PROJECT:
2X660 MW KHURJA SUPER THERMAL POWER PROJECT

(**TURBINE GENERATOR AND ASSOCIATED PACKAGES**)

CUSTOMER: THDC INDIA LIMITED.

TECHNICAL SPECIFICATION
FOR
CHEMICAL DOSING SYSTEM (NaOH DOSING)

SPECIFICATION NO: PE-TS-475-154-A001

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

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). PROJECT: **2X660 MW KHURJA SUPER THERMAL POWER PROJECT** (**TURBINE GENERATOR AND ASSOCIATED PACKAGES**)	BHEL DOCUMENTS NO.: PE-TS-475-154-A001
		REV NO: 00 / DATE:

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	TITLE: **TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING)** **PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT** **(TURBINE GENERATOR AND ASSOCIATED PACKAGES)**	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
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SECTION - A
INTENT OF SPECIFICATION

1.0 SCOPE OF INQUIRY/ INTENT OF SPECIFICATION:

This specification is intended to cover design, engineering, manufacturing, fabrication, assembly, painting, packing, inspection & testing at manufacturer's works, **mandatory spares, start up and commissioning spares,** special tools & tackles, supply and dispatch to power station site of skid mounted **CHEMICAL DOSING SYSTEM (NaOH DOSING SYSTEM)** ~~including supervision of commissioning by experience/capable engineer~~, as specified in different sections / volumes of this specification hereinafter for the **2X660 MW KHURJA SUPER THERMAL POWER PROJECT** (TURBINE GENERATOR AND ASSOCIATED PACKAGES) for following systems:-

- **NaOH Dosing system (1 number for each unit i.e. Total 2 number for station)**

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

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

1.3 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.4 DELETED

1.5 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

1.6 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

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

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

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

1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/vendor and Customer/Purchaser/Employer will mean BHEL and/or Customer (NTPC: National Thermal Power Corporation Limited) as interpreted by BHEL in the relevant context. Please refer GCC/SCC for better clarity.

1.11 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.

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

1.13 Pre-bid meeting shall be held before bid submission. Bidder to ask all their queries in Prebid clarifications format only.

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SECTION – B

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.

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SECTION – C1
SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

1.0 BRIEF DESCRIPTION OF THE SYSTEMS:

The Chemical Dosing System shall consist of NaOH dosing system to dose dilute NaOH in ECW tank and ECW line.

2.0 *NaOH DOSING SYSTEM for ECW SYSTEM*

Sodium Hydroxide (NaOH) dosing system is provided to dose NaOH solution in Equipment cooling water lines to increase pH up to 9.5. The sodium hydroxide dosing is done in the ECW cycle during the initial fill and for the compensation of cooling water for any leakage during normal run. The 1% solution of NaOH is prepared manually by opening the inlet valve of DM water and adding NaOH lye in basket. The NaOH is being dissolved by locally starting the motorized stirrer. The dosing is done manually as per requirements of desired pH in ECW line judged by trial basis. Normally the leakage is occasionally and of small quantity. At the low level of solution in tank the solution is to be prepared again.
The dosing system consists of following (Refer Data Sheet-A and P&ID).

3.0 *SCOPE OF SYPPLY:*

The bidder's scope of supply includes the following under this specification:

a) One number NaOH Dosing tank.
b) Associated Piping, valves, fitting as indicated in the P&ID of NaOH dosing system and data sheet-A enclosed and as required to make the system complete.
c) Foundation nuts & bolts to fix each skid on the floor, as required.
d) Control & instrumentation as per P&ID of NaOH dosing system, Data sheet-A and as indicated in different section in this specification.
e) Commissioning spares as indicated in specification.
f) Mandatory spares as indicated in specification.

4.0 *SCOPE OF SERVICE:*

The bidder's scope service includes the following under this specification:

a) Design and engineering.
b) Fabrication of the skid mounted chemical dosing system.
c) Inspection and testing of the skid as per the approved quality assurance plan.
d) Supply of the skid mounted chemical dosing system up to the power plant site along with all accessories as defined in the technical specification.
e) ~~Supervision of Commissioning by experienced/capable engineer~~ **~~for one (1) visit of two (2) days to supervise in Commissioning.~~**
f) Painting as per technical specification.
g) Packing of skid (**Refer Note Below**)

Note: To prevent damage to the equipment of the skid during loading/unloading, transit and in view of the site storage suitable wooden packing with steel angle/frame shall be provided. Auto Stroke controller shall be packed separately in weather proof packing box.

SUB VENDOR LIST (TABLE-1)

SL NO.	ITEM	APPROVED SUPPLIERS	PLACE	REMARKS
	MECHANICAL:			
1	**TANK/DISSOLVING BASKET/WATER SEAL POT/ CO_2 ABSORBER/BREATHER**	SELF-MAKE OF MAIN VENDOR	AS APPLICABLE	
2	**AGITATOR/STIRRER**	REMI (REFER NOTE 1)	MUMBAI	
		CEECON	CHENNAI	
		FIBRE & FIBRE		
3	**GATE/GLOBE/NON-RETURN (CHECK) VALVES**	PRECISION ENGG.	MUMBAI	
		CRESENT VALVE	MUMBAI	
		BDK	HUBLI	
		LEADER	JALANDHAR	
		CHEMTECH	MUMBAI	
		TECHNO VALVE	MUMBAI	
		FOURESS	MUMBAI	
		FLUIDLINE	MUMBAI	
		STEELSTRONG	MUMBAI	
		L&T AUDCO		
		GM ENGINEEIRNG		
		A.V. VALVES		
		ATAM VALVES	JALANDHAR	
4	**2/3 WAY VALVE MANIFOLDS**	TECHNO VALVE	MUMBAI	
		HI TECH	AHMEDABAD	
		CHEMTROL		
		BLISS ANAND	GURGAON	
		APPROVED ORIGINAL SUPPLIER FOR THE RESPECTIVE INSTRUMENT	AS APPLICABLE	
5	DELETED			
6	**PIPES**	CHOKSHI TUBES	AHMEDABAD	
		REMI	MUMBAI	
		RATNAMANI	AHMEDABAD	
		PRAKASH STEELAGE	SILVASA	
		KALYANI		
		PRAKASH		
		SAW		
7	**FITTINGS**	BHARAT FORGE	PUNE	
		RELIANCE FORGE	MUMBAI	
		EBY	MUMBAI	
		SIDDARTH & GAUTAM	FARIDABAD	
		MS FITTINGS	KOLKATA	
		PRADEEP METALS	MUMBAI	

		LTD		
		TUBE PRODUCT INCOROPORATION	BARODA	
		CSA FITTINGS		
8	**FLANGES**	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	
		RELIANCE FORGE	MUMBAI	
		CD INDUSTRIES		
9	**PAINT**	BERGER PAINTS	KOLKATA	
		ASIAN PAINTS	MUMBAI	
		SHALIMAR PAINTS	KOLKATA	
		JENSON & NICOLSON	KOLKATA	
		GUNJAN PAINT	MUMBAI	
	ELECTRICAL:			
10	**LT MOTORS**	KEC	BANGALORE	
		SIEMENS	MUMBAI	
		ABB	FARIDABAD	
		CROMPTON GREAVES LTD	MUMBAI	
		BHARAT BIJLEE	MUMBAI	
		NGEF	BANGALORE	
		MARATHON	KOLKATA	
		JYOTI	VADODARA	
		LHP	SOLAPUR	
	C&I:			
11	**LOCAL CONTROL PANEL**	INDSUSTRIAL SWITCHGEAR & APPS	MUMBAI	BOM OF THE LCP SHALL BE SUBJECT TO BHEL/ CUSTOMER APPROVAL DURING DETAILED ENGINEERING.
		PROCON	CHENNAI	
		CONTROL & SWITCHGEAR		
		PYROTECH	UDAIPUR	
		DELTA CONTROL	MUMBAI	
		RITTAL		
		SUCHITRA		
		INDUSTRIAL CONTROLS & APPLIANCES LTD.		
12	**INST CABLES (SCREENED)**	RELIANCE	BANGLORE	
		DELTON	FARIDABAD / NEW DELHI	
		NICCO	KOLKATA	
		CHORDS CABLE	BHIWADI	
		UNIVERSAL	SATNA	
		INCAB	PUNE	
		POLYCAB	DAMAN	
13	**LT CONTORL CABLES**	DELTON	FARIDABAD/NEW DELHI	
		FINOLEX	PUNE	
		NICCO	KOLKATA	
		PARAMOUNT CABLES	ALWAR	
		FGI	KOLKATA	
		POLYCAB WIRES	DAMAN	
		TORRENT CABLES	NADIAD	
		FINOLEX	PUNE	
		INDUSTRIAL CABLE	RAJPURA	

		THERMOCABLES	HYDERABAD	
		ADVANCE CABLE TECHNOLOGIES	BANGALORE	
		APAR INDUSTRIES	MUMBAI	
		CMI LTD.	FARIDABAD	
		CRYSTAL CABLE INDUSTRIES	KOLKATA	
		DIAMOND POWER	VADODARA	
		ELKEY TELELINKS	NEW DELHI	
		GOVIND CABLES	KOLKATA	
		HAVELLS INDIA	NOIDA	
		KEI INDUSTRIES	DELHI	

14	LEVEL GAUGE	BLISS ANAND PVT. LTD.	
		TOSHNIWAL BROTHERS PVT.LTD.	MAKE:NIVO CONTROLS
		SIGMA INSTRUMENTS CO.	
15	TRANSMITTERS	ABB LIMITED	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER
		Pune Techtrol Pvt. Ltd.	Only for capacitance Type Level Transmitter
		V. AUTOMAT & INTRUMENTS (P) LTD.	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS
		Moore Industries International Inc.	
		PANAM ENGINEERS	For Pressure and Diff. Pressure transmitter
		TOSHNIWAL INDUSTRIES PVT. LTD.,	
		Endress + Hauser (India) Pvt. Ltd.,	
		YOKOGAWA INDIA LIMITED,	
		SBEM PVT. LTD.	FOR CAPACITANCE TYPE.
		SIEMENS LIMITED	
		EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	
		SMART INSTRUMENTS LTD, BRAZIL	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.
		NIVO CONTROLS PVT. LTD.	For Capacitance type only
		Honeywell Automation India Limited	
16	JUNCTION BOX	Shrenik & Company,	
	JUNCTION BOX	SUCHITRA INDUSTRIES	
	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Metal type junction box only
	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	
	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	
17	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	

	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	
	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	
	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	
17	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	
	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	
	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	
	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	
	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	
	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	
	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	
	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	
	INSTRUMENT FITTINGS	AURA INCORPORATED	
	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	
	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	
	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	
	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	
	INSTRUMENT FITTINGS	PANAM ENGINEERS	
19	Pressure gauge and differential Pressure gauge	SWITZER, CHENNAI. AN INSTRUMENTS, KOLKATA, H GURU, NEW DELHI. MANOMETER INDIA, MUMBAI. GIC, MUMBAI/GOA. GLUCK INDIA, MUMBAI. BUDENBERG GAUGE. DRESSER IND. FORBES MARSHALL. WAREE.	

Notes: -

1. Bidder to note that geared motor of REMI make for stirrers (for stirrers of REMI make ONLY) is acceptable to BHEL.
2. All the finally selected sub vendors shall be subject to customer approval during detailed engineering without any delivery/ commercial implications to BHEL/ Customer.
3. ~~Calibration column may be purchased from sources as per pump manufacturer's recommendation.~~
4. The sub vendor list enclosed is indicative only and is subject to approval / acceptance by customer.

Bidder to propose his sub vendor list with back up documents (experience list, end 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 or customer.

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DRAWING DOCUMENTS DISTRIBUTION SCHEDULE

TABLE-2

SL NO	DESCRIPTION	NTPC ENGG	NTPC SITE	BHEL SITE	BHEL PEM
1	Drawing/Document for approval				
	Vendor to BHEL/NTPC	--	--	--	SC
2	Inspection/Test report				
	Vendor to BHEL/NTPC	--	--	--	2+SC
3	O&M Manual for approval				
	Vendor to BHEL/NTPC	--	--	--	SC
4	Final approved drawing/document (as built/O&M Manual)	--	2+2CD	2+2CD	--

Note-1: SC: Soft copy, CD-Compact Disc.
Note-2: All soft copy (AutoCAD/EXCEL/Microsoft Word/Stad/etc) document shall be submitted by bidder whenever required by BHEL/Customer/Consultant.

LIST OF COMMISSIONING SPARES

TABLE -3

Sl.No.	Description	Quantity per NaOH Dosing Skid
1.1	Oil Seals for drive end for motor	4 Nos.
1.2	Gaskets for drive end for motor	4 Nos.
1.3	Guide ring for plunger.	4 Nos.
1.4	Teflon rings for valve/s.	4 Nos.
1.5	Level gauge glass	4 Nos.
1.6	Back up fuse	4 Nos.
1.7	Pilot lamp	4 Nos.
1.8	Push Button	4 Nos.
1.9	Control fuse	4 Nos.
1.10	Bulb for Annunciation	4 Nos.

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LIST OF MANDATORY SPARES

LIST & QUANTITY OF MANDATORY SPARES

TABLE - 4

SL. NO.	ITEM DESCRIPTION	TOTAL QUANTITY INCLUDED FOR THE PROJECT (2 x 660 MW)
	LIST OF MANDATORY SPARES (NaoH Dosing)	
1	**Low Pressure Piping**	
a)	Valves up to size 250 NB (Population= All Units)	5% of the total population of each type, size and class OR minimum 3 nos. of each type size & class whichever is more
2	**NOT USED**	
3	**Measuring Instruments**	
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)	Pressure, Differential Pressure, Flow, level and temperature gauges	20% of the total population or minimum 2 nos of each type / rating / model
4	**INSTRUMENTATION CABLE, INTERNAL WIRING**	
(i)	Pre-fabricated cable of each type (other than DDCMIS application) (if applicable)	10% of installed quantity.
(ii)	Pre-fabricated cable connector (other than DDCMIS application) (if applicable)	10% of each type and model
(iii)	Other cables (Instrumentation and Control cable)	5% or 500 mtrs whichever is more for each type, pair and size of actual supplied quantity.
5	**PROCESS CONNECTION PIPING (FOR IMPULSE PIPING/TUBING, SAMPLING PIPING/TUBING AND AIR SUPPLY PIPING AS APPLICABLE)**	
(i)	Valves of all types	10%
(ii)	2 way, 3 way, 5 way valve manifolds	10% of each type, class, size and model
(iii)	Fittings	10%

CONTROL DESK & CONTROL PANEL (as applicable)

Sl No	Item	Quantity
(i)	UCD mounted devices as per Appendix-I to Part-A, Section-VI	10% of each type subject to max. 5 nos. of each type.
(ii)	Replacement lamps/LED's for each type of lamps/LED	100%
(iii)	Blank tiles	10% of total no. of tiles.
(iv)	MCBs	10% of each type and rating.
(v)	Fuses	100% of each type and rating.

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PAINTING SPECIFICATION (ANNEXURE-I)

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**Specification of surface preparation & painting**
1.01.00	Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.
1.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labeled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.
1.03.00	Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.
1.04.00	All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering.
1.05.0	**SURFACE PREPARATION**
1.05.01	All surfaces to be painted shall be thoroughly cleaned of oil, grease and other foreign matter. Surfaces shall be free of moisture and contamination from chemicals and solvents.
1.05.02	The following surface schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.
	SP1 Solvent cleaning
	SP2 Application of rust converter (Ruskil or equivalent grade)
	SP3 Power tool cleaning
	SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)
	SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns
	SP5 Phospating
	SP6 Emery sheet cleaning/Manual wire brush cleaning.
1.06.00	**APPLICATION OF PRIMER/PAINT**
1.06.01	The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.
1.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.
1.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.
1.06.04	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.06.05	Following are the Primer/painting schemes envisaged herein: PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104. PS3* - Zinc Chrome primer (Alkyd base) by dip coat. PS4 - Synthetic Enamel (long oil alkyd) to IS2932. PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744 PS9 - Aluminium paint to IS 2339. PS9* - Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature 400 degC – 600 degC), IS-13183 Gr.-II (for temperature 200 degC- 400 degC and IS-13183 Gr.-III (for temperature upto 200 degC) PS13 - Rust preventive fluid by spray, dip or brush. PS14 - Weldable primer-Deoxaluminate or equivalent. PS16 - High Build Epoxy CDC mastic `15'. PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.) PS18 - Epoxy based TiO2 pigmented coat PS19 - Epoxy based Zinc phosphate primer (92% zinc in dry film (min.), %VS=35.0(min.). PS-20 - Epoxy based finish paint
1.06.06	All weld edge preparation for site welding shall be applied with one coat of wieldable primer.
1.06.07	For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.

1.06.08 Primer/Painting Schedule

Sl. No	Description		Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painting DFT (Microns)	Colour Shade
				Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)		
A) Power Cycle Piping														As per NTPC Colour shade/ coding scheme
1.	All insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.		SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
2.	All un -insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	Design temperature < or equal to 60^0C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 $	35 $	155 $	
		Design temperature above 60 ^{0}C-200^0C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200^0C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH), Variable Load Hanger (VLH).		SP4*	PS19	1	40	-	-	-	PS17	1	30	70	
4.	Piping hangers/ supports (other than (3) above. (un-insulated)		SP3/SP5	PS 5	2	25	-	-	-	PS4	2	25	100	
5.	Valves													

	Cast/Forged	Design temperature < or equal to 60 degC #	SP3/SP5	PS 5	2	35	-	-	-	PS4	2	25	120	
		Design temperature above 60 degC	SP3/SP5	PS 9*	1	20	-	-	-	PS9*	1	20	40	
6.	All auxiliary Structural Steel components for pipe supports	Outside TG building and in SG envelope	SP4*	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	75	a))Epoxy coat b)Final coat of paint PS17	2 1	35 30	250	
		Within TG building	SP4*	-do-	1	35	PS18	1	35	a))Epoxy coat b)Final coat of paint PS17	2 1	25 30	150	
7.	Weld Edges		SP6 (Hand cleaning by wire brushing)	PS13 (Weldable primer)	1	25	-	-	-	-	-	-	25	

1. $ The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3rd finish coat (min.DFT 35 Microns) shall be applied at site.
2. For valves below 65NB and temperature upto and including 540 Deg.C, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint.
3. For corrosion protection of threaded hanger rods and variable spring cages, electro galvanizing in full compliance to minimum Corrosion category C3 as per EN ISO12944 is also acceptable.
4. For spring cages, 2 coats of 30 µm(min) zinc-rich epoxy resin primer with zinc content> 80 weight% in dry film followed by 2 coats of 30 µm(min) top coat of Acrylic resin Co-polymerisate with a total combined minimum DFT of 120µm is also acceptable in lieu of above specified paint scheme.
5. For corrosion protection for all inner parts of the hangers shall be atleast in full compliance to Corrosion category C3 as per EN ISO12944.
6. # - For Cast/forged valves upto & including design temperature 60Deg.C, Aluminium painting as per IS-13183 Gr-3 or better with total DFT 40Micron is also acceptable.

B) LOW PRESSURE PIPING

		Surface Preparation	Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Min. Total DFT (Microns)	
1	All Piping, fittings / components, valves, Equipments etc.	SP3/SP5	PS3/ PS5	2	25	PS 4	1	30	PS 4	2	35	150	As per NTPC Colour shade/ coding scheme
2	Stainless steel surface, Galvanized steel surface and gun metal surface.	No Painting											
3	On the internal surface for pipes 1000 Nb and above	A coat of primer followed by hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.											

PAINTING FOR ELECTRICAL EQUIPMENT

Unless explicitly stated in relevant chapters of the specification, the painting of all electrical equipment shall be as follows:
Epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). Paint shade shall be as per technical specification.

Note:

(i) Painting requirement as indicated above are bare minimum. However, any variation in the painting schedule as finally approved by BHEL / Customer shall be taken care by the bidder without any commercial and delivery implication to BHEL / Customer. Colour coding scheme shall be intimated to vendor during detail engineering.

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). **PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)**	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME II-B	
		SECTION –C1	
		REV. NO. 00	DATE:

QUALITY PLAN

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN FOR CHEMICAL DOSING SYSTEM	SPEC. NO : PE-TS-475-154-A001	DATE:
	PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES).	QP NO.: PE-QP-475-154-A001	SHEET 1 OF 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	**WELDER'S QUALIFICATION**													
1.1	WELDING PROCEDURE SPECIFICATION (WPS)	CORRECTNESS	MA	SCRUTINY	100%		ASME IX	ASME IX	QW 482	√	P	V	V	
1.2	WELDER PERFORMANCE & PROCEDURE QUALIFICATION RECORD	WELD SOUNDNESS & WELDING PERFORMANCE	MA	PHYSICAL TEST	ASME IX		ASME IX	ASME IX	QW 483 & QW 484	√	P	V	V	
2.0	**TANKS**													
2.1	**RAW MATERIAL**													
2.1.1	PLATE	CHEM & PHY PROP.	MA	CHEM & PHY TEST	1/PLATE/ HT BATCH		ASTM A 240 GR. TP 304/316		MFG. TC/LAB REPORT	√	P	V	V	IDENTIFICATION BY BHEL
		IGC TEST	MI	IGC TEST			ASTM A 262 PR 'E'			√	P	V	V	
2.1.2	PIPE FOR NOZZLE	CHEM & PHY PROP.	MA	CHEM & PHY TEST	1/HT BATCH/SIZE		ASTM A 240 GR. TP 304/316		MFG. TC/LAB REPORT	√	P	V	V	
		MICRO STRUCTURE	MI	GRAIN STRUCTURE			FOR HEAT TREATMENT			√	P	V	V	
		IGC TEST	MI	IGC TEST			ASTM A 262 PR 'E'			√	P	V	V	
2.2	**IN PROCESS**													
2.2.1	DISHED ENDS	DIMENSION	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT.		MFG. TC/LAB REPORT	√	P	V	V	
		SURFACE DEFECTS ON WELDING	MA	DP TEST	100%		ASTM E 165	NO SURFACE DEFFECTS		√	P	V	V	
3.0	**STIRRER**													
3.1	RAW MATERIAL FOR SHAFT	CHEM & PHY PROP.	MA	CHEM & PHY TEST	1/BAR				MFG. TC/LAB REPORT	√	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH		ASTM A 262 PR 'E'			√	P	V	V	
3.2	IMPELLER	CHEM PROP.	MA	CHEM TEST	1/PLATE		ASTM A 479 GR TP 304/316			√	P	V	V	
3.3	COMPLETE STIRRER WITH MOTOR	PERFORMANCE IN WATER FILED TANK												
		VIBRATION	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT.		MFG. TC	√	P	V	V	
		WOBBLING	MA	VISULA	100%		NO WOBBLING		MFG. TC	√	P	V	V	

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	PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES).	QP NO.: PE-QP-475-154-A001	SHEET 2 OF 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
4.0	**MOTORS**	ROUTINE TEST	MA	MFG. TC	100%		APPROVED DRAWING/DOCUMENT.		MFG. TC	√	P	V	V	
		TYPE TES	MA	MFG. TC	1/SIMILAR FRAME SIZE		APPROVED DRAWING/DOCUMENT.		MFG. TC	√	P	V	V	
		DEGREE OF PROTECTION	MA	MFG. TC			APPROVED DRAWING/DOCUMENT.		MFG. TC	√	P	V	V	
5.0	DELETED													
5.1														
5.1.1														
5.2	DELETED													
6.0	DELETED													

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN FOR CHEMICAL DOSING SYSTEM	SPEC. NO : PE-TS-475-154-A001	DATE:
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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
7.0	**VALVES (GATE/GLOBE/NRV/BALL)**													
7.1	RAW MATERIAL													
	BODY,BONNET COVER	CHEM & PHY PROP.	MA	CHEM.& PHY TEST	1/HT BATCH		APPROVED DRAWING/DOCUMENT		MFG. TC/LAB REPORT	√	P	V	V	
		HEAT TREAT.	MA	HEAT TREATMENT	1/HT BATCH		APPROVED DRAWING/DOCUMENT			√	P	V	V	
	TRIM MATERIAL	CHEM & PHY PROP	MA	CHEM.& PHY TEST	1/BAR/SIZE		APPROVED DRAWING/DOCUMENT			√	P	V	V	
7.2	ASSEMBLY													
		LEAKAGE (BODY & SEAT)	MA	HYDRO TEST	100%		APPROVED DRAWING/DOCUMENT	NO LEAKAGE	MFG. TC/LAB REPORT	√	P	V	V	
		LEAKAGE (SEAT)	MA	PNEUMATIC TEST	100%			NO LEAKAGE		√	P	V	V	
		DIMENSIONS	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
8.0	FITTINGS/FLANGES													
	RAW MATERIAL	CHEM & PHY PROP.	MA	CHEM.& PHY TEST	1/HT BATCH		ASTM A 182 GR TP 304/316		MFG. TC/LAB REPORT	√	P	V	V	
		HEAT TREAT.	MA	HEAT TREATMENT	100%		ASTM A 182 GR TP 304/316			√	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH		ASTM A 262 PR 'E'			√	P	V	V	
9.0	**STRAINERS**													
9.1	RAW MATERIAL FOR BODY	PHY.& CHEM. PROPERTIES	MA	PHY. & CHEM.TEST	1/BAR/SIZE		APPROVED DRAWING/DOCUMENT		MFG. TC/LAB REPORT	√	P	V	V	
9.2	SCREEN	CHEMICAL	MA	CHEMICAL	1/SIZE		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		MESH SIZE	MA	MEASUREMENT	1/SIZE		APPROVED DRAWING/DOCUMENT			√	P	V	V	
9.3	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT		MFG. TC	√	P	V	V	
		LEAKAGE	MA	HYDRO TEST	100%		APPROVED DRAWING/DOCUMENT	NO LEAKAGE	MFG. TC	√	P	V	V	
10.0	**PIPES**													

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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
10.1	MATERIAL	CHEMICAL	MA	CHEMICAL	1/HT BATCH/SIZE		ASTM A 312 GR.TP 304/316		MFG. TC/LAB REPORT	√	P	V	V	IDENTIFICATION BY BHEL. REFER NOTE-2 AND NOTE-3.
		MECHANICAL TEST	MA	MECHANICAL TEST	1/HT BATCH/SIZE		ASTM A 312 GR.TP 304/316			√	P	V	V	
		MICRO STRUCTURE	MI	GRAINS STRUCTURE	1/HT BATCH/SIZE		FOR HEAT TREATMENT			√	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE		ASTM A 262 PR 'E'			√	P	V	V	
		HYDRO TEST	MA	LEAKAGE	100%		NO LEAKAGE	NO LEAKAGE	MFG. TC/IR	√	P	V	V	
11.0	**INSTRUMENT (LG/PG/LT/PT/DPG/DPT)**													
	RAW MATERIAL FOR WETTED PARTS	CHEM. PROP.	MA	CHEM. TEST.	1/HT BATCH		APPROVED DRAWING/DOCUMENT		MFG. TC/LAB REPORT	√	P	V	V	
	FINAL INSPECTION	DIMENSION	MI	MEASUREMENT.	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		ACCURACY	MA	CALIBRATION	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		DEGREE OF PROTECTION	MA	TYPE TEST	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
12.0	**CONTROL PANEL**													
		DIMENSIONS	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT		INSPECTION REPORT	√	P	V	V	
		CONTINUITY, IR-HV-IR	MA	ELECTRICAL	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		VERIFICATION OF MAKE	MA		100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		RATING OF COMPONENTS	MA		100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		PAINT SHADES, THICKNESS	MA		100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		ADHESION	MA		100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		DEGREE OF PROTECTION	MI		100%		APPROVED DRAWING/DOCUMENT		MGF. TC/ LAB REPORT	√	P	V	V	

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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
13.0	**COMPLETE SKID ASSEMBLY**													
		DIMENSIONS & ORIENTATION	CR	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT		INSPECTION REPORT	√	P	W	V	
		LEAKAGE, CHECK ON WELDMENTS		VISUAL & HYD TEST	100%		DISCH.PIPING - 1.5 x DISCH PR. OF PUMP, SUCTION PIPING -10 KG/CM2	NO LEAKAGE		√	P	W	V	
		~~FUNCTIONAL TEST FOR INTERLOCKS~~	~~MA~~	~~VISUAL~~	~~100%~~		~~APPROVED DRAWING/DOCUMENT~~			~~√~~	~~P~~	~~W~~	~~V~~	
		LEAKAGE IN TANK		VISUAL & HYD TEST	100%		WATER FILL TEST FOR 2 HR.		NO LEAKAGE	√	P	W	V	
	PMI TEST FOR SS	GRADE CONFIRMATION	MA	CHEM. TEST	100%		APPROVED DRAWING/DOCUMENT		LAB REPORT	√	P	W	V	
		PAINTING	MA	VISUAL AND MEASUREMENT.	100%		APPROVED DRAWING/DOCUMENT		INSPECTION REPORT	√	P	V	V	
		PACKING	MA	VISUAL AND MEASUREMENT.	100%		APPROVED DRAWING/DOCUMENT		INSPECTION REPORT	√	P	W	V	

LEGENDS:

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

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER, **P**: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE. **MA**: MAJOR, **MI**: MINOR**, CR:** CRITICAL.

NOTE-1: WHEN BACK WALL ECHO IS SET TO 100% OF FSH IN SOUND AREA, DEFECT ECHO SHALL NOT EXCEED 20% OF FSH. MAX BACH WALL ECHO IS 20% OF FSH. TOTAL NO OF DEFECTS SHALL BE MAX. 5 NO IN ONE METER LENGTH. MIN DISTANCE BETWEEN TWO DEFECTS SHALL BE 3 TIMES THE DIA OF BAR.

NOTE-2: FOR PIPES PURCHASED DIRECTLY FROM MANUFACTURER'S OR AUTHORIZED DEALERS, APART FROM TC REVIEW, CHECK WILL BE AS PER CLAUSE 2.1.2 AND 10.0; HOWEVER, FOR HYDRAULIC TEST, MANUFACTURER TC SHALL BE REVIEWED. IN CASE ON IMPORTED PIPES PURCHASED FROM OPEN MARKET, TEST SHALL BE PERFORMED AS PER CLAUSE 2.1.2 AND 10.0 (INCLUDING HYDRAULIC TEST).

NOTE-3: NDT REQUIREMENT ON WELDING (TANK, PIPE, BREATHER/WATER SEAL/CO2 ABSORBER) SHALL BE AS -- A) ON BUTT WELD-- 25% DP & 25% RT FOR PUMP SUCTION SIDE & 100% DP & 100% RT FOR PUMP DISCHARGE SIDE. B) ON FILLET WELD--100% DP TEST

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	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). **PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)**	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME II-B	
		SECTION –C1	
		REV. NO. 00	DATE:

DATA SHEET-A

SL. No.	Description	NaOH
1.0	No. of skid	One (1) for each unit, i.e. Total 2 no. for entire Plant.
2.0	**Mixing cum storage tank**	
2.1	No. of tanks per Skid	One
2.2	Capacity in litres	500
2.3	Type	
2.4	Material of the tank	SS-316
2.5	Thickness	6 mm
2.6	Motorised Stirrer	SS 316, Provided with reduction gear for 200 RPM.
2.7	Dissolving basket	Provided (30 mesh B.S.) of SS 316.
2.8	Type of agitator	Motor operated
2.9	Instrument	Refer P&ID.
3.0	**Piping:**	
3.1	Material & rating	SS-316 (Sch 40 min)
3.2	Diameter	25 NB
5.0	**Valves:**	
5.1	Body Material	SS-316
5.2	Weld ends	Socket weld ends
6.0	**Fittings & Flanges**	**SS 316, CL 300**
7.0	**Structural steel**	**MOC: IS 2062**
8.0	**Ladder and platform (with Chequered Plate)**	**Shall be provided to reach top of tank and chemical filling**
9.0	**Nuts/Bolts/Fasteners**	**MOC: Stainless Steel.**

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). **PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)**	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
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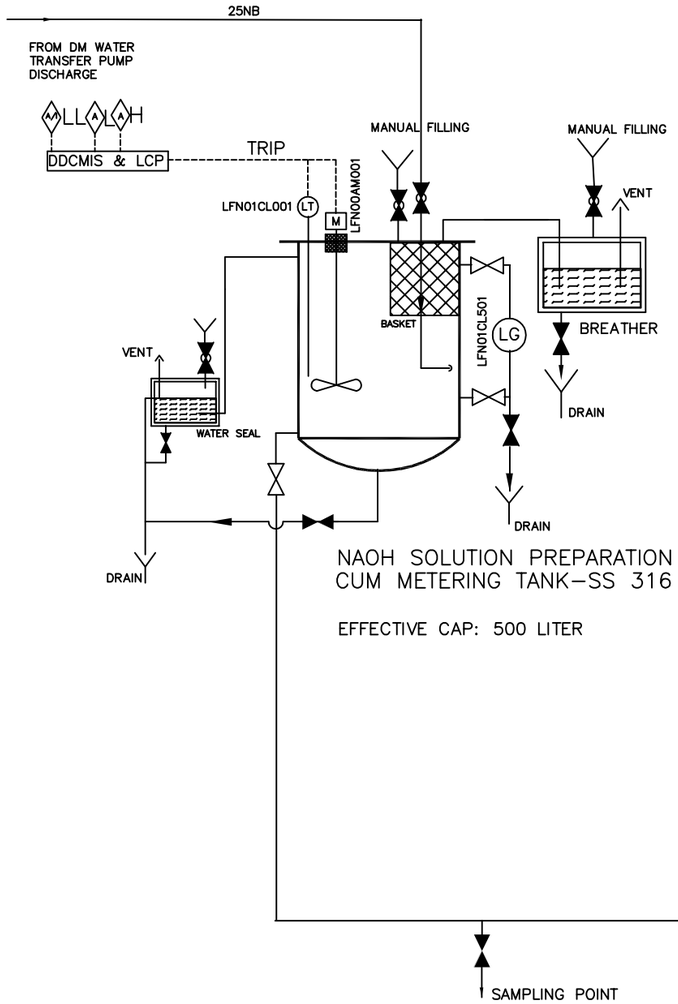
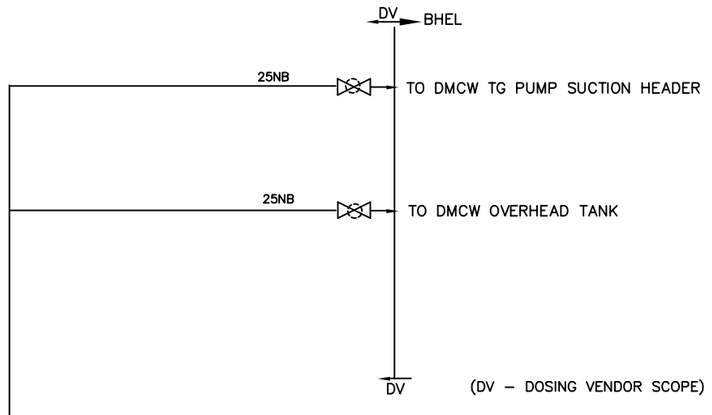
DRAWING

(P&ID FOR NaOH DOSING SYSTEM)

NOTES: –

1 TANKS SHALL BE OF SS–316 CONSTRUCTION, 6 MM THICK. DISSOLVING BASKET SS–316
2 ALL PIPING SHALL BE OF ASTM–A–312 GR.316 SCH. 40S .
3 ALL VALVES SHALL BE OF SS 316 SOCKET WELD ENDS
4 ALL DRAINS SHALL BE CONNECTED AT ONE POINT ON SKID.
5 ALL TERMINAL POINTS SHALL BE SUPPLIED WITH COUNTER FLANGES.
6 SCHEME FOR UNIT#1 IS SHOWN AND FOR THE UNIT#2 IT SHALL BE IDENTICAL.
7 TOTAL 2 NOS. SKID SHALL BE PROVIDED. (1 NO. SKID / UNIT)
8 DESIGN STANDARD OF TANK– ASME Boiler & Pressure vessels Code Section–VIII. Div.I/ IS: 2825 (Class–3)
9 AGITATOR WILL BE PROPELLER TYPE (SHAFT, PROPELLER ETC. OF SS 316 COSTRUCTION) ALONG WITH DRIVE MOTOR OF SUITABLE RATING AND PROTECTION CLASS. (WITH SLOW SPEED REDUCTION GEAR UNIT)





	LEGEND
▩	STUFFING BOX
⋈	GATE VALVE NORMALLY OPEN
⋈	GATE VALVE NORMALLY CLOSED
⋈	GLOBE VALVE NORMALLY CLOSED
⋈	GLOBE VALVE NORMALLY OPEN
–▽–	MULTI VALVE MANIFOLD
↑	VENT TO ATMOSPHERE
Y	FUNNEL
LT	LEVEL TRANSMITTER (ULTRASONIC TYPE)
LG	LEVEL GAUGE
M	STIRRER MOTOR
	STIRRER
A	ALARM
I	INTERLOCK

NTPC DRG. NO.	9915-371-110-PEM-PVM-W-513
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

DEPT CODE		NAME	SIGN	DATE
M	DRN	AR	Sd/–	04-10-21
	DESN	AR/RN	Sd/–	04-10-21
	CHD	NK	Sd/–	04-10-21
	APPD	SB	Sd/–	04-10-21

REV.	DATE	ALTD	CHD	APPD
00	09.06.20	GP	PKK	GB
01	14.07.20	RB	PKK	GB
02	14.08.20	RB	PKK	GB

TITLE
P&ID FOR NaOH DOSING SYSTEM

DEPT. SIGN | SCALE NTS | DRAWING NO. PE-DG-475-501-A001 | SHEET 1 1 OF | REV. 01

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING).	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME II-B	
	PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES	SECTION –C2	
		REV. NO. 00	DATE:

SECTION – C2
SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

	ELECTRICAL EQUIPMENT SPECIFICATION FOR CHEMICAL DOSING SYSTEM 2X660MW KHURJA STPP (TG AND ASSOCIATED PACKAGES)	SPECIFICATION NO.
		VOLUME NO. : **II-B**
		SECTION : **C**
		REV NO. : **00** DATE : 09.09.21
		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 equipments.

e) Electrical load requirement for CHEMICAL DOSING SYSTEM.

