TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)

VOLUME – II B & III

TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM

SPECIFICATION NO.: PE-TS-475-673-A001 R0

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001
		VOLUME II-B
		SECTION-
		REV. NO. 00 / DATE:

CONTENTS

VOLUME – II B

SECTION	DESCRIPTION	PAGE
	PROJECT INFORMATION	3
SECTION – I	SPECIFIC TECHNICAL REQUIREMENTS	17
SECTION – IA	SPECIFIC TECHNICAL REQUIREMENTS - MECHANICAL	18
	• ANNEXURE I : QUALITY PLAN	33
	• ANNEXURE II : SUB VENDORS LIST	41
	• ANNEXURE III : FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	84
	• ANNEXURE IV : DRAWING/DOCUMENTS REQUIRMENT & DISTRIBUTION SCHEDULE	106
	• ANNEXURE V : MANDATORY SPARES	115
	• DATASHEET - A	117
	• DRAWINGS	123
SECTION – IB	SPECIFIC TECHNICAL REQUIREMENTS – ELECTRICAL	128
SECTION – IC	SPECIFIC TECHNICAL REQUIREMENTS – CONTROL & INSTRUMENTATION	249
SECTION – D	GENERAL TECHNICAL REQUIREMENTS	321

VOLUME – III

SECTION – III	LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID	518
	COMPLIANCE CUM CONFIRMATION SCHEDULE	519
	PRE BID CLARIFICATIONS SCHEDULE	520
	SCHEDULE OF DECLARATION	521
	SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL	522

	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X600 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673A-A001
		VOLUME II-B
		SECTION-
		REV. NO. 00 / DATE:

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.

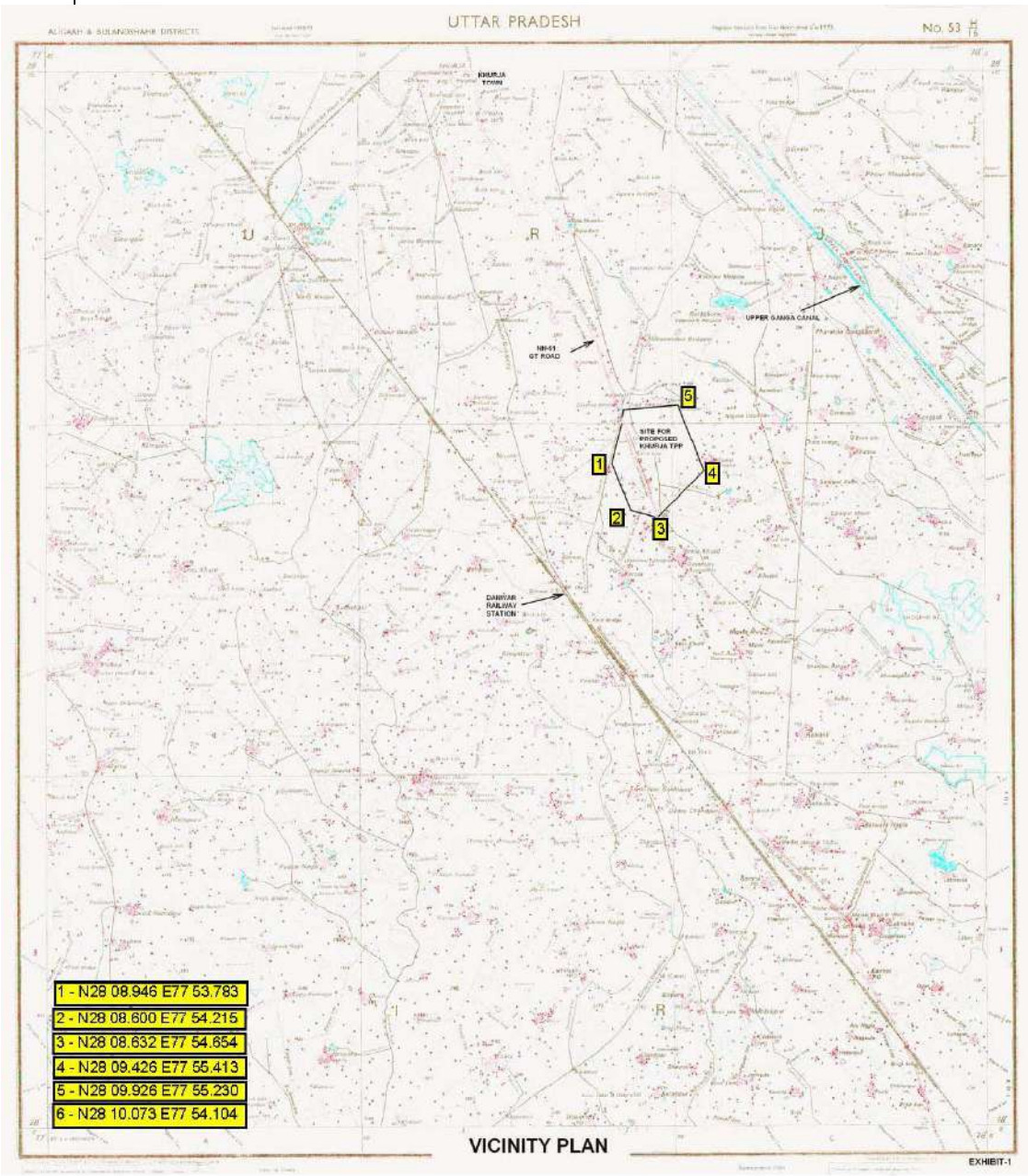
CLAUSE NO.	PROJECT INFORMATION
4.03.00	**AIRPORT** The nearest commercial airport at Delhi is located at a distance of approximately 120 kms from the project site.
5.00.00	**LAND** The land requirement for the project has been estimated as 1400 Acres for Main Plant, Balance of Plant including Coal Handling 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.**

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	Column - 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 (oC)	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

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

CLAUSE NO.	PROJECT INFORMATION

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

माह	स्टेशन का स्तर दाब STATION LEVEL PRESSURE	वायु तापमान AIR TEMPERATURE												आर्द्रता HUMIDITY		मेघ की मात्रा CLOUD AMOUNT		वर्षा RAINFALL							पहलगो पर आधारित BASED ON OBSERVATIONS 1971-2000
		माध्य MEAN						EXTREMES																
		शुष्क बल्ब DRY BULB	भीग बल्ब WET BULB	दैनिक अधिक DAILY MAX.	दैनिक न्यून DAILY MIN	माह में उच्चतम HIGHEST IN THE MONTH	माह में निम्नतम LOWEST IN THE MONTH	उच्चतम HIGHEST	दिनांक और वर्ष DATE AND YEAR	निम्नतम LOWEST	दिनांक और वर्ष DATE AND YEAR	सायंकाल आर्द्रता	वाष्प दाब VAPOUR PRESSURE	सायंकाल मेघ	निम्न मेघ LOW CLOUDS	मासिक योग MONTHLY TOTAL	वर्षा के दिनों की संख्या NO. OF RAINY DAYS	वर्षांकित पंद्रह नम महीने का योग TOTAL IN WETTEST MONTH WITH YEAR	वर्षांकित शुष्कतम महीने का योग TOTAL IN WETTEST MONTH WITH YEAR	24 घंटों में सबसे भारी वर्षा HEAVEST FALL IN 24 HOURS	दिनांक और वर्ष DATE AND YEAR	माध्य पवन गति MEAN WIND SPEED
MONTH	एच.पी.ए. hPa	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C		डि. से °C		प्रतिशत %	एच.पी.ए. hPa	आकाश के अष्टमांश Oktas of sky		मि.मी. mm		मि.मी. mm	मि.मी. mm	मि.मी. mm		कि.मी. प्र. घं. Kmph
जनवरी JAN	I 996.0	10.8	9.2	20.6	7.4	25.1	3.8	30.7	28 1991	0.6	16 1935	80	10.5	2.5	2.3	15.2	1.5	71.9 1883	0.0	53.8	12 1984	3.1
	II 993.3	18.2	13.8									60	12.4	2.3	2.0							
फरवरी FEB	I 993.7	13.3	11.1	23.6	9.5	28.8	5.0	33.3	26 1980	1.7	11 1960	75	11.6	2.5	2.2	13.9	1.4	141.0 1928	0.0	71.1	2 1928	3.5
	II 991.0	21.2	15.4									62	13.0	2.3	2.1							
मार्च MAR	I 990.9	19.3	15.2	30.0	14.1	35.5	8.9	41.7	31 1945	3.9	6 1945	63	14.1	2.3	1.9	8.5	1.0	106.7 1870	0.0	63.5	18 1870	4.2
	II 988.1	27.2	18.7									47	14.8	2.6	2.1							
अप्रैल APR	I 986.6	26.8	18.9	36.8	20.1	41.5	14.3	44.5	29 1999	10.9	9 1957	45	15.5	1.5	1.2	8.8	0.9	68.1 1908	0.0	30.6	29 1997	4.8
	II 982.9	34.3	21.3									28	14.7	2.0	1.6							
मई MAY	I 982.5	30.6	21.9	40.1	24.5	43.9	19.9	47.2	28 1988	15.5	3 1967	45	19.2	1.5	1.3	21.0	2.2	75.7 1913	0.0	41.1	20 1913	4.9
	II 979.1	37.6	24.0									30	18.8	1.6	1.4							
जून JUN	I 978.7	31.2	24.8	39.3	26.6	44.4	22.3	46.7	7 1965	18.6	2 1957	59	26.1	2.8	2.6	68.5	4.1	544.8 1933	0.0	327.2	30 1981	5.6
	II 975.3	30.5	26.0									44	25.1	3.0	2.6							
जुलाई JUL	I 978.4	29.2	26.3	34.6	26.0	39.4	23.0	44.5	2 1987	19.9	12 1988	79	31.9	6.1	5.9	217.7	10.2	576.1 1956	1.5 1941	184.6	3 1942	4.7
	II 975.4	32.2	27.3									69	32.0	6.1	5.8							
अगस्त AUG	I 980.0	28.3	26.1	33.2	25.4	36.9	22.9	42.1	11 1987	20.1	13 1957	84	32.1	6.1	5.7	247.4	11.6	529.8 1940	0.0	193.6	15 1964	4.3
	II 977.3	30.7	27.0									75	32.7	6.1	5.9							
सितम्बर SEP	I 984.6	27.4	24.5	33.8	23.8	36.9	20.7	40.2	1 1979	14.8	16 1964	78	28.6	3.2	2.9	104.1	5.2	590.5 1884	0.0	220.6	28 1984	3.7
	II 981.5	31.0	25.6									65	28.6	3.2	3.0							
अक्तूबर OCT	I 990.4	23.5	19.8	33.0	16.8	36.2	14.4	41.7	4 1952	11.0	9 1963	69	20.2	1.0	0.9	31.4	1.4	231.1 1955	0.0	138.7	13 1955	2.2
	II 987.2	29.1	21.8									51	20.4	1.0	0.8							
नवम्बर NOV	I 994.5	17.5	14.4	28.3	12.9	32.1	9.4	36.1	3 1944	5.0	30 1937	69	14.0	0.8	0.7	4.2	0.5	34.8 1904	0.0	26.2	14 1966	2.1
	II 991.5	24.0	18.2									55	16.4	0.9	0.8							
दिसम्बर DEC	I 996.7	12.3	10.4	22.5	8.5	26.7	5.3	32.8	2 1948	1.2	30 1973	77	11.2	1.7	1.4	11.0	0.6	87.6 1909	0.0	56.2	28 1977	2.7
	II 993.6	19.5	15.0									69	13.5	1.8	1.5							
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I 987.7	22.5	18.6	31.3	18.1	44.1	3.4	47.2	28	0.6	16	69	19.6	2.6	2.4	751.6	40.7	1342.9	204.5	327.2	30	3.8
	II 984.7	28.5	21.2					5	1988	1	1935	52	20.2	2.7	2.4			1933	1916	6	1981	
उपलब्ध वर्ष NUMBER OF YEARS	I	29	29	29	29	29	29	68		68		29	29	29	29	28	26	64	64	66		15
	II																					

27

985087/2022/PS-PEM-MAX

CLAUSE NO.	PROJECT INFORMATION

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : अलीगढ़
STATION : Aligarh

माह	मौसम परिघटना: के साथ दिनों की संख्या — कोहरा	धूल भरी आँधी	धूल भरी आँधी	धुआँ	तड़ित	पवन: पवन की गति के साथ दिनों की संख्या (कि. मी. प्र. घ.) — 0	1-19	20-61	62 या अधिक	पवन की दिशा के दिनों की संख्या — N	NE	E	SE	S	SW	W	NW	शांत	मेघ: मेघ सहित (सभी मेघ) दिनों की संख्या — 0	1-2	3-5	6-7	8	मेघ रहित मेघ मात्रा सहित दिनों की संख्या — 0	1-2	3-5	6-7	8	धुआँ	दृश्यता: दृश्यता सहित दिनों की संख्या — 1 कि.मी. तक	1-4 कि.मी.	4-10 कि.मी.	10-20 कि.मी.	20 कि.मी. से अधिक
MONTH	WEATHER PHENOMENA: No. OF DAYS WITH — FOG	THUN-DER	HAIL	SQUI-ALL	No. OF DAYS WITH WIND SPEED (Km. p. h.) — 0	1-19	20-61	62 or more	PERCENTAGE No. OF DAYS WIND FROM — CALM	No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) 0 K T A S — 0	1-2	3-5	6-7	8	No. OF DAYS WITH LOW CLOUD AMOUNT 0 K T A S — 0	1-2	3-5	6-7	8	FOG	No. OF DAYS WITH VISIBILITY — UPTO 1 km	1-4 km	4-10 km	10-20 km	OVER 20 km
जनवरी I	2.1	0.1	0.2	3.0	0.0	0	25	0	0.0	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	10.9	4.6	0.0
JAN II						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	8.3	12.1	0.0
फरवरी I	2.4	0.1	0.5	1.2	0.0	0	23	5	0.0	3	14	8	14	2	12	15	14	18	16	2	3	3	4	0	18	1	2	3	4	0	1.9	4.8	14.5	6.8	0.0
FEB II						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 I	2.2	0.3	0.7	0.0	0.1	0	27	4	0.0	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
MAR II						0	26	5		6	8	6	11	2	10	20	22	15	17	2	4	5	3	0	10	2	3	4	3	0	0.1	8.3	6.9	18.1	0.0
अप्रैल I	1.9	0.1	0.9	0.0	0.8	0	26	4	0.0	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
APR II						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 I	3.2	0.1	0.9	0.0	2.3	0	27	4	0.0	3	12	11	13	3	12	15	18	15	23	1	2	2	3	0	25	0	2	1	3	0	0.0	5.6	15.4	9.9	0.0
MAY II						0	27	4		7	9	6	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 I	5.2	0.0	0.5	0.0	1.0	0	26	4	0.0	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
JUN II						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 I	13.2	0.0	0.6	0.0	0.1	0	26	5	0.0	2	13	11	11	3	16	12	15	15	4	1	2	6	16	0	5	1	2	6	17	0	0.0	4.6	12.2	14.2	0.0
JUL II						0	26	5		5	14	14	12	4	14	10	12	15	2	2	3	6	16	0	3	2	3	7	15	0	0.0	5.3	7.7	16.0	0.0
अगस्त I	14.4	0.0	0.8	0.0	0.0	0	25	6	0.0	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
AUG II						0	26	5		5	14	13	10	5	14	13	9	17	2	3	3	6	16	0	2	3	3	6	17	0	0.0	5.4	7.8	18.0	0.0
सितम्बर I	7.4	0.0	0.4	0.0	0.0	0	24	6	0.0	2	11	13	15	3	14	13	11	18	16	1	4	3	6	0	17	1	3	3	5	0	0.0	1.4	10.2	16.4	0.0
SEP II						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	16.7	0.0
अक्तूबर I	1.9	0.0	0.5	0.1	0.1	0	20	11	0.0	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
OCT II						0	17	14		6	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 I	0.7	0.0	0.1	0.1	0.0	0	18	12	0.0	3	7	7	11	2	8	14	8	42	25	1	2	1	1	0	27	0	1	1	1	0	0.1	3.6	16.3	10.0	0.0
NOV II						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	6.8	11.2	0.0
दिसम्बर I	1.2	0.0	0.1	2.2	0.0	0	21	10	0.0	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
DEC II						0	17	14		3	4	3	8	1	4	20	10	47	21	2	2	3	3	0	23	1	2	3	2	0	0.1	14.6	5.9	10.4	0.0
वार्षिक योग I	55.8	0.8	6.1	8.7	4.3	0	267	78	0.0	2	12	10	14	2	12	13	12	23	224	11	29	33	65	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	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				

28

ANNEXURE-VII-1

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

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

SECTION – I
SPECIFIC TECHNICAL REQUIREMENTS
SECTION – IA - SPECIFIC TECHNICAL REQUIREMENTS – MECHANICAL
SECTION – IB - SPECIFIC TECHNICAL REQUIREMENTS – ELECTRICAL
SECTION – IC - SPECIFIC TECHNICAL REQUIREMENTS – CONTROL & INSTRUMENTATION

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
		VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

SUB-SECTION IA
SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
		VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

1.0 GENERAL

This specification is intended to cover design (i.e. Preparation and submission of drawing/ documents including " As Built " drawings and O&M Manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables (excluding chemicals), mandatory spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in site transportation, assembly, minor civil works, erection & commissioning, trial run at site, preparation of drawings in 3D and carrying out Demonstration tests at site , training of customer/ client O&M staff & final handing over to end customer in flawless condition for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification no.

PE-TS-475-673-A001 for **EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE).**

2.0 REFERENCE DOCUMENTS

A. PE-DG-475-673-A001 : P & ID FOR EFFLUENT TRANSFER SYSTEM
B. DATASHEET – A : DATASHEET – A FOR EFFLUENT TRANSFER SYSTEM
C. PE-DG-475-100-M001 : PLOT PLAN
D. EFFLUENT TRANSFER SYSTEM PIT LOCATION

3.0 SCOPE OF SUPPLY (MECHANICAL)

Following are in bidder's scope of supply:

3.1.1 Following sumps/Tanks are included in Effluent Transfer System. For Quantity and capacity of following sumps and tanks, P&ID and Data sheet of Effluent Transfer System attached in the specification may be referred. These sumps/Tanks shall be of RCC and shall be constructed by BHEL, based on inputs provide by successful bidder during contract stage.

1. BFP-A Unit 1 Pit
2. BFP-B Unit 1 Pit
3. BFP-A Unit 2 Pit
4. BFP-B Unit 2 Pit
5. TG Area Sump A Unit-1
6. TG Area Sump B Unit-1
7. TG Area Sump A Unit-2
8. TG Area Sump B Unit-2
9. CW Pit Unit-1
10. CW Pit Unit-2
11. ATM Flash Tank Unit-1
12. ATM Flash Tank Unit-2
13. COT/DOT Area Pit
14. Transformer Yard Pit Unit-1
15. Transformer Yard Pit Unit-2

Any mechanical, Electrical & control & Instrumentation work or structural work (other than civil construction work) required for these tanks & sumps shall be carried out by successful bidder at site.

3.1.2 Necessary piping, valves, fitting, instruments etc. as per P&ID for Effluent Transfer System enclosed with this technical specification. Transfer of Effluent from respective generation source and further transfer to Terminal point C/WSWS in PT Area and CW Channel along with necessary valve, fitting & flanges shall be in bidder scope.

3.1.3 The scope shall also include all interconnecting piping, fittings, supports, valves, instruments etc.

3.1.4 Bidder shall provide the instrumentation as indicated in P&ID.

3.1.5 Pumps with details as below shall be supplied complete with all instrumentation, valves, piping, motor, etc. Pumps shall be permanently fixed type pump.

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
		VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

S.NO	PUMPS TYPE WITH CAPACITY	NUMBER OF PUMPS REQUIRED	HEAD(MWC)	REMARKS
1	Horizontal Screw Type (2 m^3/h)	10	45	Please refer DATASHEET-A for further details.
2	Vertical Screw type (40 m^3/h)	8	45	
3	Vertical Screw type (60 m^3/h)	4	60	
4	Vertical Submersible type (40 m^3/h)	4	80	
5	Vertical Submersible type (15 m^3/h)	4	70	

Head provided are tentative and may be changed as per requirement during detail engineering.

3.1.6 Six (6) nos. (6W) Drum type Oil Skimmers complete with all instrumentation, valve, piping, fittings etc., along with MS oil drum of 200 litre capacity.

3.1.7 Effluent transfer pumps installed in various effluent pits shall be controlled through self-standing local control panel. Self-standing local control panel shall be in bidder's scope. Redundancy of instruments shall be provided by bidder as per requirement spelled in Section-C3 (SPECIFIC TECHNICAL REQUIRMENT- C&I).

3.1.8 Broad scope of work of this package includes all equipment and accessories. Please also refer Mechanical data sheet, P&ID and the respective section of Electrical and C&I sections for respective scopes.

3.1.9 Bidder to take care the length of piping as indicated in plot plan/elsewhere in specification of Effluent Transfer System. Pipe routing shall be decided during detailed engineering; however, bidder will consider 8 m total static head + 10% margin (or as per grade level of respective **Effluent Transfer System sump location as indicated in the attached drg in tender specs**) during pump selection.

3.1.10 All Pipes shall be MS ERW as per IS1239 heavy grade. The pipe shall be preferably run on pipe pedestals. All auxiliary steel structures (u-clamps, nuts, bolts, channels etc.) For fixing the pipe on the pedestal or trestles shall be in the scope of bidder. If buried piping is required, wrapping, coating and protection of all the buried pipe is also in bidder's scope & shall be as per IS-10221 for MS pipes.

3.1.11 All steel inserts plates with lugs, rungs, ladder, puddle pipes, bolts, edge angle in desired shape, nuts, sleeves, and all other embedding components etc. as required to grout in BHEL civil works and to support/hold the equipment being supplied under this specification shall be in bidder's scope.

3.1.12 The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases, etc. Consumption of all these consumables during the initial operation or carrying out performance guarantee test of bidder's supplied equipment (whichever is later) and final filling after the initial operation OR carrying out performance guarantee test at site (As applicable) of bidder's supplied equipment (whichever is later) shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, etc. used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate Containers. 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.

3.1.13 The pipe sizes shall be selected based on the specification requirement and shall be subject to BHEL / customer approval during detailing engineering.

3.1.14 All necessary drains, vents and sampling points with valves as specified and as required are in bidder's scope.

3.1.15 Monitoring gadgets, instruments and equipment required for maintenance (till carrying out Demonstration

test at site (As applicable) & plant handover.

3.1.16 Associated piping, instrumentation and valves required for the system.

3.1.17 All necessary instruments and controls required for easy and safe operation of the system.

3.1.18 Wherever terminal points between BHEL and bidder indicated, bidder shall provide pipes with counter flange and blank.

3.1.19 All pipes, fittings etc. Required for hand railing, platforms, and ladders shall be in the scope of bidder. All ladders shall be non-civil work. All insert plates, nuts and bolts, counter flanges wherever Applicable shall be in the scope of bidder. Supply and erection of hand railing as desired for safety purpose will be in bidder's scope.

3.1.20 All the sumps, tanks, reservoirs and other water retaining structures shall be provided with access ladders/rungs from operating platforms/ground level as the case may be.

3.1.21 Instrumentation, valves etc. Indicated in P & ID of Effluent Transfer System are bare minimum requirement, however bidder has to provide complete system for trouble free operation meeting technical specification requirement.

3.1.22 All blank flanges/counter flanges and nut & bolts for counter flange, isolations valves, tees etc. to interconnect the pipes at all terminal points.

3.1.23 Two (2) Nos of Chain pulley blocks (One for Each Unit) shall be provided. Bidder to note that chain pulley block shall be manufactured as per class-II of IS3832

3.1.24 PIPING

a) Complete piping indicated in P & ID of Effluent Transfer System is in bidder's scope of supply and erection. In addition, any additional piping required to make the system complete shall be in bidder's scope. Pipe length has to be considered by bidder in his scope as per approved equipment layout and piping layout during detailed engineering. The below indicated pipes shall be designed, supplied, erected, laid and tested by the bidder. Elbows, tees, flanges, counter flanges, Hangers and supports, embedment plates with lugs etc. required for the below given piping shall also be provided by the bidder.

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001
		VOLUME II-B
		SECTION-
		REV. NO. 00 / DATE:

b) Pipe distances from Effluent Transfer system pits to Header/Terminal Points are given below:

SL. NO.	Pipe Details	Distance (In meters)
	OILY WASTE PIPES*	
1.	Header for Oily waste	370
2.	BFP-A Pit to TG pit A Unit-1	40
3.	BFP-B Pit to TG pit B Unit-1	40
4.	BFP-A Pit to TG pit A Unit-2	40
5.	BFP-B Pit to TG pit B Unit-2	40
6.	TG Pit A to Header for CW/ADV	50
7.	TG Pit B to Header for Oily waste	45
8.	TG Pit A to Header for Oily waste	45
9.	TG Pit B to Header for Oily waste	45
10.	COT/DOT Pit to TG pit Unit-2	120
11.	Header for Transformer Yard Oily waste (Transformer Yard to Header for Oily Waste	370
12.	Transformer Yard Pit unit-1 to Header for Transformer Yard Oily waste	220
13.	Transformer Yard Pit unit-2 to Header for Transformer Yard Oily waste	220
	WASTE WATER PIPES**	
1.	Header for CW/ADV	370
2.	ATM flash tank Pit Unit-1 to Header for CW/ADV	90
3.	ATM flash tank Pit Unit-2 to Header for CW/ADV	90
4.	CW PIT Unit-1 to Header for CW/ADV	80
5.	CW PIT Unit-2 to Header for CW/ADV	80

* Bidder scope of pipe supply is till terminal points indicated in P&ID. However, Pump head shall be selected based on pumping till WSWS which is located in water treatment area. Please refer to the plot plan attached with specification for WSWS distance. Pipe size variation due to varied flow from different pumps shall be considered by bidder.

** Bidder scope of pip supply is till terminal points indicated in P&ID. However, Pump head shall be selected based on pumping till CW channel. Please refer to the plot plan attached with specification for WSWS distance. Pipe size variation due to varied flow from different pumps shall be considered by bidder

Bidder to note that no commercial settlement / adjustment shall be entertained for variation up to +/- 10% of pipe lengths tabulated above during detailed engineering.

Layout and routing shall be finalized during detailed engineering. However, system shall be designed to take care of any increase or decrease in length of piping. Pipe size shall be finalized during detail engineering.

c) In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

3.1.25 Mandatory spares as per attached Annexure-V of Section C1 to this technical specification.

3.1.26 Special tools and tackles as required for the system.

3.1.27 All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box. Finish paints for touch-up painting of equipment after erection at site in sealed container.

3.1.28 Start-up and commissioning spares as required.

4.0 ADDITIONAL REQUIREMENT

4.1 Operating platforms, ladders, supports and other structural works for each sump/tanks as well as dosing equipment etc. for Effluent Transfer System to facilitate accessibility for operation and maintenance is also in bidder's scope.

4.2 All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box. Finish paints for touch-up painting of equipment after erection at site in sealed container.

4.3 All required elbow, tee, pipe fittings etc. required for erection of the complete system including piping shall be in bidder's scope. Bidder to provide the detailed BOQ shall be derived during detail engineering. Bidder to consider 10% margin over and above the BOQ requirement of all the fittings.

4.4 Bidder shall consider 8 m static head + 10% margin (or as per grade level of respective Effluent collection sump location as indicated in the attached drg in tender specs), in addition to the losses in straight pipes and bend in pipes, tees, reducer, expander and valves etc. while selection of pump head during detailed engineering.

4.5 On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Owner along with lubrication requirements.

4.6 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.

4.7 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.

4.8 Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

4.9 Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system 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.

4.10 Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.

4.11 Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".

4.12 All necessary valves and fittings for the installations with the actuators necessary for their remote operation.

4.13 Embedment plates with lugs shall also be provided by bidder as per system requirement.

4.14 All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc. shall be in bidder's scope.

4.15 All necessary structural steel for pipe supporting structure, platforms, walkways / pathways and access stairs, mechanical plant and equipment, mechanical services and pipe work associated with Effluent Transfer system.

4.16 Instrument hook up material shall be in bidder's scope.

4.17 Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc. as required to grout in civil works and to support/hold the equipment being supplied under this specification for opening/maintenance purpose.

4.18 Wrapping, coating and protection of the entire buried pipe shall be as per IS 10221 or AWWA C 203-93.

4.19 Any item/work either supply of equipment or erection material which have not been specifically mentioned in but are necessary to complete the woks for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification and shall be in bidder's scope without any commercial, technical and delivery implication to BHEL.

4.20 All other items are also included in scope of supply as specified in other part of the specification.

4.21 Bidder shall perform the guarantee parameters as per specification requirement to the satisfaction of owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the owner during detailed engineering & mutually agreed.

5.0 MANUAL HOIST (CHAIN PULLEY BLOCK)

Two (2) number of manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

6.0 SCOPE OF SUPPLY FOR ELECTRICAL

The scope of electrical works, equipment and services shall be as Section C2 included in specification. Other electrical design details shall be as per section D of the technical specification.

7.0 SCOPE OF SUPPLY CONTROL AND INSTRUMENTATION

7.0.1 Minimum instrumentation as per PE-DG-475-673-A001, however bidder will provide all necessary instrumentation for safe and trouble free operation.

7.0.2 Other control and instrumentation design details are specified in specification section C3/D.

8.0 SCOPE OF CIVIL

The CIVIL works is excluded from the bidder's scope. Successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder, will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".

All insert plates with lugs, puddle pipe, angle, edge angle in shape as desired for edge protection of RCC structures, rung ladders, hand railing, pumps channel, bolts, nuts, gaskets etc as required to grout in BHEL civil works and to hold / support the equipment being supplied under this specification for the Effluent Transfer system shall be in the scope of bidder.

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
		VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

9.0 QUALITY ASSURANCE PLANS AND SUB VENDOR LIST

1) The quality assurance plan is enclosed as **QUALITY PLAN FOR Effluent Transfer System IN SECTION-C1.** However requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/customer shall be binding on vendor in this regard. Any changes/additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/Customer. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/check lists etc. shall be submitted to Customer/BHEL for approval. All inspection & testing etc. shall be carried out accordingly.

2) The sub vendor list enclosed in Section-C1 is indicative only and is subject to approval / acceptance by customer (NTPC). Bidder to propose his sub vendor list with back up documents (experience list, end user certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any technical, commercial & delivery implication to BHEL.

10.0 TERMINAL POINTS

Terminal Point No.	Terminal Point Description	Location of TP*
TP-27	Terminal Point for Oily Waste water	TP-A
TP-28	Terminal Point for Waste water	TP-A

TP-A location has been indicated in Effluent Transfer System Pits location drawing attached.

All the piping shall be in bidder's scope. The pipes shall be designed, supplied, erected, laid and tested by the bidder. Elbows, tees, flanges Hangers and supports, embedment plates with lugs etc required for the below given piping shall also be provided by the bidder. In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

11.0 PAINTING

Painting shall be as specified in "Surface Preparation & Painting" Sec-D of this technical specification. Internal painting of the equipment shall be suitable for withstanding effect of effluent quality. Outer painting shall be as per technical specifications. Supporting documents shall be furnished in support of suitability of the lining offered for the duty conditions by bidder during detailed engineering.

12.0 SCOPE OF SERVICE

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

12.1 Erection and commissioning unloading, storage and handling at site.

12.2 Arrangement of all instruments, reagents, monitoring gadgets for monitoring, & lab facilities to carry out, pre-commissioning, trial run, commissioning and Demonstration test.

12.3 Complete grouting for equipment, fixing and any concreting inside the tanks and lining.

12.4 All personnel required during maintenance, Commissioning and Demonstration test.

12.5 Trial run for requisite period.

12.6 Demonstration/ Performance Guarantee test.

12.7 Painting shall be as specified in "Surface Preparation & Painting" Sec-D of this technical specification. Bidder to note that paint shed shall be finalized during detailed engineering as per customer & BHEL requirement and any variation in the painting schedule as finally approved by customer shall be taken care by bidder without any commercial and delivery implication.

12.8 Final touch up paint at site.

12.9 Bidder shall perform the guarantee parameters as per specification requirement to the satisfaction of owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the owner during detailed engineering & mutually agreed.

13.0 EXCLUSIONS

13.1 Service air up to the terminal point.

13.2 Instrument air up to the terminal point.

13.3 Service water up to terminal point.

13.4 Firefighting facilities.

13.5 All chemicals.

13.6 All civil works including excavation, backfilling & foundation of equipment. However complete grouting for equipment, fixing and any concreting inside vessels and lining shall be in the scope of the bidder.

The civil works including operating / maintenance platforms and interconnection platforms (if any) with ladders / stairs & handrails, structural supports and hangers for pipes / cables / ducts, crane rails, all embedment's and inserts with lugs including anchor fasteners, bolts etc., dressing of foundations, grouting of pockets and underpinning of base plates for equipment / structures and fixing supports, filling and finishing of openings in walls, floors, cladding, roof and trenches shall be in bidder's scope.

14.0 DESIGN /CONSTRUCTION

In addition to the requirements of Section C & D the following shall also be complied under scope of this specification.
The P&ID for Effluent Transfer System (Dwg.No.- PE-DG-475-673-A001) is enclosed herein in this section for bidder's compliance.

The material of construction specified in data sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subject to BHEL / Customer approval during detail engineering without any commercial & delivery implication to BHEL.

15.0 PIPING

All piping within the Effluent Transfer System shall be in bidder's scope. Piping and valves shall be sized and rated based on flows and pressures at full-capacity operation. Piping conveying high levels of suspended solids shall be sized to maintain a minimum velocity of 0.6 m/s at the minimum flow rate to prevent solids from settling in the piping.

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001
		VOLUME II-B
		SECTION-
		REV. NO. 00 / DATE:

Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:

a) **Water Application**

	Pipe Size	Water Velocity in m/sec Below 50 mm	50-150 mm	200 mm & above
(a)	Pump suction	-----	1.2-1.5	1.2-1.8
(b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
(c)	Header	-----	1.5-2.4	2.1-2.4

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:

(i)	Carbon steel pipe	100
(ii)	Ductile Iron.	140
(iii)	Rubber lined steel pipe	120
(iv)	Stainless steel pipe	100

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.

The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.

Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.

Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered (except stainless steel piping).

Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.

Pressure drops in pipes will be based on Hazen Williams's formula.

Pumps will be sized based on the following:

Capacity: System requirement + 10% margin
Head: System requirement + 10% margin on friction losses.

16.0 OPERATION AND CONTROL PHILOSOPHY

Control of effluent transfer pumps shall be through self-standing local control panel (Bidder scope).

17.0 LAYOUT

Space requirement has been indicated in plot plan, attached with specification. All the equipment will be open to sky except control panel, hence bidder has to take care that all the equipment will be whether and dust proof. Control panel will be located in industrial shed in Effluent Transfer system area.

18.0 DRAWING/DOCUMENTS REQUIREMENT (PL REFER ELECTRICAL & C&I PORTION ALSO): -

For the Drawings/Documents submission schedule, please refer **Vol-III.**

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

19.0 SPARES

1. All the spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main equipment/components supplied under the contract.

2. The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.

3. The list of mandatory spares considered essential by the BHEL & Customer is indicated in Annexure IV. The bidder shall indicate the prices in the 'Schedule of mandatory Spares' whether or not he considers it necessary for the BHEL & Customer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.

   The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.

   All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipment.

   Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.

4. Start-up and commissioning spares are in bidder's scope of supply.

   Start-up and Commissioning spares are those which would be required during equipment or system testing, start-up and commissioning. All spares used until the plant is finally handed over by the bidder to the customer come under this category. All start-up and commissioning spares as required shall be provided by the bidder without any additional cost to the BHEL and customer.

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

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

5. In addition to the spare parts mentioned above, the Bidder shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and unit prices in Price Schedules. This list shall take into consideration the mandatory spares specified Annexure IV and should be independent of the list of the mandatory spares. The BHEL reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment.

   Price of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid upto 6 months after placement of Notification of Award. However, the Bidder shall be liable to provide necessary justification for the quoted prices for these spares as desired by BHEL.

   The vendor warrants:

   (i) That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:

   (ii) In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.

   (iii) The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the customer at least 24 (Twenty-Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.

   (iv) Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.

   (v) Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.

6. The vendor will indicate the delivery period of the spares, which the BHEL and the customer may procure in accordance with this clause.

7. In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.

8. In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.

9. It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the customer.

20.0 ADDITIONAL REQUIREMENT

1. Engineering for this project is to be carried out in Integrated Intelligent Engineering environment at BHEL end. For Details Refer Drawing Document Submission Procedure/Schedule.

2. Initial charge of all lubricants & grease.

3. All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box. Finish paints for touch-up painting of equipment after erection at site in sealed container.

4. Wherever pipe racks are not available, pipes shall run on pedestals or below ground. All fixing items such as U clamps, nuts, bolts etc. required to lay the pipes on pedestals shall be in bidder's scope of work. Coating, wrapping and protection required for buries pipes shall be in bidder's scope of work.

5. For calculation of pump head, bidder to follow the technical specification requirement. Wherever pipes are running on pipe rack, Bidder will consider 6 m static head (or as per grade level of respective effluent sump location as indicated in the attached drg in tender specs), in addition to the losses in straight length and bend in pipes and valves etc. 10% overall margin shall be considered, while selection of pump head during detailed engineering.

6. The pumps shall be designed to operate under discharge valve open and close condition.

7. Pump suction valves, re-circulation valves and discharge valves shall be provided with required limit switches for interlock & control.

8. The starting of pumps (wherever applicable) which are provided with forced water lubrication shall be interlocked with the availability of lube water by means of starting of lubrication water pumps, availability of adequate flow, pressure etc. The standby lubrication pump shall be started automatically during inadequate pressure or while tripping of working pump(s).

9. All the first fill and one Year's topping requirements or 10 % of first fill quantity, whichever is more of consumable such as greases, oil, lubricants, servo fluids/control fluids, gases and etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be furnished by the bidder. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

10. 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.

11. 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.

12. Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

13. Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.

14. The complete system shall be proven and necessary design documentation in support of proveness shall be submitted by the successful bidder in support of the systems, if asked by the customer without any price and delivery implication to BHEL and customer.

15. Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".

16. System to be designed to meet all the statutory requirements. Preparation of all necessary drawings/data/ documents for obtaining necessary Approval of statutory authorities like CCOE , IBR , Weight & Measures Department and any other agency/ competent authority ,on behalf of the customer, related to installation of system (if required) is included in bidder's scope. All expenses required to obtain the approval shall also be borne by the successful bidder. Successful bidder shall inform customer well in advance requirement of authority letter along with format for the same. After issuance of authority letter by customer, it will be vendor's responsibility to regularly follow up with the concerned authorities to obtain timely approval from these authorities. Any delay on account of the same, unless any specific information related to above approval to be furnished by customer is delayed by customer, shall be to vendor's account and shall not be used as a reason for extension in contract completion. Any change arising out of any new government norms, statutory requirements during the course of execution of the project shall be complied by the bidder without any commercial implication.

17. Vendor to attend regular engineering meeting with BHEL and customer fortnightly in BHEL or customer office as decided during detail engineering. Vendor will depute all his concerned engineering representative along with the project manager for discussion and approval. Meeting can be held at site also.

18. Space available for Effluent Transfer System is indicated/attached, elsewhere in this specification. Bidder to accommodate their equipment within the space provided.

19. Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / customer for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be review by BHEL.

20. Preparation of drawings / document / P&ID's in 3D modelling software and providing soft copy of same to BHEL.

21. Preparation of e-learning package/module and providing the same to BHEL & NTPC for the complete Effluent Transfer System. The necessary requirement shall be as per detail specified elsewhere in this specification.

22. Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.

23. Relevant requirements as per GTR, GCC, ECC & SCC.

24. Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope. Any change arising out of any new government norms, statutory requirements during the course of execution of the project shall also be complied by the bidder without any commercial implication.

25. Instrument, valves, & piping shown in the flow diagram/ P&IDs are bare minimum requirement. Any additional instrument, valves, and piping required as per system requirement, shall be in the bidders scope.

26. Capacity of monorail hoists, chain pulley blocks wherever indicated in Datasheet– A are minimum and capacity of such hoists, chain pulley block etc. shall be suitable for handling 125% of maximum weight to be handled during erection and maintenance of the equipments in the pump house, buildings etc. as the case may be.

27. All the sumps, tanks, reservoirs and other water retaining structures shall be provided with access ladders/ rungs from operating platforms/ ground level as the case may be and de-watering pits one for each section. Hand railing will be provided by bidder for safety purpose in all civil structures. Supply and erection of Hand railing as desired for safety purpose will be in bidder's scope.

28. Slings & Lifting lugs shall be provided in all equipment.

29. Charging platform for all the chemical tanks along with required handrails, accessories etc. Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts plates with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc as required to grout in civil works and to support/hold the equipment's for opening/maintenance purpose, shall be in bidder's scope.

30. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

31. Necessary pipe, piping, fitting, valves, drains, vents, sampling etc. required for the complete Effluent Transfer System. Pipe racks shall be provided by BHEL wherever available, wherever pipe racks are not available, pipe shall be laid on pedestal (BHEL or vendor's scope as per civil scope sheet). However all auxiliary steel structure (U-clamps, nuts, bolts, channels etc.) for fixing pipes on pedestal or racks shall be in bidder's scope. Static head to be informed to bidder as per height of the pipe rack.

32. Latest version of all codes and standards to be followed.

21.0 SITE VISIT BEFORE SUBMISSION OF OFFER.

Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

ANNEXURE I

QUALITY PLAN

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

Items / Components \ Test/Check	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Perfomance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
COMMON ITEMS:											
1. Horizontal Centrifugal Pumps				Y	Y			Y^1	Y		
1.1. Casing	Y^a		Y^b		Y		Y				
1.2. Impeller	Y^a		Y^b		Y					Y^d	
1.3. Shaft	Y^a		Y		Y					Y^c	
2. Vertical Pumps				Y	Y			Y^1	Y		
2.1. Casing	Y^a		Y^b		Y		Y				
2.2. Impeller	Y^a		Y^b		Y					Y^d	
2.3. Shaft	Y^a		Y		Y					Y^c	
2.4. Fabricated Parts	Y^a	Y	Y^b		Y	Y^2	Y				
3. Dosing/ Metering Pumps	Y^a				Y		Y	Y^1	Y		
4. Gate/ Globe/ Check Valves	Y^a		Y^b		Y		Y	Y	Y	Y^3, Y^6	
5. Dual Plate Check Valves	Y^a		Y^b		Y		Y	Y	Y	Y^6, Y^{12}	
6. Diaphragm Valves	Y^a				Y		Y		Y	Y^4, Y^3	
7. Butterfly Valves (Low Pr.)				Y	Y		Y	Y	Y	Y^3	

LEGENDS: Applicable tests are identified by 'Y'.

Y^a : One per Heat / Heat Treatment batch / Lot.

Y^b : On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds.

Y^c : UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 25 mm or above.

Y^d :Dynamic Balancing per ISO: 1940, Grade 6.3 minimum shall be conducted for rotating assy.

Y^1 : As per Pump governing standard. Tolerences as per HIS, USA.

Y^2 : Random 10% RT to be conducted on butt welds for Thk $\geq$10 mm.

Y^3 : Seat Leakage Test for actuator operated valves shall be done by operating the valve with job actuator.

Y^4 : Tests on Rubber Diaphragms shall be conducted per batch of Rubber mix for Tensile, Elongation, Hardness, Thickness, Bleed Resistance. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted.

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

7.1 Body & Disc (Cast	Y^a		Y^b		Y						Y^6 : Blue Matching, Wear Travel for Gate Valves and reduced pressure test for check valves shall be conducted as per relevant standards. Y^7 : Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall also be stress relieved as per the requirement of code. Y^8 : RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT. Y^9 :Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted. Y^{10} :Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted. Y^{11} :One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured. Y^{12} :Dry cycle test on valve spring for 1, 00,000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring. Y^{13}: :Test as per approved supplier practice. Y^{14} :Electronic leak test for condenser & evaporator unit. Note: The complete Piping system along with valves & fittings shall be hydraulically tested at 1.5 times design pressure or 2 times working pressure whichever is higher after erection at site.

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

Test/Check / Items / Components	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
7.2 Body and Disc (Fabricated)	Y[a]	Y	Y[b]		Y				Y	Y[2]	
7.3 Shaft	Y[a]		Y[b]		Y					Y[c]	
8. Plug/ Ball Valves (Low Pr.)	Y[a]		Y[b]	Y	Y		Y	Y	Y	Y[3]	
9. Blowers/ Compressors	Y[a]		Y[b]	Y	Y			Y	Y	Y[c], Y[d]	
10. Tanks/ Pressure Vessels	Y[a]	Y	Y[b]	Y	Y	Y[8]	Y		Y	Y[7]	
11. Rubber Lining	Y[a]				Y				Y	Y[9]	
12. Strainers	Y[a]	Y	Y[b]	Y	Y		Y		Y		
13. Pipe & Pipe Fittings	Y[a]	Y	Y		Y	Y[8]	Y		Y		
14. Agitators /Flash Mixer/ Flocculator	Y[a]	Y	Y[b]	Y	Y			Y		Y[10]	
15. Ventilation/Exhaust Fan	Y[a]		Y[b]	Y	Y			Y[11]	Y	Y[c], Y[d]	
16. Hoists & Cranes	Y[a]	Y	Y[b]	Y	Y	Y[8]		Y	Y		
17. Wrapping & Coatig Material	Y				Y				Y		
18. Package/ Split AC	Y							Y	Y	Y[14]	

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

MOTOR

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MP/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y			Y		
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes, for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y						
Complete Motor	Y	Y	Y						

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

L P PIPING

PIPES, FITTINGS, BENDS, VALVES, COATING-WRAPPING, STRAINERS EXPANSION, JOINTS, TANKS, FASTENERS, LINING ETC.

	Tests/Check / Items / Components	Material Test	DPT/MPI / RT	Ultrasonic Test	WPS/ WQS/PQR	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operational Test	Other Tests	All Tests as per relevant Std	REMARKS
1	Pipes & Pipe Fittings	Y[a] Y	[b]	Y1 Y	Y								
2	Diaphragm Valves	Y[a]	Y			[5]	Y Y				[6]		
3A	Cast Butterfly Valves (Low Pressure)				Y	Y Y Y	Y				[7]		
	Body	Y[a] Y	[b]										
	Disc	Y[a] Y	[b]										
	Shaft	Y[a] Y	Y	[c]									
3B	Fabricated Butterfly Valves	REFER NOTE 14											
4	Gate/ Globe/Swing Check / Ball Valves	Y[a] Y	[b] Y	[c] Y		[5] Y	Y Y	Y Y			[8]		
5	Dual Plate Check Valves	Y[a] Y	[b] Y	[c]	Y Y Y	Y Y Y					[4]		
6	Rolled & Welded Pipes and Mitre Bends	Y[a] Y	[3]		Y	Y[3]	Y				Y[3&15]	Y	
7	Coating & Wrapping of Pipes	Y[2]	Y								[2]		
8	Tanks & Vessels	Y[a] Y	[b] Y Y	Y	Y						[16]		
9	Strainers	Y[a] Y	[b] Y# Y		Y						[11]	#For Fabricated Strainer	
10	Rubber Expansion Joints	Y[a]	Y			[12]	Y Y	Y			[13]		
11	Internal Lining of Pipes	Y[a]	Y Y								[9]		
12	Site Welding	Y	[10] Y Y										

NOTES (MEANING OF SUPERSCRIPTS)

a One per heat/heat treatment batch/lot.

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

L P PIPING

b	On machined surfaces only for castings and on butt welds.
c	For shaft/spindles > or = 50 mm
1	100% Hydraulic test shall be carried out. Weld joints not subjected to hydraulic test shall be subjected to 100% RT
2	Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91/ IS-10221/IS 15337 as applicable.
3	Followings are the testing requirements for fabrication of pipes at site
	TESTS QUANTUM OF CHECKS
	WPS, PQR, Welder Qualification Test 100%
	DPT on root run 100% for pipes up to 1200 mm diameter
	DPT after back gauging 100% for pipes above 1200 mm diameter
	RT / UT by TIME OF FLIGHT DEFRACTION (TOFD) Technique 5% (100% of T Joints)
	DPT on finished butt weld joints 10%
	Hydraulic Test 100%, 1.5 times the design pressure or 2 times the working-pressure whichever is higher.
4	Dry Cycle Test on Dual Plate Check valve spring for one lakh Cycles shall be carried out as a type test. If Dry Cycle test carried out earlier for same material & diameter, Test report shall be reviewed.
5	Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.
6	Tests on rubber parts shall be conducted per batch of rubber mix for tensile, Elongation, hardness, adhesion, spark test, bleed resistance test. In addition, type test for 50,000 cycles of each type of diaphragm shall also be conducted.
7	Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with governing design standard in presence of owner's representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. For Proof of Design Test refer respective chapters of engineering portion in the technical specification
8	Blue matching, wear travel for gates, valves, pneumatic seat leakage, and reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes. Fire safe test for ball valve shall be done wherever specified. In case of already carried out, the test report shall be submitted for review and acceptance by NTPC Engineering. Valves shall be offered for hydro test in unpainted condition.

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

L P PIPING

9	Tensile, Elongation, Hardness, Specific Gravity, Lining Thickness, Humidity Check, Pipe temperature check, Adhesion Test and Holiday Detection Test etc as per applicable standard shall be done for all lining material and application.
10	10% of welds (Root and finished welds) shall be subjected to DPT.(100% DPT for compressed air line and boiler & deaerator fill line.).
11	Pressure drop across the strainer for each type and size as a special test shall be carried out. In case of already carried out, the test report shall be submitted for review and acceptance by NTPC Engineering.
12	During hydraulic and vacuum tests at 25mm Hg abs in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.
13	Tests on rubber for tensile, elo ngation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.
14	In addition of all tests as indicated for Cast Butter Fly valve being applicable for fabricated butterfly valves, following test shall be done for Fabricated Butter Fly Valve: a. UT as per ASTM A-435 on plate material for body and disc shall be carried out for plate thickness 25mm and above. b. 100% RT and DPT as per ASTM, Section-VIII, Di vision-I, on butt joins of body and disc. 10% DPT on other welds shall be done. c. Post weld heat treatment as per ASME, Section-VIII, Division-I on butt joints of body and disc. d. Welders and WPS shall be qualified as per ASME- section IX
15	Maximum number of segments in segmental flanges shall be four (04) only. All butt weld joints in the segmental flanges shall be examined by RT/UT. Segmental flanges exceeding 37.5 mm thickness shall be stress-relieved as per norms of ASME Section VIII after welding
16	For pressure vessel welds RT shall be done as per design code requirements.

1) The above mentioned requirement are bare minimum. However, any additional comments provided by BHEL / Customer shall be adhered by successful bidder without any commercial and delivery implication to BHEL/Customer.

TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
	SECTION-	
	REV. NO. 00	DATE:

ANNEXURE II

SUB-VENDOR LIST

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX			REF NO. : 00 REV NO.: 00 Date: 27.04.19	
Sl No.	ITEM	QP Insp Cat.	NTPC QP No. QVM- Q-	Vendor/ Manufacturer Name	PLACE	SC_APP L_ST	Remarks
1.	STATOR FRAME FABRICATION	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
2.	STATOR FRAME MACHINING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
3.	FLAT SPRINGS & SPRING BASKET (FABRICATION & MACHINING)	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	REFER NOTE-6
4.	CORE BAR FOR STATOR	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
5.	STATOR LAMINATION	II	QVE-Q-	CENTRAL STAMPING UNIT BHEL(BHEL-CSU)	JAGDISHPUR	A	
6.	RIPPLE SPRING	II	--	KREMPAL GMBH	GERMANY	A	NO SEPARATE QP
		•		SIEMENS LIMITED	INDIA	DR	
7.	TENSION BOLT FOR STATOR CORE (INSULATED)	II	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
8.	STATOR CORE ASSLY	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
9.	SPRING & SPRING BASKET ASSEMBLY	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
10.	BUS BAR CONNECTION TUBES	II	--	LUVATA PORI	FINLAND	A	NO SEPARATE QP
		II	--	BUNT METAL	AUSTRIA	A	NO SEPARATE QP
		II	--	KME GERMANY GMBH	GERMANY	A	NO SEPARATE QP
		•		SIEMENS LIMITED	INDIA	DR	
		•		HAEGANG ALLOY CO. LTD.	KOREA	DR	
11	SOLID COPPER CONDUCTOR (FOR STATOR BAR)	I	QVE-Q-	PEARL INSULATIONS	BANGLORE	A	
		I	QVE-Q-	COSMOS CONDUCTORS PVT.LTD.	BANGLORE	A	
		I	QVE-Q-	KAPSI ELECTRICAL POWER PRODUCT	BANGLORE	A	

THDC INDIA LTD.

(QA Consultant)

Singh 29.4.19
CSP Singh
DGM (QA) BHEL Haridwar

page 1 of 12

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX				REF NO. : 00 REV NO.: 00 Date: 27.04.19	
		I	QVE-Q-	MAHENDRA INDUSTRIES	BANGLORE	A	
		•		COPRAL INSULATED CONDUCTORS	HOSUR	DR	
12	HOLLOW COPPER INSULATED CONDUCTOR (STATOR BAR)	I	QVE-Q-	MAHENDRA INDUSTRIES	BANGLORE	A	
		I	QVE-Q-	PEARL INSULATIONS	BANGLORE	A	
		II		VONROLL	SWITZERLAND	A	NO SEPARATE QP
		I	QVE-Q-	COSMOS CONDUCTORS	BANGLORE	A	
13	OVER HANG SUPPORT RING	II	--	ROECHLING ENGINEERING PLASTICS	GERMANY	A	NO SEPARATE QP
		II	--	POWER & COMPOSITE TECHNOLOGIES	USA	A	NO SEPARATE QP
		•		KOMPOZYTY SP.Z.O.O	POLAND	DR	
		•		NANTONG DAWNTINE ELECTRICAL	CHINA	DR	
14	STATOR SLOT WEDGE (RAW MATERIAL)	II	--	PERMALI WALLACE PRIVATE	BHOPAL	A	NO SEPARATE QP
		II	--	MICAPLY	BHOPAL	A	NO SEPARATE QP
		•		THE BOMBAY BURMAH TRADING	RUDRAPUR (UTTARAKHAND)	DR	
		•		LAMTUF PLASTICS LTD	HYDERABAD	DR	
15	WATER SUPPLY HOSE (INSULATED)	II	--	DR SCHNABEL GMBH & CU KG LIMBURG	GERMANY	A	NO SEPARATE QP
		II	--	CRANE RESISTOFLEX	USA	A	NO SEPARATE QP
		I	QVE-Q-	MIL INDUSTRIES LIMITED	CHENNAI	A	
		•		SGL CARBON INDIA PVT. LTD	PUNE	DR	
16	HEADER FOR STATOR (ASSEMBLY)	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
17	ETS MATERIAL	II	--	THYSSEN KRUPP ELECTRICAL STEEL	NASIK	A	NO SEPARATE QP
		II	--	ARCELOR MITTAL INTERNATIONAL	LUXAMBOURG	A	NO SEPARATE QP

THDC INDIA LTD.

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX				REF NO. : 00 REV NO.: 00 Date: 27.04.19	
		II	--	THYSSENKRUPP MATERIAL TRADING GMBH	GERMANY	A	NO SEPARATE QP
		•		VOESTALPINE STAHL GMBH	AUSTRIA	DR	
18	BAFFLE RING & BAFFLE RING CARRIER MACHINING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
19	WATER BOX FOR STATOR BARS	I	QVE-Q-	MADRAS CUUPRUM	CHENNAI	A	
		II	-	ZOLLERN GMBH & CO	GERMANY	A	NO SEP QP
		•		SIEMENS LIMITED	INDIA	DR	
20	CORE PRESS RING & FINGERS	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
21	STATOR WINDING BAR	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
22	STATOR WINDING ASSEMBLY	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
23	GENERATOR SHAFT FORGING	II	--	BUDERUS EDELSTAHL	GERMANY	A	NO SEPARATE QP
		II	--	THE JAPAN STEEL WORKS LTD.(JSW)	JAPAN	A	NO SEPARATE QP
		II	--	SAARSCHMIEDE	GERMANY	A	NO SEPARATE QP
		II	--	JAPAN CASTING & FORGING(JCFC)	JAPAN	A	NO SEPARATE QP
		II	--	CHINA FIRST HEAVY INDUSTRIES	CHINA	A	NO SEPARATE QP
		•		CHINA NATIONAL ERZHONG GROUP	CHINA	DR	
		II	--	PJSC ENERGOMASHPETSTAL	UKRAINE	A	NO SEPARATE QP
		•		SHAANXI SENWELL	CHINA	DR	
		•		SHEFFIELD FORGEMASTERS	UK	DR	
		II	--	SDF Turni	ITALY	A	NO SEPARATE QP
		II	--	SC DOOSAN IMGB SA	ROMANIA	A	NO SEPARATE QP
24	GENERATOR SHAFT MACHINING		QVE-Q-	BHEL-HEEP	HARIDWAR	A	

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX				REF NO. : 00 REV NO.: 00 Date: 27.04.19	
25	CURRENT CARRYING BOLTS FOR ROTOR(M/c)	I	QVE-Q-	BHEL HEEP	HARIDWAR	A	
26	ROTOR COIL FORMING	I	QVE-Q-	BHEL HEEP	HARIDWAR	A	
27	ROTOR SLOT ANGLE	I	QVE-Q-	SAHNEY KIRKWOOD PVT. LTD.	NASIK	A	
		II	--	ABB SWITZERLAND LTD.	SWITZERLAND	A	NO SEPARATE QP
		II	--	VON ROLL ISOLA	FRANCE	A	NO SEPARATE QP
		*		POWER & COMPOSITE TECHNOLOGIES	USA	DR	
28	CENTERING RING MACHINING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
29	FIELD LEAD CORE BAR	II	--	KME GERMANY GMBH	GERMANY	A	NO SEPARATE QP
30	FIELD LEAD CORE BAR MACHINING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
31	RETAINING RING MACHINING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
32	RETAINING RING	II	--	SAARSCHMIEDE	GERMANY	A	NO SEPARATE QP
		II	--	ENERGIETECHNIK	GERMANY	A	NO SEPARATE QP
		II	--	THE JAPAN STEEL WORKS LTD.(JSW)	JAPAN	A	NO SEPARATE QP
		II	--	DEYANG WANXIN	CHINA	A	NO SEPARATE QP
		II	--	SIEMENS AG	GERMANY	A	NO SEPARATE QP
33	FAN BLADE FOR COMPRESSOR M/C	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	REFER NOTE-6
34	FAN BLADE FOR COMPRESSOR (RAW MATERIAL) HW10786 ~X20Cr 13			REFER ST LIST FOR SAME GRADE MATERIAL FOR BLADE BAR			NO SEPARATE QP
35	ROTOR WINDING ASSLY.(GEN.)	I	QVE-Q-	BHEL HEEP	HARIDWAR	A	
36	GENERATOR ROTOR -FINAL	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX				REF NO. : 00 REV NO.: 00 Date: 27.04.19	
37	BEARING SHELL FORGING(GENERATOR)	II	--	BHEL-CFFP	HARIDWAR	A	NO SEPARATE QP
		*		GOLDEN IRON AND STEEL WORKS	NEW DELHI	DR	
		*		ECHJAY INDUSTRIES PVT LTD	MUMBAI	DR	
		*		MACKEIL ISPAT AND FORGINGS LTD	KOLKATA	DR	
		*		STAR WIRE (INDIA) LTD.	BALLABGARH	DR	
		*		CHAUDHRY & SONS (FORGINGS) PVT	GHAZIABAD	DR	
		*		PAHLADRAI STEEL FORGING WORKS	KANPUR	DR	
		*		VIKRANT FORGE LIMITED	KOLKATA	DR	
		*		BAY-FORGE LIMITED	KANCHIPURAM	DR	
38	BEARING COMPLETE (EXCITER)	*		SIEMENS LIMITED	INDIA	DR	
		II	QVE-Q-	RENK AG	GERMANY	A	
		II	QVE-Q-	ZOLLERN	BRAZIL	A	
		II	QVE-Q-	EURO BEARINGS	ITALY	A	
39	END SHIELD FABRICATION &MACHINING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
40	SHAFT SEAL ASSEMBLY	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
41	BEARING SHELL MACHINING(GENERATOR)	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
42	COMPRESSOR HUB M/C & ASSEMBLY	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
43	HYDROGEN COOLER	I	QVE-Q-	BHEL	HARIDWAR	A	
		*		LORD VISHWAKARMA HEAT EXCHANGER	KANKHAL (HARIDWAR)	DR	

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX				REF NO. : 00 REV NO.: 00 Date: 27.04.19	
		•		LAXMI ENGINEERING INDUSTRIES	BHOPAL	DR	
		•		FITWELL CORPORATION	BHOPAL	DR	
44	HIGH PRESSURE HOSE FOR BEARING PEDESTAL	•		ORIENTAL ENGINEERING WORKS	YAMUNANAGAR	DR	
		•		SMT EXPORT	HARIDWAR	DR	
		•		PARKER HANNIFIN INDIA PVT.LTD	MUMBAI	DR	
		II	--	PARKER HANNIFIN	GERMANY	A	NO SEPARATE QP
45	TUBES FOR COOLERS (BRASS / COPPER TUBES)	II	--	MULTIMETALS LTD.	KOTA	A	NO SEPARATE QP
		II	--	METAL ALLOYS CORPORATION	JAMNAGAR	A	NO SEPARATE QP
		•		MEHTA TUBES LTD.	VAPI	DR	
		•		INDUSTRIAL TUBES MANUFACTURERS(ITM)	MUMBAI	DR	
46	FINNING OF COOLER TUBES	I	QVE-Q-	LAXMI ENGINEERING INDUSTRIES	BHOPAL	A	
		I	QVE-Q-	LORD VISHWAKARMA HEAT EXCHANGE	HARIDWAR	A	
		I	QVE-Q-	FITWELL CORPORATION	BHOPAL	A	
47	TERMINAL BUSHING BOX FABRICATION AND MACHING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
48	CONFORMABLE ROPE	II	--	BIW	GERMANY	A	NO SEPARATE QP
		II	--	TEXPLAS	HARIDWAR	A	NO SEPARATE QP
		II	--	SUMICA	HARIDWAR	A	NO SEPARATE QP
49	PW FITER, FINE FILTER, OIL FILTER	•		HYDAC (INDIA) PVT. LTD.	INDIA	DR	

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX				REF NO. : 00 REV NO.: 00 Date: 27.04.19	
		II	--	BOLL & KIRCH FILTERBAU GMBH	GERMANY	A	NO SEPARATE QP
		II	--	L&Z VERFAHRENSTECHNIK GMBH	GERMANY	A	NO SEPARATE QP
		•		GRAND PRIX ENGINEERING PVT LTD	FARIDABAD	DR	
50	P W TANK INCLUDING PIPING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
51	VAPOUR EXHAUSTER	II	QVE-Q-	CB DOCTOR	AHEMDABAD	A	
		II	QVE-Q-	S.K SYSTEM	DELHI	A	
		II	QVE-Q-	AIR LINK	MATHURA	A	
		II	QVE-Q-	DUSTECH	FARIDABAD	A	
52	ION EXCHANGER	I	QVE-Q-	THERMAX LTD.	PUNE	A	
		•		SIEMENS LIMITED	INDIA	DR	
		•		CHEM PROCESS	AHMEDABAD	DR	
		•		H K ENTERPRISES	AHMEDABAD	DR	
53	PW COOLER & FILTER UNIT	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
54	PW COOLER FOR STATOR	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
		I	QVE-Q-	ALFA LAVAL (INDIA) LIMITED	PUNE	A	
		•		I.D.M.C. LTD	GUJRAT	DR	
		I	QVE-Q-	TRANTER INDIA PVT. LIMITED	PUNE	A	
		I	QVE-Q-	KELVION INDIA (GEA)	PUNE	A	
		•		HRS PROCESS SYSTEMS LIMITED	PUNE	DR	

THDC INDIA LTD.

10

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX			REF NO. : 00 REV NO.: 00 Date: 27.04.19	
55	TERMINAL BUSHING	*		SIEMENS LIMITED	INDIA	DR	
		II	--	TRENCH FRANCE SAS	FRANCE	A	NO SEPARATE QP
		II	--	HSP HOCHSPANNUNGSGERAETE	GERMANY	A	NO SEPARATE QP
		II	--	SUZHOU JIU & ZHENG ELECTRIC CO	CHINA	A	NO SEPARATE QP
56	HYDROGEN DRIER (REFRIGERANT TYPE)	I	QVE-Q-	JINDAL ELECTRONICS	ROORKEE	A	
		I	QVE-Q-	MELLCON ENGS PVT	NEW DELHI	A	
		I	QVE-Q-	SPAN MANUFACTURING	ROORKEE	A	
57	SEAL OIL COOLER	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
		I	QVE-Q-	ALFA LAVAL (INDIA) LIMITED	PUNE	A	
		I	QVE-Q-	TRANTER INDIA PVT. LIMITED	PUNE	A	
		I	QVE-Q-	KELVION INDIA (GEA)	PUNE	A	
		*		I.D.M.C. LTD	GUJRAT	DR	
		*		HRS PROCESS SYSTEMS LIMITED	PUNE	DR	
58	ALKALYSER UNIT	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
59	SEAL OIL PUMP	I	QVE-Q-	ALLWEILER INDIA PRIVATE	DAMAN	A	
		I	QVE-Q-	UT PUMPS	FARIDABAD	A	
		*		ALEKTON	CHENNAI	DR	
		I	QVE-Q-	HUANGSHAN	CHINA	A	
		I	QVE-Q-	DELTA PD PUMPS PVT. LTD.	MUMBAI	A	
60	PRIMARY WATER PUMP	I	QVE-Q-	KSB INDIA	PUNE	A	

THDC INDIA LTD.

