main equipment.

c) All mandatory spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is "not applicable" for particular equipment, then suitable applicable alternate spare has been offered / shall be supplied by the bidder without any financial implication."

d) Any item which is quoted as "not applicable" by the bidder in the above list and is found to be "applicable" at a later date shall be supplied by the bidder without any commercial and delivery implication.

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e) Any cell left blank in the unpriced schedule shall be treated as “Quoted” and is included in total price.

f) Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

g) All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. The spare shall be treated and properly packed for long term storage.

SECTION: I

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ANNEXURE: III

PAINTING & COLOUR SCHEME

(FOR DETAILS REFER TO SECTION I SUB SECTION C2C)

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM LIST OF TOOLS & TACKLES	SPECIFICATION No: PE-TS-475-553-A001	
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ANNEXURE: IV

LIST OF TOOLS & TACKLES

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM LIST OF TOOLS & TACKLES	SPECIFICATION No: PE-TS-475-553-A001	
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SL NO	ITEM DESCRIPTION	UNIT	QTY
1	FLAT D WRENCH -6 MM TO 32 MM (12 Pcs)	SET	1
2	BOX WRENCHES -6 MM TO 22 MM (14 Pcs)	SET	1
3	RING SPANNER -6 MM TO 32 MM (12 Pcs)	SET	1
4	ALLEN KEYS -2 MM TO 10 MM	SET	1
5	CRESCENT SCREW SPANNER	NO.	1
6	COMPLETE SET OF SCREW DRIVER	SET	1
7	OFFSET SCREW DRIVER	NO.	1
8	INSULATED PLIER	NO.	1
9	TORCH LIGHT FOR 2 CELL	NO.	1
10	HAMMER 1 LB	NO.	1
11	OIL CAN	NO.	1
12	POCKET THERMOMETER -0 TO 50 DEG. C)	NO.	1
13	INSULATION TAPE ROLL	NO.	1
14	STEEL FOOT RULE -12"	NO.	1
15	FEELER GAUGE 9 BLADES	NO.	1
16	PIPE WRENCH	NO.	1
17	FLARE NUT (1/4")	NO.	6
18	FLARING TOOL	NO.	1
19	TUBE CUTTER	NO.	1
20	GAS CHARGING PIPE	NO.	1
21	NITROGEN CHARGING ADAPTER	NO.	1
22	FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 0 -300 MM	NO.	1
23	FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 30 -150	NO.	1
24	PSYCHRO METER	NO.	1
25	LOCK WITH KEY FOR TOOL BOX	NO.	1
26	RATCHET 1/4"	NO.	1
27	MS TOOL BOX	NO.	1
28	WRENCH SPANNER	NO.	1
29	GREASE GUN	NO.	1
30	OIL GUN	NO.	1
31	HAND LAMP	NO.	1
32	LINE TESTER	NO.	1

NOTE: List furnished above is minimum requirement. Detailed list shall be finalized during detail engineering.

SECTION: I

SUB-SECTION: E

ANNEXURE: V

DRAWINGS/DOCUMENTS SUBMISSION PROCEDURE

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS

ANNEXURE-I

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
1.	PLANT DEFINITION MANUAL-	2 sets	4 CD-ROMs
2.	Drawings "FOR APPROVAL"		
	i) Layout drawings / P&IDs	6	2 CD - ROMs
	ii) Other drawings	2	2 CD - ROMs
3.	Drawings "FOR INFORMATION"	2	2 CD - ROMs
4.	Drawings "FINAL DRAWING"	15	4 CD-ROMs
5.	Drawings "AS BUILT "	15	4 CD-ROMs
6	DATASHEETS, DESIGN CALCULATIONS, PURCHASE SPECIFICATIONS, etc. and Other type of documents		
	i) For Approval	2	2 CD - ROMs
	ii) FINAL	15	4 CD-ROMs
	iii) Analysis reports of equip-ments/ piping/ structures components/ systems employing software packages as detailed in the specifications	2	2 CD - ROMs
7.	Erection manual "1st Submission"	4 Sets	2 CD - ROMs
8	Erection manual "FINAL"	4 Sets	4 CD ROMs
9	Operation & Maintenance manual "1st submission"	4	2 CD - ROMs

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
10	Operation & Maintenance manual "FINAL"	4 Sets	4 CD-ROMs
11	Plant Hand Book "1st Submission"	4 Sets	2 CD ROMs
12	Plant Hand Book "FINAL"	4 Sets	4 CD ROMs
13	Commissioning and Performance Procedure manual "1st Submission"	4 Sets	2 CD-ROMs
14	Commissioning and Performance Procedure manual "FINAL"	4 Sets	4 CD ROMs
15	Performance and Functional GURANTEES TEST REPORT	4 Sets	4 CD ROMs
16	Project completion report	15	4 CD ROMs
17	QA programme including Organi-sation for implement-ation and QA systemmanual (with revision-servicing)	1	1 CD ROM
18	Vendor details in respect of pro-posed vendors including contractor's evaluation report.	1	1 CD ROM
19	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, PQR etc.		
	(i) For review/comment	2	2 CD-ROMs
	(ii) For final approval	2	2 CD ROMs

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
20	Welding Manual, HeatTreatment Manuals, Storage & preservation manuals		
	1st Submission	4 Sets	2 CD ROMs sets
	Final	4 sets	4 CD ROMs
21	QA Documentation Packagefor items / equipmentmanufactured and and despatched to site	2 sets	4 CD ROMs
22	QA Documentation Package for field activities on equipment / systems at site	2 sets	4 CD ROMS

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ANNEXURE: VI

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

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S. NO.	DRAWING NO.	DRAWING/DOCUMENT TITLE	SCH. WEEK FROM DATE OF LOI
1	PE-V0-475-553-A001	ITEM CATEGORISATION AND SUB VENDOR LIST FOR AC SYSTEM	12
2	PE-V0-475-553-A002	MQP FOR HORIZONTAL CENTRIFUGAL PUMPS & PUMP TEST PROCEDURE (AIR CONDITIONING SYSTEM)	12
3	PE-V0-475-553-A003	MQP FOR COOLING TOWER	12
4	PE-V0-475-553-A004	MQP FOR AIR HANDLING UNIT (DOUBLE SKIN SANDWICHED)	12
5	PE-V0-475-553-A005	MQP FOR CENTRIFUGAL FANS (AIR CONDITIONING SYSTEM)	12
6	PE-V0-475-553-A006	MQP FOR AXIAL FANS (AIR CONDITIONING SYSTEM)	12
7	PE-V0-475-553-A007	MQP FOR PIPES (AIR CONDITIONING SYSTEM)	10
8	PE-V0-475-553-A008	MQP FOR SCREW CHILLERS (WATER COOLED)	10
9	PE-V0-475-553-A009	MOTOR TYPE TEST REPORT	14
10	PE-V0-475-553-A010	MQP FOR L T MOTOR	12
11	PE-V0-475-553-A011	MQP FOR VFD	12
12	PE-V0-475-553-A012	MQP FOR PRE & FINE FILTER	12
13	PE-V0-475-553-A013	MQP FOR HEPA FILTER	10
14	PE-V0-475-553-A014	MQP FOR CI GATE,GLOBE & CHECK VALVE	10
15	PE-V0-475-553-A015	MQP FOR BALANCING VALVE	10
16	PE-V0-475-553-A016	MQP FOR BUTTERFLY VALVE	10
17	PE-V0-475-553-A017	MQP FOR AIR COOLED CONDENSING UNIT	10
18	PE-V0-475-553-A018	MQP FOR THERMAL INSULATION	10
19	PE-V0-475-553-A019	QAP OF AHU FILTERS	10
20	PE-V0-475-553-A020	WELDING PROCEDURE SPECIFICATION (WPS) FOR AC SYSTEM	10
21	PE-V0-475-553-A021	MQP FOR ELECTRIC HOIST FOR AC SYSTEM	10
22	PE-V0-475-553-A022	MQP FOR CHAIN PULLEY BLOCK FOR AC SYSTEM	10
23	PE-V0-475-553-A101	HEAT LOAD CALCULATION FOR A/C SYSTEM FOR MAIN POWER HOUSE	3
24	PE-V0-475-553-A103	HEAT LOAD CALCULATION FOR A/C SYSTEM OF SERVICE BUILDING	3

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25	PE-V0-475-553-A107	PRESSURE DROP CALCULATION OF CONDENSER WATER PIPING AND CHILLED WATER PIPING FOR MAIN PLANT A/C SYSTEM	6
26	PE-V0-475-553-A108	PRESSURE DROP CALCULATION OF CONDENSER WATER PIPING AND CHILLED WATER PIPING FOR A/C SYSTEM OF SERVICE BUILDING	6
27	PE-V0-475-553-A201	TECHNICAL DATA SHEET, GA DRAWING AND PERFORMANCE CURVES OF MOTOR FOR PUMPS, COOLING TOWER & CENTRIFUGAL FAN	14
28	PE-V0-475-553-A202	TECHNICAL DATA SHEET FOR VFD	10
29	PE-V0-475-553-A203	TECHNICAL DATA SHEET FOR TEMPERATURE GAUGE , PRESSURE GAUGE AND LEVEL GAUGE	15
30	PE-V0-475-553-A205	TECHNICAL DATA SHEET FOR TEMP SENSOR/ELEMENT	14
31	PE-V0-475-553-A206	TECHNICAL DATA SHEET FOR HUMIDITY SENSOR	15
32	PE-V0-475-553-A207	TECHNICAL DATA SHEET FOR TEMPERATURE CUM HUMIDITY INDICATOR WITH SENSOR	12
33	PE-V0-475-553-A208	TECHNICAL DATA SHEET FOR PRESSURE TRANSMITTER & TYPE TEST REPORT FOR PRESSURE TRANSMITTER	15
34	PE-V0-475-553-A209	TECHNICAL DATA SHEET FOR LEVEL TRANSMITTER & TYPE TEST REPORT FOR LEVEL TRANSMITTER	12
35	PE-V0-475-553-A210	TECHNICAL DATA SHEET FOR TEMPERATURE TRANSMITTER & TYPE TEST REPORT FOR TEMP TRANSMITTER	12
36	PE-V0-475-553-A211	TECHNICAL DATA SHEET FOR LEVEL SWITCH	12
37	PE-V0-475-553-A212	TECHNICAL DATA SHEET FOR FLOW SWITCH	8
38	PE-V0-475-553-A213	TECHNICAL DATA SHEET FOR DIFFERENTIAL PRESSURE SWITCH	7
39	PE-V0-475-553-A215	TECHNICAL DATA SHEET FOR GEYSERSTAT	10
40	PE-V0-475-553-A216	TECHNICAL DATA SHEET FOR AIRSTAT	9
41	PE-V0-475-553-A219	TECHNICAL DATA SHEET AND GA OF SOLENOID VALVE	10

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42	PE-V0-475-553-A220	TECHNICAL DATASHEET & GA OF JUNCTION BOX	8
43	PE-V0-475-553-A223	TECHNICAL DATA SHEET & GA DRAWING OF WATER COOLED SCREW CHILLERS FOR MAIN PLANT A/C SYSTEM & SERVICE BUILDING	10
44	PE-V0-475-553-A224	TECHNICAL DATA SHEETS & GA DRAWING OF COOLING TOWERS	10
45	PE-V0-475-553-A225	TECHNICAL DATA SHEET & GA DRAWING FOR CONDENSER WATER PUMPS AND CHILLED WATER PUMPS	10
46	PE-V0-475-553-A227	TECHNICAL DATA SHEET OF AHU WITH COOLING COIL AND CENTRIFUGAL FANS FOR AIR HANDLING UNITS	10
47	PE-V0-475-553-A228	TECHNICAL DATA SHEET & GA DRAWING FOR HEATER PACKAGE	10
48	PE-V0-475-553-A229	TECHNICAL DATA SHEET & GA DRAWING OF PAN HUMIDIFIER	10
49	PE-V0-475-553-A230	TECHNICAL DATA SHEET & GA DRAWING OF FRESH AIR FAN	10
50	PE-V0-475-553-A231	TECHNICAL DATA SHEET FOR HI-WALL TYPE SPLIT AIR CONDITIONER	10
51	PE-V0-475-553-A232	TECHNICAL DATA SHEET FOR CASSETTE TYPE AIR CONDITIONER	10
52	PE-V0-475-553-A234	TECHNICAL DATA SHEET FOR Y-STRAINERS	10
53	PE-V0-475-553-A235	TECHNICAL DATA SHEET & G/A/DRWG/ FOR CAST IRON VALVES(GATE VALVE,CHECK VALVE, GLOBE VALVE,BUTTER FLY VALVE (MANUAL)	10
54	PE-V0-475-553-A236	TECHNICAL DATA SHEET FOR GM GATE VALVE	10
55	PE-V0-475-553-A237	TECHNICAL DATA SHEET & GA FOR BUTTER FLY VALVE (MOTORISED)	10
56	PE-V0-475-553-A238	TECHNICAL DATA SHEET & GA FOR 3-WAY & 2 WAY MIXING VALVE	10
57	PE-V0-475-553-A239	TECHNICAL DATA SHEET& G/A/DRWG/ FOR BALANCING VALVE	10
58	PE-V0-475-553-A240	TECHNICAL DATA SHEET FOR THERMAL & ACCOUSTIC INSULATION FOR DUCTING/PIPES	10