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

	TITLE: TECHNICAL SPECIFICATION **FOR CHEMICAL DOSING SYSTEM (NaOH DOSING).** **PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT** **(TURBINE GENERATOR AND ASSOCIATED PACKAGES)** .	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME II-B	
		SECTION –C3	
		REV. NO. 00	DATE:

SECTION – C3
SPECIFIC TECHNICAL REQUIREMENTS
(CONTROL AND INSTRUMENTATION)

OPERATION AND CONTROL PHILOSOPHY:

The mode of operation of NaOH dosing system shall be **manual.**

All controls, fault indicators/alarms, interlocks, logics shall be implemented in DDCMIS only.
The ON/OFF operation of all motorized stirrers shall also be provided in DDCMIS with local ON/OFF.

All the field instruments shall be terminated at junction box.

A local panel comprising of 'START' push button, 'STOP' push button along with 'ON/OFF/TRIP' indication, local/ remote indication and local annunciation shall be provided for local operation. The Local/ Remote selection switch (soft) shall be provided in DDCMIS and its indication shall be provided in LCP. LCP shall be located on the dosing skid.

Following interlocks shall be provided at low-low Level in the mixing cum storage tank.
i) Stirrer motor of the respective tank shall be tripped.

Following conditions to be ensured before starting a stirrer
ii Level in the tank adequate.
iii MCC not disturbed.

The following signals/status shall be shown on local panel.
• Stirrer -ON.
• Stirrer - OFF.
• Stirrer - Tripped.

Following shall also be provided on LCP:
i) ON/ OFF/ Fault- Lamp Indications for agitator drive
ii) Operation 'Local selected' / operation 'Remote selected'- Lamp Indication
iii) Agitator-Start/ Stop
iv) Local LED based annunciation driven by DDCMIS.

Following fault indications with alarm annunciations shall be provided on LCP & in DDCMIS:
i) Low level in the solution preparation cum metering tank.
ii) Low-low level in the solution preparation cum metering tank.
iii) High level in the solution preparation cum metering tank.
iv) Stirrer motor tripped.
v) Stirrer motor tripped due to low-low level in solution preparation tanks.

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SPECIFIC TECHNICAL REQUIREMENTS
(NAOH DOSING SYSTEM)

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FOR NaOH DOSING SYSTEM	

Specific Technical Requirements (C&I):

1.0 NaOH Dosing system shall be operated from DCS (DCS-BHEL Scope of supply) through operator work stations.

2.0 Bidder to provide local control panel(LCP) for NaOH dosing system. This LCP will act as interface between the DCS and the field devices for commands & feedbacks.
In addition, LCP shall have the provision of command (start/stop) & feedback interface with plant DCS

3.0 Bidder to supply all the instruments (LT,LG,PT,DPT,DPG,PG etc.) required for the package along with necessary fittings, accessories and valve manifold etc. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

4.0 All the Electronic Transmitter for Pressure, Differential Pressure and DP based Flow /Level measurements shall be genuine, verifiable PROFIBUS PA compatible instruments. The transmitters shall be connected to DDCMIS through PROFIBUS PA protocol complying to IEC 61158 directly from transmitter. This is subject to customer approval and BHEL decision shall be final.

5.0 ON OFF and INCHING type actuators (Non-intrusive type) shall be Profibus-DP compatible with Open/Close command termination logic suitably built inside the actuator.

6.0 The PROFIBUS design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by bidder without any implications.

7.0 All transmitters shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) In Local Instrument Racks (LIRs) in case of covered areas. The junction boxes/LIEs/LIRs for termination of instruments are in bidder's scope. SS Junction boxes specially designed for PROFIBUS application shall be provided on as required basis. These SS JBs shall house field mounted PROFIBUS components. These SS JBs shall have suitable cover and gasket and shall have protection class of IP-66 or better. SS Cable glands and blind plugs shall be provided by the bidder.

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FOR NaOH DOSING SYSTEM	

8.0 Complete C&I system for NaOH dosing System is in bidder's scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder without any commercial implication.

9.0 The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire Chemical dosing 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.

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

11.0 415 V/230 V AC Power supply shall be provided by BHEL at a single point (Please refer the Electrical Specification for more detail), further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board, changeover circuit in his scope. Any power supply other than the above , UPS power etc., 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.

12.0 Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24 V D.C. only.

13.0 The make of the items shall be from sub-vendor list .However the make/model of various instruments/items/systems shall be subject to 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.

14.0 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.

15.0 The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.

16.0 Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. All cable interconnection details for complete system shall be in Bidders' scope.

17.0 Instrument installation and accessories required for the same shall be in Bidder's scope and shall be subject to customer/BHEL's approval during detailed engineering.

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

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

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

21.0 To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.

22.0 Redundancy of sensors shall be provided by bidder

(i) Triple redundancy for all analog and binary inputs required for protection of system/drives.

(ii) For all other control functions dual redundancy of the sensors shall be provided by the bidders.

23.0 The design of the control systems and related equipment shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant

equipment is involved and shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided/ minimized.

24.0 All panels, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).

25.0 Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.

26.0 The requirements given are to be read in conjunction with detailed Technical specification enclosed.

27.0 The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a “No deviation” certificate is to be furnished.

28.0 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange (SS316 material), nuts & bolts etc. shall also be included, wherever required with the field instruments.

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

30.0 All the wetted parts of the instruments including the accessories like root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments as well as valves shall be of SS-316 material, suitable pressure class and same shall be in bidder’s scope .

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

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

33.0 Double root valve shall be provided for all pressure tapings where the design pressure exceeds 40kg/cm2.

34.0 All the instruments PG/DPG/DPT/PT etc. as applicable shall have chemical/diaphragm seal.

35.0 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/ 5CX2.5sqmm2/ 12CX1.5sqmm2

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

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

38.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: List of Drawings/Documents and data to be furnished by bidder after award of the contract are mentioned under section" List Of Documents/Deliverables".

- GA & wiring diagram of local panel.
- Power requirement.
- Local control panel & instruments data sheet.
- Instrument schedule
- Alarm Schedule
- Any other document decided during detailed engineering.

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FOR NaOH DOSING SYSTEM	

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.

SECTION – D1
GENERAL TECHNICAL REQUIREMENTS (MECHANICAL)

VOID

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING).	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME II-B	
	PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES	SECTION –D2	
		REV. NO. 00	DATE:

SECTION – D2
GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)

REV : 0 DATE : 11.03.2015

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

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

REV : 0 DATE : 11.03.2015

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

PACKAGE : CHEMICAL DOSING SYSTEM
SCOPE OF VENDOR: SUPPLY
PROJECT: 2X660 MW KHURJA STPP-TG

9	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor*	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
10	Below grade grounding	BHEL	BHEL	
11	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
12	Electrical Equipment GA drawing & skid GA drawing	Vendor	-	For necessary interface review.

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

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

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	CHEMICAL DOSING SYSTEM	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

541900/2021/PS-PEM-MAX

CABLE SCHEDULE FORMAT

ANNEXURE III

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

541900/2021/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

TITLE		SPECIFICATION NO.
	LV MOTORS **DATA SHEET-A**	VOLUME II B
		SECTION D
	2X660 MW KHURJA STPP-TG	REV NO. 00 DATE 09.09.2021
		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
10		SIEMENS
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					
			SEAL	REV.	
NAME	SIGNATURE	DATE			

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

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.

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**

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
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
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		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

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

LEGENDS:

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

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BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

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

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

BHEL					
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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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Approved by:			

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					
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Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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Sign & Date	
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 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 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
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	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	-	-	

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

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
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	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		
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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	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.

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.

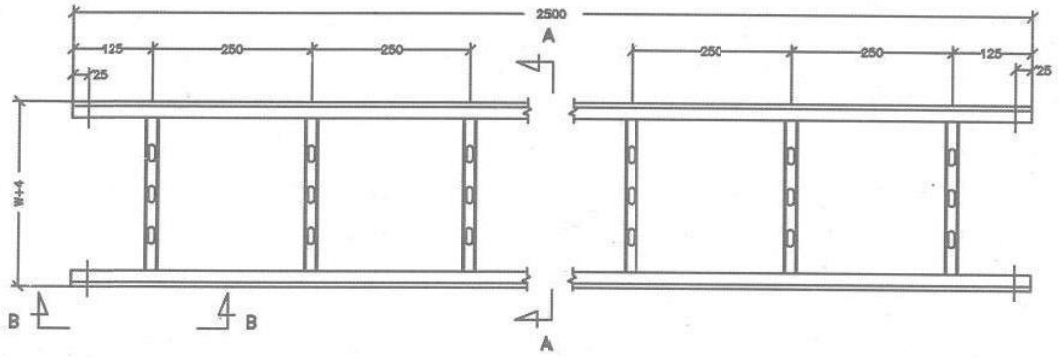
5. Cable trench/Cable vault

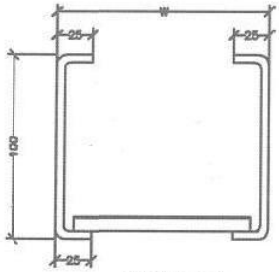
For LT switchgear/MCC room at EL 0.0M, minimum 1400 wide x 1400 deep cable trench shall be provided to route the cables. Horizontal cable trays shall be routed in cable trenches.

c) Minimum clear working space 1200mm around the equipment

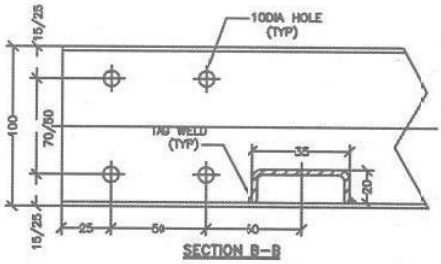
e) In buildings having MCC, minimum 2 fire door along with one rolling shutter of adequate size/capacity shall be provided.

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

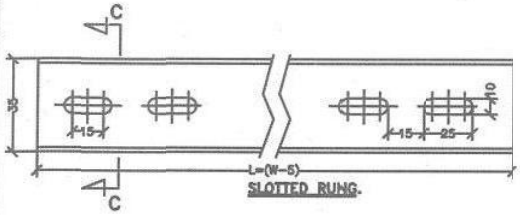




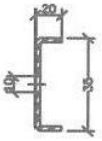
SECTION A-A



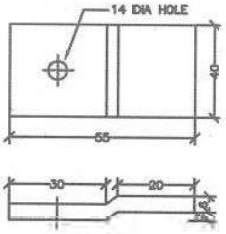
SECTION B-B



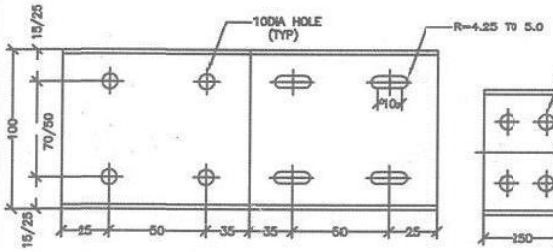
SLOTTED RUNG.



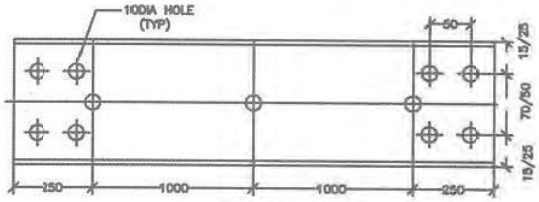
SECTION C-C



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 TRAY.
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	M3	M3	Pul	–	W	–	–	–	dd	05.07.21
RC	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RB	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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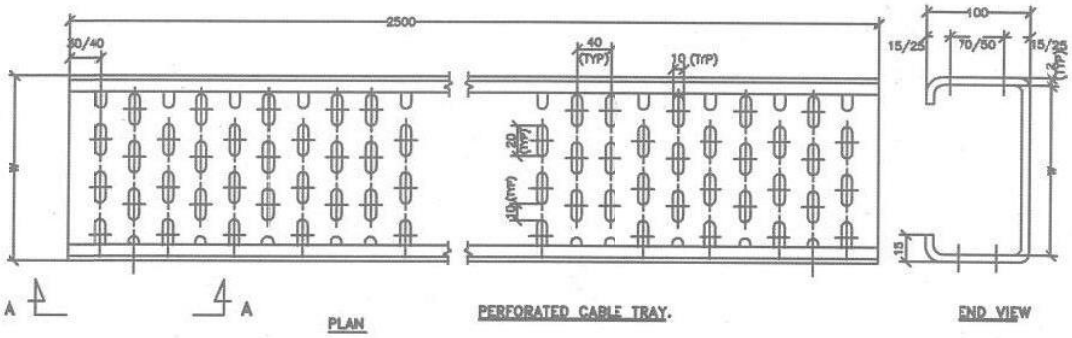
ENGINEERING DIVISION

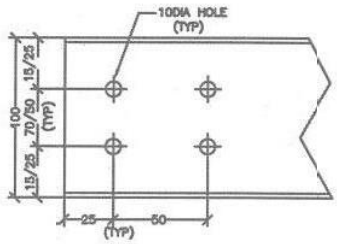
PROJECT: STANDARD

TITLE: LADDER TYPE CABLE TRAY.

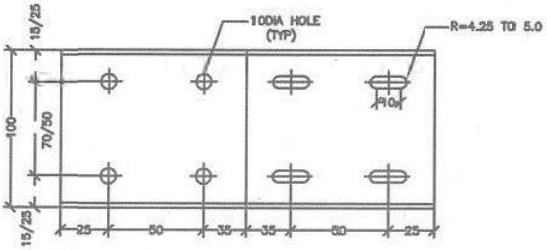
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-001	RD

541905/2021/PS-PEM-MAX





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	MB	MB	RH	-	VV	-	-	-		05.02.10
RC	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	

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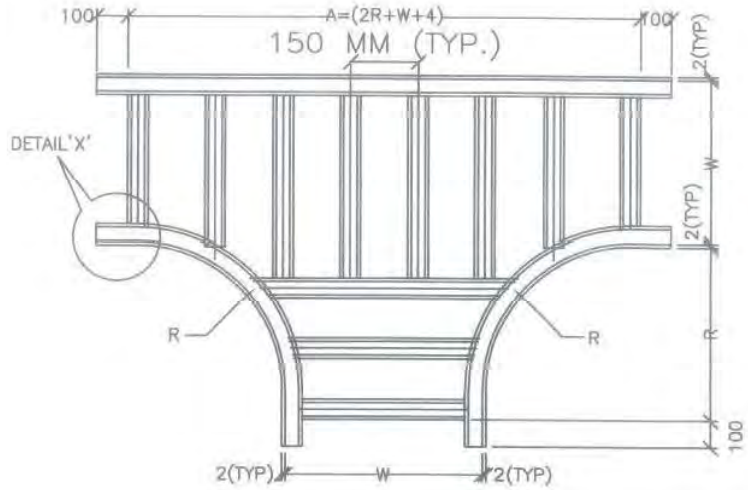
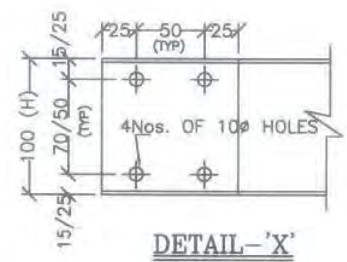
PROJECT	STANDARD		
TITLE	PERFORATED TYPE CABLE TRAY.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-002	REV. NO. RD

541905/2021/PS-PEM-MAX



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
RD	FOR TENDER PURPOSE	VC	VC	RW		VV				[illegible]	15.06.12
RC	FOR TENDER PURPOSE	AB	AB	RKP	–	VV	–	–	–	DT	5.07.2010
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	25.07.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2005

CLEARED BY

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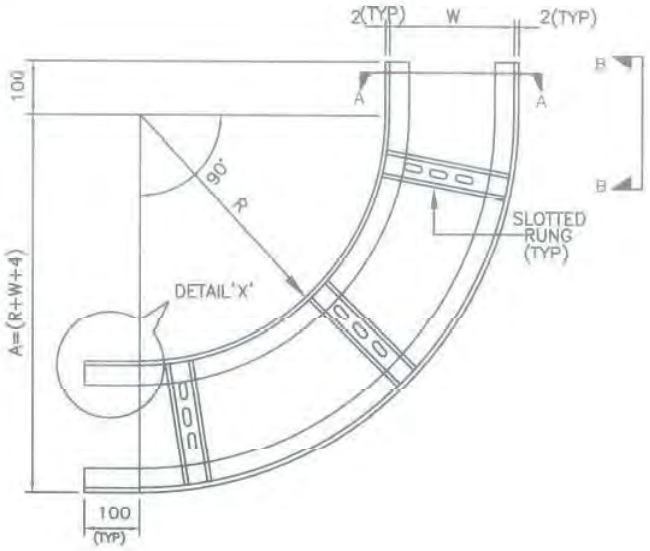
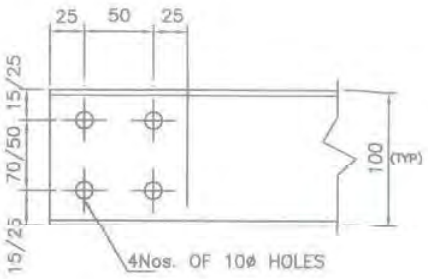
PROJECT: STANDARD

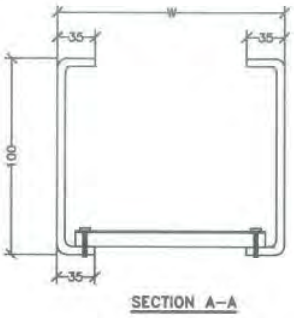
TITLE: CABLE TRAY DETAILS HORIZONTAL TEE

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-004	RD

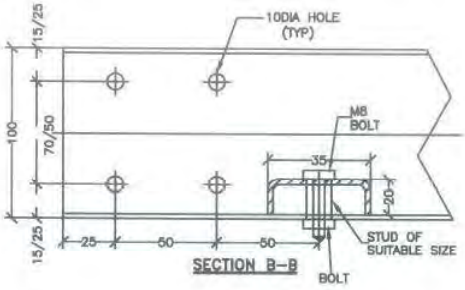




DETAIL–X



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		NJ					
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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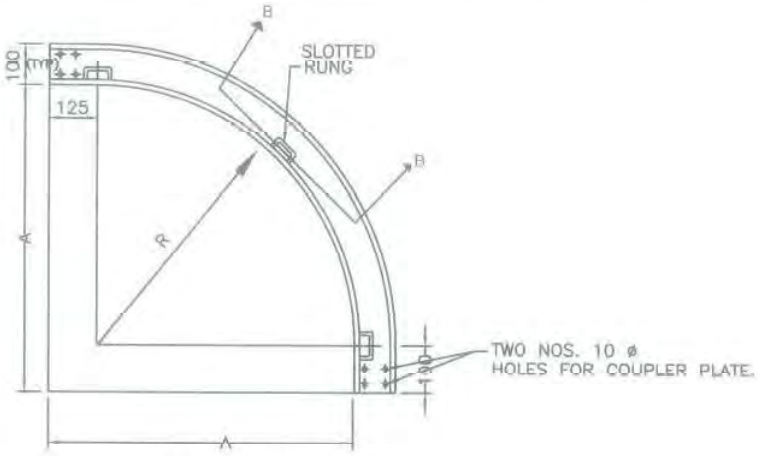
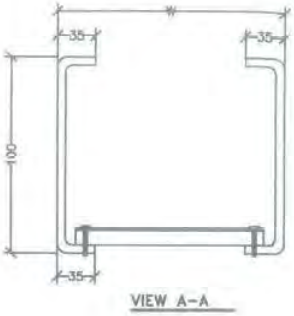
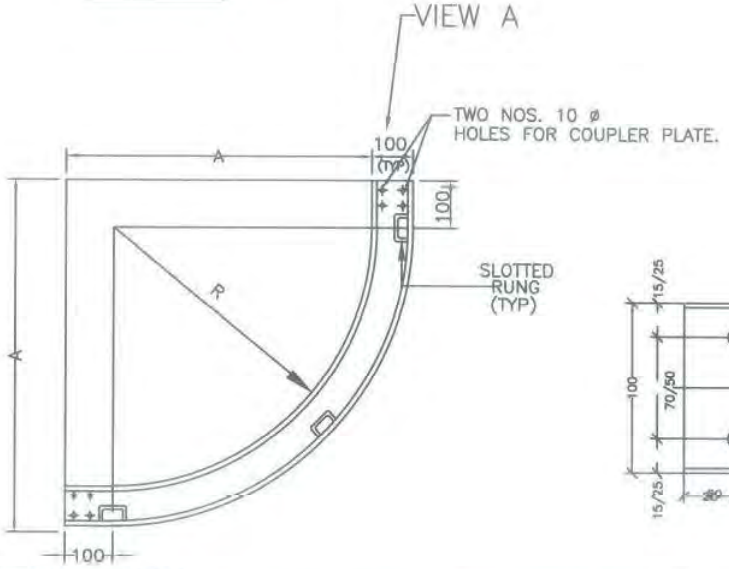
PROJECT	STANDARD		
TITLE	CABLE TRAY 90ø BENDS (CTB 90ø)		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-005	REV. NO. R0



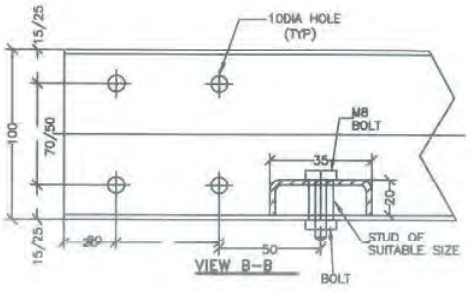
ELEVATION
90° VERTICAL ELBOW
(UPSIDE)



VIEW A-A



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	JC	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	-	-	-	-	-	-	-	-	-	

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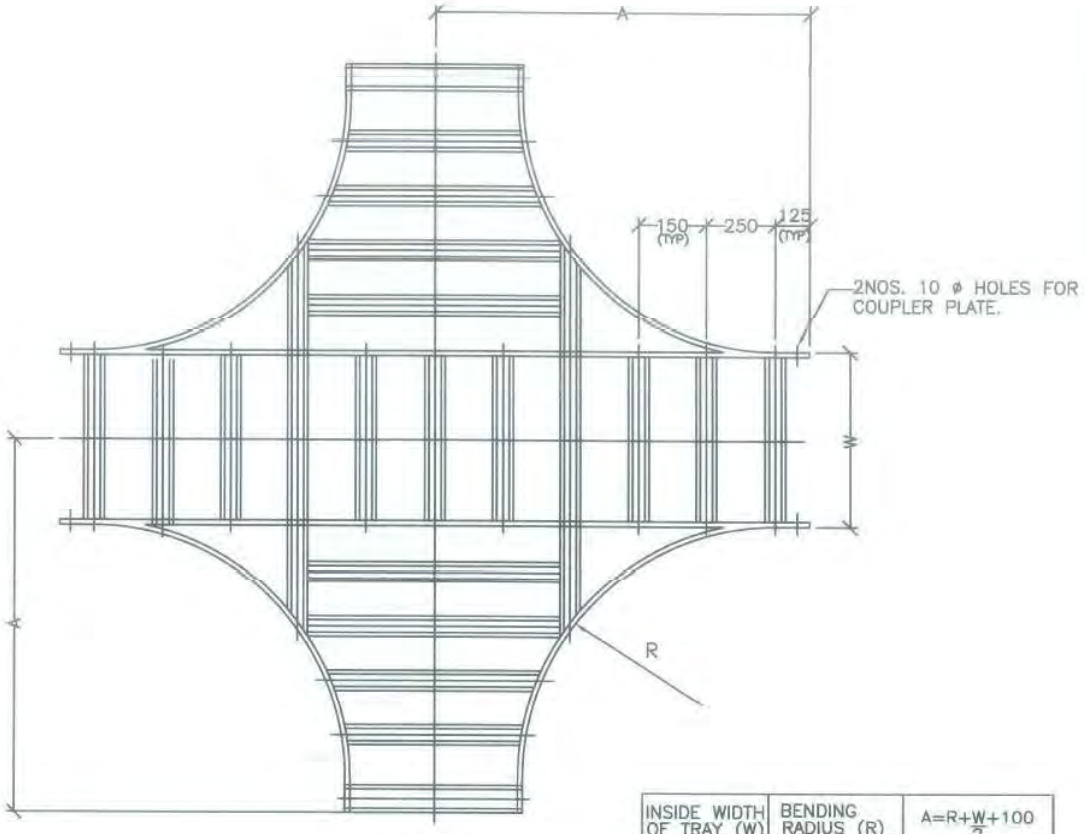
PROJECT: STANDARD

TITLE: CABLE TRAY 90° VERTICAL ELBOW (OUTSIDE)
90° VERTICAL ELBOW (INSIDE)

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-006	RD



PLAN

INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	$A=R+\frac{W}{2}+100$
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	VC		VV				DT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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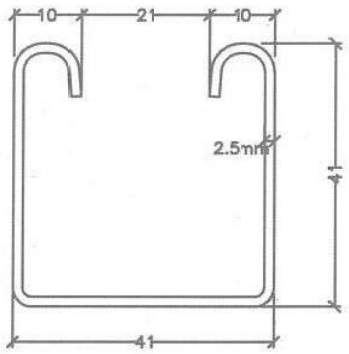
PROJECT: STANDARD

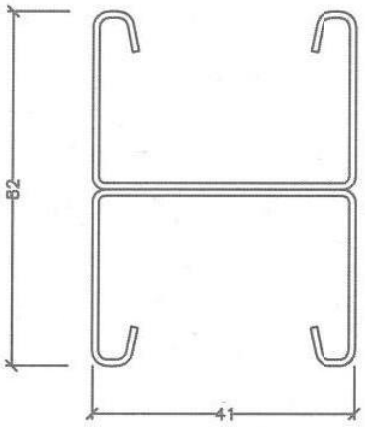
TITLE: CABLE TRAY DETAILS CROSS

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

541905/2021/PS-PEM-MAX



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&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	MB	MB	DKR	–	VV	–	–	–	AS	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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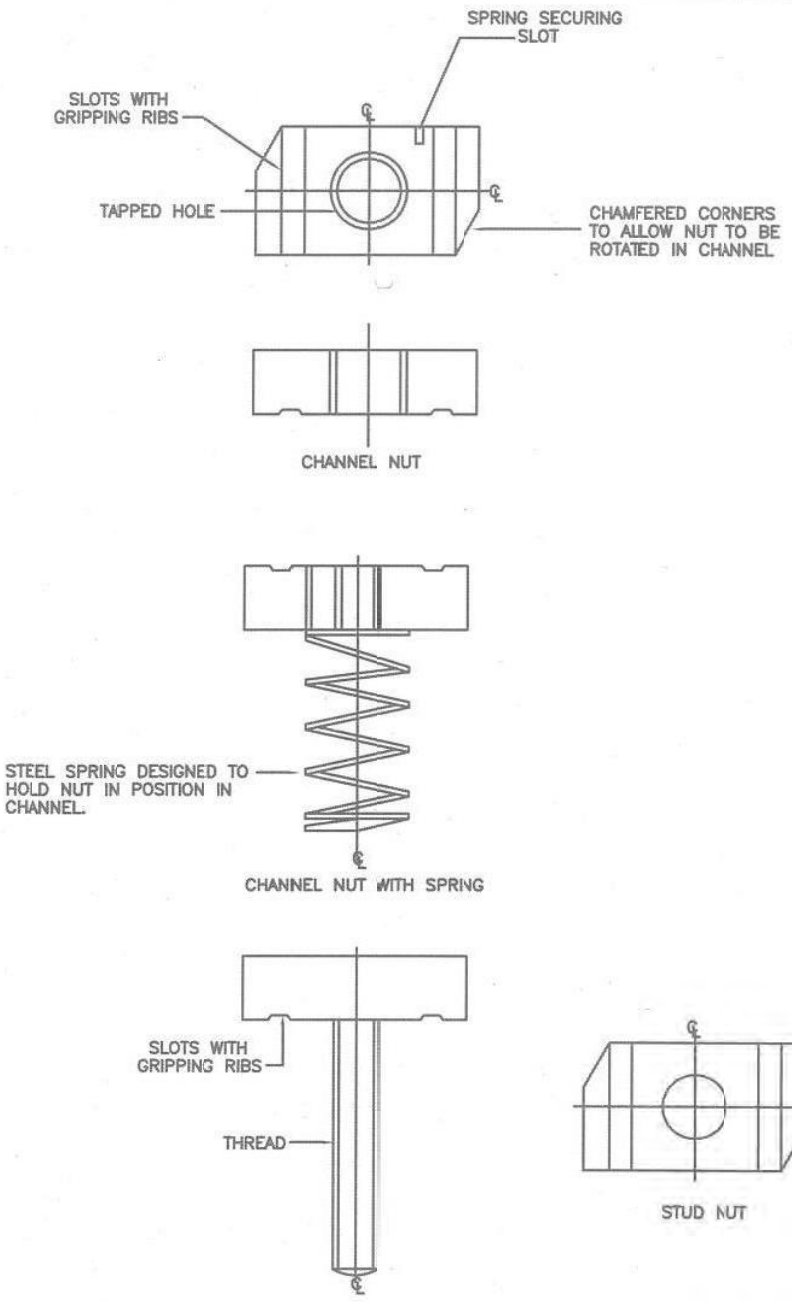
PROJECT	STANDARD		
TITLE	C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-013	REV. NO. RC

541905/2021/PS-PEM-MAX



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				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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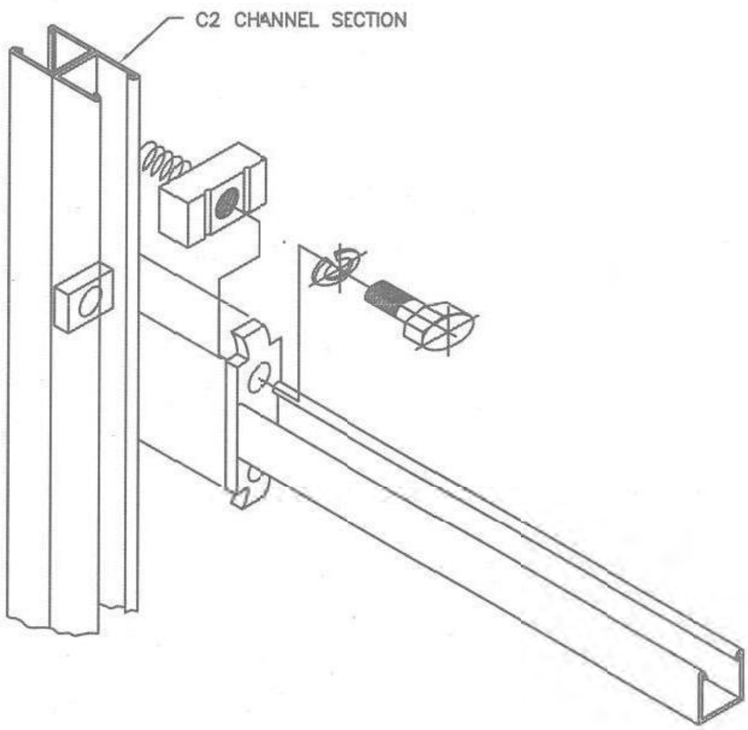
PROJECT	STANDARD		
TITLE	TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-014	REV. NO. RC

TRAY1A-211-014



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	[illegible]	[illegible]	[illegible]	—	VV	—	—	—	[illegible]	[illegible]
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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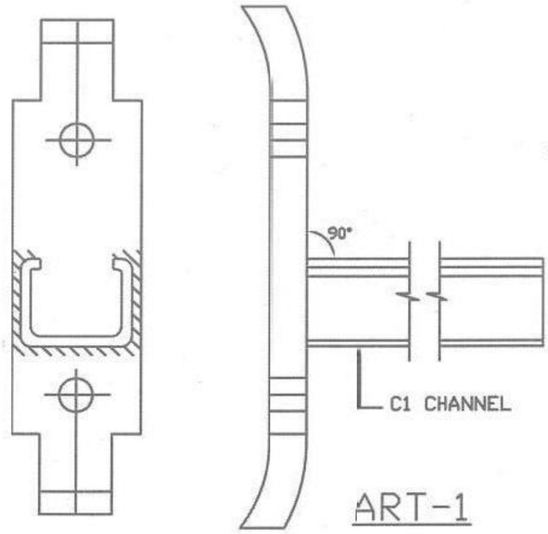
ENGINEERING DIVISION

PROJECT: STANDARD

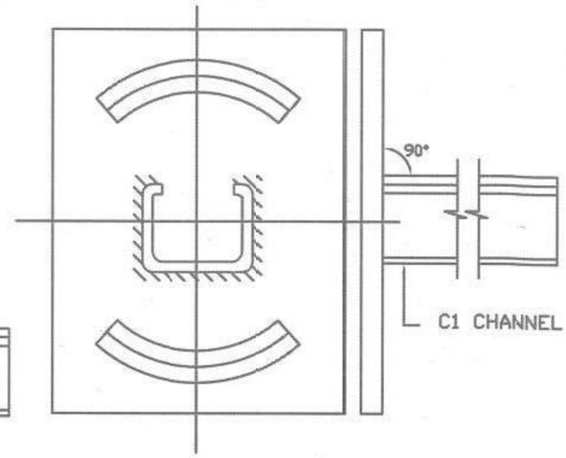
TITLE: TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM

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

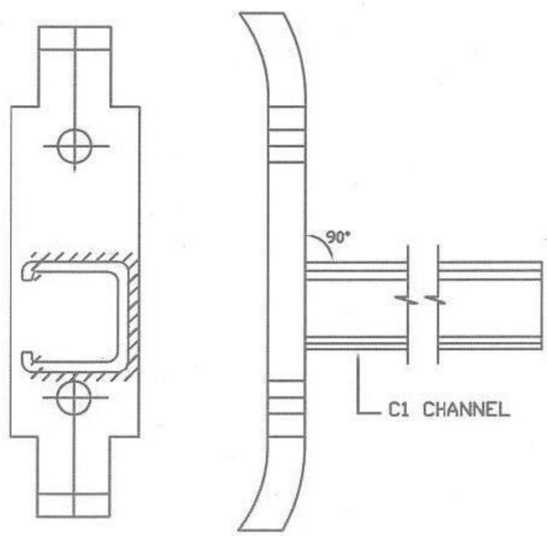
541905/2021/PS-PEM-MAX



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&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05-03-20
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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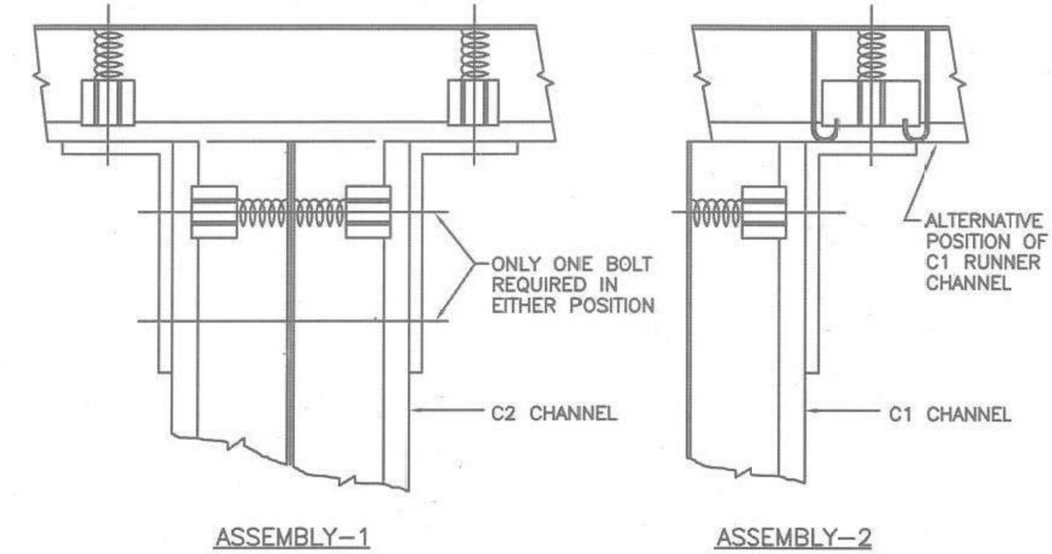
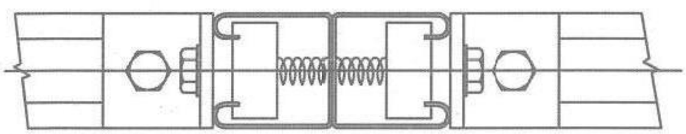
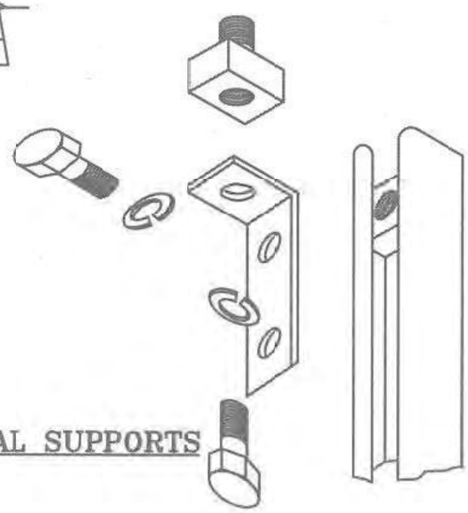
PROJECT: STANDARD

TITLE: CANTILEVER ARMS

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







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
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.09.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]
					CLEARED BY						

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NTPC LTD.
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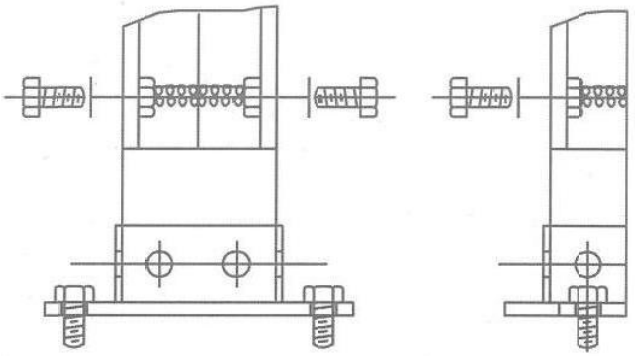
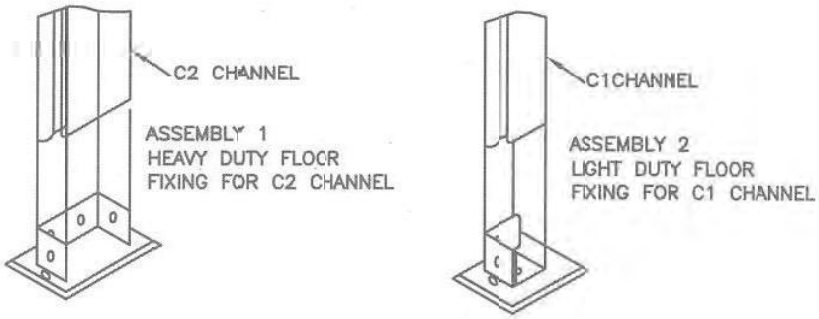
ENGINEERING DIVISION

PROJECT	STANDARD
TITLE	TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

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

541905/2021/PS-PEM-MAX





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	–	–	–	–	–	–	–	–	–	

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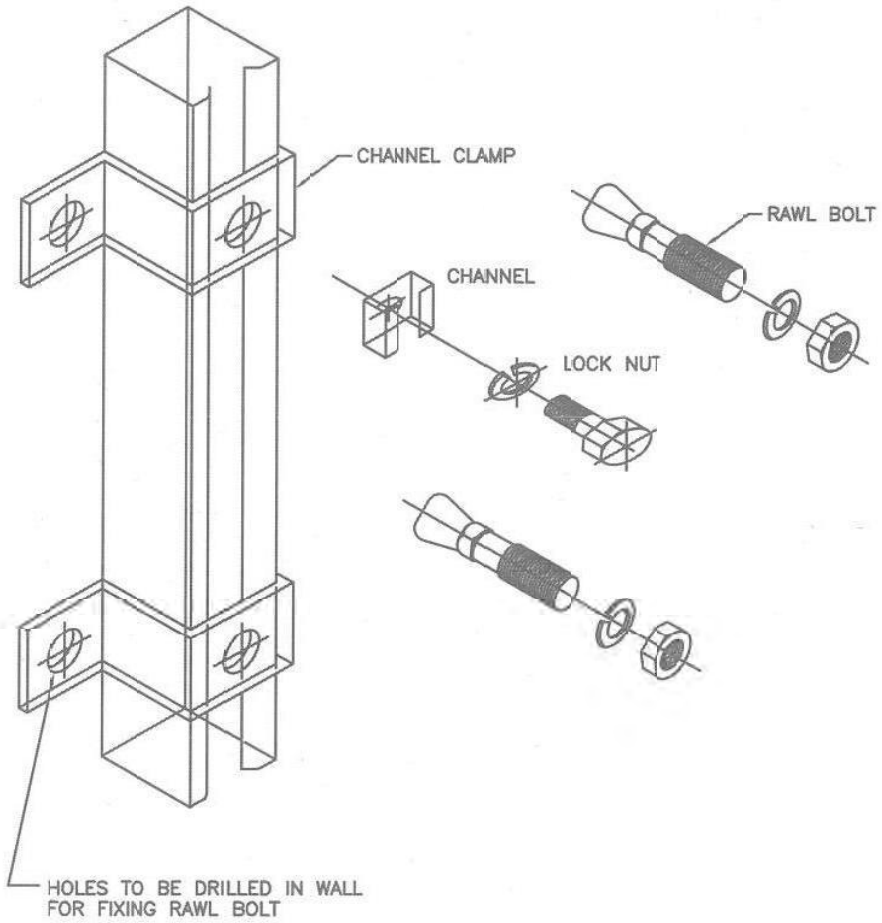
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-018	RC

541905/2021/PS-PEM-MAX



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]	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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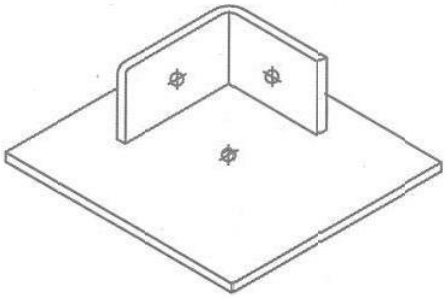
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

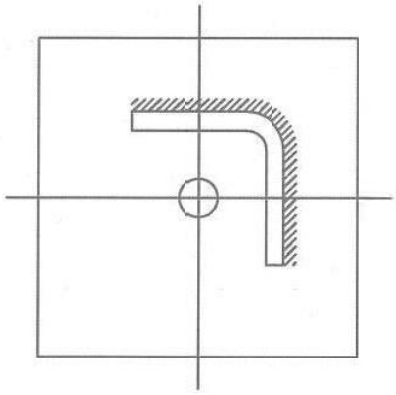
PROJECT: STANDARD

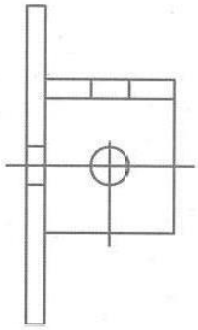
TITLE: FIXING OF CHANNEL IN TRENCH WALL

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

541905/2021/PS-PEM-MAX







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]	05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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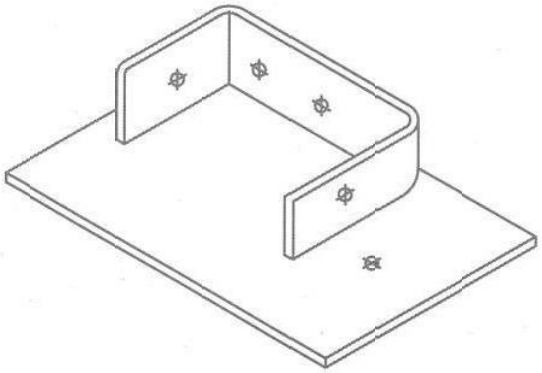
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

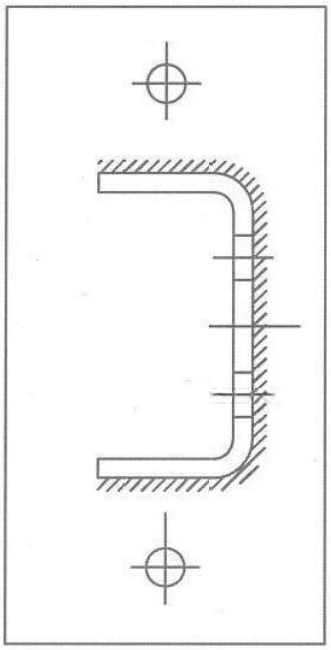
PROJECT: STANDARD

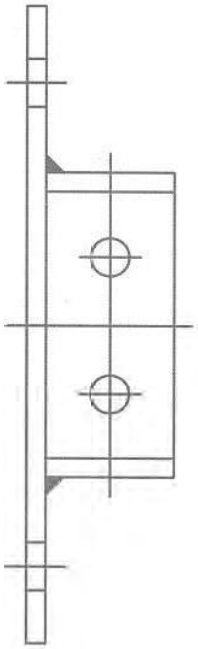
TITLE: BRACKET FLOOR PLATE LIGHT DUTY.

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

541905/2021/PS-PEM-MAX







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]	05.07.10
RB	FOR TENDER PURPOSE	DL DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	– –	–	–	–	–	–	–	–	[illegible]

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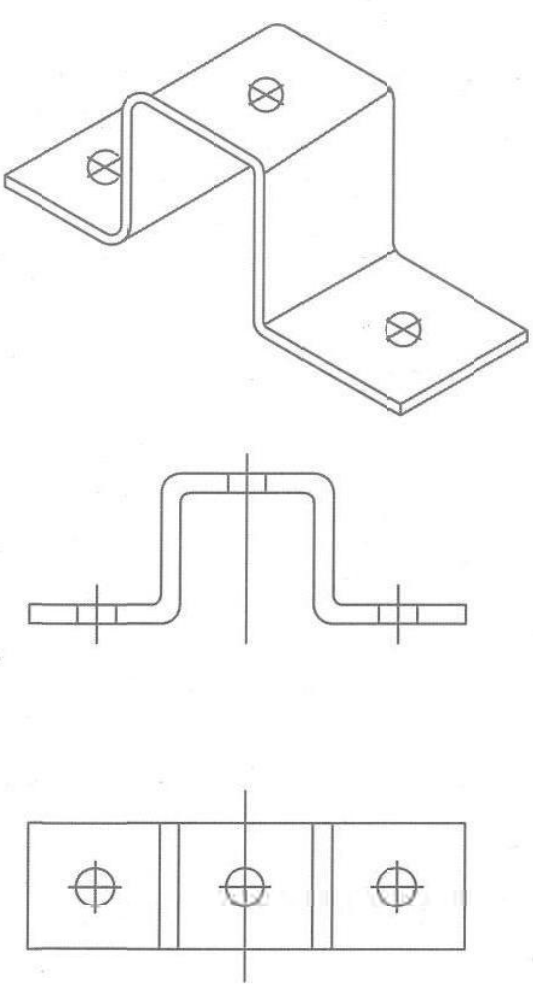
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

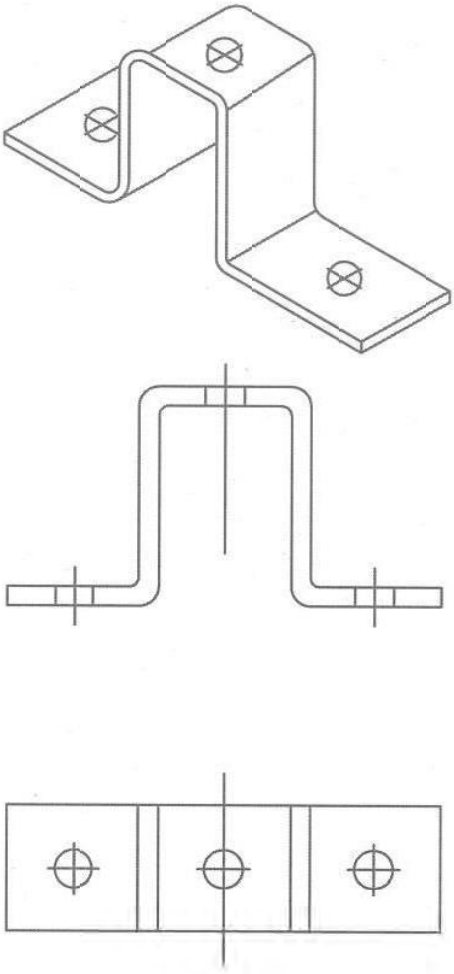
TITLE: BRACKET FLOOR PLATE HEAVY DUTY.

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

541905/2021/PS-PEM-MAX



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	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.10.21
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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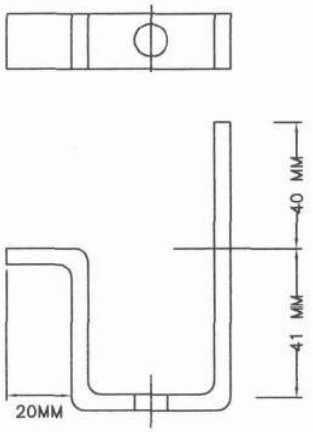
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

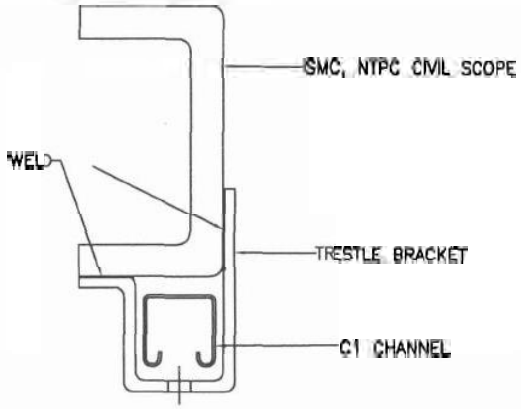
PROJECT: STANDARD

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	08.10.2018
					CLEARED BY						

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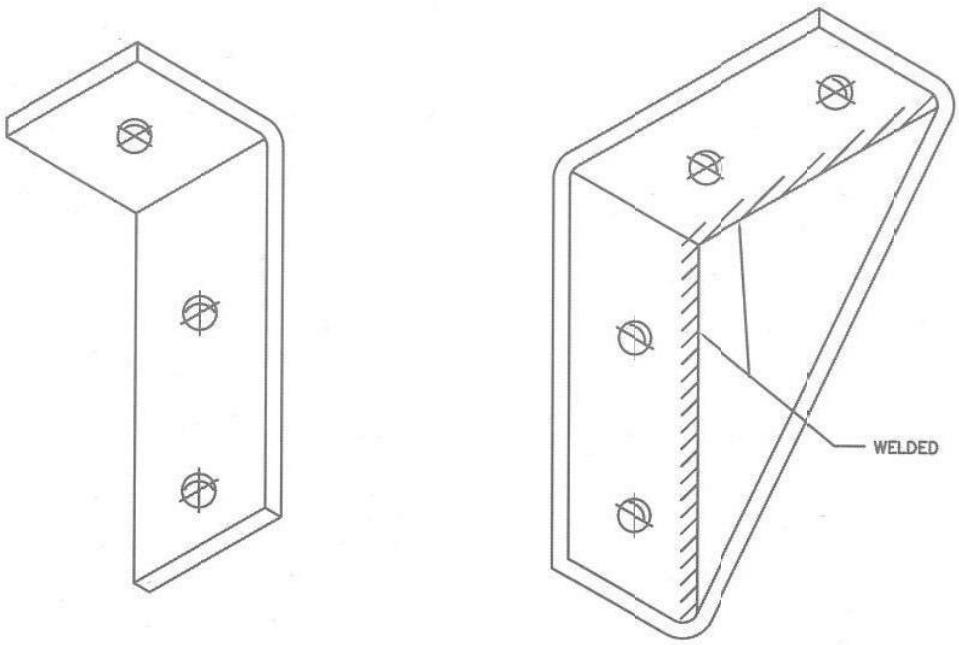
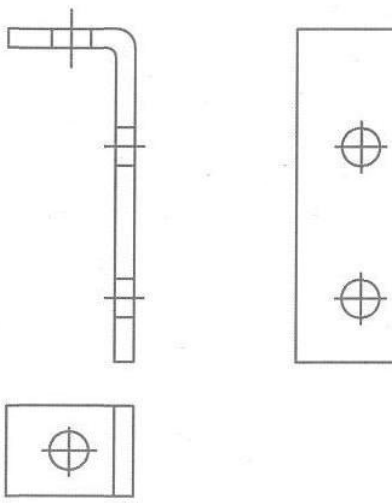
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
(FORMERLY NATIONAL THERMAL POWER CORPORATION LTD.)
ENGINEERING DIVISION

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

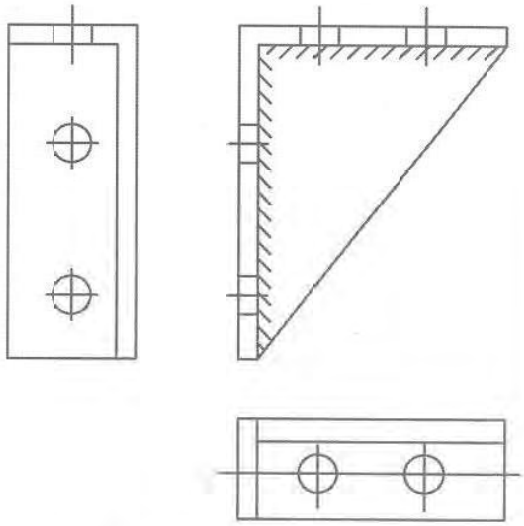
TRAY1A-211-022A

541905/2021/PS-PEM-MAX





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&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	M3	M3	PVA	–	W	–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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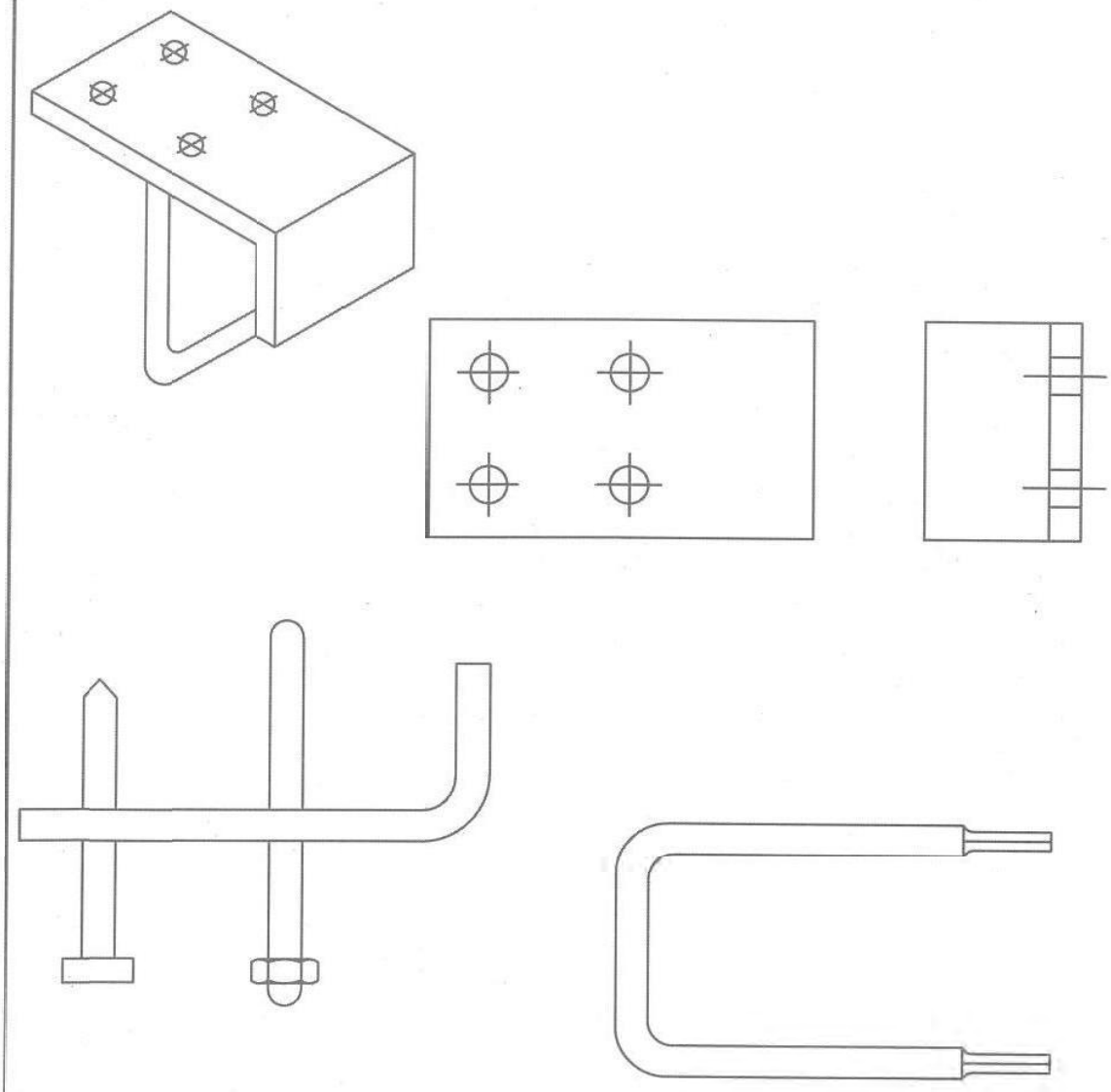
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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

541905/2021/PS-PEM-MAX



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				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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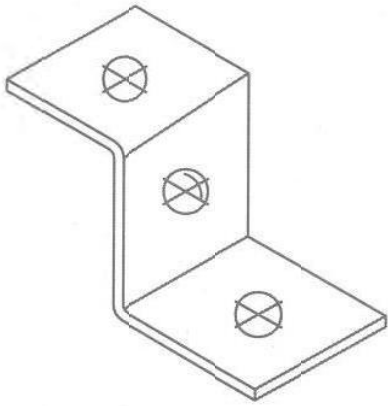
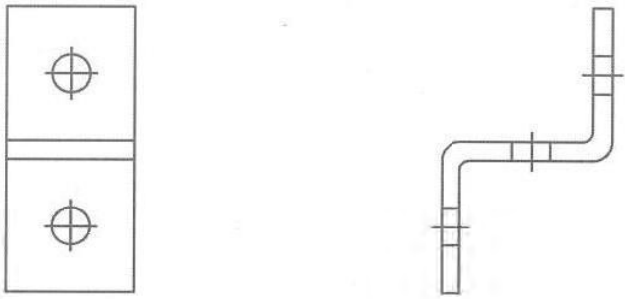
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BEAM CLAMP.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-024	RC





BRACKET–C1 CHANNEL CLAMP.

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	MB	MB	PM	–	VV	–	–	–		05/07/10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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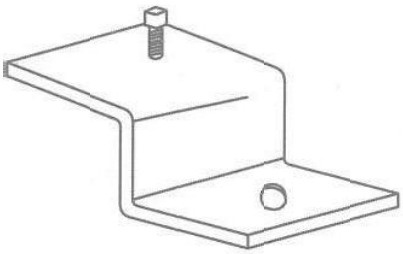
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

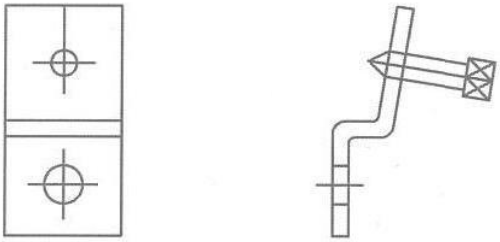
PROJECT: STANDARD

TITLE: BRACKET C1 CHANNEL CLAMP.

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

541905/2021/PS-PEM-MAX





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				–		–	–	–		05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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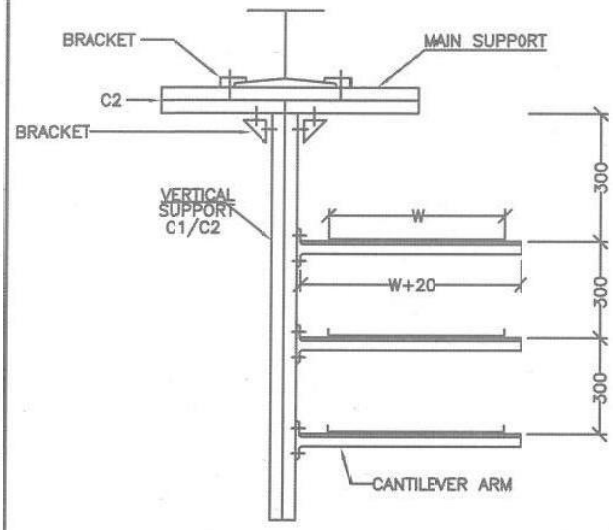
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET BEAM CLAMP

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

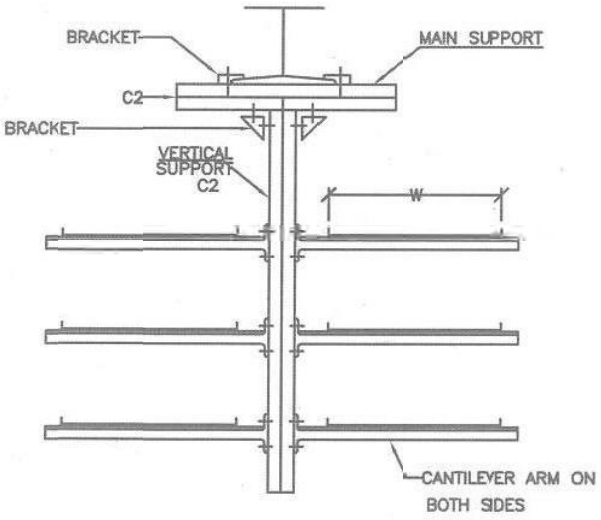
541905/2021/PS-PEM-MAX



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]

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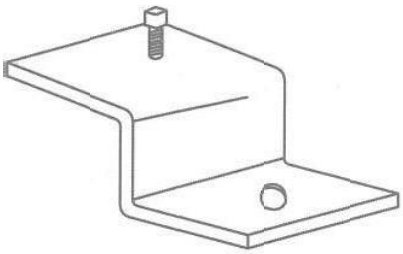
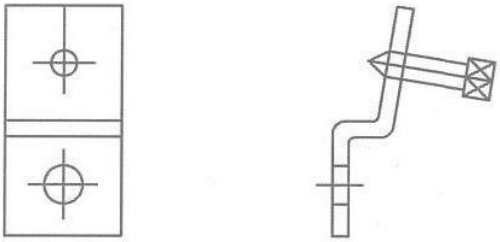
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. C000-211-PDE-A-030	REV. NO. RC

541905/2021/PS-PEM-MAX





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				–		–	–	–		05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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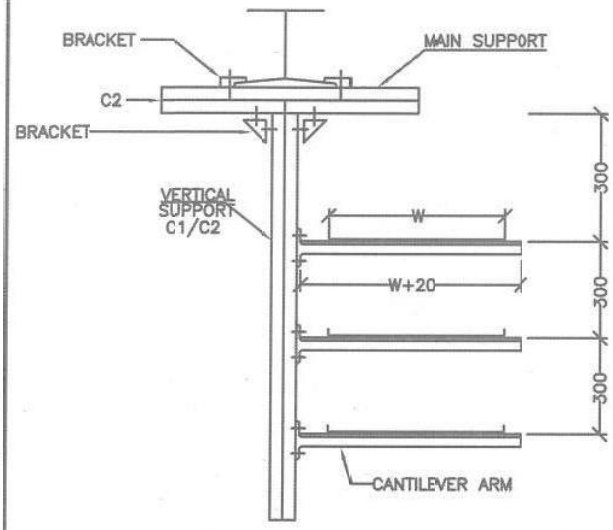
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET BEAM CLAMP

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

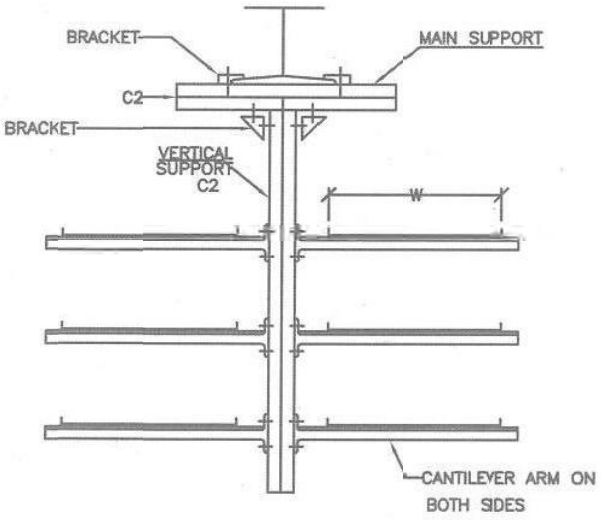
541905/2021/PS-PEM-MAX



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

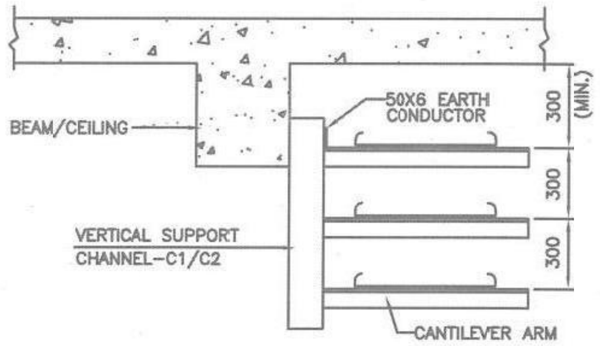
ARRANGEMENT TYPE–B2

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

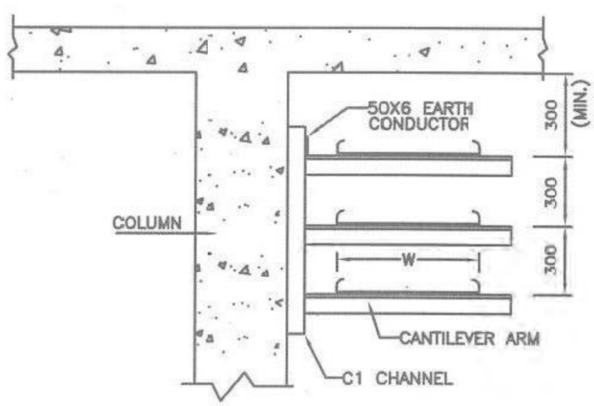
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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



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&I	ARCH	APPD	DATE
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]

CLEARED BY (M, E, C, C&I, ARCH)

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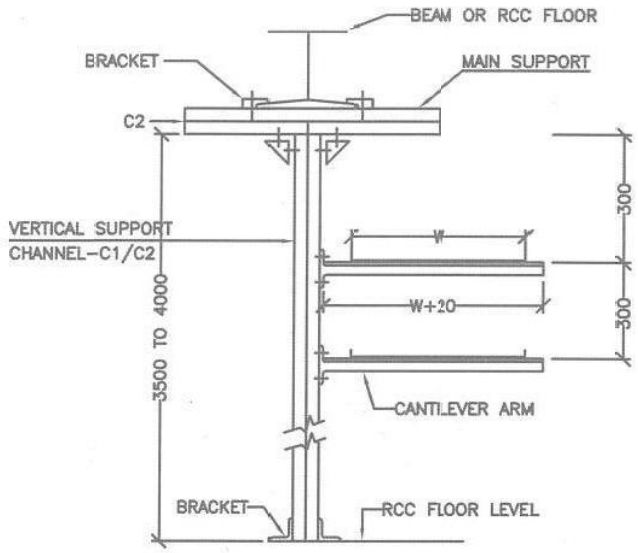
ENGINEERING DIVISION

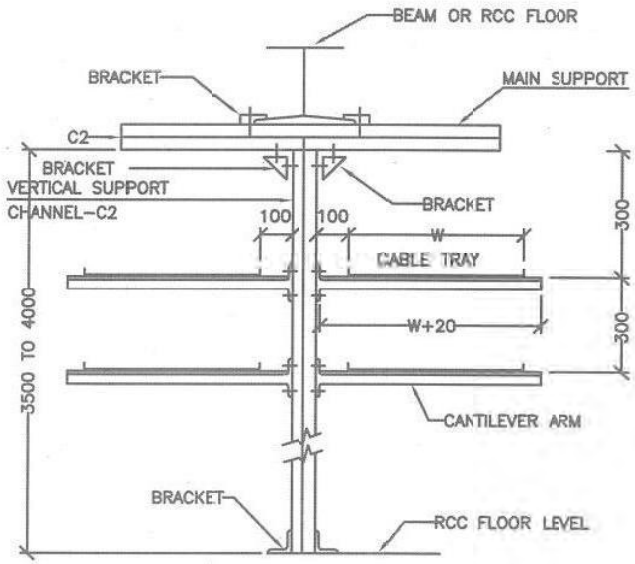
PROJECT	STANDARD
TITLE	STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-031	RC



