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.)

8.00.00 INSTRUMENTATION CABLE INSTALLATION AND ROUTING

8.01.00 All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.

8.02.00 Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:

From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm
From 415V tray system	-	610 mm
From control cable tray system	-	305 mm

8.03.00 Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.

8.04.00 Not in use

8.05.00 The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.

9.00.00 CABLE LAYING AND ACCESSORIES

9.01.00 CABLE LAYING

1 Cables shall be laid strictly in line with cable schedule.

2 Identification tags for cables.

Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.

3 Cable tray numbering and marking.

To be provided at every 10m and at each end of cable way & branch connection.

4 No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.

5 Buried cable protection

With concrete slabs; Route markers at every 20 Meters along the route & at every bend.

6 Road Crossings

Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between

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

Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.

7 Segregation (physical isolation to prevent fire jumping)

a All cable associated with the unit shall be segregated from cables of other Units.

b 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.

8 Cable clamping

All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.

	9 Optical fiber cables (OFCs) : Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure **Inside Building Area – to be laid on separate cable sub-trays** While buried- in separate buried trench approx.1.0 meter depth, to be laid in 2" rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor; While crossing roads - to be laid in GI/rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete; While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe.
	10 **Laying of Network Cable (UTP/STP) :** **Out side Building Area-** to be laid necessarily inside GI conduits with support from cable tray / Tressle structure. **Inside Building Area-** to be laid necessarily inside GI conduits on separate cable sub-trays.
9.02.00	Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fiber Optic Card Cage, Fiber Optic Line Driver, Repeater / Modem (for Optical Fiber Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.
9.03.00	Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, etc., which are required for maintenance of the system as per the type of termination used.
9.04.00	Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.
9.05.00	No splices shall be made in conductors for instrument and control circuits except where required at connections to devices equipped with factory installed pigtails. Such splices shall be made only in approved splicing boxes of fitting with removable cover. The splices shall be made with sufficient slack left in the wires to permit withdrawal of the splice from the splicing box for ease of future disconnection of the splices. All exposed conductor or connector surfaces shall be covered with a minimum of three half-lapped layers of all-weather vinyl plastic electrical tape. Taping shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the other insulation or connections requiring insulation.
9.06.00	The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests. All the cables etc. required for grounding of all equipments supplied under this package are to be supplied by the Bidder.
9.07.00	The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.

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 & 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. An 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	7035

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 galvanized 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 lead coated steel, The temperature rating of flexible conduit shall be suitable for the following areas:

(i) Mills
(ii) Drum
(iii) Main steam, RH steam
(iv) Air Heaters
(v) Furnace, BFPDTs

For the remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.
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 The Bidder shall install conduits according to the general routing as approved by Employer and shall coordinate conduit locations with other works.

11.03.00 All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductor. Conduit runs to individually mounted equipment shall be grounded to the Employer's cable tray grounding conductor with 12 AEG bare copper conductor. All grounding bushings, clamps and connectors shall be subject to approval of the Employer.

11.04.00	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.
11.05.00	All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one meter of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.
11.06.00	Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main building framing to the control room framing.
11.07.00	Conduit supports shall be furnished and installed in accordance with these specifications. Support material shall comply with the following requirements. i) Hanger rods shall be 12 mm diameter galvanized threaded steel rods. ii) Single conduit supports shall be one-hole cast metal straps and clamp backs unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.
11.08.00	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 to NEC requirements for the area classification.
11.09.00	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 utilized for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.
11.10.00	Conduits shall be securely fastened to all boxes and cabinets.
12.00.00	**CABLE SUB-TRAY & SUPPORT**
12.01.00	The cable sub-trays and the supporting system, to be generally used between Local/Group JBs and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).
12.02.00	The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. The cable trays shall not have sharp edges, burrs or projections injurious to the insulation or outer sheath of the cables.
12.03.00	The supporting arrangement of cable tray system shall be able to withstand the weight of the cable and cable tray system. The supporting interval shall not be more than the recommended span for the above loading for the type of cable tray selected. The tray shall not overhang by more than one meter from the support at the dead end. As far as practicable

	the cable sub-tray system shall be supported from one side only, in order to facilitate installation and maintenance of cables.
12.04.00	The Bidder shall furnish and install the estimated quantities and sizes of sub trays/troughs including all required fittings and adaptors on as required basis.

CUSTOMER : BHEL PEM
Contract no. GEMC-511687780453301 dated 14.12.2021
PROJECT: 2 x 800 MW NTPC KARIMNAGER TELANGANA STPP, PHASE-I(SG ISLAND PAKAGE)
DOC.No.: SCPL/CRS SHEET /726/BHEL PEM/Rev.02 , Dated 18.01.2022

CRS SHEET		
S.NO.	**COMMENTS**	**SCPL REPLY dtd.18.01.2022**
1	armour?? For dia under armour for all cables	1. Incorporated as dia over inner sheath. Please note that dia under armour and dia over inner sheath both are same for multicore cables. 2. Incorporated as Dia under armour. Please note that Diameter of insulated conductor and dia under armour both are same for single core cables
2	Strand dia values to be changed for some cables	incorporated
3	Indicate filler material, if applicable	incorporated
4	Show inner sheath correctly in drawings	incorporated
5	Indicate filler material, if applicable in drawings	incorporated
NIKHIL/18.01.2022		

Certification signature by D K Jain <dkjain01@ntpc.co.in> Validity Unknown
Digitally signed by D K Jain
Date: 2022.01.21 14:46:44 IST
Reason: CAT I
Location: NTPCEOC

TECHNICAL DATASHEET AND
CROSSECTION DRAWING FOR LT XLPE POWER CABLE

Cat-I Subject to incorporation of comment.

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
This is to certify that this document has been reviewed in PEM for confirming to the technical requirements for the project.
SIGNATURE
INITIALS OF DEALING ENGINEER
DATE 18.01.21
DEPARTMENT Electrical

REV	DATE	ALTD	CHD	APPD	ALTD	CHD	APPD	JOB NO.	424
								STATUS	CONTRACT
								DISTRIBUTION	
								TO	
								NO.	

NTPC DOC NO: **9591-102-102-PVE-Y-032**

CUSTOMER

NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT

NTPC TELANGANA SUPER THERMAL POWER PROJECT SG ISLAND (2 X 800 MW)

BHARAT HEAVY ELECTRICAL LTD PS PEM NOIDA

MANUFACTURER	SPECIAL CABLES PVT LTD.	DEPT CODE E		NAME	SIGN	DATE
			DSGN			
			CHKD			
			APPD			
TITLE	TECHNICAL DATASHEET AND CROSSECTION DRAWING FOR LT XLPE POWER CABLE	DOC. NO.	PE-V0-424-507-E211			
		SHEET	1 OF 22		REV. 01	

SPECIAL CABLES PRIVATE LIMITED
B-II/12, Mohan Co-operative, Industrial Estate, Badarpur,New Delhi

CUSTOMER : BHEL PEM
Contract no. GEMC-511687780453301 dated 14.12.2021
PROJECT: 2 x 800 MW NTPC KARIMNAGER TELANGANA STPP, PHASE-I(SG ISLAND PAKAGE)
DOC.No.: SCPL/TDS/726/BHEL PEM/Rev.02 , Dated 15.01.2022

S.NO.	DESCRIPTION	UNITS	1C X 35 SQ.MM	1C X 400 SQ.MM	1C X 630 SQ.MM
1	**General**	-	Aluminium conductor, XLPE Insulated and overall FRLS HR PVC Outer sheathed unarmoured power cables.		
1.1	Name of manufacturer	-	SPECIAL CABLES PRIVATE LIMITED/Rudrapur (Uttrakhand), India		
1.2	Place of Manufacture	-			
2	**Standards Applicable**				
2.1	**IS: 7098 Part-I**		YES		
	For general specification of XLPE Cables	-			
2.2	**IS: 8130**		YES		
	For conductor material	-			
2.3	**IS: 5831**		YES		
	For material of inner sheath & outer sheath.	-			
2.4	**IS: 3975 / IS: 8130**		NOT APPLICABLE		
	For armour of 3 core/ single core cables	-			
2.5	**IS: 10810**		YES		
	For method of tests	-			
2.6	**IS:10418**		YES		
	For cable drums	-			
2.7	**ASTMD-2863**		YES		
	For oxygen index test	-			
2.8	**ASTMD-2843**		YES		
	For smoke density test	-			
	SS:424-14-75 & IEC-332-III-Cat-B & CAT-A,		YES		
2.9	**IEC-332-I/ IEEE: 383**				
	For flammability test	-			
2.1	**IEC-754-1**		YES		
	For Acid gas generation	-			
2.11	Current rating of cables conforms to	-	IS:3961		
2.12	Short circuit rating conforms to	-	IS:7098-1		
2.13	Formula for calculating short circuit current for Different duration	-	I_{SH}=KxA/SQRT(T)		
			Where, Short circuit current in kA, K-A constant, 0.094 for aluminium conductor, XLPE insulation, A area of cross section of conductor in sq.mm, t=Fault clearing time in seconds,		
	system Fault level		50 kA for 1 sec		
	Cable Type		A2XY	A2XY	A2XY

S.NO.	DESCRIPTION	UNITS	1C X 35 SQ.MM	1C X 400 SQ.MM	1C X 630 SQ.MM
	Permissible conductor termperature				
	a) Maximum continous rating	Deg.C	90		
	b) Short Circuit rating	Deg.C	250		
3	(a) Installation Conditions at site	deg. C			
	i) Ambient air temperature	deg. C	50		
	ii) Ground temperature	cm	40		
	iii) Depth of laying of cables buried in ground	deg. C cm/W	90		
	(b) Installation conditions for current rating specified at clause 6.3				
4	CHARACTERISTICS OF FRLS SHEATH				
	(a) Oxygen index		29% as per ASTMD 2863/IS10810 (P-53)		
	(b) Temperature index		250 Deg.C As per ASTMD-2863		
	(c) Acid gas generation		Max 20% (by weight) as per IEC-754-1		
	(d) Smoke density rating		Max 60% smoke density/Min 40% light Transmission As per ASTMD 2843		
	e) Flammability test		Shall be as per IEC-60332-1-2, IEC-60332-3 cat-B, Swedish chimney test shall be as per SS: 424-1475 (class-F3) and IEEE-383		
5	CABLE DRUMS				
	(a) Type & construction		In non returnable wooden drum as per IS: 10418		
	(b) Standard drum length		As per enclosed drum schedule		
	(c) Tolerance on drum length				
6	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE				
6.1	No. of cores x size		1C X 35 SQ.MM	1C X 400 SQ.MM	1C X 630 SQ.MM
6.2	Voltage grade (Uo/U)		1.1		
6.3	Base current ratings (*) based on Cl. 3.0 (for information only)				
	(a) In air	Amp	106	524	706
	(b) In ground	Amp	105	386	492
	(c) ducts	Amp	106	378	477
6.4	Short circuit rating of conductor for 1 sec duration-main (for information only)	kA,Sec	3.29	37.6	59.22
6.5	(a) D.C. resistance of conductor at 20 deg C (main) (max)	ohm/km	0.868	0.0778	0.0469
	(a) D.C. resistance of conductor at 20 deg C (neutral) (max)	ohm/km	not applicable		
	(b) A.C. resistance of conductor at 90 deg. C (main) (for information only)	ohm/km	1.11	0.10	0.06

S.NO.	DESCRIPTION	UNITS	1C X 35 SQ.MM	1C X 400 SQ.MM	1C X 630 SQ.MM
	(b) A.C. resistance of conductor at 90 deg. C (neutral) (for information only)	ohm/km	not applicable		
	(c) Reactance of cable at Normal frequency (for information only)	ohm/km	0.097	0.077	0.075
	(d) Electrostatic capacitance of cable at normal frequency (for information only)	mF/km	0.6	0.88	0.94
6.6	CONDUCTOR				
	(a) Material type & grade	-	Stranded Aluminium as per class-2 of IS:8130		
	(b) Grade		H2		
	c) Nominnal cross sectiona area (main)		35	400	630
	d) Nominnal cross sectiona area (Neutral)		not applicable		
	(e) No & dia of wires in each core before stranding (main)	no x mm	7/2.55	59/2.94	89/3.01
	(f) No & dia of wires in each core before stranding (Neutral)	no x mm	not applicable		
	(g) Shape of conductor	-	Stranded and Circular compacted		
	(h) Direction of lay of conductor		Outermost layer shall be right handed lay		
6.7	INSULATION				
a	Material		Extruded XLPE As per IS:7098-1		
b	Nominal thickness of insulation-Main		0.9	2	2.4
c	Nominal thickness of insulation-Neutral		not applicable		
d	Minium thickness of insulation-Main		0.71	1.7	2.06
e	Minimum thickness of insulation-Neutral		not applicable		
f	Minium volume resistivity at 27 deg.C	Ohm cm	$1x10^{14}$		
g	Minium volume resistivity at 90 deg.C	Ohm cm	$1x10^{12}$Ohm		
h	Method of curring		Steam curring		
i	Core identification		1C: Black		
6.8	PVC ST2 INNERSHEATH		not applicable		
	(a) Material	-	not applicable		
	b) Whether FRLS		not applicable		
	(c) Thickness (min.)	mm	not applicable		
	(d) Method of application	-	not applicable		
	1.. Multi-core cables		not applicable		
	(i) With fillers		not applicable		
	(ii) With out fillers	Pressure Extruded	not applicable		

S.NO.	DESCRIPTION	UNITS	1C X 35 SQ.MM	1C X 400 SQ.MM	1C X 630 SQ.MM
	e) Type of filler (if used)		not applicable		
	Shape of filler (if used)		not applicable		
	f) color		not applicable		
6.9	ARMOUR		not applicable		
	(a) Material		not applicable		
	(i) Single core cables		not applicable		
	(ii) Multi-core cables		not applicable		
	(b) Size/ dimensions		not applicable		
	(c) Minimum no. of wires /formed wires		not applicable		
	(d) Tolerance on formed wire dimension		not applicable		
	(e) Maximum resistivity of GS formed wire		not applicable		
	(f) Maximum resistivity of Aluminium round wire		not applicable		
	PVC ST2 FRLS OUTERSHEATH				
6.1	(a) Material	-	Extruded HR PVC compound (Type ST2) conf.to IS: 5831/84 with FRLSH properties (outer sheath shall be resistant to rodent and termite attack)		
	b) Whether FRLS		yes		
	(c) Thickness (nom)	mm	1.8	2.2	2.2
	(d) color	-	Black		
	e) Method of applicable		Extruded		
6.11	(a) Diameter of insulated conductor	mm (fictitious)	8.5	26.6	33.1
	(b) Diameter of insulated conductor -actual	mm (appx)	9	28	34
	c) Cable diameter ~~under armour~~	mm (fictitious)	8.5	26.6	33.1
	d) Cable diameter ~~under armour~~ actual	over inner sheeth mm (appx)	9	28.5	34.5
	(e) Overall diameter of cable (appx)	mm	13.5	33	40
6.12	Tolerance on overall diameter	(±) mm	+/-2		
6.13	Minimum bending radius	x O.D	15 x D Where D is overall dia of cable		
6.14	Safe Pulling Force	kG	30 N per Sq.mm		
6.15	Weight of cable	kg./km	215	1515	2330
6.16	Dimension of drum	mm	As per IS:10418		
6.18	Cable marking on outer sheath				
	Embossing details		Cable size (cross section area and no. of cores) and voltage grade @ 5m (by embossing) Word "XLPE" "FR-LSH" etc, @ 5m (by embossing) Manufacturer's name and/ or trade name, and year of manufacture @ 5m (by embossing) 'BHEL-PEM' and 'NTPC' Name @5m (by embossing)		
	Sequential length marking		Progressive sequential marking @ 1m (by printing)		
	Marking on drums		Manufacturer's Name, Address and Contract No, Item No & Type, No of cores & Size & length of cable on Drum, 1.1kV, Year of Mfr, XLPE/FR-LSH, Cable Code, isi Mark, Is: 7098 (P-1) "BHEL-PEM" "NTPC" and net/gross weight stencilied on both sides of drum, A tag contaning same information shall be attached to the leading end of the cable, An arrow and suitable accompanying wording on one end of the reel indicating the direction in		
Note: Fiber glass tape shal be provided wherever required as per manufacterer descrition					
NIKHIL/15.01.2022					

SPECIAL CABLES PRIVATE LIMITED
B-II/12, Mohan Co-operative, Industrial Estate, Badarpur,New Delhi

CUSTOMER : BHEL PEM
Contract no. GEMC-511687780453301 dated 14.12.2021
PROJECT: 2 x 800 MW NTPC KARIMNAGER TELANGANA STPP, PHASE-I(SG ISLAND PAKAGE)
DOC.No.: SCPL/TDS/726/BHEL PEM/Rev.02 , Dated 15.01.2022

S.NO.	DESCRIPTION	UNITS	3C X 10 SQ.MM	4C X 10 SQ.MM	2C X 95 SQ.MM	3C X 95 SQ.MM	3C X 240 SQ.MM
1	**General**	-	Aluminium conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.				
1.1	Name of manufacturer	-	SPECIAL CABLES PRIVATE LIMITED/Rudrapur (Uttrakhand), India				
1.2	Place of Manufacture	-					
2	**Standards Applicable**						
2.1	**IS: 7098 Part-I**	-	YES				
	For general specification of XLPE Cables						
2.2	**IS: 8130**	-	YES				
	For conductor material						
2.3	**IS: 5831**	-	YES				
	For material of inner sheath & outer sheath.						
2.4	**IS: 3975 / IS: 8130**	-	NOT APPLICABLE				
	For armour of 3 core/ single core cables						
2.5	**IS: 10810**	-	YES				
	For method of tests						
2.6	**IS:10418**	-	YES				
	For cable drums						
2.7	**ASTMD-2863**	-	YES				
	For oxygen index test						
2.8	**ASTMD-2843**	-	YES				
	For smoke density test						
	SS:424-14-75 & IEC-332-III-Cat-B & CAT-A,		YES				
2.9	**IEC-332-I/ IEEE: 383**						
	For flammability test	-					
2.1	**IEC-754-1**	-	YES				
	For Acid gas generation						
2.11	Current rating of cables conforms to	-	IS:3961				
2.12	Short circuit rating conforms to	-	IS:7098-1				
2.13	Formula for calculating short circuit current for Different duration	-	I_{SH}=KxA/SQRT(T)				
			Where, Short circuit current in kA, K-A constant, 0.094 for aluminium conductor, XLPE insulation, A area of cross section of conductor in sq.mm, t=Fault clearing time in seconds,				

S.NO.	DESCRIPTION	UNITS	3C X 10 SQ.MM	4C X 10 SQ.MM	2C X 95 SQ.MM	3C X 95 SQ.MM	3C X 240 SQ.MM
	system Fault level		50 kA for 1 sec				
	Cable Type		A2XY	A2XY	A2XY	A2XY	A2XY
	Permissible conductor termperature						
	a) Maximum continous rating	Deg.C	90				
	b) Short Circuit rating	Deg.C	250				
3	(a) Installation Conditions at site	deg. C					
	i) Ambient air temperature	deg. C	50				
	ii) Ground temperature	cm	40				
	iii) Depth of laying of cables buried in ground	deg. C cm/W	90				
	(b) Installation conditions for current rating specified at clause 6.3						
4	CHARACTERISTICS OF FRLS SHEATH						
	(a) Oxygen index		29% as per ASTMD 2863/IS10810 (P-53)				
	(b) Temperature index		250 Deg.C As per ASTMD-2863				
	(c) Acid gas generation		Max 20% (by weight) as per IEC-754-1				
	(d) Smoke density rating		Max 60% smoke density/Min 40% light Transmission As per ASTMD 2843				
	e) Flammability test		Shall be as per IEC-60332-1-2, IEC-60332-3 cat-B, Swedish chimney test shall be as per SS: 424-1475 (class-F3) and IEEE-383				
5	CABLE DRUMS						
	(a) Type & construction		In non returnable wooden drum as per IS: 10418				
	(b) Standard drum length		As per enclosed drum schedule				
	(c) Tolerance on drum length						
6	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE						
6.1	No. of cores x size		3C X 10 SQ.MM	4C X 10 SQ.MM	2C X 95 SQ.MM	3C X 95 SQ.MM	3C X 240 SQ.MM
6.2	Voltage grade (Uo/U)		1.1				
6.3	Base current ratings (*) based on Cl. 3.0 (for information only)						
	(a) In air	Amp	48	48	223	192	349
	(b) In ground	Amp	51	51	212	177	295
	(c) ducts	Amp	48	48	196	164	276

S.NO.	DESCRIPTION	UNITS	3C X 10 SQ.MM	4C X 10 SQ.MM	2C X 95 SQ.MM	3C X 95 SQ.MM	3C X 240 SQ.MM
6.4	Short circuit rating of conductor for 1 sec duration-main (for information only)	kA,Sec	0.94	0.94	8.93	8.93	22.56
6.5	(a) D.C. resistance of conductor at 20 deg C (main) (max)	ohm/km	3.08	3.08	0.32	0.32	0.125
	(a) D.C. resistance of conductor at 20 deg C (neutral) (max)	ohm/km	not applicable				
	(b) A.C. resistance of conductor at 90 deg. C (main) (for information only)	ohm/km	3.94	3.94	0.41	0.41	0.16
	(b) A.C. resistance of conductor at 90 deg. C (neutral) (for information only)	ohm/km	not applicable				
	(c) Reactance of cable at Normal frequency (for information only)	ohm/km	0.0837	0.0837	0.074	0.074	0.072
	(d) Electrostatic capacitance of cable at normal frequency (for information only)	mF/km	0.31	0.31	0.11	0.11	0.66
6.6	CONDUCTOR						
	(a) Material type & grade	-	Stranded Aluminium as per class-2 of IS:8130				
	(b) Grade		H2				
	c) Nominnal cross sectiona area (main)		10	10	95	95	240
	d) Nominnal cross sectiona area (Neutral)		not applicable				
	(e) No & dia of wires in each core before stranding (appx) (main)	no x mm	7/1.35	7/1.35	19/2.52 2.53	19/2.53	37/2.88
	(f) No & dia of wires in each core before stranding (Neutral)	no x mm	not applicable				
	(g) Shape of conductor	-	Stranded and Circular		Stranded and Shaped		
	(h) Direction of lay of conductor		Outermost layer shall be right handed lay				
6.7	INSULATION						
a	Material		Extruded XLPE As per IS:7098-1				
b	Nominal thickness of insulation-Main		0.7	0.7	1.1	1.1	1.7
c	Nominal thickness of insulation-Neutral		not applicable				
d	Minium thickness of insulation-Main		0.53	0.53	0.89	0.89	1.43
e	Minimum thickness of insulation-Neutral		not applicable				
f	Minium volume resistivity at 27 deg.C	Ohm cm	$1x10^{14}$				
g	Minium volume resistivity at 90 deg.C	Ohm cm	$1x10^{12}$				
h	Method of curring		Steam curring				
i	Core identification		2C: Red and Black, 3C: Red, Yellow and Blue, 4C: Red, Yellow, Blue and Black				
	PVC ST2 INNERSHEATH						
	(a) Material	-	Extruded HR PVC compound (Type ST2) conf.to IS: 5831/84				
	b) Whether FRLS		Yes				
	(c) Thickness (min.)	mm	0.3	0.3	0.4	0.4	0.6