11

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX				REF NO. : 00 REV NO.: 00 Date: 27.04.19	
		I	QVE-Q-	SULZER INDIA	NAVI MUMBAI	A	
		•		WPIL LTD.	GHAZIABAD	DR	
61	H2/CO2/N2/ CYLINDER	III	QVE-Q-	BHEL APROVED SOURCES		A	COMPLIANCE TO STATUTORY REQUIREMENT
62	SEAL OIL UNIT & PIPING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
63	SEAL OIL STORAGE TANK	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	REFER NOTE-6
64	GAS UNIT & PIPING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
65	CO2 VAPOURISER	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	REFER NOTE-6
66	GENERATOR ASSEMBLY AT WORKS INCLUDING TERMINAL BUSHING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
67	SILVER BEARING COPPER HOLLOW STRIPS (ROTOR COIL)	II		BUNT METAL	AUSTRIA	A	NO SEPARATE QP
		II		BOASHIDA SWISS METAL	SWITZERLAND	A	NO SEPARATE QP
68	MULTI CONTACT BAND	III		STAUBLI TEC SYSTEMS	MUMBAI	A	Make-STAUBLI SWITZERLAND
69	WEDGES FOR ROTOR (DAMPER+SLOT)	II	--	KME	GERMANY	A	NO SEPARATE QP
		II	--	BOASHIDA SWISS METAL	SWITZERLAND	A	NO SEPARATE QP
		•		ORIENTAL COPPER	THAILAND	DR	
		II	--	BUNT METAL	AUSTRIA	A	NO SEPARATE QP NEW NAME- WIELAND AUSTRIA GMBH
		II	--	LUVATA (OUTO KUMPU PORI)	FINLAND	A	NO SEPARATE QP
70	LT MOTORS			REFER TO BHEL PEM LIST FOR THIS ITEM		A	

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX			REF NO. : 00 REV NO.: 00 Date: 27.04.19	
71	GENERAOR WORKS RUN TEST	I	QVE-Q-	BHEL HEEP	HARIDWAR	A	
72	EXCITER SHAFT MACHINING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
73	EXCITER STATOR MAIN	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
74	EXCITER STATOR PILOT	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
75	EXCITER ROTOR BALANCING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
76	RECTIFIER WHEEL MACHING & ASSLY	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
77	DC LEAD ASSLY FOR EXCITER	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
78	EXCITER ASSLY (MAIN & PILOT)	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
79	EXCITER AIR COOLER	II		BHEL	HARIDWAR	A	
		•		LORD VISHWAKARMA HEAT EXCHANGER	KANKHAL (HARIDWAR)	DR	
		•		LAXMI ENGINEERING INDUSTRIES	BHOPAL	DR	
		•		FITWELL CORPORATION	BHOPAL	DR	
80	EXCITER TEST RUN	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
81	FORGING FOR MAGNETIC HUB, CENTERING RING, INTERMEDIATE RING, CARRIER HUB/DIODE WHEEL, COMPRESSOR HUB	II	--	BHEL-CFFP	HARIDWAR	A	NO SEPARATE QP
		•		BAY-FORGE LIMITED	KANCHIPURAM	DR	
		•		KISAAN STEEL (PVT.) LTD	GHAZIABAD	DR	
		•		MACKEIL ISPAT AND FORGINGS LTD	KOLKATA	DR	
		•		STAR WIRE (INDIA) LTD.	BALLABGARH	DR	

THDC INDIA LTD.

13

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX				REF NO. : 00 REV NO.: 00 Date: 27.04.19	
		•		VIKRANT FORGE LIMITED	KOLKATA	DR	
82	MAGNETIC HUB, CENTERING RING, INTERMEDIATE RING, CARRIER HUB/DIODE WHEEL MACHINING	II		BHEL-HEEP	HARIDWAR	A	
83	MAGNET (MATERIAL ONLY)	II	--	THYSEEN KRUPP MAGNETTECHNIC	GERMANY	A	NO SEPARATE QP
		II	--	HANGZHOU PERMANENT MAGNET	CHINA	A	NO SEPARATE QP
		•		SIEMENS LIMITED	INDIA	DR	
84	PERMANENT MAGNET & SHOE ASSLY FOR EXCITER	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
85	MAIN EXCITER ARMATURE WINDING	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
86	BALANCING RING	II	--	SCHMOLZ+BICKENBECH	GERMANY	A	NO SEPARATE QP
		II	--	RV ENGG	BALLABHGARH	A	NO SEPARATE QP
		•		BSL CASTING PVT. LTD	FARIDABAD	DR	
87	EXCITER CORE PRESS RING	II	--	RATAN ENGINEERING	NEW DELHI	A	NO SEPARATE QP
		II	--	SCHMOLZ+ BICKENBECH	GERMANY	A	NO SEPARATE QP
		II	--	RV ENGG	BALLABHGARH	A	NO SEPARATE QP
		•		SOUTHERN ALLOY FOUNDRIES P LTD	CHENNAI	DR	
88	EXCITER FRAME (MAIN & PILOT)	I	QVE-Q-	BHEL-HEEP	HARIDWAR	A	
89	RC BLOCK	I	QVE-Q-	ZENTRONICS SYSTEMS	HYDERABAD	A	
		I		SIEMENS LIMITED	INDIA	DR	
90	EXCITER SHAFT FORGING	II		ALL SUPPLIERIS OF GENERATOR SHAFT FORGING		A	NO SEPARATE QP
		I	QVE-Q-	CFFP	HARIDWAR	A	

NTPC	PROJECT: KHURJA 660 MW PACKAGE: TG CONTRACTOR: BHEL HARIDWAR CONTRACT NO.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: TG & AUX	REF NO. : 00 REV NO.: 00 Date: 27.04.19

		I	QVE-Q-	BHARAT FORGE	PUNE	A	
		II		BUDERUS EDELSTAH L	GERMANY	A	NO SEPARATE QP
		*		MACKEIL ISPAT AND FORGINGS	KOLKATA	DR	
		*		OFAR S.P.A	ITALY	DR	

LEGENDS: A- APPROVED, DR- DETAILED REQUIRED, N-NOTED

NOTE 1: IN ADDITION TO ABOVE SOURCES BHEL MAY PROCURE ITEMS FROM SIEMENS, SIEMENS APPROVED SOURCES BHEL TO SUBMIT DOCUMENTS IN SUPPORT OF SIEMENS APPROVED SOURCE.

NOTE 2: LT MOTORS UPTO 50 KW SHALL BE ACCEPTED BASED ON COC OF MANUFACTURER TC AND CONTRACTOR CONFIRMING AS FOLLOWS: IT IS HEREBY CONFIRMED THAT ABOVE MENTIONED MOTOR/ MOTORS WAS/ WERE MANUFACTURED TAKING CARE OF NTPC SPECIFIC REQUIREMENTS REGARDING ABMIENT TEMP, VOLTAGE FREQUENCY VARIATION , HOT STARTS, PULL OUT TORQUES, STARTING KVA/ KW, TEMP RISE, DISTANCE BETWEEN CENTREOF STUD GLAND PLATE, SPACE HEATER AND TESTED IN ACCORDANCE WITH APPROVED DRAWING/ DATA SHEETS AND LT MOTORS ABOVE 50 KW ACCEPTANCE SHALL BE BASED ON NTPC REVIEW OF ROUTINE TEST INSPECTION REPORT AS PER IS 325 BY MAIN MOTOR/ MOTORS WAS/WERE MANUFACTURED TAKING CARE OF NTPC SPECIFIC REQUIREMENTS REGARDING AMBIENT TEMP, OLTAGE FREQUENCY AND TESTED IN ACCORDANCE WITH APPROVED DRAWINGS/ DATA SHEETS AND LT MOTORS. FOR > 75 KW, SEPARATE QP TO BE SUBMITTED

NOTE 3: QP/ INSPECTION CAT-I QP APPROVAL AND PHYSICAL INSPECTION BY NTPC: QP/ INSPECTION CAT-II QP APPROVAL BY NTPC, NO PHYSICAL INSPECTION BY NTPC. ACCEPTANCE BASED ON REVIEW OF CONTRACTOR INSPECTION REPORT/ TC. : QP/INSPECTION CAT-III NO QP APPROVAL AND INSPECTION BY NTPC, ACCEPTANCE BASED ON REVIEW OF COC BY BHEL.

NOTE 4: A* -MEANS SUPPLY EXPERIENCE OF COMPARABLE UNIT TO BE FURNISHED TO NTPC

NOTE 5: * - INSPECTION CATEGORY WILL BE DECIDED DURING VENDOR EVALUATION.

NOTE 6: MQP APPROVED FOR BHEL HARDWAR SHALL BE USED ON SUB VENDOR'S WORKS FOR FABRICATION AND MACHINING OF COMPONENTS.

THDC INDIA LTD.

(QA Consultant)

Singh
29.04.19
(SB Singh)
DGM (QAX)
BHEL Haridwar.

page 12 of 12

NTPC	PROJECT : Khurja STPP PACKAGE : TURBINE GENERATOR AND ASSOCIATED PACKAGES CONTRACTOR :BHEL CONTRACT NO : THDC/RKSH/CC-9915-371	LIST OF C&I ITEMS REQUIRING QP APPROVAL & SUB SUPPLIER APPROVAL FOR SUB QR ITEMS	REVISION NO : 00 DATE : 26.06.2019

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
1	DDCMIS		SQP								EDN
		I				SIEMENS AG	Germany	Note-1			
		I				Emerson Process Management Asia Pacific Pvt Ltd	Singapore	Note-1			
		I				Honeywell Automation India Ltd	Pune	Note-1			
		I				BHEL (MAX DNA)	Bengaluru	Note-1			
		I				Alstom India Ltd	Noida	Note-1			
		I				GE (ALSTOM)	France	Note-1			
		I				Toshiba	Japan	Note-1			
		*				BHEL(Valmet DNA)	Bengaluru	Note-1			
2	Intelligent Battery charger 24V DC / DCDB/BHMS										EDN
		II				Chabbi Electricals	Jalgaon	Note-1			Rectifier module, Controller module and Battery Health monitoring system shall be of M/s VERTIV make
		II				Eltech	Gurgaon	Note-1			Unit-II for assembly and function testing only
		II				MasTech	Jalgaon	Note-1			Rectifier modules shall be of Setec, China
		II				VERTIV ENERGY PVT LTD	Mumbai	Note-1			Rectifier module, Controller module and Battery Health monitoring system shall be of M/S VERTIV China
3	SWAS (Sampling Handling System and Dry Panel)										EDN
		I				Emerson Process Management Ltd	Navi Mumbai	Note-1			Procured from USA, assembly & testing in pawane
		I				Forbes Marshall	Pune	Note-1			
		I				SEPL	Pune	Note-1			
		*				ABB	Bengaluru	Note-1			
		*				CHEMIN CONTROLS AND INSTRUMENTATION	PONDICHERRY	Note-1			
		*				ENDRESS + HAUSER INDIA PVT LTD	MUMBAI	Note-1			
		*				STEAM EQUIPMENTS PVT LTD	KONDHWA BUDURK, PUNE	Note-1			
		*				FLOW LINE INSTRUMENTATION PVT. LTD	India	Note-1			
		*				Yokagawa	Bangalore	Note-1			
4	SWAS Analyser (Chloride)										EDN
		III				Thermo FISHER Scientific Orion	USA	Note-1			
		III				ABB	UK	Note-1			

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				ENDRESS + HAUSER INDIA PVT. LTD.	MUMBAI	Note-1			
		*				HACH LANGE S.A.R.L. CH-1222,	VESENAZ	Note-1			
		*				SWAN Analytische Instrumente AG,	CH-8340 Hinwil, Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT. LTD.,	MUMBAI	Note-1			
		*				DKK Toa	Japan	Note-1			
5	SWAS Analyser (Conductivity)										
		III				Emerson Process Management Ltd	Pawane	Note-1			EDN
		III				Hach	USA	Note-1			procured from USA, assembly & testing in pawane
		III				ABB	USA	Note-1			2-WIRE HART COMPATIBLE MAKE ABB,UK
		*				ROSEMOUNT ANALYTICAL INC IRVINE (Emerson)	Irvine	Note-1			
		*				ENDRESS + HAUSER INDIA PVT. LTD.	MUMBAI	Note-1			
		*				SWAN Analytische Instrumente AG,	CH-8340 Hinwil, Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT. LTD.,	MUMBAI	Note-1			
		*				THERMO ORION INC	BEVERLY MA 01915-6199	Note-1			
		*				DKK Toa	Japan	Note-1			
		III				Yokogawa	Japan	Note-1			
6	SWAS Analyser (Dissolved Oxygen)										EDN
		III				Thermo fisher Scientific	USA	Note-1			MODEL 1816
		III				ABB	UK	Note-1			
		III				Emerson Process Management	USA	Note-1			
		III				Hach	Switzerland	Note-1			
		*				ENDRESS + HAUSER INDIA PVT. LTD.	Mumbai	Note-1			
		*				SWAN Analytische Instrumente AG	Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT. LTD	Mumbai	Note-1			
		*				DKK Toa	Japan	Note-1			
7	SWAS Analyser (Hydrazine)										
		III				Hach	Switzerland	Note-1			EDN
		III				ABB	UK	Note-1			
		III				Thermo fisher Scientific	USA	Note-1			Orion Brand model no 2118XP

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				ROSEMOUNT ANALYTICAL INC IRVINE (Emerson)	Irvine	Note-1			
		*				ENDRESS + HAUSER INDIA PVT LTD	MUMBAI	Note-1			
		*				SWAN Analytische Instrumente AG	Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT LTD	MUMBAI	Note-1			
		*				DKK Toa	Japan	Note-1			
8	SWAS Analyser (PH)										EDN
		III				Emerson Process Management Ltd	Pawane	Note-1			procured from USA assembly & testing in pawane
		III				ABB	USA	Note-1			2-WIRE HART COMPATIBLE
		III				Hach	USA	Note-1			
		III				Yokogawa	Japan	Note-1			FXA NT 450 AND FXA 202 SERIES
		*				ENDRESS + HAUSER INDIA PVT LTD	MUMBAI	Note-1			
		*				SWAN Analytische Instrumente AG	Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT LTD	MUMBAI	Note-1			
		*				DKK Toa	Japan	Note-1			
		*				THERMO ORION INC BEVERLY MA 01915-6199	Beverly	Note-1			
9	SWAS Analyser (Phosphate)										EDN
		III				Hach	USA	Note-1			SERIES 5000,MODEL 6000100
		III				ABB	UK	Note-1			
		*				ROSEMOUNT ANALYTICAL INC IRVINE (Emerson)	Irvine	Note-1			
		*				ENDRESS + HAUSER INDIA PVT LTD	MUMBAI	Note-1			
		*				SWAN Analytische Instrumente AG	Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT LTD	MUMBAI	Note-1			
		*				DKK Toa	Japan	Note-1			
		*				THERMO ORION INC BEVERLY MA 01915-6199	Beverly	Note-1			
10	SWAS Analyser (Silica)										EDN
		III				Hach	USA	Note-1			
		III				ABB	UK	Note-1			
		III				Hach	Switzerland	Note-1			
		III				Eutech Instrument PTE Ltd (part of Thermofisher Scientific Inc)	Singapore	Note-1			BRAND-ORION

THDC INDIA LTD.

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submissi on SCH	QP approva l SCH	Proposed Sub Supplier	Country	SS Approval_S tatus	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				ROSEMOUNT ANALYTICAL INC IRVINE (Emerson)	Irvine	Note-1			
		*				ENDRESS + HAUSER INDIA PVT LTD	MUMBAI	Note-1			
		*				SWAN Analytische Instrumente AG	Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT LTD	MUMBAI	Note-1			
		*				DKK Toa	Japan	Note-1			
		*				THERMO ORION INC BEVERLY MA 01915-6199	Beverly	Note-1			
11	SWAS Analyser (Sodium)										
		III				Hach	Switzerland	Note-1			EDN
		III				ABB	UK	Note-1			POLYMETRON BRAND
		III				Orion	USA	Note-1			
		*				ROSEMOUNT ANALYTICAL INC IRVINE (Emerson)	Irvine	Note-1			
		*				ENDRESS + HAUSER INDIA PVT LTD	MUMBAI	Note-1			
		*				SWAN Analytische Instrumente AG	Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT LTD	MUMBAI	Note-1			
		*				DKK Toa	Japan	Note-1			
12	SWAS Analyser (Turbidity)										
		III				HACH	USA	Note-1			EDN
		III				ABB	UK	Note-1			
		*				ROSEMOUNT ANALYTICAL INC IRVINE (Emerson)	Irvine	Note-1			
		*				ENDRESS + HAUSER INDIA PVT LTD	MUMBAI	Note-1			
		*				SWAN Analytische Instrumente AG	Switzerland	Note-1			
		*				METTLER-TOLEDO INDIA PVT LTD	MUMBAI	Note-1			
		*				DKK Toa	Japan	Note-1			
		*				THERMO ORION INC BEVERLY MA 01915-6199	Beverly	Note-1			
13	Vibration Monitoring System	Note-7									EDN

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		II				BHEL (Valmet DNA based)	Bengaluru	Note-1			1. Imported items like Vibration Monitors, Cross Connection Cables, Buffered Output Modules, and Piezoelectric Vibration Sensors, Eddy Current type Proximity Probe, Extension Cable and Signal Conditioner will be procured from Valmet Automation, Finland 2. Indigenous items like Communication cables, networking components, blank panels, TB, OWS will be procured from owner approved sources
		II				Rockwell Automation	Sahibabad	Note-1			FOR ROCKWELL USA MAKE SYSTEM
		II				SKF	Pune	Note-1			FOR SKF USA MAKE SYSTEM
		II				Imageneous Engineering Pvt Ltd	Vadodara	Note-1			For MEGGITT SWITZERLAND MAKE VIBRATION SYSTEM
		II				Shinkawa	Japan	Note-1			
		II				GE (Bentley Nivada)	USA	Note-1			
		II				GE	Pune	Note-1			FOR GE BENTLEY USA MAKE SYSTEM
		II				MEGITT (Vibrometer)	Switzerland	Note-1			
		II				SENSONICS LIMITED	UK	Note-1			
		II				Sensonics Technology India	Kundli	Note-1			For Sensonic UK system
		II				IRD Mechanlysis Ltd	Thane	Note-1			Vibration sensors will be sourced from M/s Hansford UK ,however brand name of IRD and its logo is acceptable with suitable traceblity of M/S Hansford UK
		II				M/S Schenck Rotec India Ltd	Noida	Note-1			Loop powered sensor with indicator .Main sensor LPS-420 procured from M/S Hansford sensor UK
		II				Forbes Marshall Pvt Limited	Pune	Note-1			VMS hardware and sensors with integral cable shall be shinkawa Japan make .2. All other BOI shall be from LOA agreed sources

LEGENDS :

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY

A - For those items proposed vendor is acceptable to Customer. To be indicated with letter "A" in the list alognwith the condition of approval, if any.

DR - For those items "Detailed Required" for Customer review. To be identified with letter "DR" in the list. For these items, vendor shall be proposed for owner acceptance with-in the agreed contract schedule of the package

SQP-Standard Quality Plan RQP-Refernce Quality Plan

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by Customer and final acceptance will be on physical inspection witness by Customer

CAT - II : For those items the Quality Plans are approved by Customer. However no physical inspection shall be done by Customer. The final acceptance by Customer shall be on the basis of review of documents.

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
CAT - III : For these items Quality control to be exercised as per Main contractor Quality Assurance System. The final acceptance by NTPC shall be on the basis of Certificate of Conformance (C OC) by Main Contractor.											
UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units/works.											
* - Inspection category will be decided during vendor evaluation.											
NOTE - 1 :Manufacturer/Sub vendor shall be considered for acceptance subject to Sub-QR/provenness approval from NTPC Engineering & Owner											
NOTE - 2 : For Instrument cable <= 1 KM inspection category CAT - III, For > 1 KM to <= 10 KM Inspecton category CAT - II COC & FOR> 10 KM Inspection category CAT-I											
NOTE -3 : For Fiber Optic cable <=10KM inspection category CAT - III & for > 10KM Inspection category CAT-II											
NOTE-4 : Batteries for UPS <= 10 KVA and batteries for intelligent battery charger 24 V DC <= 40 Amp inspection category CAT-III & for Batteries for UPS> 10KVA and batteries for intelligent battery charger 24 V DC > 40 Amp rating inspection category CAT-I											
NOTE-5 UPS <= 10 KVA rating inspection category CAT-III & for > 10KVA rating inspection category CAT-I											
NOTE - 6 : For the items not appearing in the preaward list and falls in the scope of supply of the bidder, bidder and Customer will mutually discussed in future.											
NOTE - 7 - EMPTY CABINETS, COMPUTERS, SIGNAL ISOLATOR/ MULTIPLIER and TB SHALL ALSO BE ACCEPTABLE FROM OWNER ACCPETED IN QP. IF THE TOTAL INTEGRATED PANEL AND FAT IS CONDUCTED INDEGENEOUSLY											
NOTE-8 : For the C & I instrumnts mounted on the skid of the main item or supplied as a integral part of the main item, instrument to be supplied as per proven practice of the manufacturer meeting the Customer technical specification requirement.											
NOTE-9- This item is a bought out componenet of main equipments like DDCMIS ,PLC,TSI,CCTV ,PA system etc											
NOTE-10- For these controlled items, vendor shall be proposed for owner accepetance with-in the agreed contract schedule of the package											

THDC INDIA LTD.

N Agarwal
NTPC

(CH. A. V. Patwa)
BHEL

21

NTPC	PROJECT : Khurja STPP PACKAGE : TURBINE GENERATOR AND ASSOCIATED PACKAGES CONTRACTOR :BHEL CONTRACT NO : THDC/RKSH/CC-9915-371	LIST OF C&I ITEMS REQUIRING QP APPROVAL & ACCEPTABLEVENDOR AS APPROVED BY	REVISION NO : 00 DATE : ~~22.05.2019~~ 26.06.2019

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submissl on SCH	QP approva l SCH	Proposed Sub Supplier	Country	SS Approval_S tatus	SS Detail Sub.SCH	SS Approval SCH	Remark
1	ADDRESSABLE DETECTORS (MULTI SENSOR, PHOTO & HEAT DETECTORS TYPE), INTERFACE UNITS & MANNUAL CALL POINTS										PESD Hyd
		II				Schrack	Austria	A			
		II				Autronica	Norway	A			
		II				Edwards	USA	A			
		II				Notifier	USA	A			
		II				SIBELD FIRE SAFTY	UK	A			
2	Battery (Lead Acid - Plante)										
		Note-4				HOPPECKE BATTERIEN GMBH & CO KG	Germany	A			EDN
		Note-4				EXIDE	Kolkata	A			
		*				Amara Raja	Chittor	DR			
		*				HBL Nife	Hyderabad	DR			
3	Battery (Ni-Cd)										
		Note-4				AMCO SAFT INDIA LIMITED	Bengaluru	A			EDN
		Note-4				HBL POWER	Hyderabad	A			
		Note-4				SAFT	France/Sweeden	A			Upto 600AH(Hyper)
		Note-4				HOPPECKE BATTERIEN GMBH & CO KG	Germany	A			
4	Blank Panels / Cabinets										
		III				Rittal	Bengaluru	A			EDN
		III				Hoffman	Bengaluru	A			
		III				Pyrotech	Udaipur	A			
		III				BHEL	Bengaluru	A			
		*				Schneider	Bangalore	DR			
5	Concentration Analyser										
		III				HACH	USA	A			
6	Control Desk										
		I				PYROTECH WORKSPACE SOLUTIONS PVT LTD	UDAIPUR	A			EDN BOI shall be as per LOA approved sources

THDC INDIA LTD.

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		I				COSMOS MEDIA PRODUCTS PVT LTD	GREATER NOIDA	A			1. H block should be from Knurr Germany 2. Complete integrated mosaic grid should be procured from owner approved sources like Pro Plan Subklew 3. solid acrylic surface should be procured from Du Pont owner approved sources 4. Extruded Al profile structure should be procured from Hindalco (With Knurr design)
		I				ADARSHA CONTROL SYSTEM PVT LTD	Bengaluru	A			1. Mosaic items should be from owner approved sources 2. Acrylic solid surface (ASS) should be procured from Du Pont owner approved sources 3. wood works are to be done by M S C K Furn. Bangaluru
		*				HARMONY SYSTEMS	NEWDELHI	DR			
		*				CHEMIN CONTROLS AND INSTRUMENTATION	PONDICHERRY	DR			
7	Control Valve for BFP Recirculation.										
		I				Control Component India PVT Ltd	Sriety	A			HYD 1. The critical components of control valve i.e. Disk Stack (Drag technology) shall be sourced from CCI USA/CCI KOREA. The positioner from Owner approved sources & pneumatic actuators are sourced from CCI Korea 2. Control valve to be manufactureedas per CCI USA design & drawing
		I				KOSO India Pvt Ltd	Nasik	A			
		I				KSB MIL CONTROLS LTD	Thrissur (KERLA)	A			UP TO 10 INCHES & 3400 CLASS
		II				DRESSER PRODUITS INDUSTRIELS S A S	France	A			
		II				NIHON KOSO CO LTD	Japan	A			
		II				CCI	USA	A			CONDITIONAL
		II				Emerson (Fisher)	USA/France/Japan	A			
		*				HOLTER REGELARMATUREN GMBH & CO. KG	Germany	DR			
		*				Emerson Process Management	Chennai	DR			
8	Control valve for feedwater flow Control										
		I				KOSO India Pvt Ltd	Nasik	A			PEM

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		I				Emerson Process Management Ltd	Chennai	A			1 The control valve body assembly will be manufactured and sourced from Nippon Fisher ,Japan with IBR form III C certificates 2 CV testing will be carried out at FCRI Palakkad
		I				KSB MIL	Thrissur	A			1 Provision of straight type of brackets for linkage mechanism 2 Factory fitted strainer diffuser type seat ring 3 AFR with T connector for pneumatic connection to volume booster
		*				Bomafa Special Valve	Ahmedabad	DR			
		*				M/s GE Oil & Gas India Pvt Ltd,(Earlier known as Dresser India)	Coimbatore	DR			
		*				Forbes Marshell Arca Pvt Ltd	Pune	DR			
		*				Instrument Limited	Palakkad	DR			
		*				Mascot Valve	Ahmedabad	DR			
		*				R K Control Inst	Thane	DR			
		*				Severn Glocon India Pvt Ltd	Chennai	DR			
		*				Suzhou Delan Energy Sons	China	DR			
		*				Samson Control Pvt Ltd	Pune	DR			
		*				Valvitalia S P A	Italy	DR			
		*				Waldemar Pruss	Germany	DR			
9	Control valve(Other than BFP RC, FW flow Control)										
		I				KOSO India Pvt Ltd	Nasik	A			PEM
		I				KSB MIL	Thrissur	A			
		I				Emerson Process Management Ltd	Chennai	A			
		I				Forbes Marshall Arca Pvt Ltd	Pune	A			up to 16" and 900 Class
		I				M/s GE Oil & Gas India Pvt Ltd,(Earlier known as Dresser India)	Coimbatore	A			Conditional as per approval letter CW-EN-9661-II-43-20 DATED 25/04/2013
		I				Instrumentation Limited	Palakkad	A			up to 2500 class
		*				Bomafa Special Valve	Ahmedabad	DR			
		*				Mascot Valve	Ahmedabad	DR			
		*				R K Control Inst	Thane	DR			
		*				Severn Glocon India Pvt Ltd	Chennai	DR			
		*				Suzhou Delan Energy Sons	China	DR			
		*				Samson Control Pvt Ltd	Pune	DR			
		*				Valvitalia S P A	Italy	DR			
		*				Waldemar Pruss	Germany	DR			

THDC INDIA LTD.

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
10	Electrical Actuator (With gear box if applicable)										EDN
		II				Antrieb Technik Pvt Ltd	Chennai	A			For low torque app like SH EH vent circulation & Feed wtr isolation
		II				Auma	Bengaluru	A			
		II				Limitorque	Faridabad	A			Model no L120,SMB LY series, Gear Box T, UBC Series
		II				Rotork	Bengaluru	A			For low torque app (Up to 1000 Newton meter)
		II				Rotork Controls (India) Private Ltd	Chennai	A			For low torque app (Up to 1000 Newton meter) & High torque 4000 to 7000 NM With integral starter for non critical applications
		III				Auma	Germany	A			
		III				Limitorque	USA	A			
		III				Rotork	UK	A			For low torque app (Up to 1000 Newton meter)
		III				Nippon gear	Japan	A			
		III				Drehmo GMBH	Germany	A			C MATIC SERIES (DMC/DMCR)
11	Electrical Actuator (With gear box if applicable) (Field bus based)	Note-10									
12	Electrical Indicating Instruments (Mosaic Compatible)										EDN
		III				Siemens	Germany	A			
		III				Ganz	Germany	A			
		III				Gossen / Metrowatt / Camille Bauer	Germany	A			
		III				Weigell Messgerate	Germany	A			
13	Electromagnetic Flow Meter										PEM
		I				Electronet Euipment Pvt Ltd	Pune	A			Calibration upto 500 NB Inhouse, upto 110 NB by third party NABL accrediated Lab
		*				Adept Fludyne Pvt Ltd	Pune	DR			
		*				Scientific Device	Mumbai	DR			
		*				V A Valves	Jalandhar	DR			
14	Fiber optic cable		SOP								EDN
		Note-3				KEC International Ltd	Mysore	A			
		Note-3				Apar Industries Limited	Valsad	A			
		Note-3				HFCL	Goa	A			
		Note-3				Aksh Fibre	Bhiwadi	A			
		Note-3				Finolex	Pune Goa	A			
		Note-3				M/S Birla Cable Limited	Rewa	A			
		Note-3				Jiangsu Tongguang	China	A			

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		Note-3				R&M	Switzerland	A			
		Note-3				Molex	UK	A			
		Note-3				Corning	USA	A			
		*				SCHNEIDER ELECTRIC	Bengaluru	DR			
		*				NETSOFT TECHNOLOGIES	India	DR			
		*				BINARY SYSTEMS PVT LTD	India	DR			
		*				TEXONIC	Bengaluru	DR			
		*				MICRO SOLUTION	Bengaluru	DR			
		*				WEBCOM	Bengaluru	DR			
		*				MICRONOVA IMPEX	Bengaluru	DR			
		*				PRISHA NETWORK	Bengaluru	DR			
		*				AKASH SOLAR		DR			
		*				FIBERTEK	Bengaluru	DR			
		*				INTERFACE CONNECTRONICS		DR			
		*				TYCO/AMP		DR			
		*				SCHNEIDER-DIGILINK		DR			
		*				D-LINK		DR			
15	FIRE ALARM PANEL - MICROPROCESSOR BASED										PESD HYD
		II				Notifier	USA				
		II				Autronica	Norway	A			
		II				Schrack	Austria	A			
		II				Edwards	USA	A			
		II				Toshniwal Industrial Pvt Ltd	AJMER	A			FAP,MSD ,MCP,HOOTER ,ISOLATOR & CONTROL MODULE SHALL BE FROM M/S NOTIFIER 2 OTHER BOI SHALL BE AS PER LOA APPROVED SOURCES 3 M/S HONEYWELL SECURITY SHALL ACTIVELY SUPPORT M/S TOSHNIWAL DURING ENGG ,INSTALLATION & COMM OF FIRE ALARM SYSTEM
		II				M/s SHIELD FIRE SAFETY AND SECURITY LTD	UK	A			
16	Flow nozzle assembly		SQP								PEM
		I				Microprecision Product Pvt Ltd	Palwal	A			Flow nozzle assembly Alloy steel material grade P-92 & other conditions as per approval letter

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submissi on SCH	QP approva l SCH	Proposed Sub Supplier	Country	SS Approval_S tatus	SS Detail Sub.SCH	SS Approval SCH	Remark
		I				Minco India Flow Elements Pvt Ltd	Goa	A			1- up to 26 Inches for Alloy steel/ Stainless steel pipe SA335 P-11, P-22 and SA 335 P-91 2- Brach pipe will be issued as free issue item from main supplier to manufacturer or procure from Customer approved sources by manufacturer from Vendor identified in the contract agreement However raw material / forging for flow nozzle will be procured by manufacture as per their standards regular suppliers 3 Carrying out wet calibration of flow nozzle assembly at ICRI or owner agreed third party laboratory
		I				Instrumentation Limited	Palakkad	A			Approved up to alloy steel grade P-92 subject to qualified WPS & other conditions as per approval letter
		I				Starmech controls (India) Pvt Ltd	Pune	A			Approved up to alloy steel grade P-92 subject to qualified WPS & other conditions as per approval letter
		*				Dyna Fluid Valves & Flow Control	Belgaum	DR			
		*				Hydronpneumatics Pvt Ltd	Bicholim	DR			
17	H2 Gas Analyser	*				Minco India Pvt Ltd	Goa	DR			
		I				M/s Adage Automation Pvt. ltd	GOA	A			HWR 1 Hydorgen gas analyser (Calomat 6) will be imported from M/s Siemens, Garmany
		I				YOKOGAWA INDIA LTD	Bengaluru	A			Analyser Will be imported from YEC Japan Microprocessor based working on gas density principle)
		I				SIEMENS	GURGAON	A			H2 GAS ANALYSER (CALOMAT 6) WILL BE IMPORTED FROM M/S SIEMENS GERMANY (KARLSRUHE WORKS)
		III				GE Sensing EMEA	IRELAND	A			Approved for Thermal Conductivity based
		III				ABB	UK	A			
		III				Emerson (Rosemount)	USA	A			
		III				SIEMENS	Germany	A			System Integrator M/s Stormetek Chennai
		*				Environment One Corporation	USA	A			Purity Meter- conductivity Based
18	High Temp. cable (PTFE/FEP)					ABB Limited	Bangalore	DR			
		II				Thermocables	Hyderabad	A			EDN
		II				Tempsens	Udaipur	A			
		II				Habia cables	China	A			Type- Ct KX-type), 2pair & 4 pair
		II				Habia cables	Sweden	A			
		II				Thermo Electrica BV	Netherland	A			

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		II				Lapp cables	Germany	A			
		II				Kerpen cables	Germany	A			
		II				TEW & C	USA	A			
		*				ADVANCE CABLES TECHNOLOGIES	BANGALORE	DR			
		*				DELTON CABLES	NEW DELHI	DR			
		*				FLUTEF INDUSTRIES	AHMEDABAD	DR			
		*				RELIANCE INDUSTRIES	BANGALORE	DR			
		*				RJ INDUSTRIAL CORPORATION	ROORKEE	DR			
		*				TOSHNIWAL CABLES PRIVATE LIMITED	JAIPUR	DR			
		*				UNIVERSAL CABLES LIMITED	SATNA	DR			
19	Impulse Pipes/Tubes		SQP								
		II				Mahrashtra Seamless	Raigarh	A			EDN
		II				Ratnamani Metals and Tubes	Gandhinagar	A			FOR CS PIPES ONLY
		II				Heavy metals and Tubes	Gandhinagar	A			For SS only
		II				ISMT	Ahamadnagar	A			For SS & CS only
		II				Sumitomo kawasaki/Nippon	Japan	A			FOR CS AS upto Gr 22 PIPES ONLY
		II				TPS TECHNITUBE	Germany	A			
		II				Velurie & manessmann	Germany	A			
		II				Trouvay and Cauvin	France	A			
		II				Sandvik	SWEDEN	A			For SS only .Approved for SS duplex seamless Pipe upto 200NB by Mech
		*				BHARAT HEAVY ELECTRICALS LTD	TIRUCHIRAPALLI	DR			
		*				INDIAN SEAMLESS METAL TUBES LTD	PUNE	DR			
		*				JINDAL SAW LTD	CHENNAI	DR			
		*				MAXIM TUBES COMPANY PVT LTD	AHMEDABAD	DR			
		*				SURAJ STAINLESS LIMITED	AHMEDABAD	DR			
		*				MBM TUBES PVT LTD	CHATTRAL,GUJARAT	DR			
		*				TUBACEX PRAKASH INDIA PVT LTD	UMBERGAON ,GUJARAT	DR			
		*				SHUBHLAXMI METALS AND TUBES PVT. LTD.	MUMBAI	DR			
20	Instrument Cables (F,G & T/C Cables)		SQP								
		Note-2				PARAMOUNT COMMUNICATION LTD	Khaskhera	A			EDN/ PEM
		Note-2				Polycab	Daman & Diu	A			PVC,FRLS type
		Note-2				Delton	Faridabad	A			PVC,FRLS type
		Note-2				KEI	Bhiwadi	A			PVC,FRLS type
		Note-2				Elkey Telelinks	Faridabad	A			
		Note-2				CORDS	Kaharani	A			PVC,FRLS type
											PVC,FRLS type

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		Note-2				CORDS	Bhiwadi	A			PVC,FRLS type.
		Note-2				Nicco	Kolkata	A			PVC,FRLS type
		Note-2				Universal Cable	Satna	A			File for 132KV XLPE cable
		Note-2				Thermocables	Hyderabad /Mahboobnagar	A			A, B , F&G
		Note-2				Gupta Power Infrastructure Ltd	Khurdha	A			PVC,FRLS,Shielded, Multi Pair,Twisted ,Type A,B,F&G
		Note-2				CMI	Faridabad	A			PVC,FRLS type 0.5 SQMM F&G TYPE CABLES
		Note-2				Advance Cables Pvt Ltd	Bengaluru	A			0.5 SQMM F&G TYPE CABLES
		Note-2				Gemscab Industries Ltd	Bhiwadi	A			0.5 SQMM F&G TYPE CABLES
		Note-2				Apar Industries Limited	Valsad	A			0.5 SQMM F&G TYPE CABLES
		Note-2				SUYOG ELECTRICALS LTD	HALOL (GUJRAT)	A			0.5 SQMM F&G TYPE CABLES
		Note-2				SPECIAL CABLES PVT LTD	RUDRAPUR	A			0.5 SQMM F&G TYPE CABLES
		Note-2				T C COMMUNICATION	GHAZIABAD	A			PVC,FRLS type
		Note-2				TEW & C	USA	A			
		Note-2				Habia cables	Sweeden	A			
		Note-2				Kerpen cables	Germany	A			
		Note-2				Lapp cables	Germany	A			
		Note-2				Thermo electa Bv	Netherland	A			
		*				Goyolene fiber pvt ltd	India	DR			
		*				Polycab	Halol	DR			
		*				Tempsens Instruments Pvt ltd	Udaipur	DR			
		*				Mansfield company ltd	India	DR			
		*				Gupta power infrastructure ltd	India	DR			
		*				RJ industrial corporation	India	DR			
		*				Apar industries	India	DR			
		*				Govind cable industries	India	DR			
		*				Torrent Cables	India	DR			
		*				Ravin cables	India	DR			
		*				SPM power & telecom pvt ltd	India	DR			
		*				Ultracab	India	DR			
		*				Surajcables	India	DR			
		*				SPECIAL CABLES PVT LTD	New Delhi	DR			
		*				Servel Cables	Neemrana	DR			
		*				Thermo Cables Ltd.	JADCHERLA	DR			
21	Instrument Valve		SQP								
		II				BHEL	Trichy	A			EDN
		II				Instrumentation Limited	Palakkad	A			
		II				Excel Hydro	Mumbai	A			upto 6000 lbs

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		II				HP Valves and fittings	CHENNAI	A			FORGED TYPE GLOBE VALVE UPTO CLASS 4500 & PUPTO CLASS 2500,IBR/NIBR
		II				Baldota	Mumbai	A			
		II				Metpass Engineering works	Kolkata	A			Approved for 1/2" instrument valves (Globe Valve)
		III				Swagelok	USA	A			
		III				Parker	USA	A			
		III				HY Lok Corporation	Korea	A			
		III				DK TECH Corporation	Korea	A			
		III				Hamlet	Israel	A			
22	Large Video Screen (LED Based)										EDN
		I				Pyrotech Electronics Pvt Ltd	Udaipur	A			
		I				DELTA	GURGAON	A			
		I				BARCO	Noida	A			
		I				PLANAR	USA	A			
		*				Mitsubishi	Japan	DR			
		*				CHRISTIE-USA	USA	DR			
23	Level switch- cond type										EDN
		III				EMERSON (Solartron mobrey) HYDRASTEP	UK				
		III				Yarway	USA	A			
		III				LEVELSTATE	UK	A			
		II				Raman Instruments	Delhi	A			FOR EMERSON (MORBEY) UK SYSTEM
		II				Hi Tech	Kolkata	A			FOR LEVELSTATE UK SYSTEM VESSEL FROM HI TECH QP VETTING FROM LEVELSTATE
		II				BHEL	Trichy	A			
		*				SOLARTRON TRANSDUCER	U.K	*			
		*				PUNE TECHTROL PVT LTD,PUNE(SYSTEM INTEGRATOR OF FOSSIL POWER SYSTEM)	Pune	*			
		*				IGEMA GMBH,MUNSTER	GERMANY	*			
24	Local Instrument Enclosure/Rack										EDN
		I				Pyrotech	Udaipur	A			BOI from LOA approved sources
		I				Instrumentation Limited	Kota	A			BOI from LOA approved sources
		I				Sajas electrical	Trichurapalli	A			BOI from LOA approved sources
		I				Prammen	Puddukottai	A			BOI from LOA approved sources

9885/90/2022/PS-PEM-MAX

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		I				Chaman	Pondicherry	A			1- Fabrication at M/s LUFT tech India 2- Painting at M/s Supreame Coater & Fabricator 3 BOI from LOA approved sources
		*				PROCON INSTRUMENTATION (P) LTD	CHENNAI	DR			
25	Mosaic tiles /Console items										
		III				PRO PLAN EARLIER BOYKO STREY	Germany	A			FDN
		III				TEW EARLIER SUBKLEW	Germany	A			
26	PH ANALYSER										
		III				Emerson Process Management Ltd	Pawane	A			EDN
		III				HACH	Switzerland / USA	A			Make Emerson USA
		III				YOKOGAWA	Bengaluru / Japan	A			
		III				ABB	UK / USA	A			Make Yokogawa Japan
27	PLC System										
		I				M/S BEIJING K&U ELECTRICAL	BEIJING	A			ISG PESDHYD,PEM 1 PLC modules from SIEMENS 2 BOI FROM owner LOA AGRIEED SOURCES
		I				GE Intellegent plateforms Pvt Ltd	Bengaluru	A			
		I				ABB	Bengaluru	A			
		I				Schneider	Nasik	A			
		I				Rockwell	Sahibabad	A			
		I				Siemens	Nasik	A			
		I				HONEYWELL	PUNE	A			1-PLC modules should be procured from M/s Honeywell Co Ltd, Korea 2-Make of Panel (Blank Enclosure) Terminal block, Network components & interposing relay should be from owner approved source
		I				M/S VIRTUAL AUTOMATION	RANGAREDDY	A			PLC FORM M/S SCHNEIDER MAKE & OTHER BOI SHALL BE AS PER loa AGRIEED SOURCES. OTHER BOI FROM owner APPROVED MAKES
		I				M/s Cotmac Electronics Pvt Ltd	Pune	A			FOR SIEMENS MAKE PLC,BOI FROM owner APPROVED SOURCES,OP VETTED BY OEM.PROJECT SPECIFIC AUTHOTIZATION LETTER
		I				M/S Tech-Masters	Hyderabad	A			FOR GEIP MAKE PLC OTHER BOI FROM owner APPROVED SOURCES,ENGG DOCUMENT VETTED BY OEM

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		I				M/S Powertech Switchgear (I) Pvt Ltd	Sunepat	A			FOR SCHNEIDER MAKE PLC OTHER BOI FROM owner APPROVED SOURCES.ENGG DOCUMENT VETTED BY OEM
		I				M/S Unity Industrial Automation Pvt Ltd	Delhi	A			1 System integrator for Rockwell make PLC 2 BOI shall be as per LOA agreed sources ENGG DOC VETTED BY OEM
		I				EMCONS	Ranchi	A			FOR ROCKWELL MAKE PLC SYSTEM ,OTHER BOI FROM owner APPROVED MAKES.ENGG DOC VETTED BY OEM
						Schneider	Bengaluru	A			MODULES FROM SCHNEIDER,FRANCE AND ALL MAJOR BOI FROM owner APPROVED MAKED
		I				M D Industries	Vadodara	A			System integrator for GE make PLC
		I				Velox automation	Surat	A			System integrator for SIEMENS make PLC & other BOI as per LOA Engg document like QP shall be vetted by SIEMENS
		I				Wuhan Guide	China	A			System integrator for Siemens Make
28	**Radar type level transmitter**										EDN/HWR
		III				Emerson Process Management Ltd	Pawane	A			01 CQA EMERSON DTD 24.01.2011 Basic Intrument Transmitter & Probe to be procured from Emerson Singapore , only intergration & configuration at pawane works
		III				Endress & Houser	Aurangabad	A			
		III				Supreme Technology	Thane	A			Transmitter procured from Siemens Canada with Co-related TC Valid Authorisation from M/s Siemens
		III				B M Technology	Italy	A			
		III				Magnetrol	Belgium	A			
		III				ABB(K-Tech)	USA	A			
		III				Endress & Houser	Germany	A			Liquid like Oil & Water
		III				Saab Rosemount	Sweden	A			
						Emerson Process Management	Singapore	A			ROSEMOUNT 3300 GUIDED WAVE RADAR ,5400 AND 5600 NON CONTACTING RADAR
		III				Endress & Houser	Germany	A			
		III				Vega Grieshaber KG	Germany	A			
		III				Limaco	Russia	A			
		*				Honeywell India Pvt Ltd	PUNE	DR			
		*				V AUTOMAT & INSTRUMENTS P LTD	New Delhi	DR			
		*				Vega India -level & Pressure Measurement	Pune	DR			
		*				Honeywell India Pvt Ltd	Gurgaon	DR			

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
29	SHORT TERM FIRE PROOF CABLES, MICC CABLES										PEM, PESD HYD
		III				Pentair	UK	A			2CX1.5 SQ MM AND 2CX2.5SQ MM
		III				Wrexham Mineral	UK	A			2,3,4 &7 CORE CABLE
		III				KME	Italy	A			2CX1.5 SQ MM AND 2CX2.5SQ MM
		III				TYCO	UK / China	A			2CX1.5 SQ MM AND 2CX2.5SQ MM
30	Temp Transmitter										
		III				ENDRESS & HOUSER	Aurangabad	A			EDN
		III				Emerson Process Management Ltd	Pawane	A			Dual input & multiinput imported from Singapore but tagged & configured at Pawane works
		III				ABB	Bengaluru	A			DIN RAIL ,DUAL I/P FIELD MOUNTED TYPE (MAKE M/S ABB GERMANY)
		III				WIKA Instruments India Pvt Ltd	Pune	A			Model no T-32 sourced from Wika Germany & calibration at Wika Pune is acceptable
		III				Yokogawa	Japan	A			CALIBRATION AT YOKOGAWA BANGLORE IS ALSO ACCEPTABLE
		III				Moore	USA	A			MAIL APPROVAL DTD 10.04.2009 CARD 3067
		III				M System co ltd	JAPAN	A			Model No-R3HH-0
		III				Emerson	U.S.A Singapore/Germany	A			
		III				ABB	Germany	A			ASSEMBLED TT PROCURED FROM ABB,GERMANY TESTING,CALLIBRATION,CONFIG AND SUPPLY FROM FARIDABAD-MODEL TH 102
		III				Emerson	U.S.A Singapore/Pawane	A			Dual Input and Multi Input imported from singapore but tagged and configured at pawane
		III				Yokogawa	Bengaluru				Make Yokogawa japan and calibration at Yokogawa Banglore
31	Terminal Block (Cage and Clamp type)										EDN
		III				Elmex	Vadodara	A			Model should have CE Marking
		III				Phoenix	Germany / India	A			
		III				Weidmuller	Germany	A			
		III				Wago	Germany / India	A			
		III				Connectwell	Dombiwali-Mumbai	A			
32	Transmitter (Electronic) (Pressure, DP,Flow,Level application)										EDN/ HWR
		III				ABB Ltd	Bengaluru	A			2600T & critical item from ABB Italy SND ALL OTHER COMPONENTS LIKE HOUSING AND FLANGES FROM ABB approved source
		III				Emerson Process Management Ltd	Pawane	A			

THDC INDIA LTD.

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				Siemens Ltd	Thane	A			Model -SITRANS P
		III				Honeywell Automation India Ltd	Pune	A			
		III				Baldota Control and Equipment Pvt Ltd	Navi Mumbai	A			PT & DPT of LD 301 Series (SMAR)
		III				Yokogawa India Limited	Bengaluru	A			EJA-E 110,430,530 SERIES & all raw material and BOI under knocked down condotion (sensor assembly as a single unit) shall be sourced from M/S Yokogawa Japan
		III				M/s Endress + Hauser India Automation Instrument Pvt Ltd	Aurangabad	A			
		III				Emerson (Rosemount)	USA	A			
		III				YOKOGAWA	JAPAN	A			
		III				ABB	Germany / Italy	A			2600T & critical item from ABB Italy / Their approved source
		III				Siemens	France	A			Sitrans P DSIII Series
		III				Fuji Electric	France	A			FCX -AIII SERIES
		III				Fuji Elec co Ltd	China	A			FCX-III MICROPROCESSOR BASED CARD NO 3573
		III				FUJI	JAPAN	A			~~OBSERVATION BUT NO ADDRESS IS MENTIONED~~
		*				Chino Corporation	Ghaziabad	DR			
		*				SMAR EQUIPAMENTOS INDUSTRIAIS	BRAZIL	DR			
33	Transmitter (Electronic) (Pressure , DP,Flow,Level application) (Field bus base)										EDN
		I				ABB India Ltd	Bengaluru	A			One no of TT will be available at DCS supplier for function testing of field bus communication with DCS during FAT
34	Turbine supervisiory Instruments along with vibration analysis system	Note-7									EDN
		II				MEGGITT (VIBROMETER)	Switzerland				
		I				GE	Pune	A			For GE Bently ,USA make system
		I				MEGGITT (VIBROMETER)	Bengaluru	A			For Meggitt (Vibrometer) Switzerland make system
		I				Forbes Marshall	Pune	A			For Shinkawa Japan make system
		II				GE BENTLY	USA	A			
		II				SIEMENS INDUSTRY AUTOMATION	Germany	A			* Sensors should be of Meggitt (Vibrometer-Switzerland) make
		II				SHINKAWA	JAPAN	A			
		*				ROCKWELL AUTOMATION.	USA / INDIA	DR			
		*				SKF	USA / INDIA	DR			

THDC INDIA LTD.

9885/00/2022/PS-PEM-MAX

34

(34)

89

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		*				BRUEL & KJAER VIBRO	GMBH/ SHERMAN, NEWDELHI	DR			
35	Ultrasonic type level Transmitter										FDN
		II				EIP ENVIRO	Noida	A			Ultrasonic level Tx shall be BM TECHNOLOGY ITALY MAKE REQUIRED MOUNTING ARRANGEMENT TESTING ,CALIBRATION SHALL BE CARRIED OUT AT M/S EIP WORKS AUTHORIZATION LETTER ALONG WITH VALIDITY DATE ALONGWITH QP
		III				E & H	Aurangabad	A			
		III				Emerson Process Management Ltd	Pawane				Complete Intrument Transmitter & Probe to be procured from Mobrey UK , only intergration & configuration at Pawane works
		III				BM Technology	Italy	A			
		III				SIEMENS MILTRONICS	Canada	A			
		III				Nivelco Process Control	Hungary	A			Manufactured ,assembled CALIBRATED AND TESTED in hungARY Flange,EXTERNAL CAGES,MOUNTING BRACKETS PANELS ETC configured AND SUPPLIED BY NIVELCO PUNEin pune
		III				E & H	Germany	A			
		III				HAWK Measurement PTY Ltd	Australia	A			
		*				M/s FORBES MARSHALL PVT. LTD	PUNE	DR			
		*				M/s ABB INDIA LIMITED	INDIA	DR			
36	UPS WITH ACDB										
		Note-5				VERTIV ENERGY PVT LTD	Pune	A			FDN
		Note-5				VERTIV ENERGY PVT LTD	Mumbai	A			UP TO 125 KVA FOR 1 PHASE & 300 KVA FOR 3 PHASE
		Note-5				Hitachi Hitel Power Electronics Pvt Ltd	Gandhinagar	A			UP TO 160 KVA INTELLIGENT BATTERY CHARGER 24VDC
		Note-5				M/S Consul Neowatt	Pune	A			Upto 120KVA Single phase IGBT
		Note-5				KELTRON	TRIVENDRUM	A			Up to 100 KVA single phase
		Note-5				Merlin & Gerin	France	A			REFER APPROVAL LETTER
		Note-5				Gutur	Switzerland	A			
		Note-5				AEG (Saft)	Germany	A			
		Note-5				Fuji Electric	Japan	A			

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
37	Valve manifolds										FDN
		III				Baldota VALVES AND FITTINGS	Mumbai	A			2 3 5 way, 4500 class
		III				Metpress	KOLKATA	A			upto 1.2", 5 way
		III				Excel hydro	Mumbai	A			UP TO 6000 lbs
		III				Astech	Mumbai	A			
		III				HP Valves and fittings	CHENNAI	A			UPTO 5 WAYS ,UPTO 9000 PSI
		III				HYD AIR	LONAVALA	A			FOR INSTRUMENT VALVES
		III				Microprecision	Faridabad	A			
		III				Parker	USA	A			
		III				Hamlet	Israil	A			
		III				SCHNEIDER	Germany	A			
		III				HYLOK	Korea	A			
		III				DK TECH	Korea	A			
		III				Anderson Greenwood	USA	A			1/2" AND 3/4" UPTO 3000 SPL CLASS
		III				Swagelock	USA	A			
38	Wireless Solution (Microwave Tower Communication)										FDN
		I				Lotus wireless technologies India Pvt Ltd	Visakhapatnam	A			
		III				Sheetal	Pune	A			
		*				AMG SYSTEMS LTD	UK	DR			
39	Profibus cable PA & DP Type	Note-10									FDN
40	Field bus components										EDN
		III				Phoenix Contact Inc	USA	A			Materail will be allowed to dispatch from the vendor works as CAT-III item ,however all material except SS junction box will be available at DCS supplier works for functional testing
41	Temp transmitter Single & Dual Input (Field bus)										FDN
		I				ABB India Ltd	Bengaluru	A			One no of TT will be available at DCS supplier for function testing of field bus communication with DCS during FAT
	Main Contractor approved sources										
MC-1	AIR FILTER REGULATOR	III				Main contractor approved					All Packages
MC-2	Annunciator	III				Main contractor approved					All Packages
MC-3	Battery Health Monitoring System	III				Main contractor approved					All Packages
MC-4	Coupling /Interposing relays /Isolator	III				Main contractor approved					All Packages
MC-5	Compression Fitting (SS) /Socket weld fitting	III				Main contractor approved					All Packages
MC-6	Condensing Pots	III				Main contractor approved					All Packages
MC-7	Conduits - Pipe (GI) Conduits Lead Coated (Flexible)	III				Main contractor approved					All Packages

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
MC-8	Conductivity Analyser(Total/ Specific/ Stator Water)	III				Main contractor approved					All Packages
MC-9	Instrument tube fittings (air) /Copper tubing/Brass connectors	III				Main contractor approved					All Packages
MC-10	Dew point sensor /meter (H2 & Air)	III				Main contractor approved					All Packages
MC-11	Desk for OWS/EWS/Printer/Server	III				Main contractor approved					All Packages
MC-12	Digital Indicators	III				Main contractor approved					All Packages
MC-13	Flow venturi assembly	III				Main contractor approved					All Packages
MC-14	Flow Nozzle for performance calibration	III				Main contractor approved					All Packages
MC-15	Electrical Control Panel	III				Main contractor approved					All Packages
MC-16	Flow Gauge	III				Main contractor approved					All Packages
MC-17	FLOW INDICATOR CUM TOTALISER	III				Main contractor approved					All Packages
MC-18	FLOW SWITCH	III				Main contractor approved					All Packages
MC-19	FRP Junction Box /UPS power distribution board	III				Main contractor approved					All Packages
MC-20	Furniture for control Room(Chair, Almira, Lock)	III				Main contractor approved					All Packages
MC-21	Generator End Winding Vibration Monitoring System	III				Main contractor approved					All Packages
MC-22	Graphic Interface Unit	III				Main contractor approved					All Packages
MC-23	H2 Gas Leak detector	III				Main contractor approved					All Packages
MC-24	Hart Management System/ Hand Held Calibrator	III				Main contractor approved					All Packages
MC-25	Humidistat / Thermostat / Gyserstat / Airstat	III				Main contractor approved					All Packages
MC-26	KVM SWITCH/MATRIX KVM SWITCH	III				Main contractor approved					All Packages
MC-27	Level Switch (RF Type)	III				Main contractor approved					All Packages
MC-28	Level gauge (Transperent & Reflex. Tubular type) and level Indiactor (Float & Board type)	III				Main contractor approved					All Packages
MC-29	Level switch - Float/Displacer Type/Capacitance	III				Main contractor approved					All Packages
MC-30	LIMIT SWTCH	III				Main contractor approved					All Packages
MC-31	Lub Oil Control Valve- Self Regulating	III				Main contractor approved					All Packages
MC-32	Mini UPS up to 3.5 KVA	III				Main contractor approved					All Packages
MC-33	Network Components	III				Main contractor approved					All Packages
MC-34	Operator work stations /Server/Laptop/Monitor	III				Main contractor approved					All Packages
MC-35	Orifice plate assembly	III				Main contractor approved					All Packages
MC-36	Pressure / Vacuum / DP Gauges	III				Main contractor approved					All Packages
MC-37	Press. DP. Vaccum Switch	III				Main contractor approved					All Packages

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
MC-38	PRESSURE TRANSMITTER (PRESSURE, DP,FLOW,LEVEL APPLICATION)	III				Main contractor approved					All Packages
MC-39	Printer (Dot Matrix Inkjet/Laser)	III				Main contractor approved					All Packages
MC-40	Rotameter & Sight flow indicator	III				Main contractor approved					All Packages
MC-41	Reverse Rotation Indicator(RRI)					Main contractor approved					All Packages
MC-42	Smart Positioner/ E/P Converter	III				Main contractor approved					All Packages
MC-43	SOLENOID VALVE	III				Main contractor approved					All Packages
MC-44	Temperature cum Humidity Indicator	III				Main contractor approved					All Packages
MC-45	TEMPERATURE ELEMENT(THERMOCOUPLE , RTD & THERMOWELL)	III				Main contractor approved					All Packages
MC-46	TEMPERATURE GAUGE(WITH THERMOWELL)	III				Main contractor approved					All Packages
MC-47	TEMPERATURE SWITCH	III				Main contractor approved					All Packages
MC-48	Temp Transmitter Multi Input (Field bus)	III				Main contractor approved					All Packages
MC-49	Transducer	III				Main contractor approved					All Packages
MC-50	Instrument Cables (F,G & T/C Cables)	III				Main contractor approved					CPU/ AC
MC-51	Control Valves	III				Main contractor approved					CPU
MC-52	Valve manifolds	III				Main contractor approved					CPU/AC FDPS
MC-53	Beam detector	III				Main contractor approved					FDPS
MC-54	LHS Cable	III				Main contractor approved					FDPS
MC-55	Probe type Heat detector	III				Main contractor approved					FDPS
MC-56	Siren	III				Main contractor approved					FDPS
MC-57	SMF Lead Acid Battry for Microprocessor based fire alarm panel	III				Main contractor approved					FDPS

LEGENDS :

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY

A - For those items proposed vendor is acceptable to Customer. To be indicated with letter "A" in the list alognwith the condition of approval, if any.

DR - For those items "Detailed Required" for Customer review. To be identified with letter "DR" in the list. For these items, vendor shall be proposed for owner acceptance with-in the agreed contract schedule of the package

SQP-Standard Quality Plan RQP-Refernce Quality Plan

2.0 QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by Customer and final acceptance will be on physical inspection witness by Customer

CAT - II : For those items the Quality Plans are approved by Customer. However no physical inspection shall be done by Customer. The final acceptance by Customer shall be on the basis of review of documents.

CAT - III : For these items Quality control to be exercised as per Main contractor Quality Assurance System. The final acceptance by NTPC shall be on the basis of Certificate of Conformance (COC) by Main Contractor.

REF_NO	Major_Equipment	QP Inspection Category	QP No	QP submission SCH	QP approval SCH	Proposed Sub Supplier	Country	SS Approval_Status	SS Detail Sub.SCH	SS Approval SCH	Remark
UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units/works.											
* - Inspection category will be decided during vendor evaluation.											
NOTE - 1 :Manufacturer/Sub vendor shall be considered for acceptance subject to Sub-QR/provenness approval from NTPC Engineering & Owner											
NOTE - 2 : For Instrument cable <= 1 KM inspection category CAT - III, For > 1 KM to <= 10 KM Inspection category CAT - II COC & FOR> 10 KM Inspection category CAT-I											
NOTE -3 : For Fiber Optic cable <=10KM inspection category CAT - III & for > 10KM Inspection category CAT-II											
NOTE-4 : Batteries for UPS <= 10 KVA and batteries for intelligent battery charger 24 V DC <= 40 Amp inspection category CAT-III & for Batteries for UPS> 10KVA and batteries for intelligent battery charger 24 V DC > 40 Amp rating inspection category CAT-I											
NOTE-5 UPS <= 10 KVA rating inspection category CAT-III & for > 10KVA rating inspection category CAT-I											
NOTE - 6 : For the items not appearing in the preaward list and falls in the scope of supply of the bidder, bidder and Customer will mutually discussed in future.											
NOTE - 7 - EMPTY CABINETS, COMPUTERS, SIGNAL ISOLATOR/ MULTIPLIER and TB SHALL ALSO BE ACCEPTABLE FROM OWNER ACCPETED IN QP. IF THE TOTAL INTEGRATED PANEL AND FAT IS CONDUCTED INDEGENFOUSLY											
NOTE-8 : For the C & I instrumnts mounted on the skid of the main item or supplied as a integral part of the main item, instrument to be supplied as per proven practice of the manufacturer meeting the Customer technical specification requirement.											
NOTE-9- This item is a bought out componenet of main equipments like DDCMIS ,PLC,TSI,CCTV ,PA system etc											
NOTE-10- For these controlled items, vendor shall be proposed for owner acceptance with-in the agreed contract schedule of the package											

THDC INDIA LTD.

N Agarwal
NTPC

(CH-A K. Patro)
BHEL.

39

PROJECT : 2X660MW KHURJA PACKAGE : Turbine Generator and Associated Packages Sub-package-HT & LT Switchgear , HT & LT busducts, lighting, cabling, earthing, DG Set, Solar CONT. NO. : THDC/RKSH/CC-9915-371	SUB- VENDOR LIST FOR ITEMS REQUIRING SUB-VENDOR / QUALITY PLAN APPROVAL	DOC NO. : THDC/RKSH/CC-9915-371 REVISION NO. 00 DATE : PAGE : 1 OF 11

Sl. No.	ITEM	QP / INS CAT.	QP No.	Subvendor proposed by M/s BHEL	PLACE	SC APPL STATUS	Remarks
	Alternator	I	1	M/s Kirloskar Electric	Bangalore	A	415 V alternators
				M/s Cummins Generator Technology (Stamford)	U.K	A	415 V & 11 KV alternators
				M/s Leroy Somer	France	A	Up to 11kV alternator 3500 kW
				M/s Nidec	Bangalore	DR	
				M/s Marathan	USA	A	Alternators for up to 415 V, 1500 KVA DG SET
				M/s Cummins Generator Technology (Stamford)	Ahmednagar	A	415 V Alternators up to 1600 KVA
	Diesel engine	I	2	M/s Cummins	Pune	A	
				M/s Cater Pillar	USA	A	
				M/s Mitsubishi	Japan	A	Diesel engine for up to 2000 KVA DG SET
				M/s MTU	Germany	A	Diesel engine for up to 1500 KVA DG SET
				M/s Perkins	UK	A	Diesel engine for up to 2000 KVA DG SET
				M/s Perkins	Aurangabad	A	Conditions apply
				M/s Cater Pillar	Hosur	DR	
	D G set (assembly & testing) (item covered under proveness, sub-section A-1, Chapter-VI of tech spec)	I	3	M/s Sterling Generators Pvt Ltd	Silvasa	A@	For up to 415 V 1500 KVA, @- subject to sub-QR clearance from Owner
				M/s Powerica	Silvasa	A@	Up to 2000 KVA, 415 V & 1500 KVA, 11 KV, @- subject to sub-QR clearance from Owner
				M/s Jakson	Kathua	A@	Up to 415 V, 2000 KVA , @- subject to sub-QR clearance from Owner
				M/s Caterpillar	Hosur	DR@	@- subject to sub-QR clearance from Owner
				M/s. Kohler	Singapore	A@	Up to 2000 kVA ,11kV, @- subject to sub-QR clearance from Owner
				M/s CLLS	Singapore	A@	Up to 1250 kVA, 415 V, @- subject to sub-QR clearance from Owner

THDC INDIA LTD.

BHEL

40

Sl. No.	ITEM	QP / INS CAT.	QP No.	Subvendor proposed by M/s BHEL	PLACE	SC APPL STATUS	Remarks
				M/s Supernova	Rajpur	A@	@- subject to sub-QR clearance from Owner
				Absotherm	Mumbai	DR@	@- subject to sub-QR clearance from Owner
				Apollo	Bangalore	DR@	@- subject to sub-QR clearance from Owner
				JG Ankesaria	Ratlam	DR@	@- subject to sub-QR clearance from Owner
				Kirloskar	Bangalore	DR@	@- subject to sub-QR clearance from Owner
				Trans Generators	Banaglore	DR@	@- subject to sub-QR clearance from Owner
				Universal Generators	Bangalore	DR@	@- subject to sub-QR clearance from Owner
				Wartsila NSD	Bangalore	DR@	@- subject to sub-QR clearance from Owner
				Vijay Power	Bangalore	DR@	@- subject to sub-QR clearance from Owner
	11KV/6.6KV/ 3.3KV Switchgear (item covered under proveness, sub-section A-1, Chapter-VI of tech spec)	1	4	BHEL	Bhopal	A@	@- subject to sub-QR clearance from Owner
	Fast Bus Transfer Panel	1		Aartech	Parwanoo	A	FBT device Model- BTS-2000 from Cooper Power, USA
				ABB	Vadodara	A	FBT Device Model- SUE-3000 from ABB, Finland
				SEL	Delhi	A	FBT device Model- SEL-451 from SEL, USA
	LT Switchgear (item covered under proveness, sub-section A-1, Chapter-VI of tech spec)	1	5	L&T	Coimbatore	A@	@- subject to sub-QR clearance from Owner
				C&S Electric	Noida/Haridwar	A@	@- subject to sub-QR clearance from Owner
				Siemens	Mumbai	A@	@- subject to sub-QR clearance from Owner
				Schneider	Nashik	A@	@- subject to sub-QR clearance from Owner
				ABB	Bangalore	DR@	@- subject to sub-QR clearance from Owner
				Pyrotech	Udaipur	A@	@- subject to sub-QR clearance from Owner
				Tricolite	Manesar/Sahibabad	A@	@- subject to sub-QR clearance from Owner
				Nitya Electrocontrols	Noida	A@	@- subject to sub-QR clearance from Owner

Sl. No.	ITEM	QP / INS CAT.	QP No.	Subvendor proposed by M/s BHEL	PLACE	SC APPL STATUS	Remarks
				CONTROL & SCHEMATICS	Hyderabad	DR@	@- subject to sub-QR clearance from Owner
				GE Energy Services	Bangalore	DR@	@- subject to sub-QR clearance from Owner
				BHEL-EPD	Bangalore	DR@	@- subject to sub-QR clearance from Owner
	Battery charger (item covered under proveness, sub-section A-I, Chapter-VI of tech spec)	I	6	M/s Amararaja	Tirupati	A@	@- subject to sub-QR clearance from NTPC Engg
				M/s HBL- Power System	Hyderabad	A@	@- subject to sub-QR clearance from Owner
				M/s Chhabi electrical	Jalgaon	A@	@- subject to sub-QR clearance from Owner
				M/s. Chloride Power	Kolkata	A@	@- subject to sub-QR clearance from Owner
				M/s Vertiv Energy	Maharashtra	DR@	@- subject to sub-QR clearance from Owner
				M/s Mass Tech Controls	Jalgaon	A@	@- subject to sub-QR clearance from Owner
				M/s Statcon	Hapur	A@	Up to 220 V, 850 A , @- subject to sub-QR clearance from Owner
				M/s Dubas	Bangalore	A@	Up to 220 V, 800 A , @- subject to sub-QR clearance from Owner
				M/s Saft Nife Power Systems	Singapore	A@	@- subject to sub-QR clearance from Owner
				M/s Emerson	Ambernath	DR@	@- subject to sub-QR clearance from Owner
	Battery (Ni-Cd) (item covered under proveness, sub-section A-1, Chapter-VI of tech spec)	I	7	M/S HBL-Power System	Hyderabad	A@	Up to 990 Ah with conditions @- subject to sub-QR clearance from Owner
				M/S Amcosaft	Bangalore	A@	8Ah to 990Ah- KPH type 10Ah to 1365 Ah- KPM type 11Ah to 1550Ah – KPL type @- subject to sub-QR clearance from Owner
				M/s Hoppekke	Brilon, Germany	DR@	@- subject to sub-QR clearance from Owner
	Battery Lead Acid Plante (item covered under proveness, sub-section A-	I	8	M/s Exide	Kolkata	A@	@- subject to sub-QR clearance from Owner

THDC INDIA LTD.