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				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	15.07.2010
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.06.2010

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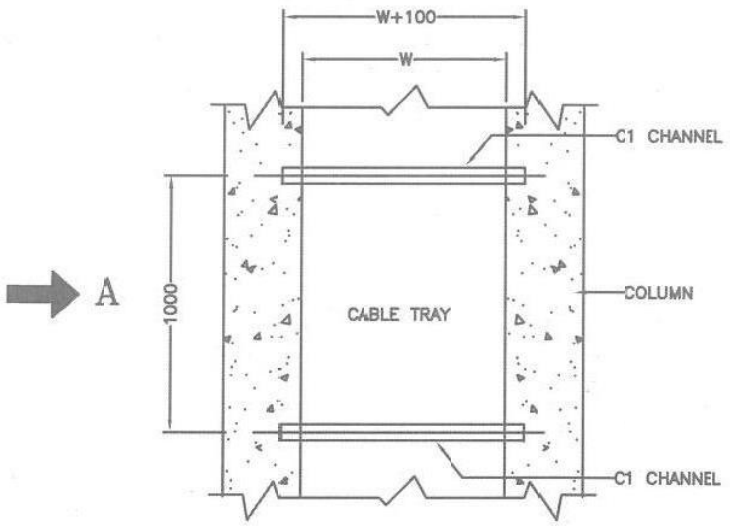
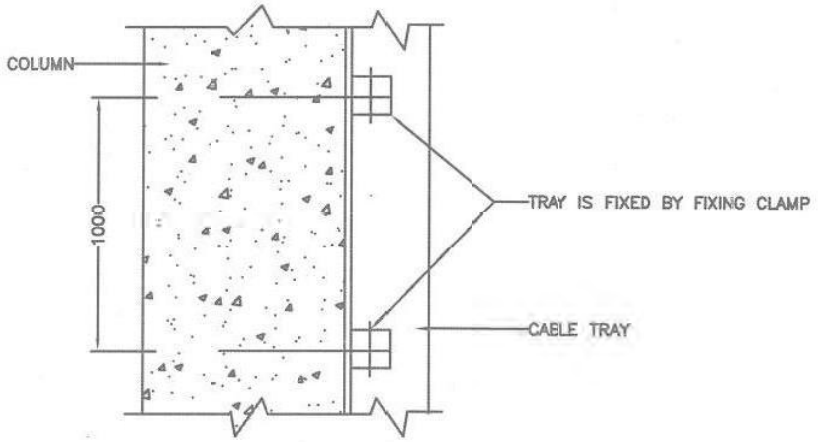
PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-032	REV. NO. RC



(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	M3	M3	[illegible]	—	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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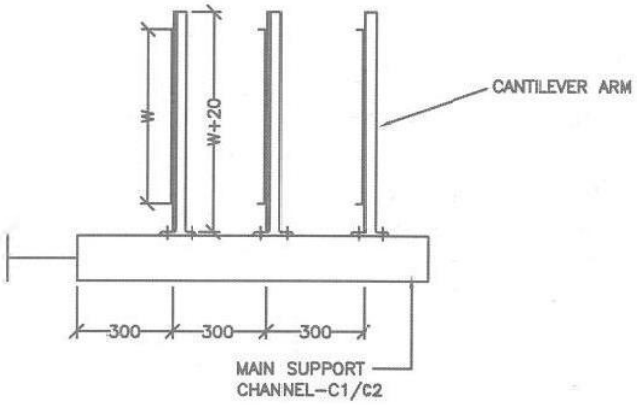
PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-033	REV. NO. RC

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	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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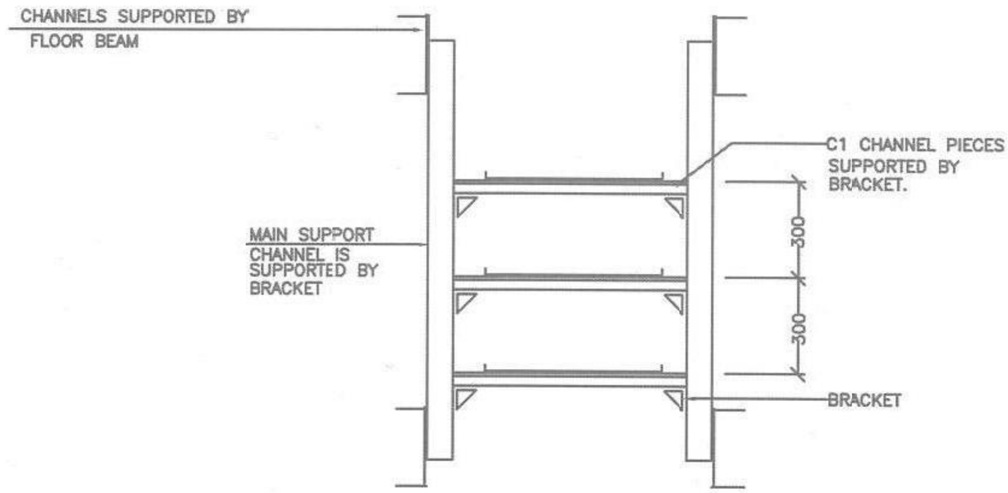
ENGINEERING DIVISION

PROJECT: STANDARD

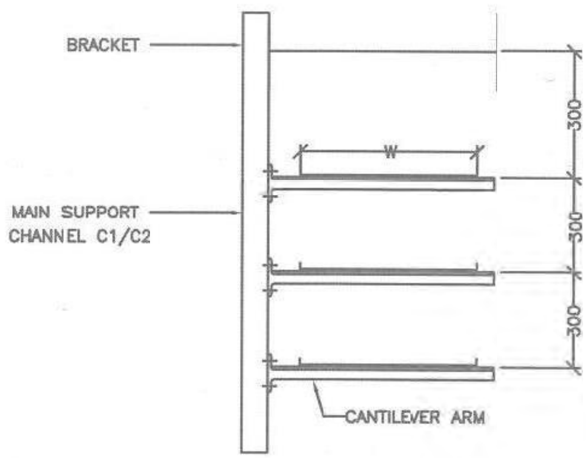
TITLE: STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-034	RC



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
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]
					CLEARED BY						

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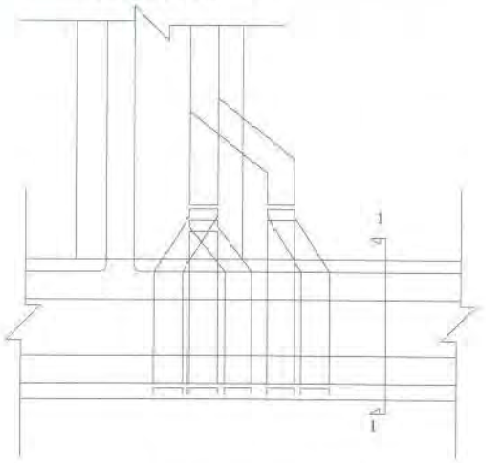
ENGINEERING DIVISION

PROJECT: STANDARD

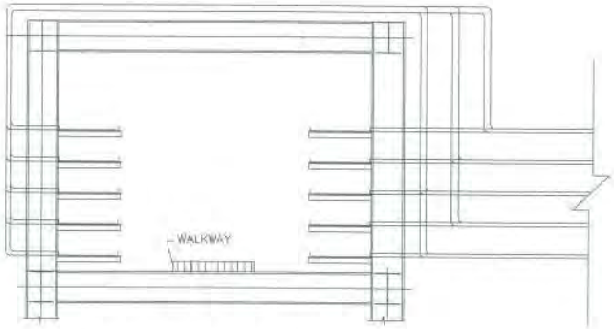
TITLE: STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-035	RC

TRESTLE–1



TRESTLE–2



SECTION 1–1

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
RA.	FOR TENDER PURPOSE										
					CLEARED BY						

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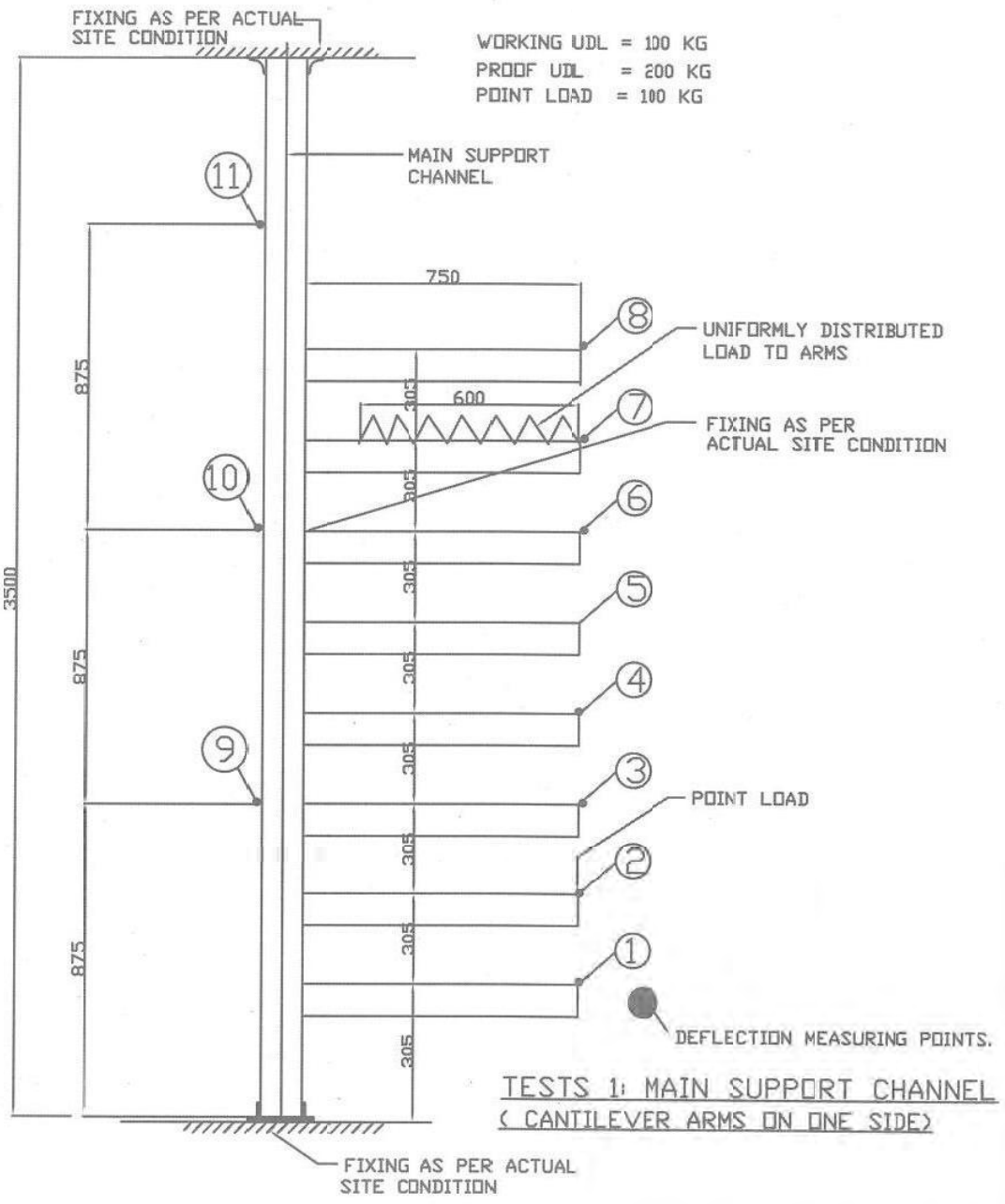
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: TYPICAL INTERCONNECTION DETAILS BETWEEN TWO PERPENDICULAR TRESTLES

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-035A	RA

541905/2021/PS-PEM-MAX



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&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	–	–	–	–	–	–	–	–	–

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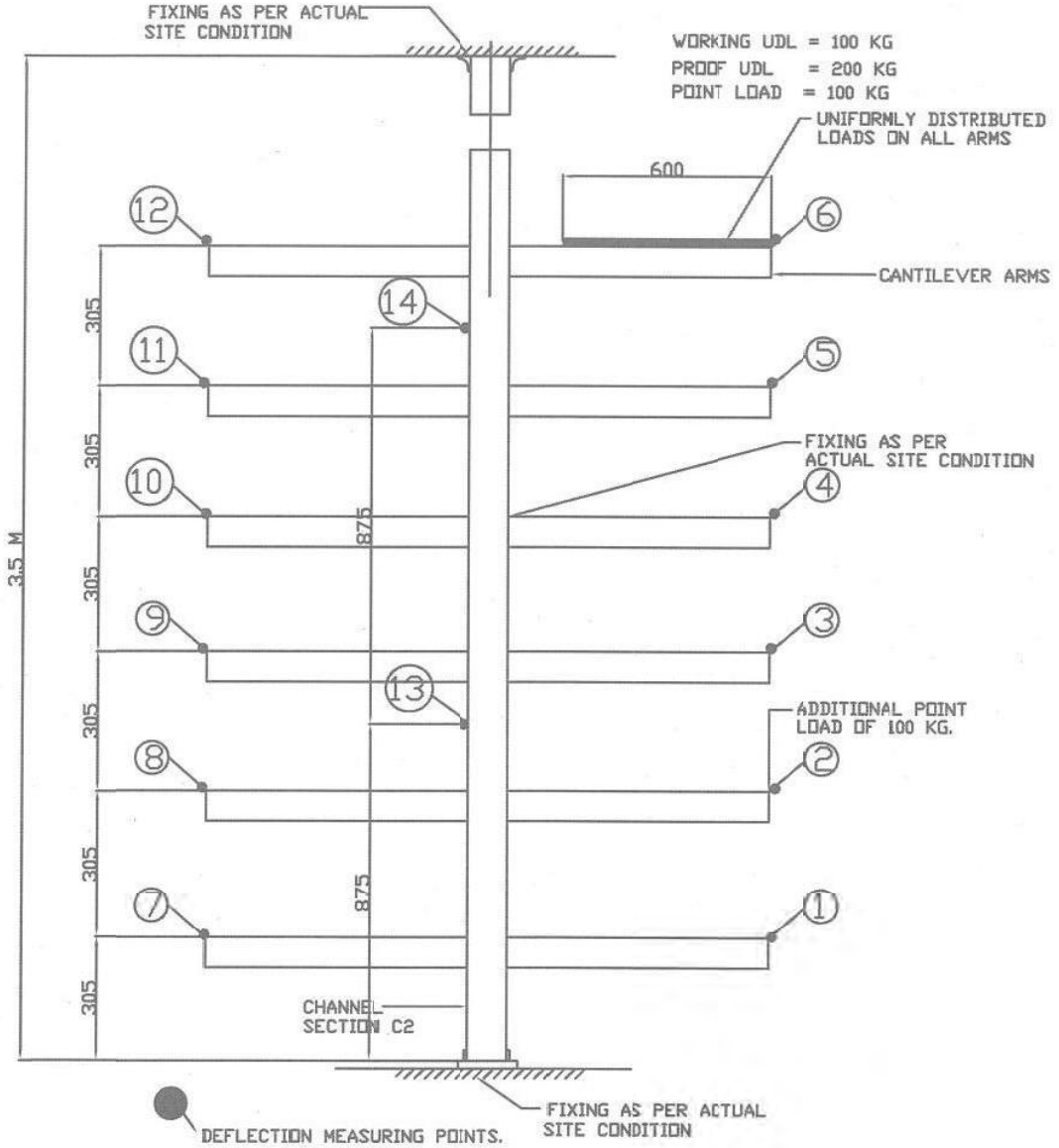
PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF STRUCTURE FOR TESTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-P0E-A-036	RC

541905/2021/PS-PEM-MAX



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				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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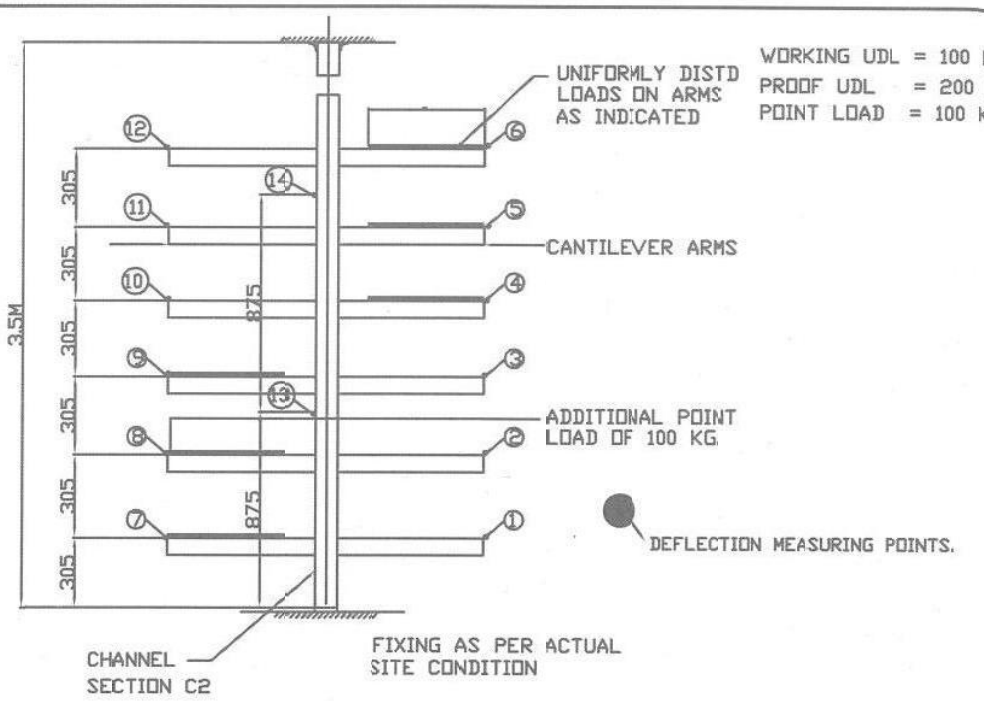
PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF STRUCTURE FOR TESTING

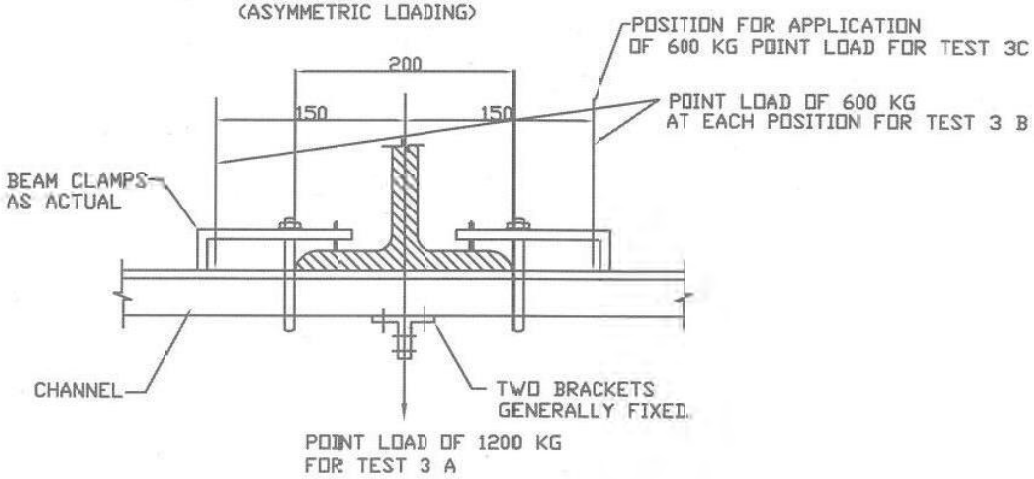
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-P0E-A-037	RC

541905/2021/PS-PEM-MAX



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			RM	–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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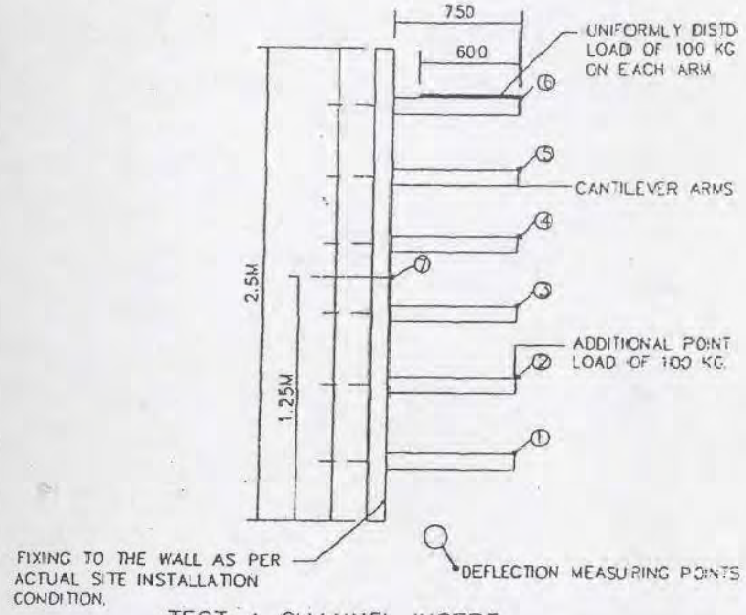
PROJECT: STANDARD

TITLE: TYPICAL DETAILS STRUCTURE FOR TESTING

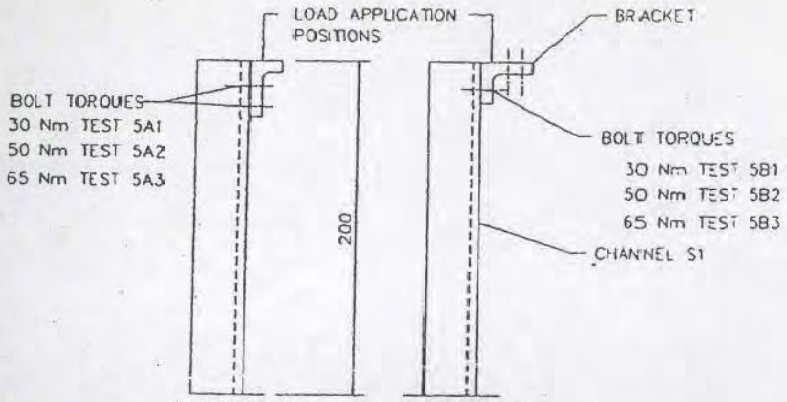
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-038	RC

541905/2021/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

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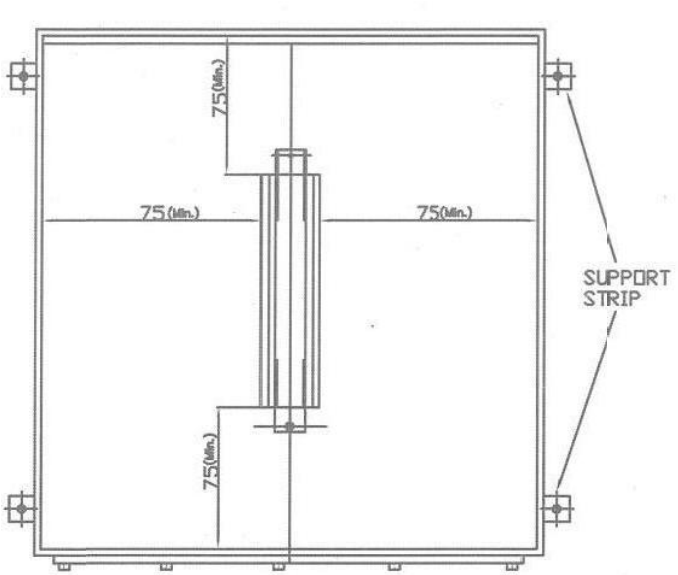
ENGINEERING DIVISION

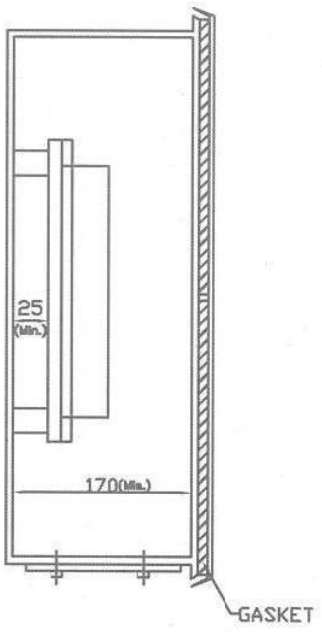
PROJECT	STANDARD		
TITLE	TYPICAL DETAILS OF STRUCTURE FOR TESTING		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-039	REV. NO. RB

CAD FILE NAME : STAND-211-039.DWG

541905/2021/PS-PEM-MAX



FRONT VIEW WITH COVER REMOVED



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				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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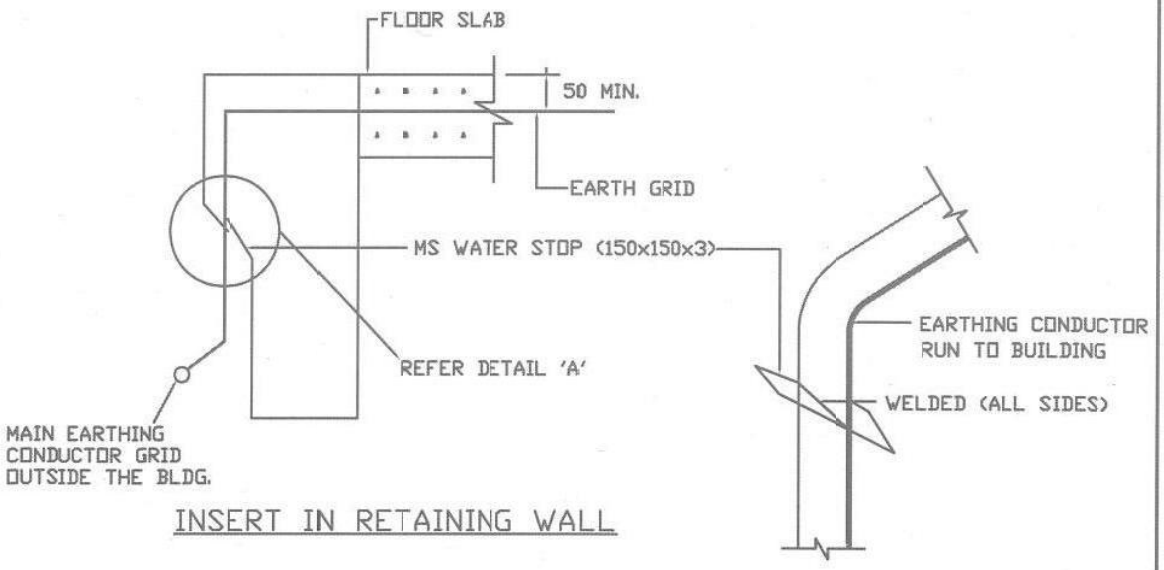
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: TYPICAL DRAWING FOR JUNCTION BOX

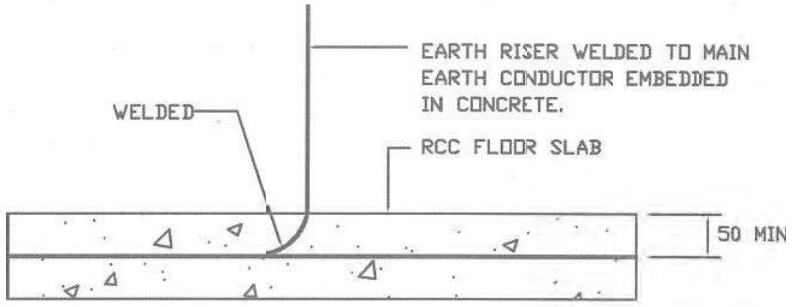
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-040	RC

541905/2021/PS-PEM-MAX



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	–	–	–	–	–	–	–	–	–	

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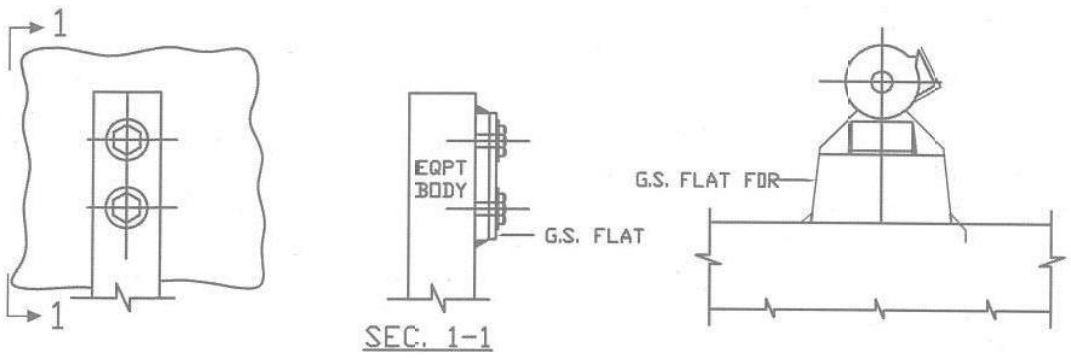
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARI

TITLE: EARTHING DETAILS

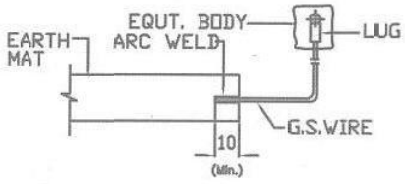
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-041	RC

541905/2021/PS-PEM-MAX

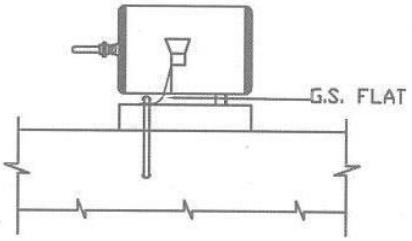


SEC. 1-1

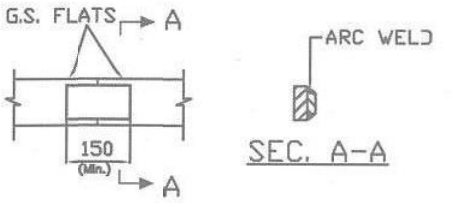
EQUIPMENT GROUNDING WITH G.S. FLAT



EQUIPMENT GROUNDING WITH G.S. WIRE

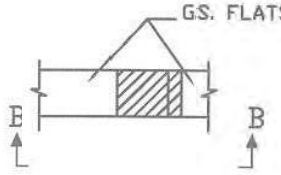


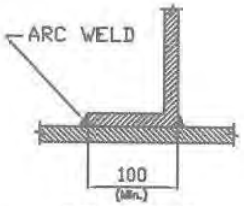
MOTOR TERMINAL BOX GROUNDING DETAIL



SEC. A-A

LAP JOINTS BETWEEN G.S. FLATS





SEC. B-B

ANGULAR JOINTS BETWEEN G.S. FLATS

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				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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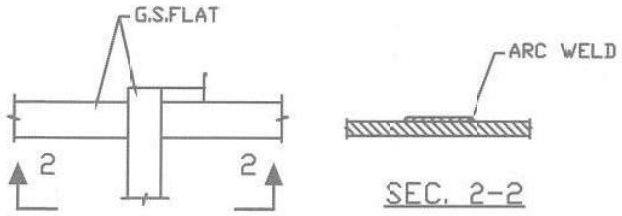
ENGINEERING DIVISION

PROJECT: STANDARD

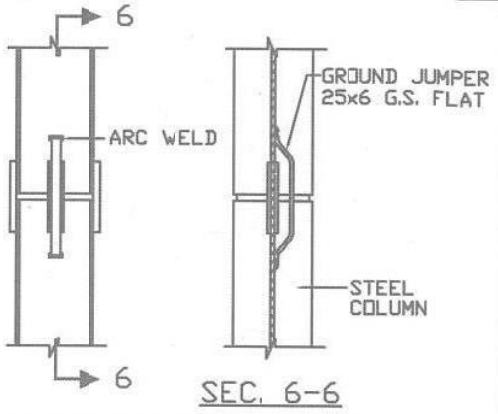
TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-042	RC

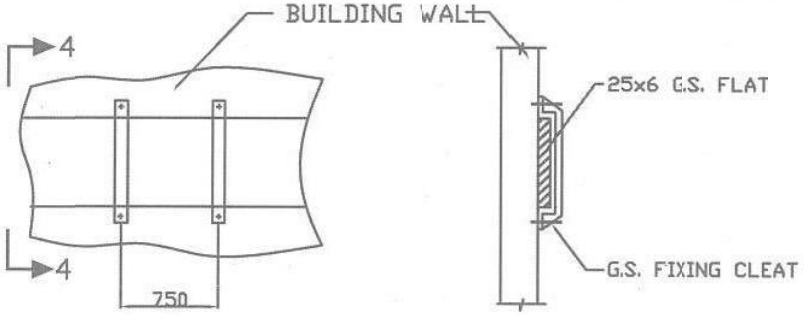
541905/2021/PS-PEM-MAX



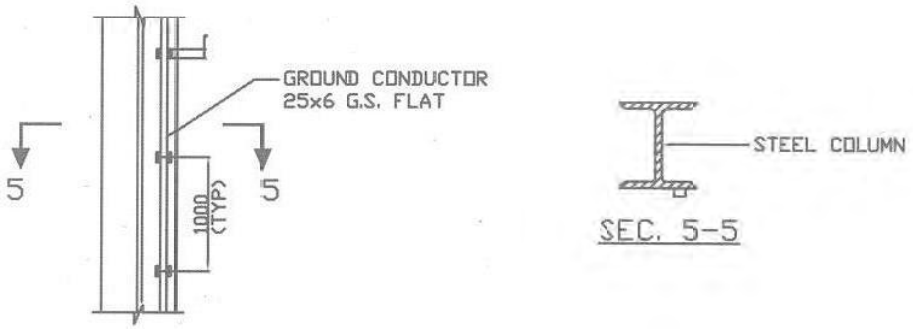
CROSS JOINTS BETWEEN FLATS



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	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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NTPC LTD.
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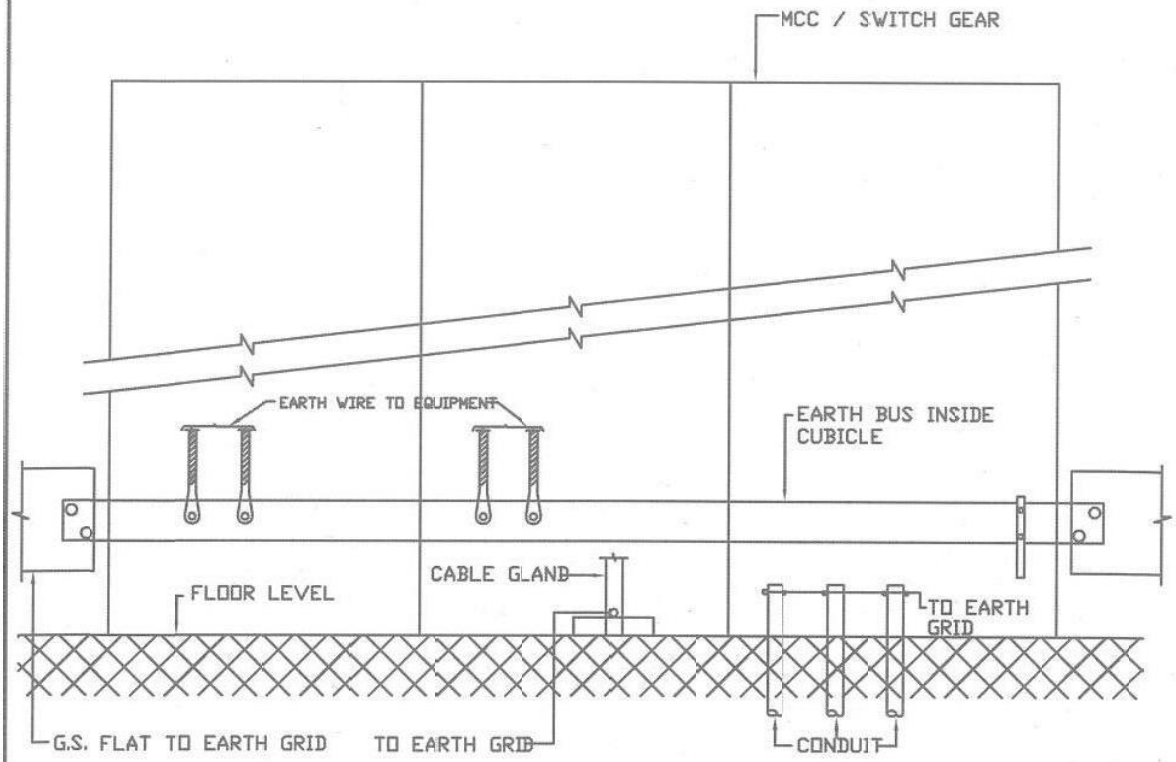
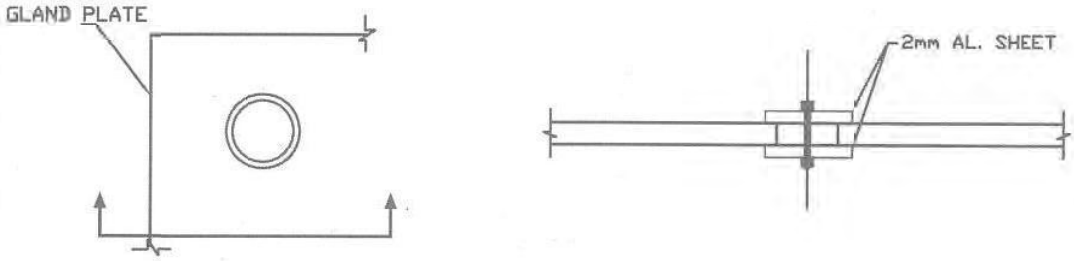
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	EARTHING DETAILS		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-043	REV. NO. RC