S.NO.	DESCRIPTION	UNITS	3C X 10 SQ.MM	4C X 10 SQ.MM	2C X 95 SQ.MM	3C X 95 SQ.MM	3C X 240 SQ.MM
	(d) Method of application	-					
	1.. Multi-core cables						
	(i) With fillers		Pressure/Vaccum Extrusion				
6.8	(ii) With out fillers		Pressure Extrusion				
	e) Type of filler (if used)		Same as inner sheath (material of filler to be Compatible with that of inner sheath) (Filler is not applicable for shaped conductor)				
	f) Material of filler if applicable		not applicable	Non hygroscopic filler material shall be provided	not applicable		
	g) Shape of filler (if used)		Circular or Hollow (Filler is not applicable for shaped conductor)				
	h) color		Black				
6.9	ARMOUR						
	(a) Material		not applicable				
	(i) Single core cables		not applicable				
	(ii) Multi-core cables		not applicable				
	(b) Size/ dimensions		not applicable				
	(c) Minimum no. of wires /formed wires		not applicable				
	(d) Tolerance on formed wire dimension		not applicable				
	(e) Maximum resistivity of GS formed wire		not applicable				
	(f) Maximum resistivity of Aluminium round wire		not applicable				
	PVC ST2 FRLS OUTERSHEATH						
6.1	(a) Material	-	Extruded HR PVC compound (Type ST2) conf.to IS: 5831/84 with FRLSH properties (outer sheath shall be resistant to rodent and termite attack)				
	b) Whether FRLS		yes				
	(c) Thickness (nom)	mm	1.8	1.8	2.2	2.2	2.8
	(d) color	-	Black				
	e) Method of applicable		Extruded				
	(a) Diameter of insulated conductor	mm (fictitious)	5	5	13.2	13.2	20.9
	(b) Diameter of insulated conductor-actual	mm (appx)	5.5	5.5	not applicable as conductor is shaped		
	c) Cable diameter over laidup cores	mm (fictitious)	10.8	12.1	26.4	28.5	45.1
6.11	d) Cable diameter over laidup cores-actual	mm (appx)	12	13.5	22.5	27.5	43
	e) Cable diameter over inner sheath	mm (fictitious)	11.4	12.7	27.2	29.3	46.3
	f) Cable diameter Over inner sehath-actual	mm (appx)	13	14.5	24	29	45
	(g) Overall diameter of cable (appx)	mm	17	18.5	29	33.5	50.6
6.12	Tolerance on overall diameter	(±) mm	+/-2				
6.13	Minimum bending radius	x O.D	12 x D Where D is overall dia of cable				

S.NO.	DESCRIPTION	UNITS	3C X 10 SQ.MM	4C X 10 SQ.MM	2C X 95 SQ.MM	3C X 95 SQ.MM	3C X 240 SQ.MM
6.14	Safe Pulling Force	kG	30 N per Sq.mm				
6.15	Weight of cable	kg./km	350	420	1105	1340	3120
6.16	Dimension of drum	mm	As per IS:10418				
6.18	Cable marking on outer sheath						
	Embossing details		Cable size (cross section area and no. of cores) and voltage grade @ 5m (by embossing) Word "XLPE" "FR-LSH" etc, @ 5m (by embossing) Manufacturer's name and/ or trade name, and year of manufacture @ 5m (by embossing) 'BHEL-PEM' and 'NTPC' Name @5m (by embossing)				
	Sequential length marking		Progressive sequential marking @ 1m (by printing)				
	Marking on drums		Manufacturer's Name, Address and Contract No, Item No & Type, No of cores & Size & length of cable on Drum, 1.1kV, Year of Mfr, XLPE/FR-LSH, Cable Code, isi Mark, Is: 7098 (P-1) "BHEL-PEM" "NTPC" and net/gross weight stencilied on both sides of drum, A tag contaning same information shall be attached to the leading end of the cable, An arrow and suitable accompanying wording on one end of the reel indicating the direction in				
NIKHIL/15.01.2022							

SPECIAL CABLES PRIVATE LIMITED
B-II/12, Mohan Co-operative, Industrial Estate, Badarpur,New Delhi

CUSTOMER : BHEL PEM
Contract no. GEMC-511687780453301 dated 14.12.2021
PROJECT: 2 x 800 MW NTPC KARIMNAGER TELANGANA STPP, PHASE-I(SG ISLAND PAKAGE)
DOC.No.: SCPL/TDS/726/BHEL PEM/Rev.02 , Dated 15.01.2022

S.NO.	DESCRIPTION	UNITS	3.5C X 25 SQ.MM	3.5C X 95 SQ.MM
1	**General**	-	Aluminium conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.	
1.1	Name of manufacturer	-	SPECIAL CABLES PRIVATE LIMITED/Rudrapur (Uttrakhand), India	
1.2	Place of Manufacture	-		
2	**Standards Applicable**			
2.1	**IS: 7098 Part-I**		YES	
	For general specification of XLPE Cables	-		
2.2	**IS: 8130**		YES	
	For conductor material	-		
2.3	**IS: 5831**		YES	
	For material of inner sheath & outer sheath.	-		
2.4	**IS: 3975 / IS: 8130**		NOT APPLICABLE	
	For armour of 3 core/ single core cables	-		
2.5	**IS: 10810**		YES	
	For method of tests	-		
2.6	**IS:10418**		YES	
	For cable drums	-		
2.7	**ASTMD-2863**		YES	
	For oxygen index test	-		
2.8	**ASTMD-2843**		YES	
	For smoke density test	-		
	SS:424-14-75 & IEC-332-III-Cat-B & CAT-A,		YES	
2.9	**IEC-332-I/ IEEE: 383**			
	For flammability test	-		
2.1	**IEC-754-1**		YES	
	For Acid gas generation	-		
2.11	Current rating of cables conforms to	-	IS:3961	
2.12	Short circuit rating conforms to	-	IS:7098-1	
2.13	Formula for calculating short circuit current for Different duration	-	I_{SH}=KxA/SQRT(T)	
			Where, Short circuit current in kA, K-A constant, 0.094 for aluminium conductor, XLPE insulation, A area of cross section of conductor in sq.mm, t=Fault clearing time in seconds,	

S.NO.	DESCRIPTION	UNITS	3.5C X 25 SQ.MM	3.5C X 95 SQ.MM
	system Fault level		50 kA for 1 sec	
	Cable Type		A2XY	A2XY
	Permissible conductor termperature			
	a) Maximum continous rating	Deg.C	90	
	b) Short Circuit rating	Deg.C	250	
3	(a) Installation Conditions at site	deg. C		
	i) Ambient air temperature	deg. C	50	
	ii) Ground temperature	cm	40	
	iii) Depth of laying of cables buried in ground	deg. C cm/W	90	
	(b) Installation conditions for current rating specified at clause 6.3			
4	CHARACTERISTICS OF FRLS SHEATH			
	(a) Oxygen index		29% as per ASTMD 2863/IS10810 (P-53)	
	(b) Temperature index		250 Deg.C As per ASTMD-2863	
	(c) Acid gas generation		Max 20% (by weight) as per IEC-754-1	
	(d) Smoke density rating		Max 60% smoke density/Min 40% light Transmission As per ASTMD 2843	
	e) Flammability test		Shall be as per IEC-60332-1-2, IEC-60332-3 cat-B, Swedish chimney test shall be as per SS: 424-1475 (class-F3) and IEEE-383	
5	CABLE DRUMS			
	(a) Type & construction		In non returnable wooden drum as per IS: 10418	
	(b) Standard drum length		As per enclosed drum schedule	
	(c) Tolerance on drum length			
6	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE			
6.1	No. of cores x size		3.5C X 25 SQ.MM	3.5C X 95 SQ.MM
6.2	Voltage grade (Uo/U)		1.1	
6.3	Base current ratings (*) based on Cl. 3.0 (for information only)			
	(a) In air	Amp	83	192
	(b) In ground	Amp	86	177
	(c) ducts	Amp	79	164

S.NO.	DESCRIPTION	UNITS	3.5C X 25 SQ.MM	3.5C X 95 SQ.MM
6.4	Short circuit rating of conductor for 1 sec duration-main (for information only)	kA,Sec	2.35	8.93
6.5	(a) D.C. resistance of conductor at 20 deg C (main) (max)	ohm/km	1.2	0.32
	(a) D.C. resistance of conductor at 20 deg C (neutral) (max)	ohm/km	1.91	0.641
	(b) A.C. resistance of conductor at 90 deg. C (main) (for information only)	ohm/km	1.54	0.41
	(b) A.C. resistance of conductor at 90 deg. C (neutral) (for information only)	ohm/km	2.445	0.820
	(c) Reactance of cable at Normal frequency (for information only)	ohm/km	0.08	0.074
	(d) Electrostatic capacitance of cable at normal frequency (for information only)	mF/km	0.41	0.61
6.6	CONDUCTOR			
	(a) Material type & grade	-	Stranded Aluminium as per class-2 of IS:8130	
	(b) Grade		H2	
	c) Nominnal cross sectiona area (main)		25	95
	d) Nominnal cross sectiona area (Neutral)		16	50
	(e) No & dia of wires in each core before stranding (main)	no x mm	7/2.14	19/2.53
	(f) No & dia of wires in each core before stranding (Neutral)	no x mm	7/1.71	7/3.02
	(g) Shape of conductor	-	Stranded and Shaped	
	(h) Direction of lay of conductor		Outermost layer shall be right handed lay	
6.7	INSULATION			
a	Material		Extruded XLPE As per IS:7098-1	
b	Nominal thickness of insulation-Main		0.9	1.1
c	Nominal thickness of insulation-Neutral		0.7	1
d	Minium thickness of insulation-Main		0.71	0.89
e	Minimum thickness of insulation-Neutral		0.53	0.8
f	Minium volume resistivity at 27 deg.C	Ohm cm	$1x10^{14}$	
g	Minium volume resistivity at 90 deg.C	Ohm cm	$1x10^{12}$	
h	Method of curring		Steam curring	
i	Core identification		Red, Yellow, Blue and Reduced core color shall be Black	
	PVC ST2 INNERSHEATH			
	(a) Material	-	Extruded HR PVC compound (Type ST2) conf.to IS: 5831/84	
	b) Whether FRLS		Yes	
	(c) Thickness (min.)	mm	0.3	0.4

S.NO.	DESCRIPTION	UNITS	3.5C X 25 SQ.MM	3.5C X 95 SQ.MM
6.8	(d) Method of application	-		
	1.. Multi-core cables			
	(i) With fillers		Pressure/Vaccum Extrusion	
	(ii) With out fillers		Pressure Extrusion	
	e) Type of filler (if used)		Same as inner sheath (material of filler to be Compatible with that of inner sheath) (Filler is not applicable for shaped conductor)	
	f) Shape of filler (if used)		Circular or Hollow (Filler is not applicable for shaped conductor)	
	g) color		Black	
6.9	ARMOUR			
	(a) Material		not applicable	
	(i) Single core cables		not applicable	
	(ii) Multi-core cables		not applicable	
	(b) Size/ dimensions		not applicable	
	(c) Minimum no. of wires /formed wires		not applicable	
	(d) Tolerance on formed wire dimension		not applicable	
	(e) Maximum resistivity of GS formed wire		not applicable	
	(f) Maximum resistivity of Aluminium round wire		not applicable	
6.1	PVC ST2 FRLS OUTERSHEATH			
	(a) Material	-	Extruded HR PVC compound (Type ST2) conf.to IS: 5831/84 with FRLSH properties (outer sheath shall be resistant to rodent and termite attack)	
	b) Whether FRLS		yes	
	(c) Thickness (nom)	mm	2	2.2
	(d) color	-	Black	
	e) Method of applicable		Extruded	
6.11	(a) Diameter of insulated conductor (main/Neutral)	mm (fictitious)	7.4/5.9	13.2/10
	(b) Diameter of insulated conductor (main/Neutral)-Nominal	mm (appx)	not applicable as conductor is shaped	
	c) Cable diameter over laidup cores	mm (fictitious)	17	30
	d) Cable diameter over laidup cores-actual	mm (appx)	16.5	29
	e) Cable diameter over inner sheath	mm (fictitious)	17.6	30.8
	f) Cable diameter Over inner sehath-actual	mm (appx)	17.5	30.5
	(g) Overall diameter of cable (appx)	mm	21.5	35
6.12	Tolerance on overall diameter	(±) mm	+/-2	
6.13	Minimum bending radius	x O.D	12 x D Where D is overall dia of cable	
6.14	Safe Pulling Force	kG	30 N per Sq.mm	
6.15	Weight of cable	kg./km	565	1515
6.16	Dimension of drum	mm	As per IS:10418	

S.NO.	DESCRIPTION	UNITS	3.5C X 25 SQ.MM	3.5C X 95 SQ.MM
6.18	Cable marking on outer sheath			
	Embossing details		Cable size (cross section area and no. of cores) and voltage grade @ 5m (by embossing) Word “XLPE” “FR-LSH” etc, @ 5m (by embossing) Manufacturer’s name and/ or trade name, and year of manufacture @ 5m (by embossing) ‘BHEL-PEM’ and ‘NTPC’ Name @5m (by embossing)	
	Sequential length marking		Progressive sequential marking @ 1m (by printing)	
	Marking on drums		Manufacturer’s Name, Address and Contract No, Item No & Type, No of cores & Size & length of cable on Drum, 1.1kV, Year of Mfr, XLPE/FR-LSH, Cable Code, isi Mark, Is: 7098 (P-1) "BHEL-PEM" "NTPC" and net/gross weight stencilied on both sides of drum, A tag contaning same information shall be attached to the leading end of the cable, An arrow and suitable accompanying wording on one end of the reel indicating the direction in	
NIKHIL/15.01.2022				

SPECIAL CABLES PRIVATE LIMITED
B-II/12, Mohan Co-operative, Industrial Estate, Badarpur,New Delhi

CUSTOMER : BHEL PEM
Contract no. GEMC-511687780453301 dated 14.12.2021
PROJECT: 2 x 800 MW NTPC KARIMNAGER TELANGANA STPP, PHASE-I(SG ISLAND PAKAGE)
DOC.No.: SCPL/TDS/726/BHEL PEM/Rev.02 , Dated 15.01.2022

S.NO.	DESCRIPTION	UNITS	2C X 2.5 SQ.MM	3C X 2.5 SQ.MM
1	**General**	-	Annealed bare copper conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.	
1.1	Name of manufacturer	-	SPECIAL CABLES PRIVATE LIMITED/Rudrapur (Uttrakhand), India	
1.2	Place of Manufacture	-		
2	**Standards Applicable**			
2.1	**IS: 7098 Part-I**		YES	
	For general specification of XLPE Cables	-		
2.2	**IS: 8130**		YES	
	For conductor material	-		
2.3	**IS: 5831**		YES	
	For material of inner sheath & outer sheath.	-		
2.4	**IS: 3975 / IS: 8130**		NOT APPLICABLE	
	For armour of 3 core/ single core cables	-		
2.5	**IS: 10810**		YES	
	For method of tests	-		
2.6	**IS:10418**		YES	
	For cable drums	-		
2.7	**ASTMD-2863**		YES	
	For oxygen index test	-		
2.8	**ASTMD-2843**		YES	
	For smoke density test	-		
	SS:424-14-75 & IEC-332-III-Cat-B & CAT-A,		YES	
2.9	**IEC-332-I/ IEEE: 383**			
	For flammability test	-		
2.1	**IEC-754-1**		YES	
	For Acid gas generation	-		
2.11	Current rating of cables conforms to	-	IS:3961	
2.12	Short circuit rating conforms to	-	IS:7098-1	
2.13	Formula for calculating short circuit current for Different duration	-	I_{SH}=KxA/SQRT(T)	
			Where, Short circuit current in kA, K-A constant, 0.143 for aluminium conductor, XLPE insulation, A area of cross section of conductor in sq.mm, t=Fault clearing time in seconds,	

S.NO.	DESCRIPTION	UNITS	2C X 2.5 SQ.MM	3C X 2.5 SQ.MM
	system Fault level		50 kA for 1 sec	
	Cable Type		2XY	2XY
	Permissible conductor termperature			
	a) Maximum continous rating	Deg.C	90	
	b) Short Circuit rating	Deg.C	250	
3	(a) Installation Conditions at site	deg. C		
	i) Ambient air temperature	deg. C	50	
	ii) Ground temperature	cm	40	
	iii) Depth of laying of cables buried in ground	deg. C cm/W	90	
	(b) Installation conditions for current rating specified at clause 6.3			
4	CHARACTERISTICS OF FRLS SHEATH			
	(a) Oxygen index		29% as per ASTMD 2863/IS10810 (P-53)	
	(b) Temperature index		250 Deg.C As per ASTMD-2863	
	(c) Acid gas generation		Max 20% (by weight) as per IEC-754-1	
	(d) Smoke density rating		Max 60% smoke density/Min 40% light Transmission As per ASTMD 2843	
	e) Flammability test		Shall be as per IEC-60332-1-2, IEC-60332-3 cat-B, Swedish chimney test shall be as per SS: 424-1475 (class-F3) and IEEE-383	
5	CABLE DRUMS			
	(a) Type & construction		In non returnable wooden drum as per IS: 10418	
	(b) Standard drum length		As per enclosed drum schedule	
	(c) Tolerance on drum length			
6	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE			
6.1	No. of cores x size		2C X 2.5 SQ.MM	3C X 2.5 SQ.MM
6.2	Voltage grade (Uo/U)		1.1	
6.3	Base current ratings (*) based on Cl. 3.0 (for information only)			
	(a) In air	Amp	28	27
	(b) In ground	Amp	35	31
	(c) ducts	Amp	32	30
6.4	Short circuit rating of conductor for 1 sec duration-main (for information only)	kA,Sec	0.36	0.36

S.NO.	DESCRIPTION	UNITS	2C X 2.5 SQ.MM	3C X 2.5 SQ.MM
6.5	(a) D.C. resistance of conductor at 20 deg C (main) (max)	ohm/km	7.41	7.41
	(a) D.C. resistance of conductor at 20 deg C (neutral) (max)	ohm/km	not applicable	
	(b) A.C. resistance of conductor at 90 deg. C (main) (for information only)	ohm/km	9.48	9.48
	(b) A.C. resistance of conductor at 90 deg. C (neutral) (for information only)	ohm/km	not applicable	
	(c) Reactance of cable at Normal frequency (for information only)	ohm/km	0.0985	0.0985
	(d) Electrostatic capacitance of cable at normal frequency (for information only)	mF/km	0.18	0.18
6.6	CONDUCTOR			
	(a) Material type & grade	-	Stranded Annealed bare copper conductor as per class-2 of IS:8130	
	(b) Grade		Electrolytic	
	c) Nominnal cross sectiona area (main)		2.5	2.5
	d) Nominnal cross sectiona area (Neutral)		not applicable	
	(e) No & dia of wires in each core before stranding (appx) (main)	no x mm	7/0.68	7/0.68
	(f) No & dia of wires in each core before stranding (Neutral)	no x mm	not applicable	
	(g) Shape of conductor	-	Stranded and Circular	
	(h) Direction of lay of conductor		Outermost layer shall be right handed lay	
6.7	INSULATION			
a	Material		Extruded XLPE As per IS:7098-1	
b	Nominal thickness of insulation-Main		0.7	0.7
c	Nominal thickness of insulation-Neutral		not applicable	
d	Minium thickness of insulation-Main		0.53	0.53
e	Minimum thickness of insulation-Neutral		not applicable	
f	Minium volume resistivity at 27 deg.C	Ohm cm	$1x10^{14}$	
g	Minium volume resistivity at 90 deg.C	Ohm cm	$1x10^{12}$	
h	Method of curring		Steam curring	
i	Core identification		2C: Red and Black, 3C: Red, Yellow and Blue	
	PVC ST2 INNERSHEATH			
	(a) Material	-	Extruded HR PVC compound (Type ST2) conf.to IS: 5831/84	
	b) Whether FRLS		Yes	
	(c) Thickness (min.)	mm	0.3	0.3
	(d) Method of application	-		
	1.. Multi-core cables			

S.NO.	DESCRIPTION	UNITS	2C X 2.5 SQ.MM	3C X 2.5 SQ.MM
6.8	(i) With fillers		Pressure/Vaccum Extrusion	
	(ii) With out fillers		Pressure Extrusion	
	e) Type of filler (if used)		Same as inner sheath (material of filler to be Compatible with that of inner sheath) (Filler is not applicable for shaped conductor)	
	f) Material of filler if applicable		Non hygroscopic filler material shall be provided	not applicable
	g) Shape of filler (if used)		Circular or Hollow (Filler is not applicable for shaped conductor)	
	h) color		Black	
6.9	ARMOUR			
	(a) Material		not applicable	
	(i) Single core cables		not applicable	
	(ii) Multi-core cables		not applicable	
	(b) Size/ dimensions		not applicable	
	(c) Minimum no. of wires /formed wires		not applicable	
	(d) Tolerance on formed wire dimension		not applicable	
	(e) Maximum resistivity of GS formed wire		not applicable	
	(f) Maximum resistivity of Aluminium round wire		not applicable	
6.1	PVC ST2 FRLS OUTERSHEATH			
	(a) Material	-	Extruded HR PVC compound (Type ST2) conf.to IS: 5831/84 with FRLSH properties (outer sheath shall be resistant to rodent and termite attack)	
	b) Whether FRLS		yes	
	(c) Thickness (nom)	mm	1.8	1.8
	(d) color	-	Black	
	e) Method of applicable		Extruded	
6.11	(a) Diameter of insulated conductor	mm (fictitious)	3.2	3.2
	(b) Diameter of insulated conductor - Nominal	mm (appx)	3.5	3.5
	c) Cable dia over laiup cores	mm (fictitious)	6.4	6.9
	d) Cable dia over laiup cores	mm (appx)	7	7.5
	e) Cable diameter over inner sheath	mm (fictitious)	7	7.5
	f) Cable diameter Over inner sehath- actual	mm (appx)	8	8.5
	(g) Overall diameter of cable (appx)	mm	12	12.5
6.12	Tolerance on overall diameter	(±) mm	+/-2	
6.13	Minimum bending radius	x O.D	12 x D Where D is overall dia of cable	
6.14	Safe Pulling Force	kG	50 N per Sq.mm	
6.15	Weight of cable	kg./km	190	220
6.16	Dimension of drum	mm	As per IS:10418	
6.18	Cable marking on outer sheath			