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59	PE-V0-475-553-A241	TECHNICAL DATA SHEET & G/A/ DRAWING OF PRE-FILTER,FINE FILTER,HEPA FILTER	10
60	PE-V0-475-553-A242	TECHNICAL DATA SHEET & G/A/ DRAWING OF FIRE DAMPER WITH ACTUATOR	12
61	PE-V0-475-553-A243	TECHNICAL DATA SHEET OF G/I SHEET	12
62	PE-V0-475-553-A244	TECHNICAL DATA SHEET OF PIPES	12
63	PE-V0-475-553-A245	TDS AND GA OF WATER SOFTENING PLANT	12
64	PE-V0-475-553-A248	TDS AND GA OF VARIABLE AIR VOLUME (VAV) ALONGWITH OCCUPANCY SENSORS	12
65	PE-V0-475-553-A249	TDS AND GA OF ELECTRIC HOIST FOR AC SYSTEM	12
66	PE-V0-475-553-A250	TDS AND GA OF CHAIN PULLEY BLOCK FOR AC SYSTEM	12
67	PE-V0-475-553-A501	STANDARD DRAWING FOR DUCT FABRICATION & SUPPORTING ARRANGEMENT (AIR CONDITIONING SYSTEM)	5
68	PE-V0-475-553-A502	STANDARD DRAWING FOR ERECTION & APPLICATION DETAIL OF INSULATION (AIR CONDITIONING SYSTEM)	5
69	PE-V0-475-553-A503	GA DRAWING OF EXPANSION TANKS / MAKE UP TANK / STORAGE TANK FOR AIR-CONDITIONING SYSTEM	5
70	PE-V0-475-553-A504	GA OF DIFFUSER / GRILL	10
71	PE-V0-475-553-A505	A/C PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL ALONGWITH PIPING LAYOUT FOR MAIN POWER HOUSE	18
72	PE-V0-475-553-A507	A/C PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL ALONGWITH PIPING LAYOUT FOR SERVICE BUILDING	18
73	PE-V0-475-553-A511	AHU ROOM LAYOUT WITH FOUNDATION DETAIL FOR MAIN POWER HOUSE	20
74	PE-V0-475-553-A512	CHILLED WATER PIPING LAYOUT DRAWING FROM A/C PLANT ROOM TO VARIOUS AHU ROOMS FOR MAIN PLANT	15
75	PE-V0-475-553-A513	AHU ROOM LAYOUT WITH FOUNDATION DETAIL FOR VARIOUS FLOORS OF SERVICE BUILDING ALONGWITH CHILLED WATER PIPING LAYOUT	22

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76	PE-V0-475-553-A515	A/C DUCT LAYOUT FOR MAIN POWER HOUSE AT EL 0/0 M	20
77	PE-V0-475-553-A516	A/C DUCT LAYOUT FOR MAIN POWER HOUSE AT EL 8/5 M & 17/0 M	17
78	PE-V0-475-553-A518	A/C DUCT LAYOUT DRAWING FOR VARIOUS FLOORS OF SERVICE BUILDING	22
79	PE-V0-475-553-A520	A/C DUCT LAYOUT ALONG WITH AHU LAYOUT DRAWING FOR CEP VFD CONTROL BUILDING	17
80	PE-V0-475-553-A522	VALVE SCHEDULE	16
81	PE-V0-475-553-A523	P & I DIAGRAM FOR A/C SYSTEM FOR MAIN POWER HOUSE	4
82	PE-V0-475-553-A525	P & I DIAGRAM FOR A/C SYSTEM FOR SERVICE BUILDING	4
83	PE-V0-475-553-A527	SPLIT AC SCHEDULE	14
84	PE-V0-475-553-A701	ELETRICAL FEEDER LIST FOR A/C SYSTEM	4
85	PE-V0-475-553-A705	LIST OF INSTRUMENTS / INSTRUMENT SCHEDULE FOR POWER HOUSE & SERVICE BUILDING	15
86	PE-V0-475-553-A707	CABLE INTER CONNECTION SCHEDULE FOR MAIN PLANT & SERVICE BUILDING (AIR CONDITIONING SYSTEM)	15
87	PE-V0-475-553-A711	LOGIC DRAWING FOR MAIN PLANT & SERVICE BUILDING	16
88	PE-V0-475-553-A713	MIMIC DRAWING FOR MAIN PLANT & SERVICE BUILDING	18
89	PE-V0-475-553-A716	DRIVE LIST FOR MAIN PLANT & SERVICE BUILDING	12
90	PE-V0-475-553-A717	I/O LIST FOR MAIN PLANT & SERVICE BUILDING	10
91	PE-V0-475-553-A719	WRITE UP & CONTROL PHILOSOPHY FOR A/C SYSTEM FOR MAIN PLANT & SERVICE BUILDING	10
92	PE-V0-475-553-A901	PG TEST PROCEDURE	15
93	PE-V0-475-553-A902	O&M MANUAL	18

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.

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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 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.
   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.

SECTION: I

SUB-SECTION: E

ANNEXURE: VII

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM FORMAT FOR OPERATION AND MAITENANCE MANUAL	SPECIFICATION No: PE-TS-475-553-A001
		SECTION : I
		Sub Section : E
		REV. 00 / DATE: AUGUST 2020
		SHEET- 1 OF 3

PROJECT NAME :
PROJECT NUMBER :
PACKAGE NAME :
PO REFERENCE :
DOCUMENT NUMBER :
REVISION NUMBER :

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

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM FORMAT FOR OPERATION AND MAITENANCE MANUAL	SPECIFICATION No: PE-TS-475-553-A001
		SECTION : I
		Sub Section : E
		REV. 00 / DATE: AUGUST 2020
		SHEET- 2 OF 3

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
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				

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM FORMAT FOR OPERATION AND MAITENANCE MANUAL	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION : I	
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		REV. 00	DATE: AUGUST 2020
		SHEET- 3 OF 3	

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.
7. 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

6. 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.

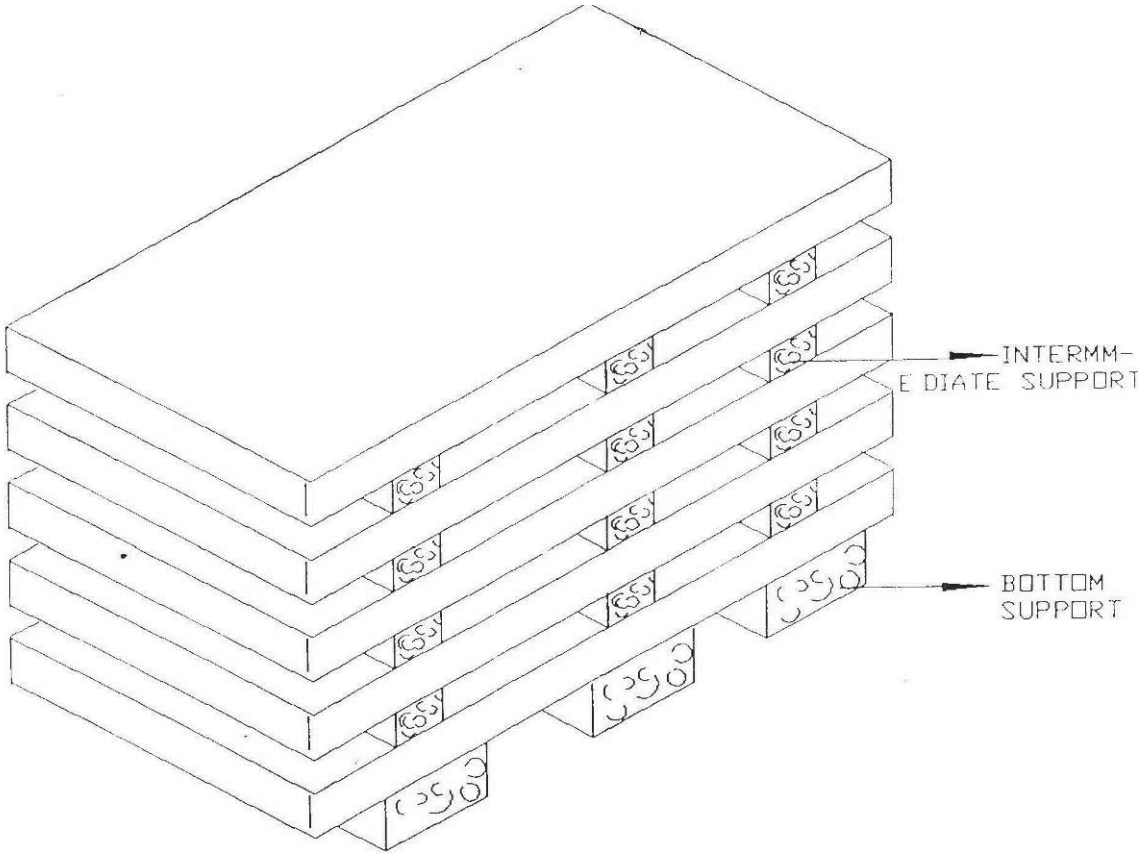

Figure – 1 – PLATE STACKING ARRANGEMENT

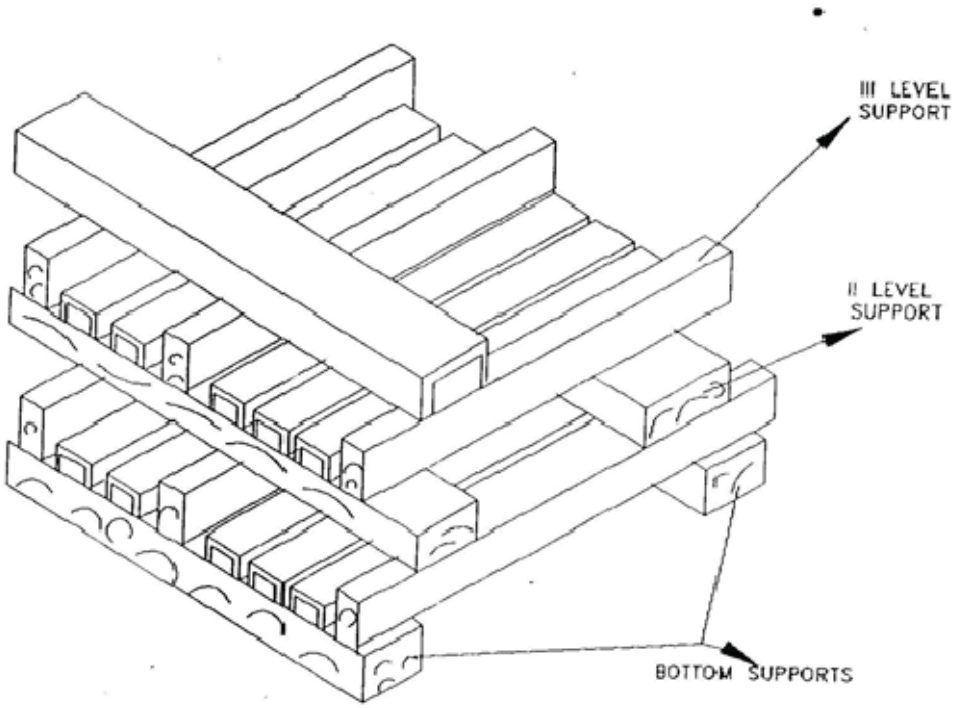

Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION: I

SUB-SECTION: E

ANNEXURE: IX

PACKING PROCEDURE

(REFER SUB-SECTION C2-B)

SECTION – II

SECTION – II

SUB SECTION – 1

INSPECTION AND TESTING

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION: II	
		SUB SECTION: 1	
		REV 00	DATE: AUGUST 2020
		SHEET- 1 of 3	

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.

KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-475-553-A001	
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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				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	

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-475-553-A001
		SECTION: II
		SUB SECTION: 2
		REV 00 / DATE: AUGUST 2020
		SHEET 1 OF 1

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 Air Conditioning System indicating 'quoted/not applicable' against each cell.
4. Deviation sheet
5. Pre bid clarification schedule
6. Sub-Supplier qualification confirmation

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION: II	
		SUB SECTION: 3	
		REV 00	DATE: AUGUST 2020
		SHEET- 1 of 2	

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.

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION: II	
		SUB SECTION: 3	
		REV 00	DATE: AUGUST 2020
		SHEET- 2 of 2	

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.

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM PRE- BID CLARIFICATION SCHEDULE	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION: II	
		SUB SECTION: 4	
		REV 00	DATE: AUGUST 2020
		SHEET 1 OF 1	

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

SECTION-II

SUB-SECTION-5

GUARANTEE POWER CONSUMPTION

2x660 MW KHURJA TURBINE GENERATOR AND ASSOCIATED PACKAGES AC SYSTEM						
GUARANTEED POWER CONSUMPTION						
SL NO	**DESCRIPTION**	**QUANTITY (WORKING)**		**POWER CONSUMPTION AS GUARANTEED (KW) AT MOTOR INPUT TERMINAL**	**DUTY FACTOR**	**TOTAL POWER CONSUMPTION AS GUARANTEED (KW)**
		(WORKING)	**(STANDBY)**			
(1)	(2)	(3A)	(3B)	(4)	(5)	(6)=(3A)x(4)X(5)
A	AC Plant for Main Plant Control Room Areas					
1	Screw Chiller units for main plant 180 TR	2	1		1	
2	Condenser water pump	2	1		1	
3	Chilled water pump	2	1		1	
4	Cooling Tower Fan motor	2	1		1	
5	AHU Fan Motor for 25.5M	2	1		1	
6	AHU Fan Motor for 8.5M	2	1		1	
7	Fresh Air fan for AHU 25.5 M	1	0		1	
8	Fresh Air fan for AHU 8.5 M	1	0		1	
B	**AC Plant for Service Building**					
1	Screw Chiller 180 TR	1	1		0.5	
2	Condenser water pump	1	1		0.5	
3	Chilled water pump	1	1		0.5	
4	Secondary chilled Water Pump including VVVF drive	1	1		0.5	
5	Cooling Tower Fan motor	1	1		0.5	
6	AHU Fan Service building	10	0		0.5	
7	Fresh Air fan for AHU of service building	10	0		0.5	
				TOTAL CONSUMPTION (KW)		
	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as **700 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 5,676** 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 5,676** per KW shall be levied on vendor.					

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM DEVIATION SHEET	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION: II	
		SUB SECTION: 6	
		REV 00	DATE: AUGUST 2020
		SHEET 1 of 1	

DEVIATION SHEET (COST OF WITHDRAWAL)

DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:- 2x660 MW KHURJA TG

PACKAGE:- AC System

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM SUB-SUPPLIER QUALIFICATION CONFRIMATION	SPECIFICATION No: PE-TS-475-553-A001
		SECTION: II
		SUB SECTION: 7
		REV 00 / DATE: AUGUST 2020
		SHEET 1 of 1

SUB-SUPPLIER QUALIFICATION CONFIRMATION

Bidder hereby confirms to meet Sub-Supplier qualification requirements as per PQR and provide required documents as mentioned in Section I Sub Section C2B for establishing chiller proven-ness after placement of order.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	KHURJA STPP (2X660 MW) TURBINE GENERATOR AND ASSOCIATED PACKAGES AIR CONDITIONING SYSTEM DRAWINGS	SPECIFICATION No: PE-TS-475-553-A001	
		SECTION: II	
		SUB SECTION: 8	
		REV 00	DATE: AUGUST 2020

SECTION-II

SUB-SECTION-8

DRAWINGS

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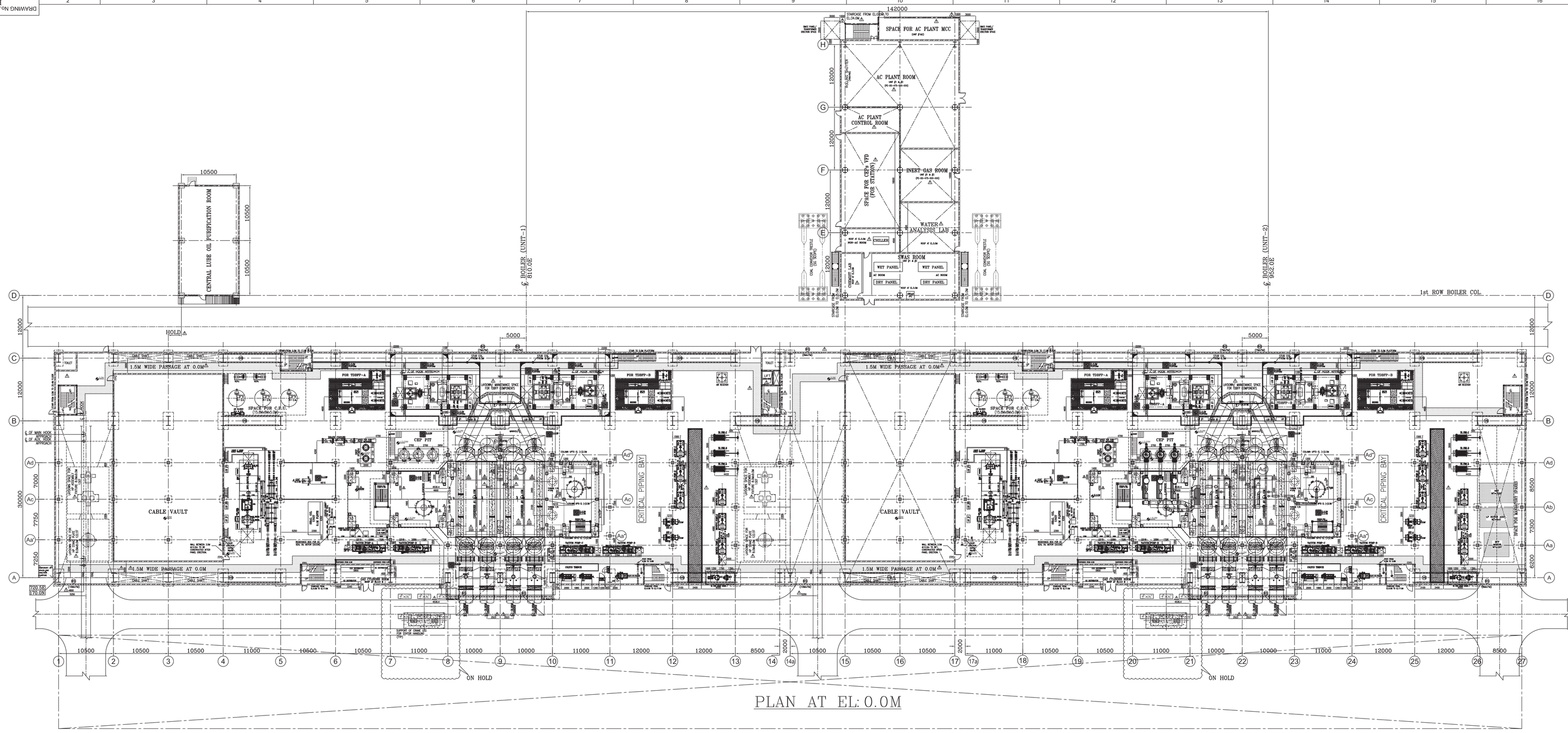
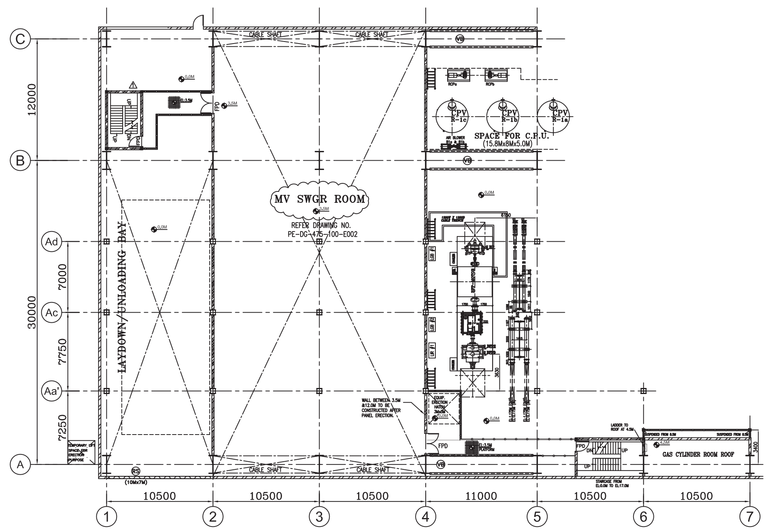
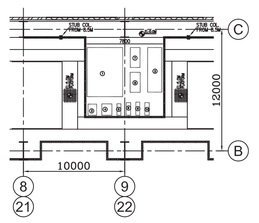
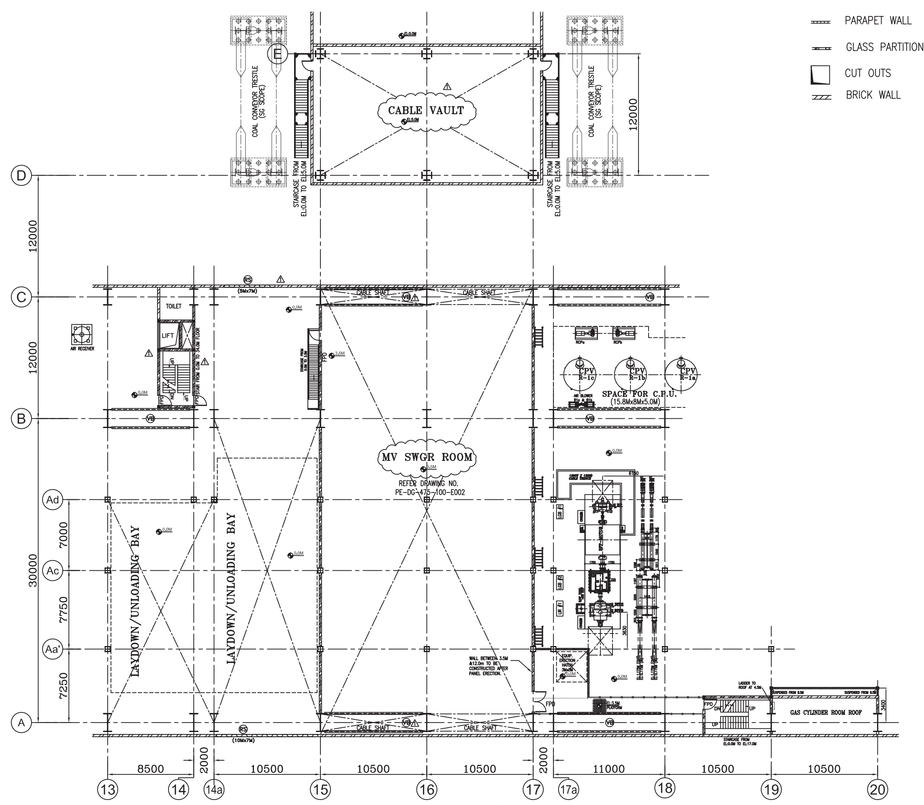
NORTH









SPACE FOR TRANSFORMER YARD

DETAIL OF LAYDOWN SPACE FOR TDBFP COMPONENTS (HOLD)

S.No.	DESCRIPTION	LENGTH	BREADTH	HEIGHT
01	MAXIMUM OF OUTER CASING + EXH. HOOD	3510	4850	4090
02	ROTOR	4400	1400	1400
03	FBP (UP)	860	1100	370
04	RBH (UP)	1000	1120	520
05	GBC–I (UP)	390	1130	520
06	GBC–I (LP)	390	1300	620
07	GBC–II (UP)	960	1970	990
08	GBC–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:194.5M.
3. EQUIPMENTS & FACILITIES SHOWN FOR PACKAGES OTHER THAN TG PACKAGE ARE SUGGESTIVE ONLY. HOWEVER IT IS PREFERRED THAT SIMILAR DETAILS BE ENSURED FROM RESPECTIVE PACKAGE VENDORS.
4. LUBE OIL PIPING BETWEEN COOLERS AND MDBFP TO BE ROUTED BELOW WALKOVER PLATFORM.