541905/2021/PS-PEM-MAX



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&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	—	—	—	—	—	—	—	—	—	

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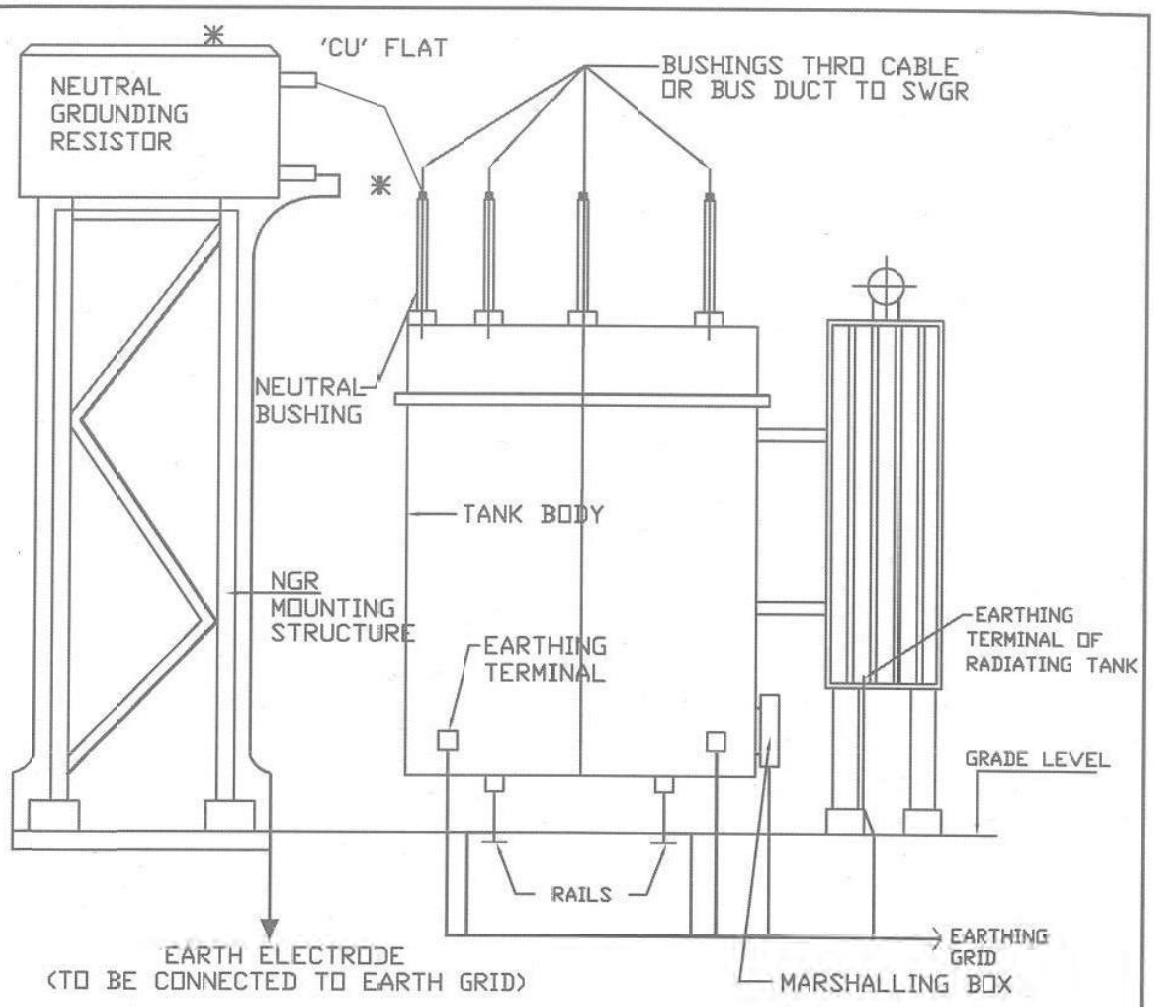
PROJECT	STANDARD		
TITLE	EARTHING DETAILS		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-044	REV. NO. RC



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	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE			RKR	–		–	–	–		05.07.19
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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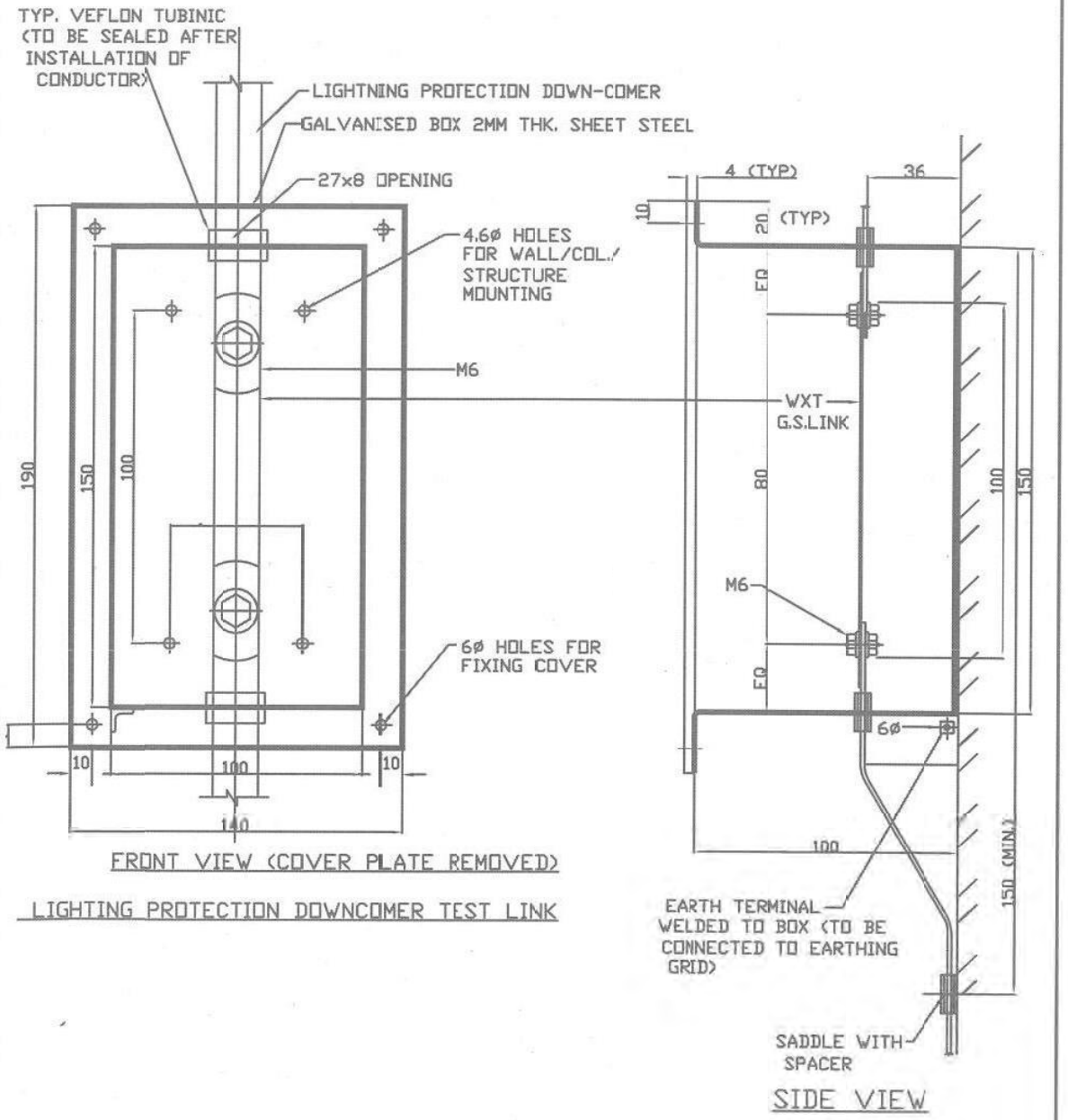
PROJECT	STANDARD		
TITLE	EARTHING DETAILS		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-045	REV. NO. RC

541905/2021/PS-PEM-MAX



LIGHTING PROTECTION DOWNCOMER TEST LINK

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&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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NTPC LTD.
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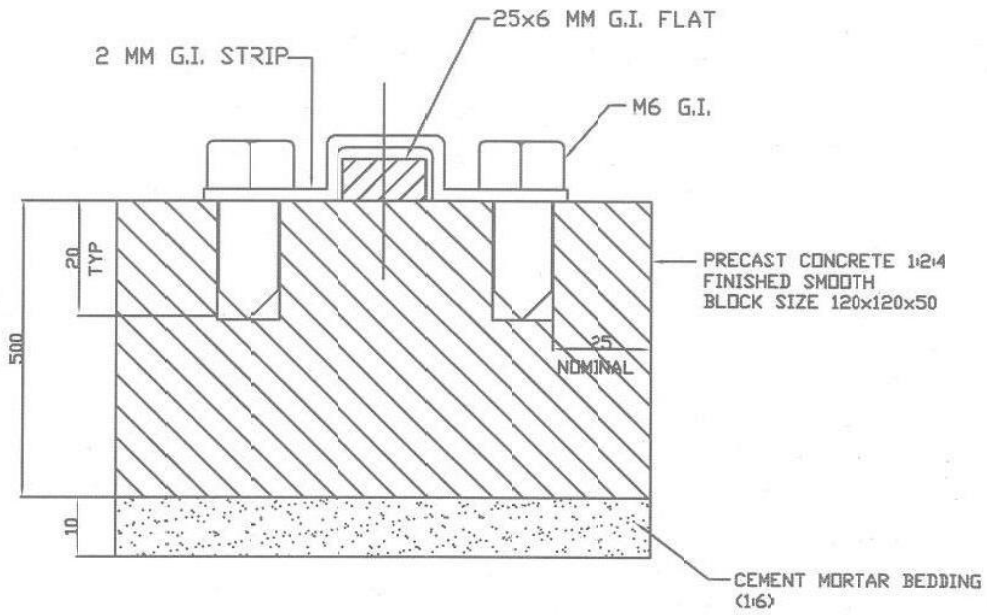
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: LIGHTNING PROTECTION DETAILS.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-047	RC



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&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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NTPC LTD.
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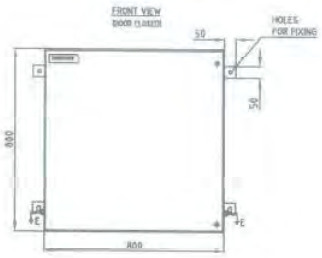
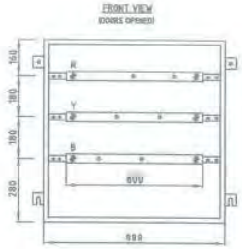
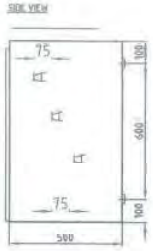
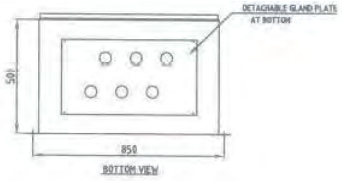
ENGINEERING DIVISION

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	RK		W					15/06/21
					CLEARED BY						

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NTPC LTD.
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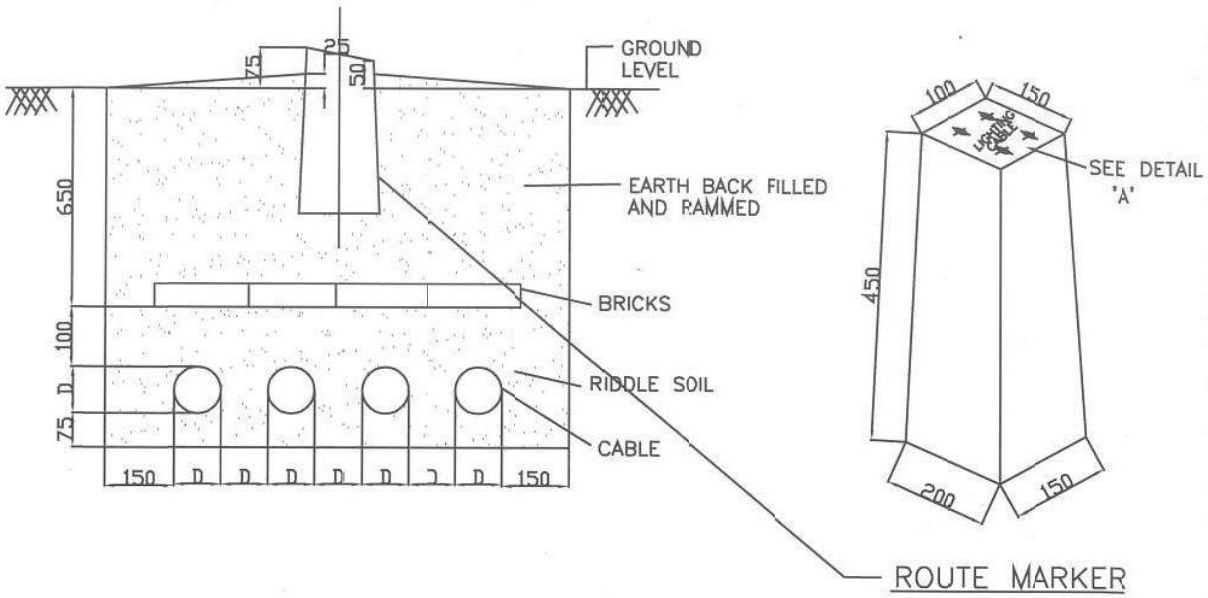
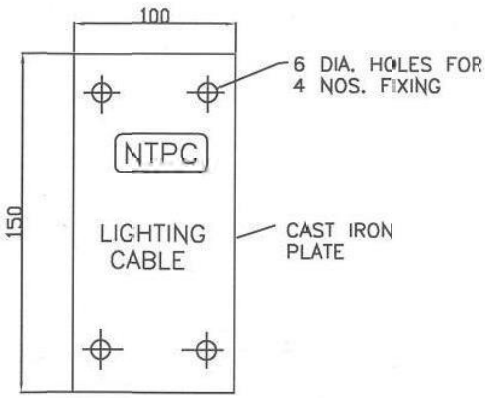
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: ADAPTOR BOX FOR LT CABLES

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-048A	RA





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	–	NV	–	–	–	AS	05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	20.11.2009
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2009

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NTPC LTD.

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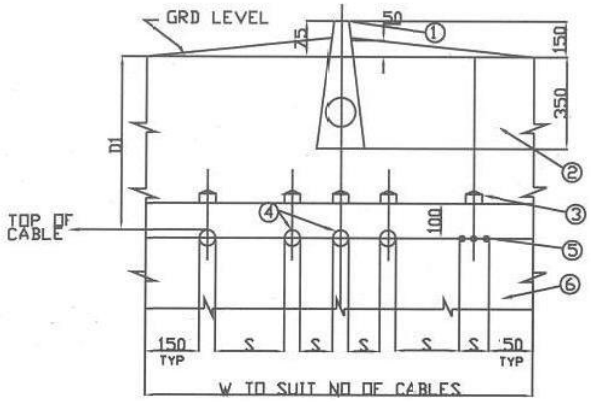
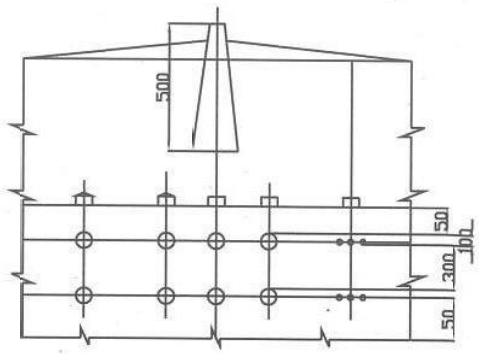
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BURIED CABLE TRENCH DETAILS FOR LIGHTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000–211–POE–A–049	RC





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 SELFLOCKING 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	CHK'D	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.12.10
RB	FOR TENDER PURPOSE	RKG	RKG	SG	–	SS	–	–	–	AS	28.11.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2006

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NTPC LTD.
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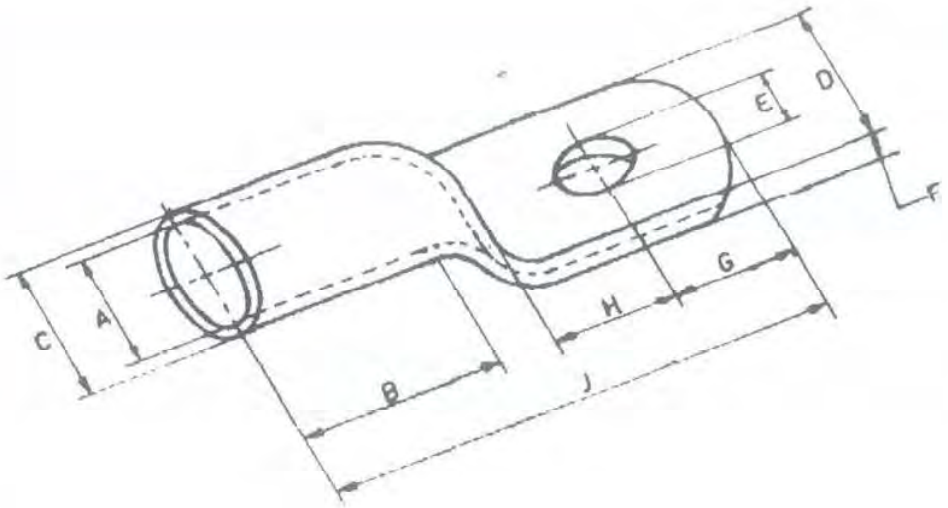
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BURIED CABLES TRENCH FOR HT & LT CABLES

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-050	RC



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

RA	FOR TENDER PURPOSE										
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH.	APPD	DATE
					CLEARED BY						

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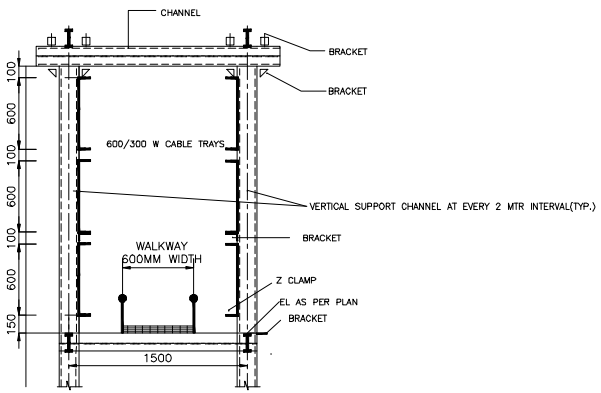
ENGINEERING DIVISION

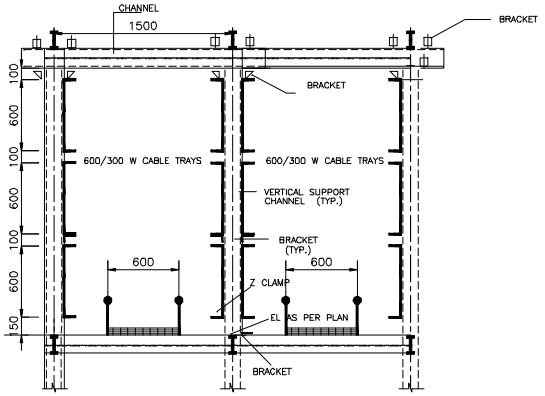
PROJECT: STANDARD

TITLE: TYPICAL DRAWING FOR CABLE LUG

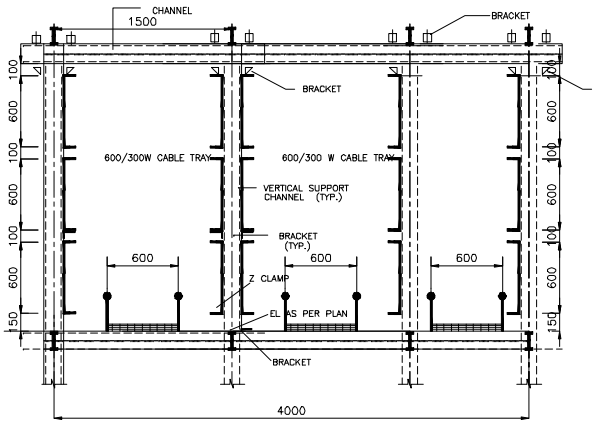
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-051	



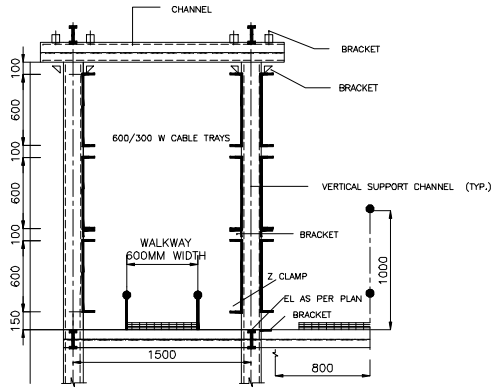
TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (6 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).



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).

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	APPD	DATE
0	RELEASED FOR CONSTRUCTION	MV		R.K		B.J	–		V.V	15-02-2018

CLEARED BY

PROJECT: KHURJA SUPER THERMAL POWER PROJECT (2X660MW)

TITLE: TYPICAL SECTION OF CABLE TRAY ARRANGEMENT IN TRESTLE

SIZE	SCALE	DRG. NO.	REV. NO.
		9915-999-POE-J-004	0

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME II-B	
		SECTION –D3	
		REV. NO. 00	DATE:

SECTION – D3
GENERAL TECHNICAL REQUIREMENTS (CONTROL AND INSTRUMENTATION)

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR NaOH DOSING SYSTEM	

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GENERAL TECHNICAL REQUIREMENTS (NAOH DOSING SYSTEM)

FORM NO. PEM-6666-0

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

GENERAL REQUIREMENT

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

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

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

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

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

541909/2021/PS-PEM-MAX	THDC INDIA LIMITED 2X660 MW STPP KHURJA- TG PACKAGE	
	TECHNICAL SPECIFICATION (C&I) FOR NaOH DOSING SYSTEM	

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LIST OF DOCUMENTS/DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR NaOH DOSING SYSTEM PACKAGE FOR 2X660 MW STPP KHURJA-TG PACKAGE (FGD SYSTEM PACKAGE)

DOCUMENT NUMBER PE-GL-475-145-I100 SHEET 1 of 1

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

NOTES: 1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

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

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR NaOH DOSING SYSTEM	

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SPECIFICATION FOR MEASURING INSTRUMENTS (PRIMARY & SECONDARY) AND CONTROL PANEL.

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**
1.01.00	Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
1.03.00	All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.
1.04.00	The necessary root valves, impulse piping, drain cocks, gauge-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.

2.02.00 GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER

Type	Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.
Principle	TDR (Time domain reflectometry)
Probe Type & Material	(i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention. (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.
Output signal	4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.
Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
Power supply	24 VDC +/- 10%.
Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
Adjustment/ calibration	Using hand held HART calibrator/ centralized PC based system (as applicable).
Zero & span adjustment	Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
Display	Integral digital display.
Load Impedance	500 ohms (minimum).
Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2
Mounting	(i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor.

	(ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor. (iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.

Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

2.03.00 Ultrasonic Type level Transmitter

S.No.	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
4.	Power supply	24 V DC +/- 10%.
5.	Temperature compensation	To be provided within transducer.
6.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
7.	Adjustment/calibration/ maintenance	Using hand held HART calibrator/ centralized PC based system (as applicable). .
8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.

9.	Sensor Material	Corrosion resistant material to suit individual application requirement.
10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
12.	Display	Integral digital display
13.	Diagnostics	Loss of echo alarm etc.
14.	Load Impedance	500 ohms (minimum).
15.	Electrical Connection	Plug and socket
16.	Accessories	• All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. • All mounting accessories required for erection and commissioning shall be provided. • For hazardous area, explosion proof enclosure as described in NEC article 500

Note:

1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under “ultrasonic transmitters” category for fly ash silo level.

	2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC. 3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.
2.04.00	HART Hand Held calibrator Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.

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

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

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

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

Notes

- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc.
- LVDT type is not acceptable.
- Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**GENERAL:**
1.01.00	Actuators shall be designed for valve operation to ensure proper function in accordance with specifications given below and complying to EN15714-2 or equivalent. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.
1.02.00	This sub-section of specification is applicable for following types of electric actuators:
1.02.01	**Modulating duty electric actuators:** These shall be provided as per standard practice of OEM of equipment, meeting other requirements of specifications. The examples of such applications are Blade pitch actuators of ID/FD/PA Fans, Scoop tube actuator of BFPs etc. For specifications of Blade pitch actuators of ID/FD/PA Fans, refer clause no. 5.00.00 of this chapter.
1.02.02	**Electric actuators for valves/ dampers/ gates (other than covered in 1.02.01):** These actuators shall be Non-Intrusive type electric actuators. The interface of these actuators with DDCMIS shall be of two types viz. with Hardwired interface and with Fieldbus interface. The common requirements of both these type of actuators are specified at clause 2.00.00, specific requirements of Non-Intrusive hardwired actuators are specified at clause 3.00.00 and specific requirements of Non-Intrusive fieldbus actuators are specified at clause 4.00.00. The applications where these two types of actuators are to be provided is specified in Part-A of Technical Specifications.
2.00.00	**COMMON REQUIREMENTS FOR NON INTRUSIVE ELECTRIC ACTUATORS**
2.01.00	**TYPE:**
2.01.01	The actuators shall have integral starters with built in SPP (Single Phasing Preventer). 415 V, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.
2.01.02	The actuators shall be Non- Intrusive electric actuator. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body.
2.02.00	**RATING:** (a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire & 50HZ +/-5%. (b) Sizing: Open/Close at rated speed against designed differential pressure at 90% of rated voltage. For ON/OFF type: Three successive open-close operations or 15 minutes, whichever is higher. For inching type: 150 starts per hour or required cycles, whichever is higher.
2.03.00	**CONSTRUCTION:** (a) Enclosure: Totally enclosed weatherproof, minimum IP-68 degree of protection. (b) Manual Wheel: Shall disengage automatically during motor operation.

2.04.00 MOTOR:

(a) Type :

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

(b) Enclosure:

Totally enclosed, self-ventilated.

(c) Insulation

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

(d) Bearings:

Double shielded, grease lubricated antifriction.

(e) Earth Terminals:

Two

(f) Protection:

Single Phasing Protection, Over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design. Suitable means shall be provided to diagnose the type of fault locally.

2.05.00 POSITION/TORQUE TRANSMITTER:

The Position/ Limit measurement shall be done using absolute encoders which will give information of position/ limit in both the directions. Electronic measurement of torque shall be provided.

2.06.00 LOCAL OPERATION:

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

2.07.00 LCD DISPLAY:

A local LCD display shall be provided to give information regarding actuator alarms, status and valve position indications as a minimum in local.

2.08.00 WIRING:

Suitable voltage grade copper wire.

2.09.00 TERMINAL BLOCK:

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

2.10.00 ACCESSORIES:

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

2.11.00 **SIL CERTIFICATION:**

All actuators shall be certified for SIL 2 or better.

3.00.00 **SPECIFIC REQUREMENTS FOR NON INTRUSIVE HARDWIRED ACTUATORS**

3.01.00 **INTERFACES:**

For ON-OFF and INCHING type actuators interface with the control system shall be through hardwired signal only.

(a) Open/Close command, open/ close status and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided hardwired.

(b) The actuator shall be able to accept open/close command at 24V DC with max. 2.5VA load from control system. Accordingly suitable isolated interface in the actuator shall be provided.

(c) Open/close command termination logic shall be suitably built inside actuator.

(d) For typical wiring diagram Refer Tender Drawing No. 0000-999-POI-A-063 (Except plug & socket connector, if not applicable)

3.02.00 **TERMINAL BOX:**

Suitable terminals/ connectors, integral to actuator, for terminating instrumentation & power cables shall be provided. Necessary glands for power cables and instrumentation cables shall be provided.

3.03.00 **TRAINING:**

Contractor shall provide training on Non-Intrusive hardwired Electric Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

4.00.00 **SPECIFIC REQUIREMENTS FOR NON INTRUSIVE FIELDBUS ACTUATORS**

4.01.00 **INTERFACES:**

For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network.

(a) Open/ close commands, open/ close feedback status, disturbance signal etc. shall be available to the Control System through the fieldbus network along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DDCMIS through the fieldbus network.

(b) All actuators shall be Foundation Fieldbus/ Profibus compatible. However the exact protocol shall be based on finalized protocol of DDCMIS. If Profibus DP protocol is envisaged then actuator shall have two (redundant) Profibus DP ports for connecting the redundant Profibus DP cables. That is if one profibus cable is cut or not working/ not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.

(c) Open/close command termination logic shall be suitably built inside actuator.

4.02.00 TERMINAL BOX:

Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided. Necessary glands for power cables and armored fieldbus cables shall be provided.

4.03.00 TRAINING:

Contractor shall provide training on Non-Intrusive Fieldbus Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

5.00.00 SPECIFIC REQUIREMENTS FOR BLADE PITCH ACTUATORS OF ID/FD/PA FANS

Sl No.	Description	Requirement
1.	Duty	Continuous duty / Modulation,
2.	Operating Ambient Temperature	-20 to +60 Deg C or better
3.	Enclosure Protection	IP 68
4.	Resolution/ Precision	0.1%- 0.2% or better of total travel
5.	Supply Voltage & frequency	415V +/- 10%, 3 Phase, 50HZ +/-5% or 230V +/- 10%, Single Phase, 50Hz +/- 5%
6.	Motor Suitable for	Continuous Duty
7.	Motor insulation Class	F
8.	Analog Control	4-20mA, (24VDC)
9.	Position Transmitter	4-20mA (24VDC)
10.	Integral Starter	Yes
11.	Terminal Block	For power cables, the grade of TBs shall be minimum 600V
12.	Accessories (if applicable)	for calibration / settings/ configuration of various parameters of actuator shall be provided
13.	Hand wheel	Yes
14.	Standard Compliance	EN 15714-2 Class D or equivalent

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		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	2X660 MW KHURJA STPP	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	■ ON / OFF ☐ INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF -20 to70 DEG C AND RELATIVE HUMIDITY OF 0-95%IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF,DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/IP:68	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM** as per IEC60034-1	
HANDWHEEL as per standard EN 12570:2000	* REQUIRED	■ YES ☐ NO	
	* ORIENTATION	■ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW) (REFER NOTE NO. 6 & 7)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF **I.S.** TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM (TO BE DECIDED DURING DETAILED ENGINEERING)	BIDDER TO FURNISH WIRING DIAGRAM	
	COLOUR SHADE	■ BLUE (RAL 5012) ■ SIEMENS GRAY RAL 7030/32 ■ TO BE DECIDED DURING DETAILED ENGINEERING	
	PAINT TYPE	■ ENAMEL ■ EPOXY CONFIRMING TO CORROSION CATEGORY C5-I ■ TO BE DECIDED DURING DETAILED ENGINEERING	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	

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		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ■ 230 V ■ 110 V	
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ■ IP 68 ■ FLAME PROOF TO BE DECIDED DURING DETAILED NGINEERING	
	@MOTOR BEARING WITH 2 EARTH TERMINALS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI FRICTION	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE)	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED (THERMISTOR PTC)	
INTEGRAL STARTER	INTEGRAL STARTER	■ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ■ CONTACTORS(REVERSING TYPE) ■ THYRISTORS	
	TYPE	☐ CONVENTIONAL ■ SMART (NON-INTRUSIVE)	
	IF SMART (REFER BELOW POINT a – g)		
	a) INTERFACE WITH CONTROL SYSTEM	■ FIELDBUS ☐ HARDWIRED	
	b) FIELDBUS PROTOCOL	■ PROFIBUS DP · PROFIBUS PA · FOUNDATION FIELDBUS	
	c) REDUNDANT PORTS (IN CASE,PROFIBUS DP PROTOCOL)	■ REQUIRED ☐ NOT REQUIRED	
	d) TORQUE MEASUREMENT TRANSMITTER(REFER NOTE NO.9)	■ REQUIRED ☐ NOT REQUIRED	
	e) POSITION MEASUREMENT TRANSMITTER(REFER NOTE NO.9)	■ REQUIRED ☐ NOT REQUIRED	
	f) LCD DISPLAY INTEGRAL TO ACTUATOR BODY(REFER NOTE NO.10)	■ REQUIRED ☐ NOT REQUIRED	
	g) SIL CERTIFICATION (SIL 2 OR BETTER)	■ REQUIRED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED	
	OPEN / CLOSE PB	■ REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	■REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL (TO BE DECIDED DURING DETAILED ENGINEERING)	REQUIRED MOTOR THERMOSTAT TRIP O/L RELAY OPTD,CONT./POWER SUPPLY FAILED,S/S IN LOCAL/REMOTE/OFF MODE,TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD,VALVE JAMMED ETC)	
	ACTION ON LOSS OF EXTERNAL ELECTRIC POWER	■ STAYPUT ■ FAIL SAFE TO BE DECIDED DURING DETAILED ENGINEERING	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) **DATASHEET & WIRING DIAGRAM OF ISOLATION DEVICE TO BE PROVIDED**	TYPE OF ISOLATING DEVICE	■ INTERPOSING RELAY ■ OPTO COUPLER TO BE DECIDED DURING DETAILED ENGINEERING	
	QUANTITY	■ 2 NOs. ■3 NOs. TO BE DECIDED DURING DETAILED ENGINEERING	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	

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		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	☐1 No ■2 Nos. : 2 Nos. (ADJ.) : ☐1 No. ■2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V	
	ACCURACY	2% OF SET VALUE	

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty applications)	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS TO BE DECIDED DURING DETAILED ENGINEERING	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	240V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@■ IP 68 @■ TO BE DECIDED DURING DETAILED ENGINEERING	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET	■ REQUIRED ☐ NOT REQUIRED (TO BE DECIDED DURING DETAILED ENGINEERING)	
	NO. OF PINS REQUIRED	■ 9 PINS ☐ 13 PINS (TO BE DECIDED DURING DETAILEDENGINEERING)	
	NOS. OF PLUG & SOCKET	☐ 1 Nos. for ON/OFF ☐ 2 NOS.(for inching duty)	
CABLE GLANDS	@ POWER CABLE GLAND	QUANTITY & SIZE TO BE DECIDED DURING DETAILED ENGINEERING	
	@ SPACE HEATER CABLE GLAND		
	CONTROL CABLE GLANDS-1		
	CONTROL CABLE GLANDS-2		
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

	RATE CONTRACT DATASHEET FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.:		
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Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS-4722, IEC 60947-5-1 AND EN 15714-3 :2010 OR LATEST VERSION.
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
7. THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH.
8. IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, MECHANICAL END STOP WITH ACCURACY OF 2% SHALL BE SUPPLIED.
9. THE POSITION/LIMIT MEASUREMENT SHALL BE DONE USING ABSOLUTE ENCODERS WHICH WILL GIVE INFORMATION OF POSITION/LIMIT IN BOTH THE DIRECTIONS.ELECTRONIC MEASUREMENT OF TORQUE SHALL BE PROVIDED.
10. A LOCAL LCD DISPLAY SHALL BE PROVIDED TO GIVE INFORMATION REGARDING ACTUATOR ALARMS, STATUS AND VALVE POSITION INDICATION AS A MINIMUM IN LOCAL.
11. IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
12. LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.
13. CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.
14. ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.
15. TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.
16. THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE.
17. AUTOMATIC PHASE CORRECTION FACILITY AND POTENTIAL FREE CONTACT FOR ANNUNCIATION OF POWER FAILURE SHALL BE PROVIDED.
18. LIMIT SWITCHES SHALL BE SILVER PLATED WITH HIGH CONDUCTIVITY AND NON-CORROSIVE TYPE. CONTACT RATING SHALL BE SUFFICIENT TO MEET THE REQUIREMENT OF CONTROL SYSTEM SUBJECT TO A MINIMUM OF 60 V, 6 VA RATING. PROTECTION CLASS SHALL BE IP67.
19. SUITABLE TERMINALS/CONNECTORS.INTEGRAL TO ACTUATORS FOR TERMINATING FIELDBUS(PROFIBUS-DP) CABLES AND POWER CABLES SHALL BE PROVIDED.NECESSARY GLANDS FOR POWER CABLES AND ARMORED FIELDBUS CABLES SHALL BE PROVIDED.
20. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +5% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
21. ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
22. OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE.
23. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ BE FILLED BY ES

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	CHETAN MALIK	RAVINDER KUMAR RAINA	RAVINDER KUMAR RAINA	NAME
SIGNATURE				SIGNATURE
DATE	27.02.2020	27.02.2020	27.02.2020	DATE

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

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.
10.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.
10.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.
10.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalized during detailed engineering. (b.) Interior:- Same as above.
10.01.05	Paint films which show sags, checks or other imperfections shall not be acceptable.
10.01.06	As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.
10.01.07	Refer Subsection Basic Design Criteria, Part B, and Section VI for grounding requirements.
10.01.08	The mimic shall be configured on the OWS and it shall be possible to control, monitor and operate the plant from the same.
10.01.09	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.