S.NO.	DESCRIPTION	UNITS	2C X 2.5 SQ.MM	3C X 2.5 SQ.MM
	Embossing details		Cable size (cross section area and no. of cores) and voltage grade @ 5m (by embossing) Word “XLPE” “FR-LSH” etc, @ 5m (by embossing) Manufacturer’s name and/ or trade name, and year of manufacture @ 5m (by embossing) ‘BHEL-PEM’ and ‘NTPC’ Name @5m (by embossing)	
	Sequential length marking		Progressive sequential marking @ 1m (by printing)	
	Marking on drums		Manufacturer’s Name, Address and Contract No, Item No & Type, No of cores & Size & length of cable on Drum, 1.1kV, Year of Mfr, XLPE/FR-LSH, Cable Code, isi Mark, Is: 7098 (P-1) "BHEL-PEM" "NTPC" and net/gross weight stencilied on both sides of drum, A tag contaning same information shall be attached to the leading end of the cable, An arrow and suitable accompanying wording on one end of the reel indicating the direction in	
NIKHIL/15.01.2022				

SPECIAL CABLES PRIVATE LIMITED
B-II/12, Mohan Co-operative Industrial Estate, Badarpur, New Delhi

PACKING DRUM LENGTH SCHEDULE

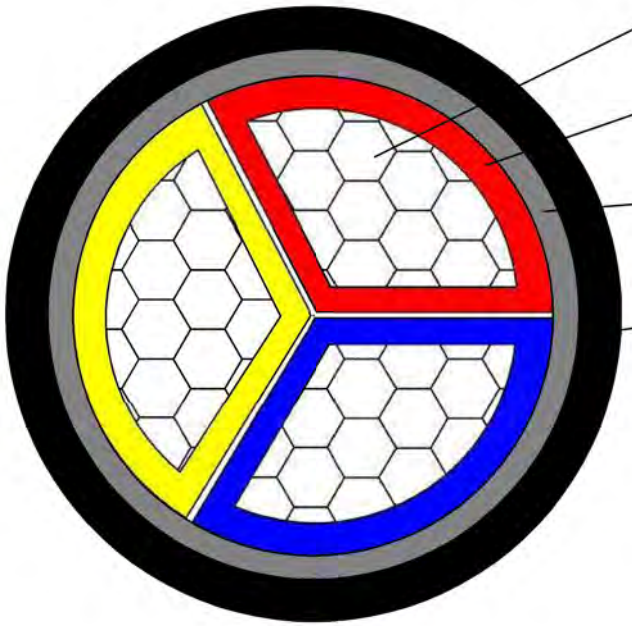
CUSTOMER : BHEL PEM

Contract no. GEMC-511687780453301 dated 14.12.2021

PROJECT: 2 x 800 MW NTPC KARIMNAGER TELANGANA STPP, PHASE-I(SG ISLAND PAKAGE)

DOC.No.: SCPL/DRUM SCHEDULE/726/BHEL PEM/Rev.02 , Dated 15.01.2022

SL. NO.	ITEMS	Cable Code	Type of Drum (Non returnable)	QUANTITY (Mtrs) as per contract no.	(NO. OF DRUMS X DRUMS LENGTHS) (MTRS) as per contract no.	Individual and overall quantity tolerance as per contract no.
1	1C x 35 Sq.mm	A2XY	Wooden	17000	17 X 1000	Overall tolerance on total dispatched quantity of each size shall be (-) 2% and (+) 0% and Tolerance on individual drum length shall be±5%
2	1C x 400 Sq.mm	A2XY	Wooden	4500	6 X 750	
3	1C x 630 Sq.mm	A2XY	Wooden	6750	9 X 750	
4	2 C x 95 Sq.mm	A2XY	Wooden	1000	1 X 1000	
5	3 C x 10 Sq.mm	A2XY	Wooden	13000	13 X 1000	
6	3 C x 95 Sq.mm	A2XY	Wooden	9000	9 X 1000	
7	3 C x 240 Sq.mm	A2XY	Wooden	500	1 X 500	
8	3.5 C x 25 Sq.mm	A2XY	Wooden	6000	6 X 1000	
9	3.5 C x 95 Sq.mm	A2XY	Wooden	3000	3 X 1000	
10	4C x 10 Sq.mm	A2XY	Wooden	500	1 X 500	
11	2C x 2.5 Sq.mm	2XY	Wooden	4000	4 X 1000	
12	3C x 2.5 Sq.mm	2XY	Wooden	63000	63 X 1000	
Note: One short length in each item can be supplied for completion of the order quantity.						
NIKHIL/15.01.2022						



Stranded and Shaped Aluminium conductors

Extruded XLPE insulation as per IS:7098-1

Extruded PVC Type-ST2 inner sheath as per IS:5831/1984

Extruded PVC Type-ST2 Outer sheath as per IS:5831/1984 with FRLS properties

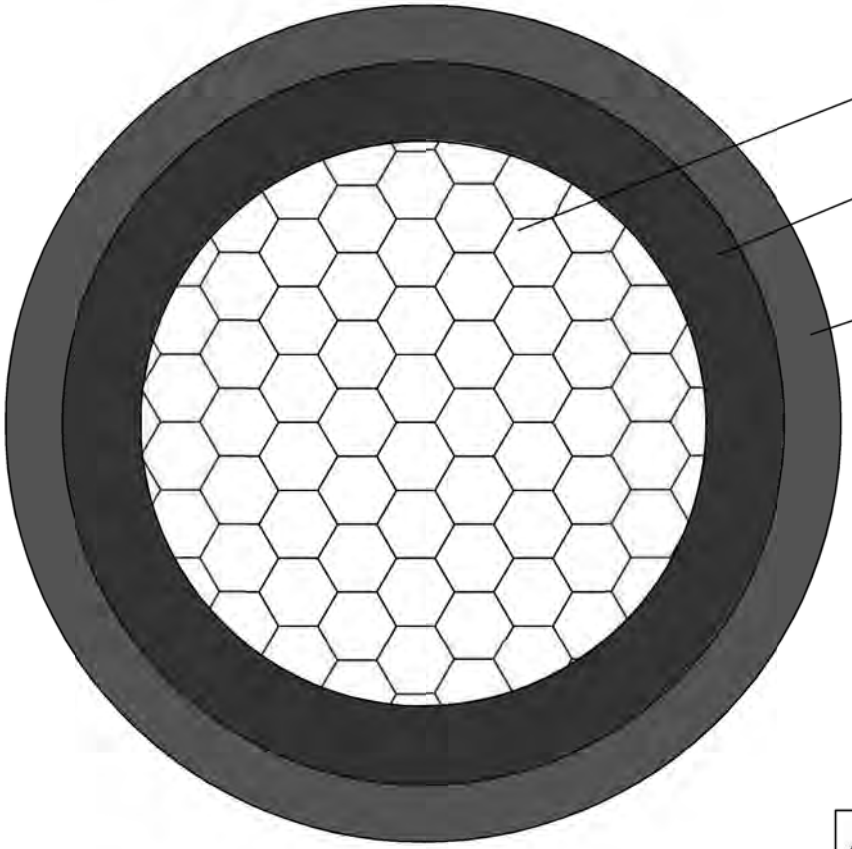
3C X 95 SQ.MM

3C X 240 SQ.MM

SPECIAL CABLES PVT LTD

Plot no 60 - 65 ,Sector 3, IIE Pantnagar , Rudrapur , U.K , 263153 INDIA

Aluminium conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.



Stranded circular compacted Aluminium conductors

Extruded XLPE insulation as per IS:7098-1

Extruded PVC Type-ST2 outer sheath as per IS:5831/1984 with FRLS properties

1C x 35 sq.mm

1C x 400 sq.mm

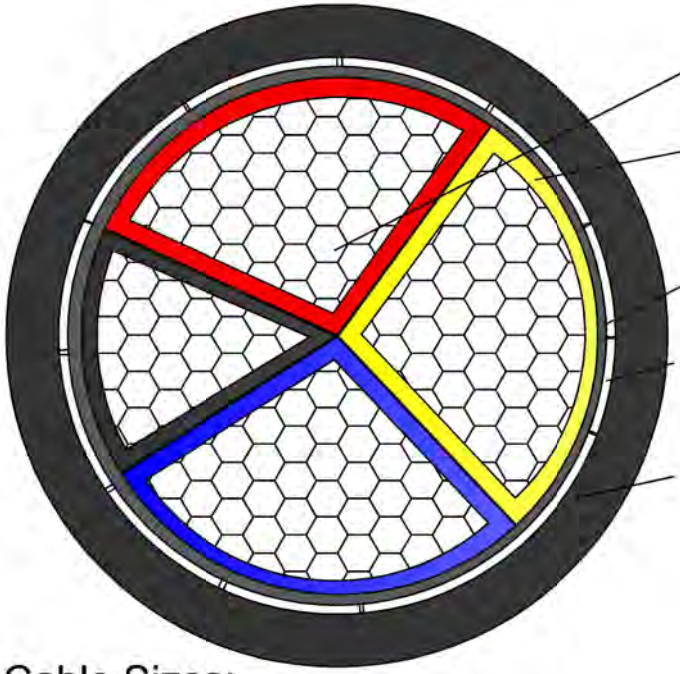
1C x 630 sq.mm

SPECIAL CABLES PVT LTD

Plot no 60 - 65 ,Sector 3, IIE Pantnagar , Rudrapur , U.K , 263153 INDIA

TITLE	Cross-sectional Drawing - Un Armoured Power Cable			
DRAWING / DOCUMENT NO.	Created by	Checked by	Approved by	Date of Approved

Aluminium conductor, XLPE Insulated and overall FRLS HR PVC Outer sheathed unarmoured power cables.



Stranded and Shaped aluminium conductor as per IS:8130

Extruded XLPE Insulation as per IS: 7098 Pt1

Extruded HR PVC Type-ST2 inner sheath as per IS:5831/1984

Extruded HR PVC Type-ST2 outer sheath as per IS:5831/1984 with FRLS properties

Cable Sizes:

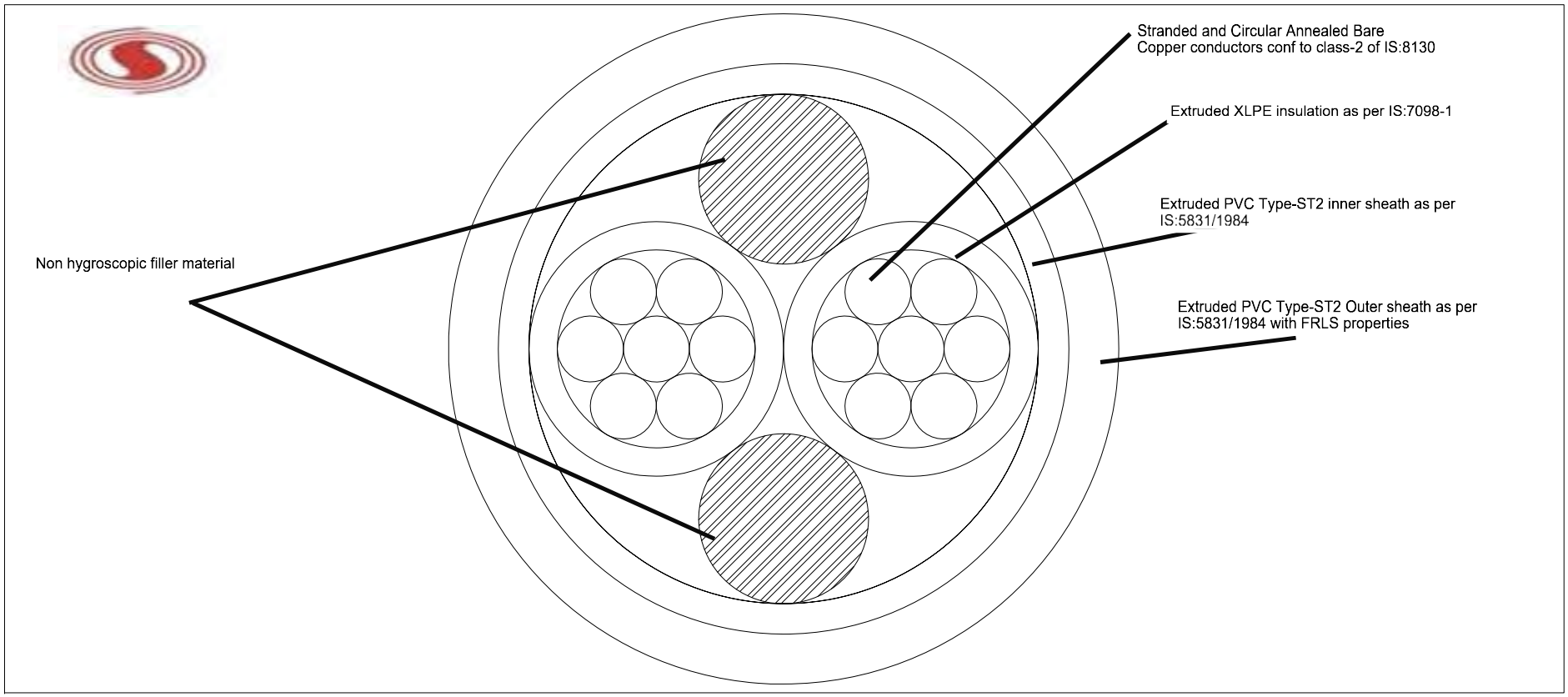
3.5C x 25 sq.mm
3.5C x 95 sq.mm

SPECIAL CABLES PVT LTD

Plot no. 60 - 65 IIE Sector-3 Rudrapur (Uttrakhand) 263153

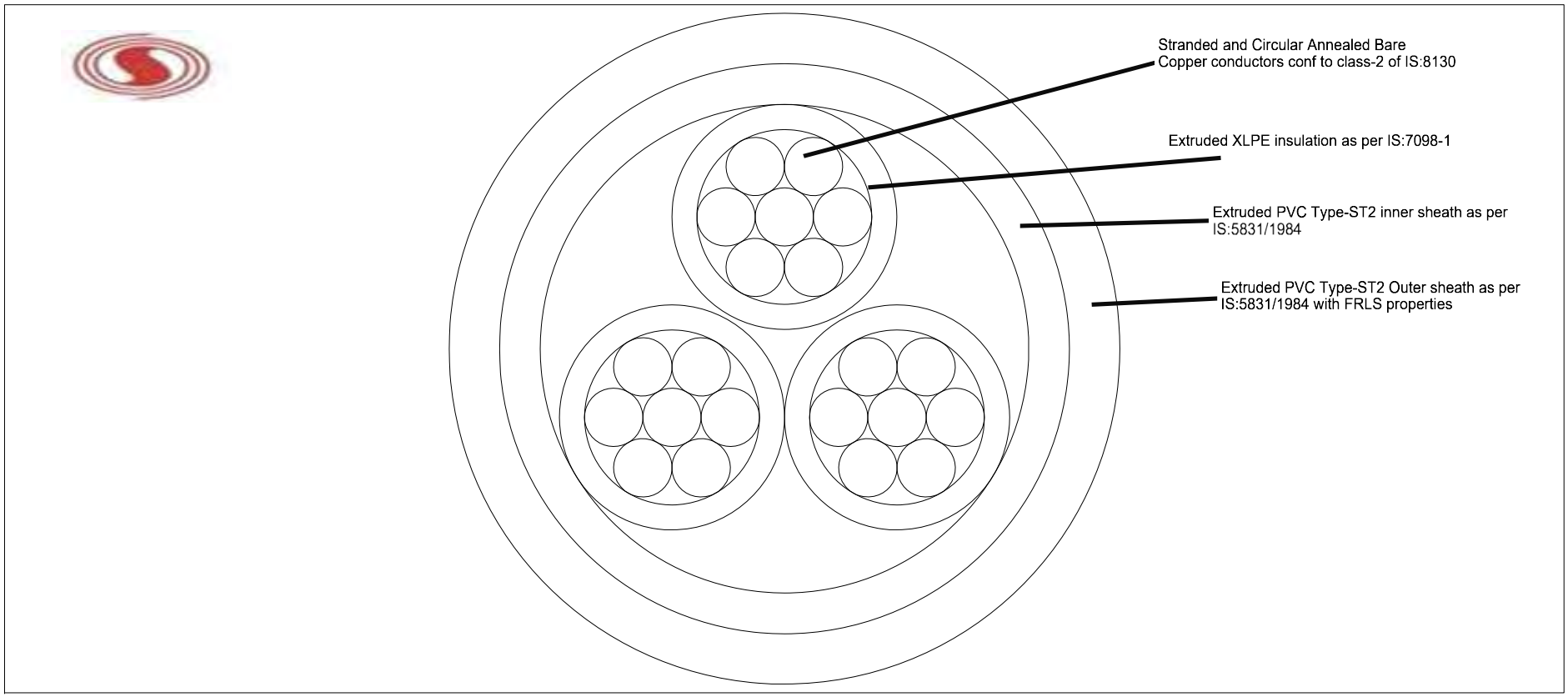
TITLE	Cross-sectional Drawing - POWER CABLES			
DRAWING / DOCUMENT NO.	Created by	Checked by	Approved by	Date of Approved

Aluminium conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.



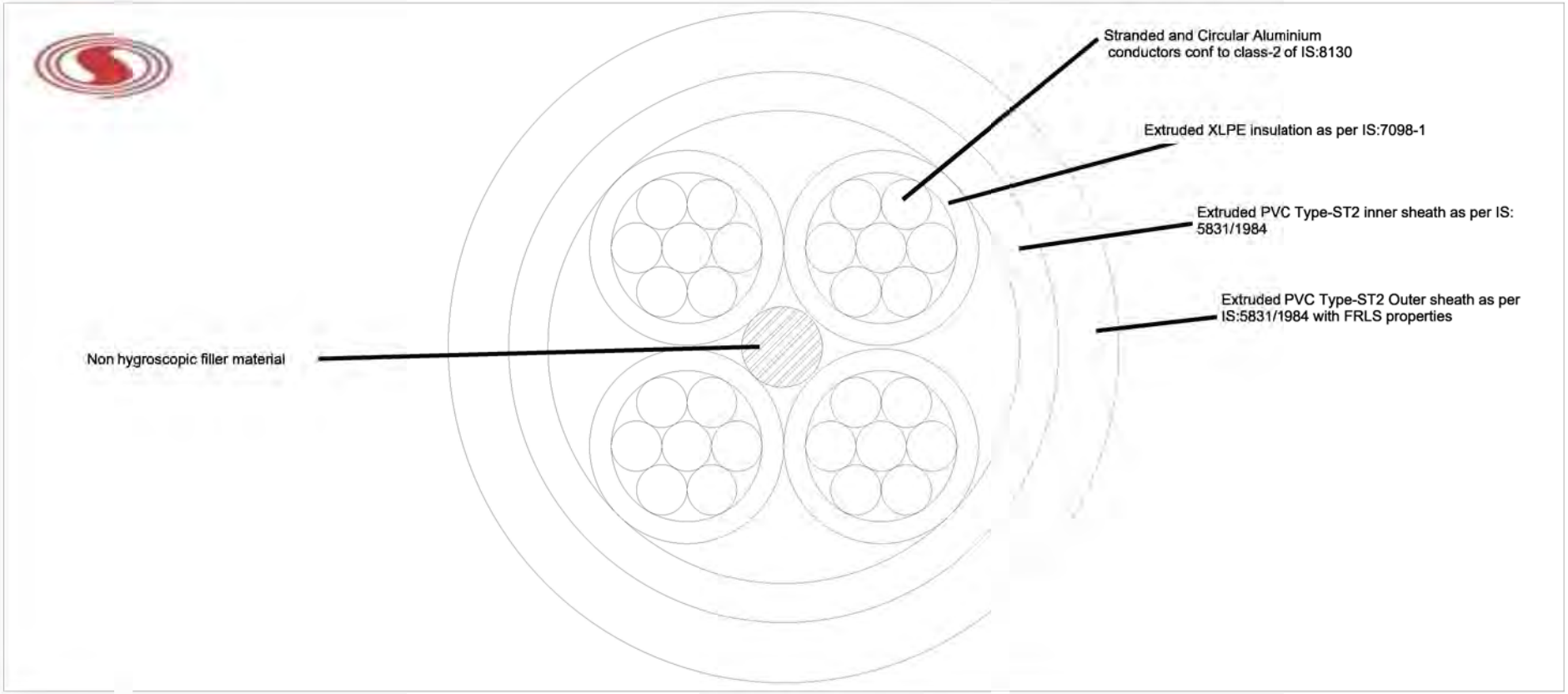
2C x 2.5 sq.mm

Annealed bare copper conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.



3C x 2.5 sq.mm

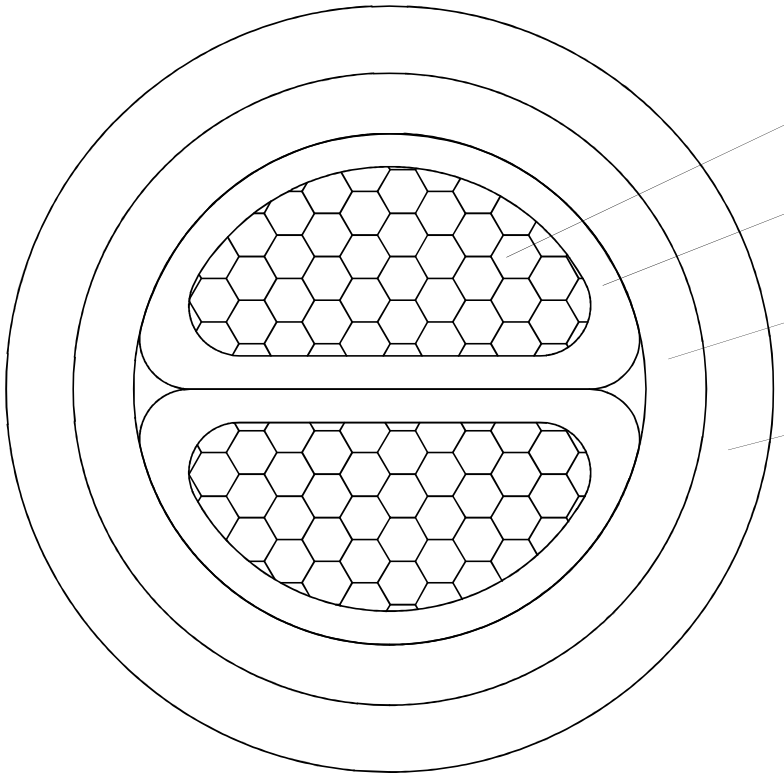
Annealed bare copper conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.