LEGEND:–

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- CUT OUTS
- BRICK WALL

REFERENCE DRAWINGS:–

1.	TG EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	9915–371–110–PEM–PVM–F–052 (PEM)
2.	TG EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	9915–371–110–PEM–PVM–F–053 (PEM)
3.	TG EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY	9915–371–110–PEM–PVM–F–054 (PEM)
4.	CROSS SECTION OF MAIN PLANT	9915–371–110–PEM–PVM–F–055 (PEM)
5.	CONDENSER ASSEMBLY (GENERAL ARRANGEMENT)	(HWR)
6	TG FOUNDATION ARRANGEMENT	(HWR)
7.	GLAND STEAM CONDENSER	(HWR)
8	FOUNDATION DETAILS OF GEN. AUXILIARY EQUIPMENTS	9915–371–110–HWR–PVC–V–072 (HWR)
9.	LAYDOWN SPACE FOR STEAM TURBINE COMPONENTS	9915–371–110–HWR–PVM–F–068 (HWR)
10.	FOUNDATION ARRANGEMENT OF CEP	(HYD)
11.	GENERAL ARRANGEMENT OF DRAIN COOLER	(HYD)
12.	VACUUM PUMP	(HWR)
13.	PLOT PLAN OF TDBFP	(HYD)
14.	LUBE OIL UNIT FOR TDBFP	(HYD)
15.	GA OF TDBFP	(HYD)
16.	AUX. FOUNDATIONS	(HYD)
17.	FOUNDATION DETAILS OF MDBFP	(HYD)
18.	GA OF MDBFP	(HYD)
19.	GA OF F/T–A	(BPL)
20.	GA OF DRAIN F/T–B	(BPL)
21.	GA OF STEAM DRAIN F/T	(BPL)
22.	GA OF UNIT F/T	(BPL)
23.	GA OF LEAKAGE/ DIRTY OIL TANK AND PUMP	9915–371–110–HWR–PVM–B–017 (HWR)
24.	GA OF WASTE OIL TANK	9915–371–110–HWR–PVM–B–118B (HWR)
25.	ARRGNT. & ASSY. OF OIL UNLOADING VESSEL	(BPL)
26.	CPU SERVICE VESSEL AREA	(PEM)
27.	PLOT PLAN OF MDBFP FOUNDATION	(HYD)
28.	GA AND FOUNDATION OF MDBFP HYD. COUPLING COOLERS	(HYD)
29.	TURBINE JB AND LIST & LAYOUT	(HWR)
30.	GA OF TG PHEs	(PEM)
31.	GA OF TG DMCW PUMPS	(PEM)
32.	GA OF ACW PUMPS	(PEM)
33.	GA OF ACW STRAINERS	(PEM)

REV.	DATE	ALTD	CHD	APPD
		⚠		

REV.	DATE	ALTD	CHD	APPD
1	04.03.2020	AKV	KK	BKA
1.	DRAWING REVISED AS PER NTPC COMMENTS DATED 31.12.2019 & 09.01.2020.			
2.	REVISION MARKED AS ⚠.			

NTPC DRG. NO.	9915–371–110–PEM–PVM–F–051
CUSTOMER	THDC INDIA LIMITED (A Joint Venture of Govt. of India & Govt. of U.P.) 2x660MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)
CONSULTANT	NATIONAL THERMAL POWER CORPORATION LTD. (A Government of India Enterprise)

JOB NO.	475
STATUS	CONTRACT
DISTRIBUTION	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

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DEPT CODE		NAME	SIGN	DATE
M	DRN	AKV	Sd/–	16.12.2019
	DESN	AKV	Sd/–	16.12.2019
	CHD	AKV/BKA	Sd/–	16.12.2019
	APPD	BKA	Sd/–	16.12.2019

TITLE: TG EQUIPMENT PLAN AT GROUND FLOOR

DEPT. | SCALE 1:300 | SIGN | DRAWING NO. PE–DG–475–100–M003 | SHEET 1 OF 1 | REV. 01

SIZE-A0

COMPUTER FILE NAME: PE–DG–475–100–M003–R1.DWG

475412020IPS-PEM-MAX

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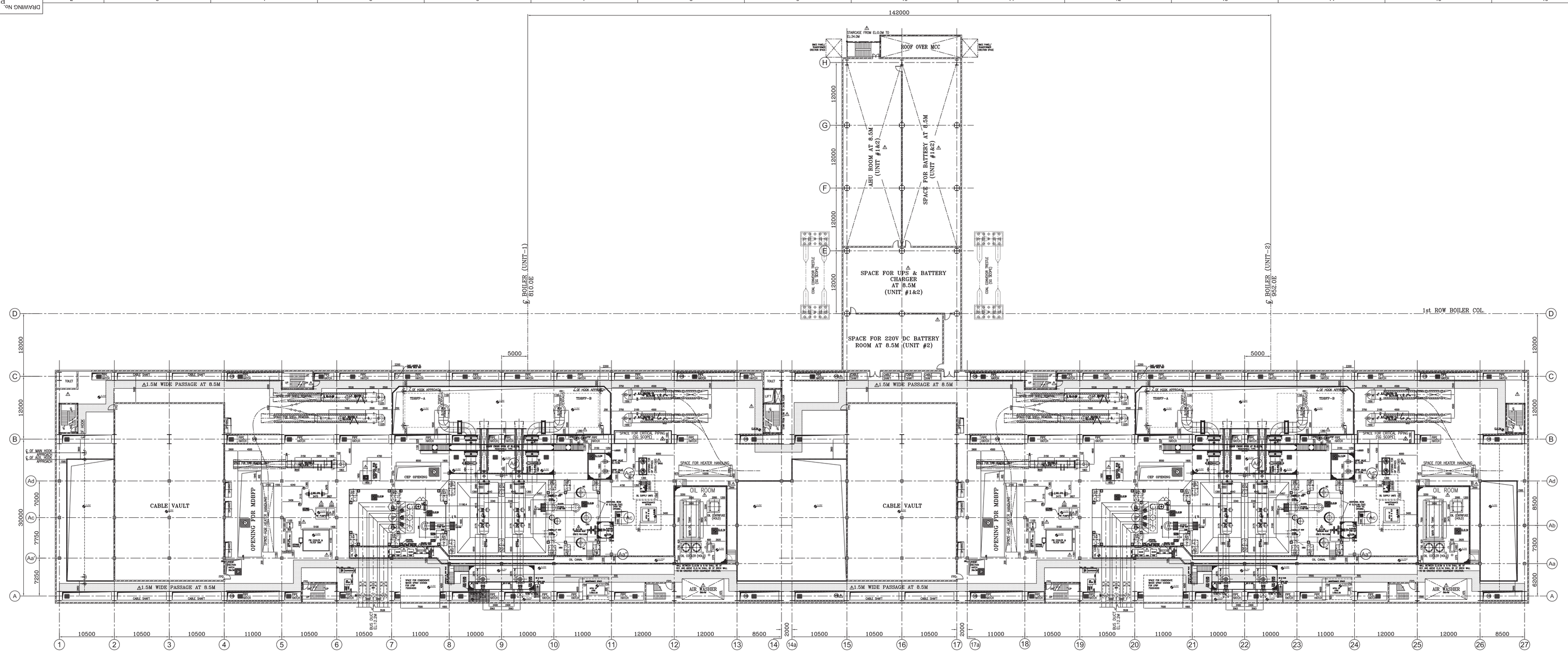
DRAWING No. PE-DG-475-100-M004

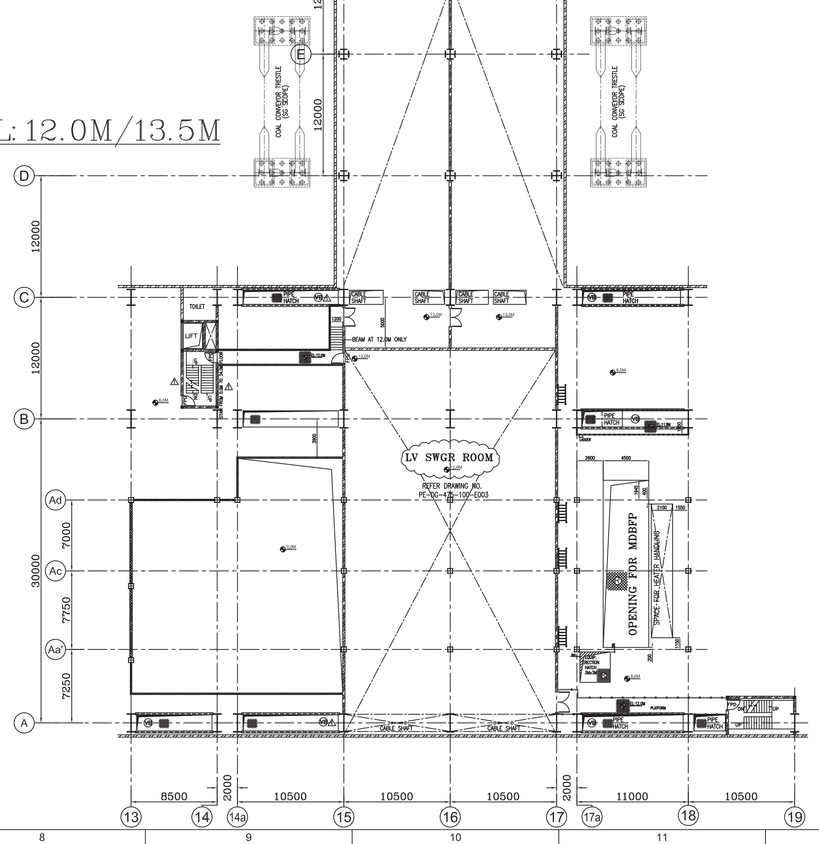
CUSTOMER'S DRAWING No.

NORTH

PLAN AT EL: 8.5M



PLAN AT EL: 12.0M/13.5M



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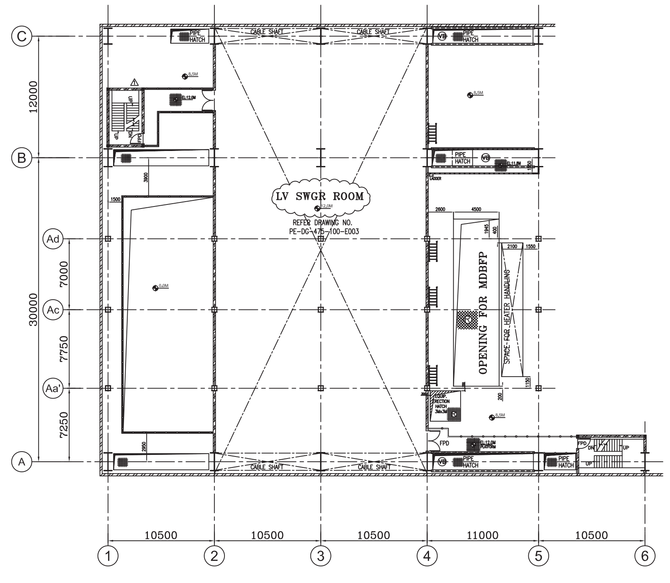

LEGEND:–

- 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:194.5M.
3. EQUIPMENTS & FACILITIES SHOWN FOR PACKAGES OTHER THAN TG PACKAGE ARE SUGGESTIVE ONLY. HOWEVER IT IS PREFERRED THAT SIMILAR DETAILS BE ENSURED FROM RESPECTIVE PACKAGE VENDORS.