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

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others
Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm.The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.

3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm2 size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm2 size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

FORM NO. PEM-6666-0

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5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **NaOH DOSING SYSTEM**	

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INSTRUMENTATION CABLE, CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

2.00.00 **SPECIFICATION OF INSTRUMENTATION CABLE**

2.01.00 **Common Requirements**

S. No.	Property	Requirement
1	Operating Voltage	225 V (peak value)
2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.
3.	Continuous operation suitability	At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.

S. No.	Property	Requirement
4.	Marking :- a.Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath. b.Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable c.Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath.	
5.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet
6.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.
7.	Ovality at any cross-section	Not more than 1.0 mm
8.	CAGE-CLAMP suitability	To be provided
9.	Color	The outer sheath shall be of blue color.
10.	Others	Repaired cables shall not be acceptable.

2.02.00 **Specific Requirements**

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
A. CONDUCTORS				
Cross section area	0.5 sq. mm			
Conductor material	ANSI type KX	ANSI type SX	Annealed bare copper	ANSI type KX
Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red
Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1
No & dia of strands	7x0.3 mm (nom)			
No. of Pairs	2	2	2/4/8/12/16/24 / 48	2

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Max. conductor loop resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4	As per ANSI MC 96.1
Reference Standard	As per ANSI MC 96.1		VDE : 0815	As per ANSI MC 96.1
B. INSULATION				
Material	Extruded PVC type YI 3			Teflon (i.e. extruded FEP)
Thickness in mm (Min/Max)	0.25/0.35			0.4 / 0.50 (nominal)
Volume Resistivity (Min) in ohm-cm	1 x 10^{14} at 20 deg. C & 1x10^{11} at 70 deg. C.			2.8x 10^{14} at 20 deg. C & 2x10^{11} at 205 deg. C.
C. PAIRING & TWISTING				
Max. lay of pairs (mm)	50			
Single layer of binder tape on each pair provided	Each core printed with number or Numbered binder tape to be provided on each pair		Yes	Each core printed with number or Numbered binder tape to be provided on each pair
Bunch (Unit Formation) for more than 4P	N.A		To be provided	N.A
Conductor /pair identification as per VDE0815	N.A.		To be provided	N.A.
D. SHIELDING				
Type of shielding	Al-Mylar tape			
Individual pair shielding	No		To be provided for F-type cable	No
Minimum thickness of Individual pair shielding	No		0.028mm (28 micron)	No

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Overall cable assembly shielding	To be provided			
Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)			
Coverage / Overlapping	100% / 20%			
Drain wire provided for individual shield	N.A.		Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper	N.A.
Drain wire provided for overall shield	Yes, Size- 0.5 sqmm,No of strands-7,Dia of strands-0.3mm,Annealed Tin coated copper			
E. FILLERS (if applicable)				
Non-hygroscopic, flame retardant	To be provided			
F. OUTER SHEATH				
Material	Extruded PVC compound YM1 with FRLS properties			Teflon (i.e. extruded FRP)
Minimum Thickness at any point	1.8 mm			0.4 mm
Nominal Thickness at any point	>1.8 mm			0.5 mm
Resistant to water, fungus, termite & rodent attack	Required			
Minimum Oxygen index as per ASTMD-2863	29 %			N.A.
Minimum Temperature index as per ASTMD-2863	250 deg.C			N.A.

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Maximum Acid gas generation by weight as per IEC-60754-1	20%			N.A.
Maximum Smoke Density Rating as per ASTMD-2843	60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			N.A.
Reference standard	VDE207 Part 5,VDE-816			VDE207 Part 6 ASTM D2116
G. Electrical Parameters				
Mutual Capacitance Between Conductors At 0.8 Khz (Max.)	200 nF/km		120 nF/km for F type 100 nF/km for G-type	200 nF/km
Insulation Resistance (Min.)	100 M Ohm/Km			
Cross Talk Figure (Min.) At 0.8 Khz	60 dB		60 dB	60dB
Characteristic Impedance (Max) At 1 Khz	N.A.		320 OHM FOR F-TYPE 340 OHM FOR G-TYPE	N.A.
Attenuation Figure At 1 Khz (Max)	N.A.		1.2 db/km	N.A.
H. COMPLETE CABLE				
Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.			N.A.

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			As per manufacturer's standard subject to employer's approval
I. CABLE DRUM				
Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to entire drum) or steel drum.			
Length	1000 m ± 5% for up to & including 12 pairs 500 m ± 5% for above12 pairs			

Note: Heat resistant instrumentation cable shall have same specification as of G/F type instrumentation cable as specified above, except that insulation and outer sheath material shall be Teflon and cable shall be suitable for continuous operation at 205 Deg. C

4.00.00 **SPCIFICATION OF CONTROL & POWER SUPPLY CABLES**

Refer Electrical sub-sections

5.00.00 **INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY**

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

TABLE A: CABLE TERMINATION TO BE FOLLOWED

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

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

Notes

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

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

3 * For high temperature applications only.

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

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

6.05.00	The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
7.00.00	**INTERNAL PANELS/ SYSTEM CABINETS WIRING**
7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.
7.02.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.
7.03.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.
7.04.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.
7.05.00	All the special tools as may be required for solder less connections shall be provided by Bidder.
7.06.00	Wire sizes to be utilised for internal wiring.

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

10.00.00	**FIELD MOUNTED LOCAL JUNCTION BOXES**		
	(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
	(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
	(iii)	Type	Screwed at all four corners for door. Door gasket shall be of synthetic rubber.

	(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply.
	(v)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm^2. A M6 earthing stud shall be provided.
	(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
	(vii)	Grounding	To be provided.
	(viii)	Color	RAL 7035

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

11.00.00 CONDUITS

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

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

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

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

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

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

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	TECHNICAL SPECIFICATION (C&I) FOR **NaOH DOSING SYSTEM**	

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PROCESS CONNECTION AND PIPING

PROCESS CONNECTION AND PIPING

1.00.00 **PROCESS CONNECTION PIPING**

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

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

1.01.02 All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The material of the impulse pipe shall be same as that of main process pipe or equivalent. The size of impulse pipe shall be ½" for Steam & Water Application and ¾" for Air & Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:

Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34
Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009
Installation Schemes	BS 6739-2009, ANSI/ISA 77.70

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

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

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

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

2.00.00 **AIR SUPPLY PIPING**

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

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

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

shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports.

2.04.00 The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location.

2.05.00 All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.

2.06.00 Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering.

3.00.00 **INSTALLATION AND ROUTING**

3.01.01 All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe form the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.

Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes.

4.00.00 **SHOP AND SITE TESTS**

4.01.01 The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-IIIE-04 (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.

4.01.02 Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.

5.00.00 **LOCAL INSTRUMENT ENCLOSURE AND RACKS**

All transmitters, switches etc. in Boiler Turbine Generator measurements (except for all fuel oil applications) shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas like Turbine/Generator area. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor.

The GA of LIR shall be similar to LIE except for front/rear doors and side panels.

.

The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55.

The instrument racks shall be constructed from 1.6 mm sheet plate and shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.

Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.

5.01.00 ENCLOSURE / RACKS FOR DUAL/SINGLE I/P TEMPERATURE TRANSMITTERS

All Dual/Single Input temperature transmitters in Boiler Turbine Generator measurements shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant like boiler area, etc. and (ii) Racks in case of covered areas like Turbine/Generator area. Integral JB shall be provided with each Enclosure and Rack.

The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance.

Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55.

Enclosure and Racks shall be free standing type.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein.

Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.

5.02.00 Local Control Panels:

Local control panels shall be designed as per IP class 65 or better. These local panels shall be suitably placed taking care of safety of the operating personnel and Instruments. For Hot and dusty environment / process (e.g. Mill reject, Ash hoppers etc), panels shall be placed at least 5mtrs away from the process.

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

Sl. No.	Area / Equipment	Impulse Pipe Ground Color		Identification Tag/Band		
		Color	RAL	Color	ISC No.	RAL
1.	Air	Grey	9002	Sky Blue	101	
2.	Water	Grey	9002	Sea Green	217	
3.	Steam	Aluminium		Signal Red	537	3001
4.	Air Steam Mixture	Aluminium		Sky Blue	101	
5.	Gas	Grey	9002	Canary Yellow	309	
6.	Oils	Grey	9002	Light Brown	410	
7.	Pulverized Fuel	Grey	9002	Silver Grey	628	
8.	Fire Installations	Fire Red	536 (ISC) 3001 (RAL)	White		9010
9.	HP Dosing	Grey	9002	Dark Admiralty Grey	632	
10.	LP Dosing / acid / alkali Piping	Grey	9002	Signal Red	537	
11.	Ash Piping	Grey	9002	French Blue	166	

Note: Ground color indicated against each piping shall be followed in case piping is not insulated /cladded.

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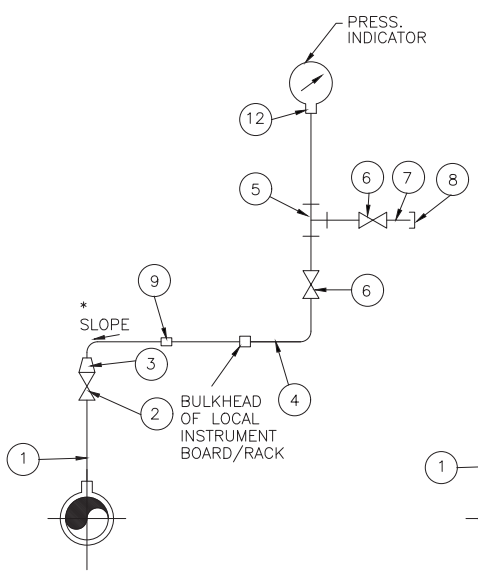
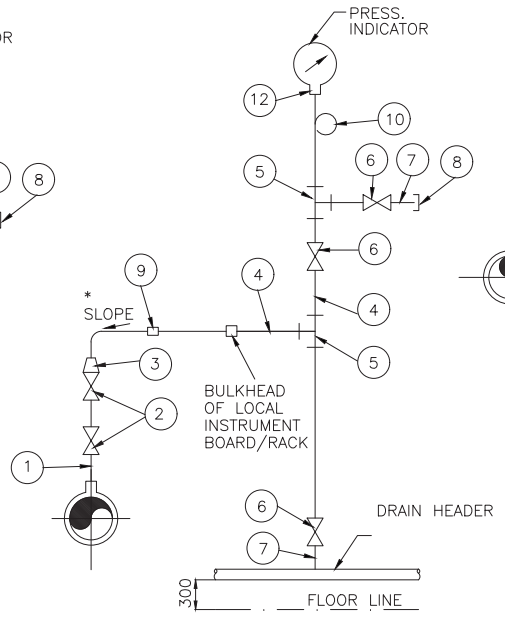
INSTRUMENT INTERFACING DRAWING

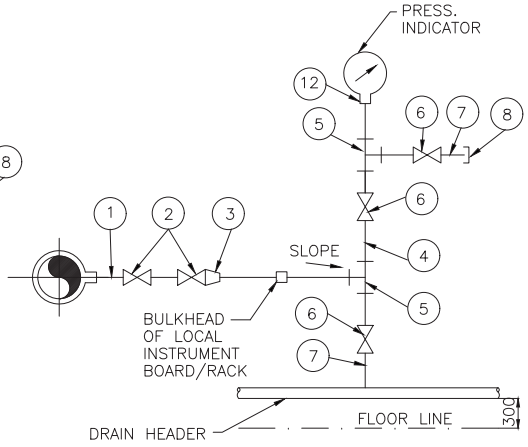


ELEVATION
INST./ SERVICE AIR



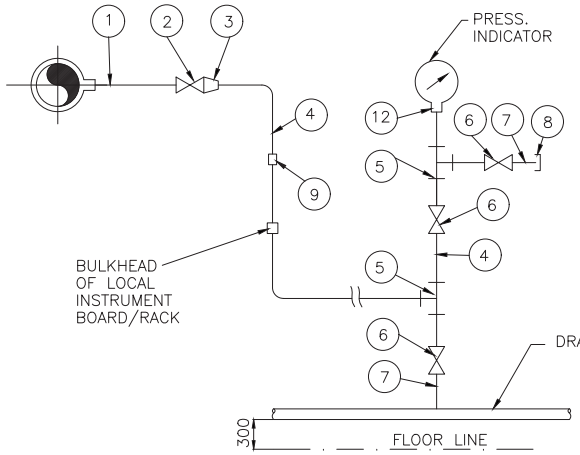
ELEVATION
STEAM SERVICE

(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)



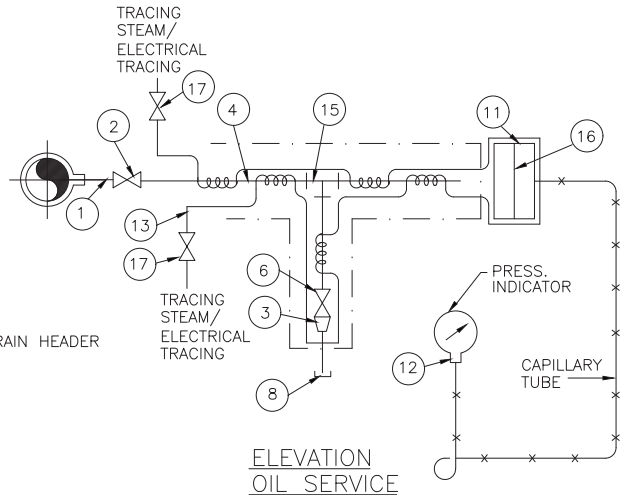
ELEVATION
LIQUID SOURCE

(GAUGE MOUNTED ABOVE INSTRUMENT SOURCE POINT)



ELEVATION
LIQUID SOURCE

(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)



ELEVATION
OIL SERVICE

(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2" , 3/4" , 1" NPS SCH 40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	1/2"/3/4"/1' SW GLOBE VALVE/GATE VALVE
3.	3/4" / 1" x 1/2" SW REDUCING INSERT
4.	1/2" / 3/4" PIPE
5.	1/2" / 3/4" SW EQUAL TEE
6.	1/2" / 3/4" SW GLOBE VALVE.
7.	1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.
8.	1/2" / 3/4" NPT(F) CAP.
9.	1/2" / 3/4" PIPE UNION.
10.	6" SS SYPHON
11.	1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.
12.	SUITABLE ADAPTER.
13.	1/4" CHROME MOLY STEEL TUBE.
14.	
15.	1"/3/4" SW EQUAL TEE.
16.	DIAPHRAGM(WAFER ELEMENT)
17.	ISOLATION VALVE 316 SS,1/4"SW

NOTES:–

1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE & NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFIRM TO ANSI–B.16–11.
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTINGS SHALL BE OF 3/4" NB SIZE.
5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON A CHANNEL OR FRAME OR A RACK..
6. * SLOPE APPROX. 50 MM / METRE.

FOR TENDER PURPOSE ONLY

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

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

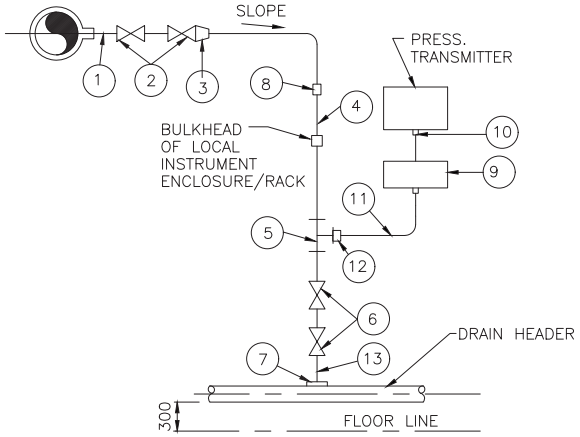
CONSULTANT
एनटीपीसी NTPC
N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

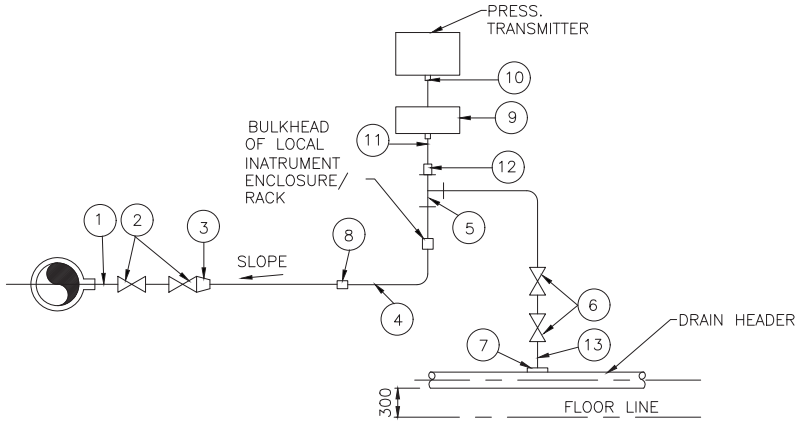
SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-110-POI-A-022	A

LIQUID PRESSURE MEASUREMENT



ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



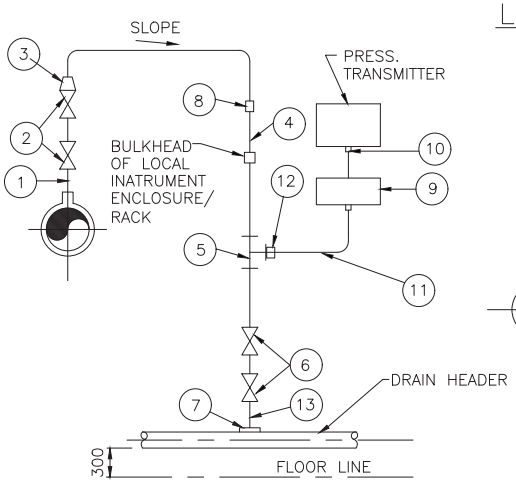
ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIST OF MATERIALS

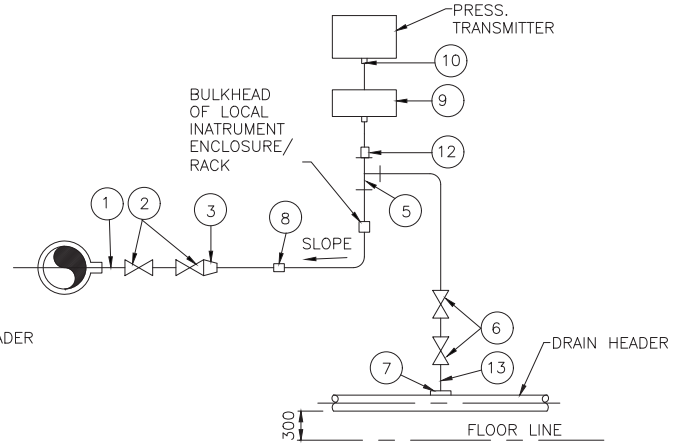
ITEM NO.	DESCRIPTION
1.	1/2" / 3/4"/1"NPS SCH. 80/160/XXS/P91 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	3/4"/1" SW GLOBE VALVE.
3.	3/4"/1" TO 1/2" REDUCING INSERT
4.	1/2" NPS PIPE
5.	1/2" SW EQUAL TEE
6.	1/2"SW GLOBE VALVE
7.	1/2"NPS SCH. 80/160 SWx1/2"CS/AS COUPLER
8.	1/2" PIPE UNION
9.	2/3 VALVE MANIFOLD (FOR DETAIL SEE DRAWING NO.0000-102-POI-A-023.
10.	SUITABLE ADAPTER
11.	SS TUBE
12.	1/2" PIPE x 1/2"TUBE UNION
13.	1/2"NPS SCH. 80/160 SWx1/2" NPT(M) CS/AS NIPPLE

STEAM PRESSURE MEASUREMENT



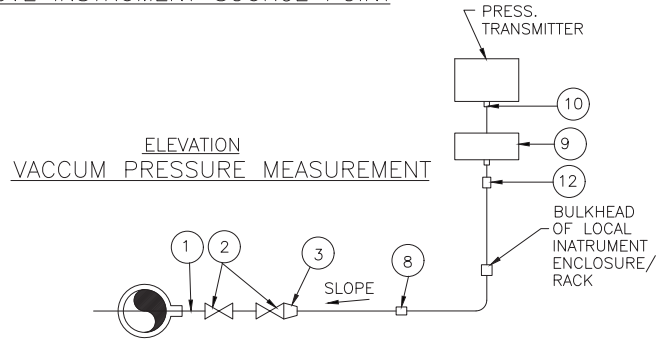
ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



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

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

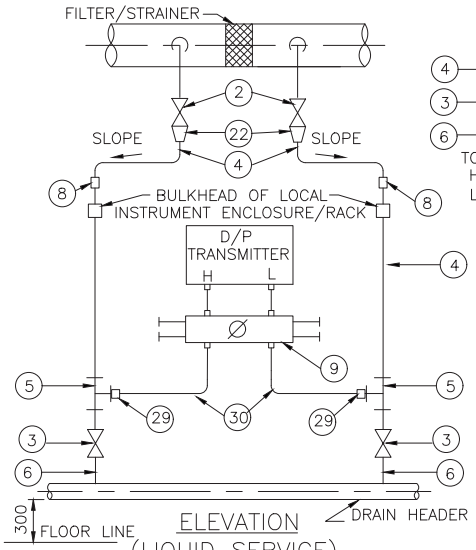
CONSULTANT **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)

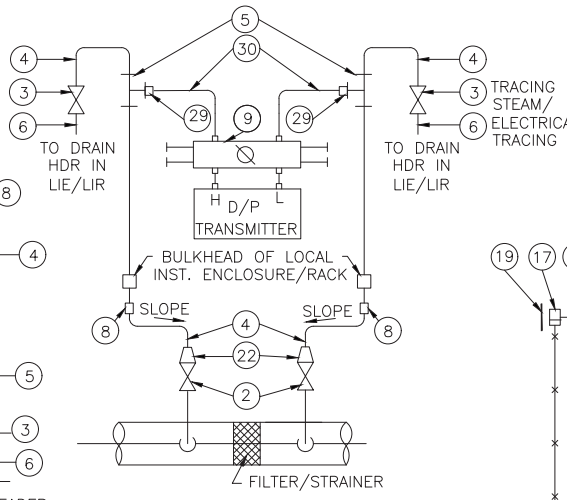
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										26.04.06
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-110-POI-A-025	A



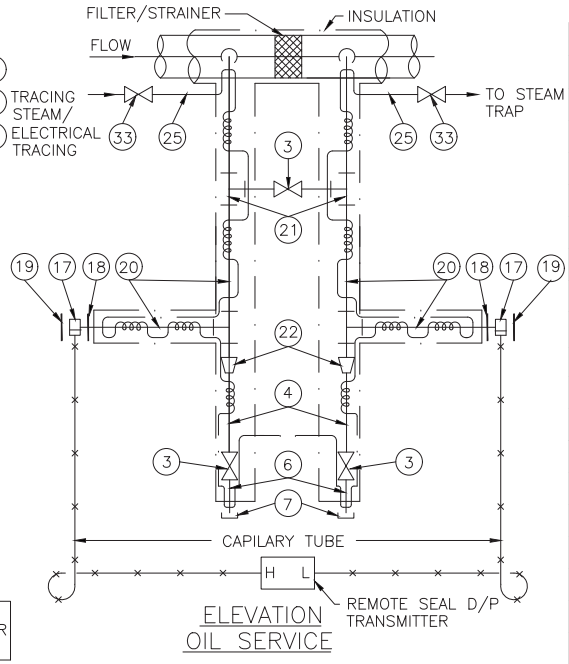
ELEVATION
(LIQUID SERVICE)

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

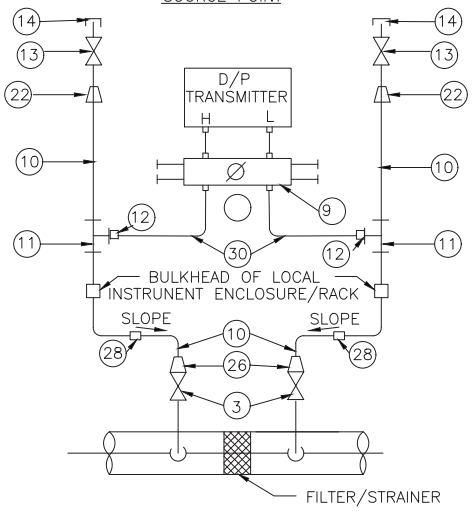


ELEVATION
(LIQUID SERVICE)

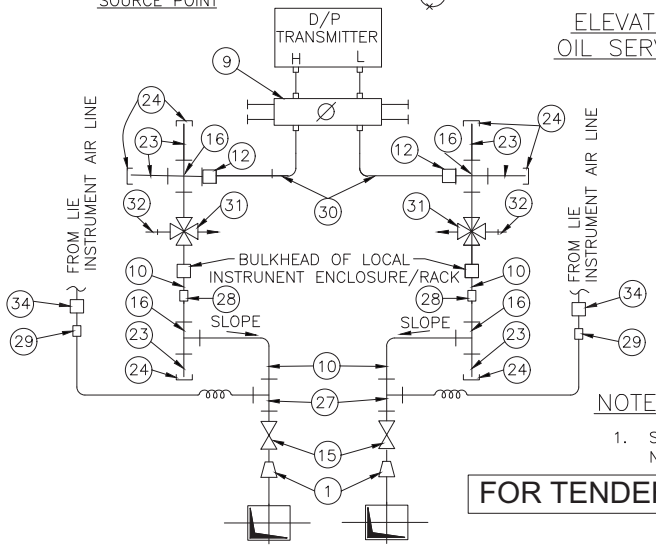
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



ELEVATION
OIL SERVICE



ELEVATION
CLEAN GAS/AIR SERVICE



ELEVATION
FUEL GAS SERVICE/DIRTY AIR SERVICE

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
DIFFERENTIAL PRESSURE MEASUREMENT

NOTES:–

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

FOR TENDER PURPOSE ONLY

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42x2 TO 3/4" SW REDUCING INSERT.
2.	3/4" SW GLOBE VALVE.
3.	1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4"/1" IN GAS/AIR APPLICATION
4.	1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" NPS SW x 1/2" NPT (M) NIPPLE.
7.	1/2" NPT (F) CAP.
8.	1/2" PIPE x 1/2" PIPE UNION.
9.	5 VALVE MANIFOLD (FOR DETAIL REFER DRAWING NO.0000–999–POI–A–026.
10.	3/4" SCH 80 CARBON/ALLOY STEEL PIPE.
11.	3/4"/1/2" SW EQUAL TEE.
12.	3/4"x1/2" TUBE UNION.
13.	1/2" SCREWED GLOBE VALVE.
14.	1/2" NPT (M) PLUG.
15.	3/4" SW GATE VALVE.
16.	3/4" SW EQUAL CROSS.
17.	WAFER ELEMENT FOR USE WITH 3"ANSI R.F. VALVE.
18.	3"BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE.
19.	3" BLIND FLANGE.
20.	1"NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.
21.	1" SW EQUAL TEE.
22.	3/4" x 1/2"SW REDUCING INSERT.
23.	3/4" SW x 3/4" NPT (M) CS/AS NIPPLE
24.	3/4" NPT (F) CS/AS CAP.
25.	1/4" NPS ALLOY STEEL PIPE.
26.	1" x 3/4" SW REDUCING INSERT.
27.	3/4" SW x 1/2" PSW BRANCH TEE.
28.	3/4" PIPE UNION
29.	1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE.
30.	SS TUBE
31.	3/4" SW 4 WAY VALVE.
32.	QUICK DISCONNECT FITTINGS.
33.	1/4" SW ISOLATION VALVE 316SS
34.	1/2" x 1/2" SS PIPE UNION.