4C x 10 sq.mm

Aluminium conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.

SPECIAL CABLE PRIVATE LIMITED



STRANDED AND SHAPED ALUMINUM CONDUCTOR

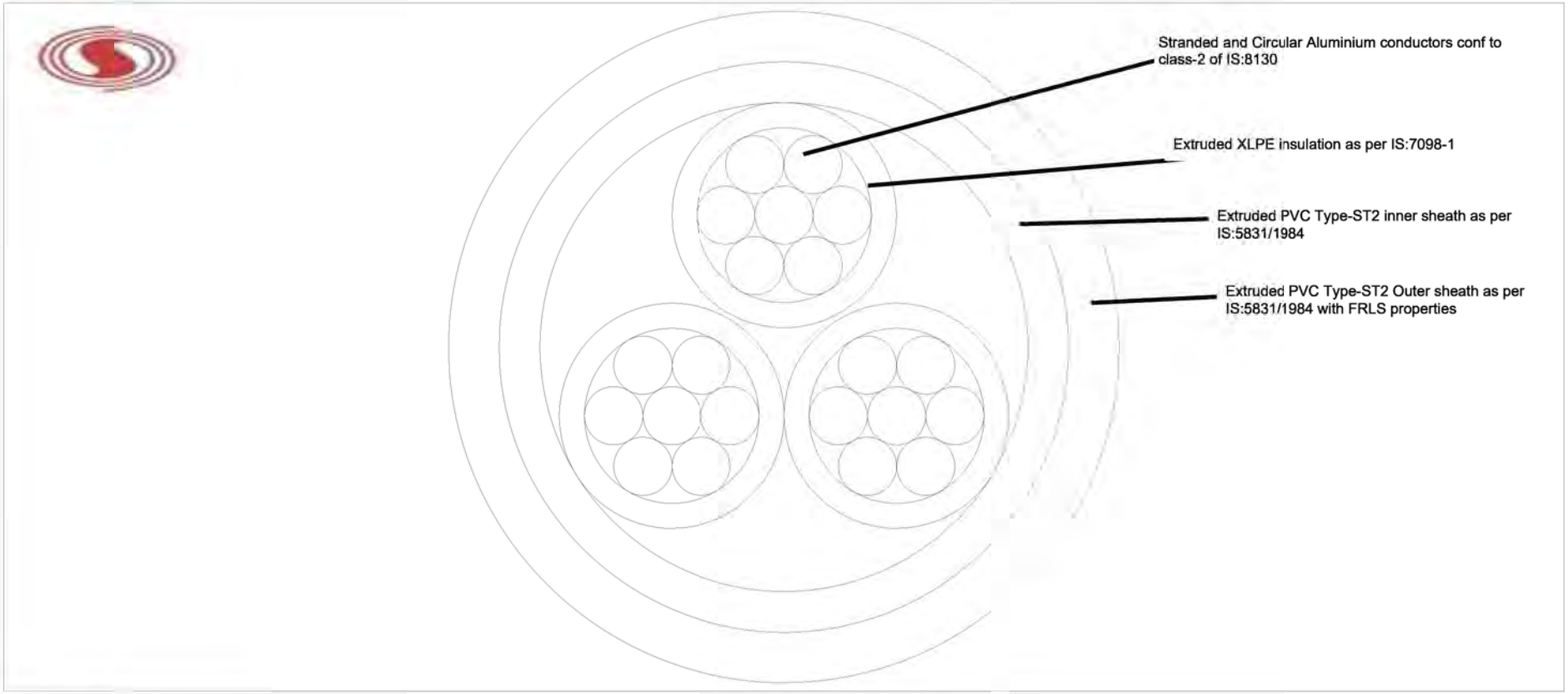
EXTRUDED, XLPE INSULATION

EXTRUDED, PVC TYPE ST2 INNER SHEATH

EXTRUDED, PVC TYPE ST2 OUTER SHEATH WITH FRLS PROPERTIES

2C x 95 Sq. mm

ALUMINUM CONDUCTOR, XLPE INSULATED, HR PVC INNER SHEATHED AND OVERALL FRLS HR PVC SHEATHED POWER CABLE



3C x 10 sq.mm

Aluminium conductor, XLPE Insulated , HR PVC Inner Sheathed and overall FRLS HR PVC Outer sheathed unarmoured power cables.

2 X 800 MW NTPC KARIMNAGAR SG PACKAGE PH-1

DRG TITLE- TECHNICAL DATASHEET- LT PVC CONTROL CABLE

NTPC DRG NO. 9591-102-102-PVE-Y-026, REV 00

BHEL DRAWING NO. - PE-V0-424-507-E131, REV 00

	NTPC COMMENT DTD 21.09.18	BHEL REPLY DTD 28.09.18
1	Indicate number of conductor and size of conductor	Indicated in revised document.
2	indicate standard length 1000M.	Same is already Indicated at Sl. No. 5.0 (b)
3		In line with NTPC comments on drg no. 9591-102-102-PVE-Y-027 (CROSS SECTIONAL DRGS- LT PVC CONTROL CABLES), cross sectional drgs have been made part of this document.

Certification signature by deepak jindal <deepakjindal@ntpc.co.in>, Validity Unknown

Digitally signed by deepak jindal
Date: 2018.10.12 10:46:01 IST
Reason: CAT IV
Location: NTPCEOC

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

This is to certify that this document has been reviewed in PEM for confirming to the technical requirements for the project.

SIGNATURE	Shweta
INITIALS OF DEALING ENGINEER	Shweta Gaba
DATE	28.09.18
DEPARTMENT	Electrical

NTPC DRG NO. 9591-102-102-PVE-Y-026

Job No	424	Customer	एनटीपीसी NTPC	NATIONAL THERMAL POWER CORPORATION LTD 2x800 MW NTPC KARIMNAGAR PROJECT (SG PACKAGE PH-1)
Status	Contract			
Project		2x800 MW NTPC KARIMNAGAR SG PACKAGE PH-1		

बी एच ई एल BHEL	BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT NOIDA		NAME	SIGNATURE	DATE
		Prepared by	PP		27.09.2018
		Checked by	DS		27.09.2018
		Approved by	NQ		27.09.2018
TITLE	TECHNICAL DATA SHEET - LT PVC CONTROL CABLE	DOCUMENT NO.	PE-V0-424-507-E131	
		REVISION NO.	1	

GUARANTEED TECHNICAL PARTICULARS

Client: BHEL- PEM
Project: 2x800 MW NTPC KARIMNAGAR TELANGANA SG PKG PHASE-1
Doc No: PE-V0-424-507-E131
CMI Reference No: CMI E-1225

Rev: 01, Dated: 27.09.2018

Sl. No.	Description		Units	3C x 1.5	7C x 1.5	12C x 1.5
A	**GENRAL**					
1.0	Name of Manufacturer	:		M/s CMI Energy India Pvt Ltd (Formerly **General Cable Energy India Pvt Ltd**)		
1.1	Place of Manufacturer	:		Address - Unit-1, Village: Bhatauli Khurd, Baddi, Tehsil, Dist: Solan (HP), 173205		
2.0	**Standard Applicable**		-			
2.1	**IS: 1554 Part-1** For general specification of PVC Cables	:	-	YES		
2.2	**IS: 8130** For conductor material	:	-	YES		
2.3	**IS: 5831** For material of inner sheath & outer sheath	:	-	YES		
2.4	**IS: 3975/IS: 8130** For armour of LT control core cables	:	-	NOT APPLICABLE		
2.5	**IS: 10810** For method of tests	:	-	YES		
2.6	**IS: 10418** For cable drums	:	-	YES		
2.7	**ASTM D-2863** For Oxygen Index test	:	-	YES		
2.8	**ASTM D-2843** For Smoke density test	:	-	YES		
2.9	**IEC: 332-III-Cat-B, IEC: 332-1** For flammability test	:	-	YES		
2.10	**IEC: 754-1** For Acid gas generation	:	-	YES		
2.11	Current rating of cables conforms to	:		IS: 3961		
2.12	Short circuit current rating conforms to	:		IS: 1554 (P-1)		
2.13	Formula for calculating short circuit current for different durations	:		$I_{SH} = k*A / \sqrt{t}$		
				where,		
				I_{SH} = Short circuit current in kA		
				K= A constant , 0.115 for Copper Conductor, PVC Insulation.		
				A= Area of Cross section of conductor in sqmm		
				t = Fault clearing time in seconds		
	Cable Type			YY	YY	YY
	Permissible conductor temperature					
	(a) Maximum continuous rating	:	Deg C	70 °C		
	(b) Short circuit rating	:	Deg C	160 °C		
3.0	(a) Installation Conditions at site					
	i) Ambient air temperature	:	Deg C	50 °C		
	ii) Ground temperature	:	Deg C	40 °C		
	iii) Depth of laying of cables buried in ground	:	cm	90		
	(b) Installation conditions for current rating specified at clause 6.3					
4.0	**CHARACTERISTICS OF FRLS SHEATH**					
	a) Oxygen Index	:		Min. 29 as per ASTM D-2863/IS: 10810 (P-58)		
	b) Temperature Index	:		Min. 250 ^{0}C as per ASTM D-2863		
	c) Acid gas generation	:		Max. 20% (by weight) as per IEC: 754-1		
	d) Smoke density rating	:		Max. 60% smoke density / Min 40% light transmission as per ASTM D-2843		
	e) Flammability Test	:		Shall be as per IEC: 60332-1, IEC: 60332-3 (Cat-B)		
5.0	**CABLE DRUMS**					
	a) Type & construction	:		In non returnable Wooden drum as per IS: 10418		
	b) Standard drum length	:	meters	1000 meters	1000 meters	1000 meters
	c) Tolerance on drum length	:	%	± 5%		
6.0	**INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE**					
6.1	No. of cores x size	:		**3C x 1.5**	**7C x 1.5**	**12C x 1.5**
6.2	Voltage grade (Uo/U)	:		1.1 kV		
6.3	Base current ratings (*) based on Cl. 3.0	:				
	a) In Air	:	Amps	14	10	8
	b) In Ground	:	Amps	21	14	12
	c) In Ducts	:	Amps	17	13	10

CMI Energy India Pvt. Ltd.

GUARANTEED TECHNICAL PARTICULARS

Client: BHEL- PEM
Project: 2x800 MW NTPC KARIMNAGAR TELANGANA SG PKG PHASE-1
Doc No: PE-V0-424-507-E131
CMI Reference No: CMI E-1225

Rev: 01, Dated: 27.09.2018

Sl. No.	Description		Units	3C x 1.5	7C x 1.5	12C x 1.5
6.4	Short circuit rating of conductor for 1 sec duration	:	kA for 1 sec	0.17	0.17	0.17
6.5	a) D.C. resistance of conductor at 20 deg. C	:	Ohm/Km (max.)	12.1	12.1	12.1
	b) A.C. resistance of conductor at 70 deg. C	:	Ohm/Km (app.)	14.5	14.5	14.5
	c) Reactance of cable at normal frequency	:	Ohm/Km (app.)	0.126	0.126	0.126
	d) Electrostatic capacitance of cable at normal frequency	:	uF/Km (app.)	0.14	0.14	0.14
6.6	**CONDUCTOR**					
	a) Material type	:		Plain annealed high conductivity bare Copper as per class-2 of IS: 8130		
	b) Grade	:		EC grade		
	c) Nominal cross-sectional area	:	Sqmm	1.5	1.5	1.5
	d) No. of strands & Nominal dia of each strands (before stranding)	:	No's/mm	7/0.525	7/0.525	7/0.525
	e) Shape of conductor	:		Stranded circular		
	f) Direction of lay of conductor	:		Outermost layer shall be Right handed lay		
6.7	**INSULATION**					
	a) Material	:		Extruded PVC "Type-A" as per IS: 5831		
	b) Nominal thickness of insulation	:	mm	0.8	0.8	0.8
	c) Minimum thickness of insulation	:	mm	0.62	0.62	0.62
	d) Minimum volume resistivity at 27 °C	:	Ohm-cm		1×10^{13}	
	e) Minimum volume resistivity at 70 °C	:	Ohm-cm		1×10^{10}	
	f) Method of curing	:		Not applicable		
	CORE IDENTIFICATION	:		For 3 cores - **RED, YELLOW & BLUE** colour, for 7 & 12 Cores - All cores of **GREY** colour with number printing		
6.8	**PVC ST-1 INNER SHEATH**					
	a) Material	:		Extruded PVC "Type ST-1" as per IS: 5831		
	b) Whether FRLS	:		No		
	c) Thickness (minimum)	:	mm	0.3	0.3	0.3
	d) Method of application	:				
	1) Multi core cables	:				
	i) With fillers	:		Pressure/Vaccum Extrusion		
	ii) With out fillers	:		Pressure Extrusion		
	e) Type of fillers (if used)	:		Same as Inner sheath (Material of filler to be compactible with that of Inner Sheath)		
	Shape of fillers (if used)	:		Circular or Hollow		
	f) Colour	:		Black		
6.9	**ARMOUR**					
	a) Material	:		Not Applicable		
	b) Type of armour	:				
	i) Single Core Cables	:		Not Applicable		
	ii) Multi Core Cables	:		Not Applicable		
	c) Size/dimensions (Nominal dia of wire)	:	mm	Not Applicable		
	d) Minimum no. of round/formed wire	:	No's (approx)	Not Applicable		
	e) Tolerance on formed wire dimension					
	f) Maximum Resistivity of GS Formed/round Wire	:	Ohm-cm	Not Applicable		
	g) Maximum Resistivity of Aluminium Formed/Round Wire :	:	Ohm-cm	Not Applicable		
	h) Short circuit rating current for 1 sec		kA/sec	Not Applicable		
6.10	**PVC ST1 FR-LSH OUTER SHEATH**					
	a) Material	:		Extruded FR-LSH PVC "Type ST-1" as per IS: 5831		
	b) Whether FR-LSH	:		Yes		
	c) Nominal Thickness	:	mm	1.80	1.80	1.80
	d) Colour	:		**GREY**		
	e) Method of application	:		Extruded		
6.11	**DIAMETERS**					
	a) Diameter of insulated conductor	:	mm (fictitious)	3.0	3.0	3.0
	b) Diameter of insulated conductor - actual	:	mm (approx)	3.3	3.3	3.3
	c) Cable diameter over laidup cores	:	mm (fictitious)	6.5	9.0	12.5
	d) Cable diameter over laidup cores - actual	:	mm (approx)	7.1	9.9	13.7
	e) Cable diameter over inner sheath	:	mm (fictitious)	7.1	9.6	13.1
	f) Cable diameter over inner sheath - actual	:	mm (approx)	8.3	11.1	14.9
	g) Overall diameter of cable	:	mm (approx.)	12.1	14.9	18.7
6.12	Tolerance on overall diameter	:	mm	± 2 mm		

CMI Energy India Pvt. Ltd.

GUARANTEED TECHNICAL PARTICULARS

Client: BHEL- PEM
Project: 2x800 MW NTPC KARIMNAGAR TELANGANA SG PKG PHASE-1
Doc No: PE-V0-424-507-E131
CMI Reference No: CMI E-1225

Rev: 01, Dated: 27.09.2018

Sl. No.	Description	Units	3C x 1.5	7C x 1.5	12C x 1.5
6.13	Minimum Bending Radius	mm		12 x O.D	
6.14	Safe Pulling Force	N/sq.mm		50 N/sq.mm	
6.15	Weight of cable (approx)	Kg/Km	175	300	450
6.16	**Dimension of drum**			As per IS: 10418	
	Tolerance on total Quanity	%		+ 0% & - 2%	
6.17	**Shipping weight**	Kg. (approx)	200	335	500
6.18	**Cable Marking on Outer Sheath**				
	Embossing Details		CMI ELECTRIC CABLE 1.1 kV, No of Cores & Cable Size, PVC, Year of Mfr, "FR-LSH", IS 1554 (P-1), ~~"BHEL-PEM"~~ NTPC @ 5 meter interval		
	Sequential Marking		Shall be provided on outer sheath by printing @ every one mtr.		
	Marking on drum		Manufacturer's Name, Address and Contract No, Item No & Type, No of cores & Size & length of cable on Drum, 1.1 kV, Year of Mfr, PVC/FR-LSH, Cable Code, ISI Mark, IS: 1554 (P-1) ~~"BHEL-PEM"~~ "NTPC" and net/gross weight stencilled on both sides of drum. A tag contaning same information shall be attached to the leading end of the cable, An arrow and suitable accompanying wording on one end of the reel indicating the direction in which it should be rolled		

*The Wire & Conductor diameter are indicative & approx and shall confirm to meet the IS requirements of conductor resistance only

CMI Energy India Pvt. Ltd.

(For CMI Energy India Pvt Ltd)

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

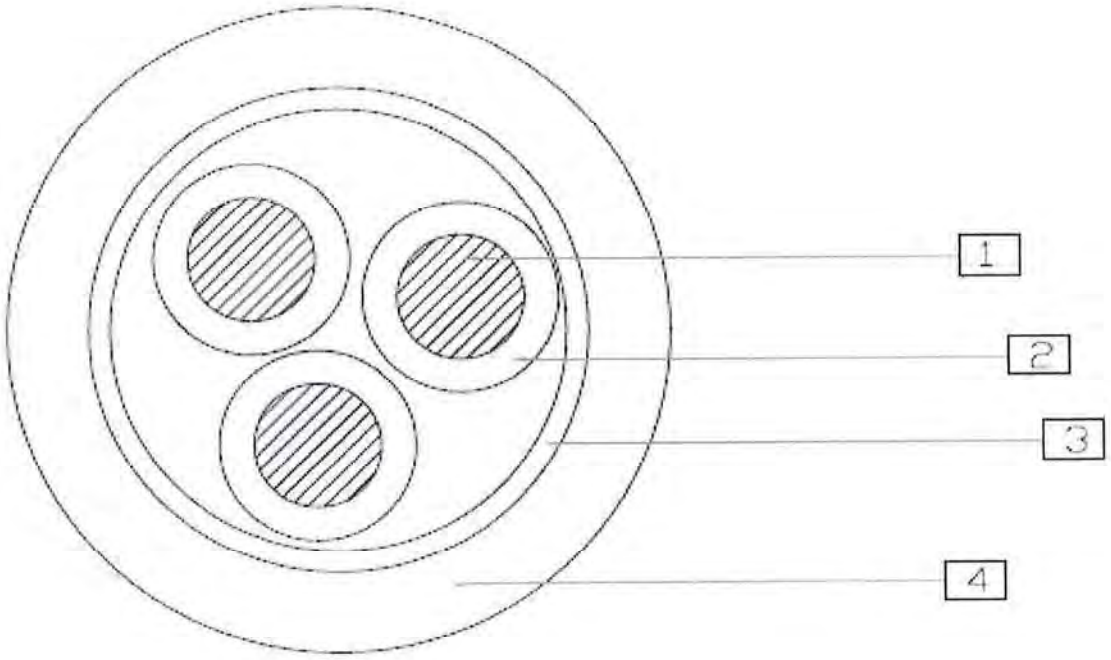
This is to certify that this document has been reviewed in PEM for confirming to the technical requirements for the project.

SIGNATURE	Shweta
INITIALS OF DEALING ENGINEER	Shweta Gaba
DATE	04.09.18
DEPARTMENT	Electrical

Job No	424	Customer	एनटीपीसी NTPC	**NATIONAL THERMAL POWER CORPORATION LTD** 2x800 MW NTPC KARIMNAGAR PROJECT (SG PACKAGE PH-1)
Status	Contract			
Project		**2x800 MW NTPC KARIMNAGAR SG PACKAGE PH-1**		

		NAME	SIGNATURE	DATE
BHARAT HEAVY ELECTRICALS LTD **PROJECT ENGINEERING MANAGEMENT** **NOIDA**	Prepared by	PP		17.08.2018
	Checked by	DD		17.08.2018
	Approved by	NG		17.08.2018
TITLE: **CROSS SECTIONAL DRAWING - LT PVC CONTROL CABLE**	DOCUMENT NO.	**PE-V0-424-507-E133**		
	REVISION NO.			

Typical Cross Sectional Drawing of 3C x 1.5 sqmm Control cable

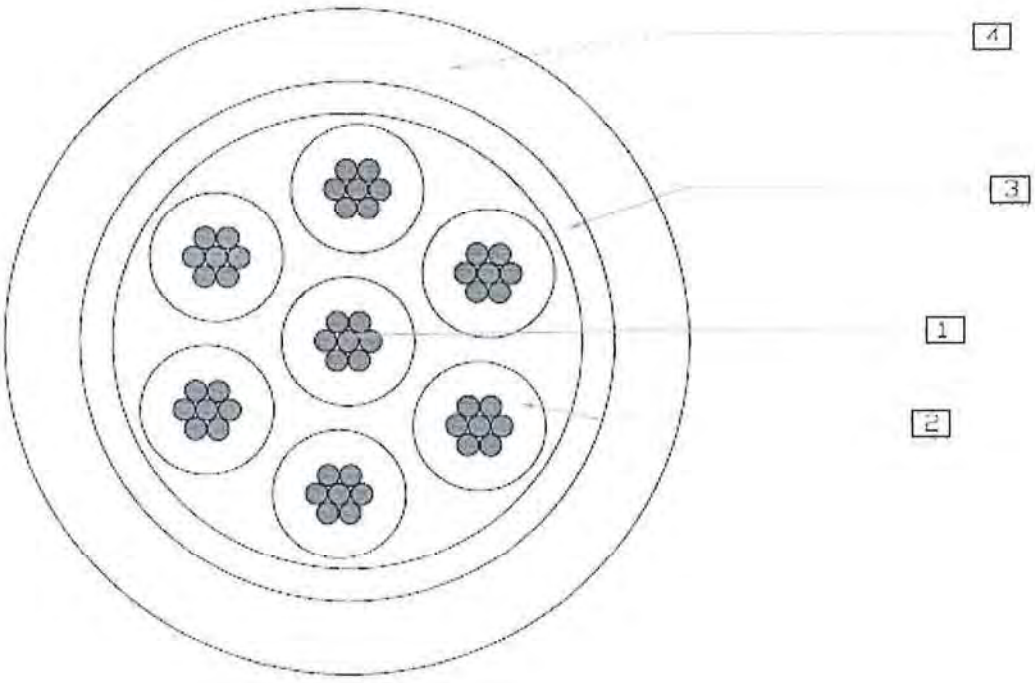


Cable Details

1. Conductor – Stranded circular Annealed bare Copper of EC grade (class 2)
2. Insulation – Extruded PVC "Type-A"
3. Inner Sheath – Extruded PVC "Type ST-1"
4. Outer Sheath – Extruded FR-LSH PVC "Type ST-1"

CMI Energy India Pvt. Ltd.