9885/00/2022/PS-PEM-MAX

Sl. No.	ITEM	QP / INS CAT.	QP No.	Subvendor proposed by M/s BHEL	PLACE	SC APPL STATUS	Remarks
	1, Chapter-IV of tech spec)						
				M/s Hoppekke	Brilon, Germany	A@	@- subject to sub-QR clearance from Owner
	IEC 61850 compliant Numerical Protection Relays (item covered under proveness, sub-section A-1, Chapter-IV of tech spec)	I	9	SEL	Pullman, USA	A@	@- subject to sub-QR clearance from Owner
				T&D	Stafford, UK	A@	P14X, P34X, P44X, P64X, P74X models only., @- subject to sub-QR clearance from Owner
				ALSTOM T&D	Chennai	A@	P14X, P24X, P34X, P44X, P64X, P74X models only., @- subject to sub-QR clearance from Owner
				ABB	Finland	A@	@- subject to sub-QR clearance from Owner
				ABB	Baroda	A@	For 6XX Series, @- subject to sub-QR clearance from Owner
				GE Multilin	Zamudio, Vizcaya, Spain/ Markham, Ontario, Canada	A@	F-650 only, @- subject to sub-QR clearance from Owner
				Schneider	Stone, UK	A@	PX30, PX40, VAMP 5X and VAMP 2XX models only. , @- subject to sub-QR clearance from Owner
				Siemens	Germany	A@	7SX Series only @- subject to sub-QR clearance from Owner
				Siemens	Goa	A@	7SR2X , 7SJ66X series only @- subject to sub-QR clearance from Owner
	Numerical Relay Network Integration(item covered under proveness, sub-section A-	I	10	Main contractor approved sources		DR@	@- subject to sub-QR clearance from Owner

THDC INDIA LTD.

7146/90/2022/PS-PEM-MAX

Sl. No.	ITEM	QP / INS CAT.	QP No.	Subvendor proposed by M/s BHEL	PLACE	SC APPL STATUS	Remarks
	1, Chapter-IV of tech spec)						
	GI cable trays, fitting & accessories including bends	I	11	Inar Profiles Ltd	Enkapalli (Vishakhapatnam)	A	
				Vatco	Mumbai	A	Galvanization at Sigma Mumbai
				Indiana cable trays	Mumbai	A	Galvanization at Karamtara galvanizer- Mumbai
				Industrial Perforation	Kolkata	A	Galvanized and offered for inspection at M/s Industrial Perforation Pvt Ltd, Ganganagar , Kolkata, WB
				Ratan Projects	Howrah	A	Galvanization at DMP Projects- Howrah
				India Electric Syndicate	Kolkata	A	Galvanization at BMW Industries/B.P Projects- Howrah
				Steelite engg.	Mumbai	A	
				Premier Power Products	Howrah	A	Galvanising at Neha Galvaniser- Howrah
				Indiana Gratings	Pune	A	
				M.J. Engineering	Okhla/ Bhiwadi	A	
				T.R.G	Chennai	A	Galvanization at TM Radhakrishna Chetty & Co-Chennai
				Amtech	Pune	A	Galvanization at B.G. Shirke – Pune
				Kannade Anand Udyog	Mumbai	A	Fabrication at their units: Plot No. 42, Morivali, MIDC, District Thane & Plot No.: D-35 Anand Nagar MIDC, Addl. Ambernath , Dist.Thane Galvanization and offer the galvanized cable trays for inspection at D-34 Anand Nagar MIDC, Addl. Ambernath, Dist.Thane.
				Rukmani	Raipur	A	Ladder type cable trays only
				Passive Infra	Hasangarh (Rohtak)	A	
				Unitech Fabricators & Engineers	Howrah/ Hoogly	A	
				Patny System	Hyderabad	A	
				Rabi Engg	Kolkata	A	Galvanizing from OWNER approved sources
				Indmark Formtech Pvt. Ltd.	Pune	DR	
				Vinfab	Thane	DR	

PROJECT : 2X660MW KHURJA PACKAGE : Turbine Generator and Associated Packages Sub-package-HT & LT Switchgear , HT & LT busducts, lighting, cabling, earthing, DG Set, Solar CONT. NO. : THDC/RKSH/CC-9915-371	SUB- VENDOR LIST FOR ITEMS REQUIRING SUB-VENDOR / QUALITY PLAN APPROVAL	DOC NO. : THDC/RKSH/CC-9915-371 REVISION NO. 00 DATE : PAGE : 6 OF 11

Sl. No.	ITEM	QP / INS CAT.	QP No.	Subvendor proposed by M/s BHEL	PLACE	SC APPL STATUS	Remarks
				Maheshwari Electrical	Noida/Gaziabad	DR	
				EROS	Nagpur	DR	
				Advance Power products	Howrah	DR	
				Pentex	Palghar	DR	
	Cable tray flexible support system (GI)	I	12	Vatco	Mumbai	A	Galvanising at Sigma Mumbai
				Inar profiles	Enkapalli	A	
				Industrial perforations	Kolkata	A	
				Premier power products	Howrah	A	Galvanising at Neha Galvaniser- Howrah
				Steelite engg.	Mumbai	A	
				Indiana gratings	Pune	A	Galvanising at Poona Galvaniser- Pune
				Amtech	Pune	A	Galvanising at B.G. Shirke- Pune
				Ratan Projects	Howrah	A	Galvanization at OWNER approved sources
				Patny Systems	Hyderabad	A	
	Lead coated steel flexible conduits	II	13	Indmark Formtech Pvt. Ltd.	Pune	DR	
				Maheshwari Electrical	Noida/Gaziabad	DR	
				Saral Industries	Raebareli	DR	
				M/s PLICA	Ghaziabad	A	
				M/s Bansal Labs	Bhopal	A	
	Junction boxes / Link Boxes/ Test Link Box/ Adopter box, Switch Boxes, Pull Boxes (Hot Dip Galvanized)	III		Main contractor approved sources with galvanization from OWNER approved sources			
	FRP Junction boxes	II	14	Main contractor approved Sources			
	Cable termination kits & straight through jointing kit	I	15	M/s 3M Electro & Communication	Pune	A	up to 33 KV
				Raychem	Halol	A	Heat shrinkable type up to 33 KV

ANNEXURE III

FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

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.

(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.

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.

1.01.00 **Guarantees under Category-I**

1.01.01 The performance guarantees which attract liquidated damages are as follows:

(i) Turbine cycle heat rate at 100% TMCR load

Guaranteed Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 77 mmHg(abs) condenser pressure with zero make up at 660 MW load (i.e 100 % of rated load).

(ii) Turbine cycle heat rate at 55% TMCR load

Guaranteed Turbine Cycle Heat rate in Kcal/Kwhr under turbine throttle main steam pressure of 150 Kg/cm2(abs) and rated main steam and reheat steam temperature at 77 mmHg(abs) condenser pressure with zero make up at 363 MW load (i.e 55 % of rated load).

(iii)TG Output

Continuous TG output of 693MW unit load (i.e. 105% of rated load) under rated steam conditions at 77 mm Hg (abs) condenser pressure with 0% make-up.

(iv)Average Condenser Pressure

Average Condenser pressure in mm Hg (abs) measured at 300 mm above the top row of condenser tubes with 693 MW output, 0% make up, design CW temperature and design CW flow.

Note: (a) The condenser pressure measurement while conducting the guarantee tests from (i) to (iv) above shall be measured at 300 mm above the top row of condenser tubes.

(v) Auxiliary Power Consumption

Auxiliary Power Consumption at 100% TMCR (660MW) Unit Load.

The total auxiliary power consumption for all the Turbine Generator auxiliaries and turbine cycle equipments and other common auxiliaries required for continuous unit operation at 660 MW (i.e 100% rate load) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up shall be guaranteed in line with the requirements stipulated in Clause 1.01.03 of this Sub-Section.

Note: Power consumption of each of the pump/fan/compressors etc. wherever mentioned shall be measured with its own drive at the switchgear end.

1.01.02 **AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY-I GUARANTEES**

If the performance guarantee(s) are not met by the Contractor during PG Test, suitable action plan with implementation schedule shall be submitted by the Contractor within 90 days of PG Test evaluation, else it will be concluded that, the equipment has failed to meet the guarantee(s) and action shall be taken as per the Contract Requirement. If the performance guarantee(s) specified at clause 1.01.01 are not met by the Contractor even after the modifications and/or replacements mentioned at clause 1.00.01 (e) of this Sub-section but are achieved within the stipulated Acceptable Shortfall Limit as indicated in this clause, Employer will accept the equipment/system/plant after levying liquidated damages as indicated here under, however, if the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, the Employer may at his discretion reject the equipment/system and recover the payment already made or accept the equipment/system only after levying liquidated damages against the Contractor, at the rates listed herein, and such liquidated damages shall be deducted from the Contract Price:

Sl. No.	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD	Upper Limiting Value
i)	For Increase in the Guaranteed Turbine Cycle heat rate in Kcal/Kwhr at	US $ 722,311 (US Dollar Seven Hundred Twenty Two Thousand	(+) 1% of the Guaranteed turbine cycle heat rate.	1795 Kcal/Kwhr

	660MW under rated steam conditions at 77 mmHg(abs) condenser pressure with zero make up	Three Hundred Eleven only) per 1 Kcal/Kwhr increase in Turbine Cycle heat rate		
ii)	For Increase in the Guaranteed Turbine Cycle Heat rate in Kcal/Kwhr under turbine throttle main steam pressure of 150 Kg/cm2(abs) and with rated steam temperature at 77 mmHg(abs) condenser pressure and zero make up at 363 MW	(**US $ 118,665** (US Dollar One Hundred Eighteen Thousand Six Hundred Sixty Five only) per 1 Kcal/Kwhr increase in Turbine Cycle heat rate	(+) 1% of the Guaranteed turbine cycle heat rate.	1905 Kcal/Kwhr
iii)	For deficiency in Continuous TG output of 693 MW unit load (i.e 105% of rated load) under rated steam conditions, 77 mmHg (abs) condenser pressure with 0% make-up	**US $ 2112** (US Dollar Two Thousand One Hundred Twelve only) per 1 KW shortfall in TG output	(-) 2.0% of the guaranteed turbine generator output.	
iv)	For deficiency in Average Condenser pressure in mm Hg(abs) measured at 300mm above top row of	**US $ 803,860** (US Dollar Eight Hundred Three Thousand Eight Hundred Sixty only) per 1 mm Hg increase in	(+) 2.5% of the guaranteed average condenser pressure	65mm Hg(abs)

	condenser tube at 693 MW, 0% makeup, design CW temperature and design CW flow.	condenser pressure		
v)	For increase in the Auxiliary power consumption in KW for the turbine generator auxiliaries and turbine cycle equipments and other common auxiliaries required for continuous operation at 100% TMCR i.e. 660 MW unit load.	**US $ 5,676** (US Dollar Five Thousand Six hundred and seventy six only) per 1 KW increase in Auxiliary Power Consumption.	(+) 1% of the guaranteed auxiliary power consumption	4200 KW
vi)	**Solar PV Module / Plant**	As per formula for calculating Applicable LD **(Refer: Clause 1.01.05)**		

NOTE :

i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.

ii) If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract.

iii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC)

iv) Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price.

v) The LD values and acceptable shortfall limits are applicable on per unit basis . The liquidated damages shall be prorated for the fractional parts of the deficiencies

vi) Bidder shall be required to confirm meeting the specified limiting values. Bids not conforming to the above shall be liable for rejection.

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)

(a) Turbine Unit Oil purifier.

(b) Turbine Unit control oil purifier.

(c) Electric oil heater for turbine lube oil tank (rated power shall be considered).

(d) Feed and discharge pumps of turbine oil purification system.

(e) Main turbine Condenser air evacuation pumps.

(f) Main turbine Condenser tube cleaning system pumps.

(g) Condensate extraction pumps.

(h) Drip pump (if envisaged).

(i) Oil purifiers of 2x50% TDBFPs and their feed and discharge pumps.

(j) Lube oil pumps of 2x50% TDBFPs and the electrical oil heater for lube oil.

(k) Auxiliary oil pump for MDBFP.

(l) Oil pumps for HP-LP bypass system.

(m) Motor Driven Boiler Feed Pump

(For this purpose only 15% of the deemed power consumed by the MDBFP and MDBP at design point as determined during shop test shall be considered).

(n) DM Cooling (normally working) Water pumps to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling (Unit auxliaries) water system.

(o) Auxiliary Cooling (normally working) water(ACW) pumps to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system.

(p) Power consumption of fans of Air washer units for TG building at its rated duty point.

(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.

2. Power consumption at rated duty point sl. no- (m) and (n) to be arrived at based on shop test.

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.

1.01.04 **HEAT RATE**

Turbine Cycle Heat Rate shall be calculated as follows & indicated in all computed heat balance diagrams:

$$\text{HEAT RATE} = \frac{M1\,(H1-h1) + M2\,(H3-H2) + Mis\,(h1-his) + Mir\,(H3 - hir)}{Pg}$$

The expression "Mis (h1-his)" in the numerator of the formula is not applicable if spray water to superheater is completely internal to the boiler (i.e. tapped from a location downstream of economizer inlet).

Where,

M1 - Quantity of live steam entering the turbine stop valve including any live steam supplied to valve stems, or glands etc. in Kg/hr.

M2 - Quantity of steam from turbine to reheater in Kg/hr.

Mir - Quantity of desuperheating water flowing into reheater system for regulation of steam temperature in Kg/hr.

Mis - Superheater desuperheating spray flow in Kg/hr.

H1 - Enthalpy in kcal/kg of live steam.

H2 - Enthalpy in kcal/kg of steam to reheat.

H3 - Enthalpy in kcal/kg of reheated steam.

h1 - Enthalpy of feed water in kcal/kg at the downstream of the junction of feed flow and bypass flow of HP heaters.

hir - Enthalpy of desuperheating water flowing into reheat system in Kcal/Kg.

his - Enthalpy of superheater desuperheating spray water in Kcal/Kg.

Pg - TG output after deducting the power consumption by auxiliaries as listed below and the same shall be 660MW, and 363MW respectively for 100%, and 55% TMCR unit load:

(a) Power taken by Excitation system (KW) including transformer losses, as applicable for various guarantee points, (The transformer losses at various points shall be based on factory test to be conducted).

(b) Power required for ventilation of oil and control fluid tanks, if ventilating fans are separately driven (KW).

(c) Power required for lubrication, if lubricating pumps are separately driven (KW).

(d) Power required for control fluid pumps, if control fluid pumps are separately driven (KW).

(e) Power required for hydrogen, seal oil auxiliaries, if separately driven (KW).

(f) Power required for stator water cooling system, if cooling pumps are driven separately (KW).

(g) Power required, for Gland steam exhauster (GSC), if GSC are separately driven(KW).

It may be noted that the heat balance diagrams and guarantees shall be furnished considering zero spray water quantity for superheater and reheater spray. During Performance Guarantee Testing, in case water is required for superheater and/or reheater temperature control, the contractor shall be entitled to heat rate correction as per correction curves to be submitted by him with his offer.

1.01.05 **PERFORMANCE GUARANTEE TEST FOR ROOFTOP SOLAR PV**

The performance Guarantee (PG) Test shall be carried out after successful commissioning of all solar rooftop locations. PG Test shall be carried out on any rooftop location by measuring Performance Ratio (PR) and comparing to the Guaranteed PR. The test shall be repeated for each location having inverter of having different make or type of control. In case there are more than one rooftop having similar inverter, the test rooftop shall be decided based on mutual consent. The mathematical formula for calculating PR is given below:

$$PR\ (\%) = \frac{\text{AC Yield(KWh)}}{\text{Installed Capacity(kWp)} \times \text{Global Inclined Insolation(kWh/m2)}} \times 100$$

For the purpose of measuring Global Inclined Insolation (GII), another pyranometer shall be installed on returnable basis, mounted at the plane of the module as per specifications mentioned in clause 10.2 of technical requirements of Solar PV Rooftop , at free of cost.

Bidder also to install Single Quadrant type of 0.2s accuracy energymeter. This meter shall have a provision of storing 15 min Net MWhr in a register for minimum 40 days and Cumulative Net MWH at every midnight for 10 days.

Both the additional supplied items i.e. pyranometer and energymeter shall be returnable basis and free of cost.

The PR measured on site will be compared with the Guaranteed PR as indicated below

Month	Guaranteed PR*
January	83.09%
February	81.85%
March	79.31%
April	76.48%
May	74.63%
June	74.44%
July	75.89%
August	76.49%
September	76.60%
October	77.72%
November	80.18%
December	82.43%
Average(PRYearly)	78.26%

Note:*If the PG test is done on the Rooftop of the building without isolation transformer the guaranteed PR to be increased by 2.5% for the considered month.

Yearly solar Insolation of the site=1825 kWhr/ m2 (as per Meteonorm)

- Measuring instruments to record on site data will include a pair of pyranometers (horizontal and inclined with sensitivity of 7µV/(W/m2), temperature sensor, signal converter.
- The Bidder will be responsible to conduct the PG test only after achieving the physical completion and synchronization of the plant and complying the relevant requirements from utility.

- The PG test will be conducted for durations in which irradiance level is greater than 750 W/m2and the test will continue until a total horizontal radiation of 5 kWh/m2 has been achieved. The data will be recorded at 15 minute intervals for validating the PR values guaranteed by the contractor against the value mentioned in the above for that month. In case of destruction due to any component failure, entire test will be repeated.
- The PR values shall be computed based on actual energy exported to the grid at the output of isolation/step-up/step-down transformer.

If failed to achieve the guaranteed performance levels, the contractor will at its own cost rectify all the defects identified during the test and take necessary steps/efforts to pass the PR test within the stipulated time span. Subsequent to rectification the PR will be restarted.

During PG test, if there is a grid outage, those time slots will not be considered

If the values are again below the guaranteed performance levels, contractor will be liable to pay Liquidated Damages (LD) to NTPC which shall be calculated as follow,

Shortfall of Performance Ratio,

Measured Insolation during test period at horizontal plane= GHITest= 5kWhr/m2

Yearly solar Insolation of the site=1825 kWhr/m2(Total Yearly GHI of site as per Meteonorm)

Short fall in PR(%)=ΔPR=Target PR-Achieved PR

Shortfall in Generation=ΔE =(ΔPR/Achieved PR))x measured Generation

Yearly shortfall in Generation (ΔEYearly =ΔE X (1825/5)x (78.26)/(PRmonth)

Applicable L.D= R x ΔEYearly

Where

R= Rate of LD= $0.95/kWhr

A Sample Calculation for 500 kW Capacity of Plant Rooftop solar PV

Month of performance of Guaranteed PR=September

Performance ratio of the month(PRmonth)=76.60

Capacity of the plant=625 kW

Yearly Average targeted Performance Ratio(PRavg)= 78.26%

Global Horizontal Insolation of Site(GY)=1825 kWhr/m2-year

Measured Global Horizontal Insolation- GHITEST=5 kWhr/m2

Measured Global Inclined Insolation- GIITEST=5.60 kWhr/m2

Capacity of the plant where PG test be conducted=500 kW

Metered Generation corresponding to radiation>750 W/m2=2116 kWhr

Measured PR=2116 × 100/(500x 5.6)=75.6%

Shortfall in PR=76.6-75.6%=1%

Shortfall in Generation for test period=(1/75.6)x2116= 28.0 kWhr

Yearly Shortfall in Generation=28.0 x (1825/5) x 78.26/76.6=10441.5 KWhr

Applicable LD= R X ΔEYearly =0.95x 10441.5 = $ 9,919.4/-

Applicable LD for complete plant =(625/500)× 9,919.4=$ 12399.3

1.02.00 **GUARANTEES UNDER CATEGORY - II**

NIL

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.

1.03.02 **Turbine hall and other EOT Crane:**

Over load test, travel & hoist speed checks etc., shall be demonstrated as per IS: 3177 (latest edition).

1.03.03 **Equipment Cooling Water System**

i) Vibration, noise and parallel operation without hunting & abnormal noise and with flow sharing within 10% of each other at the rated duty point shall be demonstrated at site.

(ii) Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site too.

1.03.04	**Condensate Polishing Unit** Effluent quality at outlet of each vessel at its rated design flow and design service length between two regenerations (as defined elsewhere).
1.03.05	**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.
1.03.06	**Ventilation System** **A. Following shall be demonstrated at Shop** 1) Capacity and discharge pressure of pumps of air washer units at its rated duty point of Ventilation system. 2) Capacity and static pressure of air washer unit fans, roof exhausters of TG building at its rated duty point of Ventilation system. **B. Following shall be demonstrated at Site** 1) Vibration & Noise level of centrifugal fans & pumps of air washer units.
1.03.07	**EOT, HOT Cranes & Monorail Hoist :** Over load tests, travel and hoist speed checks as per relevant Indian standard IS (latest edition).

1.03.08	**Passenger Lifts for TG Building & Service Building :** Over load tests, travel and hoist speed checks.
1.03.09	**Civil Works:** (i) Performance guarantee for Machine Foundations: For the following machine foundations, wherever designed without Vibration Isolation System (VIS), bidder has to furnish extended warranty of five (05) years for satisfactory static and dynamic performance of the foundation system. a) TG foundation b) TDBFP and MDBFP foundations (ii) Performance guarantee for Acid/Alkali resistant linings: The contractor shall furnish a performance guarantee for the Acid/Alkali resistant linings for a period of three(03) years from the date of completion of work or date of handing over whichever is later. (iii) Any defect observed during the guarantee period shall be made good by the contractor by re-carrying out/replacing or by rectifying (if the defect is localised) the acid-alkali resistant lining to the entire satisfaction of the Employer without any extra cost.
1.03.10	Fire Detection and Protection System a) Following shall be demonstrated at Site i) Performance test of Inert gas extinguishing system of CR, CER, UPS & Battery Charger Rooms, etc. and fire detection and alarm system as per the design parameters/ standards/TAC. b) All tests as required by the TAC.
1.03.11	The plant shall be designed to operate continuously under two shift and cyclic modes. The design would cover adequate provision for quick startup and loading of the units to full load at a fast rate. The unit shall have minimum rate of loading or unloading of 5% per minute above the control load (i.e. 50% MCR). **Plant shall be capable of minimum N1 number of daily load cycles (N1 shall not be less than 2), i.e. load variation from 100% to 50 % (and vice versa) of MCR without affecting the design life of turbine systems. In addition, the plant shall also be capable of minimum N2 number of daily load cycling (N2 shall not be less than 1) from 50% to 30% (and vice versa) of MCR with a minimum ramp rate of 3% per minute without affecting the design life and turbine systems. Bidder shall fill the values of N1 and N2 in Attachment 8 and shall demonstrate the same during initial operation.** The main plant and its auxiliaries with their controls would be designed to permit operation of the units on house load without there being any necessity to shut down the units in the event of sudden loss of total load due to tripping of transmission

	lines or any other grid disturbances. The design of the plant equipments and control system would permit participation of the plant in automatic load frequency control.
2.00.00	**PERFORMANCE GUARANTEE / ACCEPTANCE TEST**
2.01.01	**Test Interruptions** In the event of a test interruption resulting from an Event of Force Majeure or Employer-Caused-Delay, Contractor shall be entitled to relief as provided in the contract, provided that, the interrupted Performance Test must be started again and test data that were collected/recoreded during the interrupted test must be ignored.
2.02.00	**Turbine Generator Performance/ Acceptance Test**
2.02.01	Performance test for the turbine generator set will be conducted in accordance with the latest edition of ASME PTC-6. Such test shall be binding on the parties to the contract to determine compliance with the guaranteed heat balance conditions at 660 MW (100% TMCR) and 363 MW (55% TMCR) unit output corresponding to the conditions stipulated under Cl. 1.22.01 of Sub-section- A-3 (Turbine Generator and Auxiliaries), Part-B. Power consumed by the auxiliaries mentioned under clause 1.01.03 of this Sub-section which is to be deducted from electrical power generated, shall be measured during the performance / Acceptance Test. Wherever the measurement is not possible, design values of power consumption by an auxiliary shall be considered.
2.02.02	The essential mandatory requirements for instruments, methods and precautions to be employed shall be in accordance with the requirements specified in the respective codes. All the necessary instruments (in duplicate) required for the tests shall be furnished by the contractor so as to meet the accuracies specified in the codes. Any advanced class instrument system such as those using electronic devices or mass flow technique shall be arranged by the contractor, if required. For determination of primary flow to the turbine, a calibrated low Beta-ratio throat-tap nozzle assembly including required machined straight lengths meeting the requirement of ASME PTC-6 shall be provided. The test procedures, Calibration Standards, Calibration procedures etc., shall be subject to Employer's approval. All the instruments including the flow nozzle shall be calibrated by the contractor before ~~and~~ initial operation in a reputed international institute as approved by the Employer. These calibrations shall be performed in the presence of the Employer. All calibrations reports shall be made available prior to the start of the initial operation and calibration certificates in original submitted to Employer for Employer's approval in order to have enough time for any rectification(if required). The instruments shall be sealed after calibration by calibrating lab. The percentage calibration error/deviation should not be more than accuracy class of the instrument. Calibration low beta ratio throat tap nozzle assembly including flow straightener, upstream and down stream machined straight lengths, for main condensate flow measurements shall be as per ASME PTC6. All instruments including flow nozzles as necessary for conductance of PG tests shall be installed prior to the start of initial operation. Secondary flow devices shall be calibrated flow nozzle / orifice plate as per ASME-PTC 19.5.
2.02.03	Corrections to the test results for steam turbine shall be applied as per the correction curves listed in detailed technical specification Part-B. When the system is properly isolated for a

	performance test, the unaccounted for leakages should not be more than 0.1% of the design throttle flow at that load. To achieve the above value of unaccounted for leakages, the Bidder shall prepare the unit before start of initial operation. However, during the test, if it is found that the unaccounted for leakage is more than 0.1% of design throttle flow at that load, then heat rate will be increased by an amount equal to half the difference between actual unaccounted for leakage expressed as percentage of design throttle flow at that load and 0.1% (allowed by the code). If the unaccounted leakage during the test shall be more than 0.3 % of design throttle flow at that load and appreciable leakage is visible in Boiler area, mutual agreement shall be made regarding consideration of excess leakage in the calculation of test results.
2.02.04	The performance guarantee test will be carried out along with the initial operation. Ageing allowance will be given during evaluation of PG test results and hence guaranteed heat rates shall be increased by the amount calculated as per the formula given in Cl. No. 3.07, Sub-Section-3 of ASME-PTC-6 Report 1985 (Reaffirmed 1991). Period of ageing shall be considered from the date of first synchronization to the date of conductance of PG test. In calculating the above factor any period(s) during which the turbine has not been in operation at a stretch for more than a week shall not be considered.
2.02.05	The tests shall be arranged in a manner that the EMPLOYER's operation is not disrupted. Duplicate test runs shall be performed at,660 MW and 363 MW unit loads. The results of corrected heat rate shall agree within 0.25%. If they differ by more than 0.25%, third test shall be run at the same point. The corrected result of any one of the three test runs, which deviates from the corrected averaged result of all the runs by more than 0.25%, shall be eliminated; otherwise the results of all the three tests runs shall be accepted.
2.02.06	During Performance/ Acceptance test, following tests shall be carried out for T.G. set with test grade instruments as per ASME code. (i) Guarantee Turbine Cycle Heat rate test at 660MW (100% rated load) corresponding to the heat balance diagram specified in Sub-Section-A-3, Part-B, Section-VI. (ii) Guarantee Turbine Cycle Heat rate test at 363MW corresponding to the heat balance diagram specified in Sub-Section-A-3, Part-B, Section-VI. (iii) Guarantee Output test of 693 MW (105% rated load) corresponding to the heat balance diagram specified in Sub-Section-A-3, Part-B, Section-VI.
2.02.07	Performance test for the condensers will be conducted in accordance with the latest edition of ASME PTC-12.2 with the exception at (a) mentioned below : (a) Condenser pressure will be measured at 300 mm above the top row of tubes under VWO conditions, 0% make-up and design C.W. flow & design temperature. The condenser pressure shall be measured with a vacuum grid utilising ASME basket tips. The grid is fitted at 300 mm above top row of condenser tubes.

(b) Combined pressure drop in condenser tube, waterbox, and inlet and outlet piping will be measured in between intake and discharge point of the C.W. system at BIDDER'S terminal points with cleanliness factor of 0.9 and COLTCS in service.

2.03.00 **Test Reports**

The Contractor shall prepare test reports in which the methods followed, instrument readings, graphs, observations, final results obtained online, etc., shall be recorded.

Four (4) hard copies and 2 soft copies on CD –ROM of each test report shall be submitted to Employer for Approval.

2.04.00 Performance Guarantee/ Acceptance Tests on the equipments / systems not covered in this Sub-section shall be carried out as per the procedure/ test codes/ specified in respective detailed specifications/ Sub-sections in Section VI, Part-B.

ANNEXURE IV

DRAWING/DOCUMENTS REQUIRMENT & DISTRIBUTION SCHEDULE

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

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

Every revised submission incorporating BHEL/Customer comments shall be resubmitted within 7 days by bidder.

Bidder to further note that the submitted drawings/ revised drawing, should be complete in all respects. 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's / Customer's office for across the table discussions/ finalizations/ submissions of drawings.

- (a) List and schedule of drawings/documents to be submitted after award of contract shall be as per MDL.

- Bidder to note that drawings/documents submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drawings/documents approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.
  - Internet explorer version – Minimum Internet Explorer 7
  - Internet speed – 2 mbps (Minimum preferred)
  - Pop ups from our external DMS IP (124.124.36.198) should not be blocked
  - Vendor's internal proxy setting should not block DMS application's link
    - (http://124.124.36.198/wrenchwebaccess/login.aspx)
  - DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
  - For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

- Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/Customer consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/Customer.

- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.

- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.

- Editable copy of all the drawings and documents shall be provided.

- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copes whichever is later.

- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.

- Vendor to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.

- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.

- Bidder to also furnish the auto cad copy/MS-Excel/MS-word (as applicable) of the following documents after award of contract. However, any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL and customer will also be submitted by the bidder without any delivery and commercial implication to BHEL and customer.

  - P&IDs.
  - Equipment lay out.
  - Equipment Cable tray layout.
  - Civil assignment drawings.
  - Piping layout drawing.

Other requirements

- Engineering for this project is to be carried out in Integrated Intelligent Engineering environment at BHEL end. The engineering platform on which BHEL is doing the project is based on Smart Plant Suite. This is being done to have automated interface checking and thereby minimising rework at site. The engineering for packages placed in TG Hall will essentially be done using Intelligent P&ID, Intelligent Electrical, Intelligent Instrumentation and 3D modelling. For other BOPs i.e. those outside TG hall, though the same level of integration is preferable but 3D modelling is necessarily to be done and review model in compatible format is to be provided to BHEL on stages to be agreed.

Hence in line with above, bidder is required to prepare PIDs, Electrical drawings and all layout drawings using intelligent software with capability for transfer of data to and from corresponding Software being used by PEM.

- The data of models of facilities will be made available to BHEL as per the BHEL schedule for importing into BHEL model for interface checking and raising of integrated plant model. Layout and PID/electrical drawings will be extracted from the model.

- Standard write up on format compatibility of the BHEL's engineering platform for this project is attached as File formats supported by SPPID, SPI, SPEL & SP3D (Refer Section-D1).

- **e-Learning Package/ Module:**

E-learning packages shall be supplied for the equipment / system for the complete system along with associated electrical and C&I system. Bidder to refer Section-II for detail.

- Data/Reports other than listed drawings/documents will also be made available to BHEL as and when required for import into BHEL model.

- Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system 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.

- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.

	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001
		VOLUME II-B
		SECTION-
		REV. NO. 00 / DATE:

MASTER DRAWING LIST OF EFFLUENT TREATMENT PLANT

Sl No	DOCUMENT / DRAWING NO.	DRAWING / DOCUMENT TITLE	SCHEDULE OF SUBMISSION FROM LOI
	MECHANICAL		
1.	PE-V6-475-673-A001*	P&ID FOR EFFLUENT TREATMENT SYSTEM	4
2.	PE-V6-475-673-A002*	PIPING LAYOUT OF EFFLUENT TREATMENT SYSTEM	4
3.	PE-V6-475-673-A003*	SIZING CALCULATIONS AND PRESSURE DROP CALCULATIONS FOR ETS	4
4.	PE-V6-475-673-A004*	SUB VENDOR LIST AND INSPECTION CRITERIA	4
5.	PE-V6-475-673-A005	TECHNICAL DATA SHEET AND GA DRG OF PUMPS ALONG WITH MOTOR	8
6.	PE-V6-475-673-A006	DATASHEET AND GA DRG OF VALVES	10
7.	PE-V6-475-673-A007	VALVE SCHEDULE	10
8.	PE-V6-475-673-A008	PIPING SCHEDULE	10
9.	PE-V6-475-673-A009	PAINTING SCHEDULE	10
10.	PE-V6-475-673-A010	MECHANICAL GA DRG OF SUMPS	12
11.	PE-V6-475-673-A011	O& M MANUAL	20
12.	PE-V6-475-673-A012	GA AND DATASHEET OF CHAIN PULLEY BLOCK	10
13.	PE-V6-475-673-A013	GA AND DATASHEET OF OIL SKIMMERS	10
	ELECTRICAL		
14.	PE-V6-475-673-A014	ELECTRICAL LOAD LIST	10
15.	PE-V6-475-673-A015	CABLE TRAY/TRENCH & CONDUIT ROUTING DIAGRAM INCLUDING JB LOCATION OF EFFLUENT TRANSFER SYSTEM	12
16.	PE-V6-475-673-A016	EARTHING DETAIL OF EFFLUENT TRANSFER SYSTEM	12
	CONTROL AND INSTRUMENTATION		
17.	PE-V6-475-673-A017	INSTRUMENT SCHEDULE	10
18.	PE-V6-475-673-A018	DATASHEET OF LOCAL INSTRUMENTS	10

19.	PE-V6-475-673-A019	DATA SHEET AND GA FOR LCP	10
20.	PE-V6-475-673-A020	CABLE SCHEDULE AND INTERCONNECTION DIAGRAM	12
21.	PE-V6-475-673-A021	INSTRUMENT INSTALLATION DRAWINGS/ HOOK UP DIAGRAM FOR INSTRUMENTS	12
	QAP		
22.	PE-V6-475-673-A022	QAP FOR PUMP	9
23.	PE-V6-475-673-A023	QAP FOR VALVES	9
24.	PE-V6-475-673-A024	QAP FOR MS PIPES	9
25.	PE-V6-475-673-A025	QAP FOR OIL SKIMMER	9
26.	PE-V6-475-673-A026	QAP FOR CHAIN PULLEY BLOCK	9
27.	PE-V6-475-673-A027	QAP FOR LCP	9
	MANDATORY SPARE		
28.	PE-V6-475-673-A028	MANDATORY SPARES LIST FOR EFFLUENT TRANSFER SYSTEM	14

*BASIC ENGINEERING DOCUMENTS

DRAWING/DOCUMENTS DISTRIBUTION SCHEDULE

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents		
	First submission and submission with major changes		
	▪ Layout (A0&A1 sizes)	4	-
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-
	▪ P&ID (All sizes)	4	-
	a) Final drawings/documents (Directly to site)	6	2
	b) "As Built" Drawing/Documents (Directly to site)	6	2
	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2
2	Erection Manual (Directly to site)	4 sets	2
3	Operation & Maintenance manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2
4	Plant Hand Book i) First Submission	1	1
5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	--
	ii) Approved Copies (Direct to Site)	4 sets	2
7	Project Completion Report (Directly to site)	6 sets	2
8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	--
9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	--
10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment	1	--
	ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2
11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment	1 set	--
	ii) Approved copies (Direct to Site)	4 sets	2
12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2

Note:

- Quantity of prints may change during detailed engineering stage based on BHEL / Customer requirement. However, the same will be adhered by the bidder without any delivery/commercial implication to BHEL.

- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.

- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.

- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copes whichever is later.

- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.

- Bidder has to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.

- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.

- Bidder to also furnish the auto cad copy / MS-word (as applicable)/MS-Excel (as applicable) of the following documents after award of contract. However, any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL / customer will also be submitted by the bidder without any delivery/commercial implication to BHEL.

    - P&IDs.
    - Equipment lay out
    - Equipment Cable tray layout
    - Equipment earthing layout
    - Civil scope drawings.
    - Piping lay out drawing
    - Valve schedule.
    - Instrument schedule.
    - Any Other Dwg/Docs as required.

ANNEXURE V

MANDATORY SPARES

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

S. N.	DESCRIPTION	UNIT	QTY
1	**Low Pressure Piping**		
a)	Valves up to size 250 NB (Population= All Units)	Set	5% of the total population of each type, size and class OR minimum 3 nos. of each type size & class whichever is more

Note:

1. Refer Section IIA (Mandatory Spares) for general requirements and interpretation of various terms and conditions.
2. In case the main population of any item is only one no., then the spare quantity shall also be one no.
3. Wherever the quantity is given only in percentage, the spare quantity shall be distributed into various ranges/size/rating/type (as the case may be) in the same proportion of the main population. For the quantities coming less than 1, shall be treated as 1 only.
1. Identification: Each spare shall be clearly marked and labelled 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.
2. If there is one no valve only of particular type, class and size then only one no is required
4. Wherever valves are specified as mandatory spare, complete valve along with actuator and all other accessories which are the part of original supply shall also be supplied.

985102/2022/PS-PEM-MAX

DATASHEET–A

DATASHEET–A

Sl. No.					
1.0	**EFFLUENT SUMPS**				
1.1	**Description**	**BFP-A Unit 1 Pit**	**BFP-B Unit 1 Pit**	**BFP-A Unit 2 Pit**	**BFP-B Unit 2 Pit**
i)	Effective Capacity, m^3	1	1	1	1
ii)	MOC	RCC			
iii)	Type	Underground, Rectangular with Flat bottom			
iv)	Fluid Handled	Oily effluent from BFP Area (No floor wash to be considered)			
1.2	**Description**	**TG Area Sump A Unit-1**	**TG Area Sump B Unit-1**	**TG Area Sump A Unit-2**	**TG Area Sump B Unit-2**
i)	Effective Capacity, m^3	12	12	12	12
ii)	MOC	RCC			
iii)	Type	Underground, Rectangular with Flat bottom			
iv)	Fluid Handled	• Oily effluent from BFP Area • Equipment & Process Drain • Floor wash water • COT/DOT wash water (For TG Area unit-2)			
v)	Oil Skimmers	Oil skimmers to be provided for Each Sump			
1.3	**Description**	**Transformer yard pit Unit-1**		**Transformer yard pit Unit-2**	
i)	Effective Capacity, m^3	100		100	
ii)	MOC	RCC			
iii)	Type	Underground, Rectangular with Flat bottom			
iv)	Fluid Handled	Oily waste Transformer Yard			
v)	Oil Skimmers	Oil skimmers to be provided for Each Sump			
1.4	**Description**	**CW Pit Unit-1**	**CW Pit Unit-2**	**Atm Flash Tank Unit-1**	**Atm Flash Tank Unit-2**
i)	Effective Capacity, m^3			10	10
ii)	MOC	RCC			
iii)	Type	Underground, Rectangular with Flat bottom			
iv)	Fluid Handled	CW Waste water	CW Waste water	Effluent from ATM flash tank	Effluent from ATM flash tank
	Description	**COT/DOT Area Pit**			
i)	Effective Capacity, m^3	1			
ii)	MOC	RCC			
iii)	Type	Underground, Rectangular with Flat bottom			
iv)	Fluid Handled	Waste water from COT/DOT			

2.0	**EFFLUENT TRANSFER PUMPS**				
2.1	**Description**	**BFP-A Unit 1 Waste Water pumps**	**BFP-B Unit 1 Waste Water pumps**	**BFP-A Unit 2 Waste Water pumps**	**BFP-B Unit 2 Waste Water pumps**
i)	Number required	Two (1W+1S)	Two (1W+1S)	Two (1W+1S)	Two (1W+1S)
ii)	Rated capacity, m^3/ hr	2	2	2	2
iii)	Type	Horizontal Screw type			
iv)	Location	Outdoor			
i)	Fluid to be handled	Oily effluent from BFP area			
ii)	Duty	Intermittent			
iii)	Pump Speed, RPM	1500			
iv)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements			
v)	Material of Construction				
vi)	Casing	2.5% Ni CI IS:210 GR. FG 260			
vii)	Impeller/Rotor	ASTM A351 CF8M			
viii)	Shaft	SS 316			
2.2	**Description**	**TG Area Sump A Unit-1 Waste Water pumps**	**TG Area Sump B Unit-1 Waste Water pumps**	**TG Area Sump A Unit-2 Waste Water pumps**	**TG Area Sump B Unit-2 Waste Water pumps**
i)	Number required	Two (1W+1S)	Two (1W+1S)	Two (1W+1S)	Two (1W+1S)
ii)	Rated capacity, m^3/ hr	40	40	40	40
iii)	Type	Vertical Screw type			
iv)	Location	Outdoor			
i)	Fluid to be handled	• Oily effluent from BFP Area • Equipment & Process Drain • Floor wash water • COT/DOT wash water (For TG Area unit-2)			
ii)	Duty	Intermittent			
iii)	Pump Speed, RPM	1500			
iv)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements			
v)	Material of Construction				
vi)	Casing	2.5% Ni CI IS:210 GR. FG 260			
vii)	Impeller/Rotor	ASTM A351 CF8M			
viii)	Shaft	SS 316			
2.3	**Description**	**Transformer yard pit Unit-1 Waste Water pumps**	**Transformer yard pit Unit-2 Waste Water pumps**		
i)	Number required	**Two (1W+1S)**	**Two (1W+1S)**		
ii)	Rated capacity, m^3/ hr	60	60		
iii)	Type	Vertical Screw type			
iv)	Location	Outdoor			

i)	Fluid to be handled	Transformer Yard			
ii)	Duty	Intermittent			
iii)	Pump Speed, RPM	1500			
iv)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements			
v)	Material of Construction				
vi)	Casing	2.5% Ni CI IS:210 GR. FG 260			
vii)	Impeller/Rotor	ASTM A351 CF8M			
viii)	Shaft	SS 316			
2.4	**Description**	**CW Pit Unit-1 Waste Water pumps**	**CW Pit Unit-2 Waste Water pumps**	**Atm Flash Tank Unit-1 Waste Water pumps**	**Atm Flash Tank Unit-2 Waste Water pumps**
i)	Number required	Two (1W+1S)	Two (1W+1S)	Two (1W+1S)	Two (1W+1S)
ii)	Rated capacity, m^3/ hr	40	40	15	15
iii)	Type	Vertical Submersible type			
iv)	Location	Outdoor			
i)	Fluid to be handled	CW Waste water	CW Waste water	Effluent from ATM flash tank	Effluent from ATM flash tank
ii)	Duty	Intermittent			
iii)	Pump Speed, RPM	1500			
iv)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements			
v)	Material of Construction				
vi)	Casing	2.5% Ni CI IS:210 GR. FG 260, S-0.1 (max.) P-0.15 (max.)			
	Stuffing box, Gland	2.5% Ni CI IS:210 GR. FG 260			
vii)	Impeller/Rotor	ASTM A351 CF8M			
viii)	Shaft, Shaft coupling, shaft sleeves	SS 410			
ix)					
x)	Column pipe & discharge pipe, shaft enclosing	CS as per IS:2062 or eq.			
xi)	Gland packing	TIWA			
xii)	Gasket	Neoprene Rubber			
xiii)	Bolts & nuts	SS for coming in water contact else CS			
xiv)	Base plate and soleplate	CS (min. 10 thick)			
2.4	**Description**	**COT/DOT Area Waste Water pumps**			
i)	Number required	Two (1W+1S)			
ii)	Rated capacity, m^3/ hr	2			
iii)	Type	Vertical Screw type			
iv)	Location	Outdoor			
i)	Fluid to be handled	COT/DOT Area Waste Water			

ii)	Duty	Intermittent
iii)	Pump Speed, RPM	1500
iv)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
v)	Material of Construction	
vi)	Casing	2.5% Ni CI IS:210 GR. FG 260
vii)	Impeller/Rotor	ASTM A351 CF8M
viii)	Shaft	SS 316
3.0	**Chain Pulley Block**	
i)	Chain Pulley Block	Two (2) No of Chain Pulley Block shall be provided for (One for each Unit) for maintenance of pumps and equipment.

For piping and valves specification bidder to refer specification of LP PIPING, VALVES & SPECIALITIES Included under section II-A mechanical of this technical specification.

PUMPS AND PIPE SELECTION CRITERIA

Pump and Pipeline carrying water and chemicals etc. shall generally be sized on the following velocities. However wherever minimum pipe sizes are defined in the drawing/datasheets, the selected size shall not be less than the specified size.

	VELOCITY IN m/sec.		
	BELOW 50 MM.	**50-150 MM**	**200 MM AND ABOVE**
Pump Suction for water	------	1.2-1.5	1.2-1.8
Pump discharge for water	1.2-1.8	1.8-2.4	2.1-2.5
Header for water	-------	1.5-2.4	2.1-2.4
Pump Suction for chemical solution	1.0-1.2	1.1-1.3	-------
Pump discharge for chemical solution	1.2-1.4	1.3-1.5	--------
Gravity flows	Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.		

Note 1- All piping system shall be capable of withstanding the maximum pressure in the corresponding line.

Note 2- TDH of all pumps shall be decided by the supplier assuming the following 'C values in Hazen & Williams equation for calculation of friction loss.

a) **Carbon steel pipes – 100**
b) **CI Pipes /Ductile Iron pipes –100**
c) **Rubber lined steel pipe – 120**
d) **PVC/HDPE pipes – 140**
e) **Stainless steel pipes -100**

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/sump/reservoir from which the pumps draw water.

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

DRAWINGS

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING No. PE-DG-475-164-A001

CUSTOMER'S DRAWING No.

CONFIDENTIAL
COPY RIGHT AND
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
it must not be used directly or indirectly in any way detrimental to the interest of the company.

COMPUTER FILE NAME : TAL5

WASTE WATER FROM MD BFP

THROUGH GRAVITY

BFP-A UNIT-1 WASTE WATER PUMP
CAPACITY: 2 M3/H (1W+1S)
TYPE: HORIZONTAL SCREW

E1A

BFP-A UNIT-1 PIT
CAPACITY: 1 M3
MOC: RCC
LOCATION: UNDERGROUND

WASTE WATER FROM MD BFP

THROUGH GRAVITY

BFP-B UNIT-1 WASTE WATER PUMP
CAPACITY: 2 M3/H (1W+1S)
TYPE: HORIZONTAL SCREW

E1B

BFP-B UNIT-1 PIT
CAPACITY: 1 M3
MOC: RCC
LOCATION: UNDERGROUND

THROUGH GRAVITY

TRANSFORMER YARD WASTE WATER FROM

TRANSFORMER YARD SUMP UNIT-1
WASTE WATER PUMP
CAPACITY: 15 M3/H (1W+1S)
TYPE: VERTICAL SCREW

E7

TRANSFORMER YARD SUMP UNIT-1
CAPACITY: 100 M3
MOC: RCC
LOCATION: UNDERGROUND

THROUGH GRAVITY

TRANSFORMER YARD WASTE WATER FROM

TRANSFORMER YARD SUMP UNIT-2
WASTE WATER PUMP
CAPACITY: 15 M3/H (1W+1S)
TYPE: VERTICAL SCREW

E8

TRANSFORMER YARD SUMP UNIT-2
CAPACITY: 100 M3
MOC: RCC
LOCATION: UNDERGROUND

EQUIPMENT & PROCESS DRAIN

FLOOR WASH WATER

E2A

TG AREA SUMP A UNIT-1
WASTE WATER PUMP
CAPACITY: 40 M3/H (1W+1S)
TYPE: VERTICAL SCREW

TG AREA SUMP A UNIT 1
CAPACITY: 12 M3
MOC: RCC
LOCATION: UNDERGROUND

EQUIPMENT & PROCESS DRAIN

FLOOR WASH WATER

E2B

TG AREA SUMP B UNIT-1
WASTE WATER PUMP
CAPACITY: 40 M3/H (1W+1S)
TYPE: VERTICAL SCREW

TG AREA SUMP B UNIT 1
CAPACITY: 12 M3
MOC: RCC
LOCATION: UNDERGROUND

OWNER

WSWS

BIDDER'S SCOPE TILL TP-A

WASTE WATER FROM MD BFP

THROUGH GRAVITY

BFP-A UNIT-2 WASTE WATER PUMP
CAPACITY: 2 M3/H (1W+1S)
TYPE: HORIZONTAL SCREW

E3A

BFP-A UNIT-1 PIT
CAPACITY: 1 M3
MOC: RCC
LOCATION: UNDERGROUND

WASTE WATER FROM MD BFP

THROUGH GRAVITY

BFP-B UNIT-2 WASTE WATER PUMP
CAPACITY: 2 M3/H (1W+1S)
TYPE: HORIZONTAL SCREW

E3B

BFP-B UNIT-2 PIT
CAPACITY: 1 M3
MOC: RCC
LOCATION: UNDERGROUND

WASTE WATER FROM COT/DOT

THROUGH GRAVITY

COT/DOT AREA WASTE WATER PUMP
CAPACITY: 2 M3/H (1W+1S)
TYPE: HORIZONTAL SCREW

E5

COT/DOT AREA PIT
CAPACITY: 1 M3
MOC: RCC
LOCATION: UNDERGROUND

EQUIPMENT & PROCESS DRAIN

FLOOR WASH WATER

E4A

TG AREA SUMP A UNIT-2
WASTE WATER PUMP
CAPACITY: 40 M3/H (1W+1S)
TYPE: VERTICAL SCREW

TG AREA SUMP A UNIT 2
CAPACITY: 12 M3
MOC: RCC
LOCATION: UNDERGROUND

EQUIPMENT & PROCESS DRAIN

FLOOR WASH WATER

E4B

TG AREA SUMP B UNIT-2
WASTE WATER PUMP
CAPACITY: 40 M3/H (1W+1S)
TYPE: VERTICAL SCREW

TG AREA SUMP B UNIT 2
CAPACITY: 12 M3
MOC: RCC
LOCATION: UNDERGROUND

NOTE:

1) WASTE WATER SHALL BE SENT TO WSWS IN PT AREA. PUMP HEAD SHALL BE PROVIDED CONSIDERING TRANSFER OF WASTE WATER TO WSWS IN PT AREA.

JOB No.	475			
INDENT				
DISTRIBUTION				
DATE	ALTD	CHD	APPD	
26.11.20	VKB	RN	RN	
REV				
0				

OWNER: NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT: 2X660 MW KHURJA STPP (TG PACKAGE)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
A	DRN	VKB		14.08.2021
	DESN	VKB		14.08.2021
	CHD	RN		14.08.2021
	APPD	SB		14.08.2021

TITLE: P&I DIAGRAM FOR EFFLUENT COLLECTION AND DISPOSAL

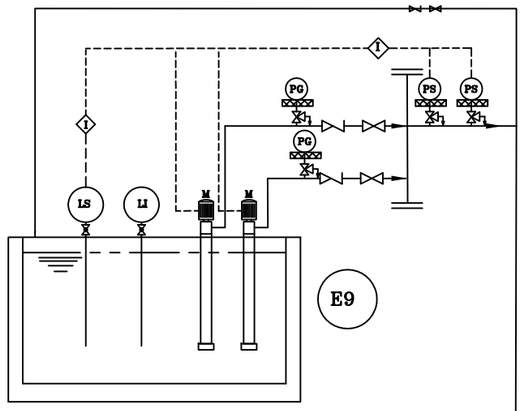
MPL	C	MSE	I	MAX	E	DEPT.	SCALE
						SIGN	
						DATE	

DRAWING No. PE-DG-475-673-A001

1 OF 2 REV 00

SIZE-A1

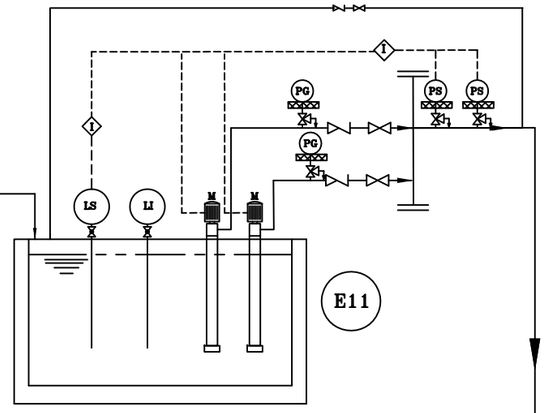
COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
it must not be used directly or indirectly in any way detrimental to the interest of the company.



CW PIT UNIT-1

CW PIT UNIT-1 WASTE
WATER PUMP
CAPACITY: 40 M3/H (1W+1S)
TYPE: VERTICAL SUBMERSIBLE

FROM ATM
FLASH TANK



ATM FLASH TANK UNIT-1 PIT
CAPACITY: 10 M3
MOC: RCC
LOCATION: UNDERGROUND

ATM FLASH TANK UNIT-1
PIT WASTE WATER PUMP
CAPACITY: 15 M3/H (1W+1S)
TYPE: VERTICAL SUBMERSIBLE

COMMON HEADER TO
CW CHANNEL UNIT-1
ON PIPE RACK/PEDESTAL

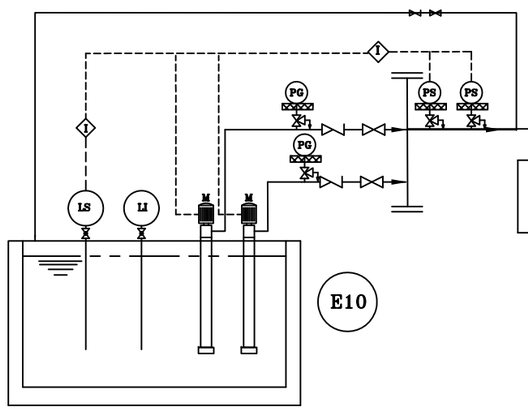
COMMON HEADER TO
CW CHANNEL UNIT-2
ON PIPE RACK/PEDESTAL

OWNER

BIDDER'S SCOPE
TILL TP-A

CW CHANNEL

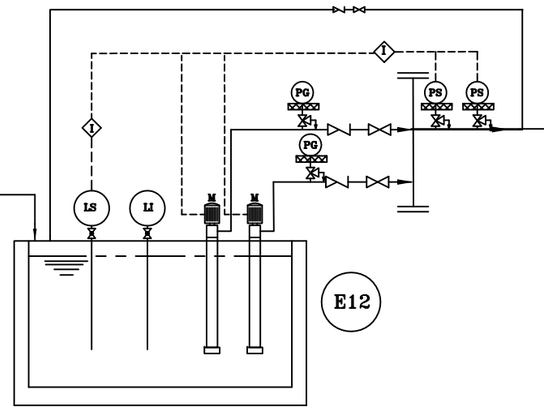
CW PUMP HOUSE



CW PIT UNIT-2

CW PIT UNIT-2 WASTE
WATER PUMP
CAPACITY: 40 M3/H (1W+1S)
TYPE: VERTICAL SUBMERSIBLE

FROM ATM
FLASH TANK



ATM FLASH TANK UNIT-2 PIT
CAPACITY: 10 M3
MOC: RCC
LOCATION: UNDERGROUND

ATM FLASH TANK UNIT-2
PIT WASTE WATER PUMP
CAPACITY: 15 M3/H (1W+1S)
TYPE: VERTICAL SUBMERSIBLE

NOTE:
1) WASTE WATER SHALL BE SENT TO CW CHANNEL. PUMP HEAD SHALL BE PROVIDED CONSIDERING TRANSFER OF WASTE WATER TO CW CHANNEL.

JOB No.	475			
PROPOSAL				
DISTRIBUTION				
DATE	ALTD	CHD	APPD	
26.11.20	VKB	RN	RN	
REV				
0				

OWNER: NTPC (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT: 2X660 MW KHURJA STPP (TG PACKAGE)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
A	DRN	VKB		14.08.2021
	DESN	VKB		14.08.2021
	CHD	RN		14.08.2021
	APPD	SB		14.08.2021

TITLE: P&I DIAGRAM FOR EFFLUENT COLLECTION AND DISPOSAL

MPL	C	MSE	I	MAX	E	DEPT.	SCALE
						SIGN	
						DATE	

DRAWING No. PE-DG-475-673-A001

2 OF 2 REV 01

SIZE-A1

DRAWING No. PE-DG-424-164-A001

CUSTOMER'S DRAWING No.

COMPUTER FILE NAME : TAL5

DRAWING NO. PE-DG-475-100-E001

CUSTOMER'S DRAWING NO. 129 985

NORTH

BFP-A PIT

BFP-B PIT

BOILER (UNIT-1)

BOILER (UNIT-2)

1.5M WIDE PASSAGE AT 8.5M

CABLE VAULT

OPENING FOR MDBFP

OIL ROOM

SPACE FOR HEATER HANDLING

SPACE FOR DRILL REMOVAL

CEP OPENING

COMPR. HOUSE

CENTRAL LUBE OIL PURIFICATION SYS

TENTATIVE LOCATION OF LIGHTING MAST

EFFLUENT TRANSFER SYSTEM PIT

EFFLUENT TRANSFER SYSTEM PIT

℄ OF TOWER

℄ OF TOWER

78.86 N

92.90(N) 716.95(E)

93.40(N) 828.7(E)

93.40(N) 854.75(E)

93.70(N) 1003.65(E)

(731.08) 98.27(N)

(837.65) 100.37(N)

152.500(N) 987.500(E)

155.0 N

162.5 N

(712.50) 155.0(N)

707.420 148.850

COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
It must not be used directly or indirectly in any way detrimental to the interest of the company.

COMPUTER FILE NAME:

REV.	DATE	ALTD	CHD	APPD
04	25.05.22			
01	DG SET FOR BOTH UNIT ARE UPDATED AS PER INPUT RECEIVED FROM ISG.			
02	CST PUMP HOUSE COORDINATE UPDATED.			

REV.	DATE	ALTD	CHD	APPD
03	09.07.21	UDAY	DS/KG	OMK
01	DRAWING REVISED AS PER CUSTOMER COMMENTS.			
02	ADDITIONAL FACILITIES i.e. PIPE CUM CABLE TRESTLE, IPBD, SPBD FOUNDATIONS AND MECHANICAL EQPT CST PUMP & TANK UPDATED.			

REV.	DATE	ALTD	CHD	APPD
02	11.12.20	AR -SD-	DS/KG -SD-	MS -SD-
	DRAWING REVISED AS PER CUSTOMER COMMENTS			

REV.	DATE	ALTD	CHD	APPD
01	06.10.20	AR -SD-	DS/KG -SD-	MS -SD-
	DRAWING REVISED AS PER CUSTOMER COMMENTS			

NTPC DRG. NO.	9915-371-110-PEM-PVE-P-021
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

COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED it must not be used directly or indirectly in any way detrimental to the interest of the company.

DEPT CODE		NAME	SIGN	DATE
M	DRN	AR	Sd/-	29.04.2020
	DESN	DS	Sd/-	29.04.2020
	CHD	KG/MS	Sd/-	29.04.2020
	APPD	DR	Sd/-	29.04.2020

TITLE EFFLUENT TRANSFER SYSTEM PIT LOCATIONS

DEPT. | SCALE 1:300 | DRAWING NO. PE-DG-475-100-E001
SIGN
SHEET 1 OF 2 | REV. 04P

SIZE-A0

PLANT NORTH

TRUE NORTH

PLANT NORTH

WEST

EAST

SOUTH

NORTH. (UTM)

WIND ROSE

LIST OF BUILDING/EQUIPMENT SHOWN

NO.	DESCRIPTION OF MAJOR ITEMS
1	STEAM GENERATOR AREA
2	ELECTROSTATIC PRECIPITATOR
3	ESP / FGD CONTROL FACILITY AND CHILLER PLANT
4	CHIMNEY
5	UNIT-1 ASH EXTRACTION & BOTTOM ASH MCC ROOM
6	AIR COMPRESSOR HOUSE & MCC ROOM
7	AUXILIARY BOILER
8	AUXILIARY BOILER CONTROL BUILDING
9	BLOW DOWN PIT
10	RAW WATER RESERVOIR-1 (LIVE STORAGE)
11	RAW WATER RESERVIOR-2 (DEAD STORAGE)
12	CONSTRUCTION STORE
13	PARKING
14	FUEL OIL TANK FARM AREA INCLUDING FOAM SHED & OWS
15	FUEL OIL UNLOADING AREA AND PUMP HOUSE
16	ASH SLURRY PUMP HOUSE
17	ASH WATER PUMP HOUSE
18	SETTLING TANK
19	SURGE TANK
20	HCSD SILO
21	HCSD PUMP HOUSE
22	LIMESTONE MILL BUILDING
23	TRANSPORT AIR COMPRESSOR HOUSE
24	FLY ASH EXTRACTION TOWER
25	VACUUM PUMPS (ESP AREA) FOR AHP
26	FLY ASH SILO
27	SILO UTILITY BUILDING & ASH SILO MCC ROOM
28	ASH WATER RECIRCULATION PUMP HOUSE
29	AMMONIA STORAGE
30	FD FAN
31	ID FAN
32	PA FAN
33	GATE COMPLEX
34	MILL REJECT HANDLING SYSTEM
35	GYPSUM DEWATERING BUILDING
36	UNIT-2 ASH EXTRACTION & BOTTOM ASH MCC ROOM
37	MAIN AHP SWITCHGEAR / CONTROL ROOM CUM COMMON FGD ELECTRICAL BUILDING
38	SEEPAGE WATER PUMP HOUSE
39	DISASTER ROOM
40	AWRS CUM SEEPAGE WATER SYSTEM SWGR ROOM
41	NOT USED
42	SEEPAGE WATER PUMP HOUSE (HCSD AREA)
43	NITROGEN CYLINDER STORAGE
44	STP
45	STP (ASH POND AREA)
46	WATCH TOWER

NOTES:

01. ALL DIMENSIONS AND LEVELS ARE IN METERS.
02. ±0.00 OF MAIN PLANT AREA CORRESPONDS TO RL(+)194.500M. WHICH IS FINISHED FLOOR LEVEL (FFL) OF MAIN POWER HOUSE BUILDING.
03. FINISHED FLOOR LEVEL IN VARIOUS BUILDING IN MAIN PLANT AREA SHALL BE 0.000M.
04. BUILDING & FACILITIES INDICATED ARE PRELIMINARY AND MAY BE CHANGE IN LOCATION & SIZE OF THE FACILITIES AFTER FINALIZATION OF VENDOR.
05. SPACE FOR LAY-DOWN & PRE-ASSEMBLY ALLOCATED UNDER OWNERS SCOPE IS UNCHANGED.
06. THE COORDINATES 7864008E, 3118100N IS COINCIDE WITH PLANT ORIGIN COORDINATES E 0.000, N 0.000.
07. FOR BUILDING DIMENSION AND CONFIGURATION, PLEASE REFER RESPECTIVE GA DRAWING.
08. CO-ORDINATES OF VARIOUS FACILITY MENTIONED ARE INDICATIVE AND WILL BE FINALIZED AFTER RECEIPT OF VENDOR INFORMATION AND FINALIZATION OF BUILDING / FACILITY LAYOUT.

HOLD :

01. THE LOCATION OF OWNER'S FACILTIES NEAR UNIT#1 BOILER AREA (WEST SIDE) IS UNDER DISCUSSION WITH NTPC/THDC/BHEL.
02. DELETED.

LEGENDS:

- DOUBLE LANE ROAD
- SINGLE LANE ROAD
- PIPE RACK
- PIPE CULVERT
- RAW WATER PIPE CORRIDOR
- GREEN BELT
- CABLE RACK
- UG ROAD CROSSING FOR ELECTRIC LINE
- TRUNK DRAIN
- RAIL LINE
- BOUNDARY WALL
- LAND BOUNDARY
- ASH SLURRY PIPE CORRODOR
- CONSTRUCTION POWER LINE
- WATCH TOWER (WT)
- OVERHEAD ELECTRIC LINE
- CABLE TRENCH
- SHALLOW TRENCH
- LIGHTING MAST (LM)

SPECIAL NOTE:-

01. ALL THE FACILITIES INDICATED IN DITHER COLOR ARE UNDER THE SCOPE OF OTHERS / CUSTOMER.
02. DELETED.
03. DELETED.

REFERENCE DRAWINGS:

DRAWING NO.	DRAWING TITLE
9915-999-POC-F-001 - REV-1	GENERAL LAYOUT PLAN

GRAPHIC SCALE 0 50 100 200 400

REV NO.	ZONE	DESCRIPTION	PPD	CHKD	APPD	DATE
05	≃	01.DRAWING HAS BEEN REVISED BASED ON NTPC COMMENTS. REVISED AS MARKED.	AK	HM/NBM	KSB	16-04-2021
04	≃	01. DRAWING HAS BEEN REVISED BASED ON FGD LAYOUT. REVISED AS MARKED.	AK	HM/NBM	KSB	06-11-2020
03	≃	01. DRAWING HAS BEEN REVISED BASED ON NTPC COMMENTS & TCM-7. REVISED AS MARKED.	AK	HM/NBM	KSB	03-06-2020
02	≃	01. DRAWING HAS BEEN REVISED BASED ON NTPC COMMENTS & GLP MOM. REVISED AS MARKED.	PJ	HM/NBM	KSB	07-02-2020
01	≃	01. DRAWING HAS BEEN REVISED BASED ON NTPC COMMENTS AND DETAIL ENGINEERING REQUIREMENTS.	PJ	HM/NBM	KSB	06-01-2020

OWNER	THDC INDIA LIMITED (A JV OF GOVT. OF INDIA & GOVT. OF UP)		
OWNER'S CONSULTANT	NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE)		
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2 x 660 MW)		
BOILER CONTRACTOR	L&T-MHI POWER BOILERS PRIVATE LTD. (Formerly known as L&T-MHPS Boilers Private Limited)	JOB NO.	11015Z
BOILER CONTRACTOR CONSULTANT	L&T-SBL L & T - SARGENT & LUNDY LTD.		
L&T-MHI DWG. NO.	11015-00-98140-3402-003	SPEC. TITLE:	GS & ANNEXURES
NTPC DWG. NO.	9915-370-301-PVC-B-034C		

	NAME	SIGN	DATE	SIZE	A0	SCALE	1:4500	WBS : -
DESIGNED	PPD	PJ / AK	06-01-2020					
CHECKED	CHKD	HM	06-01-2020					UNIT DESIGNATION 1 & 2
APPROVED	APPD	KSB						
DRAWN	CHKD	VVK	06-01-2020					SHEET 01 01 05
	APPD	SR	06-01-2020					

THIS DRAWING IS THE PROPERTY OF AND CONTAINS CONFIDENTIAL PROPRIETARY INFORMATION OF L&T-MHPS BOILERS PRIVATE LIMITED AND SHALL NOT BE REPRODUCED, USED, DISCLOSED OR TRANSMITTED IN WHOLE OR IN PART UNLESS AUTHORISED IN WRITING BY L&T-MHPS POWER BOILERS PRIVATE LIMITED.
UNLESS OTHERWISE STATED ALL DIMENSIONS ARE IN MILLIMETERS. DO NOT SCALE. IF IN DOUBT, ASK.