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

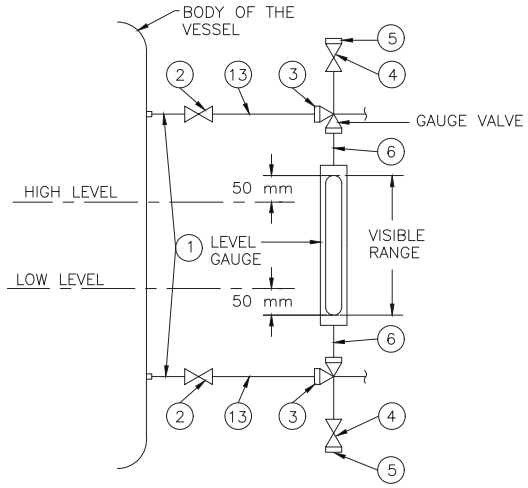
CLIENT **THDC INDIA LIMITED**
(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

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

PROJECT: TYPICAL THERMAL POWER PROJECT (TG PACKAGE)

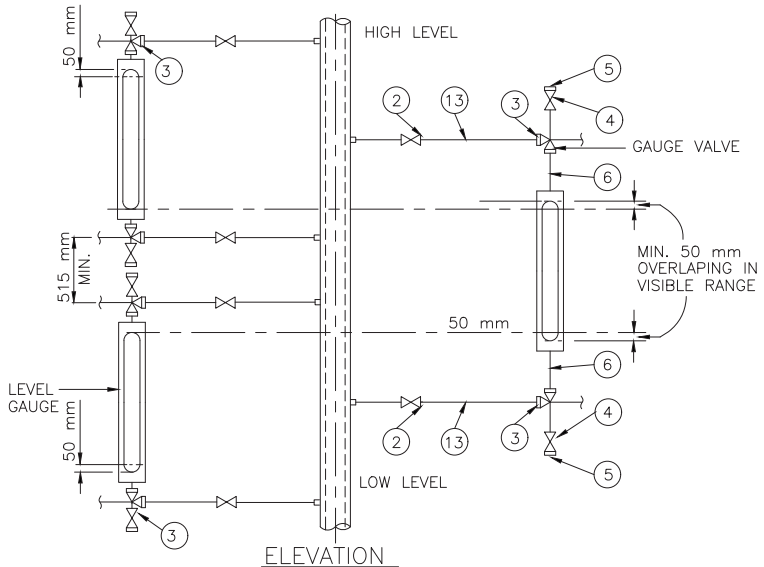
TITLE: INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS.MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-110-POI-A-030	A



ELEVATION

LOCAL LEVEL INDICATION USING GAUGE GLASS

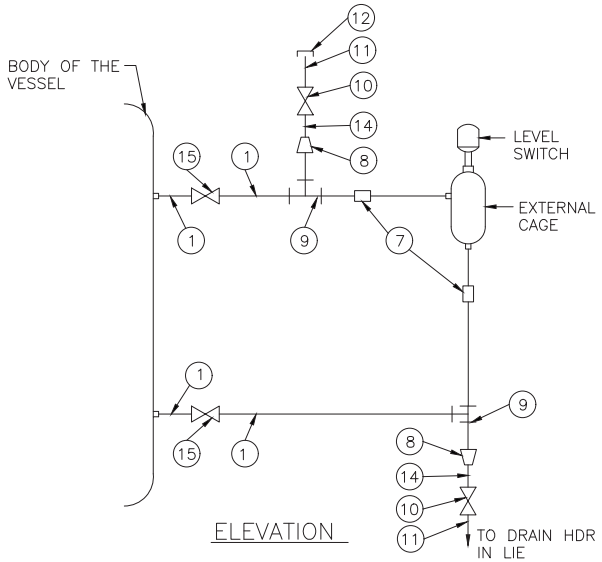


ELEVATION

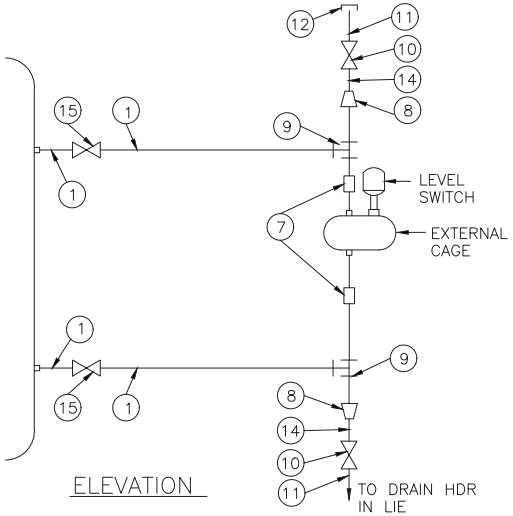
LOCAL LEVEL INDICATION USING MULTIPLE GAUGES
FOR INCREASED RANGE NOT COVERED IN A SINGLE UNIT

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

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

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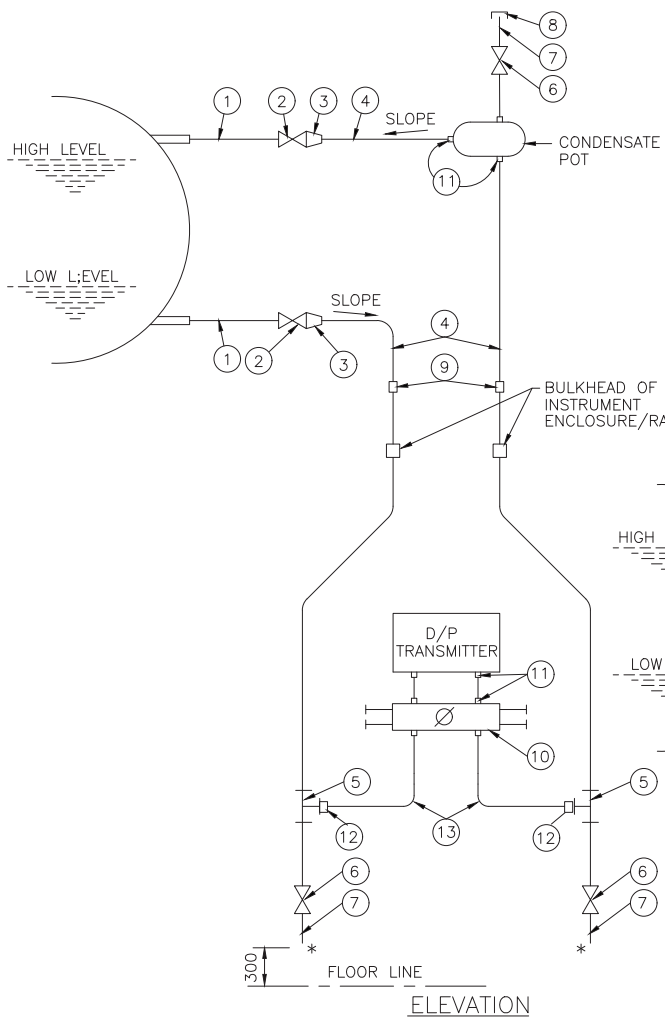
CLIENT **THDC INDIA LIMITED**
(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF UP)

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

PROJECT: TYPICAL THERMAL POWER PROJECT (TG PACKAGE)

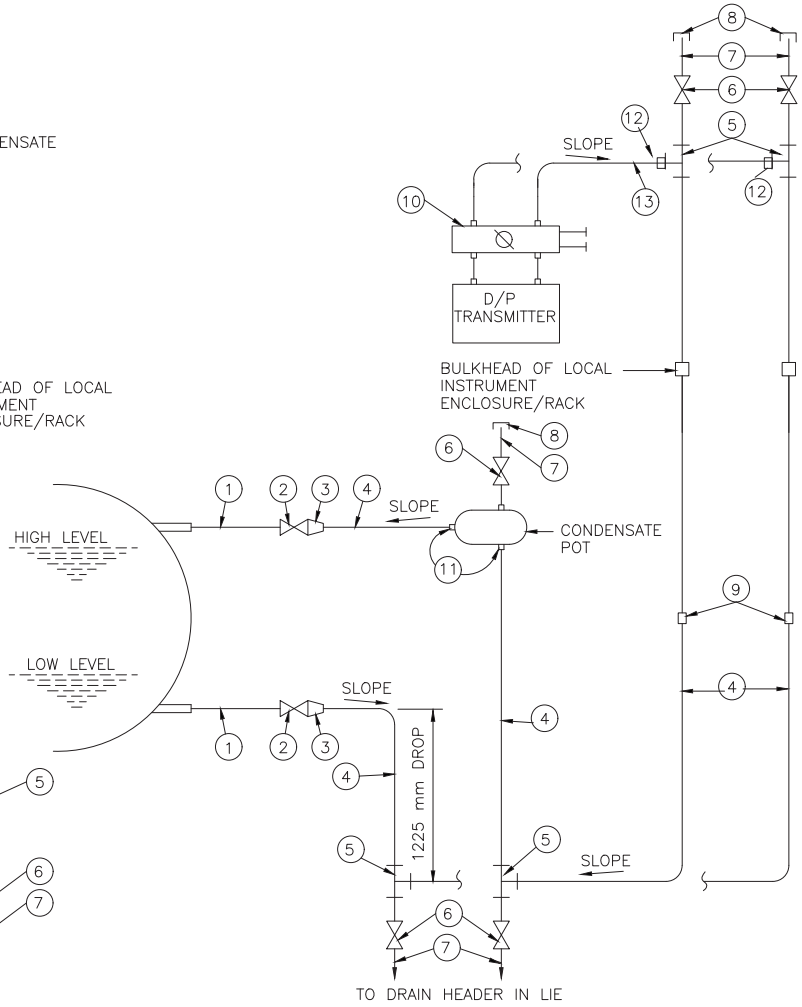
TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE & SWITCHES)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-110-POI-A-031	A



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)

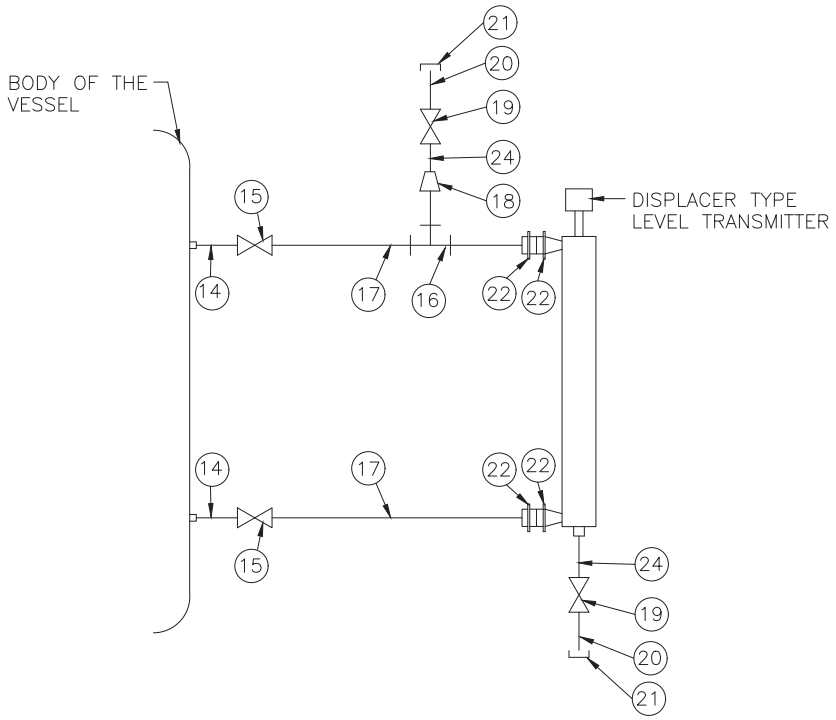
CONSULTANT एन टी पी सी NTPC
N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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
					CLEARED BY						
A	FIRST ISSUE										26.04.06

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



ELEVATION

DISPLACER TYPE LEVEL TRANSMITTER WITH SIDE CONNECTION

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	2" NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) VESSEL NOZZLE.
15.	2" SW GLOBE VALVE.
16.	2" SW EQUAL TEE.
17.	2" NPS SCH. 40/80 CS/AS PIPE
18.	2" x 3/4" SW REDUCING INSERT.
19.	3/4" SW GLOBE VALVE
20.	3/4" NPS SW x 3/4" NPT (M) CS/AS NIPPLE.
21.	3/4" NPT (F) CAP.
22.	2" ANSI 300 lbs RAISED PHASE WELD NECK FLANGE.
23.	2" ANSI FLANGE OF LEVEL TRANSMITTER.
24.	3/4" NPS SCH. 40/80 PIPE.

FOR TENDER PURPOSE ONLY

NOTES:–

1. SAME NOTES AS UNDER DRG. NO.0000–999–POI–A–023 (WHICHEVER ARE RELEVENT).

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

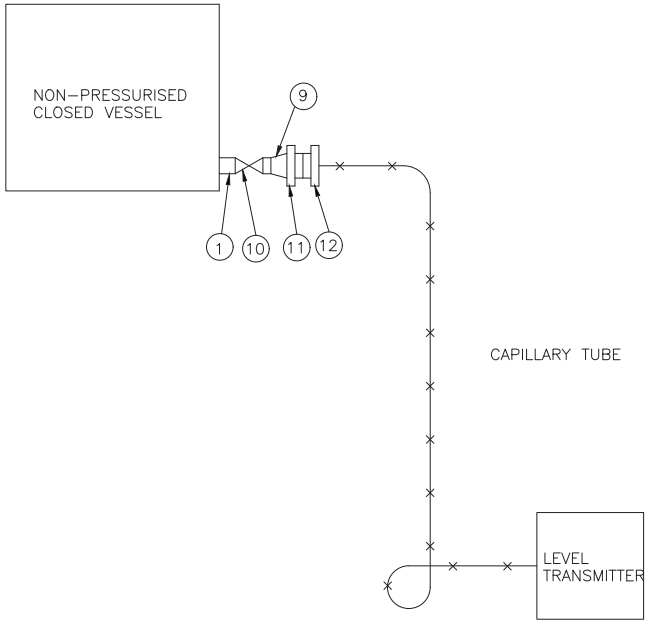
CONSULTANT
एन टी पी सी NTPC
N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT USING DISPLACER TYPE TRANSMITTERS)

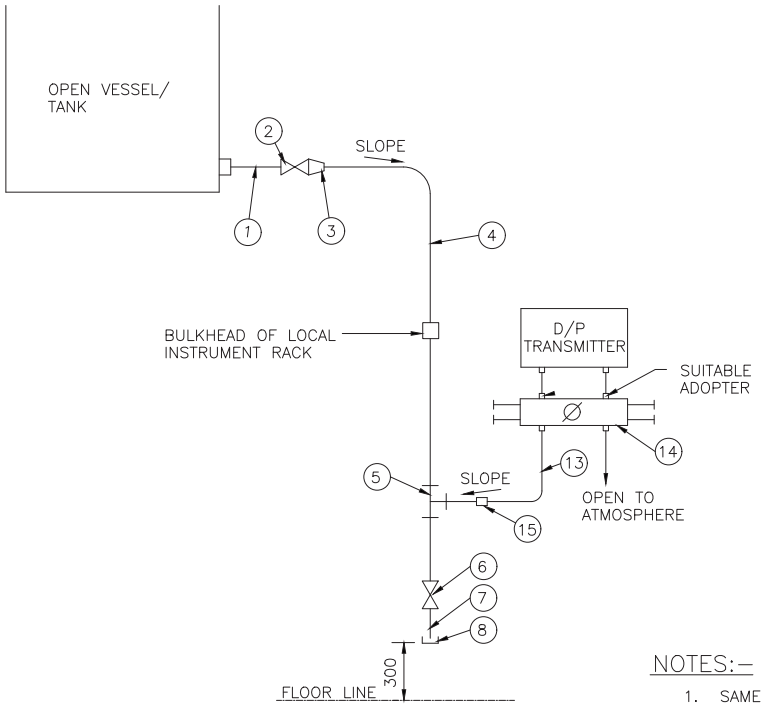
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										26.04.06
					CLEARED BY						

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



ELEVATION

LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID IN CLOSED VESSEL USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER WITH REMOTE SEAL



ELEVATION

LEVEL MEASUREMENT OF CLEAN LIQUID IN AN OPEN VESSEL USING D/P TRANSMITTER

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	3/4"/ 1" NPS 40/80 PIPE.
2.	3/4" SW GLOBE VALVE.
3.	3/4"/ 1/2" SW REDUCING INSERT.
4.	1/2" NPS SCH. 40/80 PIPE.
5.	1/2" SW EQUAL TEE.
6.	1/2" SW GLOBE VALVE.
7.	1/2" NPS SWx1/2" NPT(M) NIPPLE.
8.	1/2" NPT (F) CAP.
9.	3/4" TO 4" EXPANDER.
10.	3/4" BUTT WELDED GATE VALVE.
11.	4" ANSI 300 lbs R.F. WELD NECK FLANGE.
12.	4"ANSI MATCHING FLANGE WITH FLUSH DIAPHRAGM OF LEVEL TRANSMITTER
13.	SS TUBE.
14.	3–VALVE MANIFOLD (FOR DETAIL REF. DRG. NO. 0000–999–POI–A–023.
15.	1/2" PIPE x 1/2" TUBE UNION.

NOTES:–

1. SAME NOTES UNDER DRG. NO. 0000–999–POI–A–023.
2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

FOR TENDER PURPOSE ONLY

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

CONSULTANT
एन टी पी सी NTPC
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-OPEN VESSEL)

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-033	A

541909/2021/PS-PEM-MAX	THDC INDIA LIMITED 2X660 MW STPP KHURJA- TG PACKAGE	
	TECHNICAL SPECIFICATION (C&I) FOR NaOH DOSING SYSTEM	

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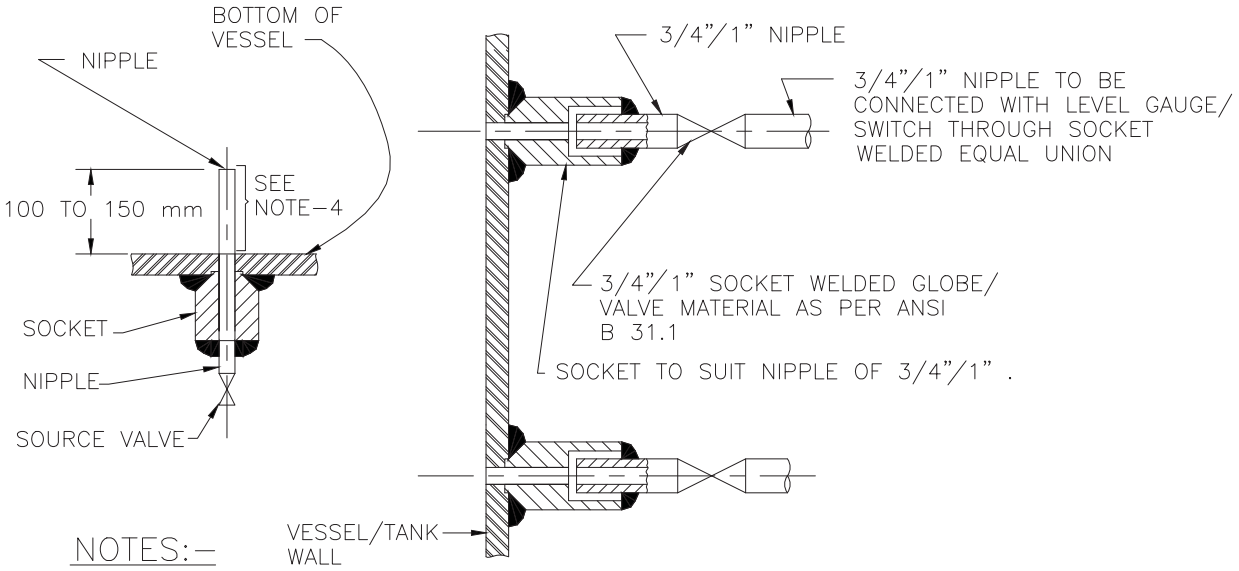
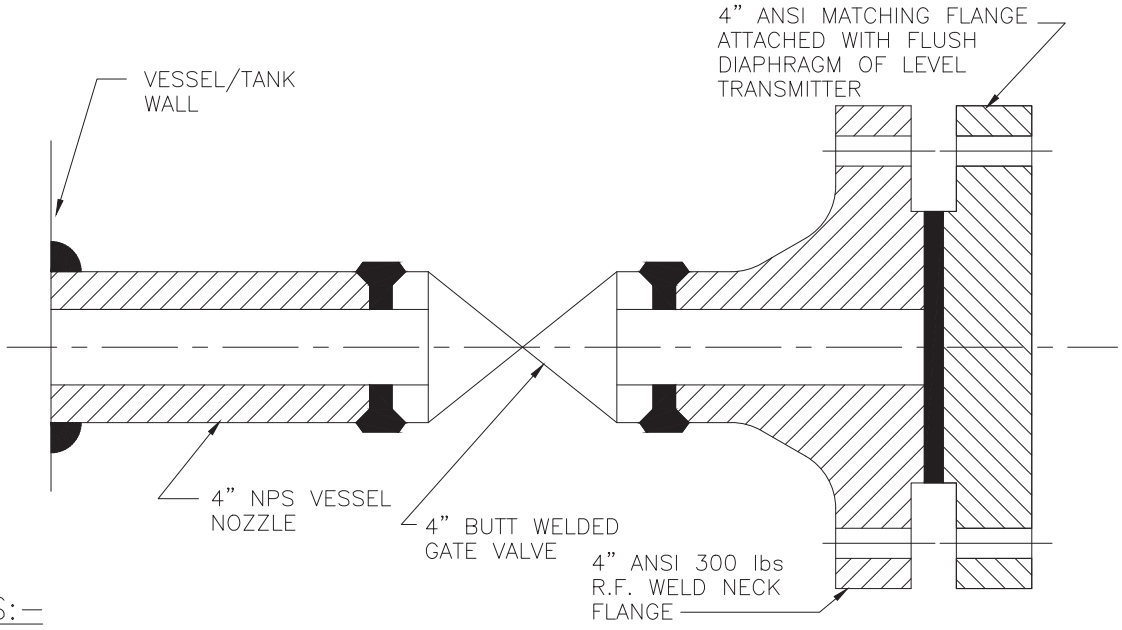
INSTRUMENT STUB DETAILS



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

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

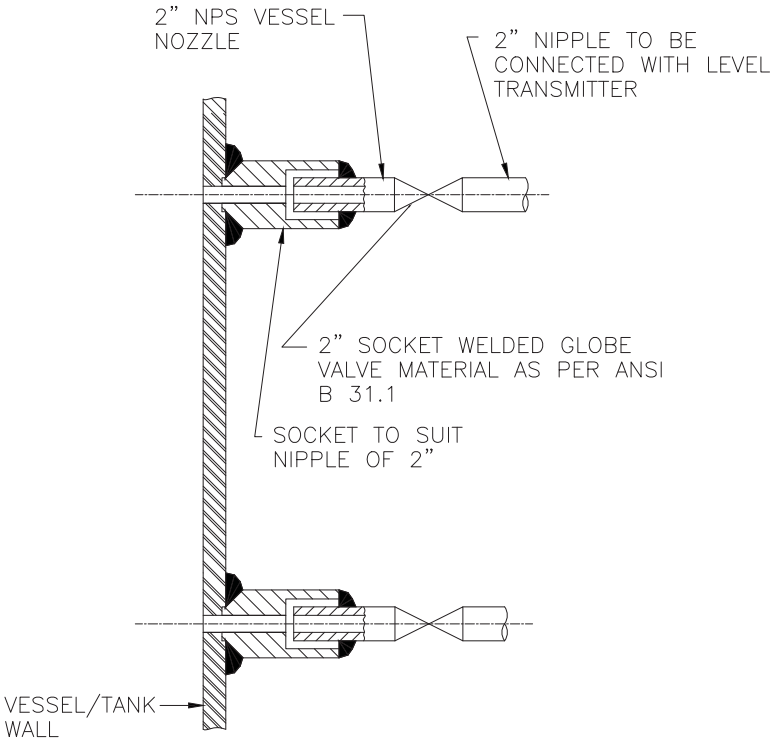
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE										26.04.06
					CLEARED BY						

PROJECT: TYPICALTHERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-110-POI-A-035 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

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

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

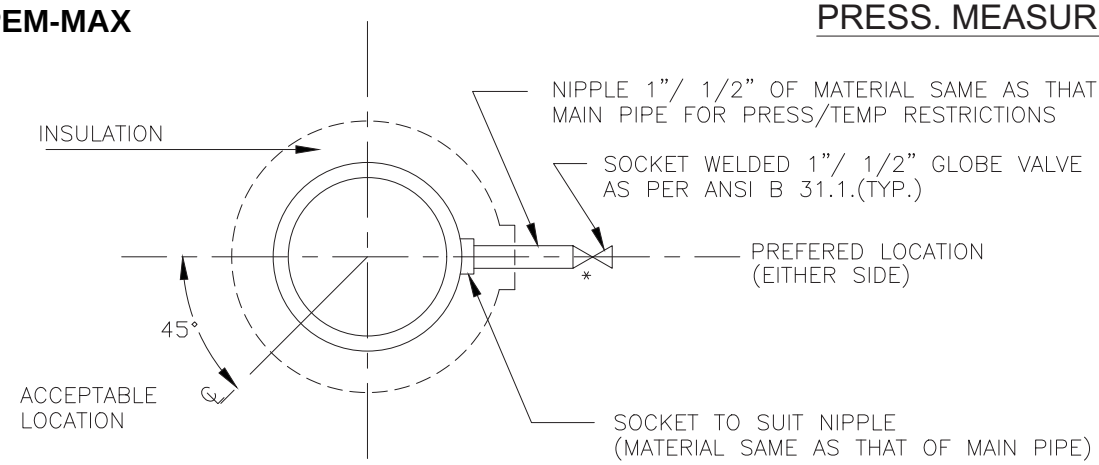
PROJECT: TYPICALTHERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

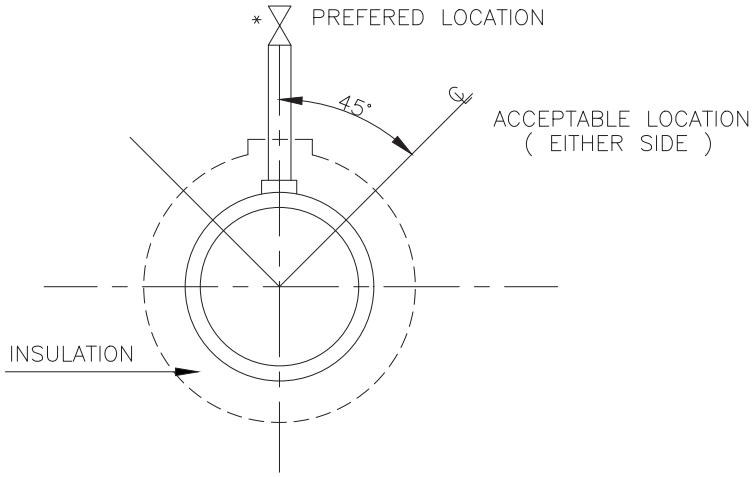
SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-110-POI-A-035 Sh–14 Of 14	A

541909/2021/PS-PEM-MAX

PRESS. MEASUREMENT

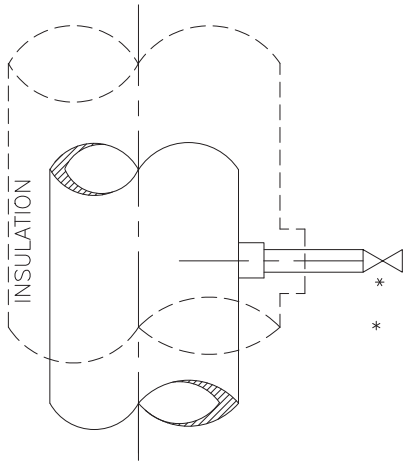


ELEVATION
LIQUID SERVICE



ELEVATION
STEAM SERVICE

PRESSURE CONNECTION ON HORIZONTAL PIPE



* USE DOUBLE ISOLATION VALVES FOR PRESSURE EQUAL TO OR EXCEEDING 40 Kg/Cm2.

FOR TENDER PURPOSE ONLY

ELEVATION
LIQUID OR STEAM SERVICE

PRESSURE CONNECTIONS ON VERTICAL PIPES

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

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

PROJECT: TYPICALTHERMAL POWER PROJECT (TG PACKAGE)

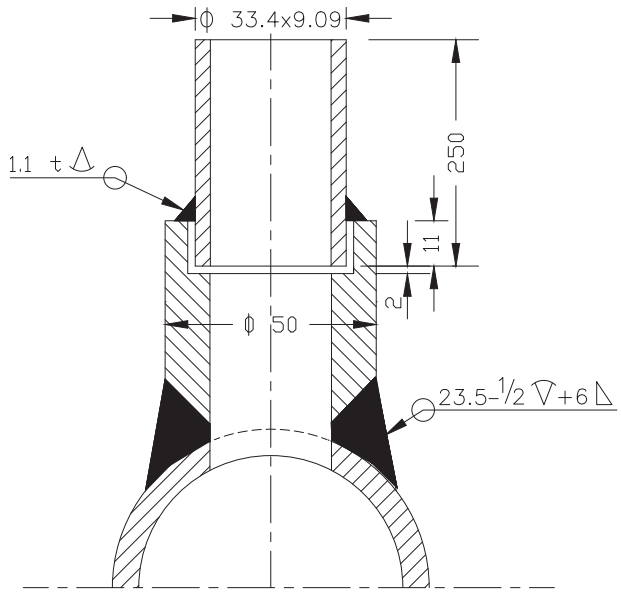
TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-110-POI-A-035 Sh–1 Of 14	A

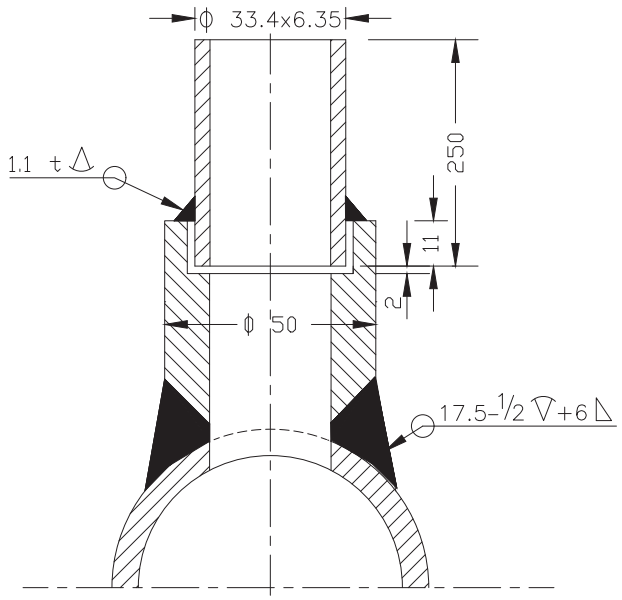
541909/2021/PS-PEM-MAX

PRESSURE MEASUREMENT

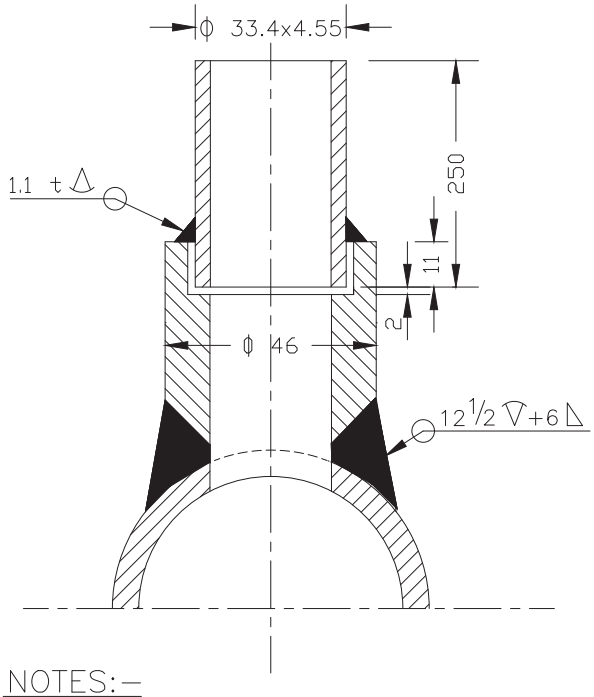
(SYSTEM PR.>40Kg/Sq Cm CL 9000)



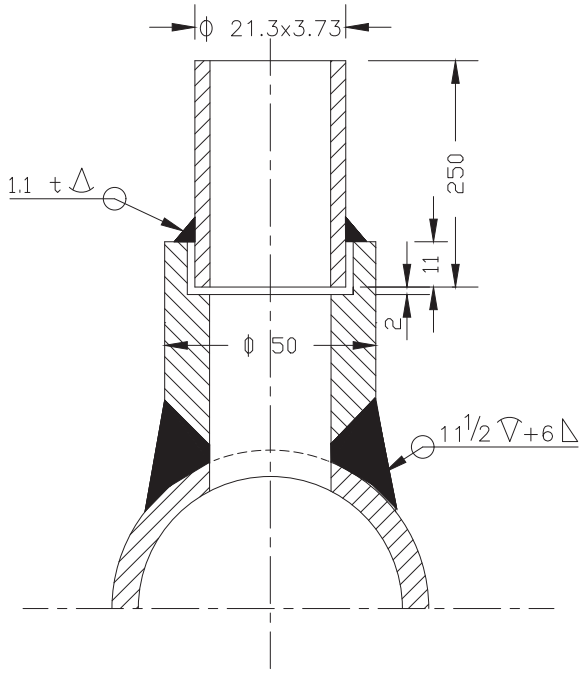
(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(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 CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

FOR TENDER PURPOSE ONLY

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

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

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

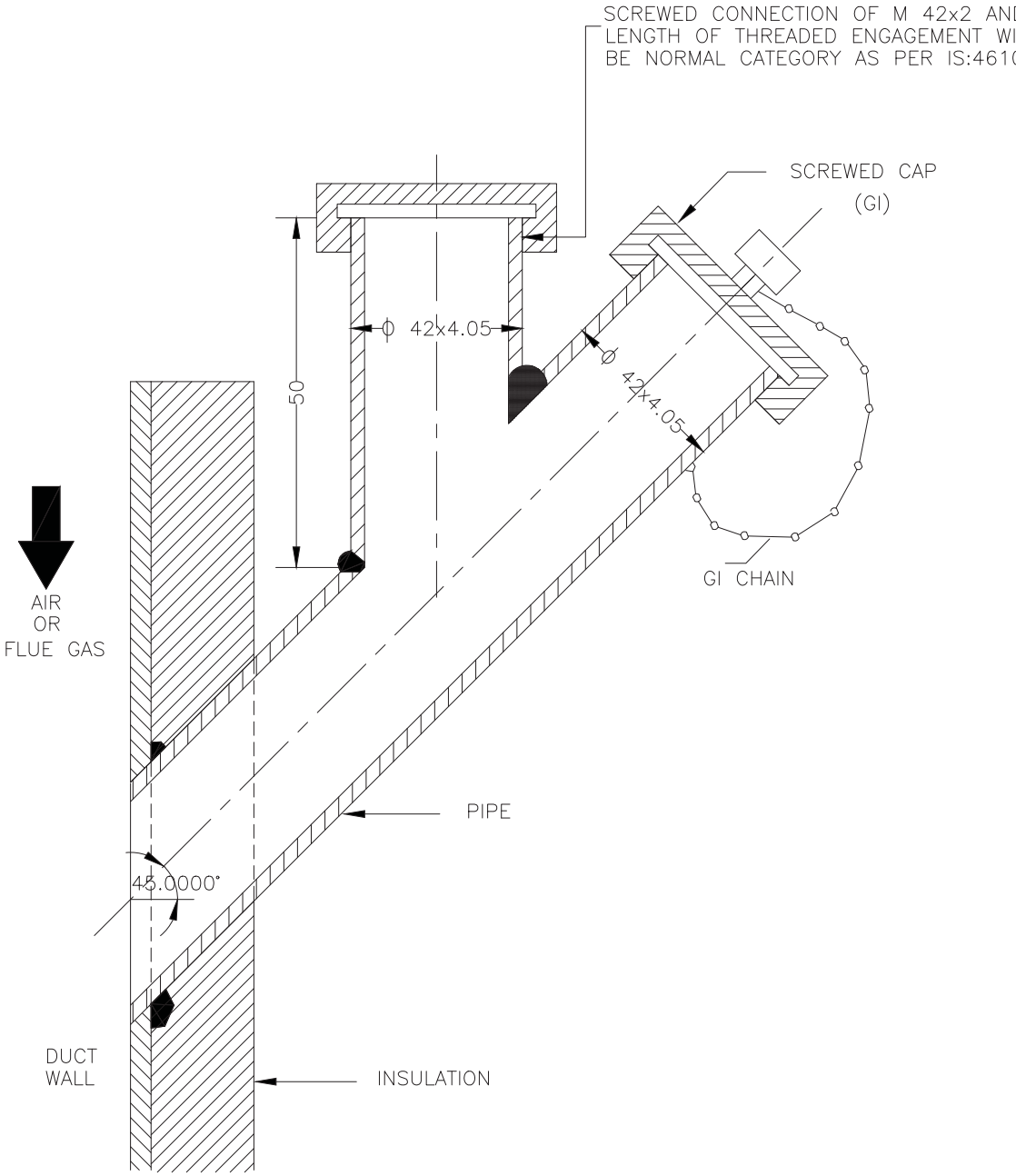
PROJECT: TYPICALTHERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-110-POI-A-035 Sh–2 Of 14	A

541909/2021/PS-PEM-MAX

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

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

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

PROJECT: TYPICALTHERMAL POWER PROJECT (TG PACKAGE)

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

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.
A4	N.T.S.	0000-110-POI-A-035 Sh–3 Of 14	A

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **NaOH DOSING SYSTEM**	

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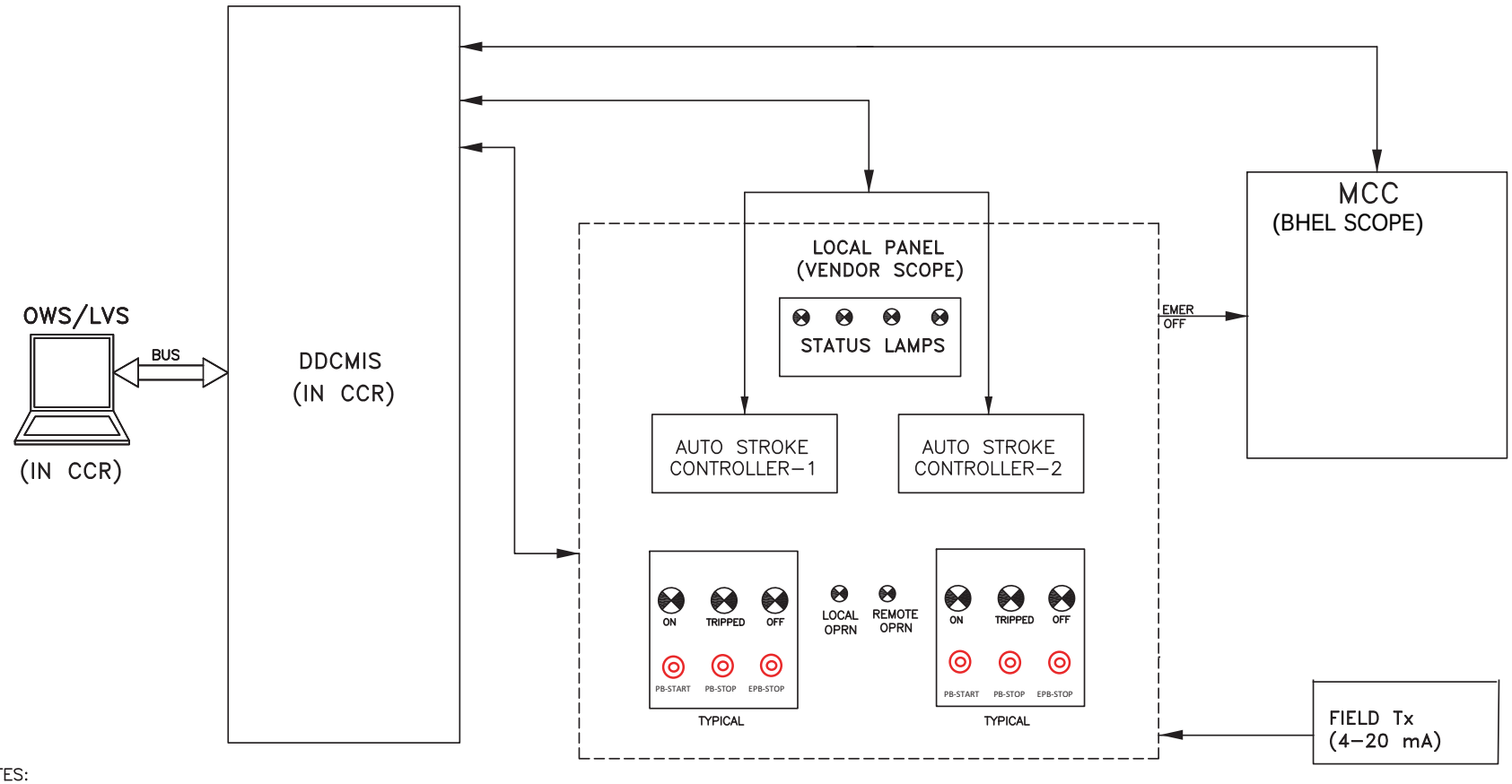
SIGNAL EXCHANGE BETWEEN DRIVES AND DCS