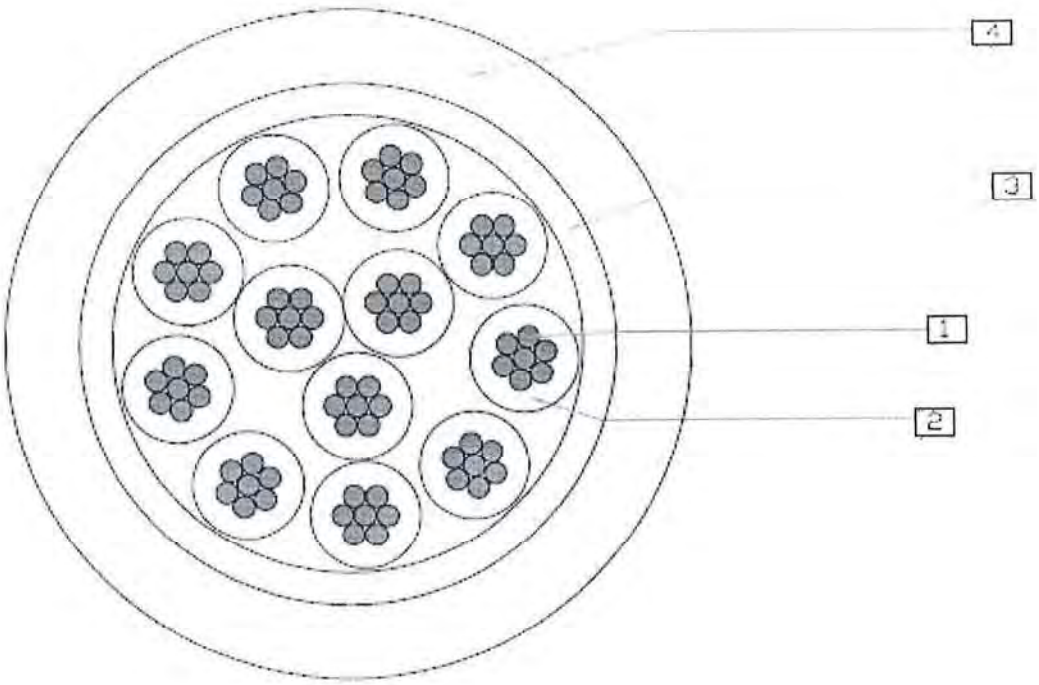
Typical Cross Sectional Drawing of 7C x 1.5 sqmm Control cable



Cable Details

1. Conductor – Stranded circular Annealed bare Copper of EC grade (class 2)
2. Insulation – Extruded PVC "Type-A"
3. Inner Sheath – Extruded PVC "Type ST-1"
4. Outer Sheath – Extruded FR-LSH PVC "Type ST-1"

Typical Cross Sectional Drawing of 12C x 1.5 sqmm Control cable



Cable Details

1. Conductor – Stranded circular Annealed bare Copper of EC grade (class 2)
2. Insulation – Extruded PVC "Type-A"
3. Inner Sheath – Extruded PVC "Type ST-1"
4. Outer Sheath – Extruded FR-LSH PVC "Type ST-1"

ENDORSEMENT SHEET FOR DATA SHEET

TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION		To be filled in by NTPC
PROJECT NAME:	2 x 800 MW NTPC KARIMNAGAR TPS	REVIEW & ENDORSEMENT BY NTPC
MAIN SUPPLIER:	BHEL PEM - NOIDA	PROJECT SPECIFIC DS NUMBER ALLOTTED
MANUFACTURER WORKS & ADDRESS:	M/S CMI LIMITED PLOT NO 71 & 82, SECTOR-6, FARIDABAD-121006	DS NO.: 9591-102-104-PVI-Z-036A REV NO.:00 DATE :
ITEM EQUIPMENT / SYSTEM / SUB-SYSTEM DETAILS I.e. MODEL TYPE SIZE / RATING etc.	SCREENED CONTROL CABLES	
BHEL DOC NO.:	PE-V0-424-507-E141	
APPROVED DS NO.:	4410-001-215-PVE-Y-026 REV 02 DATED 27-05-2016	

Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)	(TICK APPLICABLE)
I. That the item/component is identical to that consider for DS approval. OR.	
II. That there are minor changes in the item/component with respect to that consider for DS approval, however the same do not affect the contents of DS. OR	The DS is endorsed for this project without any change
III. That there are minor changes in the item / component with respect to that considered for DS approval, however the same affect the DS slightly as indicated below / in attached sheet. • Conductor Material shall be BARE instead of TINNED as per Technical Specification No PE-TS-424-507-E004 • Overall Diameter of 4P x 0.5 Sqmm (Type F) (UA) cable shall be 12.1±2mm instead of 11.5±2mm • Overall Diameter of 8P x 0.5 Sqmm (Type F) (UA) cable shall be 18.3±2mm instead of 17±2mm • Overall Diameter of 12P x 0.5 Sqmm (Type F) (UA) cable shall be 19.4±2mm instead of 18±2mm	The DS is endorsed for this project with any changes as indicated. DISTRIBUTION OF ENDORSEMENT OF A) DS: 1. MAIN SUPPLIER (WITH A COPY OF DS) 2. MANUFACTURER 3. RIO 4. CQA-SPL

Certification signature by Deepak Jindal
<deepakjindal@ntpc.co.in>
Date: 2018.02.23 14:39:51 IST
Reason: CAT I
Location: NTPCEOC

BHARAT HEAVY ELECTRICALS LTD
PROJECTS ENGINEERING MANAGEMENT
(ELECTRICAL)
This approval status shall be interpreted as laid down in the contract and it shall not relieve the contractor from his contractul obligations.
APPROVAL CATEGORY AWARDED
CAT I = Approved
CAT II = Approved with comments as noted
CAT III = Not Approved
CAT IV = Reference Drawing
Name: Priyanka
Signature:
Date:

BHEL, PEM - NOIDA SIGN.: (Main Supplier) DATE:	SIGN.: (Manufacturer) DATE: 12.02.2018	NTPC (Received/Approved by / Date & Seal)

Reference: CC215:9067

Date:27-05-16

From:	O.P. OBEROI AGM	To:	BHEL-PEM Noida
		CC:	- - -

SUBJECT : NKSTPP, EPC ELECTRICAL EQUIPMENTS PACKAGE

Please find enclosed following drawings/documents for necessary action at your end as indicated in purpose code.

VENDOR DRG NO:	BHEL-PEM
NTPC DRG NO:	4410-001-215-PVE-Y-026
REVISION NO:	02
DRG TITLE:	DATA SHEET- SCREENEDCONTROL CABLES
APP CATEGORY:	I
RELEASE DATE:	27-05-16
COMMENTS:	No comments with mark up on the document.

BHEL DOC. NO. : PE -V0-405-507-E141

NTPC DOC. NO. : 4410-001-215-PVE-Y-026

DATA SHEET
FOR
SCREENED CONTROL CABLE

CUSTOMER: NTPC Limited

PROJECT: 3x660 MW NORTH KARANPURA STPP STG-1

VENDOR : CMI LIMITED

Package : SCREENED CONTROL CABLE

REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD

JOB NO. 405

STATUS CONTRACT

DISTRIBUTION

TO

NO.

BHARAT HEAVY ELECTRICAL LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
E	DSGN	BKB		
	CHKD	NA		
	APPD	PA		

TITLE

TITLE
DATA SHEET FOR SCREENED CONTROL CABLE

BHEL DOC. NO.	PE-V0-405-507-E141		
NTPC DOC. NO.	4410-001-215-PVE-Y-026		
SHEET	1 OF 16	REV.	02

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Faridabad- 121006 (Haryana)
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DATA SHEET

(FOR UN-ARMOURED INSTRUMENT CABLE TYPE - F)

Customer:→ BHEL, NOIDA
Project : 3 x 660 MW NORTH KARANPURA STPP
P.O. No. : PW/PE/PG/KAR/P-479/15 dated 31.03.2016

NTPC Doc. No. : 4410-001-215-PVE-Y-026
BHEL Doc No. : PE-V0-405-507-E141
CMI Ref. No. : O/ CMI / BHEL NOIDA /4549/DS /01 dated 25.05.2016 Rev. 02

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² Ind & O/All scnd. (U/A)	4 P x0.5mm² Ind & O/All scnd. (U/A)	8 P x0.5mm² Ind & O/All scnd. (U/A)	12 P x0.5mm² Ind & O/All scnd. (U/A)	20 P x0.5mm² Ind & O/All scnd. (U/A)
1	Manufacturer's name		M/s CMI LIMITED.				
2	Type of Cable		Type F	Type F	Type F	Type F	Type F
3	Reference design standards		VDE -0472/ VDE-0815/IS-10810				
4	Voltage Grade	V	225 (peak)				
5	Conductor size	mm²	0.5				
6	**CONDUCTOR**						
	a. Reference standard		IS 8130				
	b. Material		Annealed Tinned Copper				
	c. Grade		Electrolytic				
	d. No. of strands/ Diameter of strands (nom.)	No / mm	7/0.3				
7	**INSULATION**						
	a. Reference standard		VDE 0207 Part 4				
	b. Material		Extruded PVC Compound Type - YI3				
	c. Thickness Min./ Max.	mm	0.25 / 0.35				
	d. Min. volume resistivity	Ω-cm	1×10^{14} at 20°C / 1×10^{11} at 70°C				
8	**PAIR & TWISTING**						
	a. Whether cores are twisted		Yes				
	b. Max. lay of Twist	mm	50				
	c. Cores of the pairs of a bunch provided		as per annexure B-I enclosed				
	d. Single Layer of Binder Tape on each pair is provided		Yes				
	e. Unit Formation of four pair polyester binder tape for cables more than 4P is provided		Yes				

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² Ind & O/All scnd. (U/A)	4 P x0.5mm² Ind & O/All scnd. (U/A)	8 P x0.5mm² Ind & O/All scnd. (U/A)	12 P x0.5mm² Ind & O/All scnd. (U/A)	20 P x0.5mm² Ind & O/All scnd. (U/A)
9	**SHIELD**						
	a. Material		Aluminium mylar tape				
	b. Thickness of individual shield (min.)	mm	0.028				
	c. Thickness of overall shield (min.)	mm	0.055				
	d. Coverage / Overlap (min.)	%	100 / 20				
10	**DRAIN WIRE**						
	a. Reference standard		IS 8130				
	b. Material		Annealed tinned copper				
	c. Size / No. of standard / Diameter of strands (nom.)	mm²/No./ mm	0.5 / 7 / 0.3				
	d. Separate drain wires for individual as well as overall shield provided		Yes				
11	Fillers (if applicable) are non hygroscopic & flame retardant		Yes				
12	**OUTER SHEATH**						
	a. Reference standard		VDE 0207 part 5/ VDE 0816				
	b. Material		Extruded PVC Type YM1 with FRLS properties				
	c. Minimum thickness	mm	1.8	1.8	1.8	1.8	1.8
	d. Oxygen index (As per ASTM-D 2863)	%	29 (min.)				
	e. Temp. Index (In °c as per ASTM-D 2863)	°c	250 (min.)				
	g. Acid gas generation as per IEC60754-1	%	20 (max.) by weight				
	f. Smoke density rating as per ASTM-D 2843	%	60 (max.)				
	g. Colour of outer sheath		Blue				
13	**COMPLETE CABLE**						
	a. Overall Diameter of Cable	mm	10.5	11.5	17	18	21
	b. Allowed Tolerance on overall diameter	mm	± 2				
	c. Ovality at any cross section	mm	Not more than 1.0 mm				
	d. Variation of dia through out cable length	mm	Not more than 1.0 mm				
14	**CABLE PARAMETERS at 20° ± 3°C**						
	a. Conductor loop resistance (max.)	Ω/km	73.4				
	b. Insulation resistance (min.)	MΩ -km	100				
	c. Mutual capacitance at 0.8KHz (max.)	nF/km	120				
	d. Cross talk at 0.8KHz (min.)	dB	60				
	e. Attenuation at 1 KHz (max.)	dB/km	1.2				
	f. Characteristic impedance (max.) At 1KHz	Ω	320				
	g. Noise Interference as per IEEE Transactions 1967 (min.)	dB	60				

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² Ind & O/All scnd. (U/A)	4 P x0.5mm² Ind & O/All scnd. (U/A)	8 P x0.5mm² Ind & O/All scnd. (U/A)	12 P x0.5mm² Ind & O/All scnd. (U/A)	20 P x0.5mm² Ind & O/All scnd. (U/A)
15	Max. Continuous operating temp.	°C	70				
16	Whether complete cable Flame retardant as per IEEE383		Yes				
17	Whether complete cable passes Swedish chimney test as per SEN 4241475 (F3)		Yes				
18	**IDENTIFICATION**						
	a. Progressive automatic on-line sequential length marking in meters to be provided on outer sheath at every one meter.		Yes				
	b. FRLS marked at every 5 mtr.		Yes, along with BHEL-PEM & NTPC				
	c. Durable marking at interval not exceeding 625 mm including Manufacturer's name, Conductor's Size, Insulation Material, Number of Pairs, Type of Cable, Voltage Grade, Year of manufacturer		Yes				
19	**TEST VOLTAGE**						
	a. High voltage test (core - core)						
	i. Voltage	KV	Core to Core : 2 KV RMS, Core to Shield : 0.5 KV RMS				
	ii. Duration	minute	1				
	b. Resistance to direct current test						
	i. Voltage		Core to Core : 1200 Volts AC, Core to Shield : 220 Volts DC				
	ii. Duration	min/days	Core to Core : 10 minutes, Core to shield : 10 days				
20	Cable cross-sectional drawings for each type of cable furnished		Yes				
21	**CABLE DRUM**						
	a. Length of single coil in a drum	Mtrs.	1000				500
	b. Tolerance on Individual Drum Length w.r.t. (a) above		+/- 5%				
	c. Wooden drum provided		Yes				
	d. Identification marks provided on both sides of drum Manufacturer's name, Country of manufacturing, Consignee Address, LOA No. , Drum No, Length of Cable, Nett & Gross Wt., Year of manufacture, Type/ Size of Cable, Voltage Grade		Yes				
22	Quantity		as per Purchase Order				

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

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Fax.: 011 - 23739902

Works :
Plot No.: 71 & 82, Sector - 6
Faridabad- 121006 (Haryana)
Ph.: 0129 - 6522707-13
Fax.: 0129 - 2242686

DATA SHEET

(FOR UN-ARMOURED INSTRUMENT CABLE TYPE - G)

Customer:→ BHEL, NOIDA
Project : 3 x 660 MW NORTH KARANPURA STPP
P.O. No. : PW/PE/PG/KAR/P-479/15 dated 31.03.2016

NTPC Doc. No. : 4410-001-215-PVE-Y-026
BHEL Doc No. : PE-V0-405-507-E141
CMI Ref. No. : O/ CMI / BHEL NOIDA /4549/DS /05 dated 25.05.2016 Rev. 02

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² O/All scnd. (U/A)	4 P x0.5mm² O/All scnd. (U/A)	8 P x0.5mm² O/All scnd. (U/A)	12 P x0.5mm² O/All scnd. (U/A)
1	Manufacturer's name		M/s CMI LIMITED.			
2	Type of Cable		Type G	Type G	Type G	Type G
3	Reference design standards		VDE -0472/ VDE-0815/IS-10810			
4	Voltage Grade	V	225 (peak)			
5	Conductor size	mm²	0.5			
6	**CONDUCTOR**					
	a. Reference standard		IS 8130			
	b. Material		Annealed Tinned Copper			
	c. Grade		Electrolytic			
	d. No. of strands/ Diameter of strands (nom.)	No / mm	7/0.3			
7	**INSULATION**					
	a. Reference standard		VDE 0207 Part 4			
	b. Material		Extruded PVC Compound Type - YI3			
	c. Thickness Min./ Max.	mm	0.25 / 0.35			
	d. Min. volume resistivity	Ω-cm	1×10^{14} at 20°C / 1×10^{11} at 70°C			
8	**PAIR & TWISTING**					
	a. Whether cores are twisted		Yes			
	b. Max. lay of Twist	mm	50			
	c. Cores of the pairs of a bunch provided		as per annexure B-I enclosed			
	d. Single Layer of Binder Tape on each pair is provided		Yes			
	e. Unit Formation of four pair polyester binder tape for cables more than 4P is provided		Yes			

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² O/All scnd. (U/A)	4 P x0.5mm² O/All scnd. (U/A)	8 P x0.5mm² O/All scnd. (U/A)	12 P x0.5mm² O/All scnd. (U/A)
9	**SHIELD**					
	a. Material		Aluminium mylar tape			
	b. Thickness of overall shield (min.)	mm	0.055			
	c. Coverage / Overlap (min.)	%	100 / 20			
10	**DRAIN WIRE**					
	a. Reference standard		IS 8130			
	b. Material		Annealed tinned copper			
	c. Size / No. of standard / Diameter of strands (nom.)	mm²/No./ mm	0.5 / 7 / 0.3			
11	Fillers (if applicable) are non hygroscopic & flame retardant		Yes			
12	**OUTER SHEATH**					
	a. Reference standard		VDE 0207 part 5/ VDE 0816			
	b. Material		Extruded PVC Type YM1 with FRLS properties			
	c. Minimum thickness	mm	1.8	1.8	1.8	1.8
	d. Oxygen index (As per ASTM-D 2863)	%	29 (min.)			
	e. Temp. Index (In °c as per ASTM-D 2863)	°c	250 (min.)			
	g. Acid gas generation as per IEC60754-1	%	20 (max.) by weight			
	f. Smoke density rating as per ASTM-D 2843	%	60 (max.)			
	g. Colour of outer sheath		Blue			
13	**COMPLETE CABLE**					
	a. Overall Diameter cf Cable	mm	10	11	16	17
	b. Allowed Tolerance on overall diameter	mm	± 2			
	c. Ovality at any cross section	mm	Not more than 1.0 mm			
	d. Variation of dia through out cable length	mm	Not more than 1.0 mm			
14	**CABLE PARAMETERS at 20° ± 3°C**					
	a. Conductor loop resistance (max.)	Ω/km	73.4			
	b. Insulation resistance (min.)	MΩ -km	100			
	c. Mutual capacitance at 0.8KHz (max.)	nF/km	100			
	d. Cross talk at 0.8KHz (min.)	dB	60			
	e. Attenuation at 1 KHz (max.)	dB/km	1.2			
	f. Characteristic impedance (max.) At 1KHz	Ω	340			
	g. Noise Interference as per IEEE Transactions 1967 (min.)	dB	60			

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² O/All scnd. (U/A)	4 P x0.5mm² O/All scnd. (U/A)	8 P x0.5mm² O/All scnd. (U/A)	12 P x0.5mm² O/All scnd. (U/A)
15	Max. Continuous operating temp.	°C	70			
16	Whether complete cable Flame retardant as per IEEE383		Yes			
17	Whether complete cable passes Swedish chimney test as per SEN 4241475 (F3)		Yes			
18	**IDENTIFICATION**					
	a. Progressive automatic on-line sequential length marking in meters to be provided on outer sheath at every one meter.		Yes			
	b. FRLS marked at every 5 mtr.		Yes, along with BHEL - PEM & NTPC			
	c. Durable marking at interval not exceeding 625 mm including Manufacturer's name, Conductor's Size, Insulation Material, Number of Pairs, Type of Cable, Voltage Grade, Year of manufacturer		Yes			
19	**TEST VOLTAGE**					
	a. High voltage test (core - core)					
	i. Voltage	KV	Core to Core : 2 KV RMS, Core to Shield : 0.5 KV RMS			
	ii. Duration	minute	1			
	b. Resistance to direct current test					
	i. Voltage		Core to Core : 1200 Volts AC, Core to Shield : 220 Volts DC			
	ii. Duration	min/days	Core to Core : 10 minutes, Core to shield : 10 days			
20	Cable cross-sectional drawings for each type of cable furnished		Yes			
21	**CABLE DRUM**					
	a. Length of single coil in a drum	Mtrs.	1000			
	b. Tolerance on Individual Drum Length w.r.t. (a) above		+/- 5%			
	c. Wooden drum provided		Yes			
	d. Identification marks provided on both sides of drum Manufacturer's name, Country of manufacturing, Consignee Address, LOA No. , Drum No, Length of Cable, Nett & Gross Wt., Year of manufacture, Type/ Size of Cable, Voltage Grade		Yes			
22	Quantity		as per Purchase Order			

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

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Ph.: 0129 - 6522707-13
Fax.: 0129 - 2242686

DATA SHEET

(FOR ARMOURED INSTRUMENT CABLE TYPE - G)

Customer:→ BHEL, NOIDA
Project : 3 x 660 MW NORTH KARANPURA STPP
P.O. No. : PW/PE/PG/KAR/P-479/15 dated 31.03.2016

NTPC Doc. No. : 4410-001-215-PVE-Y-026
BHEL Doc No. : PE-V0-405-507-E141
CMI Ref. No. : O/ CMI / BHEL NOIDA /4549/DS /06 dated 25.05.2016 Rev. 02