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT COLLECTION AND DISPOSAL 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
		VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

SPECIFIC TECHNICAL REQUIREMENT OF EFFLUENT TRANSFER SYSTEM (ELECTRICAL)

TITLE:	SPECIFICATION NO.
TECHNICAL SPECIFICATION FOR ETP	VOLUME NO. : **II-B**
	SECTION: **C**
	REV NO. : **00** DATE: 14.12.2021
2X660 MW KHURJA STPP-TG	SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
I	SPECIFIC TECHNICAL REQUIREMENTS	1
I	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR (ANNEXURE-I)	3
I	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
I	CABLE SCHEDULE FORMAT (ANNEXURE-III)	1
I	EXPLANATORY NOTES FOR CABLE ROUTING	2
I	TECHNICAL SPECIFICATION FOR MOTORS	9
I	MOTOR DATASHEET-A	1
I	SUB-VENDOR LIST	1
II	MOTOR DATASHEET-C	2
II	GENERAL TECHNICAL REQUIREMENT FOR LV MOTORS	4
II	SQP_LV MOTORS UPTO 55KW	2
II	SQP_LV MOTORS 55KW & ABOVE	9
II	TECHNICAL SPECIFICATION FOR CABLES	12
II	TECHNICAL SPECIFICATION FOR CABLING EARTHING & LIGHTNING PROTECTION,	23
II	CABLE TRAYS & ACCESSORIES, CABLE TRAY DRAWING	47

The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.

	ELECTRICAL EQUIPMENT SPECIFICATION FOR ETP 2X660MW KHURJA STPP (TG AND ASSOCIATED PACKAGES)	SPECIFICATION NO.
		VOLUME NO. : **II-B**
		SECTION : **C**
		REV NO. : **00** DATE : 14.12.2021
		SHEET : 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

b) Services and equipment as per "Electrical Scope between BHEL and Vendor".

c) 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.

d) Supply of mandatory spares as specified in the specifications of mechanical equipment's.

e) Electrical load requirement for ETP.

f) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

g) 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

h) 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.

i) Motor shall meet minimum requirement of motor specification.

j) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

k) 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

4.1 Electrical Scope Between BHEL & Vendor (Annexure-I).
4.2 Electrical Load Data Format (Annexure-II).
4.3 Cable Schedule Format (Annexure-III).
4.4 Data Sheet-A.
4.5 Data Sheet-C.
4.6 Technical Requirements-Motors.
4.7 Standard Quality Plan.
4.8 Motor Sub Vendor List

REV-0, DATE: 14.12.2021

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : ETP

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW KHURJA STPP-TG

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	

REV-0, DATE: 14.12.2021

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : ETP

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW KHURJA STPP-TG

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 based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

REV-0, DATE: 14.12.2021

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES : ETP

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW KHURJA STPP-TG

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.

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.	475	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	2X660 MW KHURJA STPP-TG	NAME		DATA FILLED UP ON	
	SYSTEM	ETP	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAUX	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

985102/2022/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

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

985102/2022/PS-PEM-MAX

TITLE	SPECIFICATION NO.
LV MOTORS **DATA SHEET-A** **2X660 MW KHURJA STPP-TG**	VOLUME II B SECTION D REV NO. 00 DATE 14.12.2021 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	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: ± 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 boxes		
	* 110 kW and above (Breaker Controlled) :		50 KA for 0.25 sec.
	* Below 110 kW (Contactor Controlled) :		50 KA protected by HRC fuse
	f) LV System grounding	:	Solidly
5.0	Class of insulation	:	Refer clause 7.03.00 of Motor cust. spec.
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	Refer clause 6.03.00 of Motor cust. spec.
7.0	Power cables data	:	Shall be given during Detailed engg.
8.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
9.0	Space heater supply **(30KW & ABOVE)**	:	240 V, 1Φ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
11.0	Locked rotor current a) Limit as percentage of FLC	:	As per IS 12615
12.0	Makes	:	BHEL/ Customer approval (Package owner to take care)
13.0	Paint shade	:	Blue (RAL 5012)
14.0	Additional tests	:	As per QP
15.0	Degree Of protection for motor/ terminal box	:	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
16.0	Type of starter provided in MCC	:	As per IS/IEC: IEC-60947-4-1, DOL
17.0	Cooling	:	As per Specification

* LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615

18.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

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

The list of approved make of the LT Motors are as mentioned below:

S. NO.	LIST OF MOTORS	
1	NON FLAME PROOF	ABB
2		BHARAT BIJLEE LTD.
3		CROMPTON GREAVES
4		GE-POWER
5		KIRLOSKAR ELECTRIC CO LTD.
6		LAXMI HYDRAULICS PVT. LTD
7		MARATHON
8		NGEF
9		RAJINDRA ELECT INDUSTRIES
11	FLAME PROOF	RAJINDRA ELECT INDUSTRIES

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

	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.
BHEL	LV MOTOR DATA SHEET - C	VOLUME II B 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	

985102/2022/PS-PEM-MAX

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

985102/2022/PS-PEM-MAX

1.0 INTENT OF SPECIFIATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

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

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

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

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

3.5 **Stress During bus Transfer**

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

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

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

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

4.0 **CONSTRUCTIONAL FEATURES**

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

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

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

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

985102/2022/PS-PEM-MAX

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

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

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

985102/2022/PS-PEM-MAX

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

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

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:	Kunal Gandhi	KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

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

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180º	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

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		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 6 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

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

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325//IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

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

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

D: DOCUMENT

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

CLAUSE NO.	TECHNICAL REQUIREMENTS

1.00.00 **CODES & 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 the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 **TECHNICAL REQUIREMENTS**

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.

2.04.00 XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.

2.06.00 For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows :

Calculated nominal dia. of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

2.06.01 The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm^2 per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.

2.06.02 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.

2.07.00 Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a.) Oxygen index of min. 29 (as per IS 10810 Part-58).

(b.) Acid gas emission of max. 20% (as per IEC-754-I).

(c.) Smoke density rating shall not be more than 60 % (as per ASTMD-2843).

2.08.00 Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:

1 core - Red, Black, Yellow or Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

4 core - Red, Yellow, Blue and Black

2.09.00 For reduced neutral conductors, the core shall be black.

2.10.00 In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.

(a.) Cable size and voltage grade - To be embossed

(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed

The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.

2.11.00 All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.

2.12.00 Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum, over the declared value in the technical data sheets.

2.13.00 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

2.14.00 Cable selection & sizing

2.14.01 Cables shall be sized based on the following considerations:

(a) Rated current of the equipment

(b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage

(c) Short circuit withstand capability

This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.

2.14.02	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.
2.14.03	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
2.14.04	All Cables shall be armoured type.
2.14.05	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and sizes shall be 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm. However for cable sizes upto 120 sq.mm. both XLPE insulated & PVC insulated LT power cables are acceptable.
2.14.06	Same cable sizes to be used for same type of application & rating of motor i.e if there are three pumps for one application, all three pumps motor should be provided with same cables sizes.
3.00.00	**CONSTRUCTIONAL FEATURES**
3.01.00	1.1 KV Grade Power Cables (a) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured, PVC outer-sheathed conforming to IS:7098. (Part-I). (b) 1.1KV grade PVC power cables shall have aluminium conductor(compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured, PVC outer-sheathed conforming to IS:1554 (Part-I). (c) 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propyline Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.
4.00.00	**CABLE DRUMS** (a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c.) The standard drum length of LT power cable with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable excluding 630 sqmm size, and 750 meter for multicore cable & single core 630 sqmm

5.00.00 TESTS

1.0 All equipments to be supplied shall be of type tested design. During detailed 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.

2.0 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.

3.0 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.

4.0 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.

5.01.00 **Type Tests**

5.01.01 The reports for the following type tests shall be submitted for one size each of LT XLPE and LT PVC Power cables. Size shall be decided by the employer during detailed engineering:

S.No.	Type test	Remarks
	For Conductor	
1.	Resistance test	
2.	Tensile test	For circular non-compacted conductors only
3.	Wrapping test	For circular non-compacted only

	For Armour Wires/ Formed Wires	
4.	Measurement of Dimensions	
5.	Tensile Test	
6.	Elongation test	
7.	Torsion test	For round wires only
8.	Wrapping test	For aluminium wires / formed wires only.
9.	Resistance test	
10(a)	Mass of zinc coating test	For GS Formed wires/wires only
10(b)	Uniformity of zinc coating	For GS Formed wires /wires only
11.	Adhesion test	For GS Formed wires/wires only
	For PVC/XLPE insulation & PVC Sheath	
12.	Test for thickness	
13.	Tensile strength & elongation tests	before ageing and after ageing
14.	Ageing in air oven	
15.	Loss of mass test	For PVC insulation and sheath only
16.	Hot deformation test	For PVC insulation and sheath only
17.	Heat shock test	For PVC insulation and sheath only
18.	Shrinkage test	
19.	Thermal stability test	For PVC insulation and sheath only
20.	Hot set test	For XLPE insulation only
21.	Water absorption test	For XLPE insulation only
22.	Oxygen index test	For outer sheath only
23.	Smoke density test	For outer sheath only
24.	Acid gas generation test	For outer sheath only
	For completed cables	
25.	Insulation resistance test (Volume resistivity method)	
26.	High voltage test	
27.	Flammability test as per IEC-332 Part-3 (Category-B)	

Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of LT power cables enclosed.

CLAUSE NO.	TECHNICAL REQUIREMENTS

1.00.00 CODES & 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 the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D –2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 TECHNICAL REQUIREMENTS

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Conductor of control cables shall be made of stranded, plain annealed copper.

2.04.00 PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.06.00	For multicore armoured cables, the armouring shall be of galvanised steel as follows: Calculated nominal dia of cable under armour — Size and Type of armour Upto 13 mm — 1.4mm dia GS wire Above 13 upto 25 mm — 0.8 mm thick GS formed wire / 1.6 mm dia GS wire Above 25 upto 40 mm — 0.8mm thick GS formed wire / 2.0mm dia GS wire Above 40 upto 55mm — 1.4 mm thick GS formed wire/2.5mm dia GS wire Above 55 upto 70 mm — 1.4mm thick GS formed wire / 3.15mm dia GS wire Above 70mm — 1.4 mm thick GS formed wire / 4.0 mm dia GS wire The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.
2.07.00	Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29. (As per IS 10810 Part-58) (b.) Acid gas emission of max. 20% (As per IEC-754-I) (c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.
2.08.00	Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted. 1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black 5 core - Red, Yellow, Blue, Black and Grey
2.09.00	For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed

	underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath: (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed. The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
2.14.00	Cable selection & sizing Control cables shall be sized based on the following considerations: (a) The minimum conductor cross-section shall be 1.5 sq.mm. (b) The minimum number of spare cores in control cables shall be as follows:

No. of cores in cable	Min. No. of spare cores
2C, 3C	NIL
5C	1
7C-12C	2
14C & above	3

2.14.01	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
2.14.02	All Cables shall be armoured type.
3.00.00	**CONSTRUCTIONAL FEATURES**
3.01.00	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).
3.02.00	1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propyline Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-

sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm.

4.00.00 CABLE DRUMS

(a.) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b.) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c.) The standard drum length for control cables with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter.

5.00.00 TESTS

All equipments to be supplied shall be of type tested design. During detailed 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.

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.

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

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.

5.01.00 **TYPE TESTS**

5.01.01 The reports for the following type tests shall be submitted for one size of control cables. Size shall be decided by the employer during detailed engineering

S. No.	Type Test	Remarks
	For Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires (If applicable)	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wire only
6.	Wrapping test	For aluminium wires / formed wires only.
7.	Resistance test	
8(a).	Mass of zinc Coating test	For GS wires/formed wires only
8(b).	Uniformity of zinc coating	For GS wires/formed wires only
9.	Adhesion test	For GS wires/formed wires only
	For PVC insulation & PVC Sheath	
10.	Test for thickness	
11.	Tensile strength and elongation test	before ageing and after ageing
12.	Ageing in air oven	
13.	Loss of mass test	For PVC insulation and sheath only
14.	Hot deformation test	For PVC insulation and sheath only
15.	Heat shock test	For PVC insulation and sheath only
16.	Shrinkage test	
17.	Thermal stability test	For PVC insulation and sheath only
18.	Oxygen index test	For outer sheath only

CLAUSE NO.	TECHNICAL REQUIREMENTS

S. No.	Type Test	Remarks
19.	Smoke density test	For outer sheath only
20.	Acid gas generation test	For outer sheath only
	For completed cables	
21.	Insulation resistance test(Volume resistivity method)	
22.	High voltage test	
23.	Flammability test as per IEC-332 Part-3 (Category-B)	

5.02.00 Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.

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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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.

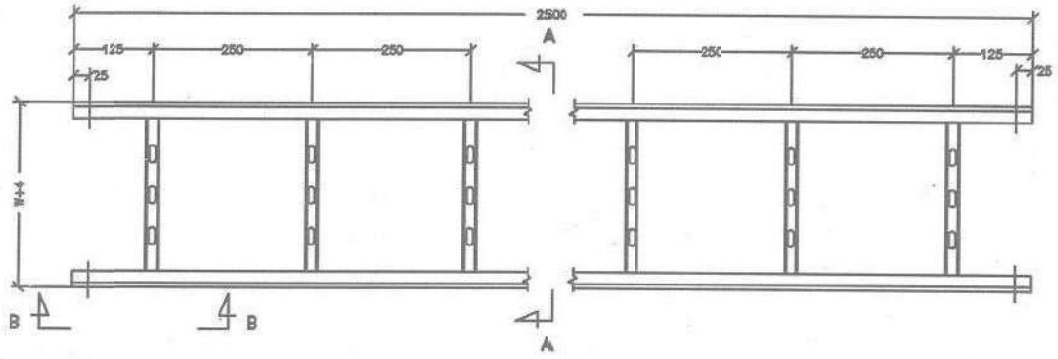
c) Minimum clear working space 1200mm around the equipment

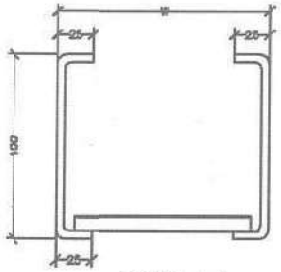
e) In buildings having MCC, minimum 2 fire door along with one rolling shutter of adequate size/capacity shall be provided.

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

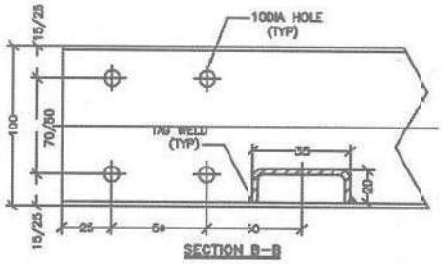
985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

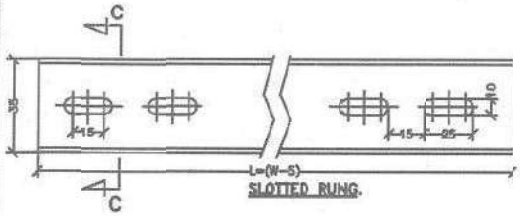




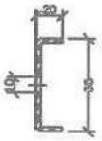
SECTION A-A



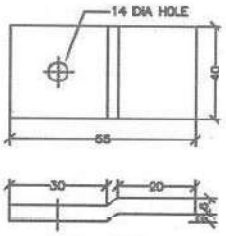
SECTION B-B



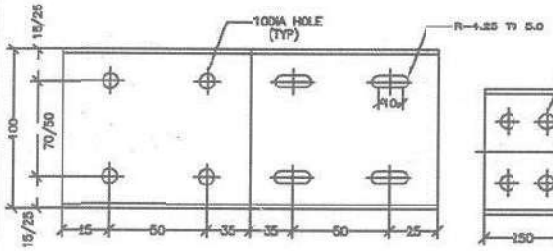
SLOTTED RUNG.



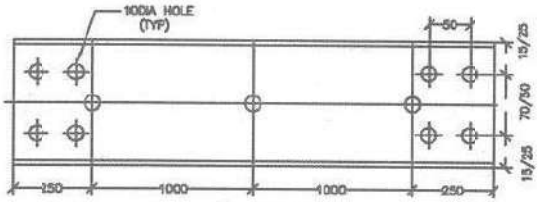
SECTION C-C



FIXING CLAMP.



COUPLER PLATE



SIDE RUNNER

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :-2mm THICK. MS SHEET.
3. FINISH :-HOT DIP GALVANISED
4. THICKNESS:-3mm COUPLER PLATE
   2mm THK.
5. TOLERANCE:-AS PER RELEVANT I.S.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	MB	MB	Pal	–	W	–	–	–	KR	05.07.10
RC	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RB	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

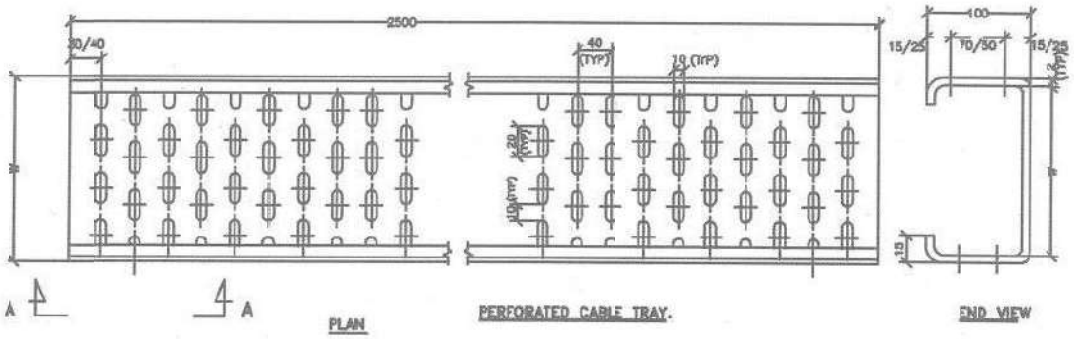
PROJECT: STANDARD

TITLE: LADDER TYPE CABLE TRAY.

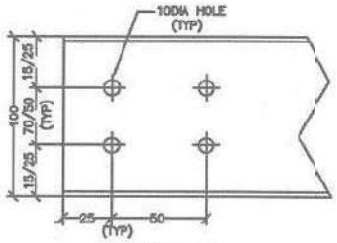
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-001	RD

985102/2022/PS-PEM-MAX

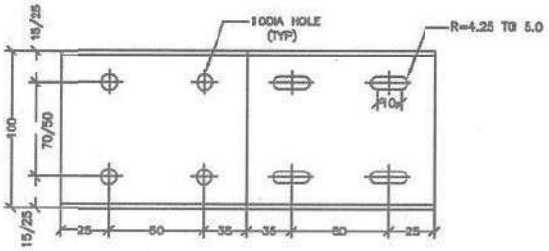
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



PLAN PERFORATED CABLE TRAY. END VIEW



SECTION A-A



COUPLER PLATE

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL:-2mm THICK. MS SHEET.
3. FINISH :-HOT DIP GALVANISED
4. THICKNESS:-3mm COUPLER PLATE 2mm TRAY.
5. TOLERANCE:-AS PER RELEVANT I.S.
6. INNER WIDTH (W) :- 150, 300 & 600mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE				-		-	-	-		05.07.10
RC	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	

एन टी पी सी NTPC

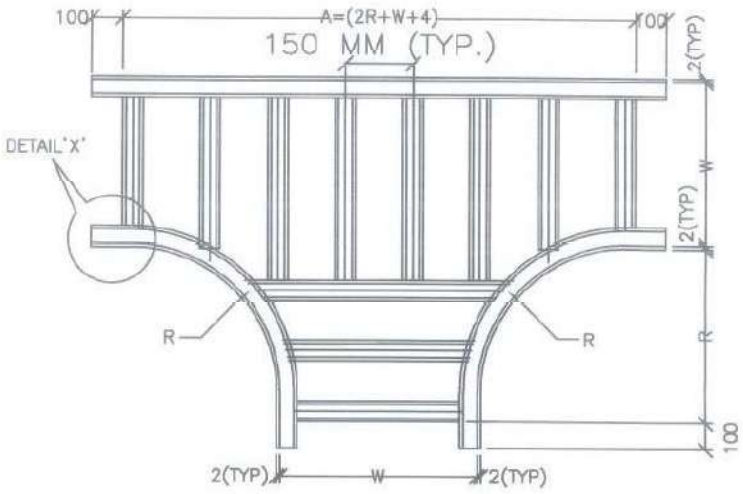
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

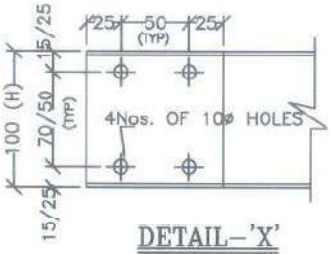
TITLE: PERFORATED TYPE CABLE TRAY.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-002	RD

This drawing and the desi it covers are the property of NTPC LTD. must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



HORIZONTAL TEE



DETAIL–'X'

INNER WIDTH OF TRAY(W)	DEPTH OF TRAY (H)	BENDING RADIUS (R)	A		
150, 300 & 600	100		150	300	600
		1200	2554	2704	3004

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :– 150, 300 & 600mm.
3. MATERIAL :– 2mm. THICK MS SHEET.
4. TOLERANCE :–AS PER RELEVANT I.S.
5. FINISH :–HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

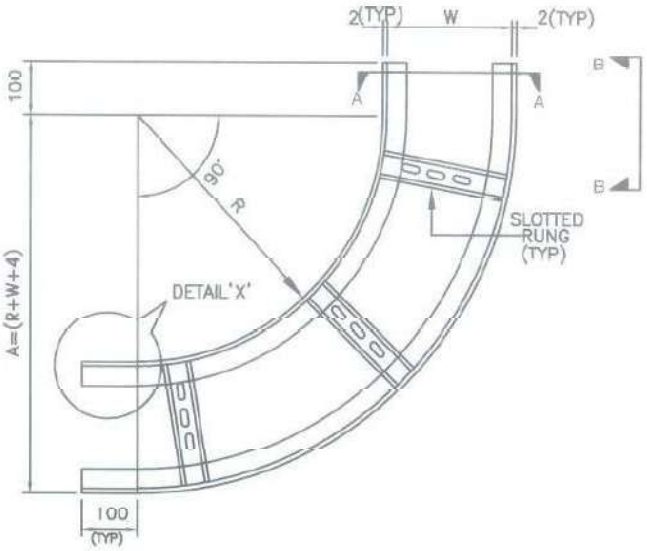
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	VC	VC			VV					15.06.22
RC	FOR TENDER PURPOSE	AB	AB	RKP	–	VV	–	–	–	DT	07.2022
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	25.07.2022
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2022

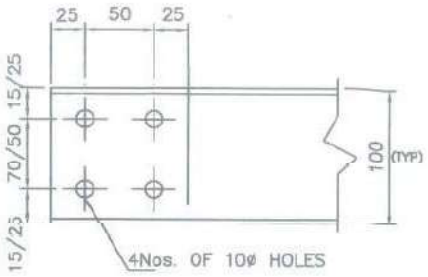
एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

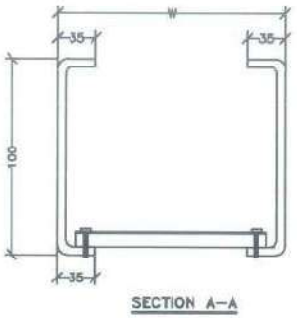
PROJECT	STANDARD		
TITLE	CABLE TRAY DETAILS HORIZONTAL TEE		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-004	REV. NO. RD

This drawing and the design covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

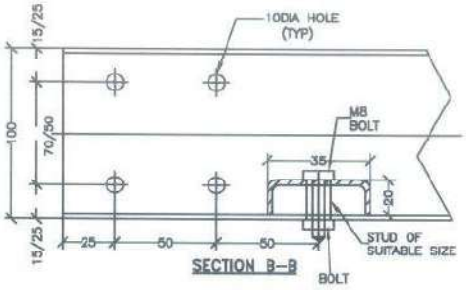




DETAIL–X



SECTION A–A



SECTION B–B

HORIZONTAL BEND 90° (BOTH LEFT & RIGHT)

INSIDE WIDTH OF TRAY(W)	DEPTH OF TRAY (H)	BENDING RADIUS(R)	A		
			150	300	600
150, 300 & 600	100	1200	1354	1504	1804

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :– 150, 300 & 600mm.
3. MATERIAL :– 2mm. THICK MS SHEET.
4. TOLERANCE :–AS PER RELEVANT I.S.
5. FINISH :–HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	√C	VC	RKP		VV				DT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	25.07.2022
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2022

एन टी पी सी NTPC

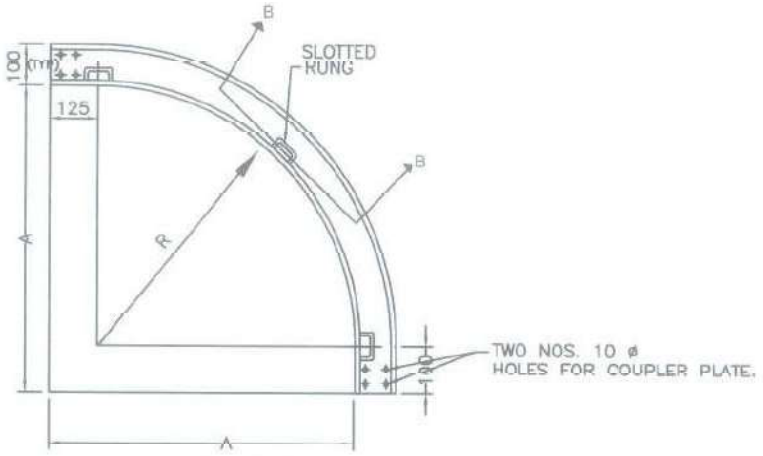
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

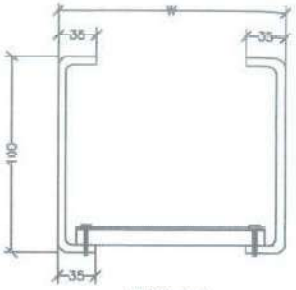
TITLE: CABLE TRAY 90ø BENDS (CTB 90ø)

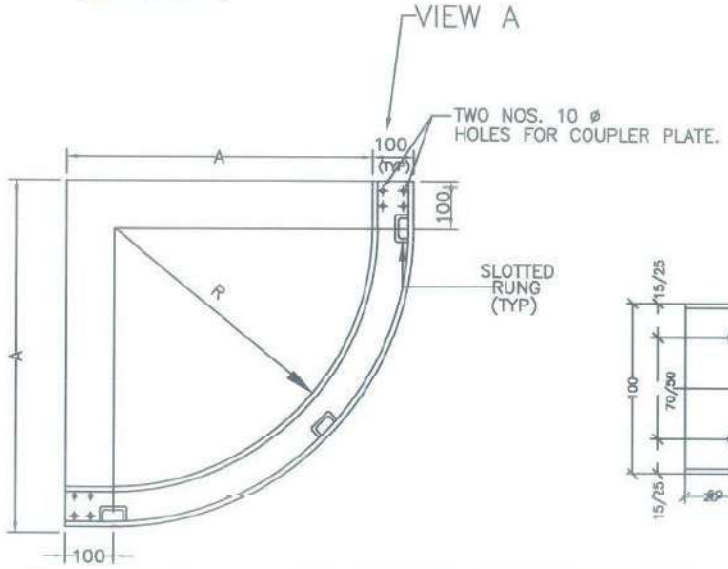
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-005	R6

985102/2022/PS-PEM-MAX

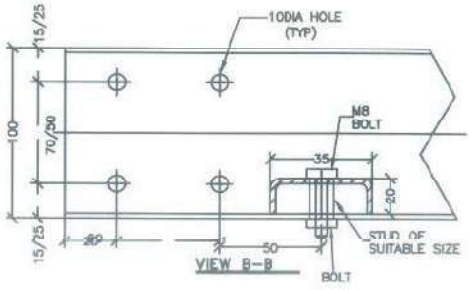


ELEVATION
90° VERTICAL ELBOW
(UPSIDE)





90° VERTICAL BEND
(DOWNSIDE)



INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	A
150, 300 & 600	1050	1150

NOTES

1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :-AS PER RELEVANT I.S.
5. FINISH :-HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	VC	VC	RKP		VV				DT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	25.07.2020
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2020

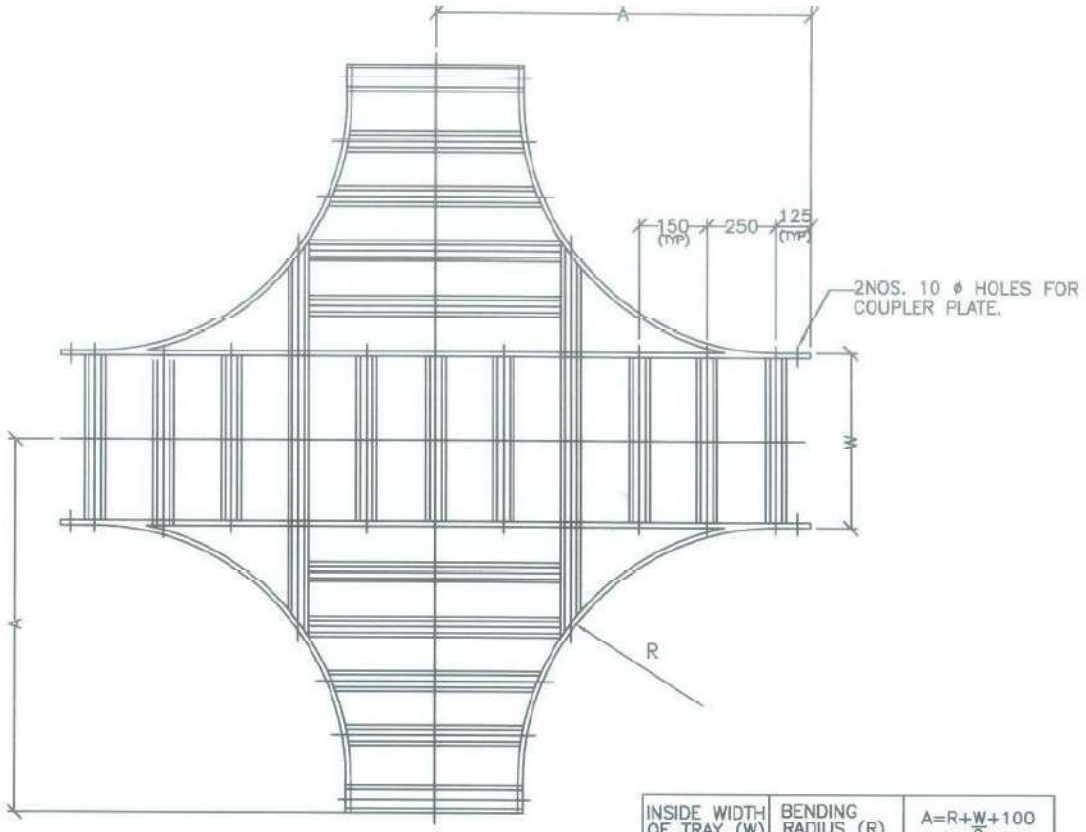
एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	CABLE TRAY 90° VERTICAL ELBOW (OUTSIDE) 90° VERTICAL ELBOW (INSIDE)		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-006	REV. NO. RD

This drawing and the design covers are the property of NTPC LTD and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

985102/2022/PS-PEM-MAX



PLAN

INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	A=R+W/2+100
600	1050	1450
300	1050	1300

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :-AS PER RELEVANT I.S.
5. FINISH :-HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	VC	VC	RKP		VV				DT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

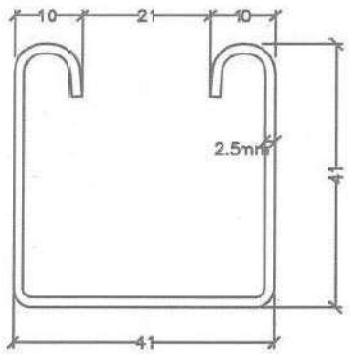
TITLE: CABLE TRAY DETAILS CROSS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-008	R0

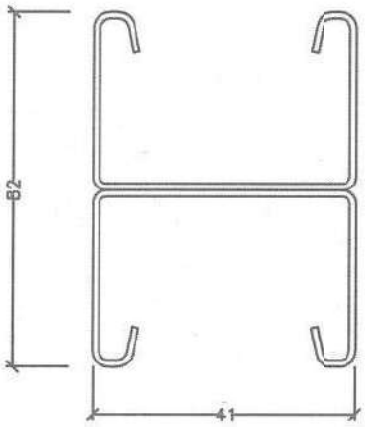
This drawing and the design covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



SINGLE CHANNEL–TYPE C1



DOUBLE CHANNEL–TYPE C2

TWO LENGTHS OF C1 WELDED BACK TO BACK

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :- 2.5mm. THICK MS SHEET.
3. TOLERANCE :–AS PER RELEVANT I.S.
4. FINISH :–HOT DIP GALVANISED

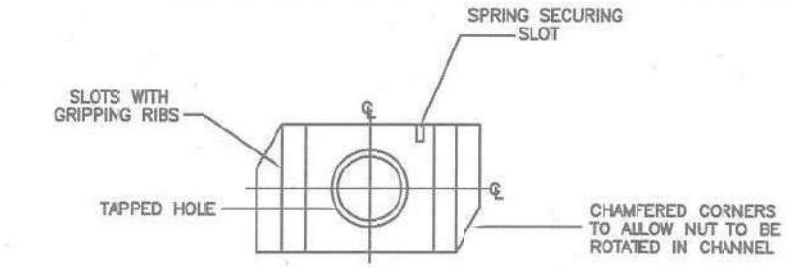
REV. NO.	DESCRIPTION	DRAWN/DESIGN	CHKD	M	E	C	C&C	ARCH	APPD	DATE
				CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	DKP	–	[illegible]	–	–	–	[illegible]	05.07.22
RB	FOR TENDER PURPOSE	DL DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	– –	–	–	–	–	–	–	–	[illegible]

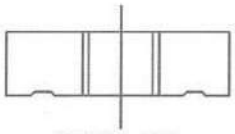
एन टी पी सी NTPC

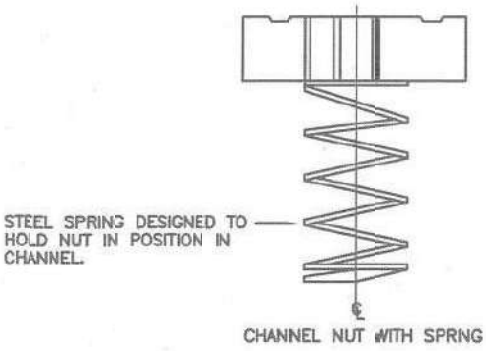
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

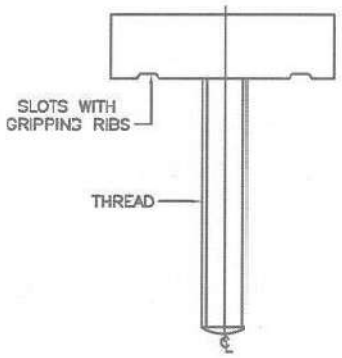
PROJECT	STANDARD		
TITLE	C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-013	REV. NO. RC

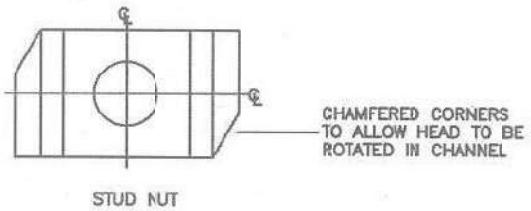
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.











TYPICAL DETAILS OF FIXING ACCESSORIES

NOTES.
1. MATERIAL :- MILD STEEL
2. FINISH :-HOT DIP GALVANISED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	AB	AB	RJH	–	VV	–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

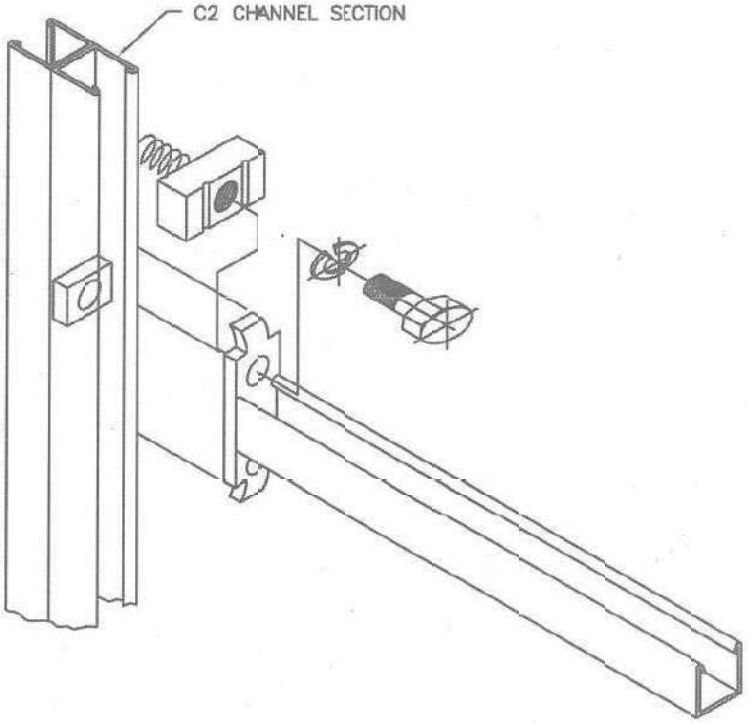
TITLE: TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-014	RC

TRAY1A-211-014

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



NOTE.

1. FINISH :-HOT DIP GALVANISED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	M3	M3	PM	–	VV	–	–	–	SD	05/22
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

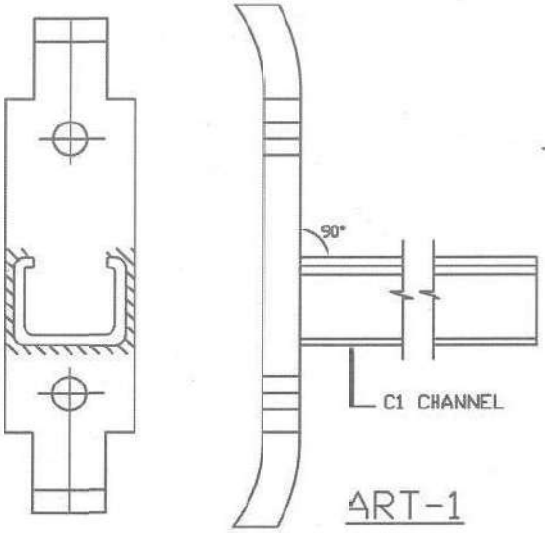
PROJECT: STANDARD

TITLE: TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM

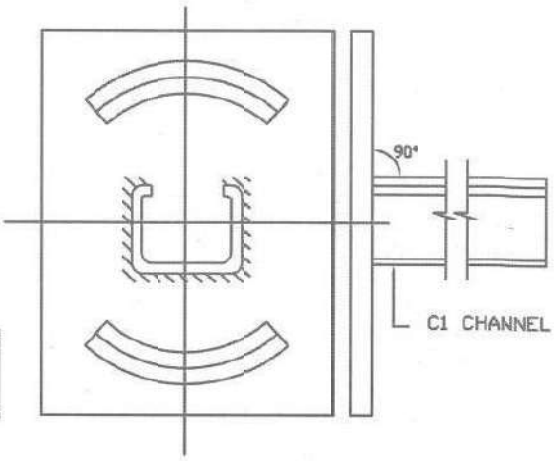
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-015	RC

985102/2022/PS-PEM-MAX

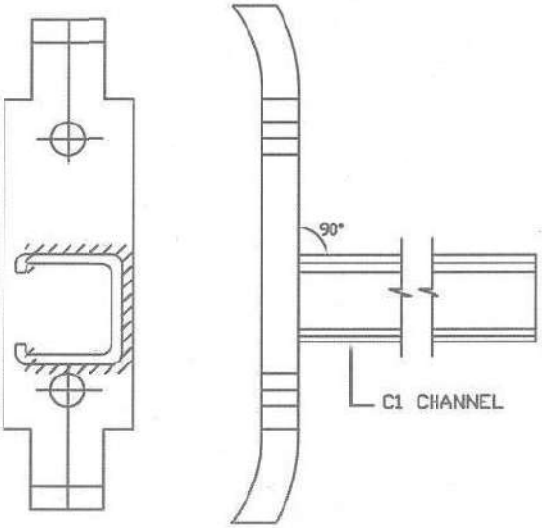
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



ART-1



ART-3



ART-2

NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.03.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

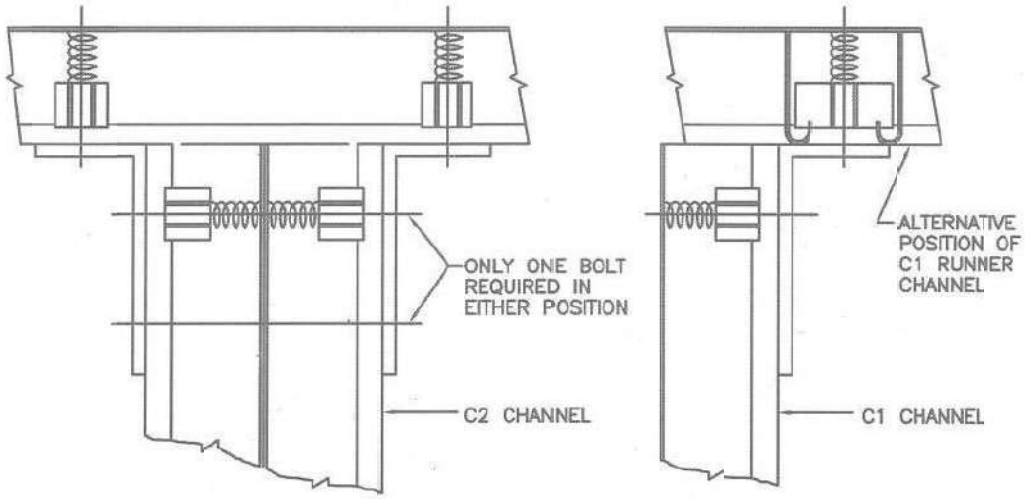
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: CANTILEVER ARMS

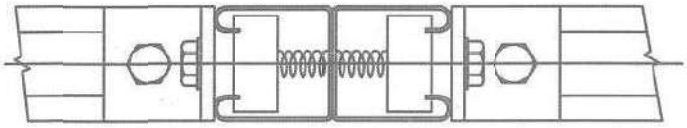
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-P0E-A-016	RC

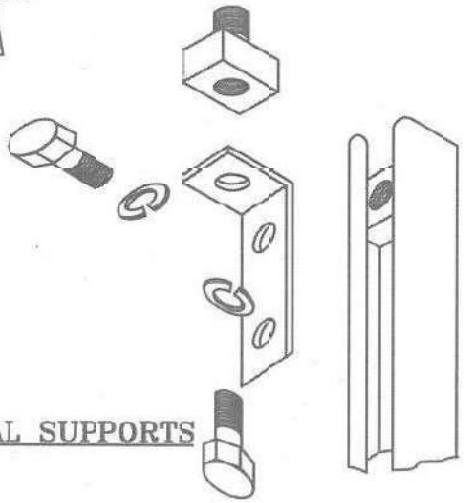
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



ASSEMBLY–1

ASSEMBLY–2





ASSEMBLY–1
UPPER FIXING C2 CHANNEL

ASSEMBLY–2
UPPER FIXING C1 CHANNEL

UPPER FIXING FOR CHANNEL VERTICAL SUPPORTS

NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05/10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

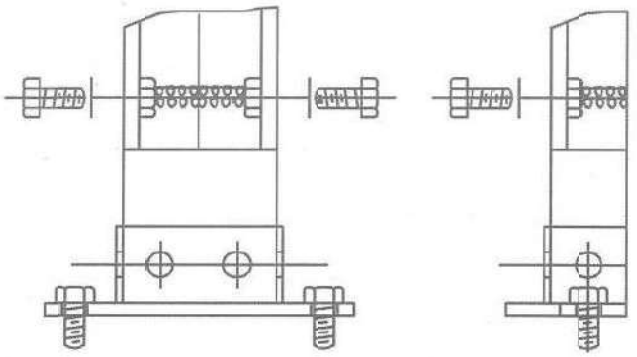
PROJECT: STANDARD

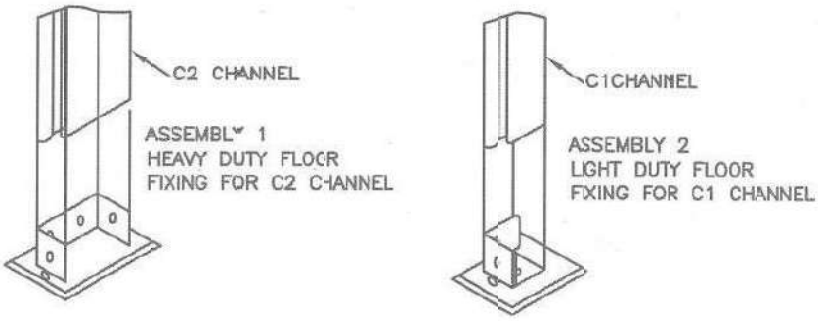
TITLE: TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-017	RC

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.





FLOOR FIXING FOR CHANNEL VERTICAL SUPPORTS

NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

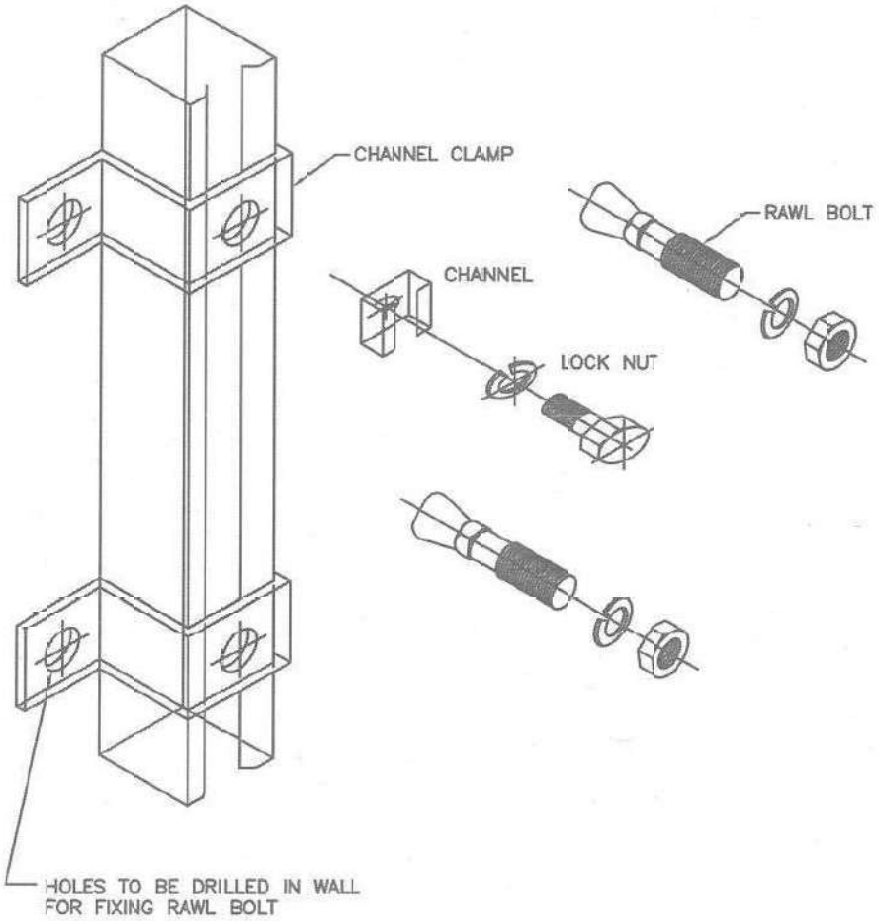
एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-018	REV. NO.: RC

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

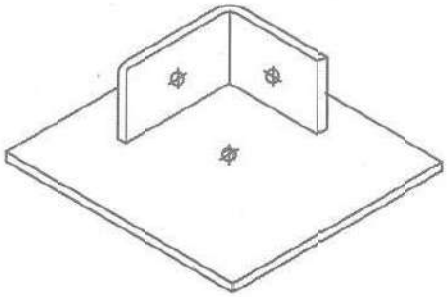
PROJECT: STANDARD

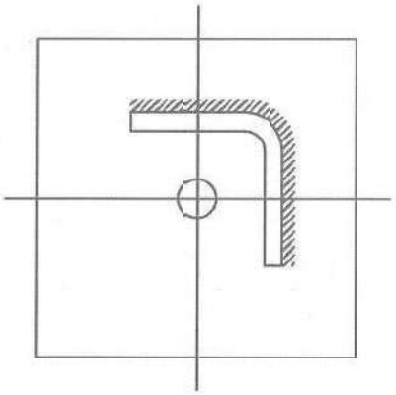
TITLE: FIXING OF CHANNEL IN TRENCH WALL

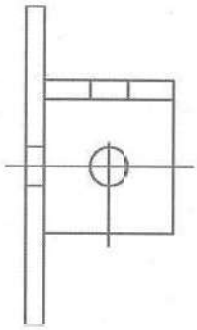
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-019	RC

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.







NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&C	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05/08/10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

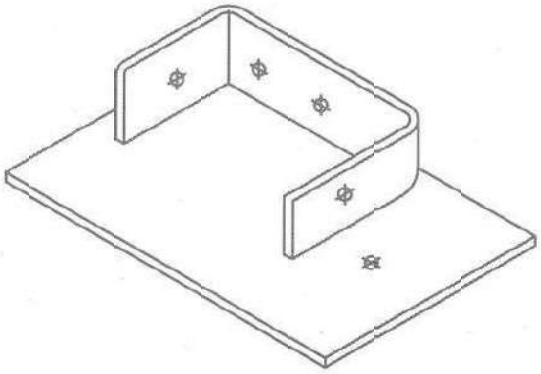
PROJECT: STANDARD

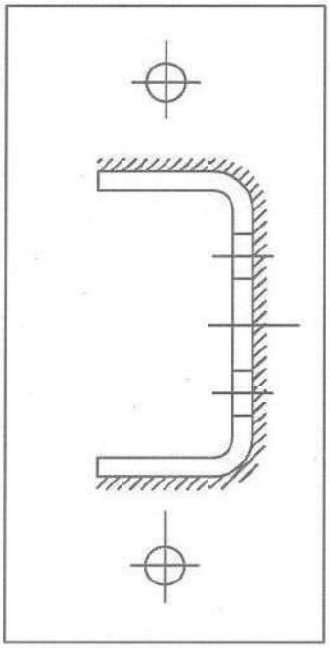
TITLE: BRACKET FLOOR PLATE LIGHT DUTY.

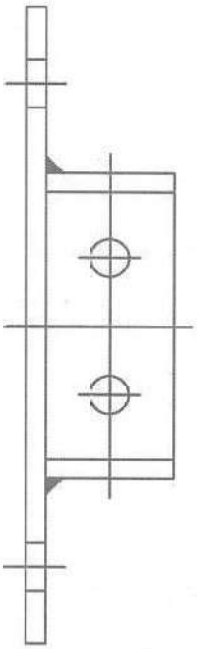
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-020	RC

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.







NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN/DESIGN	CHKD	M	E	C	C&	ARCH	APPD	DATE
				CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.07.22
RB	FOR TENDER PURPOSE	DL DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	– –	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

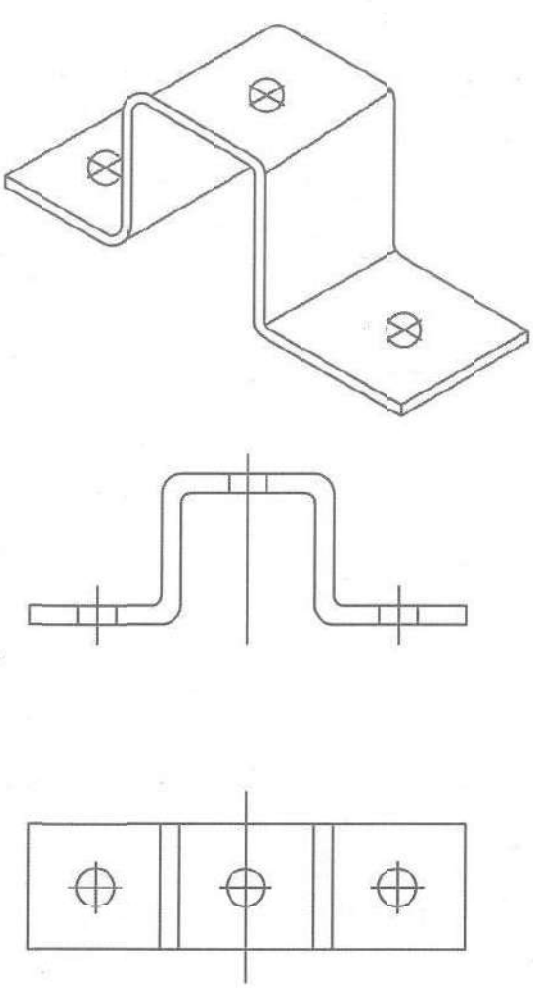
PROJECT: STANDARD

TITLE: BRACKET FLOOR PLATE HEAVY DUTY.

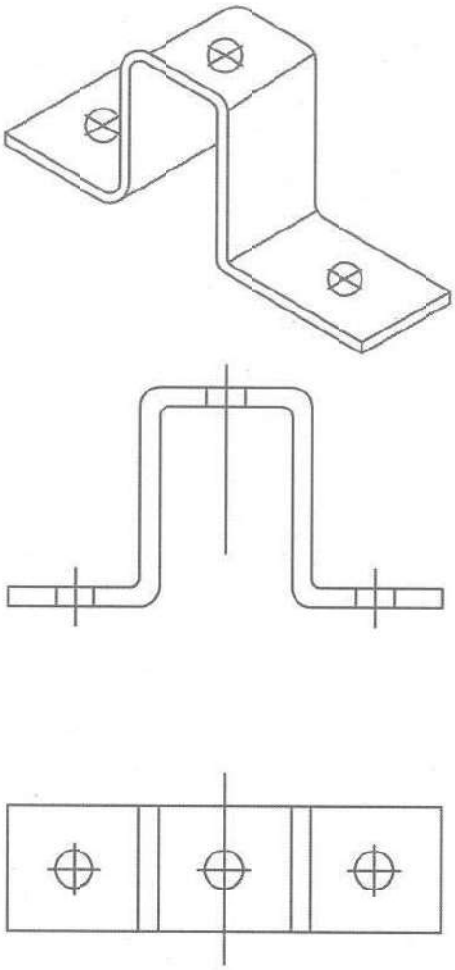
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-021	RC

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



BRACKET–C1 CHANNEL CLAMP HEAVY DUTY.



BRACKET–C2 CHANNEL CLAMP.

NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

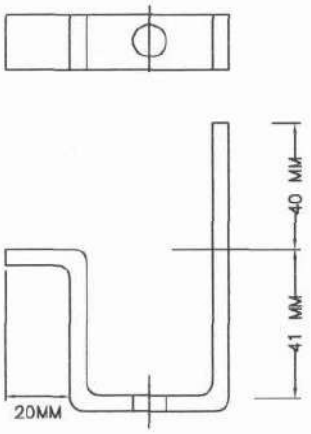
एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

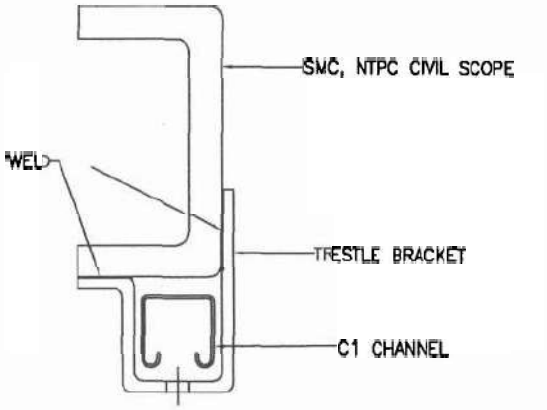
PROJECT: STANDARD

TITLE: BRACKET C1 CHANNEL CLAMP HEAVY DUTY AND BRACKET C2 CHANNEL

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-022	RC



TRESTLE BRACKET.



FIXING ARRANGEMENT OF TRESTLE BRACKET.

NOTES

1) MATERIAL : MILD STEEL.

2) FINISH : HOT DIP GALVANISED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RA	FOR TENDER PURPOSE	MV	RKP	VKM	-	SS	-	-	-	DT	08.10.2022
					CLEARED BY						

एन टी पी सी NTPC

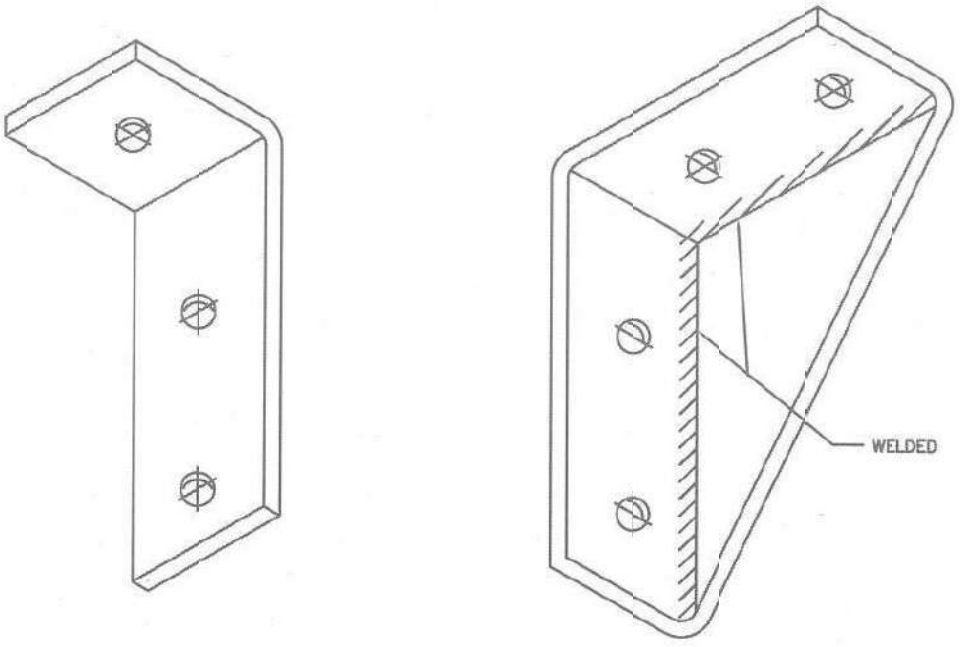
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
(FORMERLY NATIONAL THERMAL POWER CORPORATION LTD.)
ENGINEERING DIVISION

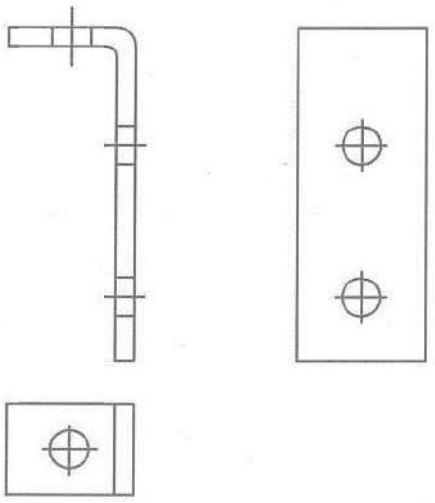
PROJECT	STANDARD		
TITLE	FIXING OF CHANNEL FOR TRESTLE AND TRESTLE BRACKET.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-022A	REV. NO. RA

TRAY1A-211-022A

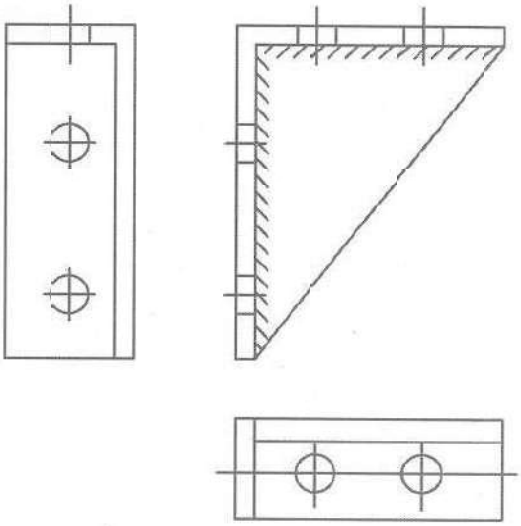
985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.





BRACKET RIGHT ANGLE.



BRACKET RIGHT ANGLE HEAVY DUTY.

NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

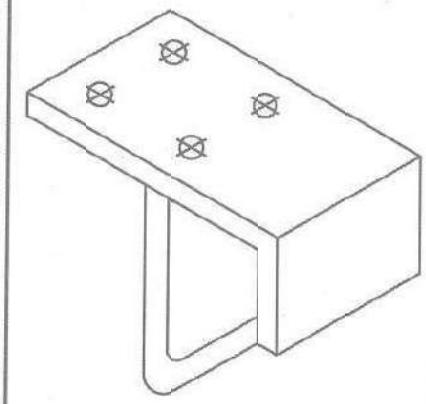
एन टी पीसी NTPC

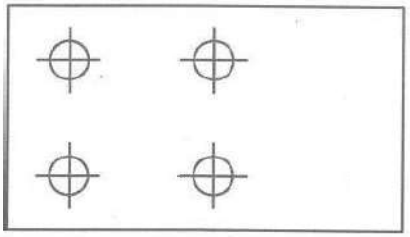
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

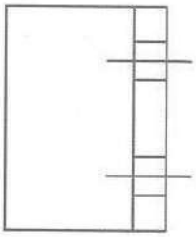
PROJECT	STANDARD		
TITLE	BRACKET RIGHT ANGLE & BRACKET RIGHT ANGLE HEAVY DUTY.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-023	REV. NO. RC

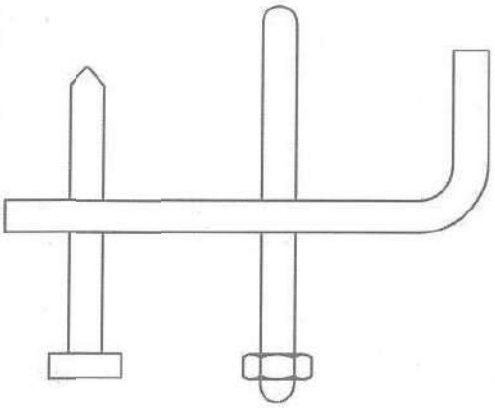
985102/2022/PS-PEM-MAX

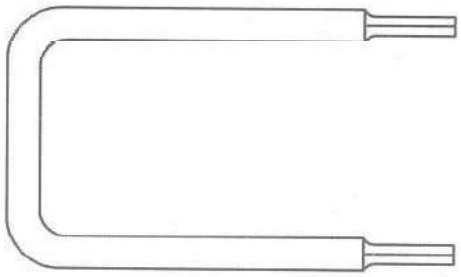
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.











NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

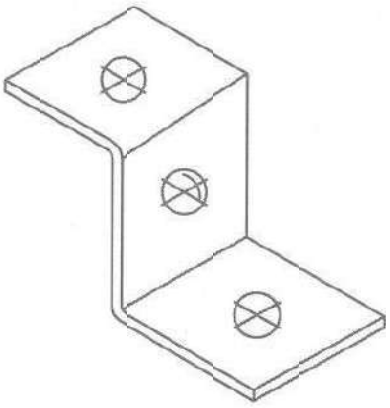
PROJECT: STANDARD

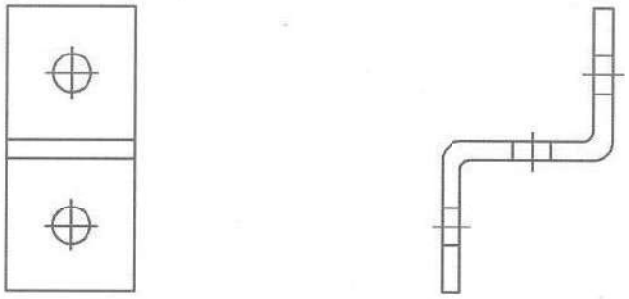
TITLE: BEAM CLAMP.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-21L-POE-A-024	RC

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.





BRACKET-C1 CHANNEL CLAMP.

NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN/DESIGN	CHKD	M	E	C	C&C	ARCH	APPD	DATE
				CLEARED BY						
RC	FOR TENDER PURPOSE	MB MB	PKP	–	VV	–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	– –	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

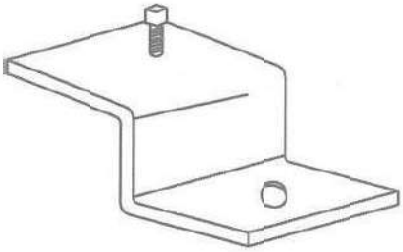
PROJECT: STANDARD

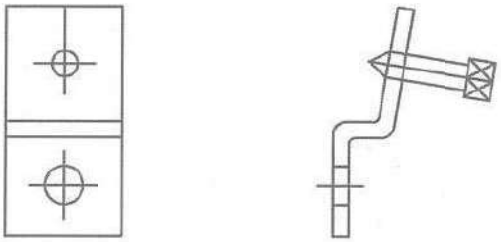
TITLE: BRACKET C1 CHANNEL CLAMP.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-025	RC

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.





NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

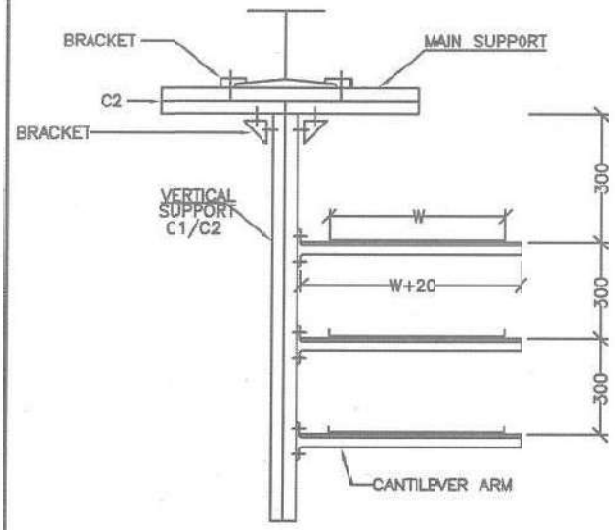
PROJECT: STANDARD

TITLE: BRACKET BEAM CLAMP

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-026	RC

985102/2022/PS-PEM-MAX

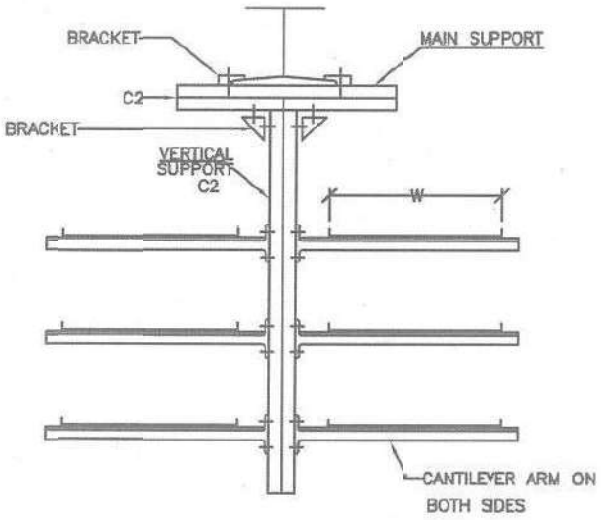
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



VERTICAL SUPPORT

1) FOR 1 TO 6 TIER OF 600mm TRAY – C2 CHANNEL
2) FOR 1 TO 3 TIER OF 300mm TRAY – C1 CHANNEL
3) FOR 4 TO 6 TIER OF 300mm TRAY – C2 CHANNEL
4) FOR 1 TO 6 TIER OF 150mm TRAY – C1 CHANNEL

ARRANGEMENT TYPE–B1



NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. IN CASE OF HANGING SUPPORT C2 CHANNEL TO BE USED FOR MAIN SUPPORT

ARRANGEMENT TYPE–B2

REV. NO.	DESCRIPTION	DRAWN/DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
				CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	DL DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	– –	–	–	–	–	–	–	–	[illegible]

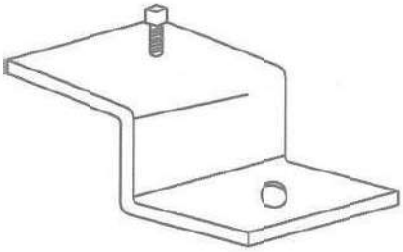
एन टी पी सी NTPC

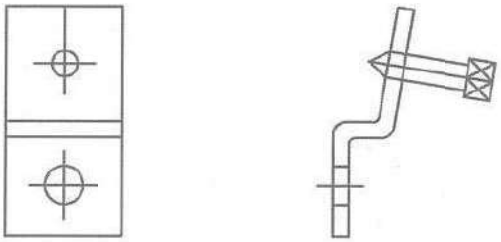
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-030	REV. NO. RC

985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.





NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

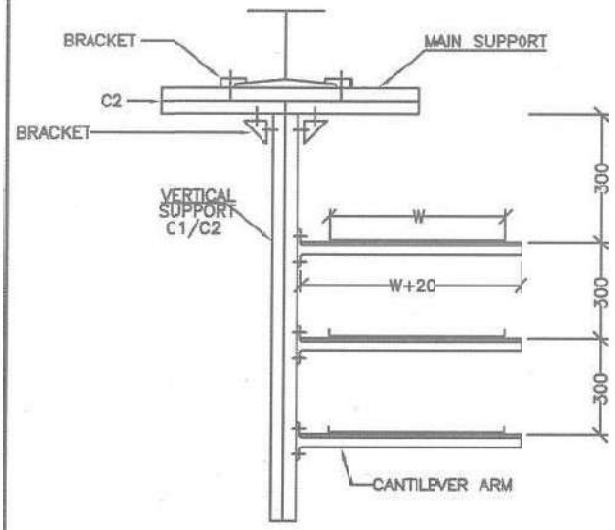
PROJECT: STANDARD

TITLE: BRACKET BEAM CLAMP

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-026	RC

985102/2022/PS-PEM-MAX

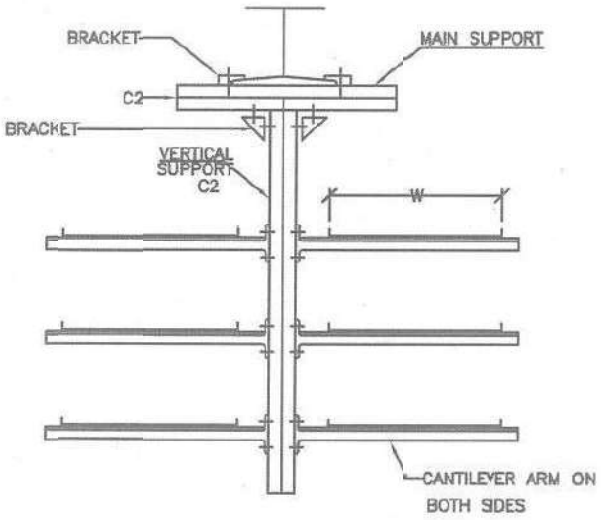
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



VERTICAL SUPPORT

1) FOR 1 TO 6 TIER OF 600mm TRAY – C2 CHANNEL
2) FOR 1 TO 3 TIER OF 300mm TRAY – C1 CHANNEL
3) FOR 4 TO 6 TIER OF 300mm TRAY – C2 CHANNEL
4) FOR 1 TO 6 TIER OF 150mm TRAY – C1 CHANNEL

ARRANGEMENT TYPE–B1



NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. IN CASE OF HANGING SUPPORT C2 CHANNEL TO BE USED FOR MAIN SUPPORT

ARRANGEMENT TYPE–E2

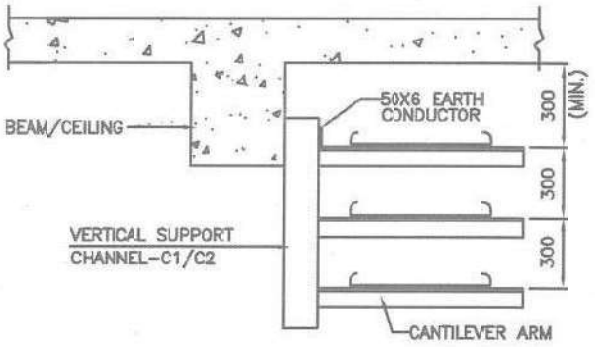
REV. NO.	DESCRIPTION	DRAWN/DESIGN	CHKD	M	E	C	C&C	ARCH	APPD	DATE
				CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	DL DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	– –	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

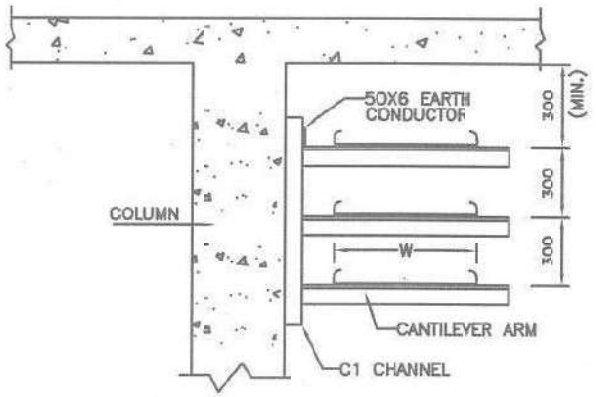
PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-030	REV. NO. RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



VERTICAL SUPPORT

1) FOR 1 TO 6 TIER OF 600mm TRAY – C2 CHANNEL
2) FOR 1 TO 3 TIER OF 300mm TRAY – C1 CHANNEL
3) FOR 4 TO 6 TIER OF 300mm TRAY – C2 CHANNEL
4) FOR 1 TO 6 TIER OF 150mm TRAY – C1 CHANNEL



ARRANGEMENT TYPE–C1

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

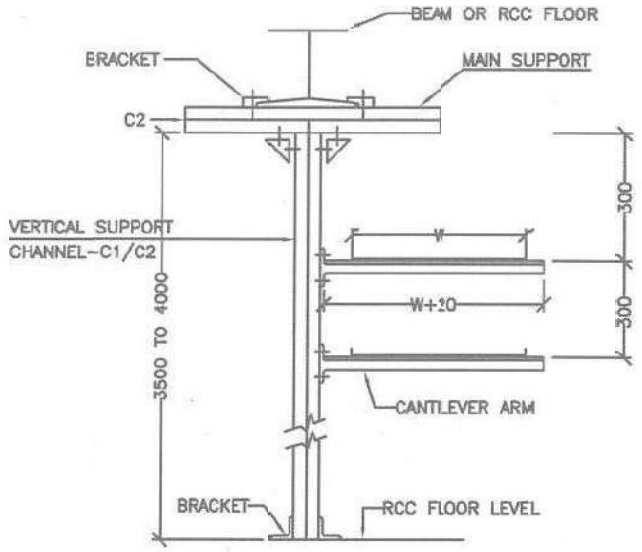
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	01.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

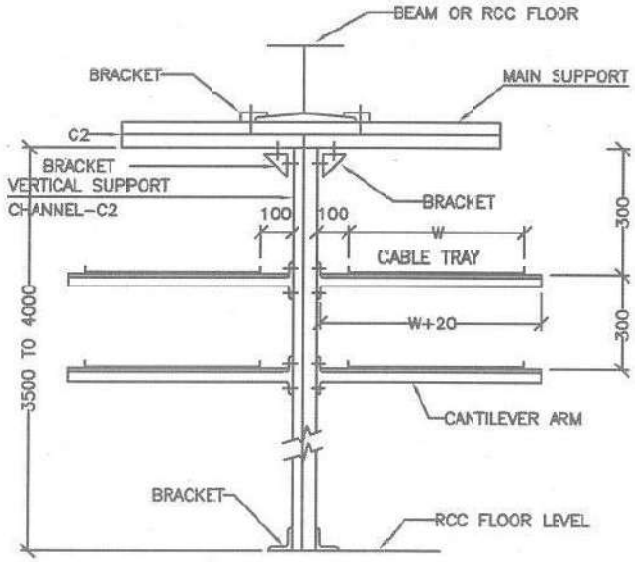
PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-031	REV. NO. RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



VERTICAL SUPPORT
1) UPTO 3 TIER – C1 CHANNEL
2) ABOVE 3 TIER – C2 CHANNEL

ARRANGEMENT TYPE-D1



ARRANGEMENT TYPE-D2

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

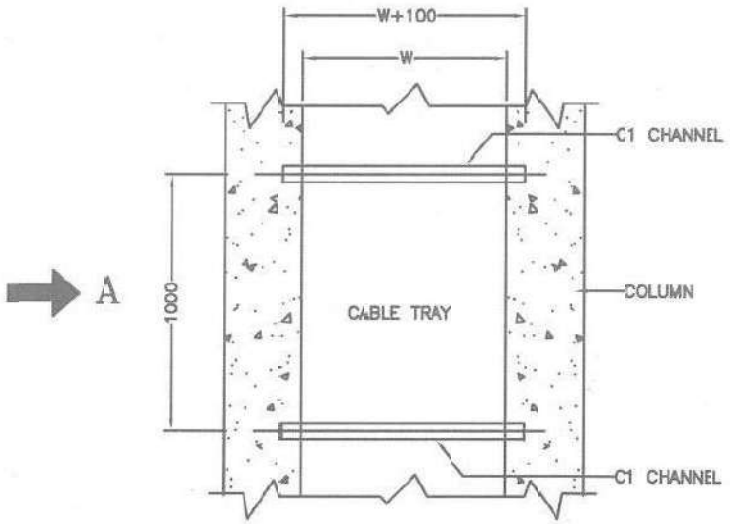
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

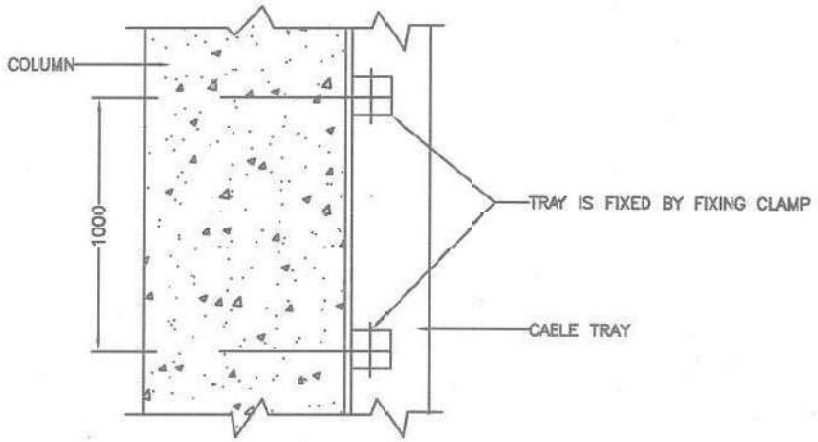
TITLE: STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-032	RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



(W=WIDTH OF CABLE TRAY)



VIEW–A

ARRANGEMENT TYPE–S1

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	—	[illegible]	—	—	—	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	—	RA	—	—	—	AS	[illegible]
RA	FOR TENDER PURPOSE	—	—	—	—	—	—	—	—	—	[illegible]

एन टी पी सी NTPC

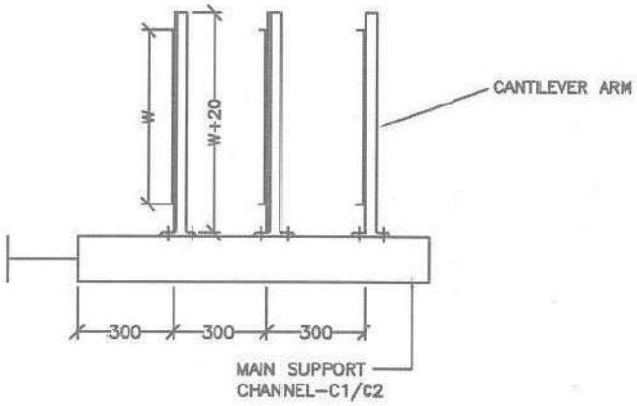
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-033	REV. NO. RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

MAIN SUPPORT

1) FOR 1 TO 5 TIER OF 500mm TRAY – C2 CHANNEL
2) FOR 1 TO 3 TIER OF 500mm TRAY – C1 CHANNEL
3) FOR 4 TO 5 TIER OF 500mm TRAY – C2 CHANNEL
4) FOR 1 TO 5 TIER OF 150mm TRAY – C1 CHANNEL



ARRANGEMENT TYPE-S2

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

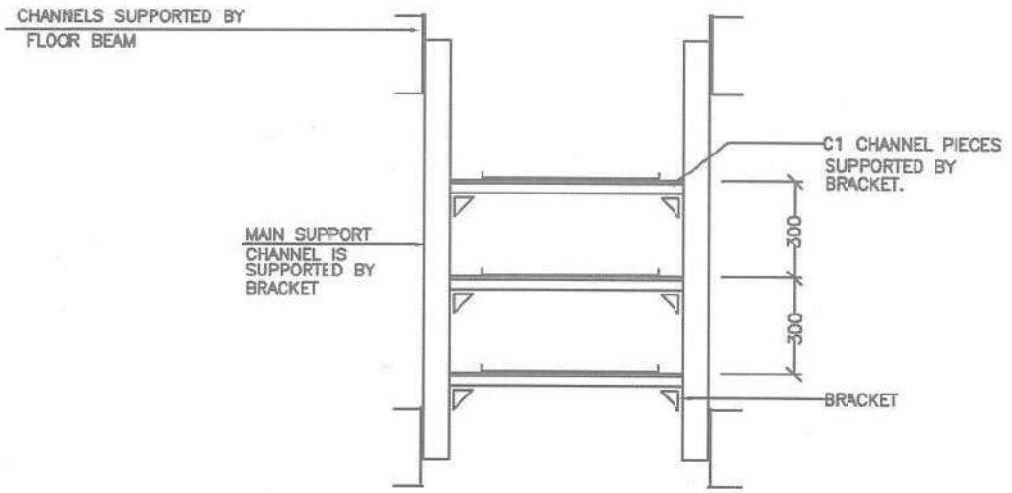
PROJECT: STANDARD

TITLE: STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-034	RC

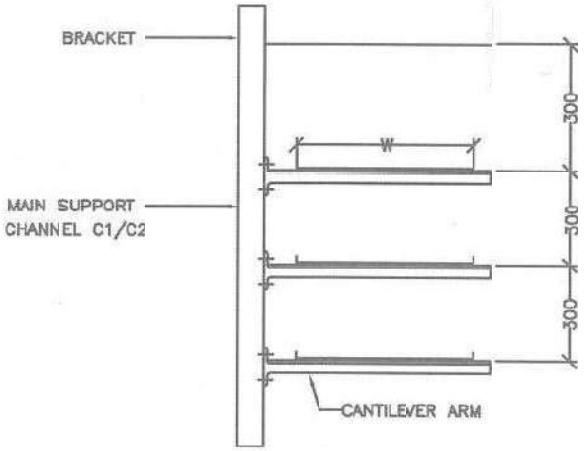
985102/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



MAIN SUPPORT
1) UPTO 3 TIER – C1 CHANNEL
2) ABOVE 3 TIER – C2 CHANNEL

ARRANGEMENT TYPE–S3



ARRANGEMENT TYPE–S4

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	01.10.22
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

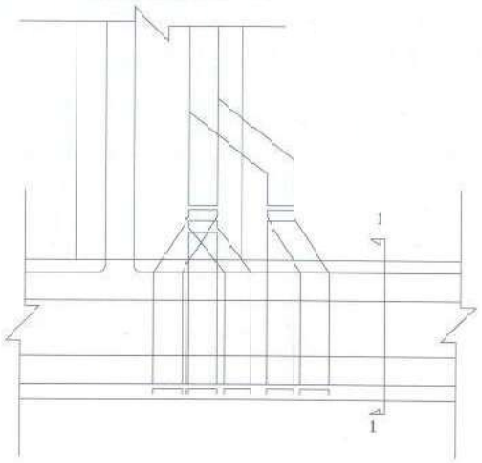
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

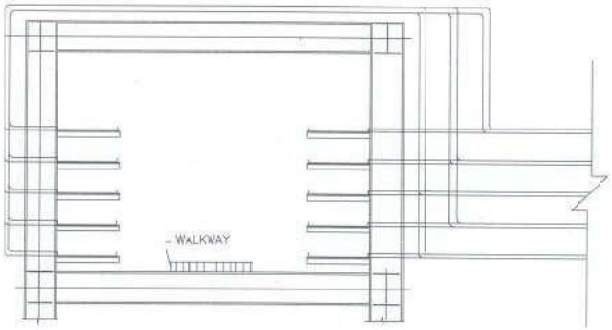
PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-035	REV. NO. RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

TRESTLE–1

TRESTLE–2





SECTION 1–1

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
FA.	FOR TENDER PURPOSE										

CLEARED BY

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

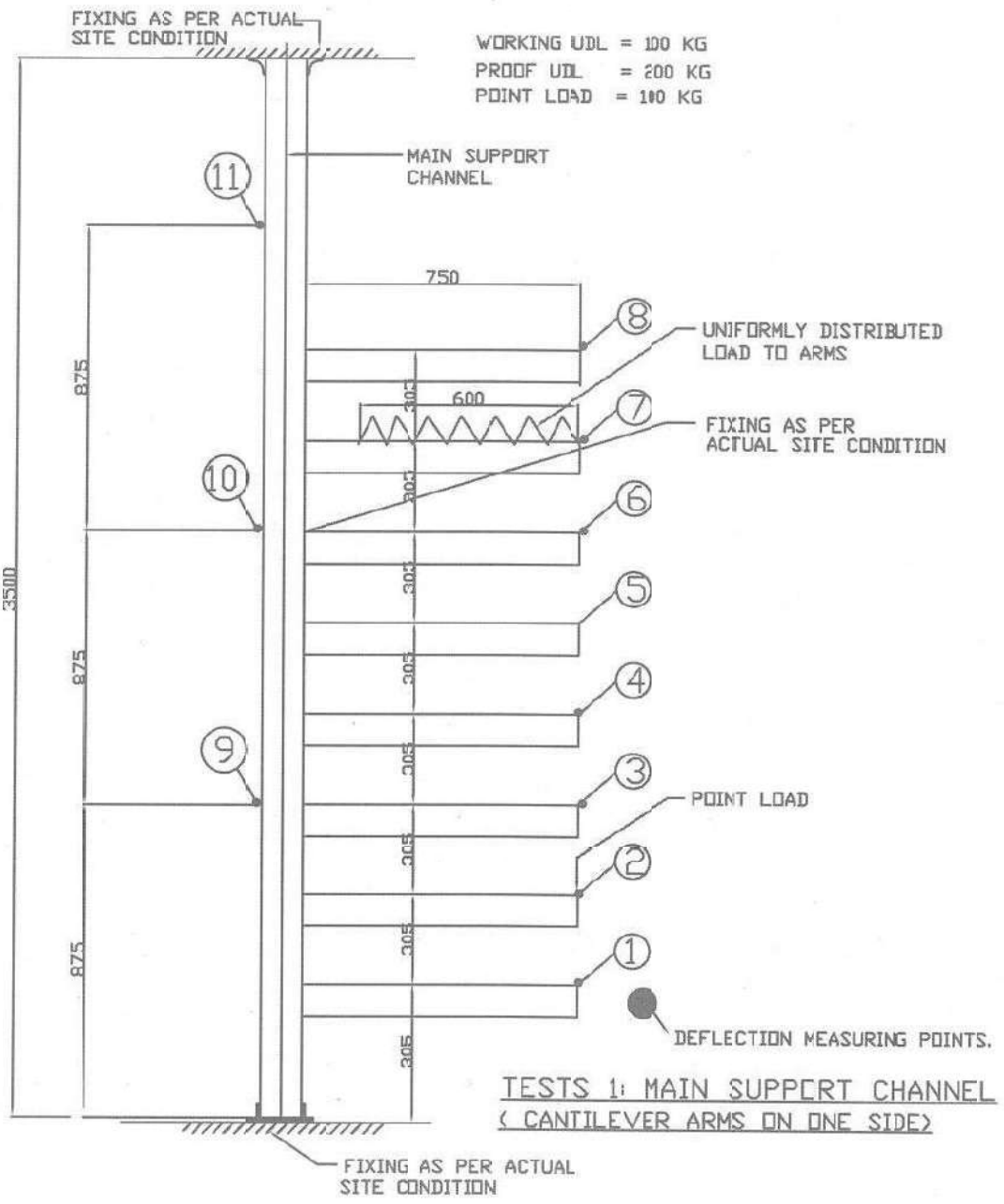
PROJECT: STANDARD

TITLE: TYPICAL INTERCONNECTION DETAILS BETWEEN TWO PERPENDICULAR TRESTLES

SIZE	SCALE	DRG. NO	REV. NO.
A4	NTS	0000-21-PDE-A-035A	FA

985109/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



TESTS 1: MAIN SUPPORT CHANNEL
(CANTILEVER ARMS ON ONE SIDE)

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKN	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

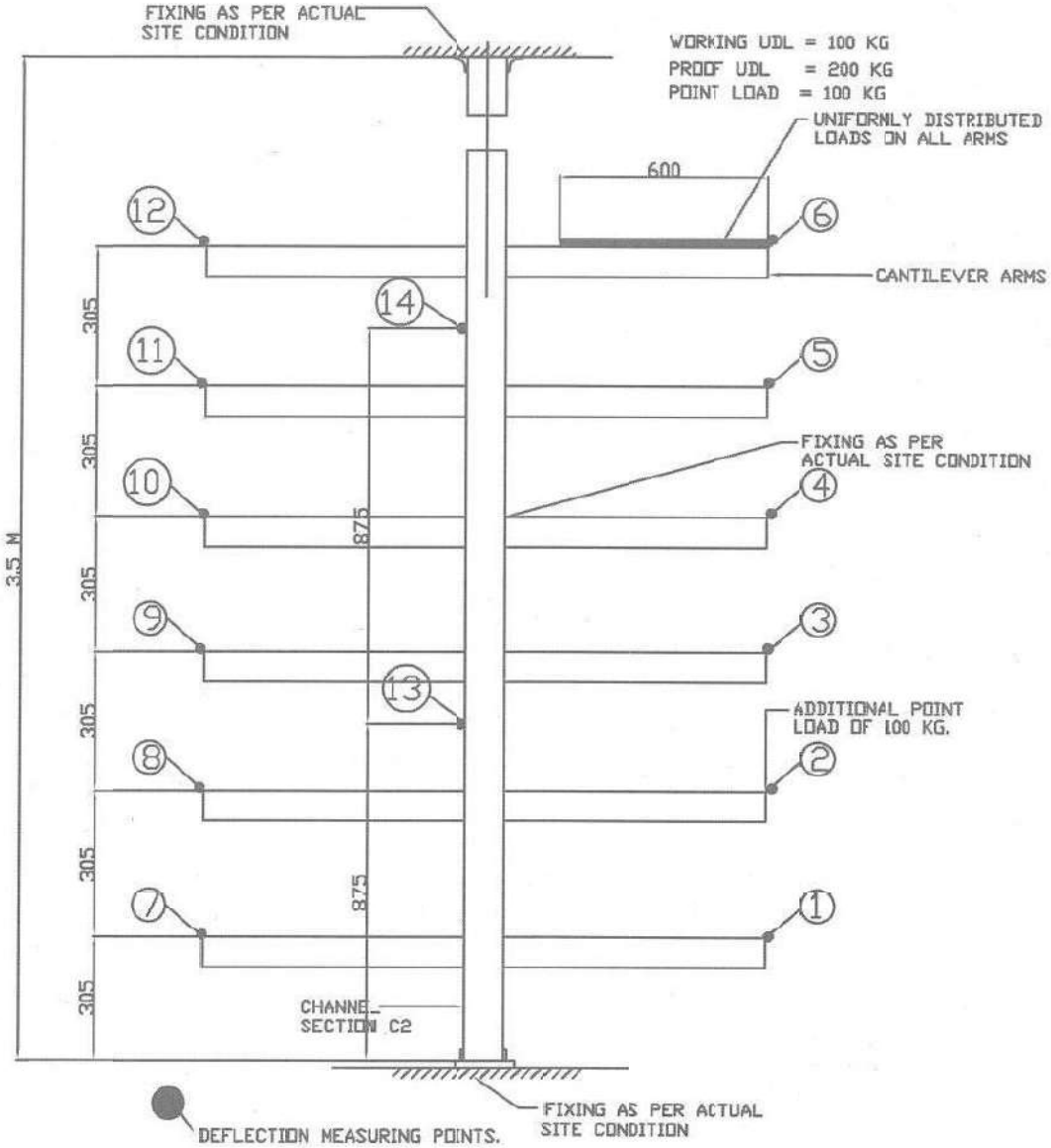
PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF STRUCTURE FOR TESTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-P0E-A-036	RC

985109/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



TEST 2A : MAIN SUPPORT CHANNEL

(CANTILEVER ARMS ON BOTH SIDES)

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&C	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKN	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

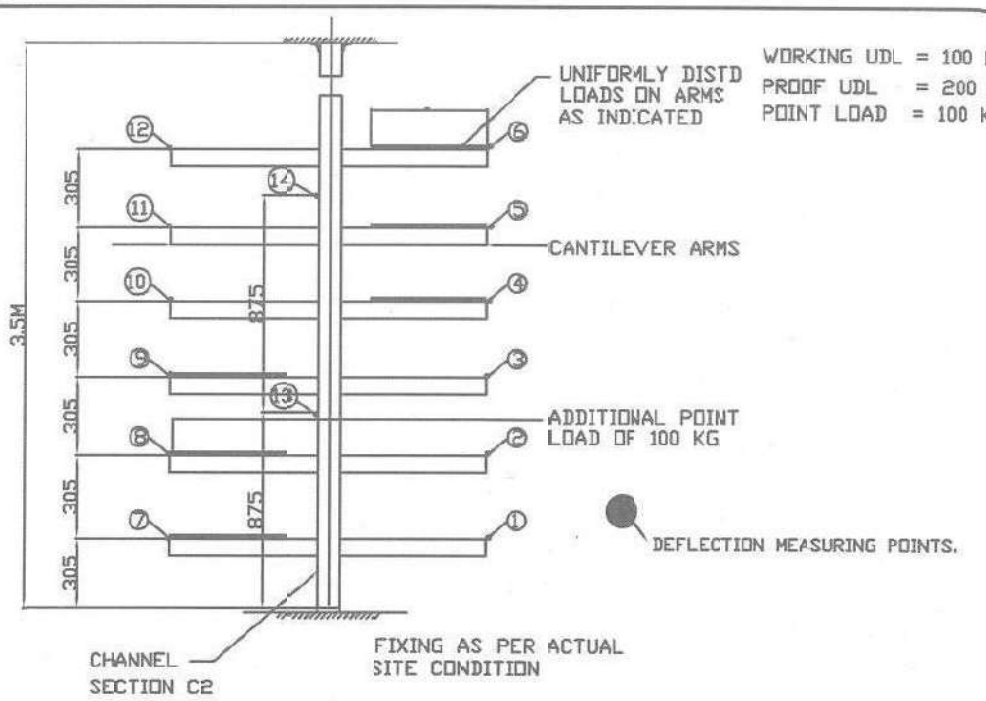
PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF STRUCTURE FOR TESTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-P0E-A-037	RC

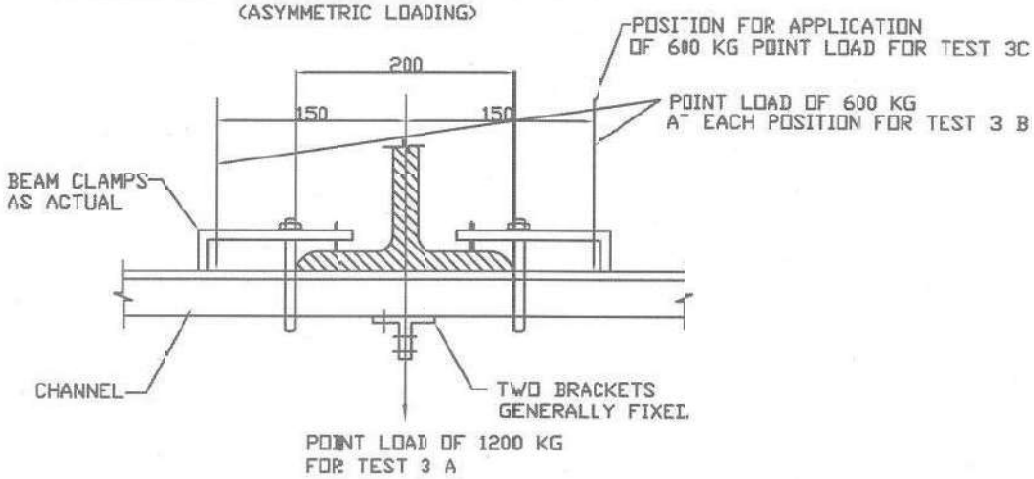
985109/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



TEST 2B MAIN SUPPORT CHANNEL

(ASYMMETRIC LOADING)



TEST 3A, 3B & 3C

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	RKC	RKG	VKM	–	SS	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

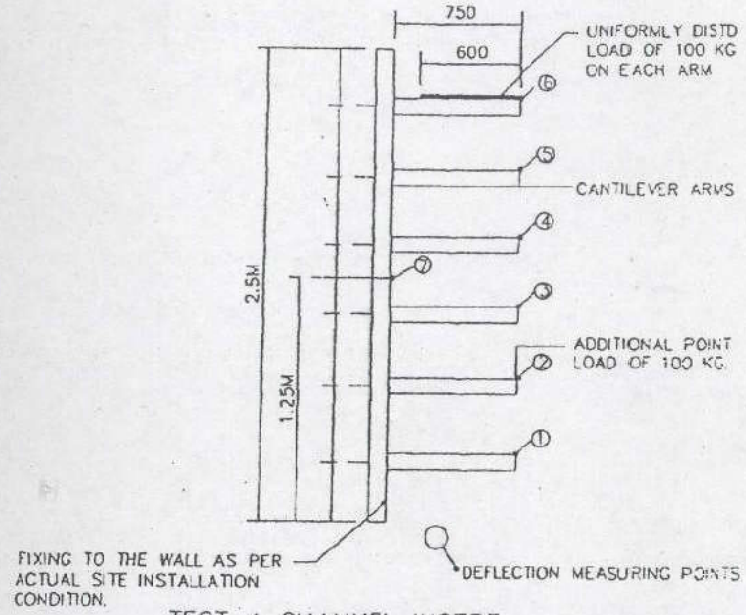
PROJECT: STANDARD

TITLE: TYPICAL DETAILS STRUCTURE FOR TESTING

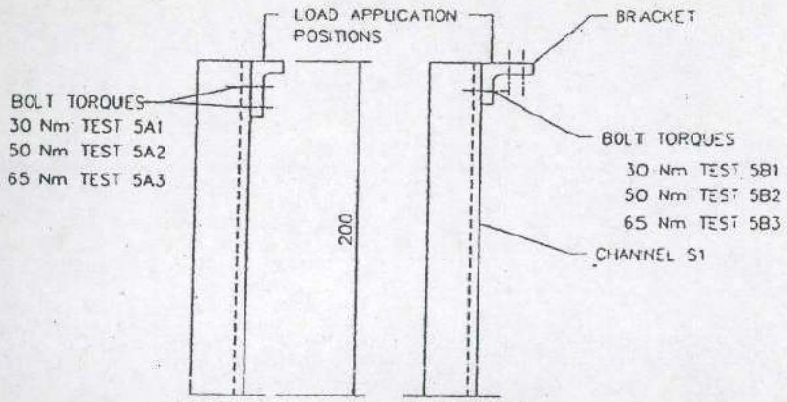
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-038	RC

985109/2022/PS-PEM-MAX

WORKING UDL = 100 KG
PROOF UDL = 200 KG
POINT LOAD = 100 KG



TEST 4 CHANNEL INSERT



ASSEMBLE USING M12 x25 MM LONG HEX. HD. SCREWS LOCK WASHERS AND M12 CHANNEL NUT WITH SPRING

TESTS 5A 1,2,3 & 5B 1,2,3 CHANNEL NUT SLIP CHARACTERISTIC.

NOTES

ALL DIMENSIONS ARE IN MM
(SCALE–NTS)

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RB	FOR TENDER PURPOSE				-		-	-	-		
RA	FOR TENDER PURPOSE ONLY				-		-	-	-		

CLEARED BY

एनटीपीसी NTPC

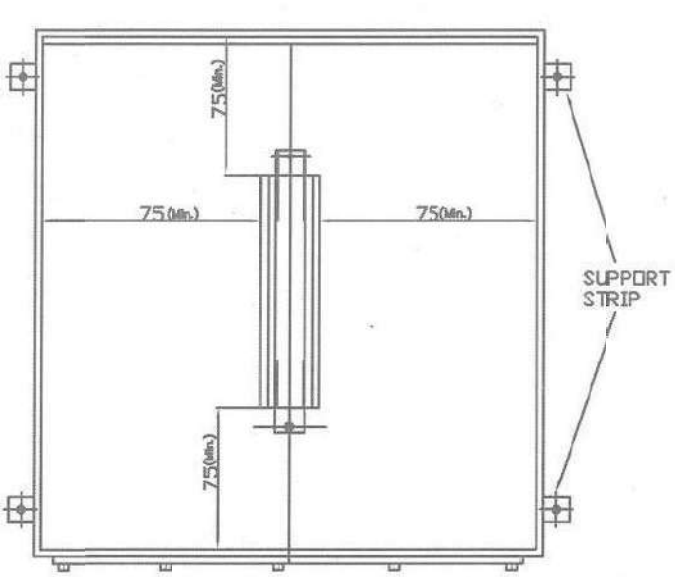
NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	TYPICAL DETAILS OF STRUCTURE FOR TESTING		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-039	REV. NO. RB

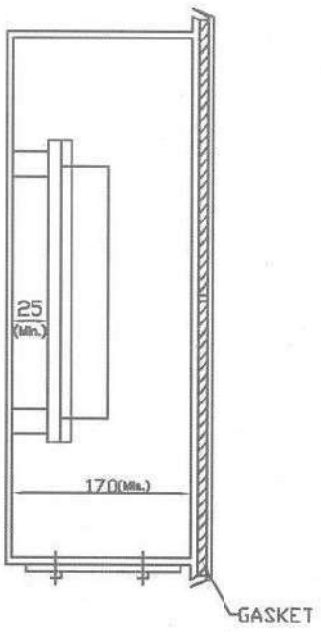
CAD FILE NAME : STAND-211-039.DWG

985109/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



FRONT VIEW WITH COVER REMOVED



NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.08.22
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

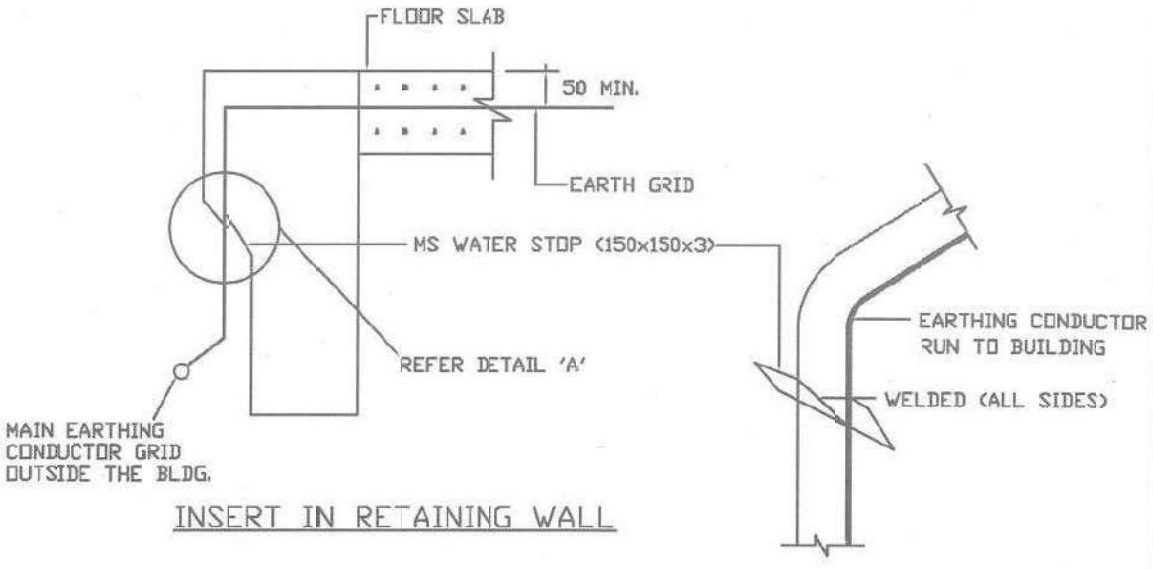
PROJECT: STANDARD

TITLE: TYPICAL DRAWING FOR JUNCTION BOX

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-040	RC

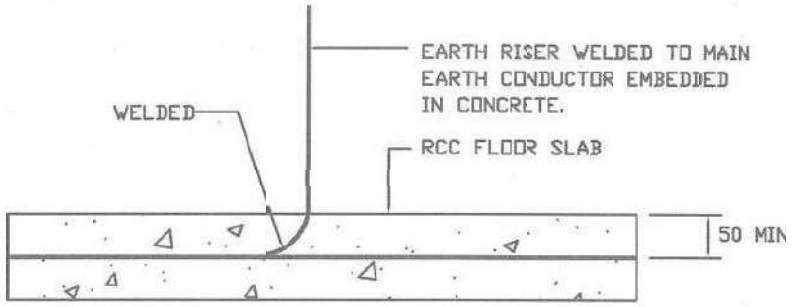
985109/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



INSERT IN RETAINING WALL

DETAIL 'A'



EARTH RISER

NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

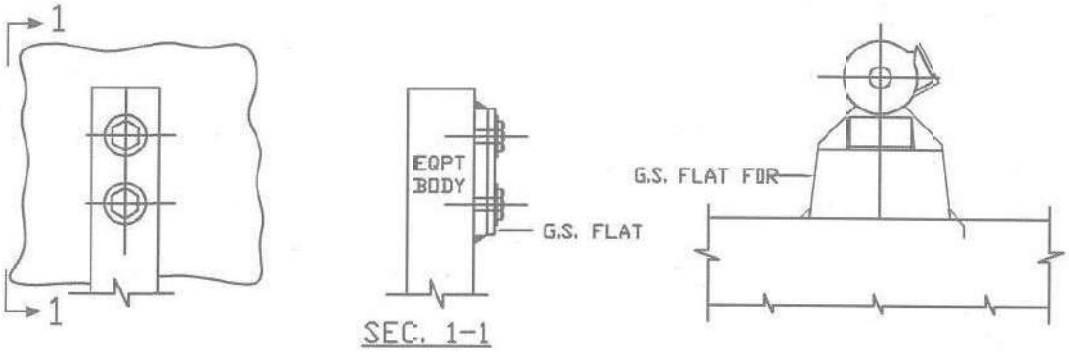
PROJECT: STANDARI

TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-041	RC

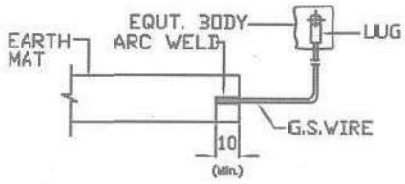
985109/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

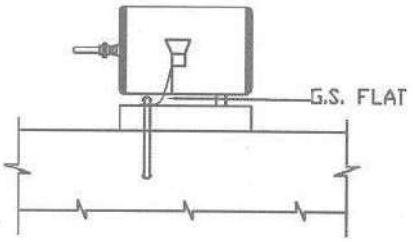


SEC. 1-1

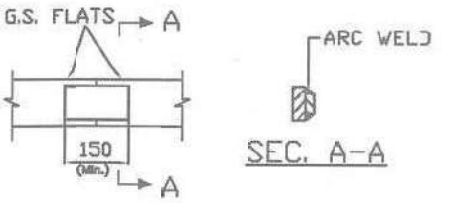
EQUIPMENT GROUNDING WITH G.S. FLAT



EQUIPMENT GROUNDING WITH G.S. WIRE

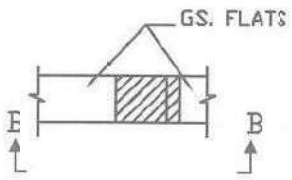


MOTOR TERMINAL BOX GROUNDING DETAIL

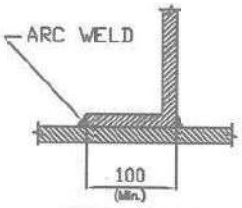


LAP JOINTS BETWEEN G.S. FLATS

SEC. A-A



ANGULAR JOINTS BETWEEN G.S. FLATS



SEC. B-B

NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	CLEARED BY M	E	C	C&I	ARCH	APPD	DATE
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

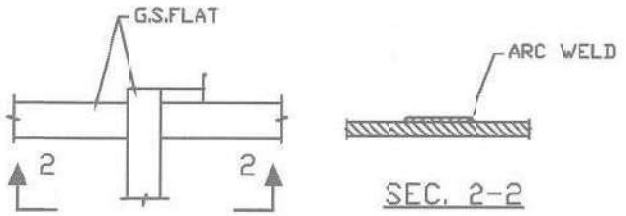
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

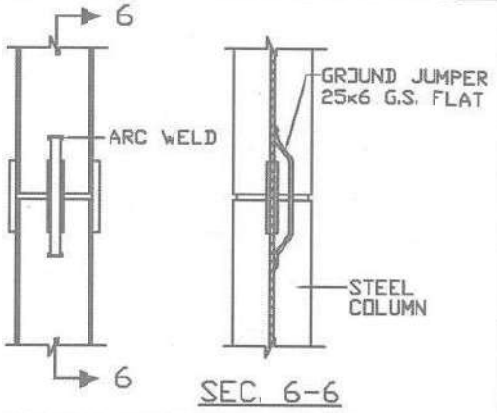
TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-042	RC

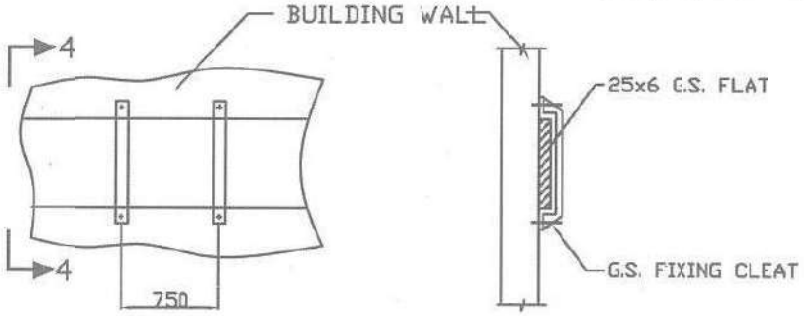
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



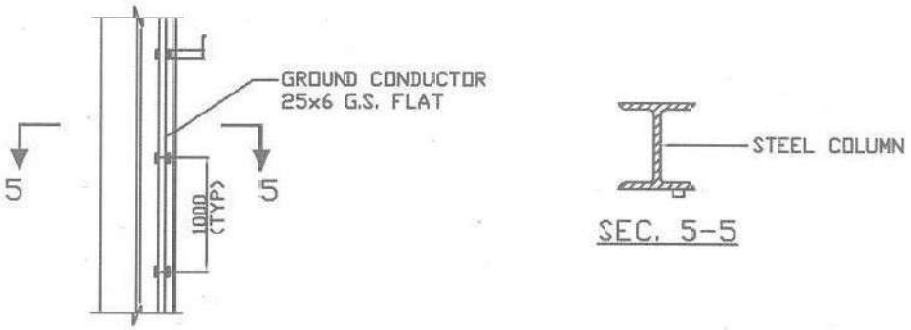
CROSS JOINTS BETWEEN FLATS



BONDING OF STEEL COLUMN



GROUND CONDUCTOR ALONG BUILDING WALL



GROUND CONDUCTOR ALONG STEEL COLUMN STRUCTURE

NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	RKC	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

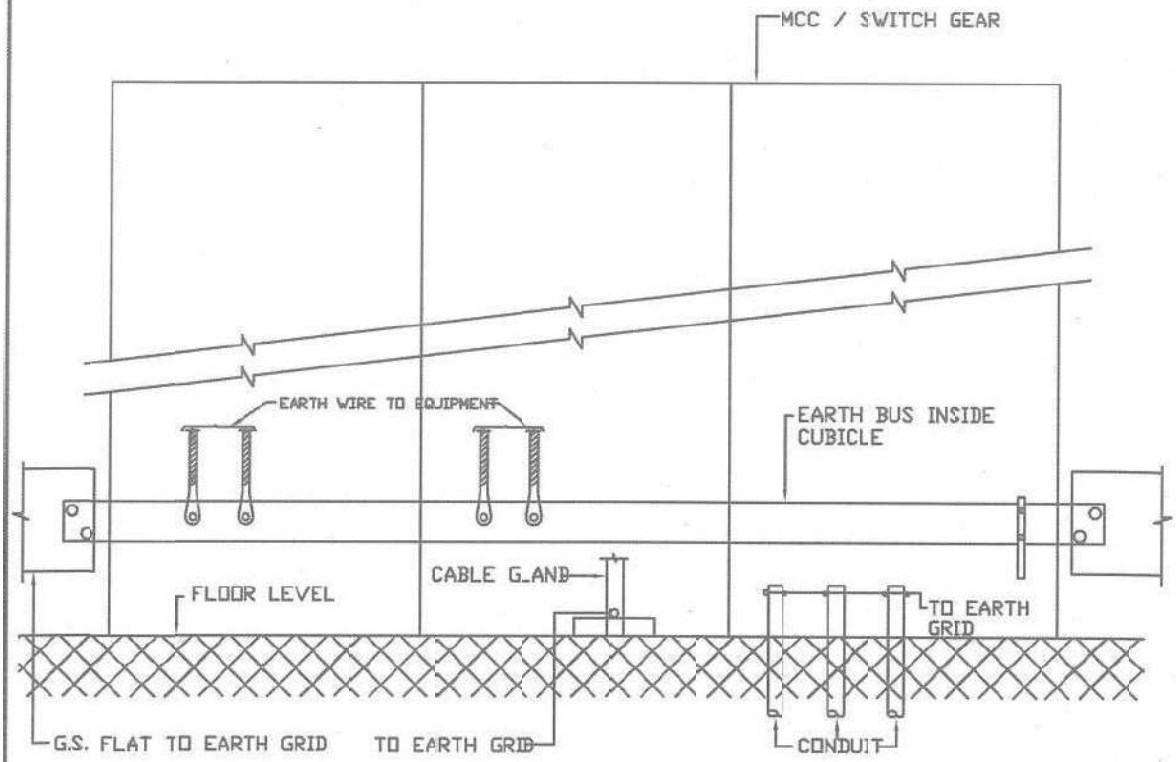
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

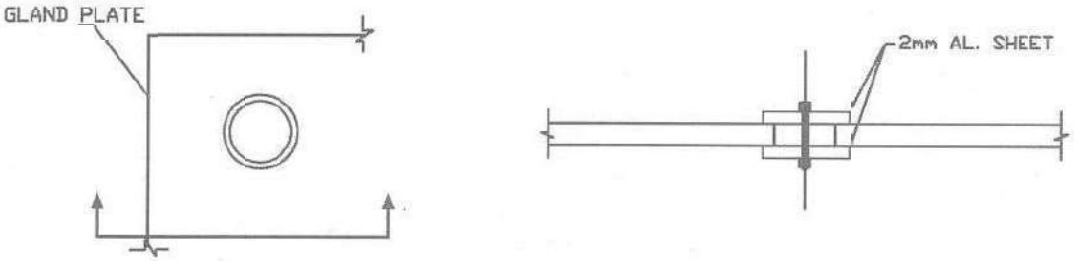
TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-043	RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



EARTHING DETAILS MCC AND SWITCHGEAR



SEALING OF UNUSED CABLE OPENING

NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	05.07.22
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	30.11.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.04.2006

एन टी पी सी NTPC

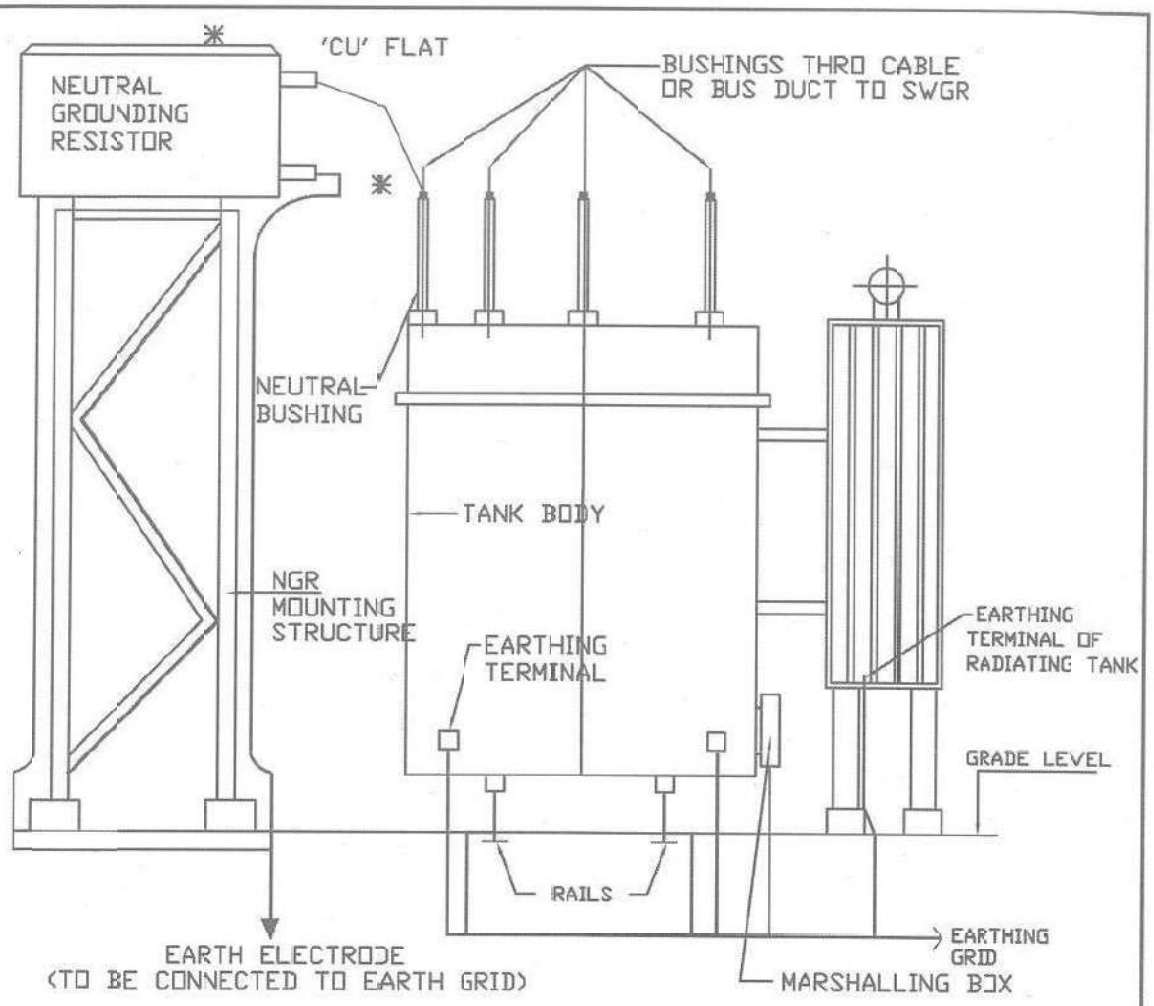
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-044	RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



EARTHING DETAILS TRANSFORMER

NOTE.
1. ALL DIMENSIONS ARE IN mm.
2. THE TRANSFORMER NEUTRAL FOR HT TRANSFORMER SHALL BE EARTHED THROUGH FLATS AS SHOWN (SUPPLIED BY TRANSFORMER SUPPLIER)

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APP'D	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		25.07.19
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

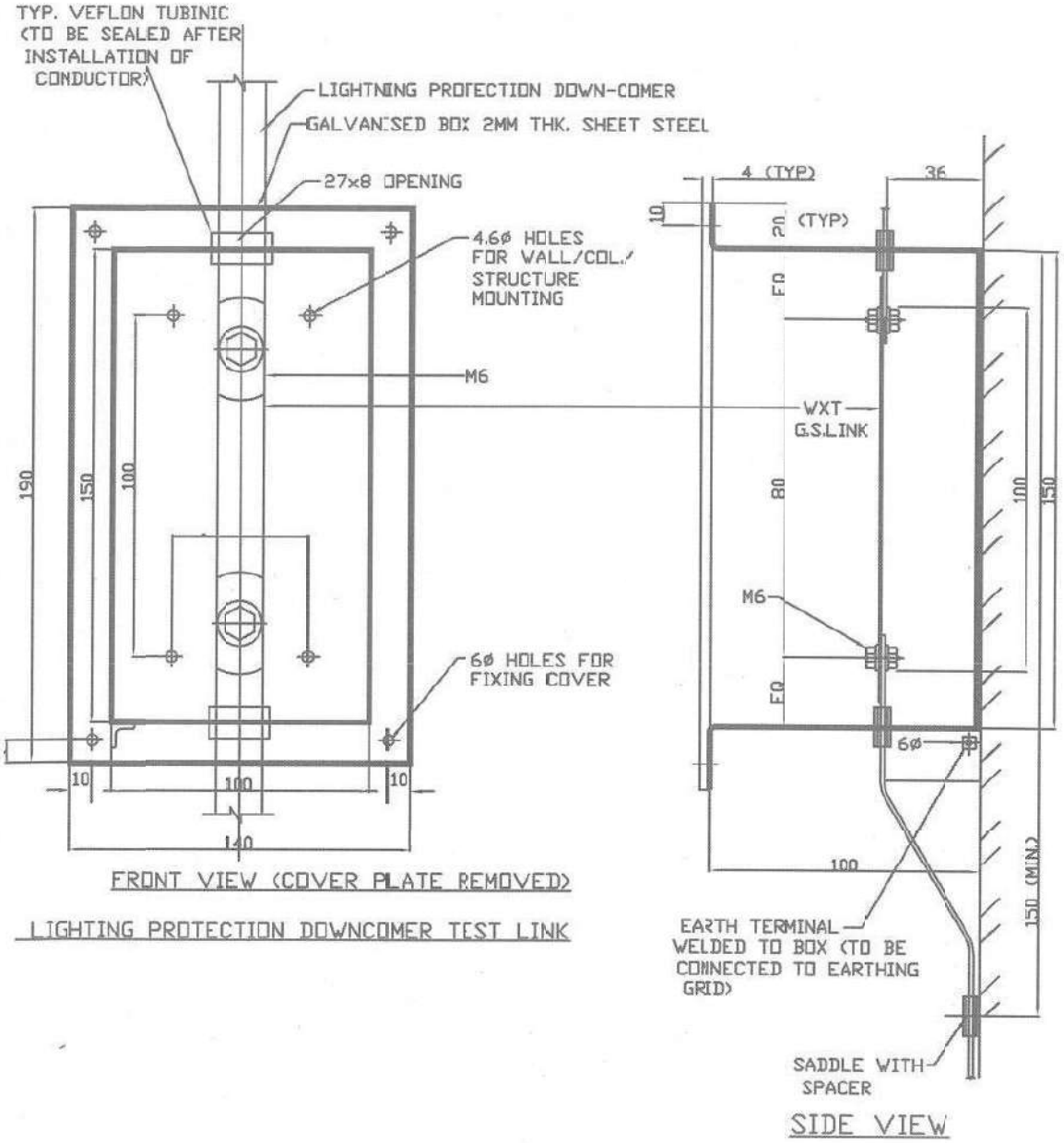
PROJECT: STANDARD

TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-045	RC

985109/2022/PS-PEM-MAX

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



NOTE.
1. ALL DIMENSIONS ARE IN mm.
2. THE TEST LINK SHALL BE OF SAME WIDTH AND THICKNESS AS THE DOWNCOMER.THE NUTS BOLTS AND WASHER TO BE OF GS.
3. THE DOWN COMER ENTRY AND EXIT POINTS IN TO BOX BE MADE WATER-TIGHT AFTER LAYING OF CONDUCTOR.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.02.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKN	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

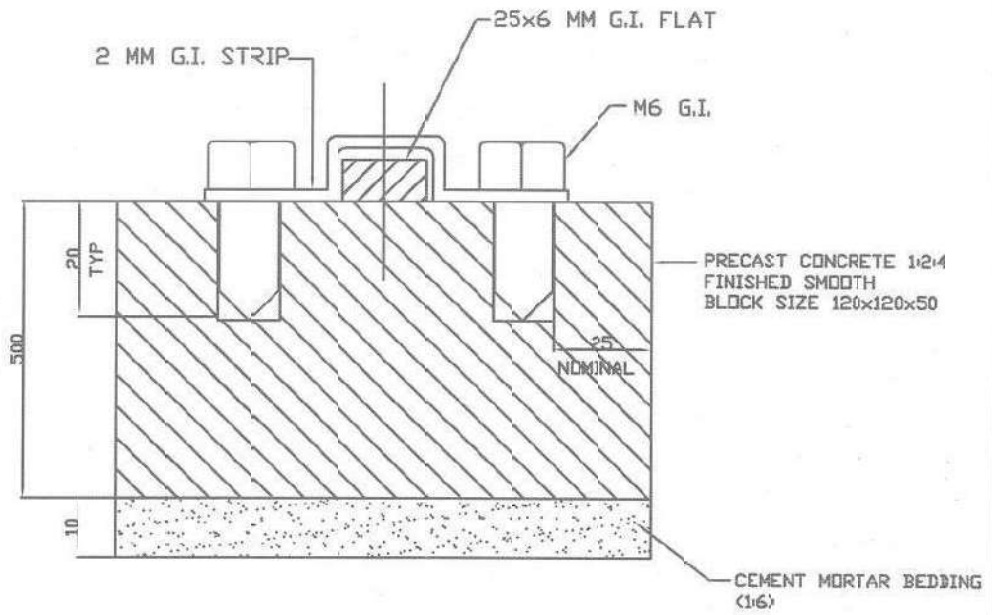
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: LIGHTNING PROTECTION DETAILS.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-047	RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



BLOCK SPACING 1000MM CENTRE TO CENTRE

TYPICAL DETAILS OF CLEATING HORIZONTAL CONDUCTOR OVER WATER PROOFING

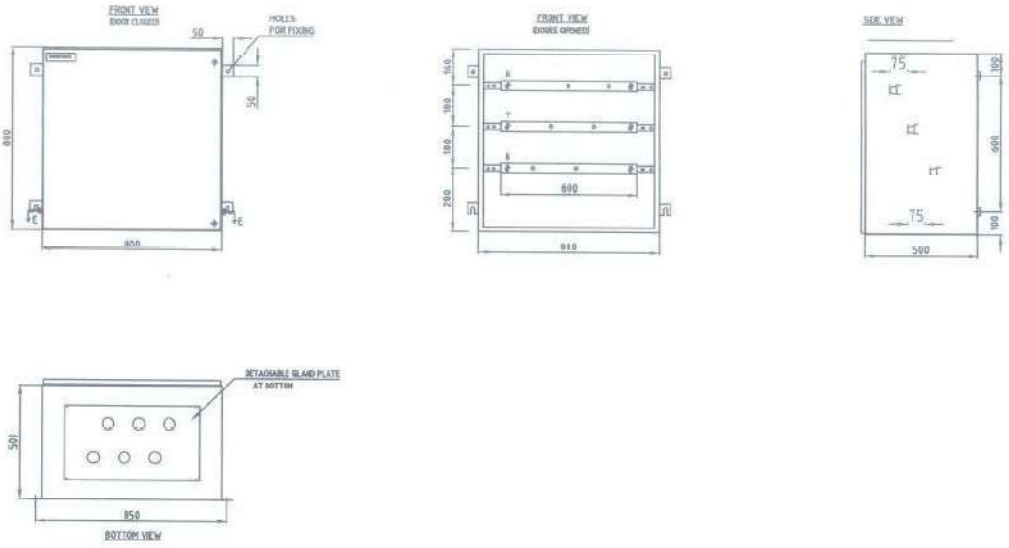
NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRWN	DESIGN	CHKD	M	E	C	C&d	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	LIGHTNING PROTECTION DETAILS		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-048	REV. NO. RC



GENERAL TECHNICAL PARTICULARS

1. ALL DIMENSIONS ARE IN MM.
2. TYPE: WALL/COLUMN/PEDESTAL MOUNTING TYPE.
3. SHEET: CRCA SHEET min. 2mm THK.
4. GLAND PLATE SHOULD BE OF 3MM THK ALUMINIUM, REMOVABLE TYPE WITH KNOCKOUT HOLE FOR I/C CABLE 1Cx300SQ.MM AL. 6NOS.
   HOLE FOR O/G CABLE–1Cx185SQ.MM AL.–6NOS.
5. PAINT: PRETREATMENT POWDER COATING
6. SHADE: GREY RAL–9002
7. CABLE ENTRY: BOTTOM
8. BUSBAR: ELECTOLYTIC GRADE TINNED CU. OF Min. 40x10MM
9. IP–55
10. BUS BAR INSULATOR–SMC TYPE
11. BUS BAR ARRANGEMENT: HORIZONTAL
12. BUS BAR SHALL HAVE ONE HOLE DRILLED FOR CABLE CONNECTION OF EACH SIZE MENTIONED AT SL NO 4 AND SUPPLIED WITH CORRESPONDING SIZE HIGH TENSILE STRENGTH ZINC COATED STEEL BOLTS.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RA	FOR TENDER PURPOSE ONLY	VC	VC	RKJ		W					15.06.22
					CLEARED BY						

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

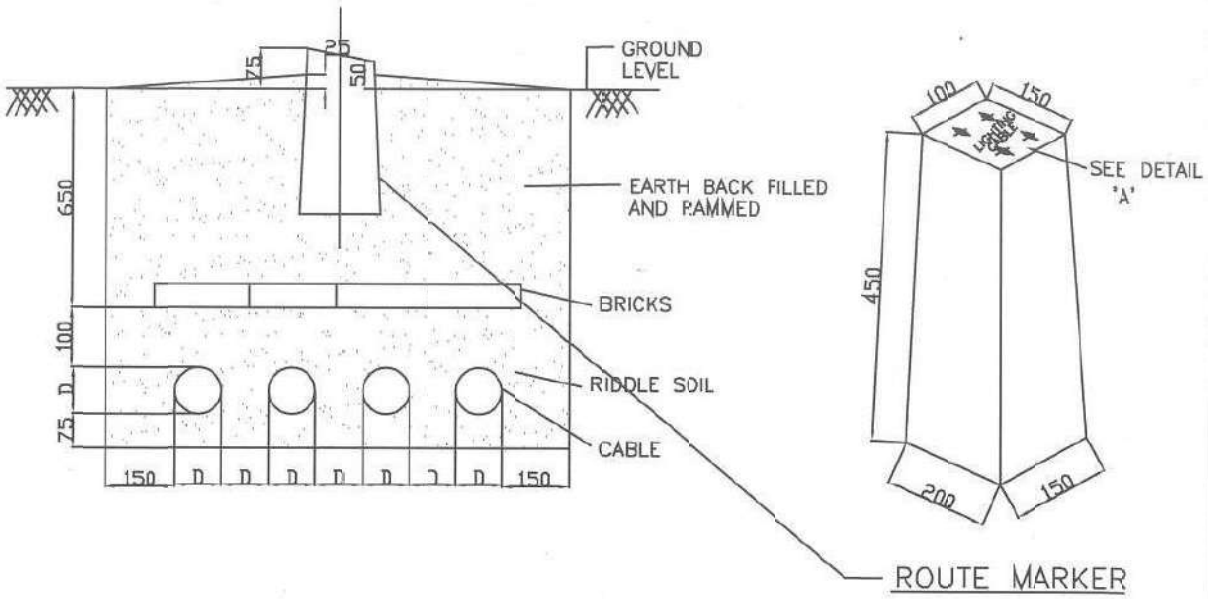
PROJECT: STANDARD

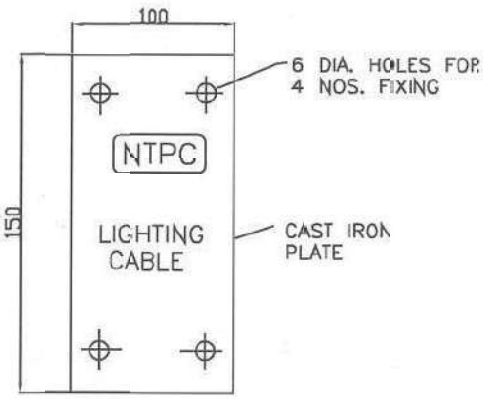
TITLE: ADAPTOR BOX FOR LT CABLES

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-048A	RA

This drawing / he design it covers are the property of NTPC LTD. and must not b / pied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.