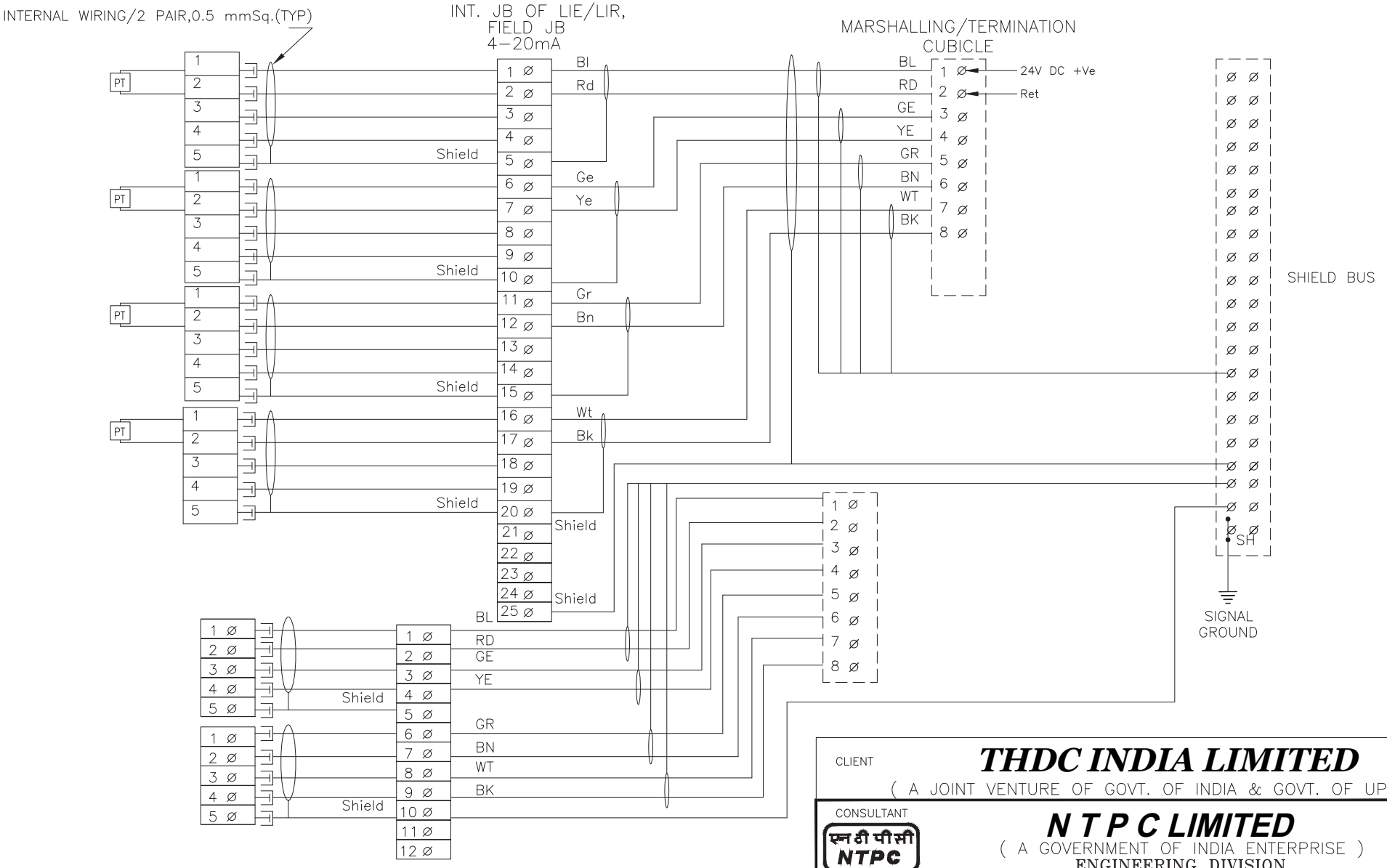
BLOCK INTERFACE FOR CHEMICAL DOSING SYSTEM (TYPICAL)



NOTES:

1. SIGNAL EXCHANGE BETWEEN DDCMIS & CHEMICAL DOSING LOCAL PANEL BE AS PER CONTROL PHILOSOPHY.
2. FIELD INSTRUMENT SHALL BE TERMINATED IN LOCAL PANEL.
3. SIGNALS FOR INTERFACE TO/FROM DDCMIS ARE ALSO TERMINATED IN LOCAL PANEL.

BHEL		DRG.NO.	PE–DG–999–145–I273A
		DATE	
	TITLE STANDARD BLOCK INTERFACE DIAGRAM FOR LP DOSING SYSTEM	REV.NO.	01
		SHT	



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

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

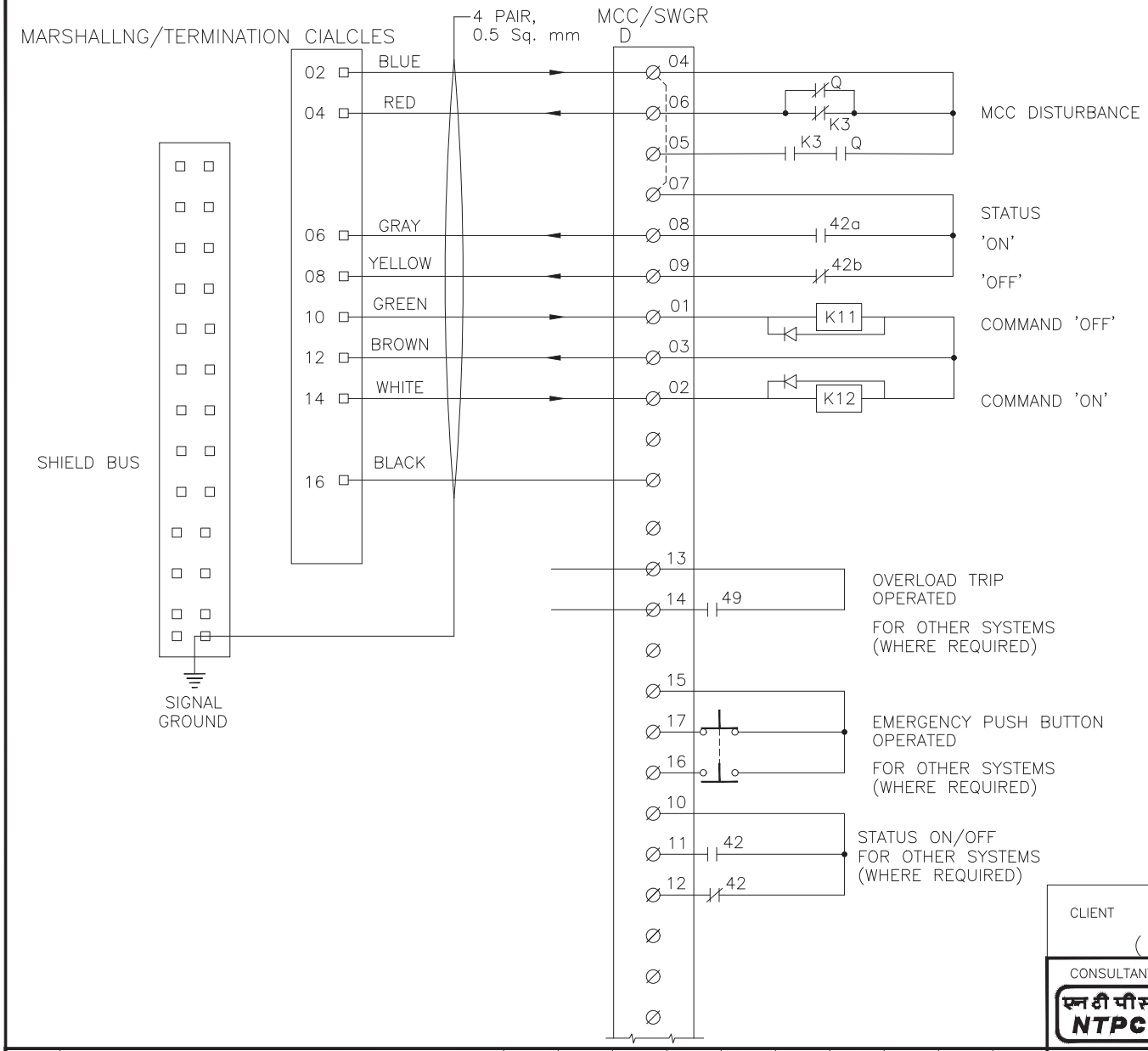
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS 4-20mA

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

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 04 OF 14	A

CAD FILE NAME: C:\PC_MS\TYPTPP_SG,TG,BOP\OCT,02\0000-999-POI-A-065SH04rD.DWG



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

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

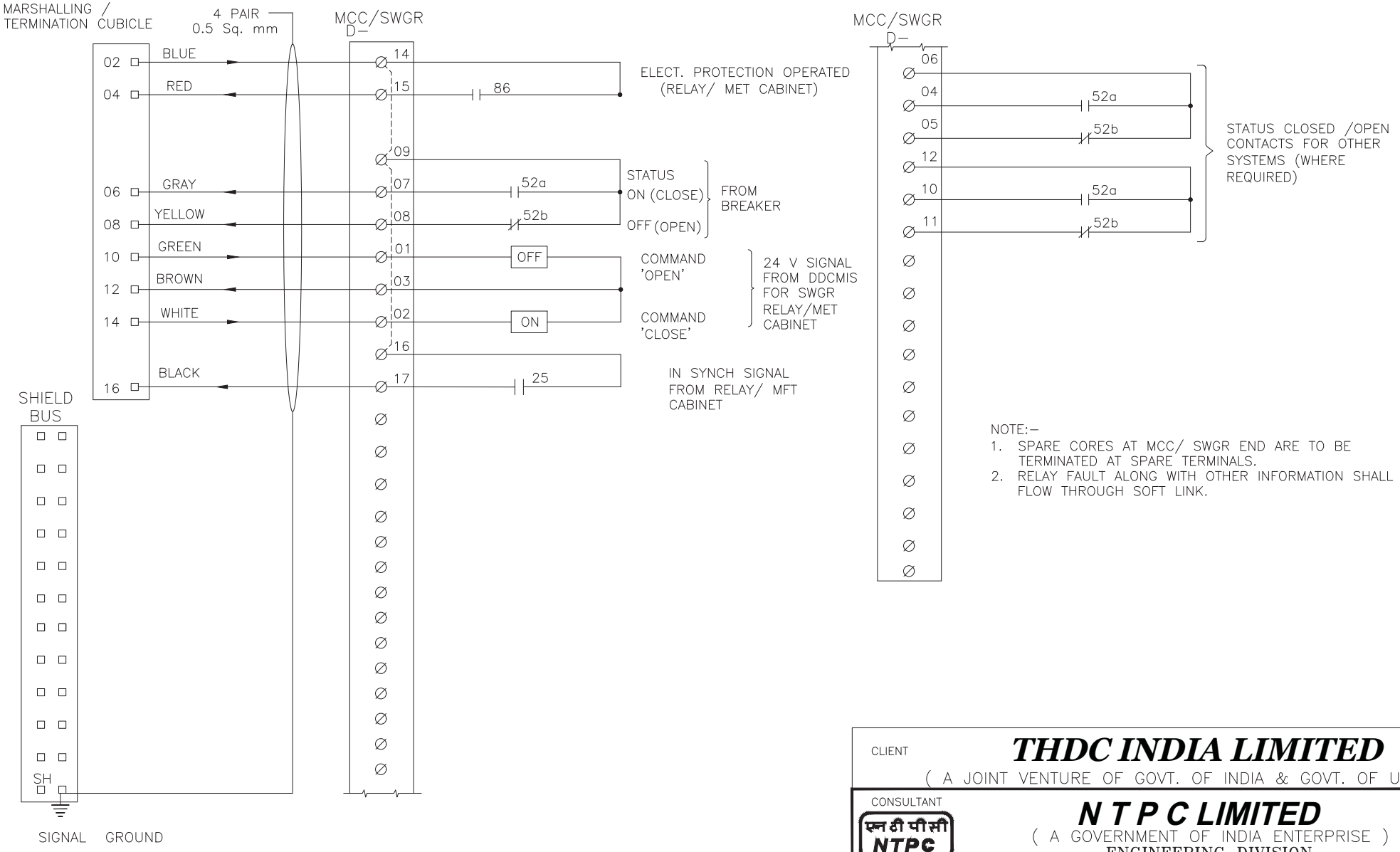
PROJECT: TYPICAL THERMAL POWER PROJECT

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

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

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 05 OF 14	A

CAD FILE NAME: C:\PC_MS\TYPTPP_SG,TG,BOP\OCT,02\0000-999-POI-A-065SH05rD.DWG



NOTE:–
1. SPARE CORES AT MCC/ SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.

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

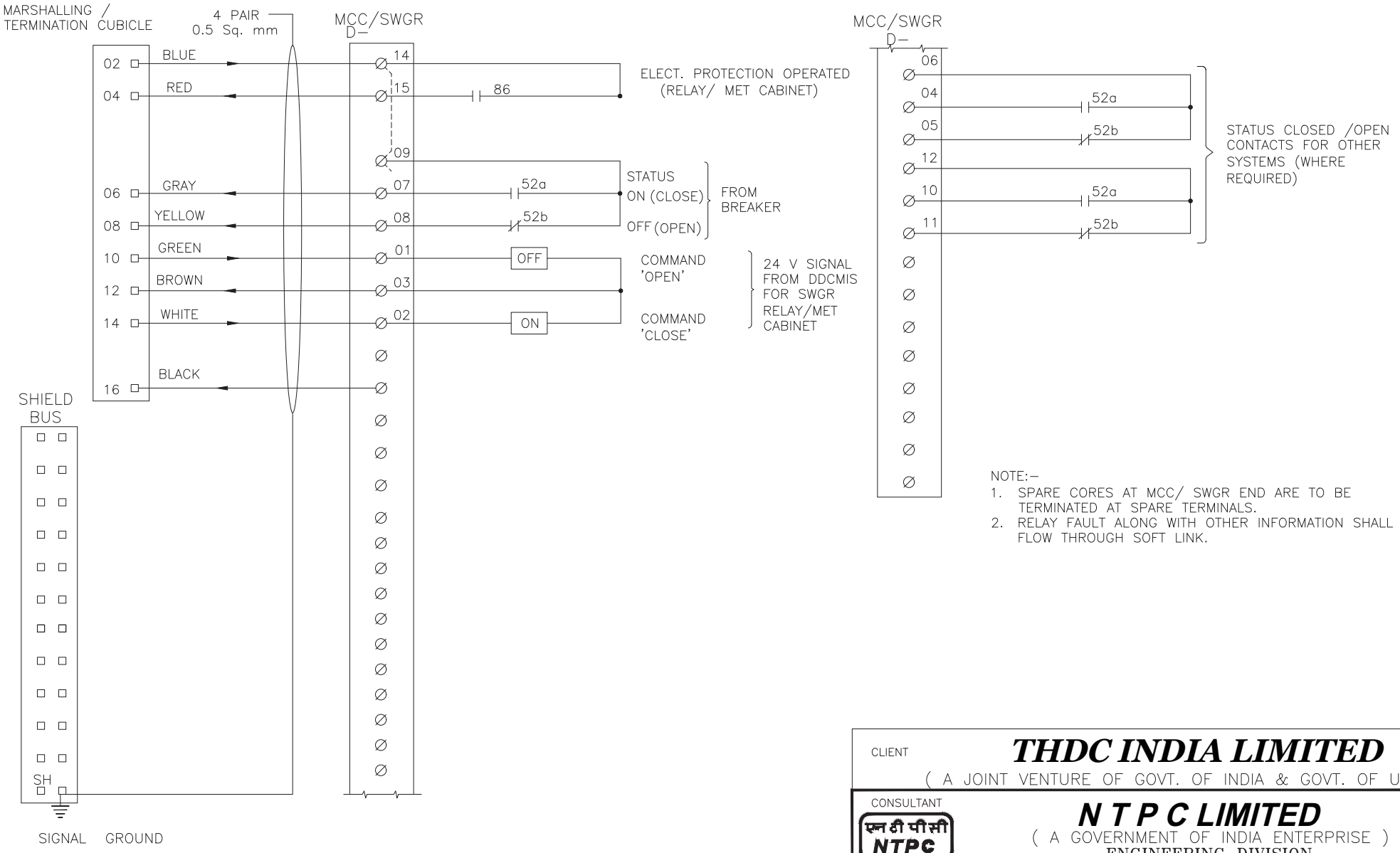
CONSULTANT **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(Elect.Bkr. -Sync.-LT)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										14.02.08
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 10 OF 14	A



NOTE:–
1. SPARE CORES AT MCC/ SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.

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

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

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(Elect.Bkr. -Non.Sync.-LT)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										14.02.08
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 12 OF 14	A

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR NaOH DOSING SYSTEM	

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QUALITY ASSURANCE FOR INSTRUMENTS & LCP AND TYPE TEST REQUIREMENTS

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) Page- 1/2									
TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-60770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y
R-Routine Test A- Acceptance Test Y – Test applicable									
: Note: **1)** This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.									

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) Page- 2/2

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **			Y	Y **	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y *	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Analysers	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

PROCESS CONNECTION & PIPING

TESTS / ITEMS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening,flaring,hydrotest,hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydrulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure Y Y Y	Y	Y Y Y	Y Y	Y Y Y	Y												
Local instruments racks Y Y Y Y	Y Y	Y Y Y	Y Y	Y Y													
Junction Box Y Y Y Y* Y Y Y																	
Gauge Board Y Y Y Y Y Y Y Y	Y																
Impulse pipes and tubes Y Y Y	Y	Y															
Socket weld fittings ANSI B-16.11	Y	Y Y		Y Y													
Compression fittings Y Y Y	Y Y	Y															
Instrument valves & Valve manifolds	Y	Y Y		Y Y													
Copper tubings ASTM B75 Y	Y	Y															

*-applicable for painted junction boxes.

Note: R-Routine Test A- Acceptance Test Y – Test applicable

Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

CLAUSE NO.

QUALITY ASSURANCE

INSTRUMENTATION CABLE

TESTS / ITEMS	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y			Y			Y								
Insulation(VDE-207)				Y	Y	Y	Y						Y		Y
Pairing/Twisting				Y	Y		Y								
Shielding				Y			Y			Y					
Drain wire	Y			Y			Y		Y	Y					
Inner Sheath				Y	Y	Y	Y					Y	Y		
Outer Sheath				Y	Y	Y	Y					Y	Y		
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)				Y			Y								

Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.

Note : ® - Routine Test A - Acceptance Test Y - Test Applicable

Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)
- ** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk (As applicable)

\+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

CLAUSE NO.

QUALITY ASSURNACE & INSPECTION

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes Characteristics / ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

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

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.

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

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 ma□or 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 A□SI 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 A□SI 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 E□ □1000-4-12 which is equivalent to A□SI 37.90.1/ IEEE-472 may also be adopted for SWC test.

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

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

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

v) Electrostatic discharge tests as per E□ □1000-4-2 or equivalent.

vi) Radio frequency immunity test as per E□ □1000-4-□ or equivalent.

vii) Electromagnetic Field immunity as per E□ □1000-4-3 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. □o	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 □
1	Elect. Metering instruments	As per standard (col 4)	IS-124□	□o	□o
2	Transducers	As per standard (col 4)	IEC-□0□□□,IS127□4	□o	□o
3	Thermocouple	Degree of protection test	IS-13947	□o	□o
4	RTD	As per standard (col 4)	IEC-□0751	□o	□o
5	Electronic transmitter	As per standard (col 4)	BS-□447 / IEC-□0770	□o	□o
□	E/P converter	As per standard (col 4)	Mfr. standard	□o	□o
7	Dust emission monitor	Degree of protection test	IS-13947	□o	□o
□	Instrumentation Cables Twisted & Shielded□				
	-Conductor	Resistance test	VDE-0□15	□o	□o
		Diameter test	IS-10□10	□o	□o
		Tin Coating test (Persul-phate test)	IS-□130	□o	□o
	-Insulation	Loss of mass	VDE 0472	□o	□o
		Ageing in air ovens□□	VDE 0472	□o	□o
		Tensile strength and	VDE 0472	□o	□o

		elongation test before and after ageing□□			
		Heat shock	VDE 0472	□o	□o
		Hot deformation	VDE 0472	□o	□o
		Shrinkage	VDE 0472	□o	□o
		Bleeding & blooming	IS-10□10	□o	□o
	-Inner sheath□□□	Loss of mass	VDE 0472	□o	□o
		Heat shock	VDE 0472	□o	□o
		Cold bend/ cold impact test	VDE 0472	□o	□o
		Hot deformation	VDE 0472	□o	□o
		Shrinkage	VDE 0472	□o	□o
	-Outer sheath	Loss of mass	VDE 0472	□o	□o
		Ageing in air ovens□□	VDE 0472	□o	□o
		Tensile strength and elongation test before and after ageing□□	VDE 0472	□o	□o
		Heat shock	VDE 0472	□o	□o
		Hot deformation	VDE 0472	□o	□o
		Shrinkage	VDE 0472	□o	□o
		Bleeding & blooming	IS-10□10	□o	□o
		Colour fastness to water	IS-5□31	□o	□o
		Cold bend/ cold impact test	VDE-0472	□o	□o

		Oxygen index test	ASTMD-2□□3	□o	□o
		Smoke Density Test	ASTMD-2□43	□o	□o
		Acid gas generation test	IEC-□0754-1	□o	□o
	-fillers	Oxygen index test	ASTMD-2□□3	□o	□o
		Acid gas generation test	IEC-□0754-1	□o	□o
	-AL-MYLAR shield	Continuity test		□o	□o
		Shield thickness		□o	□o
		Overlap test		□o	□o
	-Over all cable	Flammability Test	IEEE 3□3	□o	□o
		Swedish Chimney Test	SE□ 4241475	□o	□o
		□oise interference	IEEE Trans-actions	□o	□o
		Dimensional checks	IS 10□10	□o	□o
		Cross talk	VDE-0472	□o	□o
		Mutual capacitance	VDE-0472	□o	□o
		HV test	VDE-0□15	□o	□o
		Drain wire continuity		□o	□o

□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 □ & ASTMD-211□ for TEFLO□ 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)	A□SI 37.90.1, □o IEEE-472,E□ □1000-4-12		□o
Dry Heat Test	IEC-□□-2-2 or□ equivalent	□o	□o
Damp Heat test	IEC-□□-2-3 or□ equivalent	□o	□o
Vibration test	IEC□□-2-□ or□ equivalent	□o	□o
Electrostatic discharge test	E□ □1000-4-2 orr equivalent	□o	□o
Radio frequency immunity test	E□-□1000-4-3 orr equivalent	□o	□o
Electromagnetic field immunity	E□ □1000-4-3 orr equivalent	□o	□o
Degree of Protection	IS-13947 or□ equivalent	□o	□o

10	Battery □□	As per standard (col 4)	IS-1091□ (□i-Cd Batteries)	□o	□o
			IS-1□52 (Lead Acid Plante Batteries)	□o	□o
11	□OT APPLICABLE				
12	□PS (Applicable for each model and rating)				

1) Type Test reports of same series of UPS with similar PCB's cards and controllers as the target □PS system shall be acceptable.

2) For Dry heat, Damp heat and vibration, the tests conducted on individual PCB's shall be acceptable.

	Surge Withstand Capability(SWC)	A□SI 37.90.1, IEEE-472,E□ □1000-4-12	□o	□o
	Dry Heat Test	IEC-□□-2-2 or equivalent	□o	□o
	Damp Heat test	IEC-□□-2-3 or equivalent	□o	□o
	Vibration test	IEC□□-2-□ or equivalent	□o	□o
	Electrostatic discharge test	E□ □1000-4-2 orr equivalent	□o	□o
	Radio frequency immunity test	E□-□1000-4-3 orr equivalent	□o	□o
	Electromagnetic field immunity	E□ □1000-4-3 orr equivalent	□o	□o
	Degree of protection test	IS-13947	□o	□o
	Fuse Clearing Capability	Approved procedure	□o	□o
	Short Circuit current capability	IEC □014□-2	□o	□o
13	Voltage Stabilisers	Over Load Test	Approved procedure	□o	□o

		Temp rise test without redundant fans	Approved procedure	□o	□o
14	Public Address System				
	IP based PA system components	As per Standard	IEC □02□□-1□	□o	Yes
15	LIE / LIR	Degree of protection test	IS-13947	□o	□o
1□	Flue gas analy□ers	Degree of protection test	IS-13947	□o	□o
17	Master Clock	Functional test	As per approved procedure	□o	□o
1□	C□C Box	Degree Of protection test	IS-13947	□o	□o
19	□unction Box	Degree Of protection Test	IS-13947	□o	□o
20	OPC Data Access Server, Data Exchange Server & Historical Data Access Server	OPC Compliance Testing		□o	□o (Self certification is also acceptable)
21	Conductivity Type Level Switch	Degree of protection test	IS-2147	□o	□o
22	Local Gauges	Degree of protection test	IS-2147	□o	□o
23	Process actuated Switches	Degree of protection test	IS-2147	□o	□o
24	Control Valves	CV test	ISA 75.02& 75.11	□o	□o
25	PLCs	As per standard (Col	IEC 1131	□o	□o

4)

2□	Flow Orifice Venturi	□o□□le plates,	Calibration	ASME PTC BS 1042	□o	□o

□□ The contractor shall submit for Employers approval the reports of all the type test as per latest IS-1091□ 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.

N□□□:

Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **NaOH DOSING SYSTEM**	

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MANDATORY SPARE LIST

CLAUSE NO.	MANDATORY SPARES
2.00.00	MEASURING INSTRUMENTS

3	**Measuring Instruments**	
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
c)	Pressure, Differential Pressure, Flow, Level and temperature switches	20% of the total population or minimum

CLAUSE NO.	MANDATORY SPARES

		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

5.00.00 CONTROL DESK & CONTROL PANEL (as applicable)

Sl No	Item	Quantity
(i)	UCD mounted devices as per Appendix-I to Part-A, Section-VI	10% of each type subject to max. 5 nos. of each type.
(ii)	Replacement lamps/LED's for each type of lamps/LED	100%
(iii)	Blank tiles	10% of total no. of tiles.
(iv)	MCBs	10% of each type and rating.
(v)	Fuses	100% of each type and rating.
(vi)	Boiler and Turbine trip pushbuttons	2 nos of each type and rating.

CLAUSE NO.	MANDATORY SPARES

8.00.00 PROCESS CONNECTION PIPING (FOR IMPULSE PIPING/TUBING, SAMPLING PIPING/TUBING AND AIR SUPPLY PIPING AS APPLICABLE)

Sl. No.	ITEM	QAUNTITY
(i)	Valves of all types	10%
(ii)	2 way, 3 way, 5 way valve manifolds	10% of each type, class, size and model
(iii)	Fittings	10%
(iv)	Purge meters	5% of each model
(v)	Filter regulators	20% of each model

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **NaOH DOSING SYSTEM**	

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SUB VENDOR LIST

541909/2021/PS-PEM-MAX

PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 9/20/2021 10:13:36 AM

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
1	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	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
2	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	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
3	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	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
4	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	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
5	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	Works-1->NA NA -- Phone- FAX : Pincode : Email :
6	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	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
7	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com
8	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net	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
9	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	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
10	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	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
11	145-11000-A	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	
12	145-11000-A	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	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
13	145-11000-A	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	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
14	145-14000-A	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	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
15	145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
16	145-14000-A	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	
17	145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	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
18	145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	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
19	145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	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
20	145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,	Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad-MAHARASHTRA India Phone-9881000474, FAX : 0240-2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetzer.endress.com
21	145-14000-A	TRANSMITTERS	PANAM ENGINEERS	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
22	145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	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
23	145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	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

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

24	145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	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
25	145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :
26	145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	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
27	145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vspl.net.in	
28	145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net	
29	145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	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
30	145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com	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
31	145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	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
32	145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com	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
33	145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	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
34	145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	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
35	145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	
36	145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	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
37	145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	
38	145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	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
39	145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	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
40	145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	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
41	145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com	
42	145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com	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
43	145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com	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
44	145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	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
45	145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	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
46	145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	

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

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47	145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com	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
48	145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	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
49	145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	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
50	145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	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

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

	THDC INDIA LIMITED **2X660 MW STPP KHURJA- TG PACKAGE**	
	TECHNICAL SPECIFICATION (C&I) FOR **NaOH DOSING SYSTEM**	

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KKS NUMBERING PHILOSOPHY

DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

2X660 MW KHURJA – TG PACKAGE

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-**1.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

1) Sewage Treatment Plant : GRS, GRN, GRC

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level

CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- *Equipment Code – AA*

		N1	N2 N3
Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*1*	*51 to 99*
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			

	Hydraulic	-	3	01 to 99
	NRV (Without actuation)	-	4	01 to 99
	Manual	-	5	01 to 99
	Manual	-	6	01 to 99
	Relief & Safety Valves	-	7	01 to 99
	Reserve	-	8	01 to 99
	Reserve	-	9	01 to 99
ii)	Field Instruments			
	Field Transmitters & Analog Signals	-	0	01 to 99
	Field Switches & Binary Signals	-	1	00 to 99
	PG Test Point	-	4	00 to 99
	Gauges	-	5	00 to 99
	Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
	(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ……. Where system code is same.

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). PROJECT2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME III	
		REV. NO. 00	DATE:

VOLUME-III

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). PROJECT: **2X660 MW KHURJA SUPER THERMAL POWER PROJECT** (**TURBINE GENERATOR AND ASSOCIATED PACKAGES**)	BHEL DOCUMENTS NO.: PE-TS-475-154-A001 VOLUME: III SECTION: REV NO: 00 DATE:

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME III	
		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).

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/Customer.

11. Prices for recommended spares (if any) for three year operation shall be furnished separately and not to be included in the base price.

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING). PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)	BHEL DOCUMENTS NO.: PE-TS-475-154-A001
		VOLUME III
		REV. NO. 00 / DATE:

DRAWING/DOCUMENTS SUBMISSION SCHEDULE FOR CHEMICAL DOSING SYSTEM

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

For the Drawings/Documents Submission Procedure, please refer **Sec-C1**. The submission of soft copy or hard copy of the drawing/document whichever is later will be considered as final date of submission of the drawing/document. 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 note that the drawings to be submitted by bidder in the event of award of contract shall be as per the below given drawing/document list. Bidder to note that any additional drawings/documents requirement during detailed engineering shall be provided by bidder without any technical, commercial and delivery implications to BHEL. Bidder confirmed that every revised submission incorporating comments – within 7 days.

Bidder further confirmed that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

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

Sl. No.	BHEL Drg. No.	Title	CATEGORY	No. of weeks for document submission after placing LOI/LOA	SIZE OF DRAWING/ DOCUMENT
1	PE-V1-468-154-A001	P&I DIAGRAM	A	4	A1
2	PE-V1-468-154-A002	GA DRAWING	A	4	A1
3	PE-V1-468-154-A003	DATA SHEET FOR SYSTEM	A	6	A4
4	PE-V1-468-154-A004	LCP DRAWING	A	6	A4
5	PE-V1-468-154-A005	QAP	A	4	A1
6	PE-V1-468-154-A006	PACKING PROCEDURE	A	8	A4
7	PE-V1-468-154-A007	O& M MANUAL	A	8	A4

(b) 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

	TITLE: **TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING).** **PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT** **(TURBINE GENERATOR AND ASSOCIATED PACKAGES)**	BHEL DOCUMENTS NO.: PE-TS-475-154-A001	
		VOLUME III	
		REV. NO. 00	DATE:

NOTES:

1. A= APPROVAL, I = INFORMATION.
2. ANY ADDITIONAL DRAWINGS-DOCUMENTS REQUIRED DURING DETAILED ENGINEERING STAGE SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL, TECHNICAL AND DELIVERY IMPLICATION TO BHEL AND CUSTOMER.
3. BIDDER TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/NTPC APPROVED FORMATS LIKE MS EXCEL, MS WORD OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST, FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, ETC. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.
4. DOCUMENTS PERTAINING TO PROVENNESS TO BE SUBMITTED BY THE BIDDER.
5. DWG. / DOCUMENT SHALL BE UPLOADED BY THE SUCCESSFUL BIDDER ON WRENCH /DMS. PROCEDURE FOR THE SAME WILL BE INFORMED AFTER AWARD OF CONTRACT.

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING).	BHEL DOCUMENTS NO.: PE-TS-475-154-A001
		VOLUME III
	PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT (TURBINE GENERATOR AND ASSOCIATED PACKAGES)	
		REV. NO. 00 / DATE:

DECLARATIONS

I ……..……certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated …….. and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name ……

Authorized representative's Signature ……..

Name ……

Bidder's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated

BHEL-PEM-MAUX
PRE-QUALIFICATION CRITERIA

	PACKAGE: CHEMICAL DOSING SYSTEM	PE-PQ-STD-154-A001	
		DATE	09/06/2021
		REV NO	00

1.0	Supplier should have capabilities for design/ manufacture and having in-house/ out-sourced facility for testing of Chemical Dosing System.
2.0	The supplier has to submit either of following supporting documents meeting above mentioned pre-qualifying requirement a. Copy of minimum one (1) performance certificate in English from end user along with copy of related Purchase Order (PO) or letter of intent (LOI) or letter of award (LOA) or work order (WO) specifying that the product/ equipment is running successfully for one (1) year from date of commissioning meeting the minimum pre-qualifying requirement. OR b. Minimum two PO/ LOI /LOA/ WO placed with a minimum gap of six (6) months from same purchaser meeting the minimum pre-qualifying requirement. OR c. Minimum one PO/ LOI /LOA/ WO after commissioning of first order from same purchaser meeting the minimum pre-qualifying requirement. OR d. In case, vendor has executed contract (s) for BHEL-PEM, internal assessment by BHEL-PEM shall be followed for evaluation for satisfactory performance. For this, vendor to submit the request along-with relevant documents. OR e. Minimum three customer's/ third party's inspection reports/ test certificates/commissioning certificates meeting the minimum pre-qualifying requirement.
3.0	Minimum one (1) no. PO/ LOI/LOA/WO shall be submitted which should not be more than Ten (10) years old, for establishing continuity in business. This is over and above the requirement of PO/ LOI/LOA/WO mentioned at Sl. no. 2.0 above.
4.0	The bidder should be an OEM and will meet PQR based on its own credentials. Bid from joint venture (JV) company /Consortium bid is not acceptable.