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² O/All scnd. (Arm.)	4 P x0.5mm² O/All scnd. (Arm.)	12 P x0.5mm² O/All scnd. (Arm.)
1	Manufacturer's name		M/s CMI LIMITED.		
2	Type of Cable		Type G	Type G	Type G
3	Reference design standards		VDE -0472/ VDE-0815/IS-10810		
4	Voltage Grade	V	225 (peak)		
5	Conductor size	mm²	0.5		
6	**CONDUCTOR**				
	a. Reference standard		IS 8130		
	b. Material		Annealed Tinned Copper		
	c. Grade		Electrolytic		
	d. No. of strands/ Diameter of strands (nom.)	No / mm	7/0.3		
7	**INSULATION**				
	a. Reference standard		VDE 0207 Part 4		
	b. Material		Extruded PVC Compound Type - YI3		
	c. Thickness Min./ Max.	mm	0.25 / 0.35		
	d. Min. volume resistivity	Ω-cm	1×10^{14} at 20°C / 1×10^{11} at 70°C		
8	**PAIR & TWISTING**				
	a. Whether cores are twisted		Yes		
	b. Max. lay of Twist	mm	50		
	c. Cores of the pairs of a bunch provided		as per annexure B-I enclosed		
	d. Single Layer of Binder Tape on each pair is provided		Yes		
	e. Unit Formation of four pair polyester binder tape for cables more than 4P is provided		Yes		

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² O/All scnd. (Arm.)	4 P x0.5mm² O/All scnd. (Arm.)	12 P x0.5mm² O/All scnd. (Arm.)
9	SHIELD				
	a. Material		Aluminium mylar tape		
	b. Thickness of overall shield (min.)	mm	0.055		
	c. Coverage / Overlap (min.)	%	100 / 20		
10	DRAIN WIRE				
	a. Reference standard		IS 8130		
	b. Material		Annealed tinned copper		
	c. Size / No. of standard / Diameter of strands (nom.)	mm²/No./ mm	0.5 / 7 / 0.3		
11	Fillers (if applicable) are non hygroscopic & flame retardant		Yes		
12	INNER SHEATH				
	a. Material, Type & standard		Extruded PVC Type YM1 as per VDE 0207part 5/ VDE0816		
	b. Whether FRLS		No		
	c. Colour		Black		
	d. Thickness (min.)	mm	0.3		
13	ARMOUR				
	a. Material		Galvansied Steel Round Wire/ Strip as per IS 3975		
	b. Minimum coverage	%	90%		
	c. Method of joining		Welding		
	d. Breaking load of joint		95% of normal armour		
	e. Size (nom.)	mm	1.4	1.4	4x0.8
	f. No. of wires (approx.)	No.	16	18	9
14	OUTER SHEATH				
	a. Reference standard		VDE 0207 part 5/ VDE 0816		
	b. Material		Extruded PVC Type YM1 with FRLS properties		
	c. Minimum thickness	mm	1 8	1.8	1.8
	d. Oxygen index (As per ASTM-D 2863)	%	29 (min.)		
	e. Temp. Index (In °c as per ASTM-D 2863)	°c	250 (min.)		
	g. Acid gas generation as per IEC60754-1	%	20 (max.) by weight		
	f. Smoke density rating as per ASTM-D 2843	%	60 (max.)		
	g. Colour of outer sheath		Yellow		
15	COMPLETE CABLE				
	a. Overall Diameter of Cable	mm	14	15	21
	b. Allowed Tolerance on overall diameter	mm	± 2		
	c. Ovality at any cross section	mm	Not more than 1.0 mm		
	d. Variation of dia through out cable length	mm	Not more than 1.0 mm		

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² O/All scnd. (Arm.)	4 P x0.5mm² O/All scnd. (Arm.)	12 P x0.5mm² O/All scnd. (Arm.)
16	CABLE PARAMETERS at 20° ± 3°C				
	a. Conductor loop resistance (max.)	Ω/km	73.4		
	b. Insulation resistance (min.)	MΩ -km	100		
	c. Mutual capacitance at 0.8KHz (max.)	nF/km	100		
	d. Cross talk at 0.8KHz (min.)	dB	60		
	e. Attenuation at 1 KHz (max.)	dB/km	1.2		
	f. Characteristic impedance (max.) At 1KHz	Ω	340		
	g. Noise Interference as per IEEE Transactions 1967 (min.)	dB	60		
17	Max. Continuous operating temp.	°C	70		
18	Whether complete cable Flame retardant as per IEEE383		Yes		
19	Whether complete cable passes Swedish chimney test as per SEN 4241475 (F3)		Yes		
20	IDENTIFICATION				
	a. Progressive automatic on-line sequential length marking in meters to be provided on outer sheath at every one meter.		Yes		
	b. FRLS marked at every 5 mtr.		Yes, along with BHEL-PEM & NTPC		
	c. Durable marking at interval not exceeding 625 mm including Manufacturer's name, Conductor's Size, Insulation Material, Number of Pairs, Type of Cable, Voltage Grade, Year of manufacturer		Yes		
21	TEST VOLTAGE				
	a. High voltage test (core - core)				
	i. Voltage	KV	Core to Core : 2 KV RMS, Core to Shield : 0.5 KV RMS		
	ii. Duration	minute	1		
	b. Resistance to direct current test				
	i. Voltage		Core to Core : 1200 Volts AC, Core to Shield : 220 Volts DC		
	ii. Duration	min/days	Core to Core : 10 minutes, Core to shield : 10 days		
22	Cable cross-sectional drawings for each type of cable furnished		Yes		

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

Sr. No.	DESCRIPTION	UNIT	2 P x0.5mm² O/All scnd. (Arm.)	4 P x0.5mm² O/All scnd. (Arm.)	12 P x0.5mm² O/All scnd. (Arm.)
23	CABLE DRUM				
	a. Length of single coil in a drum	Mtrs.	1000		
	b. Tolerance on Individual Drum Length w.r.t. (a) above		+/- 5%		
	c. Wooden drum provided		Yes		
	d. Identification marks provided on both sides of drum Manufacturer's name, Country of manufacturing, Consignee Address, LOA No. , Drum No, Length of Cable, Nett & Gross Wt., Year of manufacture, Type/ Size of Cable, Voltage Grade		Yes		
24	Quantity		as per Purchase Order		

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

ANNEXURE - B-I

For 4-pair cables, the colour scheme shall be as follows:-

PAIR	CORE	COLOUR
1st Pair	1st core	Blue
1st Pair	2nd core	Red
2nd Pair	1st core	Grey
2nd Pair	2nd core	Yellow
3rd Pair	1st core	Green
3rd Pair	2nd core	Brown
4th Pair	1st core	White
4th Pair	2nd core	Black

In case of higher number of pairs, the above colour scheme shall be repeated and to distinguish between two pairs giving same colour code in a cable, suitable colour bands shall be used. e.g. all , eight core of first unit shall have one band of PINK colour. The complete scheme is given below & the order of colour bands shall be PINK, ORANGE, VIOLET, etc....

Unit No.	COLOUR OF BANDS	BAND MARKS
1	PINK	= 1 = = = 1 = =
2		= 1 1 = = = 1 1 = =
3		= 1 1 1 = = = 1 1 1 = =
4		= 1 1 1 1 = = = 1 1 1 1 = =
5	ORANGE	= 1 = = = 1 = =
6		= 1 1 = = = 1 1 = =
7		= 1 1 1 = = = 1 1 1 = =
8		= 1 1 1 1 = = = 1 1 1 1 = =
9	VIOLET	= 1 = = = 1 = =
10		= 1 1 = = = 1 1 = =
11		= 1 1 1 = = = 1 1 1 = =
12		= 1 1 1 1 = = = 1 1 1 1 = =

L

The dimension L shall be limited between 60 mm and 80 mm. The bands shall be neat and cover at least ninety percent (90%) of the periphery of the core.

Band markings shall not be easely erasable and shall also meeting Bleeding & Blooming test and colour fastness to water test requirement as per relevant standard

For Cables more than 4 pair, polyester tape over first unit shall be marked 1, polyester tape over unit 2 shall be marked 2, polyester tape over unit 3 shall be marked 3, polyester tape over unit 4 shall be marked 4, polyester tape over unit 5 shall be marked 5, polyester tape over unit 6 shall be marked 6, polyester tape over unit 7 shall be marked 7, polyester tape over unit 8 shall be marked 8, polyester tape over unit 9 shall be marked 9, polyester tape over unit 10 shall be marked 10, polyester tape over unit 11 shall be marked 11 and polyester tape over unit 12 shall be marked 12 for unit identification.....

For CMI LIMITED

Pratyaksh Agarwal
Dy. General Manager Technical

TECHNICAL SPECIFICATION

FOR CABLING AND EARTHING

(ANNEXURE-IV)

CABLING, EARTHING AND LIGHTNING PROTECTION

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
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 burried cables, if essential ,shall not have concentration of more than 4 cables in one route. All buried cables, Cables for switchyard and CHP shall be armoured

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**

Clear access passage of at least 750mm wide & 2.1 mt clear heights shall be provided at entrances and along the cable trays in cable vault. Wherever the passage is through cable routes & across the cable tray the clear height shall not be less than 1.5 mts.

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**

For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be preferably followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering.
Cable trenches provided 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

3.02.00 **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.

3.03.04 FOR COAL 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 High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

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

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,11kV,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, taped type or heat shrinkable type. Further cold shrinkable type termination kits 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 as per system requirements, shall be furnished for the offered type of terminations & jointing kits. 33kV, 11kV, 6.6 kV & 3.3kV grade joints and terminations shall be type tested as per IS:13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. 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 as per DIN standard suitable for aluminium compacted conductor cables.
3.05.02	Straight through joint and termination shall be capable of withstanding the fault level for the system.
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 IS/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 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 inbuilt ELCB rated for suitable mA sensitivity.
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

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 two 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	The earthing system shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 50 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year. 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 minimum 10 mts. Minimum two nos of risers shall be provided for each equipment in SG 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.
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	40 mm dia. MS rod	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 NOT APPLICABLE

6.01.01 Lightning protection system shall be in strict accordance with IS:2309 .

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 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.

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 Employer either at third party lab or in presence of client/Employers 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.

e) 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.

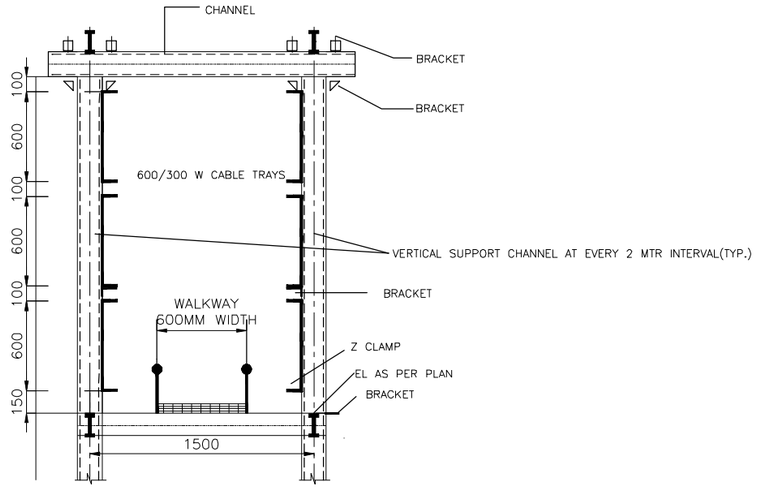
3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.

4) Check for earth continuity and earth connection of cable trays.

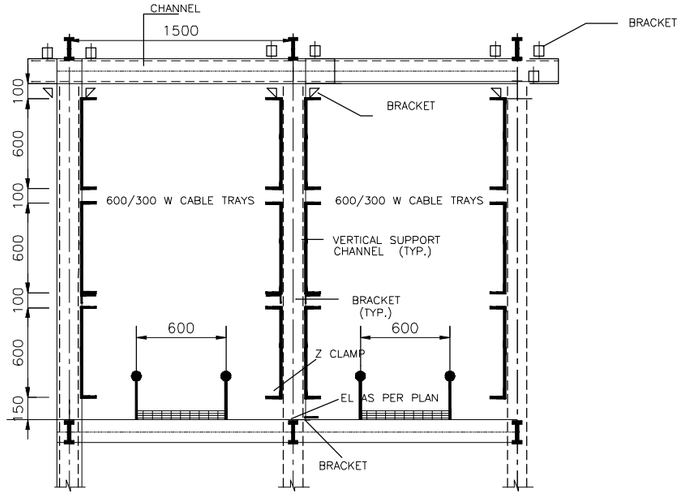
8.03.00 **Earthing and Lightning protection system**

1) Earth continuity checks.

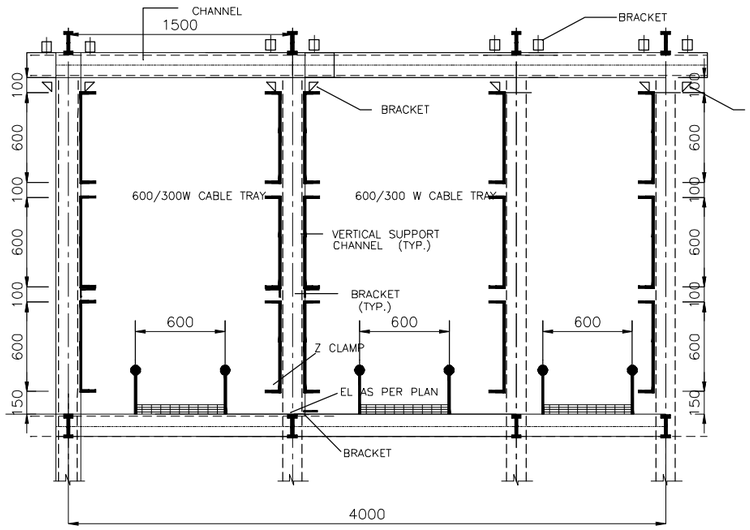
2) Earth resistance of the complete system as well as sub-system.



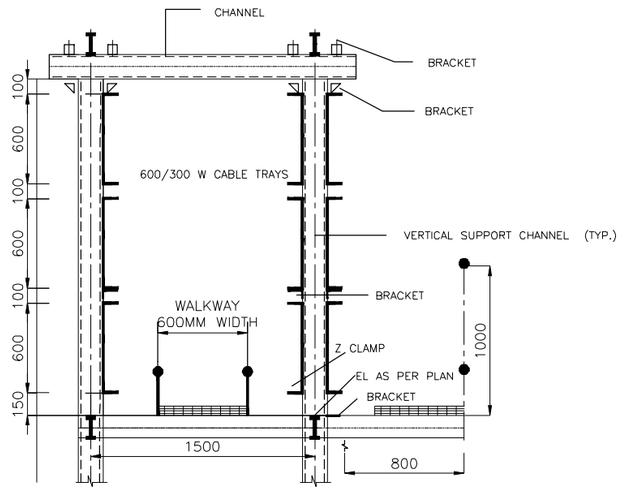
TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (6 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).



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).

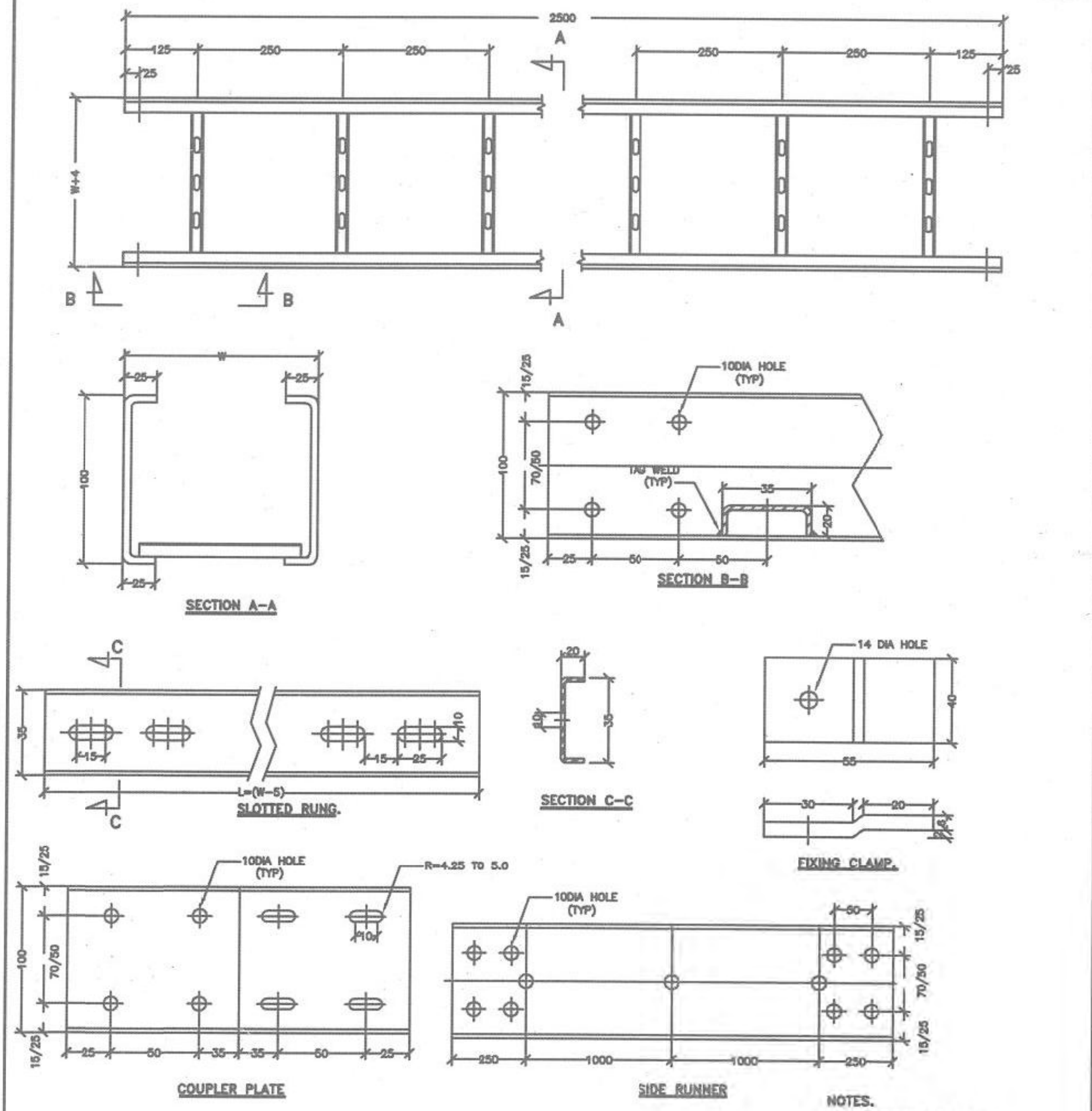
NTPC Limited.
(A Government of India Enterprise)
ENGINEERING DIVISION

PROJECT: TELANGANA SUPER THERMAL POWER PROJECT
STAGE–I (2X800MW)

TITLE: TYPICAL SECTION OF CABLE TRAY ARRANGEMENT IN TRESTLE

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	CLEARED BY M	E	C	C&I	APPD	DATE
0	RELEASED FOR CONSTRUCTION	MV					–			23-01-2015

SIZE	SCALE	DRG. NO.	REV. NO.
		9591-999-POE-J-004	0



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&I	ARCH	APPD	DATE
RD	FOR TENDER PURPOSE	[signature]	[signature]	[signature]	–	[signature]	–	–	–	[signature]	05-07-10
RC	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RB	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]
					CLEARED BY						

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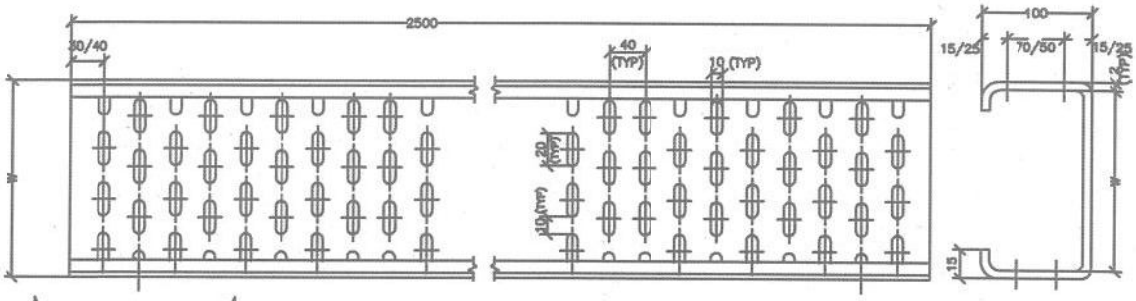
NTPC

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

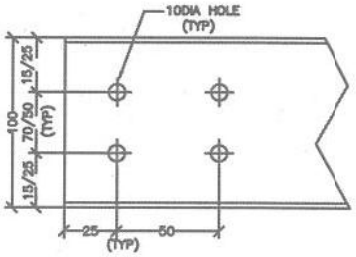
PROJECT: STANDARD

TITLE: LADDER TYPE CABLE TRAY.

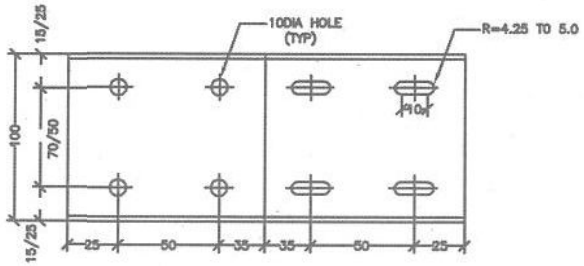
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-001	RD



PLAN PERFORATED CABLE TRAY. END VIEW



SECTION A-A



COUPLER PLATE

NOTES.

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	KB	KB	RKP	-	VV	-	-	-	KB	05.02.10
RC	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	

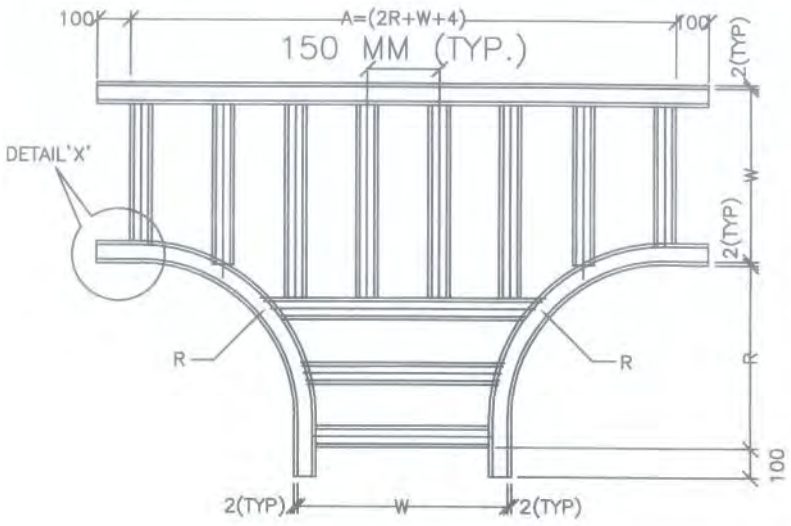
एन टी पी सी NTPC

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

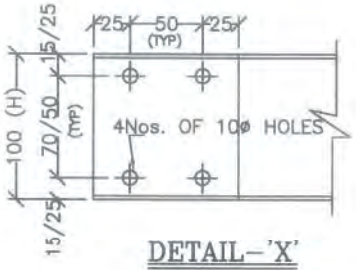
PROJECT: STANDARD

TITLE: PERFORATED TYPE CABLE TRAY.