REFERENCE DRAWING:–

1.	TG EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	9915-371-110-PEM-PVM-F-051 (PEM)
2.	TG EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	9915-371-110-PEM-PVM-F-053 (PEM)
3.	TG EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR AND BELOW	9915-371-110-PEM-PVM-F-054 (PEM)
4.	CROSS SECTION OF MAIN PLANT	9915-371-110-PEM-PVM-F-055 (PEM)
△5.	CONDENSER ASSEMBLY (GENERAL ARRANGEMENT)	9915-371-110-HWR-PVM-B-022 (HWR)
6.	GENERATOR OUTLINE	(HWR)
△7.	OIL ROOM ARRANGEMENT	9915-371-110-HWR-PVM-B-013 (HWR)
△8.	FOUNDATION DETAILS OF GEN. AUXILIARY EQUIPMENTS	9915-371-110-HWR-PVC-V-072 (HWR)
9.	LP BYPASS VALVE ARRANGEMENT	(HWR)
10.	GENERAL ARRANGEMENT OF LP HEATER No.–1	(HWR)
11.	GENERAL ARRANGEMENT OF LP HEATER No.–2	(HWR)
12.	GENERAL ARRANGEMENT OF LP HEATER No.–3	(HYD)
13.	GENERAL ARRANGEMENT OF LP HEATER No.–4	(HYD)
14.	GENERAL ARRANGEMENT OF LP HEATER No.–5	(HYD)
15.	GENERAL ARRANGEMENT OF HP HEATER No.–7A	(HYD)
17.	GENERAL ARRANGEMENT OF HP HEATER No.–7B	(HYD)
△18.	OIL CANAL DETAILS	9915-371-110-HWR-PVM-B-020 (HWR)
19.	TURBINE JB AND LIST & LAYOUT	(HWR)
20.	FOUNDATION LAYOUT OF IPBD	(RPR)

NTPC DRG. NO.	9915-371-110-PEM-PVM-F-052
CUSTOMER	THDC INDIA LIMITED (A Joint Venture of Govt. of India & Govt. of U.P.) 2x660MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)
CONSULTANT	NATIONAL THERMAL POWER CORPORATION LTD. (A Government of India Enterprise)

JOB NO. 475
STATUS CONTRACT
DISTRIBUTION

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

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REV.	DATE	ALTD	CHD	APPD

REV.	DATE	ALTD	CHD	APPD
1	05.03.2020	AKV	KK	BKA

1. DRAWING REVISED AS PER NTPC COMMENTS DATED 31.12.2019 & 09.01.2020.
2. REVISION MARKED AS △.

DEPT CODE		NAME	SIGN	DATE
M	DRN	AKV	Sd/–	16.12.2019
	DESN	AKV	Sd/–	16.12.2019
	CHD	AKV/BKA	Sd/–	16.12.2019
	APPD	BKA	Sd/–	16.12.2019

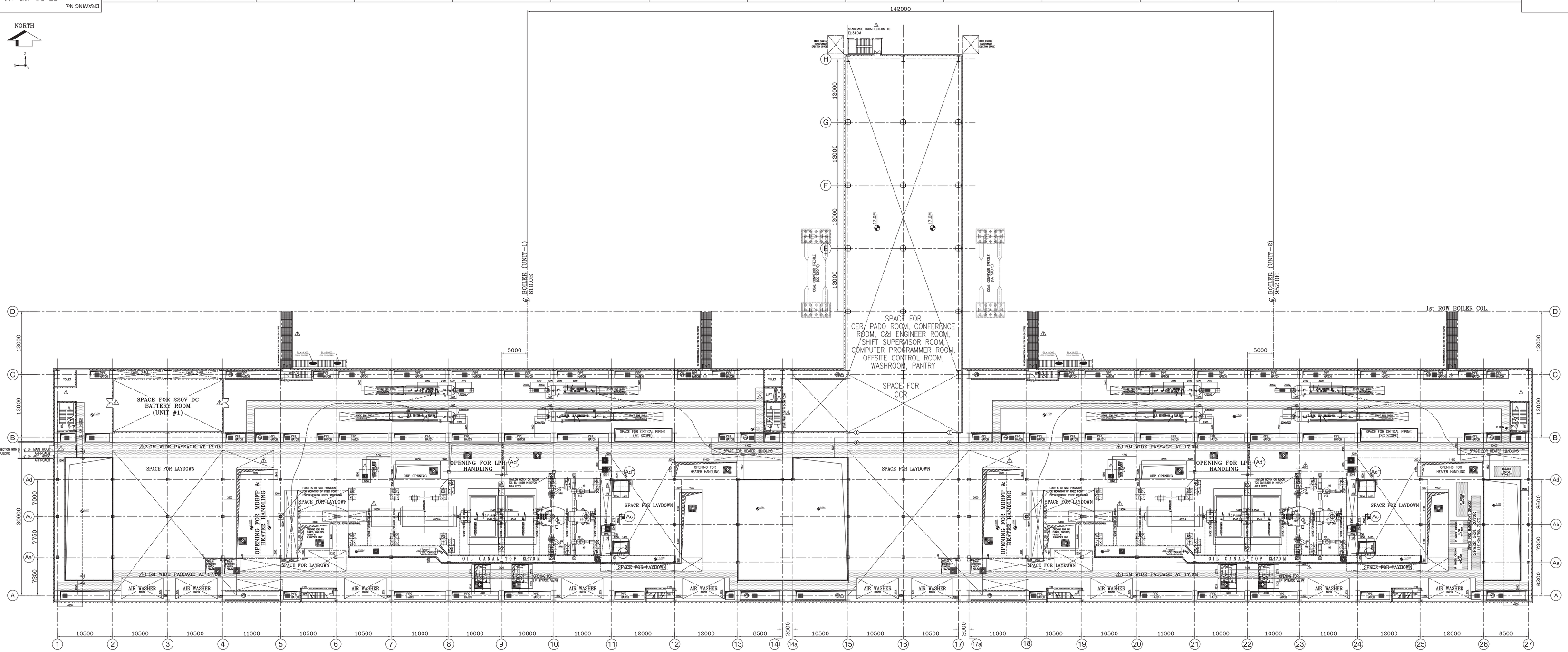
TITLE: TG EQUIPMENT PLAN AT MEZZANINE FLOOR

DEPT. SIGN | SCALE 1:300 | DRAWING NO. PE-DG-475-100-M004 | SHEET 1 OF 1 | REV. 01

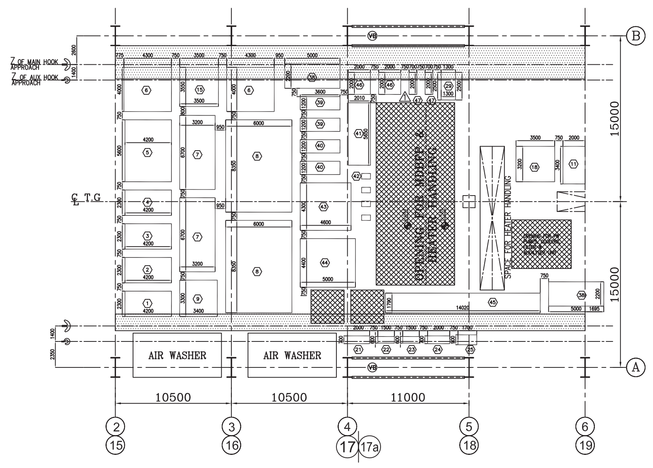
SIZE-A0

COMPUTER FILE NAME: PE-DG-475-100-M004-R1.DWG

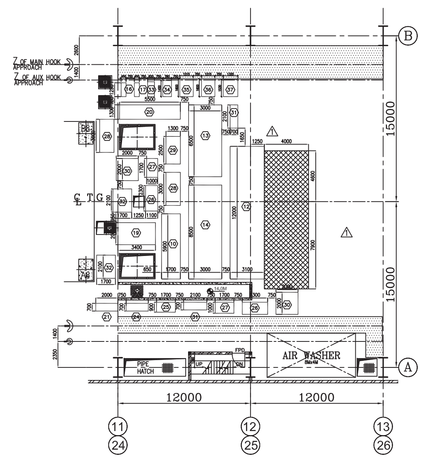
475412020IPS-PEM-MAX



PLAN AT EL: 17.0M



LAYDOWN SPACE FOR TURBINE & GENERATOR COMPONENTS



LAYDOWN SPACE FOR TURBINE & GENERATOR COMPONENTS

DETAIL OF LAY-DOWN SPACE FOR TG COMPONENTS.

S.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	3.4x3.3
(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) (TE) 2NOS.	0.8	0.45x1.25
(17)	LPSSC (U/H) (GE) 2 NOS.	0.8	0.45x1.25
(18)	IP INNER CASING (U/H)	34	3.5x3.2
(19)	HP INNER CASING (L/H)	18	3.4x2.0
(20)	HP SHAFT	20	5.5x1.3
(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.	10	5.0x2.2
(39)	END SHIELD [ES] 2NOS. (U/H) & (L/H)	8	3.6x1.2
(40)	END SHIELD [TS] 2NOS. (U/H) & (L/H)	8	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	19	5.0x4.4
(45)	GENERATOR ROTOR WITH BASE FRAME	80	14.020x1.79
⚠ (46)	LP BYPASS STOP VALVE 2NOS.	2.5	2.0x2.0
⚠ (47)	LP BYPASS STOP VALVE ACTUATOR 2NOS.	0.5	2x0.7

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:194.5M.
3. EQUIPMENTS & FACILITIES SHOWN FOR PACKAGES OTHER THAN TG PACKAGE ARE SUGGESTIVE ONLY. HOWEVER IT IS PREFERRED THAT SIMILAR DETAILS BE ENSURED FROM RESPECTIVE PACKAGE VENDORS.

REFERENCE DRAWING:–

1.	TG EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	9915-371-110-PEM-PVM-F-051 (PEM)
2.	TG EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	9915-371-110-PEM-PVM-F-052 (PEM)
3.	TG EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR LEVEL	9915-371-110-PEM-PVM-F-054 (PEM)
4.	CROSS SECTION OF MAIN PLANT	9915-371-110-PEM-PVM-F-055 (PEM)
5.	GENERAL ARRANGEMENT OF HP HEATER No.–8A	(HYD)
6.	GENERAL ARRANGEMENT OF HP HEATER No.–8B	(HYD)
7.	GENERAL ARRANGEMENT OF HP HEATER No.–9A	(HYD)
8.	GENERAL ARRANGEMENT OF HP HEATER No.–9B	(HYD)
9.	FOUNDATION PLAN	(HWR)
⚠11.	OIL CANAL DETAILS	9915-371-110-HWR-PVM-B-020 (HWR)
12.	LAYDOWN SPACE FOR GENERATOR COMPONENTS	(HWR)
⚠13.	LAYDOWN SPACE FOR STEAM TURBINE COMPONENTS	9915-371-110-HWR-PVM-F-068 (HWR)
⚠14.	OIL ROOM ARRANGEMENT	9915-371-110-HWR-PVM-B-013 (HWR)
15.	LP BYPASS VALVE ARRANGEMENT	(HWR)
16.	CCR/ CER/ COMPUTER ROOM LAYOUT	(PEM)
17.	TURBINE JB AND LIST & LAYOUT	(HWR)

NTPC DRG. NO.	9915-371-110-PEM-PVM-F-053
CUSTOMER	THDC INDIA LIMITED (A Joint Venture of Govt. of India & Govt. of U.P.) 2x660MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)
CONSULTANT	NATIONAL THERMAL POWER CORPORATION LTD. (A Government of India Enterprise)

JOB NO. 475
STATUS CONTRACT
DISTRIBUTION

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

REV.	DATE	ALTD	CHD	APPD

REV.	DATE	ALTD	CHD	APPD
1.	07.03.2020 AKV		XX	BKA
1.	DRAWING REVISED AS PER NTPC COMMENTS DATED 31.12.2019 & 09.01.2020.			
2.	REVISION MARKED AS ⚠1.			