DETAIL – 'A'

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ROUTE MARKERS SHALL BE CONSTRUCTED OF CONCRETE WITH CAST IRON PLATE, WITH THE ROUTE INFORMATION ENGRAVED ON IT, BOLTED ON TOP OF THE CONCRETE BLOCK AS SHOWN.
3. CAST IRON PLATE SHALL BE OF Min. 6.0mm THICKNESS.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	KB	KB	RKP	–	NK	–	–	–	AS	05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	30.11.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2006

एन टी पी सी NTPC

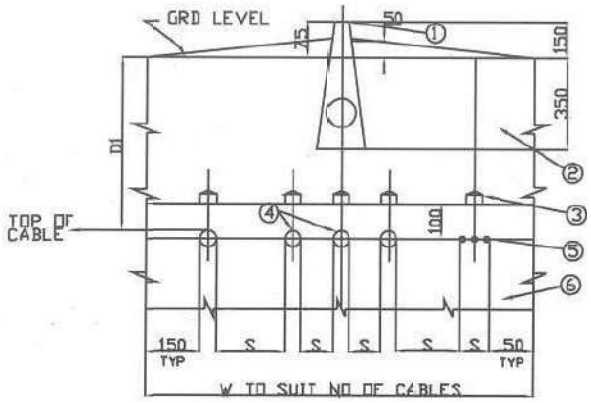
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

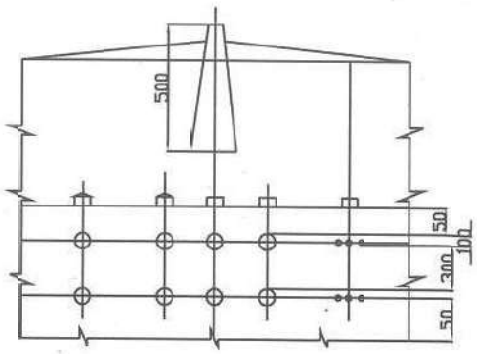
PROJECT: STANDARD

TITLE: BURIED CABLE TRENCH DETAILS FOR LIGHTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-049	RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.





DIRECTLY BURIED CABLES IN SINGLE LAYER

DIRECTLY BURIED CABLES IN TWO LAYER

LEGEND

① CABLE ROUTE MARKER
② EARTH BACK FILLED & RAMMED
③ PROTECTIVE COVERS
   a) BRICKS FOR LOW VOLTAGE CABLES
   b) RCC FOR HIGH VOLTAGE CABLES WITH HOLE AT EACH END TO TIE EACH OTHER WITH G.S. WIRE
④ ARMOURED POWER CABLE
⑤ ARMOURED CONTROL CABLE
⑥ FINE SAND/RIDDLED SOIL COMPACTED

DIMENSION MIN.	1100V GRADE CABLES	FOR 3.3 KV TO 11KV	ABOVE 11KV & UPTO 33KV
D1	750	900	1050
S (WITH HORIZONTAL AND VERTICAL SPACING)	= d BETWEEN CABLES OF SAME CLASS = 300MM BETWEEN CABLES OF DEFT CLASS = 400MM BETWEEN 1/C POWER CABLE AND COMMUNICATION CABLE. = 300MM BETWEEN MULTICORE POWER CABLE & COMMUNICATION CABLE.		

d - OVERALL DIAMETER OF THE BIGGER OF THE TWO CABLES.
D1 - MINIMUM DEPTH OF LAYING FROM GROUND SURFACE TO TOP OF CABLES.

NOTE

1. SINGLE CORE CABLES SHALL BE RUN IN TREFOIL FORMATION AND SHALL BE BOUND BY SELFLECKING CABLE TIES AT EVERY 750 MM.
2. CABLE IDENTIFICATION TAG SHALL BE TIED AT BOTH ENDS OF THE CABLE.
3. IF THE MINIMUM CLEARENCE AS INDICATED THE ABOVE TABLE FOR CABLES OF DIFFERENT CLASSES ARE NOT FEASIBLE BRICK BARRIERS SHALL BE USED BETWEEN ADJACENT CABLES.
4. G.I/HUME/HDPE. PIPES SHALL BE PROVIDED FOR ROAD CROSSING AT A MINIMUM DEPTH OF 600 FROM THE GRADE LEVEL AS DECIDED BY NTPC.
5. ALL DIMENSIONS ARE IN mm

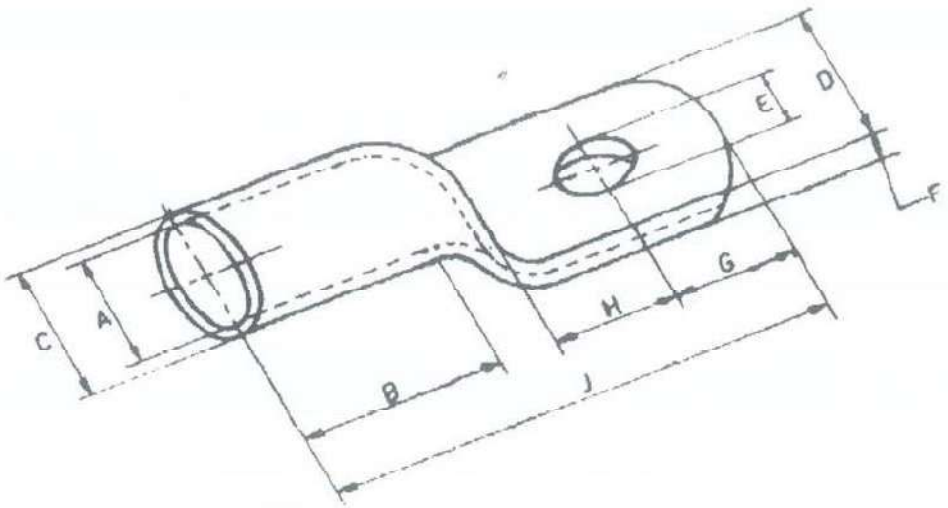
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	PKP	–	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	SG	–	SS	–	–	–	AS	28.11.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2006

एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT			
STANDARD			
TITLE: BURIED CABLES TRENCH FOR HT & LT CABLES			
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-060	REV. NO.: RC

This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



S.No.	Conductor Size HT Power Cables	E (Dimensions in mm)
1	95 sq.mm	13
2	150 sq.mm	17
3	300 sq.mm	17

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH.	APPD	DATE
RA	FOR TENDER PURPOSE				-		-	-	-		
		CLEARED BY									

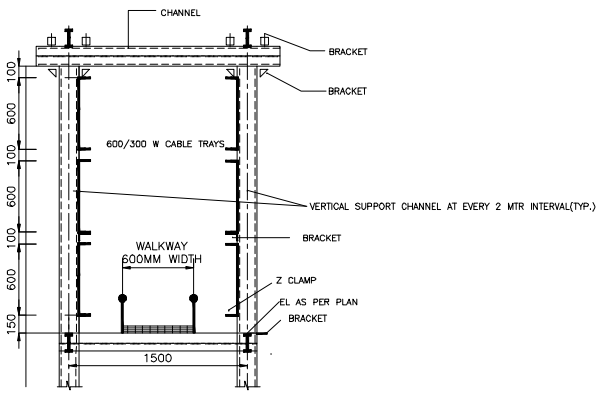
एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

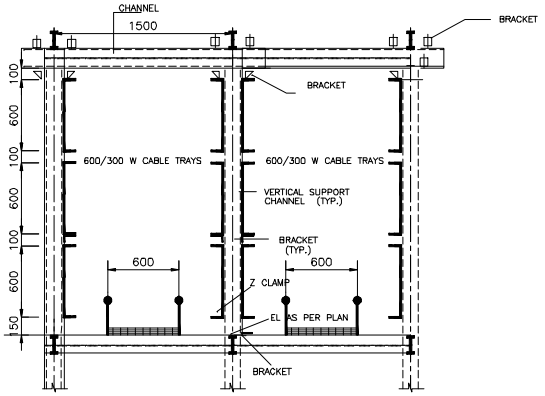
PROJECT: STANDARD

TITLE: TYPICAL DRAWING FOR CABLE LUG

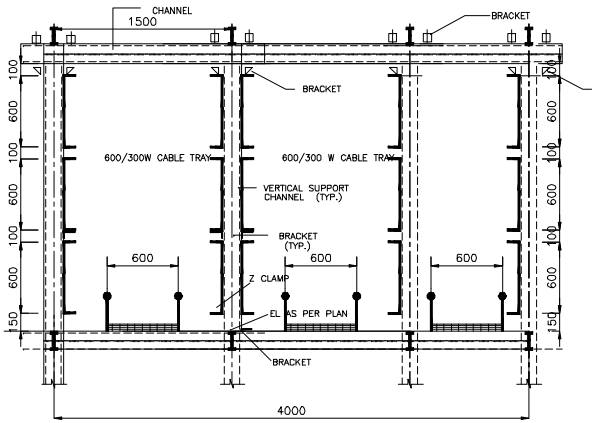
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-051	



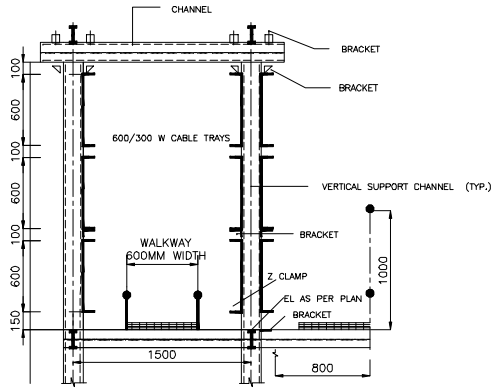
TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (6 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).



TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 12 NOS)
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).



TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 18 NOS)
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).



TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 9 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).

This document is the property of NTPC LTD.
No part of this document will be reproduced by any means without the written permission.

NTPC Limited.
(A Government of India Enterprise)
ENGINEERING DIVISION

PROJECT: KHURJA SUPER THERMAL POWER PROJECT (2X660MW)

TITLE: TYPICAL SECTION OF CABLE TRAY ARRANGEMENT IN TRESTLE

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	CLEARED BY	APPD	DATE
0	RELEASED FOR CONSTRUCTION	MV		R.K	M E C C&I BJ –	V.V	15-02-2018

SIZE	SCALE	DRG. NO.	REV. NO.
		9915-999-POE-J-004	0

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT COLLECTION AND DISPOSAL 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

SPECIFIC TECHNICAL REQUIREMENT OF EFFLUENT TRANSFER SYSTEM (C&I)

985109/2022/PS-PEM-MAX

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

TECHNICAL SPECIFICATION (CONTROL AND INSTRUMENTATION) FOR CDDJSELR TRALQDCP QWQRCK

	THDC INDIA LIMITED **2 X 660 MW STPP KHURJA – TG PACKAGE**		DESG	CM
	JOB NO: 475		CHKD	SSB
	REV. NO. 00	DATE : 25.07.2022	APPD	SSB

C&I SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM

	C&I SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM	THDC INDIA LTD. 2X660 MW STPP KHURJA - TG PACKAGE

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	INDEX SHEET
3	C&I SPECIFIC TECHNICAL REQUIREMENTS
4	MEASURING INSTRUMENTS
5	INSTRUMENT STUB DETAILS & HOOK-UP
6	QUALITY ASSURANCE
7	TYPE TEST REQUIREMENT
8	MANDATORY SPARES LIST
9	SUB VENDOR LIST

C&I SPECIFIC TECHNICAL REQUIREMENT
FOR
EFFLUENT TRANSFER SYSTEM

	C&I SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM	THDC INDIA LTD. 2X660 MW STPP KHURJA - TG PACKAGE

Specific Technical Requirements (C&I)

1.0 Supply of self-standing local control panel for pumps of EFFLUENT TRANSFER SYSTEM, along with its instrumentation shall be under bidder's scope. The local control panels shall have provision for START/ STOP and indication lamps for automatic operation of individual pumps.

2.0 415V AC Power supply shall be provided by BHEL at a single point. Further distribution to various instruments/equipment of the system shall be in bidder's scope. Bidder to include necessary UPS/ 24 V DC charger, power distribution board, changeover circuit in their 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.

3.0 Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder without any commercial implication.

4.0 The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire 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.

5.0 Bidder shall include in his proposal all the instruments and devices that are needed for completeness of the plant auxiliary system/ equipment supplied by the bidder. During detail engineering, if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any commercial implication.

6.0 All field instruments enclosure shall be IP65, local panel/cabinet enclosure shall be IP 55, unless otherwise specified. Canopy shall be provided for panels, cabinet enclosures, Junction Boxes etc.

7.0 The make of the items shall be from sub-vendor list. However, in case of any additional make/model of various instruments/items/systems (apart from Sub-vendor list), same shall be subject of approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

8.0 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.

9.0 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.

10.0 The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.

11.0 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.

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

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

14.0 Number of pairs to be selected for Screen/ Control cable

(a) F-Type: 2P/4P/8P/12P(Size : 0.5 mm2)
(b) G-Type: 2P/4P/8P/12P(Size : 0.5 mm2)
(c) Core Cable: 3CX2.5sqmm2/ 5CX2.5 mm2/ 12CX1.5 mm2

15.0 Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification.

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.

	C&I SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM	THDC INDIA LTD. 2X660 MW STPP KHURJA - TG PACKAGE

MEASURING INSTRUMENTS

985109/2022/PS-PEM-MAX

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-zeroing 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). For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.
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.

13.04.00 **ROTAMETERS**

Sr. No.	Features	Essential / minimum requirements
1.	Type	Variable Area Metal Tube
2.	Fluid media	Water/oil
3.	Tube body	SS316
4.	Material of float	316 SS
5.	Indicator	Linear scale
6.	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 100 mm)
7.	Housing protection class	IP-55
8.	Accuracy	± 2% of measured value.

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.

21.00.00 **Limit switches**

For offsite plant (except PT, DM, Chlorination, chemical treatment, Liquid effluent treatment) application Limit switches shall be silver plated with high conductivity and non corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.

For main plant application limit switches are to be provided as per contractor standard and proven practice.

For PT, DM, Chlorination system , chemical treatment, Liquid effluent treatment plant , limit switches of manual valves and solenoid operated on-off valves shall be of inductive proximity type and shall be mounted inside the enclosure: pl. refer the minimum specification requirement below .

Operating voltage Range	10-40 V DC
Sensing system	Inductive Proximity type , 2 Wire
Sensor Contact Type	NO
Reverse polarity and short circuit protection	Yes
IP Class-Sensor	IP67
IP Class-Enclosure(Switch box)	IP67
Cable entry-Enclosure(Switch box)	2no-1/2" NPT
Casing material-Sensor	Brass /SS
Enclosure(Switch box) Housing material	FRP or SS
Operating Ambient temp(sensors)	-5 to 70 deg C
Max allowed Voltage Drop across sensor	5 V
Standard applicable	EN 60947-5-2 or equivalent.

SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.

Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
1	Sensing Element and material	Bourdon for high pressure, Diaphragm/Bellow for low pr. Of 316 SS	Mercury in steel for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary.	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	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.

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.

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'

	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.

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS –999- 145 –054A	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE : 16-09-2013
		SHEET 5	OF 6

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

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

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.

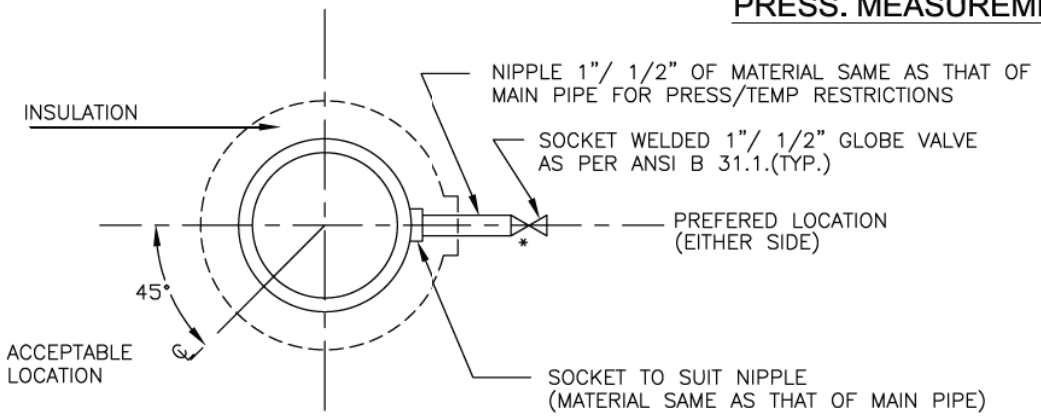
7.0 MARKING AND PACKING

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.

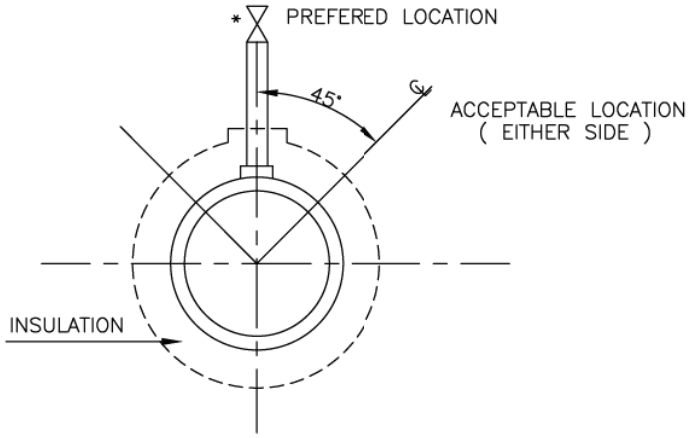
INSTRUMENT STUB DETAILS & HOOK-UP DIAGRAM

985109/2022/PS-PEM-MAX

PRESS. MEASUREMENT

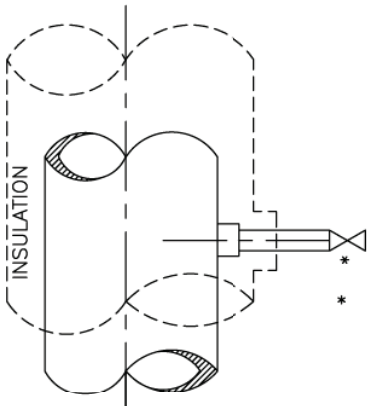


ELEVATION
LIQUID SERVICE



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

FOR TENDER PURPOSE ONLY

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

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

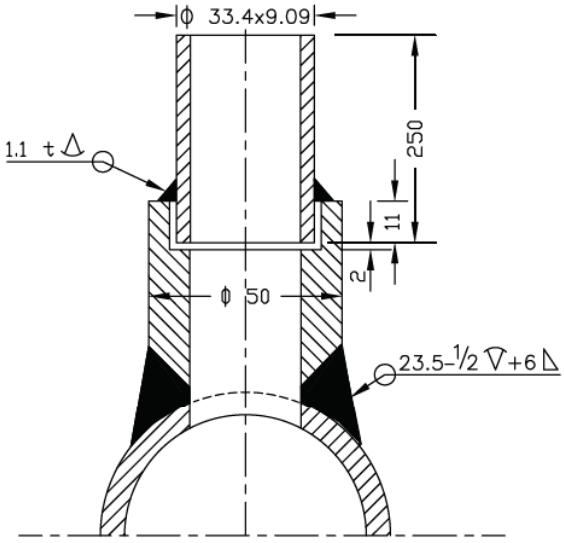
TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

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

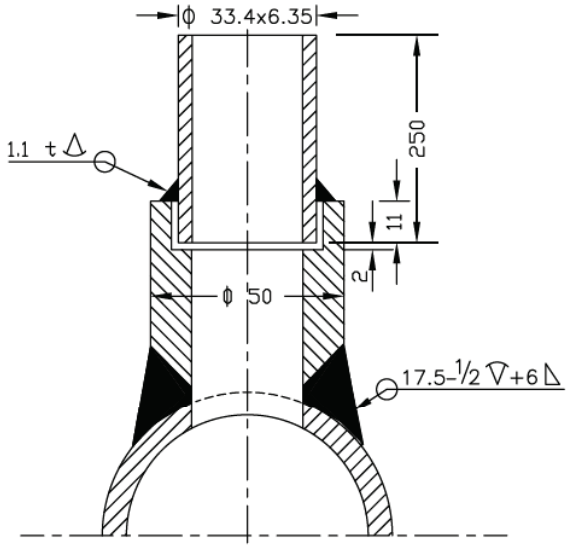
985109/2022/PS-PEM-MAX

PRESSURE MEASUREMENT

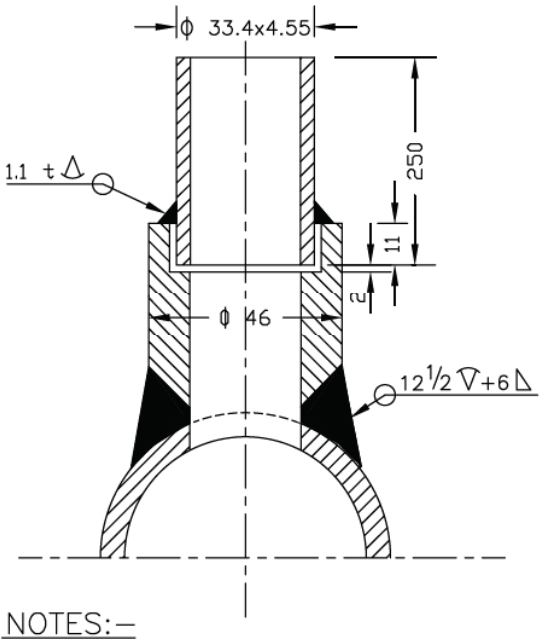
(SYSTEM PR.>40Kg/Sq Cm CL 9000)



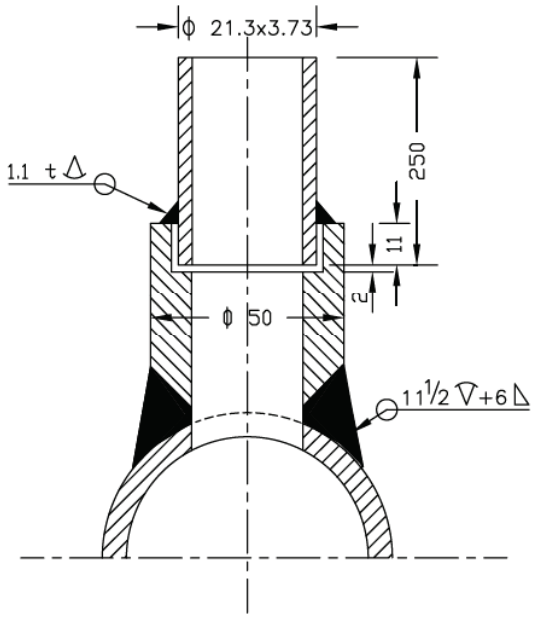
(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(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.

FOR TENDER PURPOSE ONLY

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

एन टी पी सी NTPC

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

PROJECT: TYPICALTHERMAL POWER PROJECT

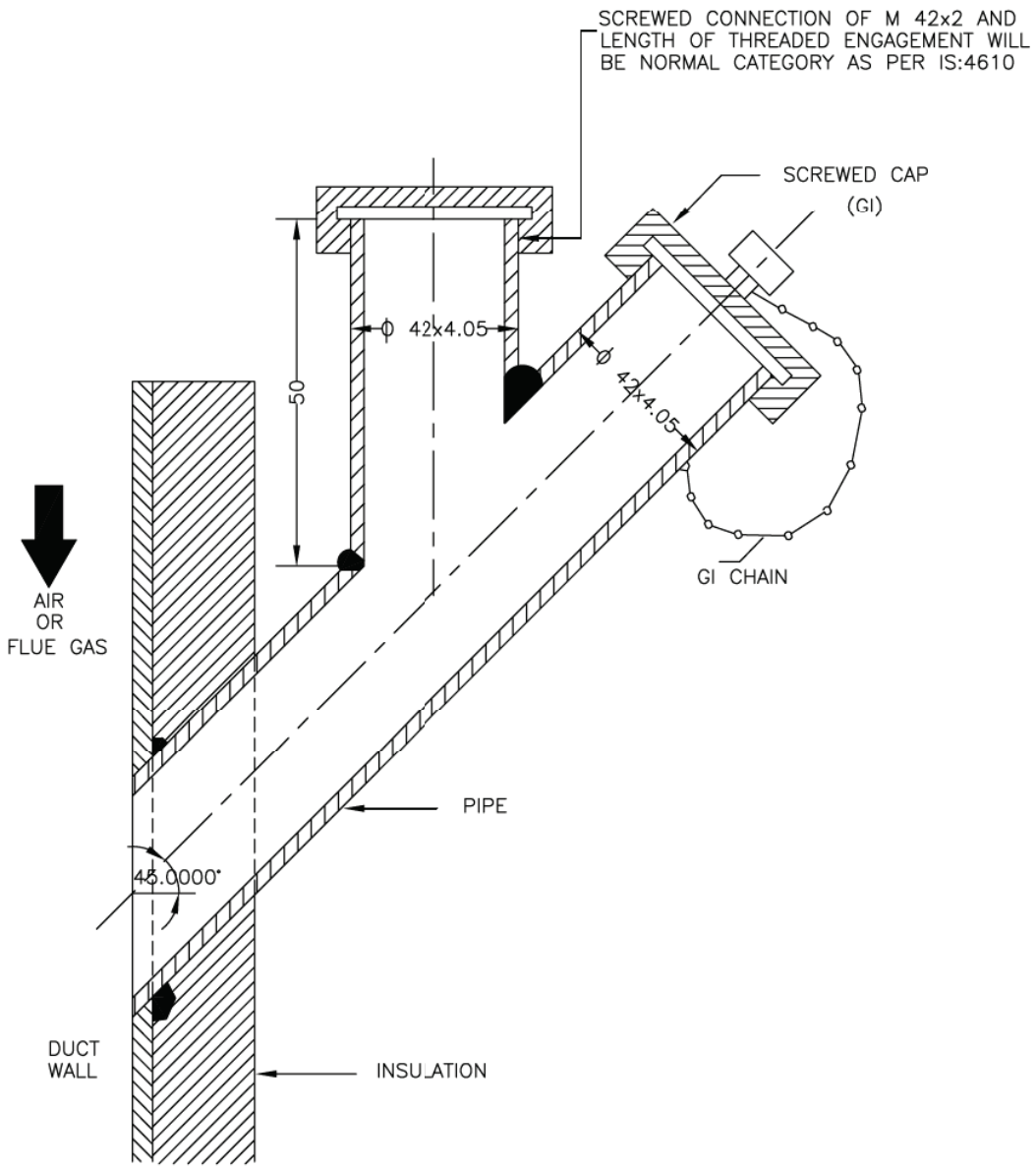
TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh–2 Of 14	A

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

PRESS. MEASUREMENT



NOTES:–

1. THIS TYPE OF PRESSURE CONNECTON SHALL BE PROVIDED FOR PRESSURE MEASUREMENTS IN AIR AND FLUE GAS DUCT/FURNACE.
2. DIMENSIONS ARE INDICATIVE ONLY.

FOR TENDER PURPOSE ONLY

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

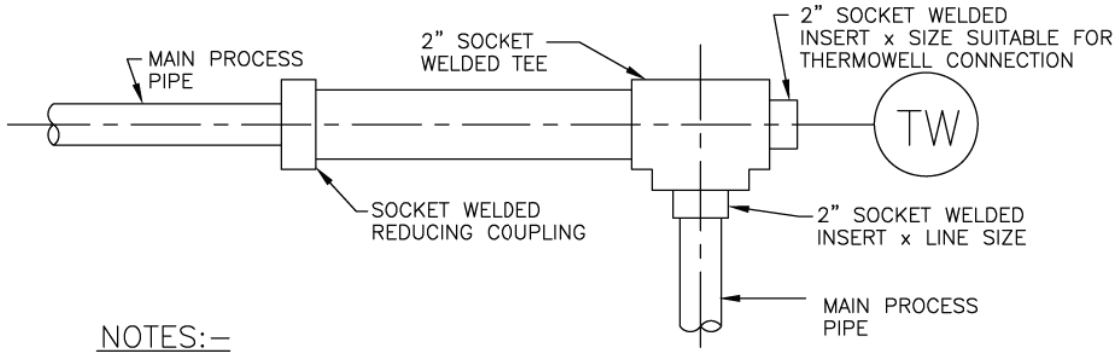
एन टी पी सी NTPC **N T P C LIMITED** (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

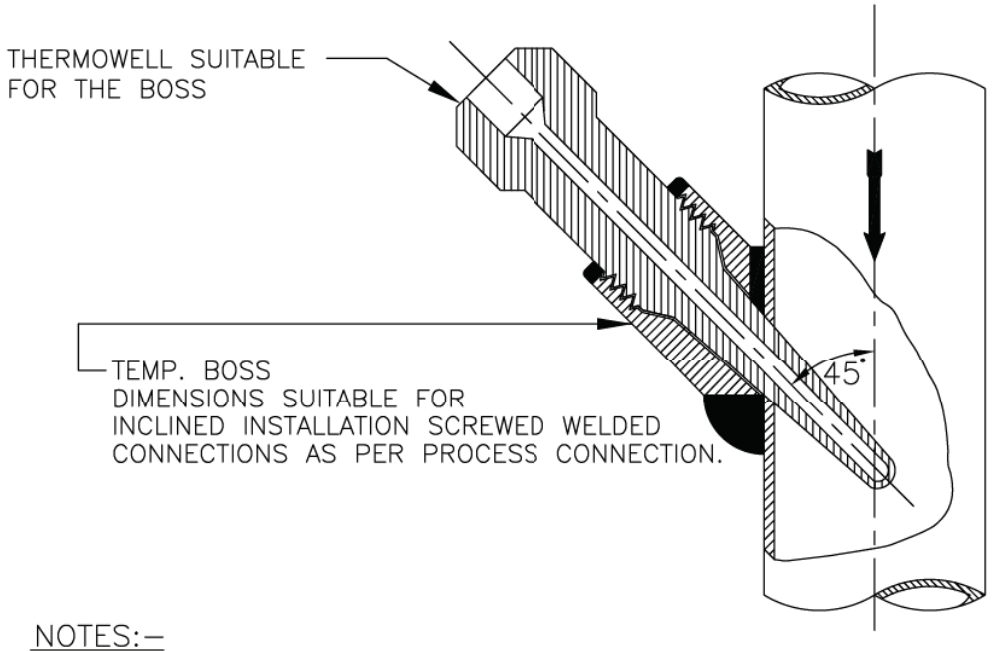
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh–3 Of 14	A

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).

FOR TENDER PURPOSE ONLY

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

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

CLEARED BY

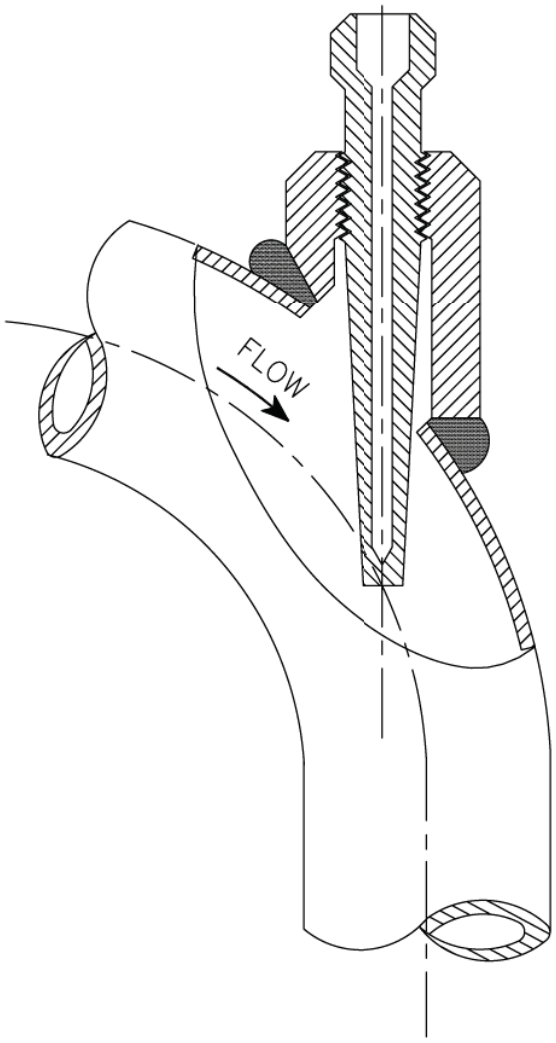
एन टी पी सी NTPC **N T P C LIMITED** (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: TYPICALTHERMAL POWER PROJECT (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.

FOR TENDER PURPOSE ONLY

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

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

CLEARED BY

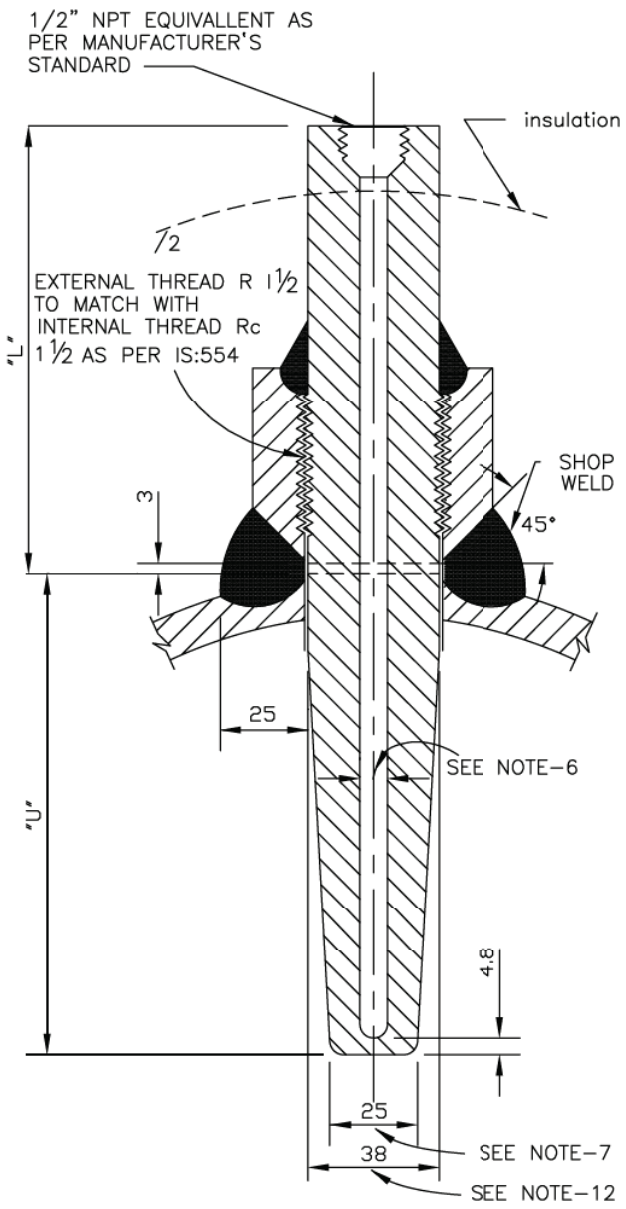
एन टी पी सी NTPC — **N T P C LIMITED** (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

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–5 Of 14	A

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 1 1/2
13. THE "U" & "L" DIMENSIONS SHALL BE BE SELECTED BASED ON PARTICULAR APPLICATION AND THE SAME SHALL BE SUBJECT TO OWNER'S APPROVAL DURING DETAILED ENGINEERING.
14. ALL DIMENSIONS ARE INDICATIVE ONLY.

FOR TENDER PURPOSE ONLY

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

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

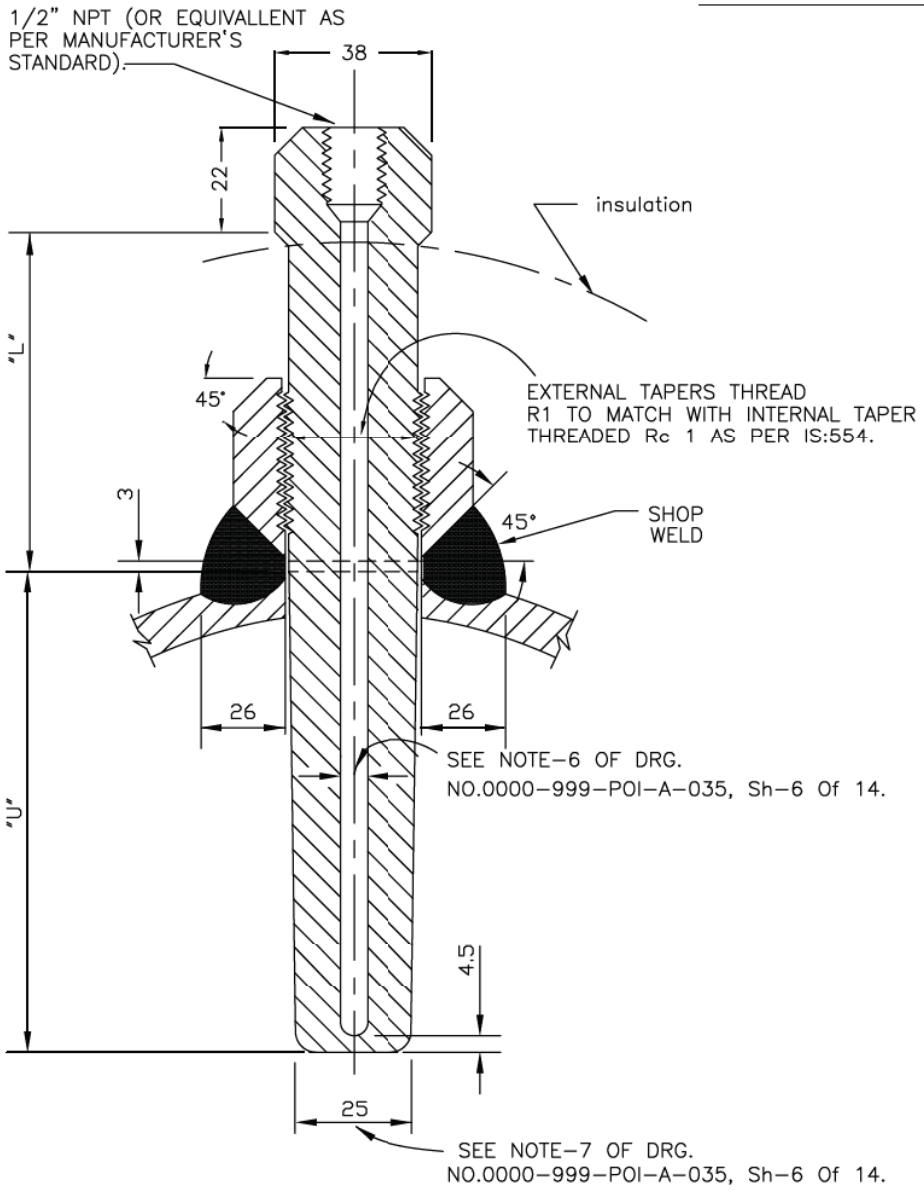
एन टी पी सी NTPC **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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.

FOR TENDER PURPOSE ONLY

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

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

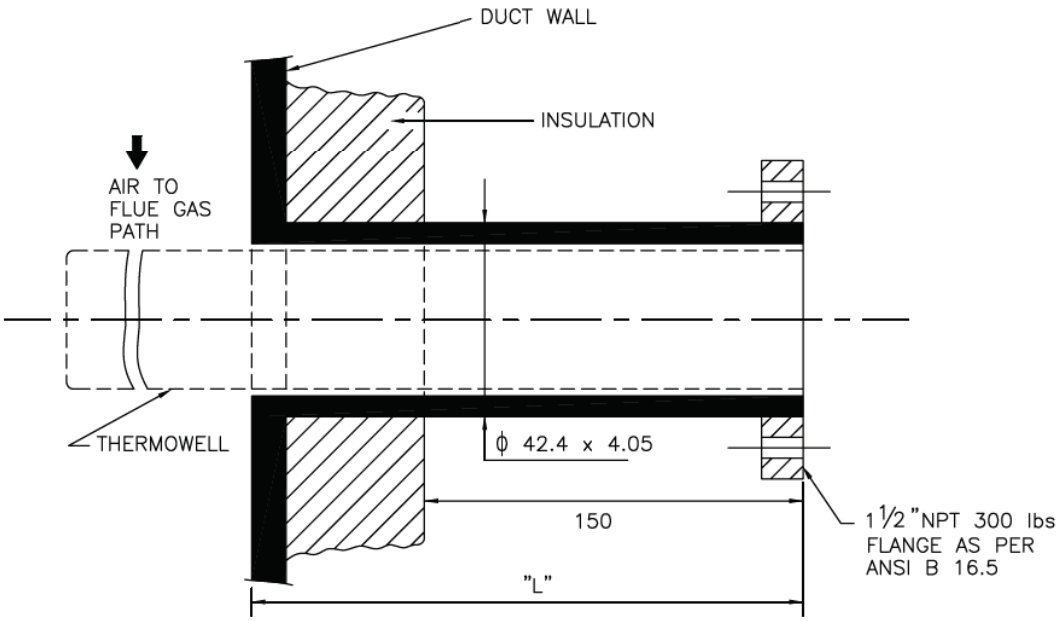
एन टी पी सी NTPC **N T P C LIMITED** (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

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-7 Of 14	A

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.

FOR TENDER PURPOSE ONLY

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

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

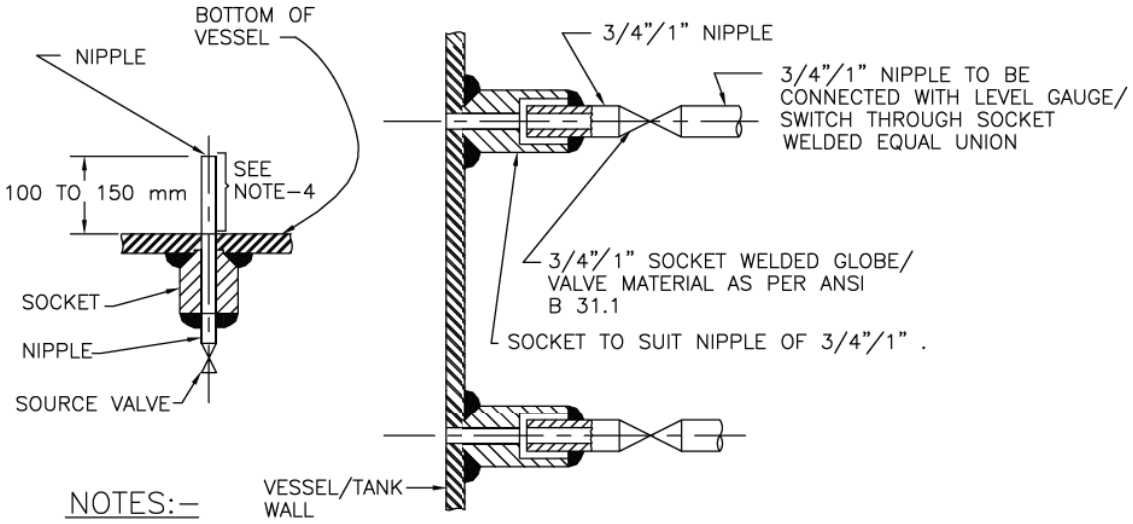
एन टी पी सी NTPC **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

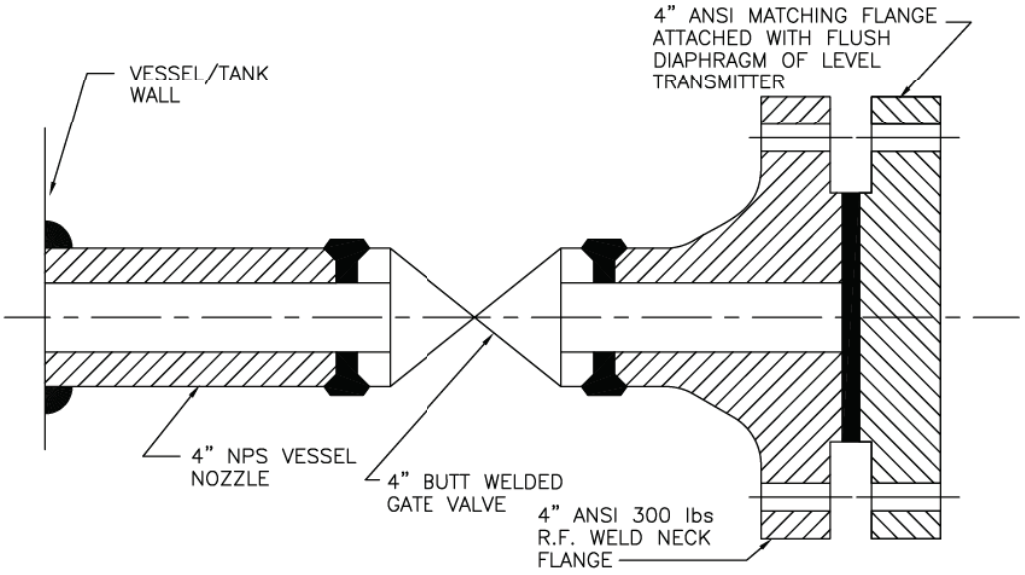
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh–8 Of 14	A

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.

FOR TENDER PURPOSE ONLY

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

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

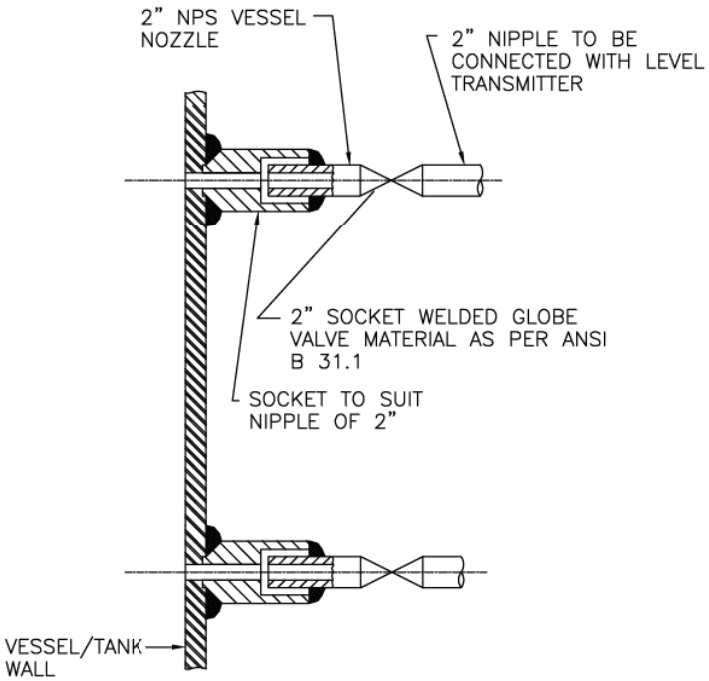
एन टी पी सी NTPC **N T P C LIMITED** (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

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–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.

FOR TENDER PURPOSE ONLY

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

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

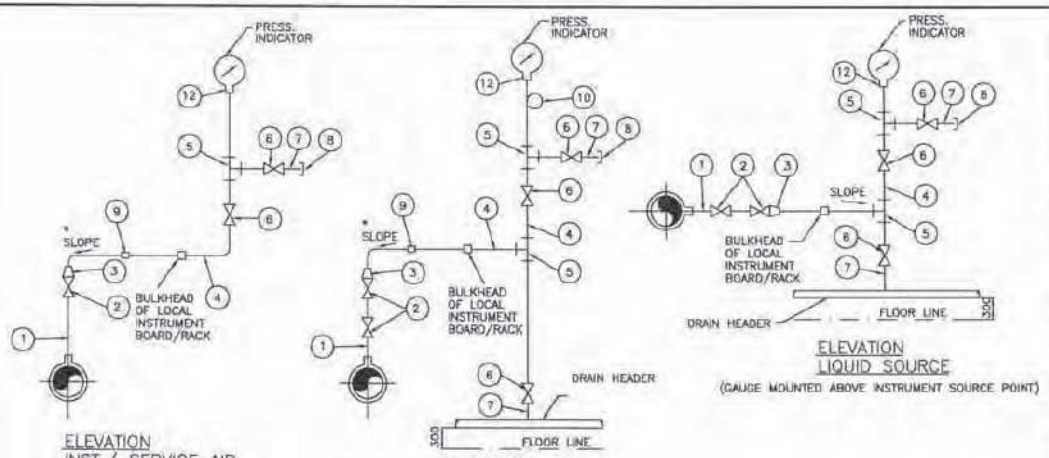
एन टी पी सी NTPC **N T P C LIMITED** (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

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–14 Of 14	A

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



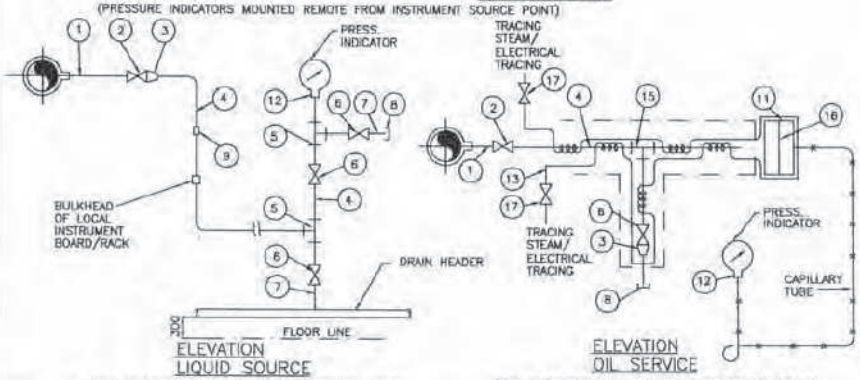
ELEVATION
INST./ SERVICE AIR

(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)

ELEVATION
STEAM SERVICE

ELEVATION
LIQUID SOURCE

(GAUGE MOUNTED ABOVE INSTRUMENT SOURCE POINT)



ELEVATION
LIQUID SOURCE

(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)

ELEVATION
OIL SERVICE

(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2", 3/4", 1" NPS SCH 40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	1/2"/3/4"/1" SW GLOBE VALVE/GATE VALVE
3.	3/4" / 1" x 1/2" SW REDUCING INSERT
4.	1/2" / 3/4" PIPE
5.	1/2" / 3/4" SW EQUAL TEE
6.	1/2" / 3/4" SW GLOBE VALVE
7.	1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.
8.	1/2" / 3/4" NPT(F) CAP.
9.	1/2" / 3/4" PIPE UNION.
10.	6" SS SYPHON
11.	1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.
12.	SUITABLE ADAPTER.
13.	1/4" CHROME MOLY STEEL TUBE.
14.	
15.	1"/3/4" SW EQUAL TEE.
16.	DIAPHRAGM(WAFER ELEMENT)
17.	ISOLATION VALVE 316 SS,1/4"SW

NOTES:-

1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE & NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFIRM TO ANSI-B.16-11.
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTINGS SHALL BE OF 3/4" NB SIZE.
5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON A CHANNEL OR FRAME OR A RACK..
6. * SLOPE APPROX. 50 MM / METRE.

FOR TENDER PURPOSE ONLY

एन टी पी सी
NTPC

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

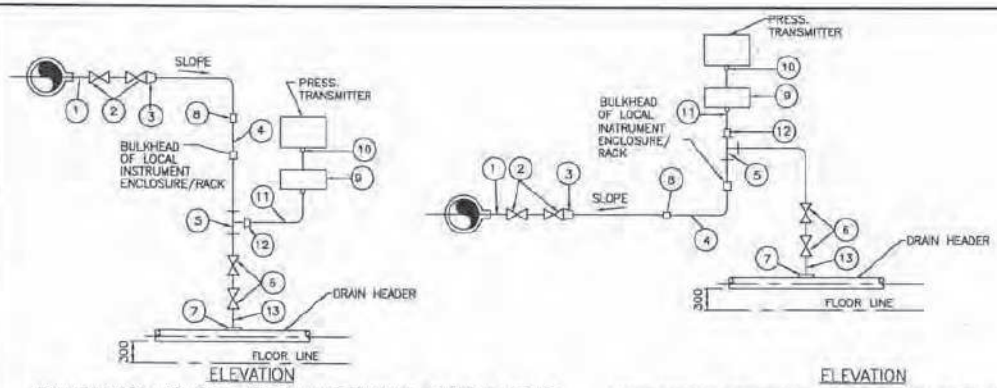
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

REV.NO	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APP'D	DATE
					CLEARED BY						
A	FIRST ISSUE							T.G.			21.08.12

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-022	A

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



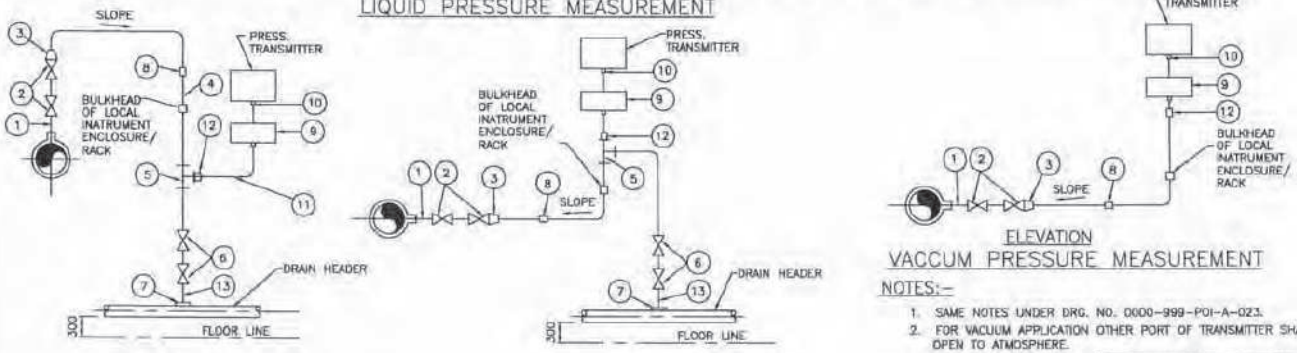
ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIQUID PRESSURE MEASUREMENT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2"/ 3/4"/1"NPS SCH. 80/160/XXS/PSI 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 DETAL SEE DRAWING NO.0000-102-POI-A-023.
10.	SUITABLE ADAPTER
11.	SS TUBE
12.	1/2" PIPE x 1/2"TUBE UNION
13.	1/2"NPS SCH. 80/160 SWx1/2" NPT(M) CS/AS NIPPLE



ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

STEAM PRESSURE MEASUREMENT

ELEVATION
VACCUM PRESSURE MEASUREMENT

NOTES:-

1. SAME NOTES UNDER DRG. NO. 0000-999-POI-A-023.
2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

FOR TENDER PURPOSE ONLY

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

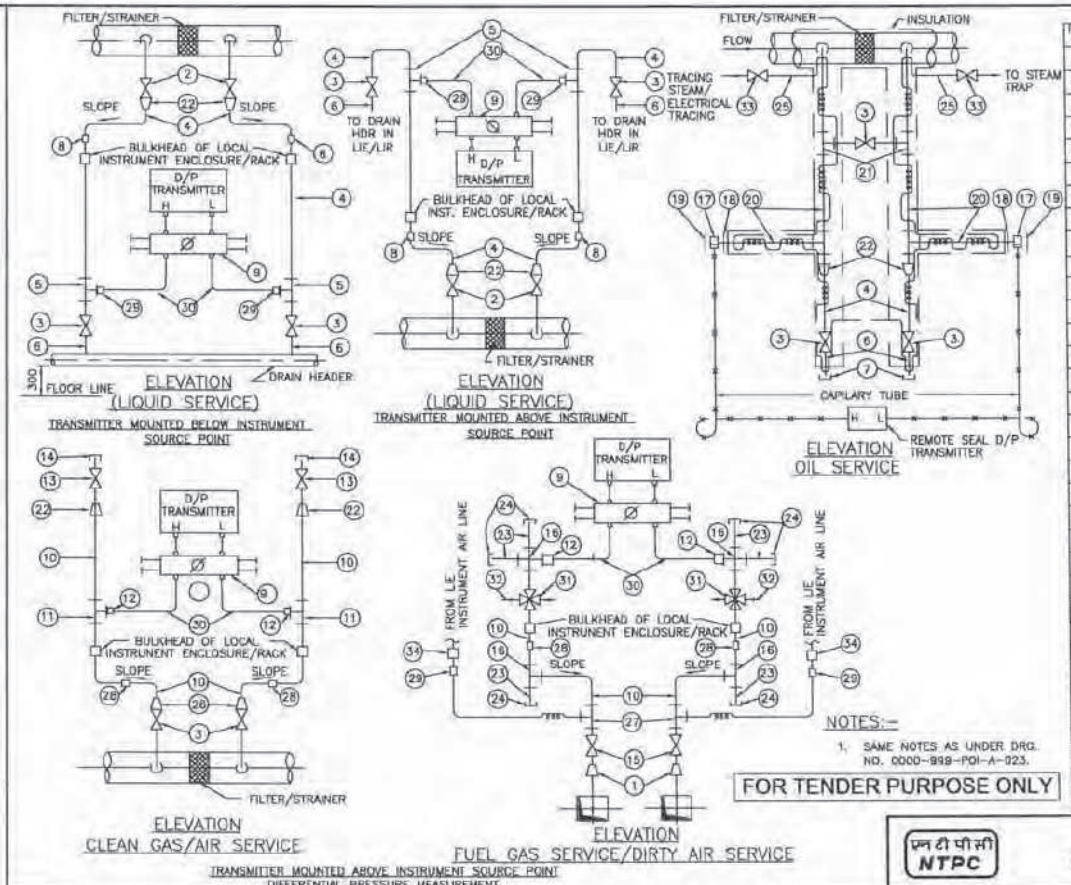
N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-025	A

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



ITEM NO.	LIST OF MATERIALS DESCRIPTION
1.	42x2 TO 3/4" SW REDUCING INSERT.
2.	3/4" SW GLOBE VALVE.
3.	1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4"/1" IN GAS/AIR APPLICATION
4.	1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" NPS SW x 1/2" NPT (M) NIPPLE.
7.	1/2" NPT (F) CAP.
8.	1/2" PIPE x 1/2" PIPE UNION.
9.	5 VALVE MANIFOLD (FOR DETAIL REFER DRAWING NO.0000-999-POI-A-026.
10.	3/4" SCH 80 CARBON/ALLOY STEEL PIPE.
11.	3/4"/1/2" SW EQUAL TEE.
12.	3/4"x1/2" TUBE UNION.
13.	1/2" SCREWED GLOBE VALVE.
14.	1/2" NPT (M) PLUG.
15.	3/4" SW GATE VALVE.
16.	3/4" SW EQUAL CROSS.
17.	WAFER ELEMENT FOR USE WITH 3"ANSI R.F. VALVE.
18.	3"BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE.
19.	3" BLIND FLANGE.
20.	1"NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.
21.	1" SW EQUAL TEE.
22.	3/4" x 1/2"SW REDUCING INSERT.
23.	3/4" SW x 3/4" NPT (M) CS/AS NIPPLE
24.	3/4" NPT (F) CS/AS CAP.
25.	1/4" NPS ALLOY STEEL PIPE.
26.	1" x 3/4" SW REDUCING INSERT.
27.	3/4" SW x 1/2" PSW BRANCH TEE.
28.	3/4" PIPE UNION
29.	1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE.
30.	SS TUBE
31.	3/4" SW 4 WAY VALVE.
32.	QUICK DISCONNECT FITTINGS.
33.	1/4" SW ISOLATION VALVE 316SS
34.	1/2" x 1/2" SS PIPE UNION.

NOTES:-

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

FOR TENDER PURPOSE ONLY

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

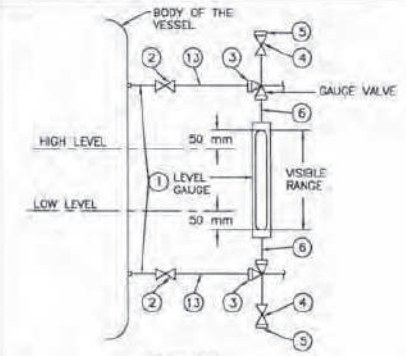
TITLE: INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS.MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)

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

CLEARED BY

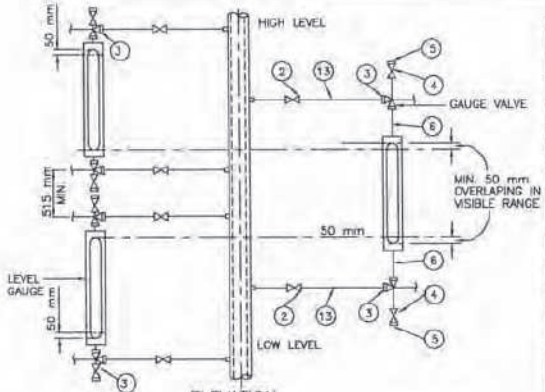
SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-030	A

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



ELEVATION

LOCAL LEVEL INDICATION USING GAUGE GLASS

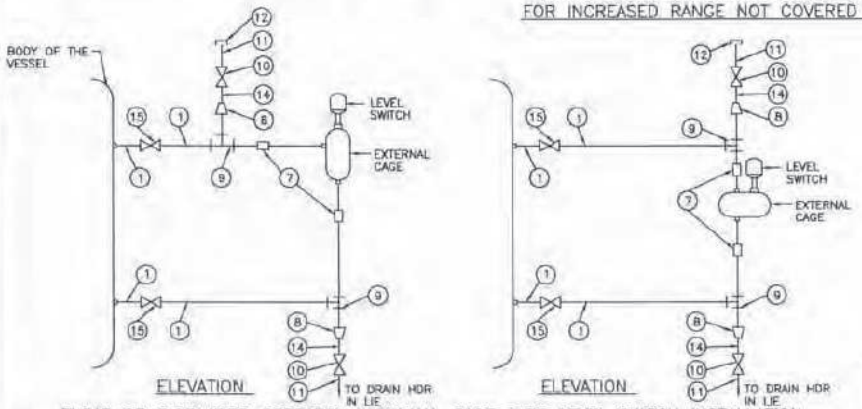


ELEVATION

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

एन टी पी सी NTPC

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

PROJECT: TYPICAL THERMAL POWER PROJECT

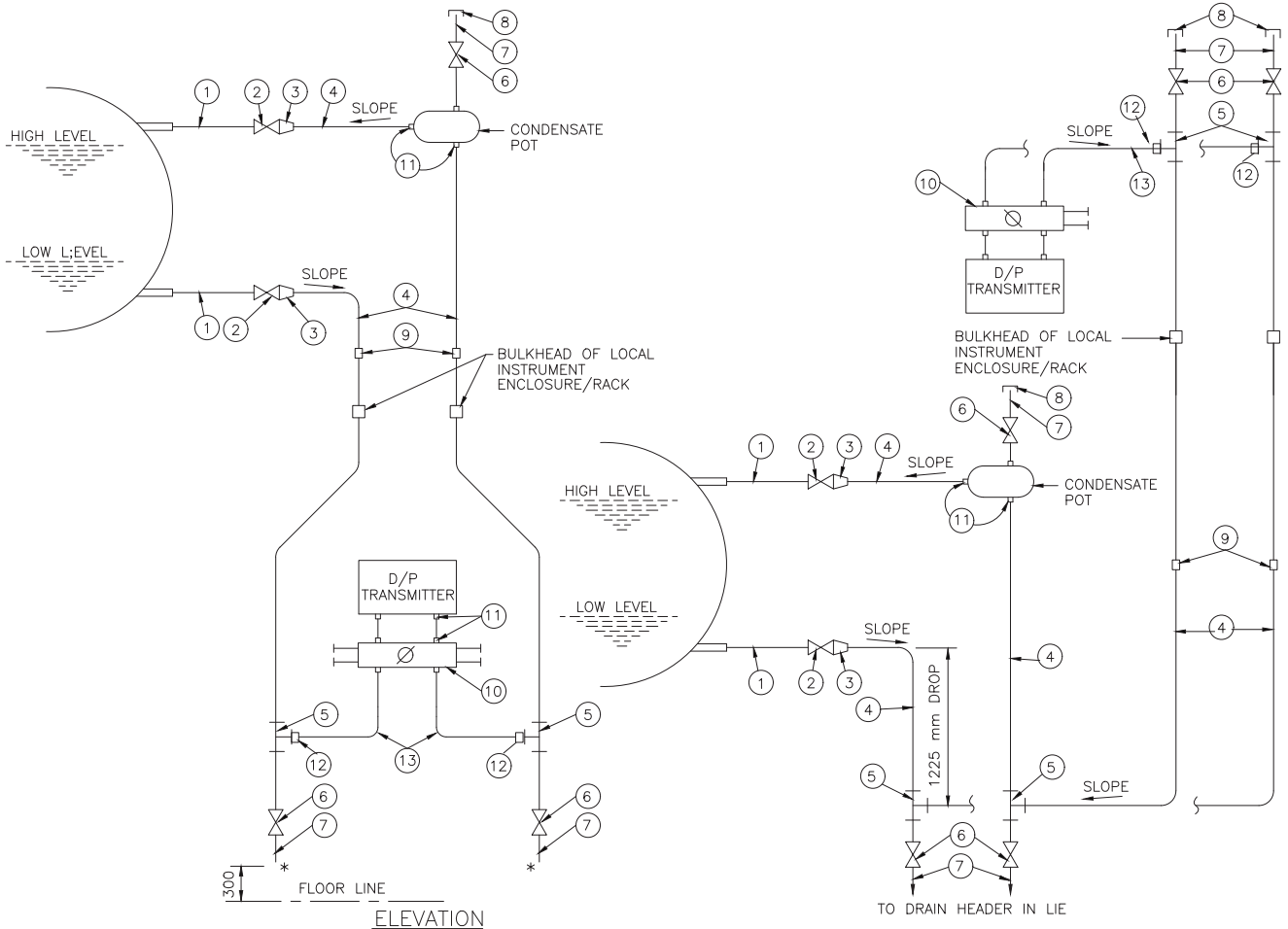
TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE & SWITCHES)

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

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1" NPS SCH.40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) CARBON /ALLOY STEEL PIPE.
2.	1" SW GLOBE VALVE.
3.	3/4"/1" TO 1/2" REDUCING INSERT.
4.	1/2" NPS SCH.80/160/XXS(AS PER PROCESS REQ.)CS/AS PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" SW GLOBE VALVE.
7.	1/2" NPS SWx1/2" NPT(M) CS/AS NIPPLE.
8.	1/2 NPT (F) CAP.
9.	1/2" PIPE UNION.
10.	5-VALVE MANIFOLD (FOR DETAILS REF. DRG. NO.0000-999-POI-A-026.
11.	SUITABLE ADAPTER.
12.	1/2" PIPE x 1/2" TUBE UNION.
13.	S.S. TUBE.