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



HORIZONTAL TEE



DETAIL–'X'

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

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	VC	VC	RKP		VV					15/6/12
RC	FOR TENDER PURPOSE	AB	AB	RKP	–	VV	–	–	–	DT	5.07.2010
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	15.07.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2000

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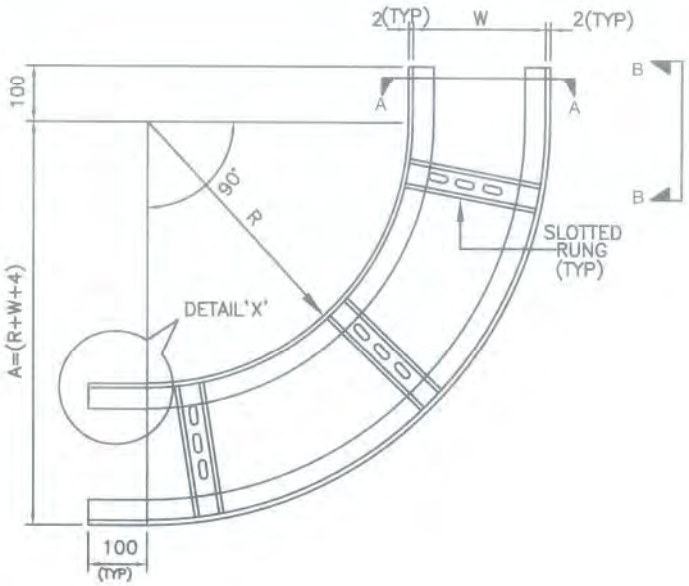
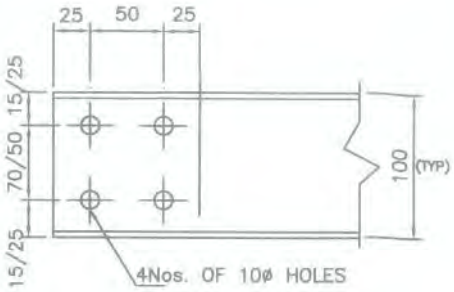
ENGINEERING DIVISION

PROJECT: STANDARD

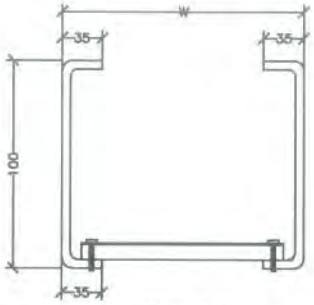
TITLE: CABLE TRAY DETAILS
HORIZONTAL TEE

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

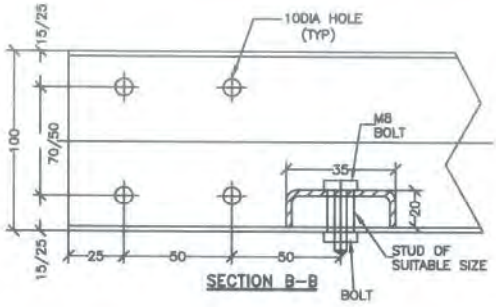




DETAIL–X



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	JC	VC	RKP		NJ				DT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	25.07.2010
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2008

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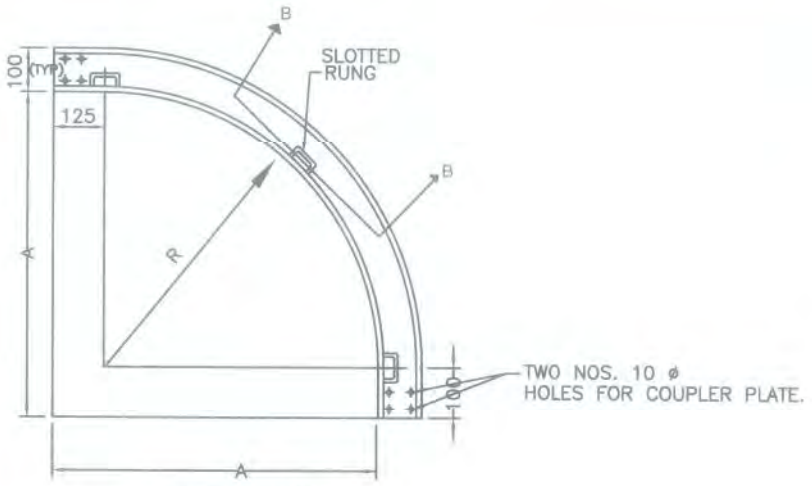
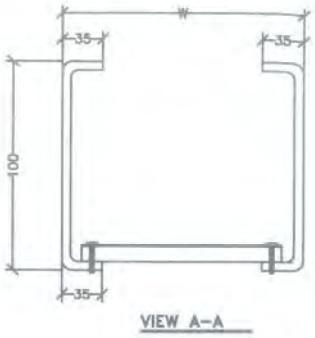
ENGINEERING DIVISION

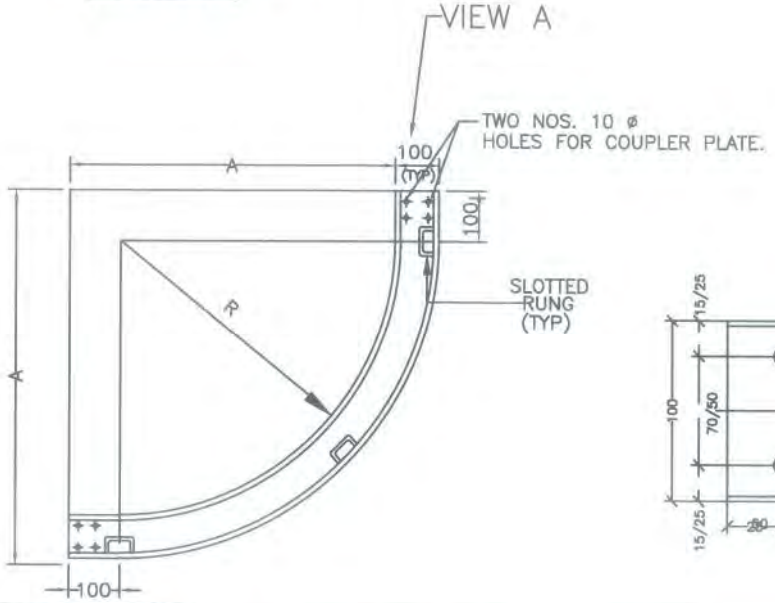
PROJECT	STANDARD		
TITLE	CABLE TRAY 90ø BENDS (CTB 90ø)		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-005	REV. NO. R0



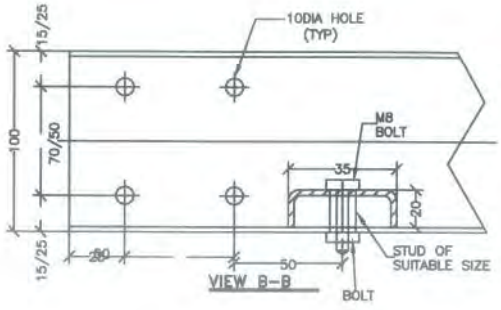
ELEVATION
90° VERTICAL ELBOW
(UPSIDE)



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	VC	RKP		VV				DT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.2010
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2008

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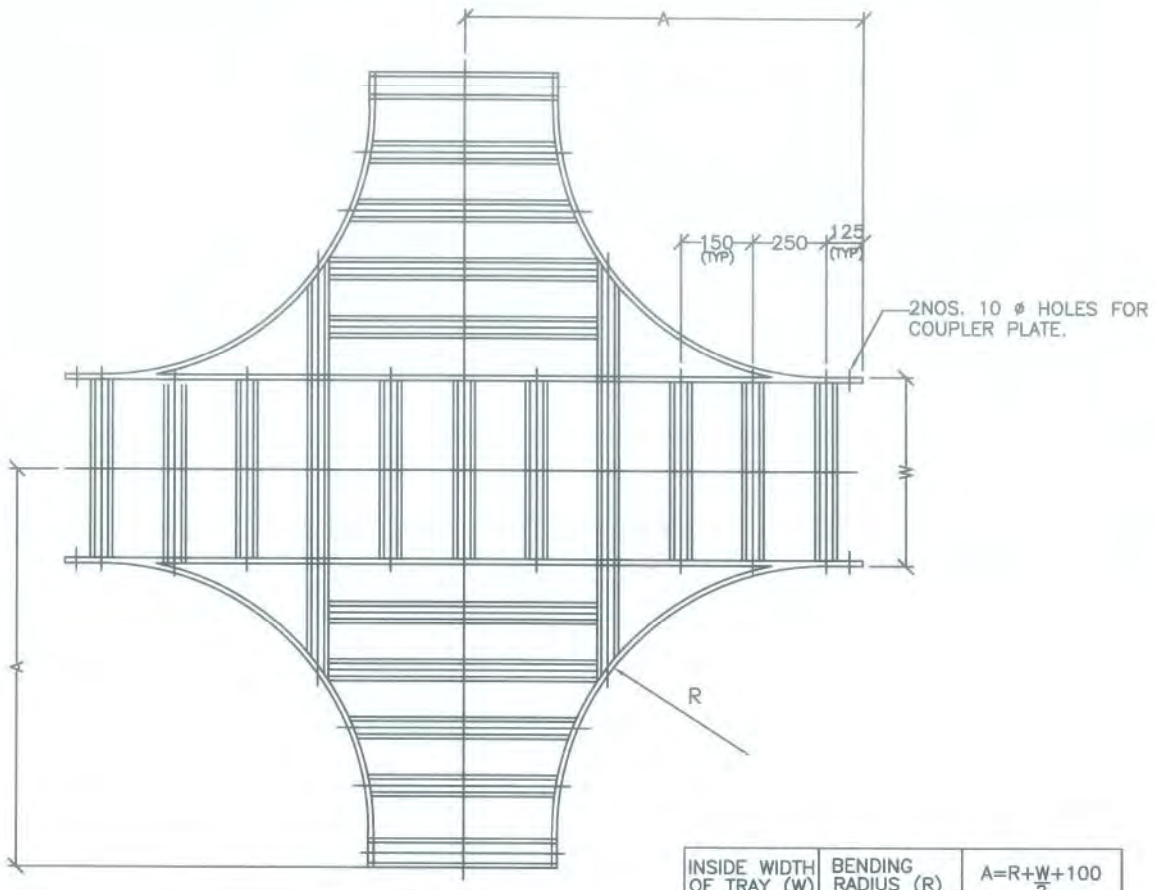
ENGINEERING DIVISION

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	RKP		VV				DT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	25.07.2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.05.2006

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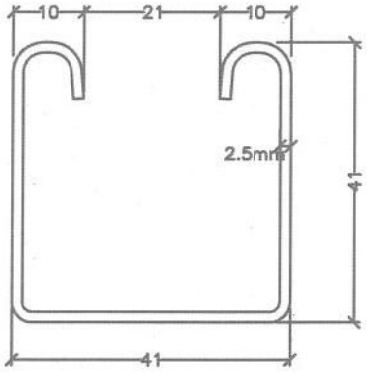
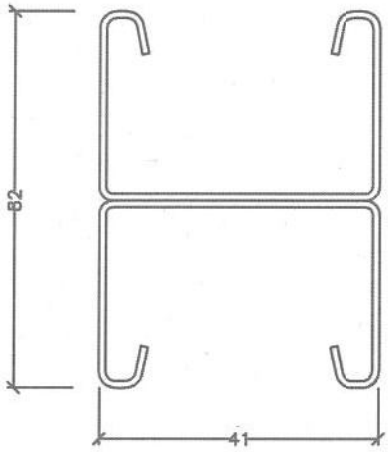
PROJECT: STANDARD

TITLE: CABLE TRAY DETAILS CROSS

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



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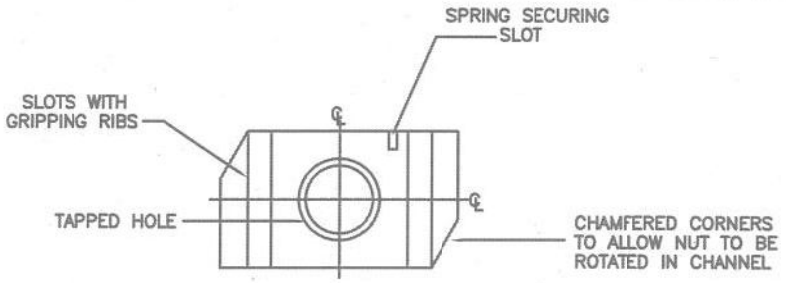
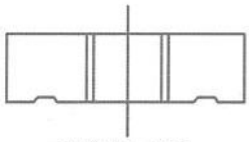
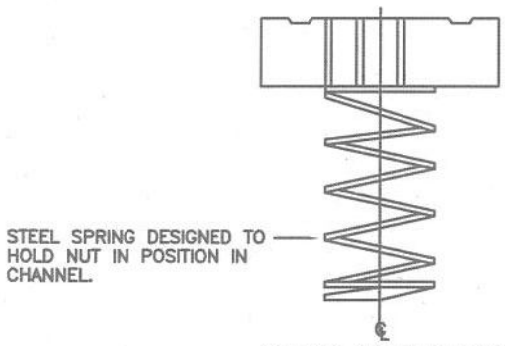
PROJECT	STANDARD		
TITLE	C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-013	REV. NO. RC

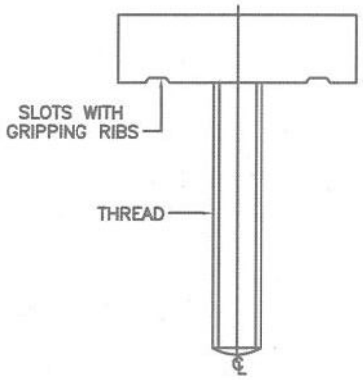


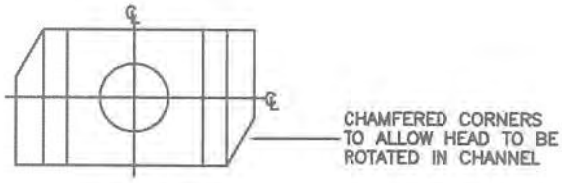


CHANNEL NUT



CHANNEL NUT WITH SPRING





STUD NUT

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				–		–	–	–		25.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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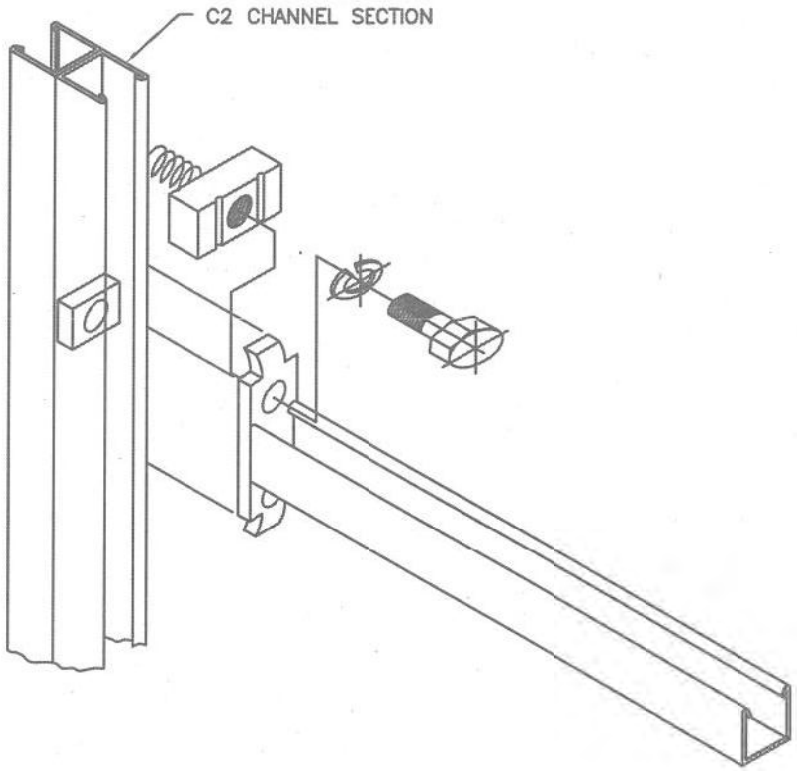
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-014	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]	–	[illegible]	–	–	–	[illegible]	[illegible]
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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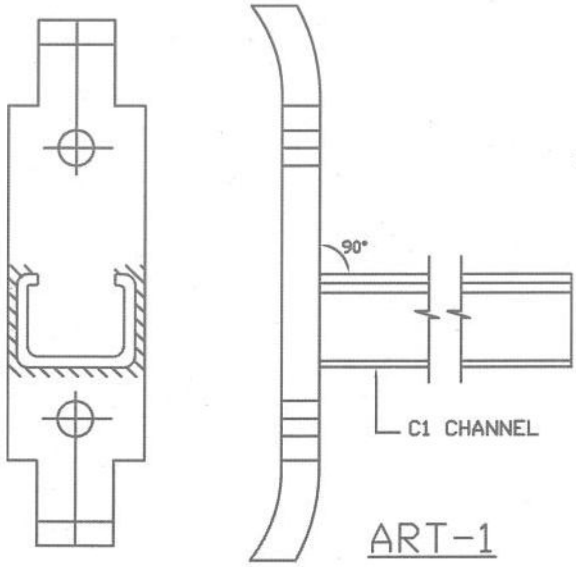
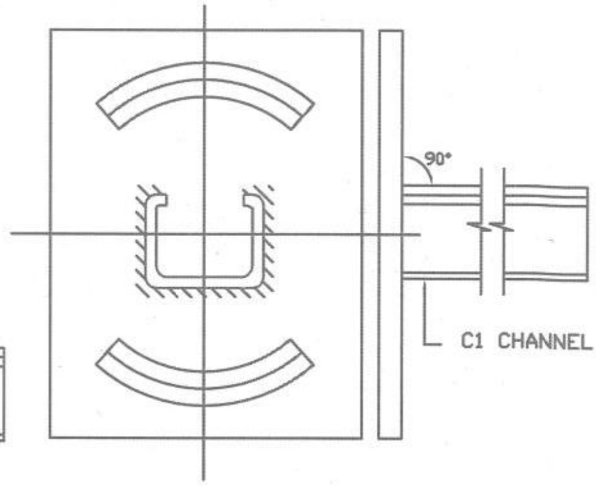
PROJECT: STANDARD

TITLE: TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM

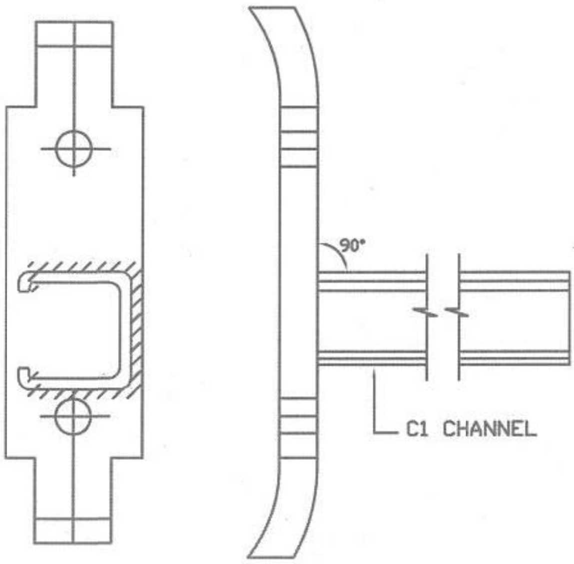
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-015	RC



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
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]
					CLEARED BY						

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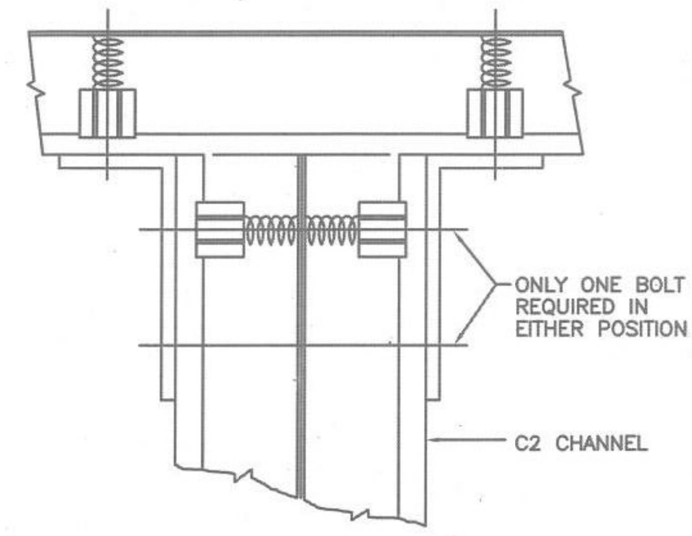
ENGINEERING DIVISION

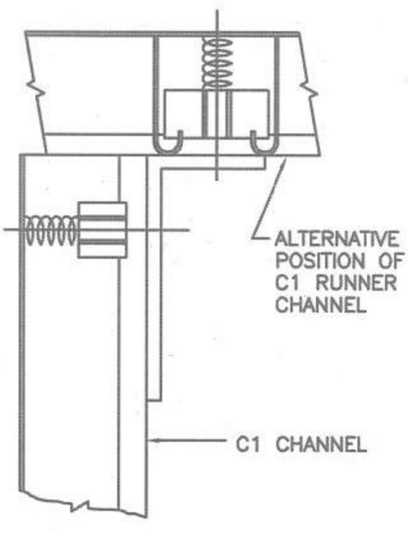
PROJECT: STANDARD

TITLE: CANTILEVER ARMS

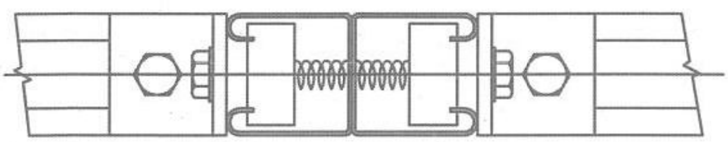
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-016	RC