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DEPT CODE		NAME	SIGN	DATE
M	DRN	AKV	Sd/–	16.12.2019
	DESN	AKV	Sd/–	16.12.2019
	CHD	AKV/BKA	Sd/–	16.12.2019
	APPD	BKA	Sd/–	16.12.2019

TITLE
TG EQUIPMENT PLAN AT OPERATING FLOOR

DEPT. SCALE 1:275 DRAWING NO. PE-DG-475-100-M005
SIGN SHEET 1 OF 1 REV. 01
SIZE-A0

COMPUTER FILE NAME: PE-DG-475-100-M005-R1.DWG
475412020/PS-PEM-MAX

4754I2020/PS-PEM-MAX
COMPUTER FILE NAME: PE-DG-475-100-M006-R1.DWG
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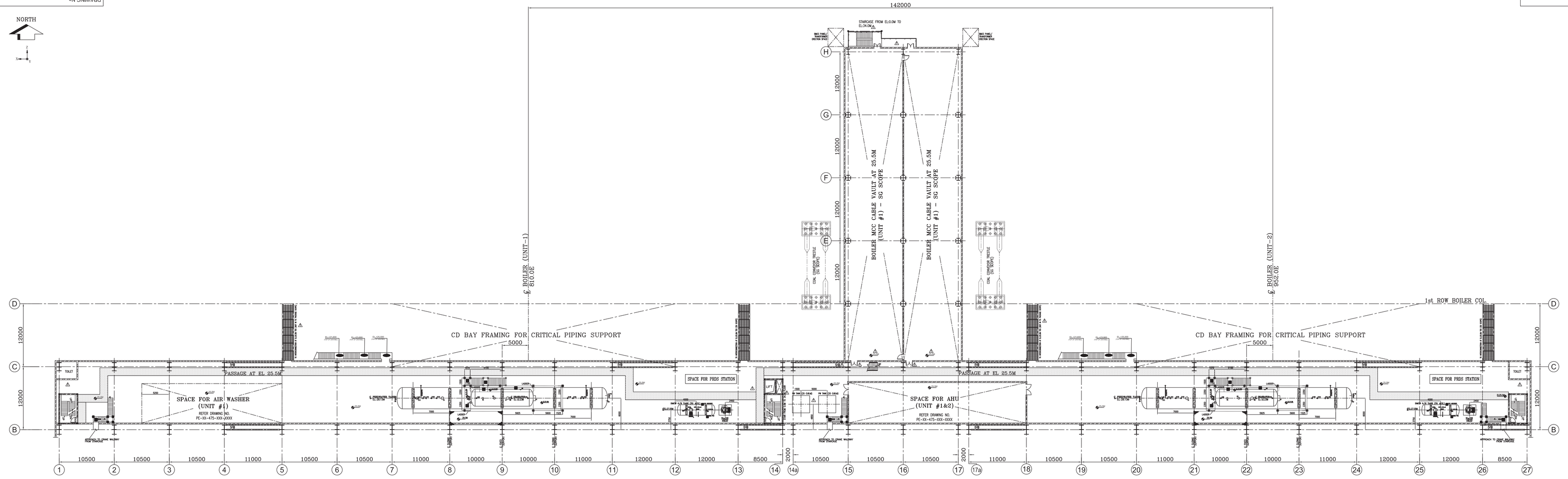
DRAWING No. PE-DG-475-100-M006

CUSTOMER'S DRAWING No.

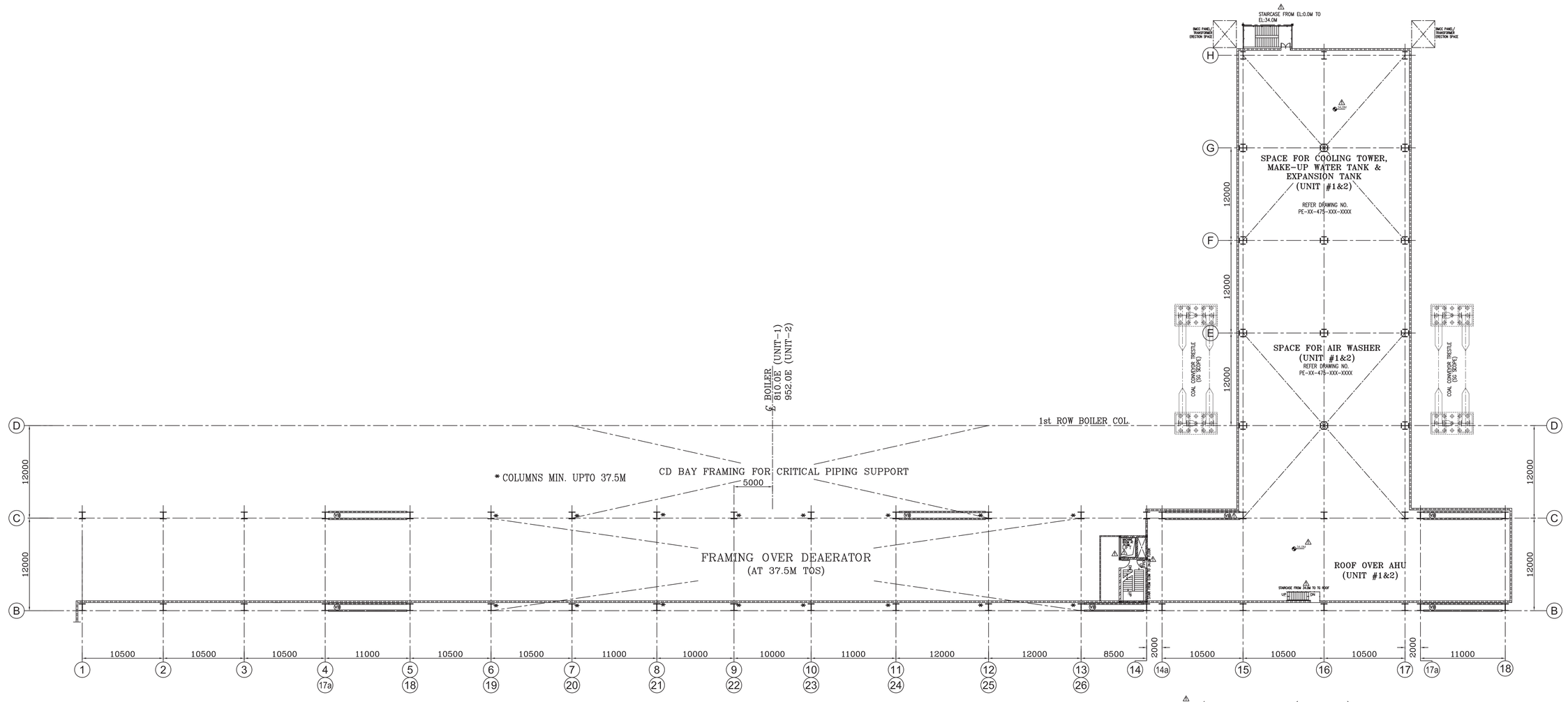
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

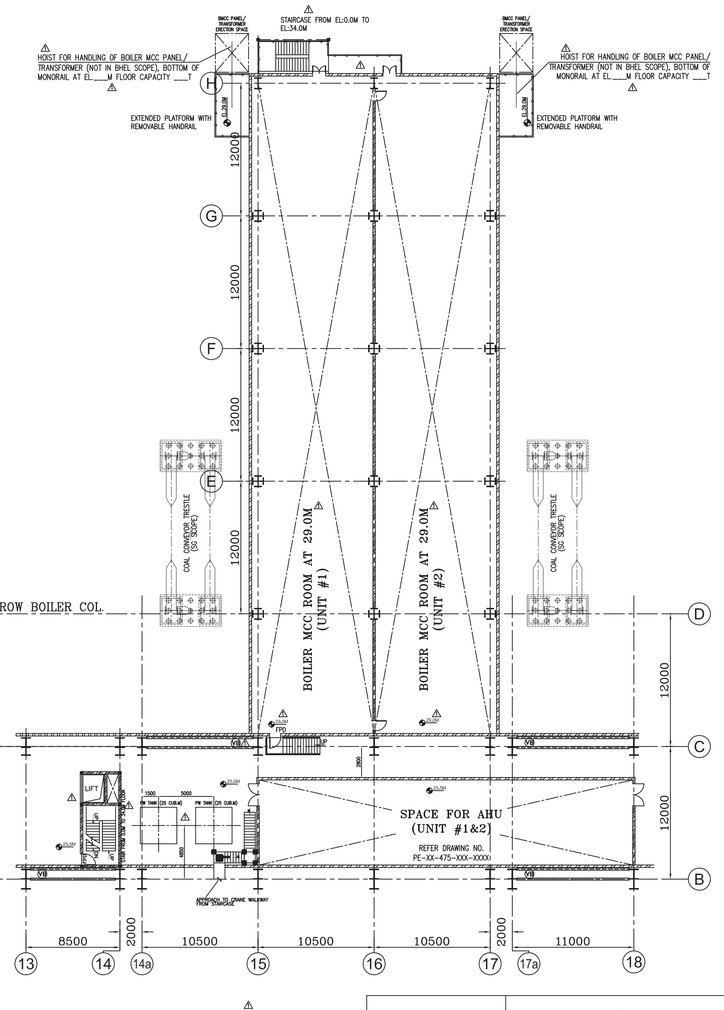
NORTH



PLAN AT EL: 25.5M△



PLAN AT EL: 34.0△/ 37.5M(TOS)



PLAN AT EL: 29.0M△

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:194.5M.
3. EQUIPMENTS & FACILITIES SHOWN FOR PACKAGES OTHER THAN TG PACKAGE ARE SUGGESTIVE ONLY. HOWEVER IT IS PREFERRED THAT SIMILAR DETAILS BE ENSURED FROM RESPECTIVE PACKAGE VENDORS.

REFERENCE DRAWING:–

1. TG EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	9915-371-110-PEM-PVM-F-051 (PEM)
2. TG EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	9915-371-110-PEM-PVM-F-052 (PEM)
3. TG EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPEARTING FLOOR IN BC BAY	9915-371-110-PEM-PVM-F-053 (PEM)
4. CROSS SECTION OF MAIN PLANT	9915-371-110-PEM-PVM-F-055 (PEM)
5. GA OF DEAERATOR	(HYD)
6. DEAERATOR PLATFORM ASSEMBLY	(HYD)
7. GA OF DMCW O/H TANK	(BPL)
8. GA OF NaOH DOSING SKID	(PEM)
9. GA OF SERVICE WATER TANK	(PEM)
10. GA OF POTABLE WATER TANK	(BPL)

LEGEND:–

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- CUT OUTS
- BRICK WALL

REV.	DATE	ALTD	CHD	APPD

REV.	DATE	ALTD	CHD	APPD
1	07.03.2020	AKV	KK	BKA
1.	DRAWING REVISED AS PER NTPC COMMENTS DATED 31.12.2019.			
2.	REVISION MARKED AS △.			

NTPC DRG. NO.	9915-371-110-PEM-PVM-F-054
CUSTOMER	THDC INDIA LIMITED (A Joint Venture of Govt. of India & Govt. of U.P.) 2x660MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)
CONSULTANT	NATIONAL THERMAL POWER CORPORATION LTD. (A Government of India Enterprise)

JOB NO.	475
STATUS	CONTRACT
DISTRIBUTION	

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POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

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DEPT		NAME	SIGN	DATE
CODE	DRN	AKV	Sd/–	16.12.2019
M	DESN	AKV	Sd/–	16.12.2019
	CHD	AKV/BKA	Sd/–	16.12.2019
	APPD	BKA	Sd/–	16.12.2019