NOTES:-

1. SAME NOTES AS UNDER DRG. NO.0000-999-POI-A-023. (WHICHEVER ARE RELEVENT).

* TO DRAIN HEADER IN LIE/LIR.

FOR TENDER PURPOSE ONLY

LEVEL MEASUREMENT OF CLEAR NON-VISCOUS OR NON-CORROSIVE LIQUID IN CLOSED VESSEL WITH CONDENSABLE ATMOSPHERE USING D/P TRANSMITTER

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

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.

CLAUSE NO.

QUALITY ASSURANCE

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.

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				
13	Voltage Stabilisers	Over Load Test	Approved procedure	No	No

		Temp rise test without redundant fans	Approved procedure	No	No
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

			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.

MANDATORY SPARES

LIST OF C&I MANDATORY SPARES		
1	**Measuring Instruments**	**Required Quantity**
a)	**TRANSMITTERS**	
(i)	Transmitters of all type, range and model no. (For the measurement of Pressure, differential pressure flow, level, temperature etc.)	10%. of each type and model
(ii)	Interface modules at field(between field transmitter & DDCMIS)like Zener barrier, power supply isolator, isolater(as applicable)etc.	10% of each type
b)	**Temperature elements**	
(i)	RTD's	10% of each type and length
(ii)	Thermocouples	10% of each type and length
(iii)	Thermo well for above applications 10% of each type and length	10% of each type and length
c)	**Pressure, Differential Pressure, Flow, Level and temperature switches**	**20% of the total population or minimum 2 nos of each type/ rating/model**
d)	**Pressure, Differential Pressure, Flow, Level and temperature gauges**	**20% of the total population or minimum 2 nos of each type/ rating/model**
2	**POWER SUPPLY SYSTEM**	
	24 V DC power supply system	
(i)	Rectifier Modules 10% of each size/rating	10% of each size/rating
(ii)	Controller module 10% of each model	10% of each model
(iii)	AC/DC isolators, DC/DC isolators, contactors, timers, relays	10% of each type and rating
(iv)	Fuses of each type and rating	200%
(v)	Fuse free Circuit breakers of each type and rating	5% or 1 no of each type and rating. Whichever is more (1Lot).
(vi)	Cooling Fans	10% or 2 nos. of each type whichever is more.
(vii)	Relays of all types including overload relays	10%
(viii)	Capacitors	1 Set
3	**CONTROL PANEL**	
(i)	Replacement lamps/LED’s for each type of lamps/LED	100%
(ii)	MCB's	10% of each type and rating
(iii)	Fuses	100% of each type and rating

	C&I SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM	THDC INDIA LTD. 2X660 MW STPP KHURJA - TG PACKAGE

SUB VENDOR LIST

Sl No	Package Name	PEM Supplier Code	Supplier Name	Reg Status	Supplier Communication Address	Supplier Works Address	Department	Tech Limit	Fin Limit	DT Regular	MSE status	Validity of MSE Certificate	Remarks
1	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A010	A.N. INSTRUMENTS PVT. LTD.	REGULAR	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email :	C&I				Micro	30-Sep-15	, , ,
2	TEMPERATURE GAUGE	A010	A.N. INSTRUMENTS PVT. LTD.	REGULAR	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email :	C&I				Micro	30-Sep-15	, , ,
3	TRANSMITTERS	B049	ABB INDIA LIMITED	REGULAR	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com		C&I	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER					(1) A GROUP COMPANY OF ABB, NOW. (2) NAME OF VENDOR CHANGED FROM BIRLA-KENT TAYLOR LIMITED TO ABB LIMITED W.E.F. 27.06.2011 , Technical limit reviewed and changed on 05.06.2014; Technical limit further reviewed on 12.10.2015; , Name changed from ABB Limited to ABB India Limited on 23.08.2018 as per 16th MISCC-Electrical and C& ,
4	ELECTROMAGNETIC FLOW METER	A216	Adept Fluidyne Pvt. Ltd.	REGULAR	Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com	Works-1-> Plot No 4,S.No.17/1-B Kothrud Industrial Estate -Pune-MAHARASHTRA india Phone- 020 25464551 FAX : Pincode : 411038 Email :	C&I			12-Sep-16	Small	31-Mar-22	, , ,
5	ULTRASONIC FLOW METERS	A216	Adept Fluidyne Pvt. Ltd.	REGULAR	Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com	Works-1-> Plot No 4,S.No.17/1-B Kothrud Industrial Estate -Pune-MAHARASHTRA india Phone- 020 25464551 FAX : Pincode : 411038 Email :	C&I			07-Nov-17	Small	31-Mar-22	, , ,
6	JUNCTION BOX	A101	AJMERA INDUSTRIAL & ENGINEERING WORKS	REGULAR	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	Works-1->JIGNESH MAHENDRA AJMERA DENA BANK BLDG., SHREE NAGESHINDL. ESTATE,STATION ROAD, -MUMBAI-MAHARASHTRA INDIA Phone- 022 67973578 FAX : Pincode : 400 088 Email : ajmera@ajmera.net	C&I			26-Nov-10			Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; , APPROVED FOR GALVANIZED AND FRP JUNCTION BOXES; Technical limit reviewed on 30.04.2014 , ,
7	INSTRUMENT FITTINGS	A121	Arya Crafts & Engineering Pvt. Ltd.	REGULAR	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 :		C&I			16-Jun-12	Small	29-Jun-18	, , ,
8	INSTRUMENT FITTINGS	A079	AURA INCORPORATED	REGULAR	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com		C&I			27-Jan-09			, , ,
9	INSTRUMENTS PIPE FITTINGS	A079	AURA INCORPORATED	REGULAR	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com		C&I			27-Jan-09			, , ,
10	INSTRUMENTS TUBE FITTINGS	A079	AURA INCORPORATED	REGULAR	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com		C&I			27-Jan-09			, , ,
11	SIGHT FLOW INDICATORS	B068	B.K.EQUIPMENTS PVT.LTD.	REGULAR	T. BALAKRISHNAN/S.VENKATESH 217 , ARCOT ROAD PORUR , CHENNAI Phone- 9444057761 Pincode : 600116 Email : bkequip@gmail.com	Works-1->V.KARUNANIDHI/P.BABU 217 , ARCOT ROAD,PORUR , -CHENNAI-TAMIL NADU INDIA Phone- 9444131187 FAX : 044-24766852 Pincode : 600116 Email :	C&I			30-Jul-10			, , ,
12	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	B085	Barksdale GmbH, Germany	REGULAR	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de		C&I			01-Sep-10			, , ,
13	LEVEL SWITCH-CAPACITANCE TYPE	W017	Baumer Technologies India Pvt. Ltd.	REGULAR	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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com	C&I						, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 , ,
14	LEVEL SWITCH-FLOAT TYPE	W017	Baumer Technologies India Pvt. Ltd.	REGULAR	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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com	C&I						, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 , ,

15	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	W017	Baumer Technologies India Pvt. Ltd.	REGULAR	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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com	C&I						, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 , ,
16	TEMP. ELEMENT	W017	Baumer Technologies India Pvt. Ltd.	REGULAR	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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com	C&I						, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 , ,
17	TEMPERATURE GAUGE	W017	Baumer Technologies India Pvt. Ltd.	REGULAR	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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com	C&I						, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 , ,
18	LEVEL GAUGE	B077	BLISS ANAND PVT. LTD.	REGULAR	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 92B & 93B,Sec-V, IMTManesar -GURGAON-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 122002 Email : bharat@blissanand.com	C&I				Small	31-Mar-22	, , ,
19	LEVEL SWITCH-CONDUTIVITY TYPE	B077	BLISS ANAND PVT. LTD.	REGULAR	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 92B & 93B,Sec-V, IMTManesar -GURGAON-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 122002 Email : bharat@blissanand.com	C&I				Small	31-Mar-22	, , ,
20	SIGHT FLOW INDICATORS	B077	BLISS ANAND PVT. LTD.	REGULAR	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 240, Sector-3, HSIIDC, Bawal -Rewari-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 123501 Email : bharat@blissanand.com	C&I				Small	31-Mar-22	Reassessed on 07.04.2016; , , ,
21	CONTROL VALVE	B207	BOMAFA SPECIAL VALVE SOLUTIONS PVT LTD	REGULAR	Mr. K.M. Anklesaria/ R. M. Anklesaria Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva Ahmedabad Phone- 079-40083825 Pincode : 382445 Email : info@bomafa-india.com	Works-1->Mr. K.M. Anklesaria/ Mr. R.M. Anklesaria Dir Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva, -Ahmedabad-GUJARAT INDIA Phone- 079-40083825 FAX : Pincode : 382445 Email : info@bomafa-india.com	C&I			17-Dec-16	Small	31-Mar-22	, , ,
22	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	B083	BOSE PANDA INSTRUMENTS PVT.LTD.	REGULAR	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@gmail.com bosepanda@vsnl.net	C&I			20-Aug-14	Micro	31-Mar-23	Trial to Hold as per SEARP amd-3,w.e.f. 15-09-12 , Supplier registered in trial category on 30.10.2010 and was thereafter put in susp-hold category as per SEARP Amd-03 on 15.09.2012. Further, on evaluation put in permanent category on 20.08.2014; , ,
23	FLOW ELEMENT - ORIFICE	C203	CHEMTROLS INDUSTRIES PVT. LTD.	REGULAR	Mr. K. NANDAKUMAR AMAR HILL, SAKI VIHAR ROAD, POWAI, MUMBAI Phone- 022-67151261 Pincode : 400072 Email : manikandan@chemtrols.com	Works-2->+Works -II :M/s Chemtrols Samil (I) Pvt. Ltd.,Plot No.F-43,44 Others Additional Ambernath Industrial ,M.I.D.C., Ambernath -Thane-MAHARASHTRA INDIA Phone- 22-67151261,9821014902 FAX : 91-22-28571913 Pincode : 421503 Email : manikandan@chemtrols.com	C&I			08-Aug-17	Small	19-Jun-18	, , ,
24	CONTROL VALVE	C228	CIRCOR FLOW TECHNOLOGIES INDIA PVT. LTD.	REGULAR	Mr. Vinodh Gopinath, Senior Director SF No. 337/2, No.15 Naranapuram Village,Ponnandampalayam Coimbatore Phone- 9500928448 Pincode : 641659 Email : santhosh.ponnusamy@circor.com	Works-1->Mr. Santhosh Ponnusamy Others SF No. 337/2, No.15, Naranapuram Village,Ponnandampalayam - Coimbatore-TAMILNADU INDIA Phone- 9500928448 FAX : 04212321600 Pincode : Coimbatore Email :	C&I			23-Aug-20			Registered on 23.08.2020 as per 15th MISCC , , ,
25	INSTRUMENT FITTINGS	C067	Comfit & Valve Pvt. Ltd.	REGULAR	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	Works-1->Miss Sonal Pithadia/Miss Pavan Chavda Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway, Laxmipura -Nandasan-GUJARAT INDIA Phone- 8460848087 FAX : 2764-267036/37 Pincode : 382705 Email : domestic@com-fit.com	C&I			29-Feb-12			, , ,
26	Cold Junction Compensation Box (CJCB)	C048	CREATIVE INSTRUMENTS & CONTROLS	REGULAR	NO-17/1 , 1ST FLOOR , 11TH CROSS 1ST K BLOCK , RAJAJINAGAR, BANGALORE-560010 Phone- Pincode : Email : crinstruments@gmail.com		C&I						, , ,
27	LEVEL SWITCH-FLOAT TYPE	D046	D.K. INSTRUMENTS PVT.LTD.	REGULAR	N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@vsnl.net		C&I			30-Jul-10			, , ,

28	TEMP. ELEMENT	I022	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	REGULAR	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com	Works-1->Mr. A.D.Solomon J-14, MIDC, TARAPORE, BOISER STN., -THANE-MAHARASHTRA India Phone- FAX : Pincode : Email : trivtech@vsnl.com	C&I						, , ,
29	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	D021	DRESSER INDUSTRIES INC.	REGULAR	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com		C&I						, , ,
30	TEMPERATURE SWITCH	D021	DRESSER INDUSTRIES INC.	REGULAR	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com		C&I						, , ,
31	ANUBAR (DELTA TUBE)	D212	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	REGULAR	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	Works-1->Mr. Yogish M. Kulkarni Dir Plot # 23, Udyambag, -Belgaum-KARNATAKA INDIA Phone- 0831-4210386 FAX : 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	C&I			05-Aug-16	Micro	31-Mar-23	, , ,
32	FLOW ELEMENT - NOZZLE	D212	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	REGULAR	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	Works-1->Mr. Yogish M. Kulkarni Dir Plot # 23, Udyambag, -Belgaum-KARNATAKA INDIA Phone- 0831-4210386 FAX : 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	C&I			05-Aug-16	Micro	31-Mar-23	, Technical limit reviewed on 30.10.2017. , ,
33	FLOW ELEMENT - ORIFICE	D212	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	REGULAR	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	Works-1->Mr. Yogish M. Kulkarni Dir Plot # 23, Udyambag, -Belgaum-KARNATAKA INDIA Phone- 0831-4210386 FAX : 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	C&I			05-Aug-16	Micro	31-Mar-23	, , ,
34	ELECTROMAGNETIC FLOW METER	E211	Electronet Equipments Pvt Ltd.	REGULAR	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com	Works-1-> Others Plot No. 84, 85 & 86, Tiny Industrial Estate, Kondhwa Budruk -Pune-MAHARASHTRA INDIA Phone- 20-26932039 FAX : 20-26934122 Pincode : 411048 Email : ho@eeplindia.com	C&I			12-Sep-16	Small	31-Mar-22	, , ,
35	FLOW ELEMENT - ORIFICE	E211	Electronet Equipments Pvt Ltd.	REGULAR	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com	Works-1-> Others Plot No. 84, 85 & 86, Tiny Industrial Estate, Kondhwa Budruk -Pune-MAHARASHTRA INDIA Phone- 20-26932039 FAX : 20-26934122 Pincode : 411048 Email : ho@eeplindia.com	C&I			13-Jun-19	Small	31-Mar-22	, , ,
36	ULTRASONIC FLOW METERS	E211	Electronet Equipments Pvt Ltd.	REGULAR	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com	Works-1-> Others Plot No. 84, 85 & 86, Tiny Industrial Estate, Kondhwa Budruk -Pune-MAHARASHTRA INDIA Phone- 20-26932039 FAX : 20-26934122 Pincode : 411048 Email : ho@eeplindia.com	C&I			07-Nov-17	Small	31-Mar-22	, , ,
37	TRANSMITTERS	R002	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	REGULAR	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA,MIDC, PAWANE, -NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022-66736000 Pincode : 400 705 Email : Kalpesh.chandan@emerson.com	C&I						, , ,
38	CONTROL VALVE	F015	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	REGULAR	147, KARAPAKKAM VILLAGE, CHENNAI Phone- 23722184, 23716242 Pincode : 600096 Email : jatinder.singh@emerson.com	Works-1->Mr. Rangarajan (Head - Lean and Manufact 147,Karapakkam Village, -Chennai-TAMIL NADU India Phone- 0444903 4395 FAX : Pincode : 600097 Email : Rangarajan.M@emerson.com	C&I						Vendor's name changed from "Fisher Sanmar Limited" to "Emersion Process Management Chennai Limited" w.e.f. 22.09.2011 , , ,
39	TRANSMITTERS	E057	Endress + Hauser (India) Pvt. Ltd.,	REGULAR	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,	Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad-MAHARASHTRA India Phone- 9881000474, FAX : 0240-2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetzer.endress.com	C&I	"Except Displacement Type Level Transmitters"		24-Oct-13			, Technical Limit reviewed and changed from "For temperature transmitter only" to "Except Displacement Type Level Transmitters" w.e.f. from 21.03.2018 , ,
40	ELECTROMAGNETIC FLOW METER	E047	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	REGULAR	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com	Works-1->Mr Ashish Shaha, J-501, M.I.D.C. Pimpri, -PUNE-MAHARASHTRA INDIA Phone- 9370469464 FAX : Pincode : 411018 Email : northsales@eurekaflow.com	C&I			23-Apr-22	Small	31-Mar-23	Temporary code allotted on 17.07.2021 for 2X660 MW BIFPCL MAITREE KHULNA STPP , Supplier registered as per 2nd MISCC FY 2022-23 dated 23.04.2022 , ,
41	FLOW ELEMENT - ORIFICE	E047	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	REGULAR	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com	Works-1->Mr Ashish Shaha, J-501, M.I.D.C. Pimpri, -PUNE-MAHARASHTRA INDIA Phone- 9370469464 FAX : Pincode : 411018 Email : northsales@eurekaflow.com	C&I			23-Apr-22	Small	31-Mar-23	, Supplier registered as per 2nd MISCC FY 2022-23 dated 23.04.2022 , ,
42	ROTAMETER	E047	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	REGULAR	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com	Works-1->Mr S. M. Alawani/Mr V. V. Deshpande J-501, M.I.D.C. Pimpri, -PUNE-MAHARASHTRA INDIA Phone- 9325751732 FAX : 020-30681731 Pincode : 411018 Email : works@eurekaflow.com	C&I			30-Jul-10	Small	31-Mar-23	, , ,

43	ULTRASONIC FLOW METERS	F206	FLASH FORGE PVT LTD	REGULAR	Mr. Gautam Makker, 503, 'A'-wing, Delphi, Orchard Avenue Road, Powai Mumbai Phone- 022-42784300 Pincode : 400076 Email : hemendrapatil@f-f.co.in	Works-1-> Others M/s Endress & Hauser, Aurangabad, Maharastra - Aurangabad-MAHARASHTRA INDIA Phone- FAX : Pincode : Email : Works-2->+ Others M/s Endress & Hauser, Bhiwandi,Thane -Thane-MAHARASHTRA INDIA Phone- FAX : Pincode : Email :	C&I			04-Nov-16			Exclusive partner for bidding of BHEL tender for M/s Endress & Hauser make Ultrasonic Flowmeters and MOU agreement valid upto 30.06.2018 , Manufacturing works at M/s Endress & Hauser, Aurangabad, Maharashtra and M/s Endress & Hauser, Bhiwandi, Thane, Maharashtra , ,
44	ULTRASONIC FLOW METERS	F211	FLEXIM Flexible Industriemesstechnik GmbH	REGULAR	Boxberger Str., 4, Berlin Berlin Phone- 0049 30 93 66 76 60 Pincode : 12681 Email : info@flexim.de	Works-1-> Others Boxberger Str. 4, -Berlin- GERMANY Phone- 0049 30 93 66 76 60 FAX : Pincode : 12681 Email : info@flexim.de	C&I			14-Nov-17			, , ,
45	JUNCTION BOX	F201	FLEXPRO ELECTRICALS PVT. LTD.	REGULAR	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	Works-1->Mr. Dineshbhai Zaveri CEO C-1/ 27&37, GIDC, Kabilpore, -Navsari-GUJARAT INDIA Phone- 02637-265140,265003 FAX : 02637-265308 Pincode : 396424 Email : flexpro@flexproltd.com	C&I	Metal type junction box only		02-Feb-15			Technical limit reviewed on 12.10.2015; , , ,
46	INSTRUMENT FITTINGS	H024	Fluid Controls Pvt. Ltd.	REGULAR	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	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com	C&I			14-Feb-12			Name changed from M/s Hyd-Air Valves Pvt. Ltd. to M/s Fluid Controls Pvt. Ltd. as per 25th MISCC-Electrical and C&I dtd. 20.02.2014 , , ,
47	INSTRUMENTS PIPE FITTINGS	H024	Fluid Controls Pvt. Ltd.	REGULAR	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	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com	C&I			30-Mar-10			, , ,
48	INSTRUMENTS TUBE FITTINGS	H024	Fluid Controls Pvt. Ltd.	REGULAR	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	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com	C&I			17-Sep-09			, , ,
49	INSTRUMENT FITTINGS	F040	FLUIDFIT ENGINEERS PVT. LTD.	REGULAR	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	Works-1->Mr. Abbas Bhola Unit No. 16, Supreme Industrial Estate,Kaman Bhiwandi Road,Devdal, -Vasai East-MAHARASHTRA India Phone- 9920044113 FAX : 07303178243 Pincode : 401208 Email : ab@fluidfitengg.com	C&I			15-Jan-14	Small	23-Feb-17	Registered as per 22nd Electrical and C&I MISCC Meeting dtd. 15.01.2014 , , ,
50	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	F016	FORBES MARSHALL (HYD) LTD.	REGULAR	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	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@forbesmarshall.com	C&I						, , ,
51	TEMPERATURE GAUGE	F016	FORBES MARSHALL (HYD) LTD.	REGULAR	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	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@forbesmarshall.com	C&I						, , ,
52	CONTROL VALVE	F030	FORBES MARSHALL ARCA PVT.LTD.	REGULAR	A-34/35 , MIDC ESTATE, H-BLOCK, PIMPRI, PUNE, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com	Works-1->Mr. Sanjeev Shinde A-34/35 MIDC Estate,H Block, Pimpri, -Pune-MAHARASHTRA India Phone- 9323176406 FAX : 020-27442040 Pincode : 411018 Email : sshinde@forbesmarshall.com	C&I	No technical limit exists except for feed control valve. For feed control valves, approved up to sub-critical power plants of 600 MW rating.		16-Dec-10			, Technical limit reviewed on 30.04.2014 and further revised on 29.12.2015; , Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; ,
53	VIBRATION MONITORING SYSTEM	F034	FORBES MARSHALL PVT. LTD	REGULAR	Mr. Kekoo Vacha P No. B 85, Phase II, Chakan Industrial Area, VIL.-Savardari Chakan, Tal:Khed PUNE Phone- 9823092007 Pincode : 410501 Email : kvacha@forbesmarshall.com		C&I			24-Aug-12			IN ASSOCIATION WITH SHINKAWA ELECTRIC CO. LTD.,JAPAN (V.CODE S155) AS PER AGREED SCOPE MATRIX.ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR
54	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	G071	GAUGE BOURDON INDIA PVT. LTD.	REGULAR	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com	C&I			06-Mar-14	Small	11-Jun-18	Registered as per 26th MISCC-Electrical and C&I dtd. 06.03.2014. , , ,

55	TEMP. ELEMENT	G071	GAUGE BOURDON INDIA PVT. LTD.	REGULAR	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com,	C&I			29-Dec-15	Small	11-Jun-18	, , ,
56	TEMPERATURE GAUGE	G071	GAUGE BOURDON INDIA PVT. LTD.	REGULAR	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com,	C&I			28-Mar-13	Small	11-Jun-18	, , ,
57	VIBRATION MONITORING SYSTEM	G068	GE INDIA INDUSTRIAL PVT. LTD.	REGULAR	Mr. Pramod Kaushik/Vijay Pal BUILDING NO-7A, 4TH FLOOR GURGAON Phone- 0124-4808515 Pincode : 122002 Email : vijay.pal@ge.com		C&I			24-Aug-12			PARENT COMPANY: BENTLY NEVADA INC, USA. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR AS DECIDED BY 4TH MISCC (ELECT AND C&I) HELD ON 24.08.2012. , , ,
58	PROGRAMMABLE LOGIC CONTROLLER	G035	GE Intelligent Platforms Private Limited	REGULAR	90/B, ELECTRONICS CITY, HOSUR ROAD, BANGLORE Phone- 28528328 Pincode : 561229 Email : shivesh.k.jha@ge.com		C&I						, , ,
59	LEVEL SWITCH-FLOAT TYPE	G060	GENERAL INSTRUMENTS CONSORTIUM	REGULAR	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com		C&I			30-Sep-10			Workas at- GAUGES BOURDON INDIA PVT. LTD. (A MFG. UNIT OF GENERAL INSTRUMENTS CONSORTIUM , PLOT NO-4, 5 & 6, JAWAHAR Co-op. INDUSTRIAL ESTATE, KAMOTHE, PANVEL- 410 209 , , ,
60	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	G060	GENERAL INSTRUMENTS CONSORTIUM	REGULAR	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com		C&I			30-Sep-10			Workas at- GAUGES BOURDON INDIA PVT. LTD. (A MFG. UNIT OF GENERAL INSTRUMENTS CONSORTIUM , PLOT NO-4, 5 & 6, JAWAHAR Co-op. INDUSTRIAL ESTATE, KAMOTHE, PANVEL- 410 209 , , ,
61	TEMP. ELEMENT	G032	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	REGULAR	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com	C&I			09-May-13	Micro	31-Mar-23	GCC Rev.5 has been accepted in toto. , , ,
62	TEMPERATURE GAUGE	G032	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	REGULAR	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com	C&I				Micro	31-Mar-23	GCC Rev.5 has been accepted in toto. , , ,
63	TEMPERATURE GAUGE	G047	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	REGULAR	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in	Works-1->Mrs Saanvi Naik BICHOLIM, -BICHOLIM-GOA INDIA Phone- 9595855152 FAX : Pincode : 403 529 Email : saanvi.naik@thermostatic.in	C&I			30-Jul-10			, , ,
64	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H023	H.GURU INDUSTRIES	REGULAR	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	Works-1->NA NA -- Phone- FAX : Pincode : Email :	C&I		OVERALL PENDING ORDER VALUE (EXCLUDING VALUE OF ORDERS ALREADY EXECUTED) FOR ALL PACKAGES FOR WHICH VENDOR IS REGISTERED SHALL NOT EXCEED RS. 1.0 CRORE				, Financial limit reviewed on 05.06.2014; , ,
65	TEMPERATURE GAUGE	H023	H.GURU INDUSTRIES	REGULAR	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	Works-1->NA NA -- Phone- FAX : Pincode : Email :	C&I		OVERALL PENDING ORDER VALUE (EXCLUDING VALUE OF ORDERS ALREADY EXECUTED) FOR ALL PACKAGES FOR WHICH VENDOR IS REGISTERED SHALL NOT EXCEED RS. 1.0 CRORE				, Financial limit reviewed on 05.06.2014; , ,
66	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H040	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	REGULAR	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhahazra@hgurusouth.com	C&I			30-Jul-10	Micro	31-Mar-23	, , ,

67	TEMPERATURE GAUGE	H040	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	REGULAR	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhahazra@hgurusouth.com	C&I			30-Jul-10	Micro	31-Mar-23	, , ,
68	LEVEL SWITCH-CONDUTIVITY TYPE	H047	HI-TECH SYSTEMS & SERVICES LTD.	REGULAR	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA Phone- 033-22290045 Pincode : 700016 Email : sandeep@hitech.in	Works-1->Mr. Jitendra Kumar/Mr. Debasis Dey 82/1, Sarsuna Main Road, -KOLKATA-WEST BENGAL INDIA Phone- 9883994030 FAX : Pincode : 700061 Email : jitendra@hitech.in	C&I	Vendor shall source import contents of Level Switch (Conductivity Type) from Levelstate Systems Ltd., United		01-Jun-09			Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014; , ,
69	TRANSMITTERS	T031	Honeywell Automation India Limited	REGULAR	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com	C&I						, , ,
70	PROGRAMMABLE LOGIC CONTROLLER	H063	Honeywell Automation India Limited ,	REGULAR	56 & 57, Hadapsar Industrial Estate, Pune, Phone- 9689940949, Pincode : Email : amit.aglave@honeywell.com,	Works-1-> 56 & 57, Hadapsar Industrial Estate, -Pune-MAHARASHTRA India Phone- 9689940949, FAX : 020-66039800, Pincode : Email : amit.aglave@honeywell.com	C&I			28-Mar-13			, , ,
71	INSTRUMENT FITTINGS	H61	HP VALVES & FITTINGS INDIA PVT. LTD.	REGULAR	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	Works-1->S. Harichandran/ P.S. Pandi B-11, Mugappair Industrial Estate, -CHENNAI-TAMIL NADU INDIA Phone- 044-25252537 FAX : 044-26252538 Pincode : 600037 Email : sales@hpvalvesindia.com	C&I			30-May-12	Small	31-Mar-23	, , ,
72	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	D003	INDFOS (INDIA) LIMITED	REGULAR	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		C&I						, , ,
73	TEMPERATURE SWITCH	D003	INDFOS (INDIA) LIMITED	REGULAR	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		C&I						, , ,
74	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	I041	INDFOS INDUSTRIES LIMITED	REGULAR	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com		C&I						, , ,
75	FLOW ELEMENT - ORIFICE	I030	INSTRUMENTATION ENGINEERS PVT LTD	REGULAR	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	Works-1->MR. A.V.MURTHY/MR. K.T. RAVISANKER PLOTS 1,2,3, PHASE-III,IDA, JEEDIMETLA - HYDERABAD-TELANGANA INDIA Phone- 9885107312 FAX : 040-23096401 Pincode : 500055 Email : sales@ieflowmeters.com	C&I			11-Apr-13	Micro	31-Mar-22	, , ,
76	ROTAMETER	I030	INSTRUMENTATION ENGINEERS PVT LTD	REGULAR	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	Works-1->MR. A.V.MURTHY/MR. K.T. RAVISANKER PLOTS 1,2,3, PHASE-III,IDA, JEEDIMETLA - HYDERABAD-TELANGANA INDIA Phone- 9885107312 FAX : 040-23096401 Pincode : 500055 Email : sales@ieflowmeters.com	C&I				Micro	31-Mar-22	, , ,
77	SIGHT FLOW INDICATORS	I030	INSTRUMENTATION ENGINEERS PVT LTD	REGULAR	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	Works-1->MR. A.V.MURTHY/MR. K.T. RAVISANKER PLOTS 1,2,3, PHASE-III,IDA, JEEDIMETLA - HYDERABAD-TELANGANA INDIA Phone- 9885107312 FAX : 040-23096401 Pincode : 500055 Email : sales@ieflowmeters.com	C&I				Micro	31-Mar-22	, , ,
78	CONTROL VALVE	I006	INSTRUMENTATION LTD.	REGULAR	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, -PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com;mraj@ilpgt.com;gireesh@ilpgt.com, commercial@ilpgt.com;fa2@ilpgt.com;nazeera@ilpgt.com;pkv@ilpgt.com	C&I						SICK PSU. BIFR CASE. , , ,
79	FLOW ELEMENT	I006	INSTRUMENTATION LTD.	REGULAR	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com		C&I						SICK PSU. BIFR CASE. , , ,

80	FLOW ELEMENT - NOZZLE	I006	INSTRUMENTATION LTD.	REGULAR	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, -PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com;mraj@ilpgt.com;gireesh@ilpgt.com, commercial@ilpgt.com;fa2@ilpgt.com;nazeera@ilpgt.com;pkv@ilpgt.com	C&I						SICK PSU. BIFR CASE. , , ,
81	FLOW ELEMENT - ORIFICE	I006	INSTRUMENTATION LTD.	REGULAR	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, -PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com;mraj@ilpgt.com;gireesh@ilpgt.com, commercial@ilpgt.com;fa2@ilpgt.com;nazeera@ilpgt.com;pkv@ilpgt.com	C&I						SICK PSU. BIFR CASE. , , ,
82	JUNCTION BOX	K043	K.S.INSTRUMENTS PVT.LTD.	REGULAR	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net		C&I			30-Jul-10			, , ,
83	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	K054	Kaustubha Udyog,	REGULAR	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com		C&I			28-Mar-13	Small	30-Mar-20	, , ,
84	CONTROL VALVE	K048	Koso India Private Limited,	REGULAR	H 33 & 34, MIDC, Ambad, Nashik, Phone- 09650233433 Pincode : 422010, Email : enquiry@koso.co.in;jetmal.gour@koso.co.in	Works-1->P.J.ASHOK KUMAR/SEEMA ANAND Control Valve Division, H-33&34, MIDC, Ambad, -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in;enquiry@koso.co.in Works-2->+P.J.ASHOK KUMAR/SEEMA ANAND J-1,MIDC,Ambad -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in;enquiry@koso.co.in	C&I			30-Sep-09	Medium	31-Mar-23	, The name has been changed from M/s KOSO FLUID CONTROLS (PVT) LTD to M/s Koso India Private Limited as per 11th MISCC Elect and C&I dated 30.07.2013. , Approved works at Control Valve Division, H-33&34, Ambad, Nashik w.e.f. 12.10.2015; Additional works at "J-1,MIDC,Ambad, nashik-422010" approved w.e.f. 17.06.2016; ,
85	CONTROL VALVE	M005	KSB MIL CONTROLS LTD.	REGULAR	Mr.Jacob Cherian/Mr.Geo Jolly Meladoor, Annamanada P.O. MALA, Thrissur Phone- 0480-2695700 Pincode : 680741 Email : biju.simon@ksb.com	Works-1->Mr.Biju Simon/Mr.Jose Paul Meladoor, Annamanada, -Thrissur-KERALA INDIA Phone- 9447555500 FAX : 91 480 2890952 Pincode : 680741 Email : jose.paul@ksb.com	C&I						, Name changed from MIL Controls limited to KSB MIL Control limited based on MISCC dated 06.04.2017 , ,
86	LEVEL SWITCH-CAPACITANCE TYPE	L005	LEVCON INSTRUMENTS PVT. LTD.	REGULAR	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com		C&I						, , ,
87	LEVEL SWITCH-CONDUTIVITY TYPE	L005	LEVCON INSTRUMENTS PVT. LTD.	REGULAR	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com	Works-1-> 38G, PICNIC GARDEN ROAD, -KOLKATA-WEST BENGAL INDIA Phone- FAX : Pincode : Email :	C&I			01-Jun-09			, , ,
88	LEVEL SWITCH-FLOAT TYPE	L005	LEVCON INSTRUMENTS PVT. LTD.	REGULAR	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com		C&I			01-Jun-09			, , ,
89	CONTROL VALVE	M224	Mascot Valves Pvt. Ltd.	REGULAR	166-167 GIDC Naroda Ahmedabad Phone- 0792282 1619 Pincode : 382330 Email : dom.sales@mascotvalves.com	Works-1->Varun Patel Dir 166-167 ,GIDC Naroda -Ahmedabad-GUJARAT India Phone- 0792282 1619 / 3369 FAX : Pincode : 382330 Email : dom.sales@mascotvalves.com	C&I			29-Aug-17	Small	31-Mar-23	, , ,
90	VIBRATION MONITORING SYSTEM	M097	MEGGITT INDIA PVT. LTD.	REGULAR	LJ Swaminathan/Gaurav Anand Unit-04A, Level-02, Bagmane Laurel Bagmane Tech Park, CV Raman Nagar Bangalore Phone- +91-9731577119 Pincode : 560093 Email : gaurav.anand@meggitt.com		C&I			24-Aug-12			PARENT COMPANY: MEGGITT SA, SWITZERLAND. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR AS DECIDED BY 4TH MISCC (ELECT AND C&I) HELD ON 24.08.2012. , , ,
91	ANUBAR (DELTA TUBE)	M009	MICRO PRECISION PRODUCTS PVT. LTD.	REGULAR	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com	Works-1->Mr. SANJEEV CHAUHAN ,H.B. No.-40 Others Revenue Estate, Village-Dudhola, Tehsil & Distt.-Palwal -Faridabad-Haryana India Phone- 9560742713 FAX : Pincode : 121002 Email : anil.bhati@wika.com	C&I			26-Nov-15	Medium	31-Mar-23	, New Works "H.B. No.-40, Revenue Estate, Village-Dudhola, Faridabad-121102 , Haryana " approved w.e.f. 07.05.2018 due to shifting. , ,

92	FLOW ELEMENT	M009	MICRO PRECISION PRODUCTS PVT. LTD.	REGULAR	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com		C&I				Medium	31-Mar-23	REGISTERED AS MSED VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , , ,
93	FLOW ELEMENT - NOZZLE	M009	MICRO PRECISION PRODUCTS PVT. LTD.	REGULAR	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com	Works-1->Mr. SANJEEV CHAUHAN ,H.B. No.-40 Others Revenue Estate, Village-Dudhola, Tehsil & Distt.-Palwal -Faridabad-Haryana India Phone- 9560742713 FAX : Pincode : 121002 Email : anil.bhati@wika.com	C&I			15-Nov-11	Medium	31-Mar-23	REGISTERED AS MSED VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , New Works "H.B. No.-40, Revenue Estate, Village-Dudhola, Faridabad-121102 , Haryana " approved w.e.f. 07.05.2018 due to shifting. , ,
94	FLOW ELEMENT - ORIFICE	M009	MICRO PRECISION PRODUCTS PVT. LTD.	REGULAR	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com	Works-1->Mr. SANJEEV CHAUHAN ,H.B. No.-40 Others Revenue Estate, Village-Dudhola, Tehsil & Distt.-Palwal -Faridabad-Haryana India Phone- 9560742713 FAX : Pincode : 121002 Email : anil.bhati@wika.com	C&I			15-Nov-11	Medium	31-Mar-23	REGISTERED AS MSED VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , New Works "H.B. No.-40, Revenue Estate, Village-Dudhola, Faridabad-121102 , Haryana " approved w.e.f. 07.05.2018 due to shifting. , ,
95	VENTURI METER	M009	MICRO PRECISION PRODUCTS PVT. LTD.	REGULAR	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com		C&I			22-Oct-11	Medium	31-Mar-23	, , ,
96	FLOW ELEMENT - NOZZLE	M201	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	REGULAR	Mr. Raghavendra M. Kulkarni D2-49/50, Tivim Industrial Estate, Karaswada Mapusa Phone- 0832-2257059 Pincode : 403526 Email : gicflowelement@giconindia.com	Works-1->Mr. Raghavendra M. Kulkarni Dir D2-49/50, Tivim Industrial Estate,Karaswada - Mapusa-GOA INDIA Phone- 0832-2257059 FAX : 022-24455026 Pincode : Email : ramk@giconindia.com	C&I			02-Feb-15	Small	31-Mar-23	, Supplier Re-assessed on 27.05.2021 (2nd MISCC FY 2021-22) , ,
97	FLOW ELEMENT - ORIFICE	M201	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	REGULAR	Mr. Raghavendra M. Kulkarni D2-49/50, Tivim Industrial Estate, Karaswada Mapusa Phone- 0832-2257059 Pincode : 403526 Email : gicflowelement@giconindia.com	Works-1->Mr. Raghavendra M. Kulkarni Dir D2-49/50, Tivim Industrial Estate,Karaswada - Mapusa-GOA INDIA Phone- 0832-2257059 FAX : 022-24455026 Pincode : 403526 Email : gicflowelement@giconindia.com	C&I			28-Apr-17	Small	31-Mar-23	, Supplier Re-assessed on 27.05.2021 (2nd MISCC FY 2021-22) , ,
98	ANUBAR (DELTA TUBE)	M075	MINCO (INDIA) PRIVATE LIMITED	REGULAR	Mr. Rajeev Vasudeva, D/35, TIVIM INDUSTRIAL ESTATE, KARASWADA, MAPUSA, Goa, Phone- 9313637073 Pincode : 403526, Email : gicdelhi@general-gauges.com	Works-1-> D/35,TIVIM INDUSTRIAL ESTATE, KARASWADA,MAPUSA, -Goa-Goa India Phone- 9320197825, FAX : 0832-2257262, Pincode : 403526, Email : santoshkumar@general-gauges.com	C&I				Small	31-Mar-23	One time code accorded for 2x660 MW Suratgarh STPS, Stage-V. Hold uplifted w.e.f. 27.12.2017. , , Suspension Delisting w.e.f. 11.08.2015 due to non participation in RA for Banharpalli Project for Flow Orifice. Hold uplifted w.e.f. 27.12.2017. ,
99	FLOW ELEMENT - NOZZLE	M075	MINCO (INDIA) PRIVATE LIMITED	REGULAR	Mr. Rajeev Vasudeva, D/35, TIVIM INDUSTRIAL ESTATE, KARASWADA, MAPUSA, Goa, Phone- 9313637073 Pincode : 403526, Email : gicdelhi@general-gauges.com	Works-1-> D/35,TIVIM INDUSTRIAL ESTATE, KARASWADA,MAPUSA, -Goa-Goa India Phone- 9320197825, FAX : 0832-2257262, Pincode : 403526, Email : santoshkumar@general-gauges.com	C&I				Small	31-Mar-23	NO FURTHER TENDER/P.O. TILL FINAL REVIEW AFTER 3rd ORDER EXECUTION.Hold uplifted w.e.f. 27.12.2017. , , Suspension Delisting w.e.f. 11.08.2015 due to non participation in RA for Banharpalli Project for Flow Orifice. Hold uplifted w.e.f. 27.12.2017. ,
100	FLOW ELEMENT - ORIFICE	M075	MINCO (INDIA) PRIVATE LIMITED	REGULAR	Mr. Rajeev Vasudeva, D/35, TIVIM INDUSTRIAL ESTATE, KARASWADA, MAPUSA, Goa, Phone- 9313637073 Pincode : 403526, Email : gicdelhi@general-gauges.com	Works-1-> D/35,TIVIM INDUSTRIAL ESTATE, KARASWADA,MAPUSA, -Goa-Goa India Phone- 9320197825, FAX : 0832-2257262, Pincode : 403526, Email : santoshkumar@general-gauges.com	C&I			03-May-13	Small	31-Mar-23	Hold uplifted w.e.f. 27.12.2017. , , Suspension Delisting w.e.f. 11.08.2015 due to non participation in RA for Banharpalli Project for Flow Orifice. Hold uplifted w.e.f. 27.12.2017. ,
101	PROGRAMMABLE LOGIC CONTROLLER	M205	MITSUBISHI ELECTRIC INDIA PVT. LTD.	REGULAR	Mr. Mehul Dholakia Emerald House, EL-3, J Block, M.I.D.C., Bhosari, Pune Phone- 020-27102000 Pincode : 411026 Email : mehul.dholakia@asia.meap.com	Works-1->Mr. Mehul Dholakia Others Emerald House, EL-3, J Block, M.I.D.C., Bhosari, -Pune-MAHARASHTRA INDIA Phone- 020-27102000 FAX : 020-27102100 Pincode : 411026 Email : mehul.dholakia@asia.meap.com	C&I			15-Sep-15			, , ,
102	TRANSMITTERS	M091	Moore Industries International Inc.	REGULAR	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills - CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : gcruz@miinet.com	C&I			24-Aug-11			INDIAN REPRESENTATIVE: CHEMTROL INDUSTRIES LTD, , , ,
103	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	N214	Nesstech Instruments Private Limited	REGULAR	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkapadia@nesstech.co.in	C&I			11-May-17			, , ,
104	TEMP. ELEMENT	N214	Nesstech Instruments Private Limited	REGULAR	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkapadia@nesstech.co.in	C&I			11-May-17			, , ,

105	ELECTROMAGNETIC FLOW METER	N040	NIVO CONTROLS PVT. LTD.	REGULAR	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. S L Sadani Others 104 - 115,Electronic Complex - Indore-MADHYA PRADESH INDIA Phone- 0731-4081307 FAX : Pincode : 452010 Email : sales@nivocontrols.com;sadanis@nivocontrols.com	C&I			18-Jan-20	Small	31-Mar-23	Supplier registered as per 15th MISCC-Electrical and C&I dated 18.01.2020 , , ,
106	TRANSMITTERS	N040	NIVO CONTROLS PVT. LTD.	REGULAR	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. S L Sadani Others 104 - 115,Electronic Complex - Indore-MADHYA PRADESH INDIA Phone- 0731-4081307 FAX : Pincode : 452010 Email : sales@nivocontrols.com;sadanis@nivocontrols.com	C&I	For Capacitance type only		20-Sep-14	Small	31-Mar-23	Registered in permanent category as per 11th MISCC-Electrical and C&I (FY 2014-15) dt. 20.09.2014. , Technical limit reviewed on 12.10.2015; , ,
107	ULTRASONIC FLOW METERS	N209	NIVUS GMBH	REGULAR	Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com	Works-1->Mr. Marcus Fischer CEO Im Taele 2, Eppingen, -Baden Wuerttemberg,-Foreign Country GERMANY Phone- 0049-726291910 FAX : Pincode : 75031 Email : carolin.schuster@nivus.com	C&I			05-Jul-16			M/s Automation and Maintenance Systems approved as authorised distributor of M/s Nivus GmbH w.e.f. 01.11.2016 , , ,
108	INSTRUMENT FITTINGS	P082	PANAM ENGINEERS	REGULAR	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com	C&I			07-Feb-13			, , ,
109	TRANSMITTERS	P082	PANAM ENGINEERS	REGULAR	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com	C&I	For Pressure and Diff. Pressure transmitter		20-Aug-15			, , ,
110	INSTRUMENT FITTINGS	P81	Perfect Instrumentation Control (India) Pvt. Ltd.	REGULAR	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	Works-1->Shahanawaz Khan Vishweshwar Ind. Premises Co-op Soc. Ltd,F-18/19, Pradhikaran,Bhosadi MIDC -PUNE-MAHARASHTRA INDIA Phone- 020-30694134 FAX : 022-23013010 Pincode : 411026 Email : shahanawaz.khan@perfectinstrumentation.com	C&I			23-Mar-12			, , ,
111	INSTRUMENT FITTINGS	P046	PRECISION ENGINEERING INDUSTRIES	REGULAR	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com	C&I			14-Feb-12			, , ,
112	INSTRUMENTS PIPE FITTINGS	P046	PRECISION ENGINEERING INDUSTRIES	REGULAR	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com	C&I						, , ,
113	INSTRUMENTS TUBE FITTINGS	P046	PRECISION ENGINEERING INDUSTRIES	REGULAR	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com	C&I						, , ,
114	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A126	PRECISION MASS PRODUCTS PVT. LTD.	REGULAR	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com	C&I			23-Nov-12			Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by supplier. , , ,
115	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	A126	PRECISION MASS PRODUCTS PVT. LTD.	REGULAR	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com	C&I			23-Nov-12			Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by supplier. , , ,
116	TEMPERATURE GAUGE	A126	PRECISION MASS PRODUCTS PVT. LTD.	REGULAR	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com	C&I			23-Nov-12			Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by supplier. , , ,
117	LEVEL SWITCH-CAPACITANCE TYPE	P068	Pune Techtrol Pvt. Ltd.	REGULAR	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : bo@punetechtrol.com		C&I			23-Mar-12			, , ,

118	LEVEL SWITCH-FLOAT TYPE	P068	Pune Techtrol Pvt. Ltd.	REGULAR	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com		C&I			23-Mar-12			, , ,
119	TRANSMITTERS	P068	Pune Techtrol Pvt. Ltd.	REGULAR	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com		C&I	Only for capacitance Type Level Transmitter		07-Oct-14			Technical limit reviewed on 12.10.2015; , Manufacturing works: J-52/7, MIDC, Bhosari, Pune , ,
120	TEMP. ELEMENT	P061	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	REGULAR	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in	Works-1->A A KULKARNI/ VINOD C G PLOT NO. 71,BICHOLIM INDUSTRIAL ESTATE -BICHOLIM-GOA INDIA Phone- 9326114409 FAX : 91 832 2363381 Pincode : 403529 Email : pyroworks@pyro-electric.in	C&I			28-Jan-09			, , ,
121	LEVEL SWITCH-CONDUTIVITY TYPE	R047	RAMAN INSTRUMENTS PVT.LTD.	REGULAR	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	Works-1->NA -- Phone- FAX : Pincode : Email :	C&I	Vendor shall source import contents of Level Switch (Conductivity Type) from Mobrey Measurement, an operating unit of Morbey Ltd., Slough, Berkshire, United		01-Jun-09			Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014; , ,
122	PROGRAMMABLE LOGIC CONTROLLER	R021	ROCKWELL AUTOMATION INDIA LTD	REGULAR	(ALLENBRADLEY),C-11, SITE-4, INDUSTRIAL AREA SHHIBABAD, GHAZIABAD Phone- 2895247-52 Pincode : 201010 Email : pmehrotra@rockwell.com	Works-1->Anup Sharma C-11 Site-4 Industrial Area,Sahibabad - Ghaziabad-UTTAR PRADESH India Phone- 0120-4017926 FAX : 0120-2895224 Pincode : 201010 Email : raindia@ra.rockwell.com	C&I			30-Jul-10			, , ,
123	VIBRATION MONITORING SYSTEM	R056	ROCKWELL AUTOMATION INDIA PVT LTD	REGULAR	A-66, SEC- 64, NOIDA, Phone- 0120-4671236 Pincode : 201301 Email : raindia@ra.rockwell.com; asharma@ra.rockwell.com		C&I			24-Aug-12			PARENT COMPANY: ROCKWELL AUTOMATION INC,USA. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR AS DECIDED BY 4TH MISCC (ELECT AND C&I) HELD ON 24.08.2012. , , ,
124	ELECTROMAGNETIC FLOW METER	R057	Rockwin Flowmeter India Pvt. Ltd.	REGULAR	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com	Works-1-> B-24, Site-IV, Sahibabad Industrial Area, -Ghaziabad-UTTAR PRADESH India Phone- 9810129687 FAX : 01202895450 Pincode : 201010 Email :	C&I			27-May-21	Small	31-Mar-23	Supplier registered on 27.05.2021 as per 2nd MISCC FY 2021-22 , , ,
125	ULTRASONIC FLOW METERS	R057	Rockwin Flowmeter India Pvt. Ltd.	REGULAR	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com	Works-1->MR Rajiv PRAKASH B-24, Site-IV, Sahibabad Industrial Area, -Ghaziabad-UTTAR PRADESH India Phone- 9810129687 FAX : 01202895450 Pincode : 201010, Email : rajiv@rockwin.com	C&I			14-Mar-17	Small	31-Mar-23	, , ,
126	CONTROL VALVE	S280	SAMSON CONTROLS PVT. LTD.	REGULAR	Mr. Atul raje-MD D 281, MIDC Ranjangaon Ta Shirur Pune Phone- 02067246600 Pincode : 412220 Email : sales@samsoncontrols.net	Works-1-> Others D 281, MIDC Ranjangaon -Pune-MAHARASHTRA India Phone- 02067246600,8554997963 FAX : Pincode : 412220 Email : sales@samsoncontrols.net	C&I			15-Jun-18	Medium	31-Mar-22	"Hydro test bench for 6" to 12", 2500# ANSI rating is available at unit II, D-100 MIDC Ranjangaon, Tal. Shirur, Dist. Pune." , , ,
127	LEVEL SWITCH-CONDUTIVITY TYPE	S123	Sapcon Instrument Pvt Ltd.	REGULAR	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com	Works-1->Mr. Ashwin R Palshikar/Mr. Navin Bodse 131 PALSHIKAR COLONY, -INDORE-MADHYA PRADESH INDIA Phone- 9754261005 FAX : 0731-2475475 Pincode : 452004 Email : sales@sapcon.in	C&I			22-Oct-11			, , ,
128	LEVEL SWITCH-FLOAT TYPE	S106	SBEM PVT. LTD.	REGULAR	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	Works-1->MR. MOHAN PADWAL 691/A/2,BIBWEWADI INDL ESTATE -PUNE-MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : wm@sbem.co.in	C&I			30-Jul-10			, , ,
129	TRANSMITTERS	S106	SBEM PVT. LTD.	REGULAR	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	Works-1->MR. MOHAN PADWAL 691/A/2,BIBWEWADI INDL ESTATE -PUNE-MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : wm@sbem.co.in	C&I	FOR CAPACITANCE TYPE.		31-May-11			Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; , Technical limit reviewed on 30.04.2014 & 12.10.2015; , ,
130	PROGRAMMABLE LOGIC CONTROLLER	S083	SCHNEIDER ELECTRIC INDIA PVT.LTD.	REGULAR	A-4 , MOHAN CO-OP INDL AREA MATHURA ROAD NEW DELHI Phone- Pincode : 110044 Email : aditya.bawa@schneider-electric.com		C&I						, , ,
131	ELECTROMAGNETIC FLOW METER	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	REGULAR	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	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane - Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com	C&I			31-May-17	Small	22-Feb-21	, , ,

132	FLOW ELEMENT - ORIFICE	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	REGULAR	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	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane - Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com	C&I			31-May-17	Small	22-Feb-21	, , ,
133	LEVEL SWITCH-CAPACITANCE TYPE	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	REGULAR	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	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane - Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com	C&I			31-May-17	Small	22-Feb-21	, , ,
134	LEVEL SWITCH-FLOAT TYPE	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	REGULAR	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	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane - Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com	C&I			31-May-17	Small	22-Feb-21	, , ,
135	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	REGULAR	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	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane - Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com	C&I			31-May-17	Small	22-Feb-21	, , ,
136	ROTAMETER	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	REGULAR	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	Works-1->Scientific Centre, S.No. 65, Hissa No. 7,By-Pass Juction, Kausa, -Mumbai-MAHARASHTRA INDIA Phone- 9892230623, FAX : 022-25491408/9 Pincode : 400 612, Email : sales@scientificdevices.com	C&I			05-Dec-12	Small	22-Feb-21	, , ,
137	SIGHT FLOW INDICATORS	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	REGULAR	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		C&I			05-Dec-12	Small	22-Feb-21	, , ,
138	TEMP. ELEMENT	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	REGULAR	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	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane - Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com	C&I			31-May-17	Small	22-Feb-21	, , ,
139	CONTROL VALVE	S163	Severn Glocon India Pvt. Ltd.	REGULAR	F96 & F97, Sipcot Industrial Park, Irungattukottai, Chennai, Phone- 044-47104200, Pincode : 602117, Email : info@severnglocon.co.in,	Works-1->Mr. K.Kaushik, F96 & F97, Sipcot Industrial Park,Irungattukottai, -Chennai-TAMIL NADU India Phone- 044-47104200, FAX : 044-47100073, Pincode : 602117, Email : info@severnglocon.co.in	C&I			29-May-18	Small	31-Mar-23	, Technical limit reviewed on 30.04.2014 and 12.10.2015; , Deleted due to non-response in 4 consecutive tenders w.e.f. 27.07.2016;.Registered again w.e.f. 29.05.2018 ,
140	JUNCTION BOX	S114	Shrenik & Company,	REGULAR	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	Works-1->Mr.Pulin Shah/ Mr. Kaloesh Parmar 39 A/3 ,Panchratna Industrial Est,Sarkhej-Bavla Road, Changodhar -Ahmedabad-GUJARAT INDIA Phone- 98250 80339 1 FAX : 079-26932424 Pincode : 382213 Email : sales@sumip.com	C&I			24-Mar-10			Registered for FRP JBs AND METAL JBs. , Technical limit reviewed on 30.04.2014; , ,
141	PROGRAMMABLE LOGIC CONTROLLER	S001	SIEMENS LIMITED	REGULAR	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :	C&I						, , ,
142	TRANSMITTERS	S001	SIEMENS LIMITED	REGULAR	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :	C&I						Comm Add: Attn Mr K.K.Bedi/ Mr Sanjay Satpute, Siemens Ltd. EFIE, Plot no 6A, Sec-18, Maruti Industrial Area, Gurgaon - 122015, Ph 0124-3836250 , , ,
143	LEVEL GAUGE	S008	SIGMA INSTRUMENTS CO.	REGULAR	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	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in	C&I						, , ,
144	LEVEL SWITCH-CAPACITANCE TYPE	S008	SIGMA INSTRUMENTS CO.	REGULAR	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	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in	C&I						, , ,

145	LEVEL SWITCH-CONDUTIVITY TYPE	S008	SIGMA INSTRUMENTS CO.	REGULAR	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	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in	C&I						, , ,
146	LEVEL SWITCH-FLOAT TYPE	S008	SIGMA INSTRUMENTS CO.	REGULAR	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	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in	C&I			01-Jun-09			Vendor shall source import contents of Level Switch (Conductivity Type) from Mobrey Measurement, an operating unit of Morbey Ltd., Slough, Berkshire, United Kingdom. , , ,
147	SIGHT FLOW INDICATORS	S008	SIGMA INSTRUMENTS CO.	REGULAR	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	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in	C&I						Reassessed on 27.04.2016; , , ,
148	VIBRATION MONITORING SYSTEM	S156	SKF INDIA LIMITED	REGULAR	Mr. Shishir Joshipura SERVICE BUSINESS UNIT, CHINCHWAD, PUNE Phone- +91 982 3161755 Pincode : 411033 Email : sandeep.gadre@skf.com		C&I			24-Aug-12			PARENT COMPANY: SKF CONDITION MONITORING INC, USA. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR AS DECIDED BY 4TH MISCC (ELECT AND C&I) HELD ON 24.08.2012. , , ,
149	TRANSMITTERS	S039	SMART INSTRUMENTS LTD, BRAZIL	REGULAR	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		C&I	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL					Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014 , ,
150	DIFFERENTIAL PRESSURE SWITCH	S010	SOR INC.	REGULAR	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com		C&I						, Reassessed on 21.03.2018. , ,
151	LEVEL SWITCH-CONDUTIVITY TYPE	S010	SOR INC.	REGULAR	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com	C&I						, , ,
152	LEVEL SWITCH-FLOAT TYPE	S010	SOR INC.	REGULAR	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com	C&I						, Reassessed on 21.03.2018. , ,
153	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	S010	SOR INC.	REGULAR	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com	C&I						, , ,
154	TEMPERATURE SWITCH	S010	SOR INC.	REGULAR	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com	C&I						, , ,
155	ANUBAR (DELTA TUBE)	S044	STAR-MECH CONTROLS (I) PVT.LTD.	REGULAR	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	Works-1->VIVEK GOTE/ MAHúNDRA BANSODE Sr no.54, Plot No.ll0,Swami ViVekanand Industrial Est.HADAPS -PUNE-MAHARASHTRA INDIA Phone- 02026970450 FAX : 02026970470 Pincode : 411028 Email : marketing@starmech.net	C&I				Small	31-Mar-23	, , ,
156	FLOW ELEMENT	S044	STAR-MECH CONTROLS (I) PVT.LTD.	REGULAR	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	Works-1->VIVEK GOTE/ MAHúNDRA BANSODE Sr no.54, Plot No.ll0,Swami ViVekanand Industrial Est.HADAPS -PUNE-MAHARASHTRA INDIA Phone- 02026970450 FAX : 02026970470 Pincode : 411028 Email : marketing@starmech.net	C&I				Small	31-Mar-23	, , ,
157	FLOW ELEMENT - NOZZLE	S044	STAR-MECH CONTROLS (I) PVT.LTD.	REGULAR	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	Works-1->VIVEK GOTE/ MAHúNDRA BANSODE Sr no.54, Plot No.ll0,Swami ViVekanand Industrial Est.HADAPS -PUNE-MAHARASHTRA INDIA Phone- 02026970450 FAX : 02026970470 Pincode : 411028 Email : marketing@starmech.net	C&I				Small	31-Mar-23	, , ,

158	FLOW ELEMENT - ORIFICE	S044	STAR-MECH CONTROLS (I) PVT.LTD.	REGULAR	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	Works-1->VIVEK GOTE/ MAHúNDRA BANSODE Sr no.54, Plot No.ll0,Swami ViVekanand Industrial Est.HADAPS -PUNE-MAHARASHTRA INDIA Phone- 02026970450 FAX : 02026970470 Pincode : 411028 Email :	C&I				Small	31-Mar-23	, , ,
159	VENTURI METER	S044	STAR-MECH CONTROLS (I) PVT.LTD.	REGULAR	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	Works-1->VIVEK GOTE/ MAHúNDRA BANSODE Sr no.54, Plot No.ll0,Swami ViVekanand Industrial Est.HADAPS -PUNE-MAHARASHTRA INDIA Phone- 02026970450 FAX : 02026970470 Pincode : 411028 Email :	C&I			22-Oct-11	Small	31-Mar-23	, , ,
160	JUNCTION BOX	S095	SUCHITRA INDUSTRIES	REGULAR	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com	Works-1->B. Srinivas Suchitra Industries, Opp No 53, Muneshwara Black Devinagar, Lottagal hal - BANGALORE-KARNATAKA INDIA Phone- 080-23511247 FAX : Pincode : 560094 Email : suchitra_industries@yahoo.com	C&I						, , ,
161	ANUBAR (DELTA TUBE)	S009	SWITZER PROCESS INSTRUMENTS PVT. LTD.	REGULAR	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, - CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com	C&I			30-Jul-10	Small	20-May-19	Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , , ,
162	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	S009	SWITZER PROCESS INSTRUMENTS PVT. LTD.	REGULAR	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, - CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com	C&I				Small	20-May-19	Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , , ,
163	TEMPERATURE SWITCH	S009	SWITZER PROCESS INSTRUMENTS PVT. LTD.	REGULAR	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, - CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com	C&I				Small	20-May-19	Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , , ,
164	FLOW ELEMENT - ORIFICE	T211	TANSA EQUIPMENTS PVT. LTD.	REGULAR	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com	Works-1-> Others Mohanjee Sundarjee Road, Raghunath Nagar, Thane -Mumbai-MAHARASHTRA INDIA Phone- FAX : Pincode : 400604 Email :	C&I			29-Nov-16			, , ,
165	ROTAMETER	T211	TANSA EQUIPMENTS PVT. LTD.	REGULAR	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com	Works-1-> Others Mohanjee Sundarjee Road, Raghunath Nagar, Thane -Mumbai-MAHARASHTRA INDIA Phone- FAX : Pincode : 400604 Email :	C&I			29-Nov-16			, , ,
166	TEMP. ELEMENT	T107	Tempsens Instrument (I) Pvt Ltd	REGULAR	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com	Works-1->Mr. S.D Deval B-188A ROAD NO.5 ,M.I.A -UDAIPUR-RAJASTHAN INDIA Phone- 9352501530 FAX : 0294-3057750 Pincode : 313003 Email : deval@tempsens.com	C&I			30-Nov-11	Medium	31-Mar-22	, , ,
167	TEMP. ELEMENT	T115	Thermal Instrument India Pvt. Ltd.	REGULAR	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com	Works-1->Mr. Raghavendra M. Kulkarni Survey No. 250A/B, Post-Mangaon,Tal.- Kudal, Dist.- Sindhudurg, --MAHARASHTRA India Phone- 09322664709 FAX : 022-24455026 Pincode : 416519 Email : ramk@giconindia.com	C&I			20-Sep-14			Registered as per 11th MISCC-Electrical and C&I (FY 2014-15) dt. 20.09.2014. , , ,
168	FLOW ELEMENT	T108	TM TECNOMATIC SPA	REGULAR	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com	Works-1->Mrs. Enrica Bazzocchi VIA DELLE INDUSTRIE, 36, - CREMONA- Italy Phone- 39037221574 FAX : 39037228318 Pincode : 26100 Email : sales@tmtecnomatic.com	C&I			22-Dec-11			, , ,
169	VENTURI METER	T108	TM TECNOMATIC SPA	REGULAR	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com	Works-1->Mrs. Enrica Bazzocchi VIA DELLE INDUSTRIE, 36, - CREMONA- Italy Phone- 39037221574 FAX : 39037228318 Pincode : 26100 Email : sales@tmtecnomatic.com	C&I			19-Oct-12			AS PER DECISION OF MISCC-ELECT AND C&I HELD ON 19.10.2012 , , ,
170	LEVEL GAUGE	T001	TOSHNIWAL BROTHERS PVT.LTD.	REGULAR	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com		C&I	MAKE:NIVO CONTROLS					, , ,
171	TEMPERATURE SWITCH	T001	TOSHNIWAL BROTHERS PVT.LTD.	REGULAR	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com		C&I						, , ,

172	TEMP. ELEMENT	T111	TOSHNIWAL INDUSTRIES PVT. LTD.,	REGULAR	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com	C&I			28-May-13	Small	31-Mar-23	GCC Rev.5 has been accepted in toto. , , ,
173	TRANSMITTERS	T111	TOSHNIWAL INDUSTRIES PVT. LTD.,	REGULAR	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com	C&I			28-May-13	Small	31-Mar-23	GCC Rev.5 has been accepted in toto. , , ,
174	ULTRASONIC FLOW METERS	T111	TOSHNIWAL INDUSTRIES PVT. LTD.,	REGULAR	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1->RAJEEV TOSHNIWAL, MD Others INDUSTRIAL ESTATE, MAKHUPURA -AJMER-RAJASTHAN INDIA Phone- FAX : 1456601111 Pincode : 305002 Email : info@tipl.com	C&I			06-Aug-20	Small	31-Mar-23	Registered on 06.08.2020 as per 12th MISCC , , ,
175	LEVEL SWITCH-CAPACITANCE TYPE	V040	V. AUTOMAT & INTRUMENTS (P) LTD.	REGULAR	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	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com	C&I			28-Jan-09	Small	31-Mar-23	, , ,
176	LEVEL SWITCH-CONDUTIVITY TYPE	V040	V. AUTOMAT & INTRUMENTS (P) LTD.	REGULAR	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	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com	C&I				Small	31-Mar-23	, , ,
177	LEVEL SWITCH-FLOAT TYPE	V040	V. AUTOMAT & INTRUMENTS (P) LTD.	REGULAR	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	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com	C&I				Small	31-Mar-23	, , ,
178	SIGHT FLOW INDICATORS	V040	V. AUTOMAT & INTRUMENTS (P) LTD.	REGULAR	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	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-34, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com	C&I			21-Jan-17	Small	31-Mar-23	, , ,
179	TRANSMITTERS	V040	V. AUTOMAT & INTRUMENTS (P) LTD.	REGULAR	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	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com	C&I	a)DISPLACEMENT TYPE TRANSMITTERS . b)PRESSURE AND DP TRANSMITTERS		28-Jan-09	Small	31-Mar-23	Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014 , ,
180	ELECTROMAGNETIC FLOW METER	V212	V.A Valves	REGULAR	Mr.Vishal Jain, Udyog Nagar, Gadaipur, Jalandhar Phone- 9872626376 Pincode : 144004 Email : support@fedrelflowmeters.com	Works-1->Mr.Vishal Jain Dir Udyog Nagar, Gadaipur, -Jalandhar-PUNJAB INDIA Phone- 01812601741,9872626376 FAX : Pincode : 144004 Email : support@fedrelflowmeters.com	C&I			14-Sep-18	Small	31-Mar-23	, , ,
181	INSTRUMENT FITTINGS	V039	VIKAS INDUSTRIAL PRODUCTS	REGULAR	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com	C&I		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs).	14-Feb-12			, Financial limit reviewed on 05.06.2014 , ,
182	INSTRUMENTS PIPE FITTINGS	V039	VIKAS INDUSTRIAL PRODUCTS	REGULAR	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com	C&I		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs).	22-Dec-11			, , ,
183	INSTRUMENTS TUBE FITTINGS	V039	VIKAS INDUSTRIAL PRODUCTS	REGULAR	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com	C&I		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs). The registration category & the financial limit may be reviewed after survey in March 2009 and approval thereof. Registered w.e.f. 22.01.2009.	30-Jul-10			, , ,
184	TRANSMITTERS	Y10	YOKOGAWA INDIA LIMITED,	REGULAR	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE-KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com	C&I			14-Jun-13			Subject to submission of renewed ISO certificate & compliance to GCC; Relevant documents (ISO 9001:2008 and GCC Rev-05) furnished on 18.06.2013. , , ,

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
		VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**Cover page**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	**Index**				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	**Description of Plant/System**				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	**Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)**				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**Operation Guidelines for plant personal/user/operator**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				

5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
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**				

GENERAL TECHNICAL REQUIREMENT OF PUMPS

Annexure-I to ECW system Specification

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 rotodynamic 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 with the highest head at shut-off condition. Shut-off head shall be more than the rated design head and the percentage variation may vary depending on the specific speed of the pumps (i.e) 10-15% for

pumps of specific speed upto1000 US units, about 15 to 20% for specific speed in the range of 1000 to 2000 US units, about 20% to 40% for specific speed of 2000 to 4000 US units and above 50% for specific speed of 4000 to 7000 US Units

(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.