TITLE: TG EQUIPMENT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY

DEPT. | SCALE 1:275 | DRAWING NO. PE-DG-475-100-M006

SIGN | SHEET 1 OF 1 | REV. 01

SIZE-A0

DRAWING No. PE-DG-475-100-M007

CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

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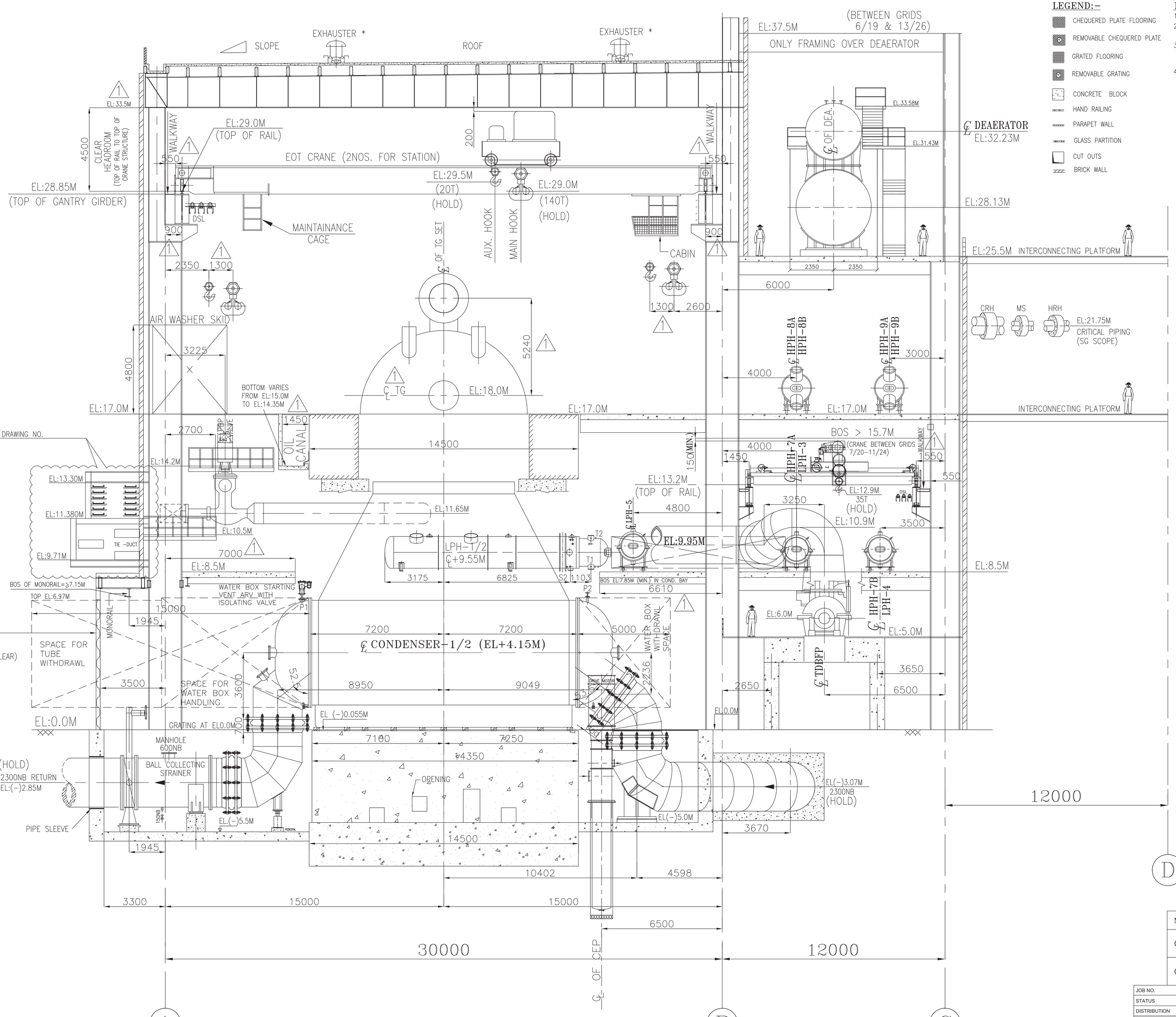

LEGEND:–

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- CUT OUTS
- BRICK WALL

NOTES:–

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4. * FOR EXACT LOCATIONS REFER ROOF DRAWING OF CIVIL.

REFERENCE DRAWING:–

1.	TG EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	9915-371-110-PEM-PVM-F-051 (PEM)
2.	TG EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	9915-371-110-PEM-PVM-F-052 (PEM)
3.	TG EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	9915-371-110-PEM-PVM-F-053 (PEM)
4.	TG EQUIPMENT LAYOUT PLAN AT DEAERATOR FLOOR	9915-371-110-PEM-PVM-F-054 (PEM)

NTPC DRG. NO.	9915-371-110-PEM-PVM-F-055
CUSTOMER	THDC INDIA LIMITED (A Joint Venture of Govt. of India & Govt. of U.P.) 2x660MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)
CONSULTANT	NATIONAL THERMAL POWER CORPORATION LTD. (A Government of India Enterprise)

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DEPT CODE		NAME	SIGN	DATE
M	DRN	AKV	Sd/-	16.12.2019
	DESN	AKV	Sd/-	16.12.2019
	CHD	AKV/BKA	Sd/-	16.12.2019
	APPD	BKA	Sd/-	16.12.2019

REV.	DATE	ALTD	CHD	APPD

REV.	DATE	ALTD	CHD	APPD
1.	11.03.2020	AKV	KK	BKA

1. DRAWING REVISED AS PER NTPC COMMENTS DATED 31.12.2019.
2. REVISION MARKED AS △1.

TITLE
CROSS SECTION OF MAIN PLANT

DEPT. | SCALE 1:75 | DRAWING NO. PE-DG-475-100-M007
SIGN | SHEET 1 OF 1 | REV. 01

SIZE:A0

COMPUTER FILE NAME: PE-DG-475-100-M007-R1.DWG

475&1/2020/PS-PEM-MAX

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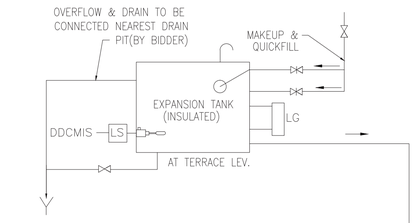
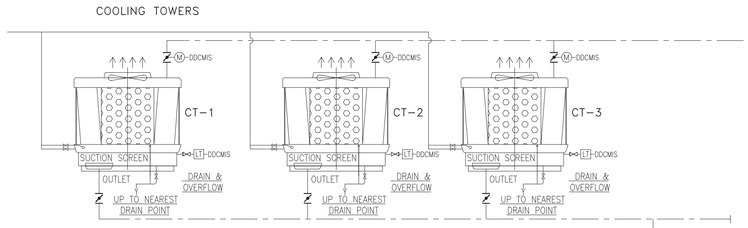




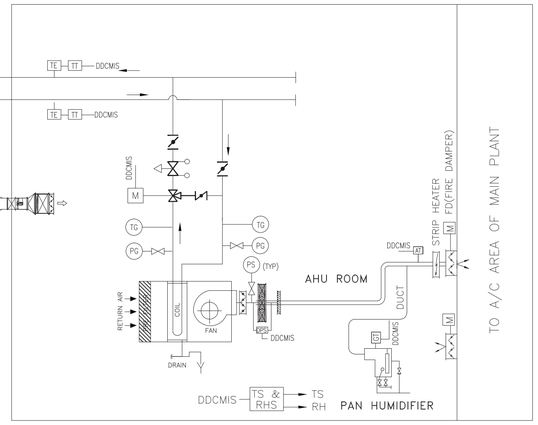
CHILLED WATER PUMP DETAIL	
NAME	QTY
CHWP-1 TO 3	3 NOS(2W+1S/B)

CONDENSER WATER PUMP DETAIL	
NAME	QTY
COND.WP-1 TO 3	3 NOS(2W+1S/B)

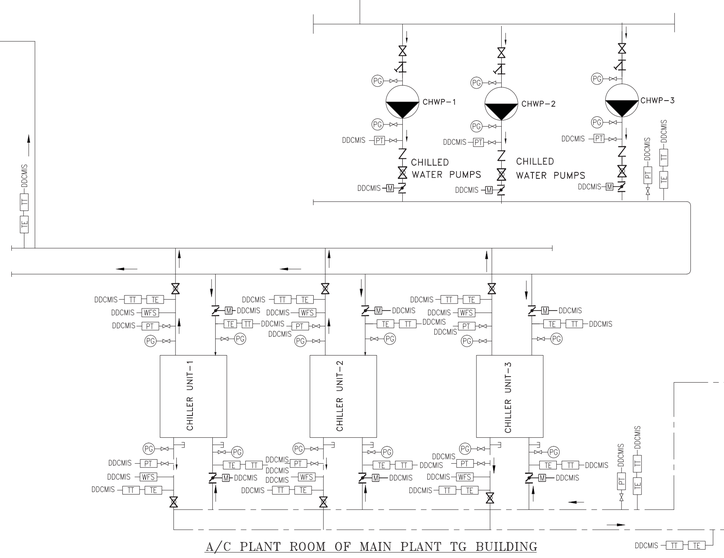
COOLING TOWER DETAILS	
NAME	QTY
CT-1 TO 3	3 NOS(2W+1S/B)

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) ,3 NO EACH FLOAT VALVE, M-UP/Q.FILL & DRAIN CON.
TG	TEMPARATURE GAUGE
LG	LEVEL GAUGE
LT—DDCMIS	LEVEL TRANSMITER
LS—DDCMIS	LEVEL SWITCH
GT—DDCMIS	GEYSER STAT
AT—DDCMIS	AIR STAT
DPS—DDCMIS	DIFFERENTIAL PRESSURE SWITCH
WFS—DDCMIS	WATER FLOW SWITCH
DDCMIS TS & RHS TS RH	RH SENSOR &TEMP.SENSOR
TE—DDCMIS	TEMPARATURE ELEMENT(SENSOR)
PT—DDCMIS	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	3 WAY VALVE (MODULATING WITH ACTUATOR)
	GLOBE VALVE
	CHECK VALVE
	'Y' STRAINER
M	BUTTERFLY VALVE(MOTORISED)
	BUTTERFLY VALVE
LEGEND	DESCRIPTION

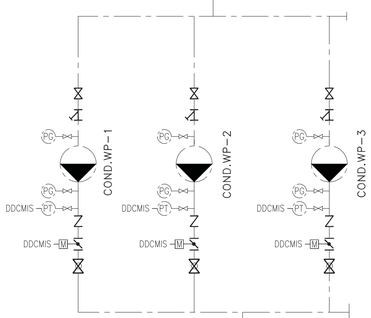
TO OTHER AHU ROOMS



TYPICAL CONNECTION DETAIL FOR AHU ROOM



A/C PLANT ROOM OF MAIN PLANT TG BUILDING



CONDENSER WATER PUMPS

NOTE:

1) CAPACITY OF ALL THE A/C EQUIPMENTS SHALL BE FINALISED DURING DETAILED ENGINEERING.
2) SIZE OF PIPES, VALVES ETC SHALL BE FINIALISED DURING DETAILED ENGINEERING
3) NUMBER OF AHU AND AHU CAPACITY SHALL BE FINIALISED DURING DETAILED ENGINEERING
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.
10) The instruments mentioned in this P&ID are bare minimum and any other instrument required as per system requirement/ customer observations during detail engineering shall be provided by bidder without any commercial implication.
11) The redundancy of the instruments shall be as per C&I portion of technical specification.

FOR TENDER PURPOSE ONLY

CLIENT
THDC INDIA LIMITED
(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT
एन टी पी सी लिमिटेड
NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT
KHURJA SUPER THERMAL POWER PROJECT
STAGE-I (2x660MW)

TITLE
SCHEMATIC DIAGRAM FOR A/C SYSTEM FOR MAIN PLANT TG BUILDING

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	CLEARED BY C	M	E	C&I	APPD	DATE

SIZE	SCALE	DRG.NO.	REV.
A1	NTS	9915-002-POM-A-054	01

CAD FILE NAME : 9915-002-POM-A-054

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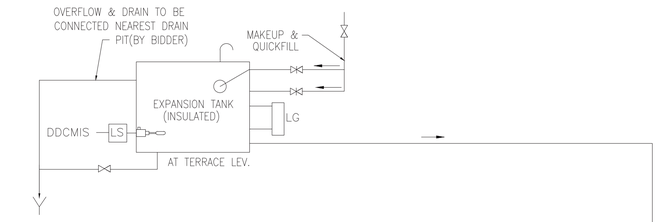
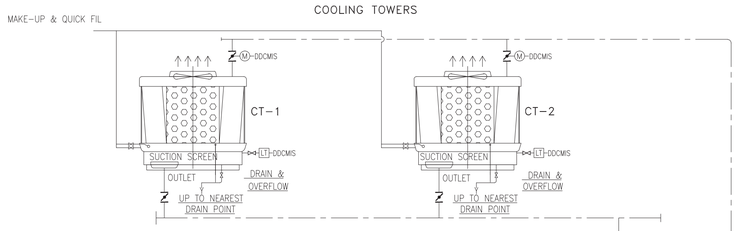
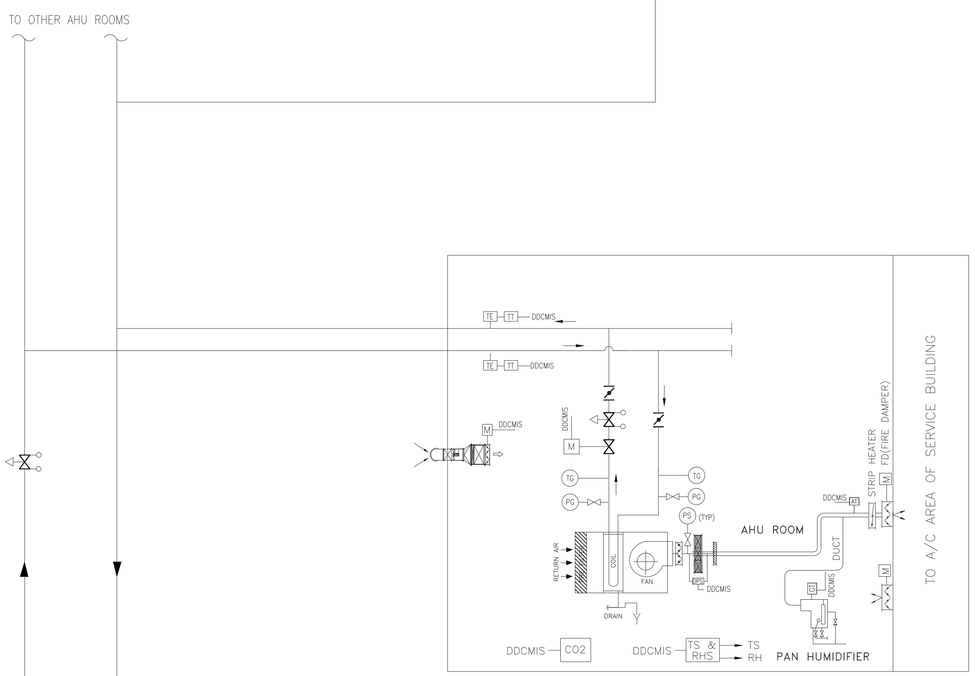


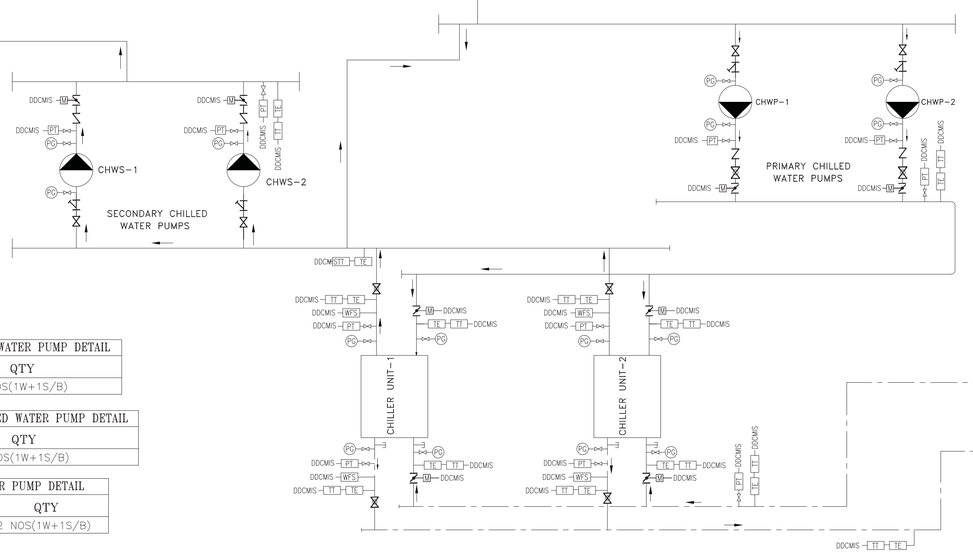


	HEPA FILTER
	FINE FILTER
	PRE FILTER
FD	ML TYPE FIRE DAMPER(MOTORISED)
VCD	VOLUME CONTROL DAMPER (ML TYPE)
NRD	NON RETURN DAMPER (ML TYPE)
	FLOW CONTROL VALVE
	GATE VALVE
	FLOAT VALVE
M	MOTORIZED GLOBE VALVE(INCHING TYPE)
	BALANCING VALVE
M	2 WAY VALVE (MODULATING WITH ACTUATOR)
	GLOBE VALVE
	CHECK VALVE
	'Y' STRAINER
M	BUTTERFLY VALVE(MOTORISED)
	BUTTERFLY VALVE
LEGEND	DESCRIPTION

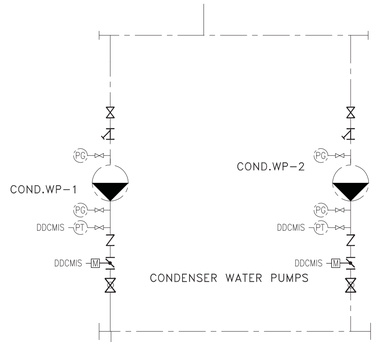
TE	TEMPERATURE TRANSMITTER)
	CH.WATER SUPPLY & RETURN PIPE
	COND.WATER SUPPLY & RETURN PIPE
	OPEN DRAIN PIT
	ATMOSPHERIC VENT
	DESCALING CONNECTION
	STRIP HEATER
	FRESH AIR FAN WITH PRE FILTER & FINE FILTER
	CENTRIFUGAL FAN
	PUMP
	PAN HUMIDIFIER WITH 25NB GATE VAVE(3 NOS EACH) ,1 NO EACH FLOAT VALVE, M-UP/Q.FILL & DRAIN CON.
TG	TEMPARATURE GAUGE
LG	LEVEL GAUGE
LT—DDCMIS	LEVEL TRANSMITER
LS—DDCMIS	LEVEL SWITCH
GT—DDCMIS	GEYSER STAT
AT—DDCMIS	AIR STAT
DPS—DDCMIS	DIFFERENTIAL PRESSURE SWITCH
WFS—DDCMIS	WATER FLOW SWITCH
DDCMIS TS & RHS TS RH	RH SENSOR &TEMP.SENSOR
TE—DDCMIS	TEMPARATURE ELEMENT(SENSOR)
PT—DDCMIS	PRESSURE TRANSMITTER
PG	PRESSORE GAUGE
LEGEND	DESCRIPTION



TYPICAL CONNECTION DETAIL FOR AHU ROOM



A/C PLANT ROOM OF SERVICE BUILDING



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)

NOTE:

1) CAPACITY OF ALL THE A/C EQUIPMENTS SHALL BE FINALISED DURING DETAILED ENGINEERING BASED ON HEAT LOAD CALCULATION OF SERVICE BUILDING
2) SIZE OF PIPES, VALVES ETC SHALL BE FINIALISED DURING DETAILED ENGINEERING
3) NUMBER OF AHU AND AHU CAPACITY SHALL BE FINIALISED DURING DETAILED ENGINEERING BASED ON THE FINILASIED ARCHITECTURAL DRAWING OF THE SERVICE BUILDING
4) VARIABLE AIR VOLUME BOX (VAV) SHALL BE PROVIDED FOR OPTIMUM USE OF AHU THROUGH VVVVFD. NUMBERS OF VAV BOX SHALL BE FINIALISED 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) TEMPERATURE SENSOR (TS) & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDED IN EACH AHU ROOM.
10) AIR RELEASE VALVES AS PER SYSTEM REQUIREMENT SHALL BE PROVIDED AT SUITABLE LOCATIONS.
11) ALL WATER PIPES SHALL BE AS PER TECHNICAL SPECIFICATION.
12) The instruments mentioned in this P&ID are bare minimum and any other instrument required as per system requirement/ customer observations during detail engineering shall be provided by bidder without any commercial implication.
13) The redundancy of the instruments shall be as per C&I portion of technical specification.

FOR TENDER PURPOSE ONLY

CLIENT
THDC INDIA LIMITED
(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT
एन टी पी सी लिमिटेड
NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT
KHURJA SUPER THERMAL POWER PROJECT
STAGE – I (2x660MW)

TITLE
SCHEMATIC DIAGRAM FOR A/C SYSTEM FOR SERVICE BUILDING

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
					CLEARED BY					

SIZE	SCALE	DRG.NO.	REV.
A1	NTS	9915-002-POM-A-056	01

CAD FILE NAME : 9915-002-POM-A-056

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TOTAL HARDNESS
40–60 PPM

MAKE UP/SOFT WATER
TANK
(CAP: AS PER SPEC.)

CT

TO HEAT LOAD

CORROSSION INIHIBATOR
SCALE INHIBATOR & NAOCL
DOSING (* REFER NOTE–5)

MAKE–UP

BD

dpt
dps
FT
PT
PI
DMF/ACF
SOFTNER
BLENDING WATER
MUWP–2
MUWP–1
(*)
MAKE UP WATER AT TERMINAL PT.
(*)PUMPING ARRGT. TYP. FOR POWERHOUSE
UNIT# 1&2, SERVICE BUILDING#1&2

REJECTS OF WATER SOFTENING PLANT
AC VENDOR
CMB OF ETP
BRINE
DILUTION
CUM BUFFER
TANK
(CAP.2M3)
BHEL
SUMP FOR REJECTS
SUMP PUMPS
2 NOS. (1W+1S)
2M FROM THE
NEAREST PIT

SKID MOUNTED WATER SOFTENING PLANT
(TYP. FOR POWERHOUSE UNIT# 1&2, SERVICE BUILDING#1 & 2

ACF– ACTIVATED CARBON FILTER
DMF– DUAL MEDIA FILTER
BD – BLOW–DOWN
CT – COOLING TOWER
(FT) FLOW TRANSMITTER
(DPS) DIFF. PRESS. SWITCH

NOTES:

1. KKS TAGGING SHALL BE PROVIDED FOR ALL INSTRUMENTS & EQPT.
2. BD BLOW DOWN TO BE CONTROLLED TO ENSURE A CYCLE OF CONCENTRATION OF 05
3. INSTRUMENTS WHICH ARE USED FOR PROTECTION / CLCS SHALL BE TRIPLE REDUNDANT, USED FOR INTERLOCK& PERMISSIVE SHALL BE DUAL REDUNDANT AND USED FOR ONLY ALARM OR INDICATION SHALL BE SINGLE.
4. VALVES & INSTRUMENTS SHOWN ARE MINIMUM. THE SAME SHALL BE PROVIDED IN LINE WITH THE MAIN PLANT PHILOSOPHY TECHNICAL SPECIFICATION.
5. DMF/ACF FILTER MEDIA SHALL CONSIST OF GRADED QUARTZ SAND INCLUDING GRAVELS & PEBBLES (FREE FROM CARBONATES AND OTHER FOREIGN MATTER) AND ANTHRACITE AS PER REQUIREMENT.
5. SUITABLE COOLING WATER TREATMENT PROGRAM (Viz SCALE INHIBITOR/ CORROSION INHIBITOR/ BIO DISPERSANT/NAOCL ETC.) MUST TO DOSED TO MAINTAIN A CORROSION, SCALE & MICROBIOLOGICAL FOULING FREE WATER CHEMISTRY IN THE COOLING WATER CIRCUIT FOR EFFICIENT OPERATION OF AC SYSTEM.
6. MOC SHOULD BE AS PER TECHNICAL SPECIFICATION AND SHALL BE COMPATIBLE WITH THE PROCESS REQMT. & FLUID BEING HANDLED BIDDER TO GIVE DETAILS OF IN SUPPORT OF THE MOC THUS SELECTED FOR SUITABILITIES OF THE MATERIAL WHEREVER NOT SPECIFIED IN THE TENDER.
7. BASED ON LAYOUT CONSIDERATIONS SUMP FOR REJECTS AND BLOW DOWN MAY NOT BE PROVIDED. BIDDER TO CHOOSE THE REQUIRED PUMP ACCORDINGLY.

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

CUSTOMER: THDC INDIA LIMITED (A Joint Venture of Govt. of India & Govt. of U.P.)
2x660MW KHURJA SUPER THERMAL POWER PROJECT
(TURBINE GENERATOR AND ASSOCIATED PACKAGES)

CONSULTANT: NATIONAL THERMAL POWER CORPORATION LTD.
(A Government of India Enterprise)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO. 475
STATUS CONTRACT
DISTRIBUTION

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DEPT CODE		NAME	SIGN	DATE
M	DRN			
	DESN			
	CHD			
	APPD			

TITLE: SCHEMATIC DIAGRAM OF WATER SOFTENING PLANT

DEPT. M SCALE NTS SIGN

DRAWING NO. PE–DG–475–553–A001

SIZE-A0

CAD FILE NAME:
475x1202020PS-PEM.MAX