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

(g) 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.

(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 as per manufacturer's standard practice. Suitable method of locking the wearing ring shall be used.

(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.

(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 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.

(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)

Continuous Motor rating (at 50 0 C ambient) shall be at least 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 in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump. 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).

Annexure-2 to ECW system Specification

SUBMERSIBLE PUMPS

1.00.00 **SCOPE**

1.01.00 This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's / sub-vendor's delivery to site, of submersible pumps.

2.00.00 **CODES AND STANDARD**

The design manufacture and performance of submersible pumps shall be comply with all currently applicable statues, regulation, and safely codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable Indian standards listed below other Nation Standards are acceptable, if they are established to be equal or superior to the listed standards. Nothing in these specifications shall be construed to relieve the contractor of this responsibility.

2.01.00 **List of Applicable Indian Standards**

IS:8034 - Submersible pumps for clear cold fresh water

IS:5120 - Technical requirement of Rotodynamic Special Purpose pumps.

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

3.00.00 **DESIGN AND PERFORMANCE REQUIREMENTS**

a) The pump shall be of single stage mono - block type with non-clog design.

b) Components of Identical pumps shall be interchangeable.

c) Pumps shall have a continuously rising head characteristics.

4.00.00 **MOTOR RATING**

Continuous motor rating (at 50 deg. C ambient) for pumps shall be atleast ten percent (10%) above the maximum load demand of the driven equipment in the complete operating range to take care of the system frequency variations.

5.00.00 **FEATURES OF CONSTRUCTION**

a) Pumps shall be of Submersible, wet pit type.

b) Pumps shall be able to pass through solids upto 40 mm and capable of handling waste water which may contain, sludge, plastic solids etc.

c) Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc.

d) Pumps shall be portable type and capable of using in any sump as and when required. Pump shall be provided with required stool, flexible, hoses chain connection etc. for easy installation, removal and maintenance. Adequate length of chain required for lowering the pump into the sump and flexible type discharge pipe shall be provided.

e) Impeller

Impeller type shall be open/semi-closed type/closed as indicated elsewhere. Enclosed impellers shall be equipped with seal rings on their hubs. In case of open impeller, the pump shall be design to take care of the additional thrust produced.

6.00.00 **MOTOR**

i) Motor shall be coupled directly to the impeller shaft.

ii) The motor shall be suitable for operation when submersed in water. The housing shall have required degree of protection.

iii) Necessary arrangement to be made to make cable entry absolutely water tight, with cores cast in insulation along with cable gland 'O' ring seat.

iv) Built in temperature sensors are to be provided to enable tipping of motor if temperature rises above the design temperature limit. These sensors are to be used directly in the circuiting of control panel. The control circuit should trip the motor if the temperature rises beyond safe limits.

v) Moisture sensors are to be embedded in motor chamber to trip the motor in case of moisture entry in motor due to failure of pump mechanical seal.

vi) Motor shall be oil filled/oil lubricated or water filled type. Pressure equalizing diaphragm and sand guards with seal shall be provided to prevent the water and sand entering the motor.

vii) Power supply to the motor and control connections shall be preferably combined in one cable and shall be flexible copper conductor PVC insulated, armoured and overall hard grade PVC sheathed, and suitable for under water service. The cable gland shall be properly sealed to prevent entry of pumped liquid the motor. Length of the cable shall be of suitable for site conditions. The cable shall be terminated on the control panel with necessary facility to terminate with the power receptacle.

viii) For pumps which are specified under portable application, Cable shall be suitable for continuous winding/un winding duty on a cable reeling drum and shall be installed on a trolley mounted on wheels. Associated control panel is also to be mounted on the trolley.

ix) Water level controller shall be provided which should be with two level controls, high to start and low to stop.

7.00.00 **Equipment Data Sheet**

Type of pump	:	Submersible type fixed inside pits/ sump with guides /lifting chains
Type of Working Fluid	:	Drains with particle size upto 40 mm

Type of impeller		:	Open
Type of lubrication		:	Self / Grease / Oil
Speed		:	Preferrably 1500 rom (maximum)

Material of Construction

a)	Casing	:	2% Nickel Cast Iron, IS:210 Grade FG 260;
b)	Impeller	:	SS-316 / CF8M
c)	Shaft	:	SS- 410
d)	Bolts & nuts	:	SS-316
e)	Accessories	:	Suction Strainer, Pump stand, Adaptors for discharge flange, Level measuring devices/ Controllers, Lifting hook & chain Handle to agitate debris etc, Discharge hose connected with piping upto the drains etc.

f) The discharge, suction /column pipes shall be heavy grade Carbon steel externally lined with epoxy or galvanised.

Annexure-3 to ECW system Specification

VERTICAL SUMP PUMPS

1.00.00 **Equipment Data Sheet**

Type of pump		:	Vertical (volute type casing) sump pump with column pipe, discharge flange etc.
Type of Working Fluid		:	Drains with particle size upto 40 mm
Type of impeller	:	Open	
Type of lubrication		:	Self / Grease / Oil
Speed		:	Preferably 1500 rpm (maximum)

Material of Construction

a)	Casing	:	2% Nickel Cast Iron, IS:210 Grade FG 260;	
b)	Impeller	:	SS-316 / CF8M	
c)	Shafts	:	SS- 410	
d)	Column pipe	:	Carbon steel as per IS:2062	
e)	Discharge pipe	:	Carbon steel as per IS:2062	
f)	Stuffing box	:	2% Nickel CI,IS:210 Grade FG 260;	
g)	Gland	:	2% Nickel CI,IS:210 Grade FG 260;	
h)	Bolts & nuts	:	SS-316	
i)	Accessories	:	Suction Strainer, Level measuring devices/ Controllers etc.	

Note - In case of MOC of Pump (Horizontal/ Vertical) mentioned in Section IA Datasheet A then, same shall prevail.

GENERAL TECHNICAL REQUIREMENT (GTR)

PART - C

CONTENTS

Clause No.	Description
1.00.00	Introduction
2.00.00	Brand Name
3.00.00	Base Offer & Alternate Proposals
4.00.00	Completeness of Facilities
5.00.00	Codes & Standards
6.00.00	Equipment Functional Guarantee
7.00.00	Design of Facilities/ Maintenance & Availability Considerations
8.00.00	Documents, Data and Drawings to be furnished by Contractor
9.00.00	Quality Assurance Programme
10.00.00	Pre-commissioning and Commissioning Facilities
11.00.00	Guarantee Tests
12.00.00	Taking over
13.00.00	Training Of Employer's Personnel
14.00.00	Safety Aspects During Construction And Erection
15.00.00	Noise Level
16.00.00	Packaging and Transportation
17.00.00	Electrical Enclosure
18.00.00	Instrumentation and Control
19.00.00	Electrical Noise Control
20.00.00	Instrument Air System
21.00.00	Tapping Points for Measurements
22.00.00	System Documentation
23.00.00	Maintenance Manuals of Electronic Modules
Annexure - I	
Annexure - II	
Annexure - III	
Annexure - IV	
Annexure - V	

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

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 (excluding regeneration chemicals 33% HCL and 48% NaOH) 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 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.

Note:

1. For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.
2. The total man months in each area shall be divided into suitable number of modules which shall be discussed and finalized during post award stage.
3. Duration of each module shall not be less than 10 (ten) working days out of which 20 % shall be for plant/manufacturers' works visits and 80% shall be 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			

Area	Topics	MANDAYS
Condensate Polishing Plant (CPU)	**System/Product Design** - Basic design features including Pre-filters - Theory & principle of operation - Latest technological trends in CPU & Pre-filters and design aspects & Selection criteria. **Plant Visit** - Operational feedback - O&M history / problems related to CPU plant **Visit to Manufacturer's Work** -Manufacturing process of pre-filters and major equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	**3**

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

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	Code of practice for use of immersion vibrators for consolidating concrete.
IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS: 4326	Code of practice for earthquake resistant design and construction of buildings.
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

एनटीपीसी NTPC	Project : Stage : Package : Supplier : Contractor No. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL SUB-SYSTEM :	DOC. NO.: REV. NO. : DATE : PAGE : OF

S.No.	ITEM	QP/ Insp. Cat.	QP No.	QP Sub-Schedule	QP approval schedule	Propcsed 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

एनटीपीसी NTPC	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-OAI-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 : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER :
		ITEM SUB-SYSTEM	QP NO. : REV.NO. : DATE : 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
SIGNATURE	

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.....

REVIEWED BY	APPROVED BY	APPROVAL SEAL

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

714406/2022/PS-PEM-MAX

985109/2022/PS-PEM-MAX

LOW PRESSURE PIPING

1.00.00 **LOW PRESSURE PIPING**

1.01.00 The Scope of Low Pressure (LP) piping systems for the following services shall be as defined in various tender drawings & the sub section pertaining to "Terminal points and exclusions" and shall include the following systems:

(a.) Circulating water piping (non encased portion).

(b.) DM water normal make-up piping (condenser makeup, ECW makeup for ECW tanks, make up to CPU regeneration plant, make up to condensate storage tank etc..)

(c.) DM Emergency make up piping (emergency make up to condenser, ECW tanks emergency make-up and condensate storage & transfer system.

(d.) Boiler (Steam Generator) and Deaerator fill piping.

(e.) Equipment Cooling Water (ECW) piping including its chemical dosing system for primary circuit.

(f.) Auxiliary cooling water piping.

(g.) HVAC make-up piping

(h.) Service water piping.

(i.) Instrument Air piping.

(j.) Service (plant) Air piping

(k.) Potable water system (including tank).

(l.) TG sump pit discharge, CW pit discharge and Atmospheric drain Vessel discharge piping.

(m.) Drain & vent piping, recirculation piping , Valves, breakdown orifices wherever required and any other piping system required to make the Low Pressure (LP) piping systems in the bidder's scope complete

(n.) Tanks as described elsewhere in the specification for the above systems. (Including condensate storage tanks etc.).

1.02.00 The scope covers the following for the complete LP piping systems mentioned above:

a) Design, engineering, manufacturing, supply, fabrication , testing packaging, transportation to site, storage, taking delivery of Employer

supplied equipment from site stores, in plant transportation, erection, cleaning, testing and commissioning of all items i.e., piping fittings, supports/ hangers, valves, actuators, motors, specialities, tanks, chemical dosing system for Equipment Cooling Water System, instruments, drains, vent including drain/ vent valves, air release valves (if applicable) etc.

The items though not specifically mentioned or indicated here in but are needed to make the system / equipment complete shall also be furnished and treated as if included in the specification unless otherwise specifically excluded.

b) Surface preparation, priming and painting of all non-insulated above ground piping and equipment except galvanized steel piping & surfaces , stainless steel piping & surfaces and gun metal surfaces.

Paints and varnishes, primers, thinners etc. as required for anti-corrosive protection of piping & equipment above ground.

c) Bidder shall provide anti-corrosive protection (coating & wrapping or anticorrosive tape) on the external surfaces of pipes to all directly buried piping including galvanized carbon steel piping.

On the internal surface of all pipes 1000 mm and above, a coat of primer followed by a hot coat of coal tar enamel paint or coal tar epoxy paint shall be applied.

Bidder's scope of supply/ work shall include but not be limited to items such as, Pipes, headers and manifolds, bends, elbows, returns, tees, laterals, crosses, reducers/ expanders, caps and closures, couplings, plugs, sleeves, and saddles, stubs and bosses, unions and other similar fittings, flanges, gaskets, fasteners and sealants, ring joints, backing rings, all types of valves including drain/ vent/ air release valves, 3-way valves(where applicable) with test connection for instruments/ manifolds etc.actuators, specialties, orifices, flow nozzles, etc. as per finalized single line flow diagrams and layout drawings/ isometric drawings.

Bidder’s scope shall also cover distribution of service air , service water and potable water to various facilities/buildings (under contractor scope)

including providing tap offs at various floors of TG building.

1.03.00 The scope also covers the following:

a) Complete assemblies of hangers, secondary supports (channels/angles etc. taking support from main beam) , anchor, guides, restraints, etc. including welded attachments, clamps, devices tie-rods, turn-buckles, springs and spring cages, shoes, rollers, trapezes etc.

b) Weather hoods for pipes crossing ceilings and walls.

c) Instrument tapping and stub connections, root valves, 3-way valves (where applicable) with test connections, drains and vent valves & expanders / reducers as required and instruments as indicated else where for instruments supplied by the Contractor..

d) Drain funnels, drip pans, moisture traps etc. where ever required shall be provided.

e) Instrument tapping, stub connections, root valves and instrument tubing up to root valves for instruments supplied by the Employer for onward connections by the Employer. Contractor shall furnish the list of all such tapping with their X, Y, Z co-ordinates.

f) All supporting attachments like plates, saddles, stools, shoes, base plate, saddle plates, angles, channels, I-beams, trapeze, cantilevers, brackets, sways, braces, nuts, bolts, cleats, clamps, needed to complete the erection of piping system covered under this specification.

Anchor bolts, bed & foundation plates, pipe sleeves and Nuts to be embedded in concrete for piping where ever indicated in the drawing. All grouting and chipping work (including supply of cement, sand and stone chips) for equipment foundations, pipe supporting etc.

Reinforced concrete valve chambers wherever required for underground piping.

g) Excavation, preparation of bed, backfilling with compaction of soil and removal of extra-earth to designated places in case of pipes to be buried.

h) Bidder shall also design, supply, fabricate, erect, set and commission all hangers, tie-rods, turn-buckles, supports, guides, restraints, anchors, etc. as required for the, piping system. This includes the provision of all associated steel work including brackets, cradle supports, duck foots, channels, angles, etc. It is Bidder's responsibility to estimate these requirements and include them in their offer price. Whenever, straight run of the yard pipes are more than 300 meters, flexibility analysis shall be conducted by the contractor to identify the requirement of loops, type of supports etc.

.i) In covered concrete trenches bidder shall supply necessary supporting materials such as stools, saddles, base plates, clamps, U-bolts, angles, clips etc.

j) Bidder shall supply all necessary drains and vents with drain & vent valves including anti-flash funnels and moisture traps for compressed air system as required for the safe and effective draining-venting of the piping systems based on the approved flow scheme / single line diagram. It is bidder's responsibility to identify the requirements of drains, vents, and supply the necessary pipe work, fittings, hangers and supports etc. for the same.

k) Bidder shall supply and install necessary matching pieces as may be needed for connection of piping systems with equipment terminals, valves and specialties.

l) Bidder shall erect all instrument impulse piping and fittings from the tap-off point of the last root valve including the root valve and instruments.

m) Bidder shall perform necessary internal machining of pipe for installing orifices, flow nozzles, straightening vanes etc.

n) The Bidder shall prepare the flow diagrams, detailed dimensional piping layout/ Isometric/ fabrication/ As built drawings of all the systems along with Cross sectional drawings, showing all supports and equipment as required.

o) In addition to submission of drawings as stipulated above bidder shall also furnish the data/ documents with respect to following:

1) Thickness calculation of CW duct/large diameter buried pipes as per AWWA-M-11.

p) Bidder's scope of supply for fabrication, erection, cleaning, testing and commissioning of the piping systems installed by him shall include the following:-

All welding consumables like welding electrodes, filler rods and wires; gases like oxygen, acetylenes, argon, carbon-dioxide, propane, backing rings etc.

Films for radiographic examination of welds.

X-ray and Gamma -ray equipment including isotopes, dye penetrants, and other required non-destructive testing materials and equipment (all to be taken back by the Bidder after completion of work).

All heating and stress relieving equipment, thermocouples asbestos blankets, cables, temperature recorders, charts heat sensitive chalks and crayons etc. (All to be taken back by bidder after completion of work).

All machinery, equipment tools and tackles as required for transportation handling, fabrication and erection (All to be taken back by Bidder after completion of work).

All equipment/ materials as required for cleaning, flushing, blowing out and hydro testing of the piping systems; these shall include but not be limited to pumps and compressors with prime movers, instruments, pipe work with supports, valves, strainers and other specialities, blanks, plugs, spool pieces, dummy plates, electrical accessories, etc. (All to be taken back by Bidder after completion of work). All scaffolding materials and false work (To be taken back by Bidder after completion of work).

1.04.00 The contractor shall provide Services of erection superintendent and foremen, fitters and riggers, welders, transport and crane operators and other skilled and unskilled labour.

The design engineering and providing all temporary pipe work as required for erection, cleaning, flushing, blowing out, testing and commissioning of the piping system is the responsibility of the Bidder.

The Bidder's scope shall include design, supply of required structural steel (except those which are specifically excluded), their fabrication and erection where ever required.

The Bidder shall include in his offer a complete set of special tools and tackles required for handling the various equipment / piping system during maintenance.

Bidder scope of services shall include the following also.

i) Obtaining approval from Chief Inspector of Boiler as per Indian Boiler Regulation, (IBR - 1950) for design/ fabrication/ erection / testing of piping / fittings / valves and specialties coming under the purview of IBR, if any.

ii) The bidder shall also identify and satisfy all other statutory code requirement as may be necessary for the piping systems covered in this specification.

iii) Certified copies of test reports for all tests and examinations specified in the specification shall be furnished to the Project Manager. Cost of meeting all statutory requirements and furnishing the required certificates shall be deemed included in the proposal price.

LOW PRESSURE PIPING

1.00.00 **EQUIPMENT SIZING CRITERIA**

1.01.00 All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

1.02.00 For all Low Pressure piping systems covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.

1.03.00 Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:

a) **Water Application**

	Pipe Size	Water Velocity in m/sec Below 50 mm	50-150 mm	200 mm & above
(a)	Pump suction	------	1.2-1.5	1.2-1.8
(b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
(c)	Header	------	1.5-2.4	2.1-2.4

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:

(i)	Carbon steel pipe	100
(ii)	Ductile Iron.	140
(iii)	Rubber lined steel pipe	120
(iv)	Stainless steel pipe	100

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.

(b) **Compressed Air Application**

Compressed air 15.0 m/sec.(under Average Pressure & Temp. conditions)

1.04.00 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.

1.05.00 Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.

1.06.00 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered (except stainless steel piping).

1.07.00 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.

1.08.00 High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.

1.09.00 Material of construction for pipes carrying various fluids shall be as specified elsewhere.

1.10.00 Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.

1.11.00 Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.

1.12.00 Threaded joints shall be provided with Teflon sealant tapes.

1.13.00 Following types of valves shall be used for the system/service indicated.

SYSTEM	**TYPES OF VALVES**					
	Butterfly	Gate	Globe	Check	Ball	Plug
Water	x	x	x	x	x	
Air		x	x	x	x	
Drains & vents		x	x	x		
Fuel oil (if any)		x	x	x	x	x

1.14.0 Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.

2.00.00	**TECHNICAL SPECIFICATION**
2.01.00	**GENERAL**
	Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc.
2.02.00	**Pipes and fittings**
2.02.01	All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.
2.02.02	Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.
2.02.03	Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.
2.02.04	Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).
2.02.05	Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.
2.02.06	The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.
2.02.07	Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.
2.02.08	For rubber lined ERW pipes, beads shall be removed for pipe size 80 NB and above.
2.02.09	Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.

2.02.10 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.

2.02.11 For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.

Transient analysis /surge analysis where ever specified and required shall be conducted in order to determine the location , number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.

2.03.00 **Material**

2.03.01 Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified, The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.

2.03.02 No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.

2.03.03 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.

2.03.04 All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.

2.03.05 Material of construction for pipes carrying various fluids shall be as follows:

Sl No	Type of Fluid	Material
1.	i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)	IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.
2.	i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)	Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below
3.	i) Drinking (potable) water ii)Compressed air (Instrument & service air)	ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.
4.	(Condensate) spill water	ASTM A 106 Gr. B
5.	Effluents from Neutralization pit	MSRL

2.03.06	In water lines, pipes upto 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr.B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.
2.03.07	Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.E-250B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr.E-250B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).
2.03.08	In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness. Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.
2.03.09	Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).
2.03.10	Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.
2.03.11	Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
2.03.12	If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.
2.04.00	**Field routed pipes:**
2.04.01	Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipes and submit to Employer for approval.
2.05.00	**Slope/Drains and Vents**
2.05.01	Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size

up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes.

2.05.02 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

2.06.00 **Pipe Joints**

In general all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.

2.06.01 **Screwed Joints**

(a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/ ANSI B1.20.1 (taper) NPT / IS: 554 unless specified otherwise.

(b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be field joined by welding for protection of Galvanising Zinc layer. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.

(c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.

(d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing.

(e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where

galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.

2.06.02 **Welded Joints**

(a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.

2.06.03 **Flanged Joints**

(a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.

(b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.

(c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

2.07.00 **Bends/elbows/mitre bends/ Tees/ Reducers & other fittings**

2.07.01 For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11.Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1).

However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.

2.07.02 For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. However, mitre bends are also acceptable for rubber lined pipes above 1200 NB. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.

2.07.03 For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.

2.07.04 Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes upto and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.

2.07.07 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

2.08.00 **Flanges**

2.08.01 Flanges shall be slip on type or weld neck type. Welding of flanges in tension is not permitted.

2.08.02 All flanges and-flanged drilling shall be to ANSI B 16.5 / BS EN-1092 / AWWA C - 207 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. E-250B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 or equivalent.

2.09.00 **Specific technical requirement of laying buried pipe with anti-corrosive treatment**

The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.

2.09.01 **Trenching**

(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.

2.09.02 **Preparation and cleaning of piping**

(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand or grit blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.

(b) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.

2.09.03 **Coating and wrapping/ Anti corrosive Protection Coal tar tape**

a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:

(1) Coating primer (coal tar primer)

(2) Coating enamel (coal tar enamel)

(3) Wrapping materials.

All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.

Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat.
Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of. Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.

Total thickness of completed coating and wrapping shall not be less than 4.0 mm.

b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar primer in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total thickness of the finished protective coating shall be 4.0 mm minimum.

2.09.04 **Trench bed preparation and back filling**

Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.

2.09.05 **Laying of galvanized steel (GI) pipes**

All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste.

All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and " anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.

2.10.00 **Cleaning and flushing**

2.10.01 All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.

2.10.02 Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing . However for pipe sizes below 100nb the pipes may be cleaned internally by compressed air blowing as an alternative to internal blast cleaning. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done by air blowing only.

2.10.03 After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.

2.10.04 All compressed air pipe work shall be cleaned by blowing compressed air.

2.11.00 **Specification for hangers and supports**

2.11.01 All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.

2.11.02 The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.

2.11.03 At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.

2.12.00 **Design/Construction/Material Particulars of Gate/ Globe /Check /Butterfly / Ball / Air release /Float valves / Moisture Traps.**

2.12.01 **GENERAL**

(a) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.

(b) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required.

(c) The valves coming in vacuum lines shall be of extended gland type and/or water sealed.

(d) The actuator-operated valves shall be designed on the basis of the following:

(1) The internal parts shall be suitable to support the pressure caused by the actuators;

(2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.

(3) All actuator-operated valves shall be provided with hand operated gearing mechanism also.

(4) All actuators operated valves shall open/ close fully within time required by the process.

(e) Valves coming under the purview of IBR shall meet IBR requirements.

(f) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.

(g) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer

2.12.02 **VALVE BODY MATERIAL**

Valve body material for various services shall be as follows:

Valve body material for water application like Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) , drinking water etc. shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below.

For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water: SS body and disc along with SS internals. However for butterfly valves, Cast Iron /Ductile Iron/SG iron/carbon steel body and disc with elastomer lining are also acceptable.

Condensate: Cast Carbon Steel / Forged Carbon Steel.

2.12.03 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of

applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

Standards and Codes

AWWA-C-504	Rubber seated butterfly valves.
BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.
IS-778	Gun-metal gate, globe and check valves for general purpose.
BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.
IS-780	Sluice valves for water works purpose (50-300 mm size)
IS-2906	Sluice valves for water works purpose (350-1200 mm size)
IS-5150	Cast iron wedge and double disc gate for general purpose.
BS-5152	Specification for cast iron globe valves.
BS-5153	Cast iron check valves for general purpose.
IS-5312	Swing check type reflux (non-return) valves.
ANSI B 16.34	Standard for valves.
API-594	Standard for Dual-check valves.
API-600	Steel gate valves.
ANSI-B-16.10	Valves face to face and other relevant dimension.
API-598	Valves inspection test.

2.12.04 **End Connections**

The end connections, shall comply with the following:

Socket welding (SW) - ANSI B 16.11

Butt Welding (BW) - ANSI B 16.25.

Threaded (SC) - ANSI B 2.1

Flanged (FL) - ANSI B 16.5& AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges).

2.13.00 **Gate/Globe/Check Valves**

(a) All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).

(b) All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or

socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.

(c) All gun metal body valves shall have screwed ends.

(d) All flanged end valves/specialties. shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints.

(e) Gate/sluice valves shall be used for isolation of flow. All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc. Gate valves shall be provided with the following accessories in addition to other standard items:

(1) Hand wheel

(2) Position indicator (for above 50 mm NB valve size)

(3) Draining arrangement wherever required.

(f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction. Preferably, the valves shall be of the vertical stem type. Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.

The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.

(g) Check valves shall be used for non-return service. They shall be swing. check type or double door (Dual plate)check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB.

(h) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);

(i) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.

(j) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing. The valves shall be preferably outside screw & yoke type.

(k) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.

(l) All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.

(m) For Cl gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.

2.13.01 **MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)**

(a) The materials shall generally comply with the following:

(1) **Cast Steel Valves**

Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105
Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105
Trim.	ASTM A 182 Gr. F6 or Equivalent

(2) **Stainless steel valves**

Body & Bonnet	SS 304
Disc	-do-
Trim.	SS 316

(3) **Cast iron valves**

Body & bonnet	BS 1452 Gr. 14/ IS-210 Gr. FG 260
Seating surfaces and rings	13% chromium steel/ 13% Chrome overlay
Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260
Hinge pin for non-return valves	AISI 316
Stem for gate globe valves	13% chromium steel or Equivalent
Back seat	13 % chromium steel / 13% Chrome overlay

(4) **Gun Metal valves**

Body and bonnet	IS 318 Gr. 2/ Equivalent Standard
Trim.	-do-

(b) Cast iron body valves shall have high alloy steel stem and seat.

(c) Material for counter flanges shall be the same as for the piping.

(d) Forged carbon steel valves are also acceptable in place of Gun metal valves.

2.14.00 **Air Release Valve**

(a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.

(b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.

(c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass.

(d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.

2.15.00 **Butterfly valves**

2.15.01 **Design/Construction**

(a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or AWWA-C-516 or any other approved equivalent standard latest edition depending on size. Fabricated steel (IS: 2062 GR. E-250B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter.

(b) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of lugged Wafer construction are also acceptable

(c) Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.

(d) Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.

Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

2.15.02 **Material of Construction (Butterfly Valves)**

Materials and other design details shall be as indicated below :

(a) **Cast Iron Butterfly Valves**

Body & Disc	ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated

	Shaft	BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.
	Seat ring	18-8 Stainless steel
	Seal	Nitrile Rubber

(b) **Stainless Steel Butterfly Valves**

Body & Disc	SS 304
Shaft	SS 316
Seat Rings	EPT/BUNA-N/Neoprene

(c) **Carbon steel Butterfly Valves**

Body & Disc	ASTM A 216, Gr. WCB
Shaft	SS 304
Disc & Seat Rings	EPT/BUNA-N/Neoprene

(d) **Elstomer lined Butterfly Valves**

Body & Disc	ASTM A48, Gr. 40 / IS: 210. Gr. FG-260 / SG Iron (ductile iron) IS 1865 Gr 400-15 or BSEN 1563, Gr EN GJS-400-15 / ASTM A 216, Gr. WCB with elastomer lining.
Shaft	SS 316

2.15.03 **Proof of Design Test (Type Test) for Butterfly Valves**

Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder.

All valves that are designed and manufactured as per AWWA-C-504 / AWWA-C-516 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504/AWWA-C-516. For Butterfly valves, designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504/AWWA-C-516.

2.16.00 **Float operated valves**

(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.

(b) DESIGN AND CONSTRUCTION FEATURES

The following design and construction feature of the valve shall be the minimum acceptable.

(c) Valves shall be right-angled or globe pattern.

(d) Valves shall be balance piston type with float ball.

(e) Leather liner shall not be provided.

(f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats.

(g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.

(h) The valves shall have flanged connections.

2.17.00 **Tanks and Accessories**

2.17.01 The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803/IS804/IS 805/ IS 2825/ API 650/ IS 4049/ IS 4682 (part-I) and IS 4864 to 4870/ ASME B & PV code Sec.-VIII as the case may be.

2.17.02 **DESIGN AND CONSTRUCTION**

(a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS:803 & API 650.

(b) Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement.

(c) Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.E-250B (or equivalent) for ordinary wafer application when it is not corrosive in nature.

(f) Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.

(j) Tanks shall be provided with float operated level indicators/level gauges/level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.

(k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing dm water, alkaline water or power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO2 absorber vessel shall be provided with the initial fill of chemicals.

(l) Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.

(m) Tank supporting arrangement as approved by Employer shall be provided with all plates/angles/joints/flats and supporting attachment including lugs, saddles, legs etc.

(o) Tank fabrication drg. and design calculations shall be approved by the Project Manager.

2.17.03 **Corrosion protection**

(a) A corrosion allowance, applicable to surface in contact with corrosive media, when required after thorough cleaning by blast cleaning preceded by wire brushing shall be taken into consideration.

(b) Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.

(c) Each tank shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.

Sl. No.	Description	Tech. Particulars
DRINKING WATER TANK		
a)	Quantity	One per each Unit
b)	Liquid to be handled	Drinking Water
c)	Size and Min. Plate Thickness	5m long x 2.5m wide x 2.5m high; Plate Thk. (min.) 8mm Overall Cap.= 31.25 M^3 (Effective cap.: 25M^3).
d)	Type	Pressed steel rectangular tank Closed top/ welded construction
e)	Design pressure	Atmospheric
f)	Tank Standard	BS-1564/IS-804 (Latest Edition)
g)	Material of Construction	Plates to ASTM-A-36/IS-2062 Gr.B
h)	Flange Material Standard	ASTM-A-105/IS-2062-Gr. B
i)	Accessories	
	(i) Vent, Overflow, drain piping & valve	To be provided
	(ii) Manhole	To be provided
	(iii) Stair/Platform	To be provided
	(iv) Supporting structure	To be provided
	(v) Internal ladder	To be provided
	(vi) Level indicator	To be provided
	(vii) Root valve for level transmitter	To be provided
j)	Protection of Internal surface	Two coats of food grade epoxy paint

k)	Protection of external surface	Two coats of EPOXY based paint preceded by one(1) coat of primer. (minimum DFT 100 micron)
l)	Location	On Power House roof.

.....

1.00	**CONDENSATE STORAGE TANKS**	
1.01	Number required	one for each unit
1.02	Capacity of each tank (Effective)	350 Cu.m (for 660MW units),
1.03	Size (Dia & Height)/Plate Thickness	8.6mX7.2m minimum, Shell & Roof plate Thickness 8mm and Base plate thickness 10mm
1.04	Type and pressure class	Vertical, cylindrical, atmospheric
1.05	Material of construction	MS- (IS-2062 Gr.B or equivalent) as per specified code, 8mm thickness (minimum)
1.06	Location	Outdoor
1.07	Overflow, drain, vent and Sample connection(piping &valve)	required
1.08	Level Indicator	
	a) Number	One for each tank
	b) Type	Mechanical float type with dial type indicator (Guide wire, Float and Housing of Stainless steel - 316 Gr. construction)
1.09	Manhole (minimum 500mm size)	Two (2)-one on shell and the other on roof
1.10	Special Fittings	
	a) Hydraulic Seal of Overflow/Drain	Required

	b)	Additional nozzle Connection	number and size to be indicated to successful Bidder
	c)	Nozzle connection for Instrument/spare	Three (3) nos. for each tank
	d)	CO2 Absorber for vent (not to be kept on roof of tank, but to be kept on ground level)	required
	e)	Outside stair case (spiral)	required
	f)	Inside Ladder	Required
	g)	Draw off sump	required
	h)	Root valve for level Transmitter	Root valves for two (2) nos. level transmitter for each tank Required

---

2.18.00 **RUBBER EXPANSION JOINTS**

2.18.01 All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.

2.18.02 The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.

2.18.03 The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.

2.18.04 The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.

2.18.05 Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.

2.18.06 Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipe lines.

2.18.07 The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the' duck' shall be either a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.

2.18.08 The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.

2.18.09 All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr E-250B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber

when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.

2.18.10 The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges. The flanges shall be as per ANSI B 16.5. For higher sizes, not covered under ANSI B 16.5, the same shall be as per AWWA.

2.18.11 All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.

2.18.12 Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.

2.18.13 Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.

2.18.14 Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless Steel material.

2.18.15 **Life cycle test for RE Joints of Condenser CW Inlet Outlet lines:**

Life cycle test certificates shall be furnished by the bidder for each type and size of RE joints supplied by the Bidder, in the absence of which actual Life cycle test shall be conducted on one rubber expansion joint of each type and size .

2.19.00 **STRAINERS**

2.19.01 **Simplex type**

The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition shall not exceed 1.5 MCW at full flow. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The material of construction of various parts shall be as follows:

(a)	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)
(b)	Strainer Element	Stainless steel (AISI 316)
(c)	End connection	Screwed upto 50 mm Nb, and Flanged above 50 mm Nb

2.19.02 **Duplex type**

(a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting

pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.

(b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. E-250B and internally epoxy-painted above 50 mm NB.
Strainer element	Stainless steel (AISI 316)
End connection	Screwed up to 50mm Nb, and Flanged above 50 mm Nb. Gasket shall be of full face type

(c) The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.

(d) The size of the strainer and the flow direction will be indicated on the strainer body casting.

(e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

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.

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

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

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

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

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

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.

714406/2022/PS-PEM-MAX

985109/2022/PS-PEM-MAX

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.

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

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	

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

	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	

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX
473

	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		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
`	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICHKNESS, ADHESION TEST * DIMENSION	MA	VISUAL/MEASUR	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V	
8	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V	
4.0	FINAL INSPECTION												

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

	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:39	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION , CURRENT MEASUREMENT,LIMIT SWITCH OPERATION.	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD TEST.	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	V	CHP
5	PAINTING												
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade , DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample					P	V		
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P			
	NOTE:												
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.												
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between centerof stud and gland plate and tested in accordance with approved drawing/data sheet.												

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

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX
475

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

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	
		-GRADE	MA	REVIEW	100%		-DO-	-DO-	HT CHRT ✓	P	V	V	
			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

7144O6/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

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

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

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	

	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

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

BHEL	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	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%		-DO-	-DO-	IR	✓				
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

714406/2022/PS-PEM-MAX
985109/2022/PS-PEM-MAX

REV: 00 DATE:

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

PACKAGE: ELECTRIC HOIST FOR CPU
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.

SURFACE PREPARATION & PAINTING

1.00.00	**Specification of surface preparation & painting**
1.01.00	Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.
1.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be 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°C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 $	35 $	155 $	
		Design temperature above 60 °C-200°C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200°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 mini mum 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 a s 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.											

PRE-COMMISSIONING AND COMMISSIONING

PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

1.00.00 GENERAL

1.01.00 The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.

1.02.00 It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.

1.03.00 The Contractor upon completion of installation of equipments and systems, shall conduct precommissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All precommissioning/ commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.

2.00.00 TESTING / COMMISSIONING SCHEDULE

The Contractor shall submit to the Employer, his testing/ commissioning schedules for various equipments/ systems covered under the contract, for approval, at least 18 months before the actual commissioning of the equipment/ systems.

The testing/ commissioning schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of documents and commissioning checks to be submitted and their content details shall be agreed upon during preaward discussions.

The list of model commissioning documents viz. standard checklists, testing/ commissioning schedules, commissioning tests and checks and the details regarding contents of testing/ commissioning schedule are indicated in this chapter. These schedules are indicative only.

(i) Testing Schedules & Commissioning Schedules.

(ii) Standard Checklist of Items.

(iii) Commissioning Test and checks

(iv) Brief write-up on Contents of Testing Schedule.

(v) Demonstration/Acceptance test procedures during Commissioning/Initial operation

Procedures/ Schedule shall be approved by the Employer.

3.00.00 PRECOMMISSIONING & COMMISSIONING ACTIVITIES

3.01.00 **General**

The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.

3.02.00 **DEMONSTRATION DURING COMMISSIONING**

The following test shall be demonstrated during commissioning for which the bidder has to furnish the procedure and get the approval of employer.

3.02.01 **Start-up, Loading, Unloading and Shutdown Capabilities (For Turbine Generator)**

(i) **Unit Start Up**

Start-up time (upto full load), and loading capabilities for the Turbine Generator together for cold start conditions (greater than 36 hours shutdown), warm start conditions (between 8 and 36 hours shutdown) and hot start conditions (less than 8 hours shutdown) as indicated by the Contractor in the offer and accepted by the EMPLOYER shall be demonstrated, ensuring that the various turbine operational parameters like vibration, absolute and differential expansion, eccentricity and steam-metal temperature mismatch etc. are within design limits.

(ii) Sudden Total Loss of External Load

On occasions, the steam turbine generator unit may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip but shall continue to be in operation under the control of its speed governor to supply power for the plant auxiliary load with HP-LP bypass in operation while staying within the agreed limits of steam to metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity. The same shall be

demonstrated. Further, the provisions of Part-B, Section-VI, shall also be complied with.

(iii) **Steam Metal Temperature Mismatch Limitation**

The steam-metal temperature differential for cold, warm and hot start up , loading / unloading and shutdown conditions shall be within the permissible limits indicated by the Bidder in the offer and accepted by the Employer.

3.02.02 **Turbine Generator Set Capability**

The steam turbine generator unit shall be capable of delivering at generator terminals the output as indicated by the BIDDER in the heat balances submitted alongwith his bid, under the following conditions.

(a) Maximum continuous output at generator terminals corresponding to both strings of HP heaters out of operation, under rated steam conditions, at a condenser pressure of 89 mm of Hg (Abs) and 3% make up& Aux. Steam requirement tapped from CRH, generating not less than the rated output OR output corresponding to design BMCR heat duty, whichever is less without overstressing turbine components.

(b) Demonstration of minimum ramp rate of 5% per minute above the control load (i.e. 50% MCR).

NOTE: While conducting the tests of (a) above the condenser pressure measurement shall be done at 300mm above the top row of condenser tubes.

3.02.03 **Turbine Auxiliaries**

(i) **H.P./L.P. Bypass Capabilities**

The HP & LP Bypass system should satisfy the following functional requirements under automatic interlock action. It should come into operation automatically under the following conditions :

(a) Generator circuit breaker opening.

(b) HP - IP stop valves closing due to turbine tripping.

(c) Sudden reduction in demand to house load.

Under all these conditions, while passing the required steam flows as per the relevant heat balances, the condenser should be able to swallow the entire steam without increasing the exhaust hood temperature and condenser pressure beyond the maximum permissible value indicated by the BIDDER in his offer and accepted by the EMPLOYER. The same shall be demonstrated.

714406/2022/PS-PEM-MAX

985109/2022/PS-PEM-MAX

(ii) **Steam Condensing Plant for main turbine**

(a) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads.

(b) Oxygen content in condensate, at hotwell outlet, shall not exceed 0.015 CC per litre over the entire load range and shall be determined according to calorimetric Indigo - Carmine method.

(c) Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system.

(d) When one half of the condenser is isolated, condenser shall be capable of taking at least 60% T.G. load under EMCR conditions.

(e) The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17 deg.C below the temperature corresponding to absolute suction pressure shall not be less than 20 SCFM. Correction curves for establishing the capacity at site conditions shall also be furnished.

(f) The air and vapour mixture from air cooling zone of condenser shall be 4.17 deg.C below the saturation temperature corresponding to 25.4 mm Hg (abs) suction pressure. Correction curves for establishing the same at site conditions shall also be furnished.

(g) Condenser on load tube cleaning system life of sponge rubber balls & Number of balls lost during 1000 hrs of plant operation shall be as indicated by bidder in the offer & accepted by the Employer.

(iii) **Steam Condensing Plant for drive turbine condenser (if envisaged)**

(a) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads.

(b) Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system.

(c) The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17 deg.C below the temperature corresponding to absolute suction pressure shall be demonstrated. Correction curves for establishing the capacity at site conditions shall also be furnished.

(d) The air and vapour mixture from air cooling zone of condenser shall be 4.17 deg.C below the saturation temperature corresponding to 25.4 mm Hg (abs) suction pressure. Correction curves for establishing the same at site conditions shall also be furnished.

(iv) **Feed water heaters & Deaerator**

(a) TTD's and DCA's of feed water heaters in line with 660 MW TMCR heat balance shall be demonstrated.

(b) Difference between saturation temperature of steam entering the deaerator and temperature of feed water leaving deaerator.

(c) Dissolved O2 content in Deaerator effluent at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 CC/litre determined as per ASTM-D--5543-09 or Indigo Carmine method.

(vi) **Condensate Extraction Pumps**

(a) Each CEP set shall be capable of delivering flow & total dynamic head corresponding to runout point as specified.

(b) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated.

(vii) **Drip Pumps (if envisaged)**

(a) Each drip pump shall be capable of delivering flow & total dynamic head corresponding to design point as specified.

(b) The vibration and noise level shall be demonstrated.

(viii) **Boiler feed pumps**

(a) Each boiler feed pump set shall be capable to deliver flow and total dynamic head corresponding to runout point as specified elsewhere.

(b) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated as per specification requirements.

(c) Cold start up / hot start up of the unit using TDBFP with motive steam from auxiliary steam header.

3.02.04 **Balance Pumps, Blowers, Fans, Compressors and rotating equipment.**

a) The vibration, noise level and parallel operation, wherever applicable, of the pumps, blowers, fans, compressors and rotating equipment shall be demonstrated.

b) Pumps, blowers, fans, compressors and rotating equipment shall be capable of delivering flow and head corresponding to design point as specified.

3.02.05 **Pre-commissioning & Commissioning activities requiring approval of the employer:**

(a) Hydraulic Test for STG integral piping, heat exchangers, condenser tubes & condenser, equipment cooling water system pipes and associated equipment etc. shall be done. The hydraulic test of other piping system as per statutory requirement and specified elsewhere shall also be carried out. All equipment needed for the tests shall be furnished by the Contractor.

(b) Oil flushing of lube oil system, control & jacking oil system, etc. for turbines shall be done. Entire flushing oil requirement & refilling with fresh oil and other consumables along with flushing equipment shall be met by the Contractor.

(c) High Pressure/Low Pressure (HP/LP) bypass tests, vacuum tightness test as per approved procedures shall be done by the Contractor after arranging & lining up of all the necessary equipment by him.

(d) Steam blowing & chemical cleaning, as applicable of integral piping of the turbo-generator, Low pressure piping, Power cycle piping & other piping in the scope of the Contractor shall be done by the Contractor.

(e) Steam blowing & chemical cleaning, as applicable of integral piping of CEP sets & other piping in the scope of the Contractor shall be done by the Contractor.

(f) All tests and activities pertaining to the CEP and its drive as per manufacturer's recommendations and as given in the chapter and covered in the specification.

(g) Steam blowing & chemical cleaning, as applicable of integral piping of Drip Pump sets & other piping (if applicable) in the scope of the Contractor shall be done by the Contractor.

(h) All tests and activities pertaining to the Drip Pump and its drive (if applicable) as per manufacturer's recommendations and as given in the chapter and covered in the specification.

(i) Steam blowing & chemical cleaning, as applicable of integral piping of the Heaters & other components in the scope of the Contractor shall be done by the Contractor.

(j) All tests and activities pertaining to the Heater as per manufacturer's recommendations and as given in the chapter and covered in the specification.

(k) Oil flushing of lube oil system, control & jacking oil system, for BFP sets shall be done. Entire flushing oil requirement & refilling with fresh oil and other consumables alongwith flushing equipment shall be met by the Contractor.

(l) Steam blowing & chemical cleaning, as applicable of integral piping of BFP sets & other piping in the scope of the Contractor shall be done by the Contractor.

(m) All tests and activities pertaining to the BFP and its drive as per manufacturer's recommendations and as given in the chapter and covered in the specification.

(n) Hydraulic Test for all low and high pressure piping, equipment cooling water system pipes and associated equipment etc. shall be done as per statutory requirement and specified elsewhere shall be carried out. All equipment needed for the tests shall be furnished by the Contractor.

(o) All tests and activities pertaining to the Generator and Excitation as per manufacturer's recommendations and covered in the specification.

(p) All tests and activities pertaining to the Generator Auxiliaries viz Primary water system, Seal oil system, Gas system etc., as per manufacturer's recommendations and covered in the specification.

(q) Any other pre-commissioning checks/ tests and activities as described below and also those mutually agreed between the Contractor & the Employer shall be undertaken .

CONTROL & INSTRUMENTATION SYSTEM REQUIREMENTS

3.02.07 For STG integral controls the following requirement shall be demonstrated through native HMI of the respective DDCMIS..

3.02.08 The offered control system shall meet the requirement of initial pressure at turbine inlet as per the requirement of IEC-45-1 or equivalent as defined under mechanical sections of the specification. In order to realize the stipulated process requirement of TG systems that will be realized by interaction with employer procured control system Bidder will provide all required data and necessary interfaces so that Integrated Plant operation and control can be seamlessly realized by the employer.

3.02.09 The offered control system shall meet the process requirements specified under Sub Section OPERATING CAPABILITY OF THE PLANT, Part-B of Technical Specifications

3.02.10 Further the Contractor DDCMIS and Employer's SG C&I part of DDCMIS shall be properly integrated to achieve total plant operation. All required interfacing requirements shall be provided by the Contractor for enabling this integration of the total plant C&I and achieving the performance requirements. Tests in this regard shall be carried out at site by the Employer to verify the integrated performance of the total plant C&I. In case during these tests or otherwise it is observed that the behaviour/response of Contractor's system (drives actuators/valves etc.) is not satisfactory/acts as a limitation/restriction in achieving the permissible limits, the

Contractor shall carry out all required modifications, rectification etc. in his systems without any price repercussions whatsoever so that the permissible limits can be achieved. Contractor shall depute his experts for associating in the above tests and also for carrying out the necessary modifications, rectification etc. in Contractor's equipment and Control systems.

3.02.11 In case the Contractor feels that some specific requirements are to be met by the SG C&I contractors, then the same has to be clearly brought out in the offer. (For example the loop reaction time is specified as 500 millisec. in SG C&I specification).

3.02.12 Contractor shall meet system performance and parametric requirement follows -

3.02.13 On the bidder's supplied DDCMIS system ,the following parametric tests shall also be conducted under worst case loading conditions (details of worst case loading shall be as agreed during detailed engineering.)

(i) For control system

- CPU loading, Cycle time/controller reaction time

(ii) For MMIPIS

- CPU loading, spare duty cycle, Memory Spare Capacity (if applicable as per standard practice of bidder)

(iii) Spare duty cycle for system bus (if applicable as per standard practice of bidder)

(iv) Various display response time

(v) System accuracy

(vi) Display update time

3.02.14 For the parametric test, the following requirements shall be met

(i) **Processor Spare Duty Cycle (Free Time)**

- Under worst case loading of MMIPIS and system bus each MMIPIS processor shall have 40% free time when measured over any two second period and 50% free time when measured over any one minute period. (if applicable as per standard practice of bidder)

- Under worst case loading conditions of control system, control system processor shall have 20% free time when measured over any one minute period.

- The Bidder shall furnish all necessary data to fully satisfy the Employer that the processor spare duty cycle figures quoted by the Bidder are realistic and based on configuration and computation capability of the offered system and these shall be actually achieved in the fully implemented system as commissioned at project site.

(ii) **System Bus Spare Duty Cycle (Free Time)**

The system bus shall have min. 50% free time during the worst case loading conditions of control system, MMIPIS and the system Bus, measured over any 2 seconds interval. (if applicable as per standard practice of bidder)

(iii) **Response Time**

(a) Display:

The time from mouse click or last button pressed to the commencement of the requested display under the worst case loading conditions shall not be worse than the following:

All control related displays	2 sec
Point Details Display(single point)	1-2 secs
Bar chart display (20 points, current data)	2-3 secs.
Operator guide/plant start-up guide message display (full screen of alphanumeric information and a maximum of ten numbers of dynamic data items)	1-2 secs.
Plant mimic display of fair complexity with a minimum of 120 numbers of dynamic data items e.g., values, macros, line segment, etc.	2-3 secs.
Group review display (current values of twenty points)	2-3 secs.
X-Y plot display (2 X-Y- plots and a single display requiring both historical as well as current data)	3-4 secs.
X-T plot display (Trend of 6 analog points and a single display requiring both historical as well as current data)	3-4 secs.
Plant Summary display (e.g., bad point summary, limit check removed point summary. Assume the whole data base search is required and the summary display contains ten points only).	3-4 secs.

(b) Command:

The response time for screen update, after the execution of the control command, from the time the command is issued (for example command to start a motor to the time the screen is updated) shall be within two seconds (excluding the drive actuation time).

(iv) **System Accuracy Requirements**

The overall system accuracy from signal input terminals to output presentation on display and printers shall meet process requirement as agreed during detailed engineering.

(v) **Display Updated Rates**

All displays shall be updated at least every two seconds.

3.03.00 LIST OF TEST / ACTIVITIES TO BE PERFORMED ON TG & AUXILIARY (BUT NOT LIMITED TO THE FOLLOWING)

A) **TESTING SCHEDULES**

1. TURBINE ON BARRING GEAR
2. BEARING AND JACKING OIL INITIAL CIRCULATION
3. HP BYPASS SYSTEM
4. LP BYPASS SYSTEM
5. GOVERNOR OIL CONTROL SYSTEM
6. VACUUM RAISING PLANT
7. CONDENSER & COLTCS SYSTEM
8. CENTRAL OIL PURIFICATION PLANT
9. HYDRAULIC TEST PROCEUDRE FOR
   - A) LUB OIL SYSTEM
   - B) CONTROL OIL & JACKING OIL SYSTEM
   - C) GENERATOR SEAL OIL SYSTEM
   - D) GENERATOR STATOR WATER SYSTEM

E) GENERATOR GAS SYSTEM (Alternatively, pneumatic test with suitable leak detection method shall also be acceptable subject to owner's approval)

F) HEATERS

10. OIL FLUSHING OF LUB OIL SYSTEM

11. OIL FLUSHING OF CONTROL & JACKING OIL SYSTEM

12. OIL FLUSHING OF GENERATOR SEAL OIL SYSTEM

13. ALKALI FLUSHING FOR CONDENSATE SYSTEM

14. HP/ LP BYPASS SYSTEM

15. CONDENSER FLOOD TEST

16. CONDENSER VACUUM TIGHTNESS TEST

17. STEAM BLOWING OF GLAND SEAL PIPE LINES, AUX. STEAM PIPELINE

18. CEP

19. Drip Pump (if applicable)

20. HEATER

21. DEAERATOR

22. BFP

23. BEARING AND JACKING OIL INITIAL CIRCULATION

24. GOVERNOR OIL CONTROL SYSTEM

25. HYDRAULIC TEST PROCEDURE FOR

A) LUB OIL SYSTEM

B) CONTROL OIL & JACKING OIL SYSTEM

C) WATER SYSTEM

D) HEAT EXCHANGERS

26. OIL FLUSHING OF LUB OIL SYSTEM

27. OIL FLUSHING OF CONTROL & JACKING OIL SYSTEM

28. STEAM BLOWING OF GLAND SEAL PIPE LINES, AUX. STEAM PIPELINE

29 HT MOTORS

B) COMMISSIONING SCHEDULE

1. Turbine Gland sealing system for Main Turbine
2. HP-LP Bypass system
3. Turbine Initial Run up for Main Turbine
4. Lube Oil / Governing Oil System for Main Turbine
5. LP HEATERS
6. HP HEATERS
7. DEAERATOR STEAM OPERATION
8. Turbine Gland sealing system for BFP turbine
9. Turbine Initial Run up for BFP turbine
10. Lube Oil / Governing Oil System for BFP turbine
11. Generator and excitation system
12. Generator seal oil system
13. Generator stator water system
14. Generator gas system

C) COMMISSIONING TESTS/CHECKS

1. Test running of all pumps
2. Condenser vacuum test, feed water heater operational tests for establishing correct cascaded flow, heater water levels etc. & checking of all parameters as per approved heat balance diagrams.
3. Test for HP/LP bypass valves operation & their control system.
4. Test for operation of governing control system for turbines.
5. Standard commissioning tests and procedures as per Contractor's practice for steam turbine generator and other equipment / auxiliaries within the Contractor's scope of work.

6. Checks on operation of all individual control loops in the turbine generator control system.

7. Checks on correct functioning of the Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT).

8. Standard commissioning tests and procedures as per Contractor's practice for CEP and other equipment / auxiliaries within the Contractor's scope of work.

9. Checks on operation of all individual control loops in the CEP control system.

10. Standard commissioning tests and procedures as per Contractor's practice for Drip Pump (if applicable) and other equipment / auxiliaries within the Contractor's scope of work.

11. Checks on operation of all individual control loops in the Drip Pump control (if applicable) system.

12. Feed Water Heater operational test for establishing correct cascaded flow, heater water levels and checking of all parameters as per approved heat balance diagram

13. Standard commissioning tests and procedures as per Contractor's practice for heaters and deaerator and other equipment / auxiliaries within the Contractor's scope of work.

14. Checks on operation of all individual control loops in the heater and deaerator control system.

15. Test for operation of governing control system for BFP turbines.

16. Standard commissioning tests and procedures as per Contractor's practice for BFP and other equipment / auxiliaries within the Contractor's scope of work.

17. Checks on operation of all individual control loops in the BFP control system.

18. Checks on correct functioning of the BFP Turbine for Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT).

19. Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications.

20. Checks on operation of all rotating equipments to ascertain level of noise and vibration

21. Checks on operation of all static equipments to ascertain level of noise and vibration

22. Standard commissioning tests and procedures as per manufacturer's practice for Generator, Excitation and its auxiliaries within the Contractor's scope of work.

3.04.00 Chemical Cleaning of Pressure Parts

Complete chemical cleaning procedure, the scheme and layout including parameters of the pumps, size of tanks, materials of construction, the rate of consumption and total requirements of steam and water for such cleaning process shall meet the approval of the Employer.

The Contractor shall furnish all labour, materials such as the required chemicals and other consumables, all equipment such as acid transfer and acid circulating pumps complete with drive motors, acid storage and acid mixing tanks, all temporary piping, valves and specialities and local instruments for pressure, temperature and flow measurements and any other items needed to carry out the process. All equipment required for chemical cleaning shall be supplied by the contractor.

The Employer will arrange to supply Raw water and Demineralised water required for the cleaning operations at the Terminal Point's as indicated elsewhere, in the specification.

The Contractor shall take care to dispose off the used chemicals and the effluents from the cleaning operations, after neutralisation, meeting all the statutory regulations and in a manner acceptable to the Project Manager and which would comply with the norms of the State Pollution Control Board. This include construction of suitable neutralization pit, channels, disposal equipments etc.

The Contractor shall specifically make all necessary arrangements for prevention of any fire accidents, explosions etc. during the performance of the chemical cleaning operations.

The Contractor shall ensure that during the cleaning process the procedure adopted shall be such as to consume minimum demineralized water.

All equipment needed for such preservation including the nitrogen cylinders, interconnecting piping and any regulating equipment for N2 cap and other preservatives shall be provided by the Contractor and the same shall also become the property of the Employer after completion of the chemical cleaning.

The Contractor shall provide adequate safety and protective equipment for all his employees and ensure that they are worn at all times of danger. Specialised treatment equipment (such as required for first aid when using hydrofluoric acid) must be provided at the place of handling acid. An acid cleaning report and log of each cleaning must be provided by the Contractor to the Employer, immediately after the cleaning operation.

3.05.00 **Steam Blowing**

Steam blowing of various pipelines shall be carried out by the Contractor as per requirements/scope of work of this specification. In addition if any other piping, not specifically mentioned in the scope of the Contractor and is also required to be steam blown, the Contractor shall also to perform steam blowing of these additional piping during steam blowing operation.

The Contractor shall give recommended procedures, method of blowing and scheme for steam blowing indicating clearly additional system, if any, to be cleaned by steam blowing and furnish data/ write-up/ layouts/ drawings to that effect to the Employer for the Employer's approval.

The Contractor shall furnish his recommendations regarding use of various test equipments and instruments and termination/acceptance criteria for steam blowing, which in any case shall meet the steam turbine-generator requirements.

The systems which should be ready and operational before steam blowing and are in the scope of the Contractor shall be made ready/operational by the Contractor by the scheduled date for starting of steam blowing.

For equipments/components installed on high pressure boiler external piping, such as various thermowells, flow meter, control valves, HP/LP Bypass valves etc., the Contractor shall comply with guidelines to be followed during steam blowing, with respect to removal / blanking / replacement of such items their internals etc. by spool pieces as given by the respective manufacturer/sub-contractor.

Supply of all such spools (as above) and/or blanks, temporary piping and supports etc. as required, cutting / welding / edge preparation and rewelding required for blanking, temporary piping connection and/or for replacements by spool pieces shall be the responsibility of the Contractor. After steam blowing removal of spool pieces & temporary piping and reinstallation of various components, shall also be the responsibility of the Contractor.

The Contractor shall ensure successful and timely completion of steam blowing of all systems and will render all help/services as required including:

(i) Services of test/operating personnel/supervisors.

(ii) Extending all cooperation during erection, pre-commissioning of plant and equipment to be made ready and operational before starting steam blowing.

(iii) Extending all cooperation for interface engineering of equipments/components of temporary system required for steam blowing operation.

(iv) Contractor's engineers shall be available for all coordination meetings arranged by the Employer for finalising the details of temporary system for steam blowing.

3.06.00	**Balance of Plant equipment & systems** All pre-commissioning tests & activities as indicated above and elsewhere in the technical specification shall be performed by the Contractor.
3.07.00	**Commissioning of Facilities**
3.07.01	**General** Upon completion of precommissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities. Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence. The Contractor shall finalise the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer. The Contractor shall furnish requisite no. of copies of procedures and list of start up, precommissioning, commissioning and initial operation tests for Employer's approval. The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be. Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.
4.00.00	**Initial Operation** Upon completion of system checking/tests and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.
5.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).

714406/2022/PS-PEM-MAX

985109/2022/PS-PEM-MAX

6.00.00	**COMMISSIONING SPARES**
6.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commission-ing spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However. such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.
6.02.00	These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME II-B	
		SECTION-	
		REV. NO. 00	DATE:

SITE STORAGE & PRESERVATION GUIDELINES FOR MECHANICAL BOP's

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.

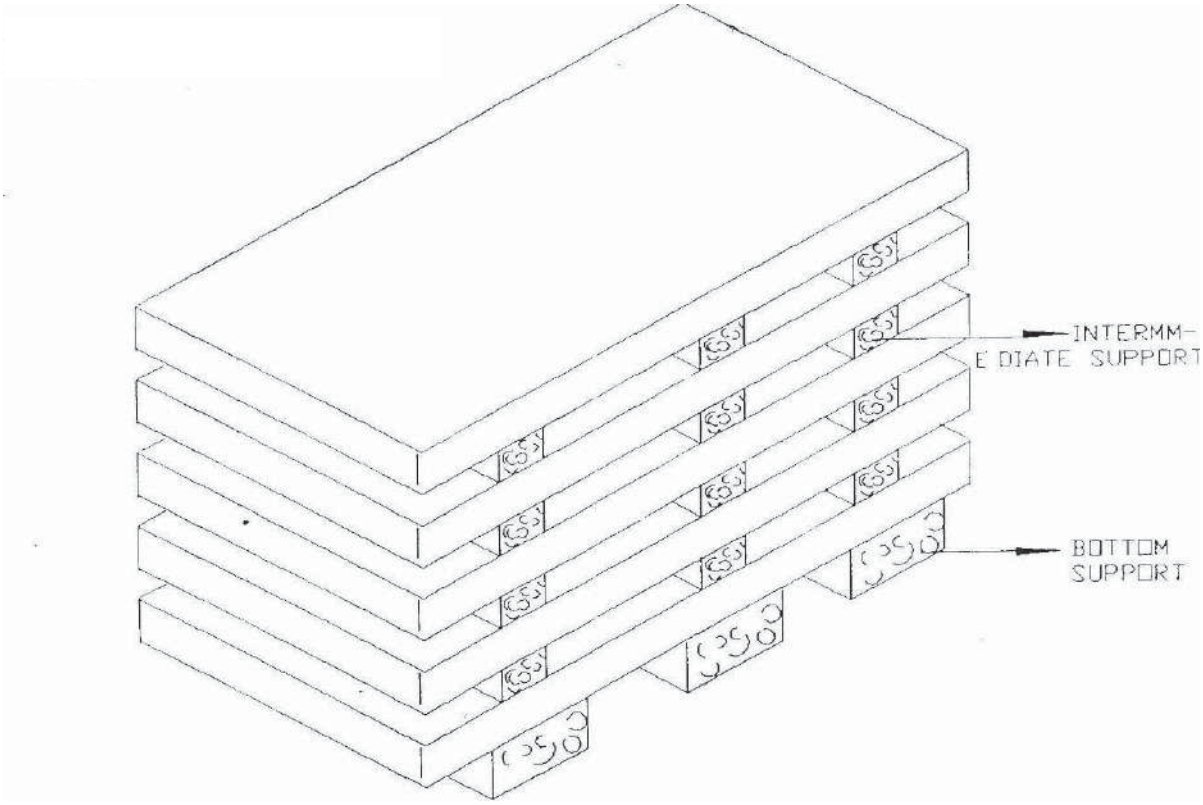


Figure – 1 – PLATE STACKING ARRANGEMENT

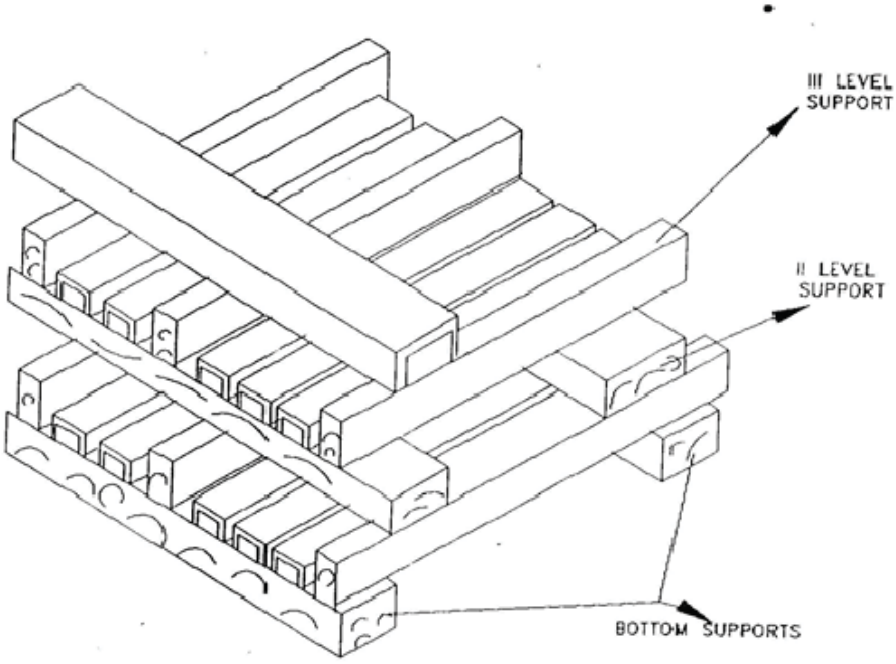


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME III	
		SECTION-	
		REV. NO. 00	DATE:

VOLUME - III

SECTION – III

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME III	
		SECTION-	
		REV. NO. 00	DATE:

LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID

1.0 Bidder to furnish following documents/information along with the bid (For Electrical and C&I Please Refer the Respective Section of the Specification).

- Deviation if any strictly in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed). In case of No Technical Deviation, bidder to furnish the same format stating “No Deviation w.r.t. technical Specification” duly Stamped & Signed.
- Compliance certificate. (Stamped & Signed)
- Schedule of Declaration. (Stamped & Signed)
- Un Price Schedule duly filled in. (Stamped & Signed)

Any other documents submitted by bidder except as asked in the bid’s specification shall not be evaluated & considered as null & void.

NOTES:

1) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

2) All drawings/documents shall be approved by BHEL/Customer during detailed engineering stage. Successful Bidder shall comply with the comments of the customer/BHEL without any price & delivery implication.

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME III	
		SECTION-	
		REV. NO. 00	DATE:

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
3. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
4. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
5. There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
6. The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
7. The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL and Customer).
8. All sub vendors shall be subject to BHEL/CUSTOMER approval.
9. Any special tools & tackles, if required, shall be in bidder's scope.
10. Performance guarantee test parameters shall stand valid till the satisfactory completion of Performance guarantee test and its acceptance by BHEL and Customer.

985109/2022/PS-PEM-MAX

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-475-673-A001	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	VOLUME III	
		SECTION-	
		REV. NO. 00	DATE:

PRE BID CLARIFICATION SCHEDULE

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

	TITLE: TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001
		VOLUME III
		SECTION-
		REV. NO. 00 / DATE:

SCHEDULE OF DECLARATION

I ……..……certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated …….. and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name …….

Authorized Representative's Signature ……..

Name …….

Bidder's Name …….

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated.

	TITLE:	
	TECHNICAL SPECIFICATION FOR EFFLUENT TRANSFER SYSTEM 2X660 MW KHURJA STPP (TG PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-475-673-A001
		VOLUME III
		SECTION-
		REV. NO. 00 / DATE:

THIS IS A PART OF TENDER TECHNICAL SPECIFICATION PE-TS-475-673-A001

SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL

PROJECT: 2 X 660 MW KHURJA STPP (TG PACKAGE)

EFFLUENT TRANSFER SYSTEM

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF withdrawal OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF withdrawal OF DEVIATION IS APPLICABLE	NATURE OF COST OF withdrawal OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given seperately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.