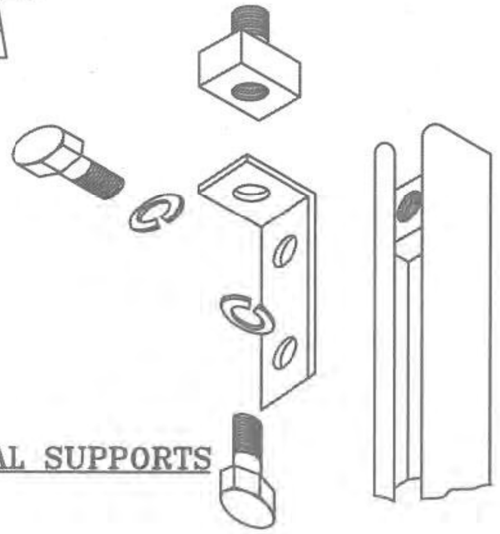


ASSEMBLY–1



ASSEMBLY–2





ASSEMBLY–1
UPPER FIXING C2 CHANNEL

ASSEMBLY–2
UPPER FIXING C1 CHANNEL

UPPER FIXING FOR CHANNEL VERTICAL SUPPORTS

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	[illegible]
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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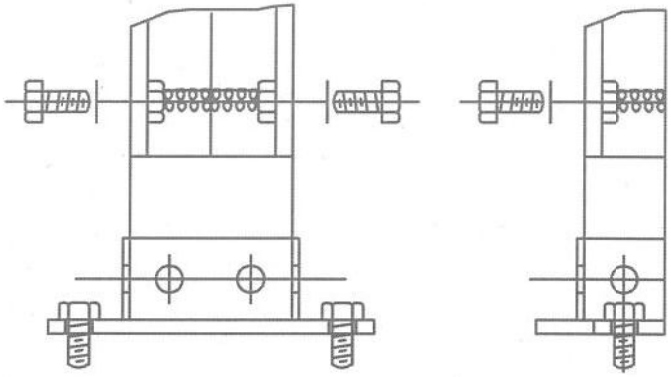
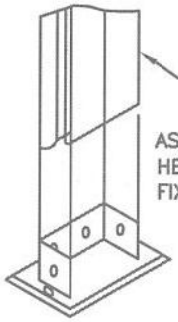
ENGINEERING DIVISION

PROJECT: STANDARD

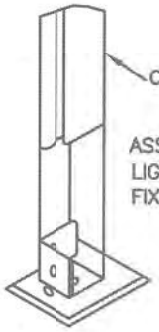
TITLE: TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

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





ASSEMBLY 1
HEAVY DUTY FLOOR
FIXING FOR C2 CHANNEL



ASSEMBLY 2
LIGHT DUTY FLOOR
FIXING FOR C1 CHANNEL

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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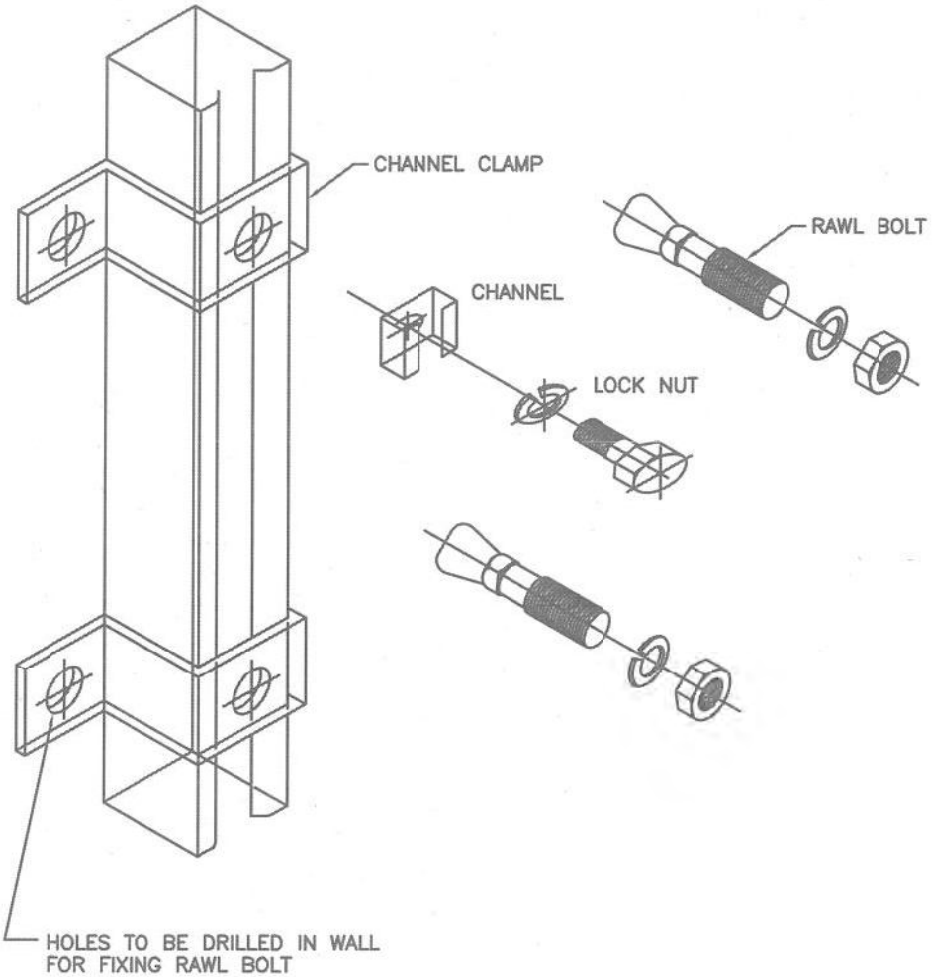
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

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



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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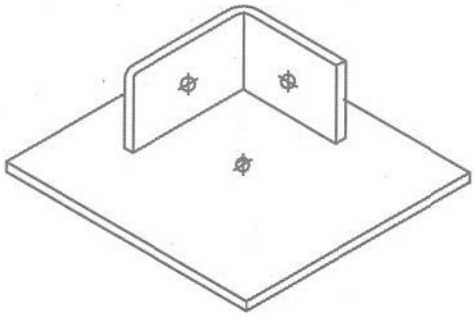
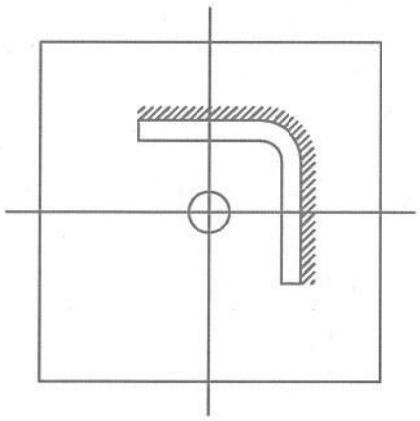
ENGINEERING DIVISION

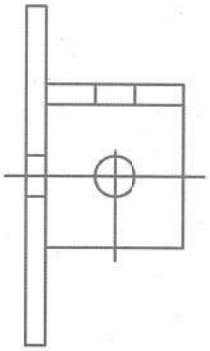
PROJECT: STANDARD

TITLE: FIXING OF CHANNEL IN TRENCH WALL

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







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

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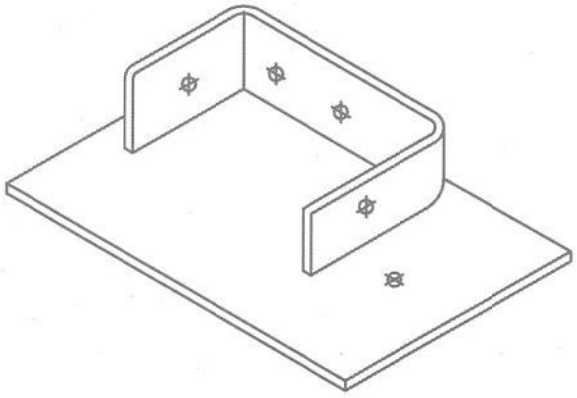
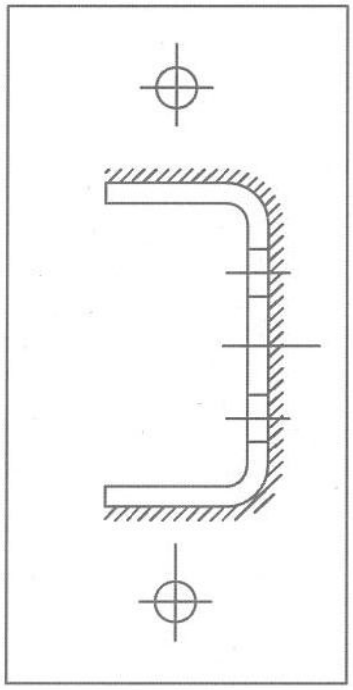
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

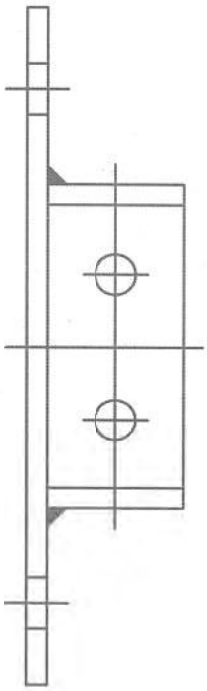
PROJECT: STANDARD

TITLE: BRACKET FLOOR PLATE LIGHT DUTY.

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







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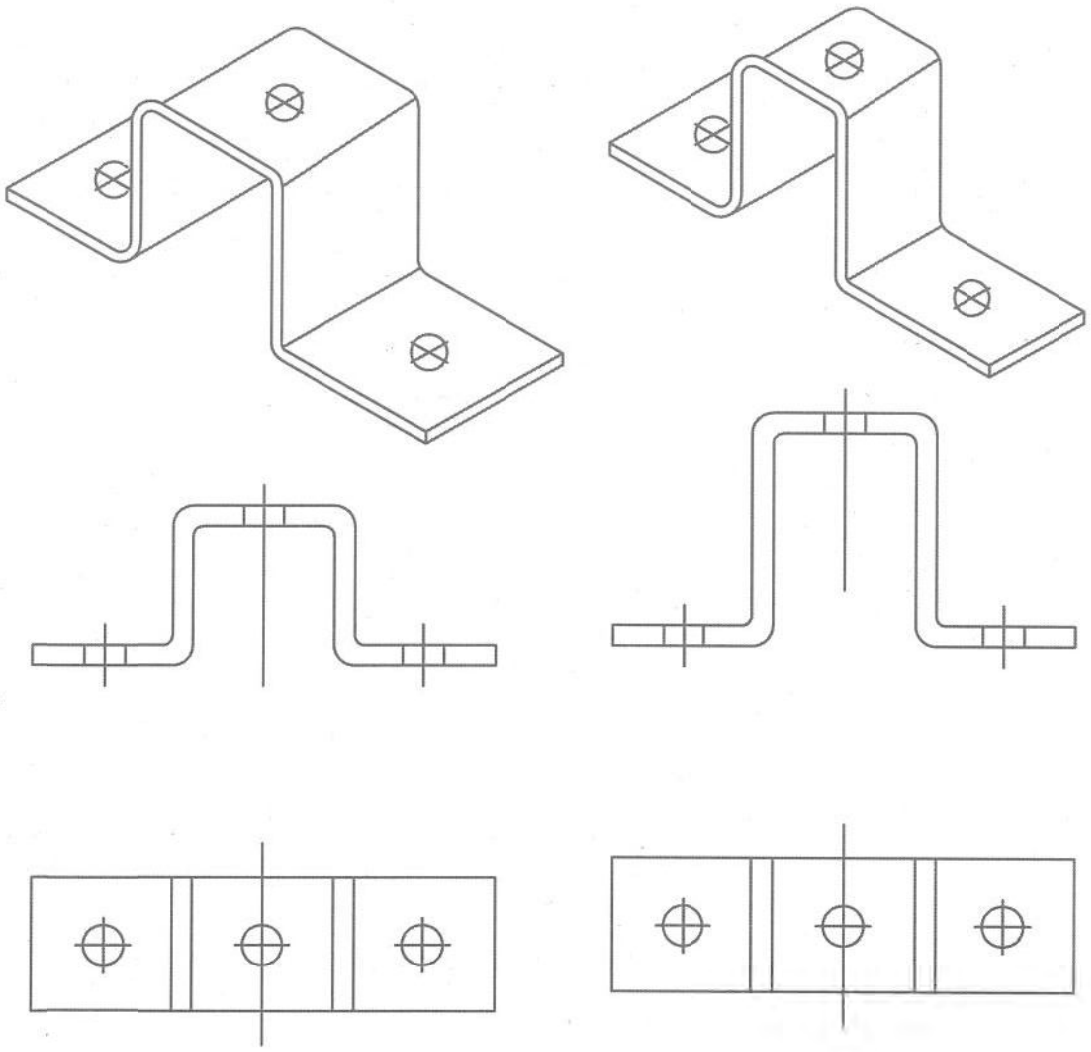
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET FLOOR PLATE HEAVY DUTY.

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



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&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.
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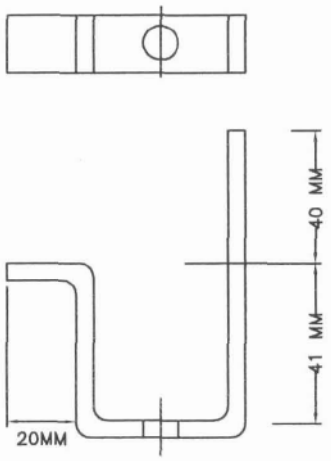
ENGINEERING DIVISION

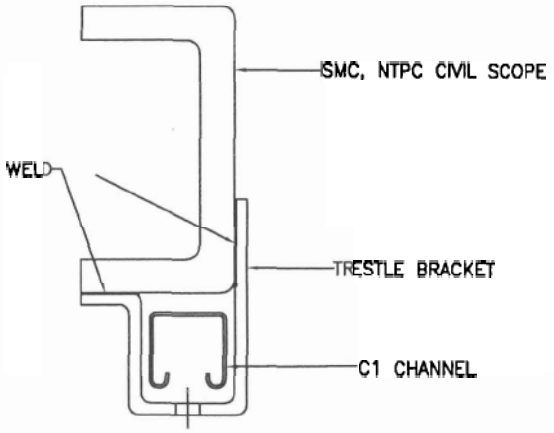
PROJECT: STANDARD

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
					CLEARED BY						
RA	FOR TENDER PURPOSE	MV	RKP	VKM	–	SS	–	–	–	DT	08.10.2008

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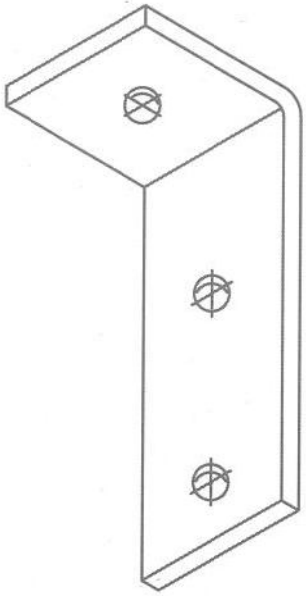
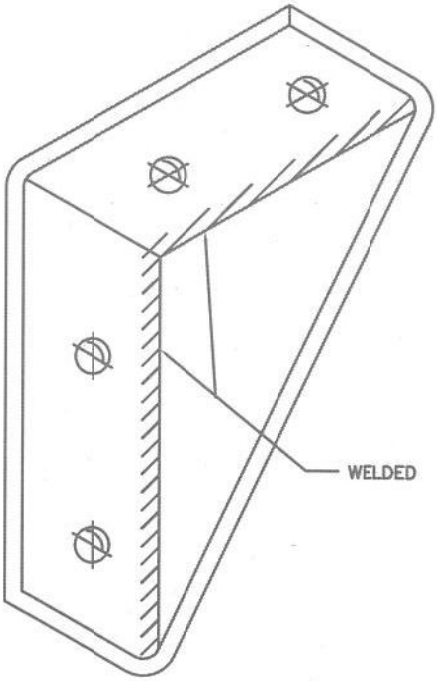
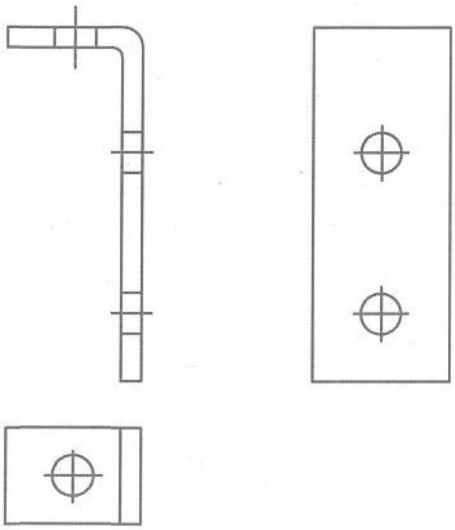
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
(FORMERLY NATIONAL THERMAL POWER CORPORATION LTD.)
ENGINEERING DIVISION

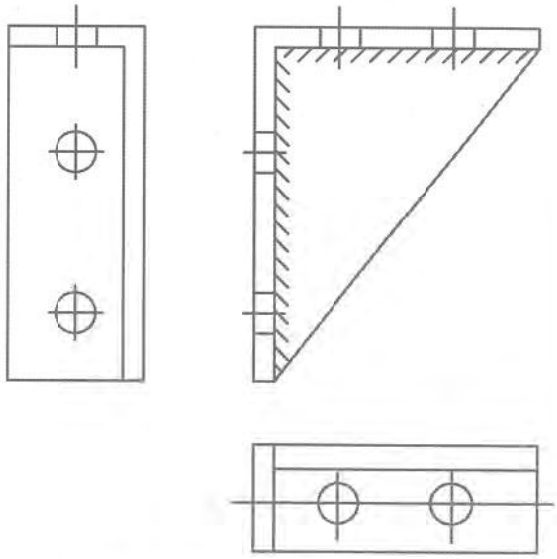
PROJECT	STANDARD		
TITLE	FIXING OF CHANNEL FOR TRESTLE AND TRESTLE BRACKET.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-022A	REV. NO. RA







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	MB	MB	PM	–	NV	–	–	–		05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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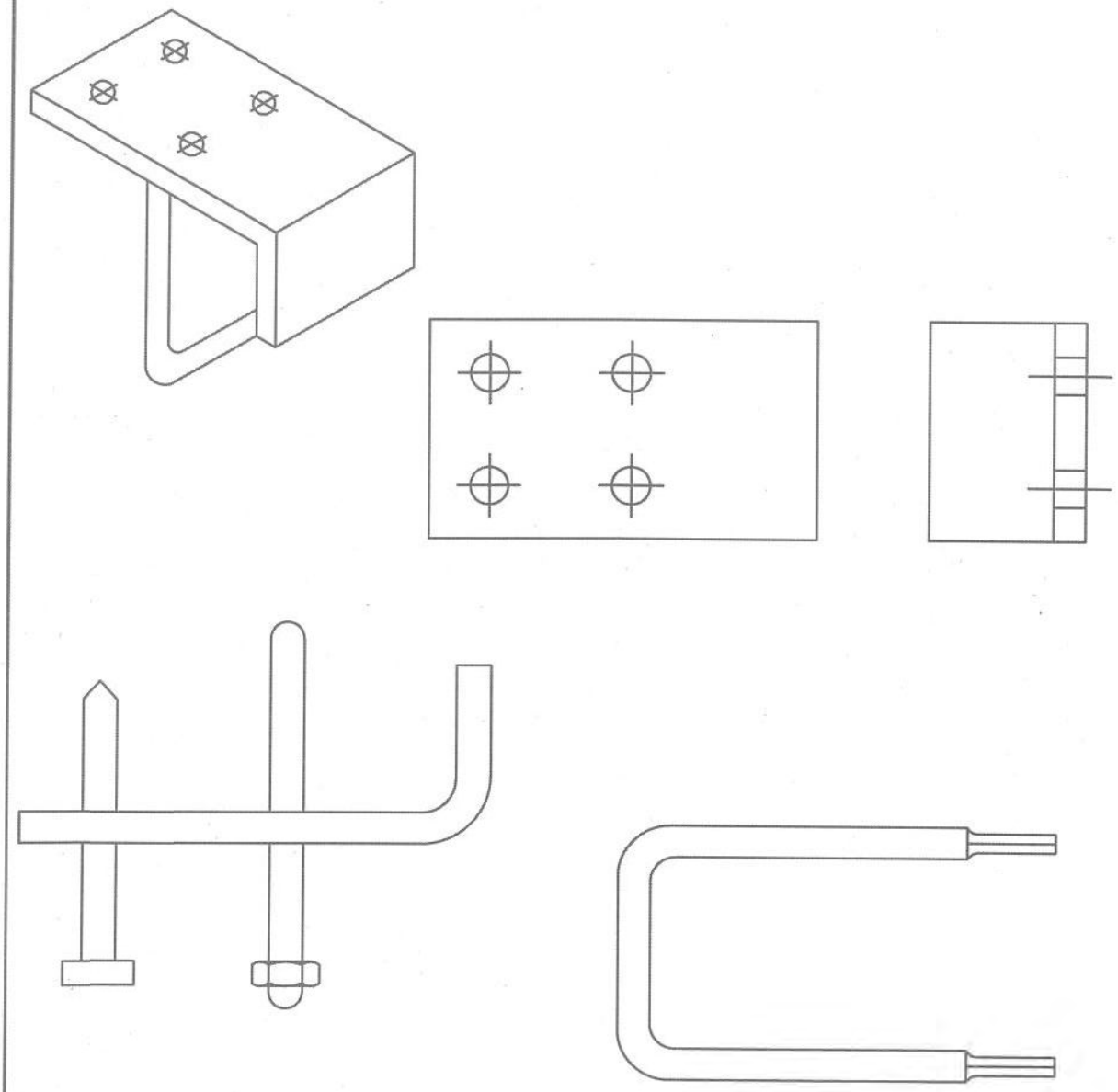
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET RIGHT ANGLE &
BRACKET RIGHT ANGLE HEAVY DUTY.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-023	RC



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				–		–	–	–		05/10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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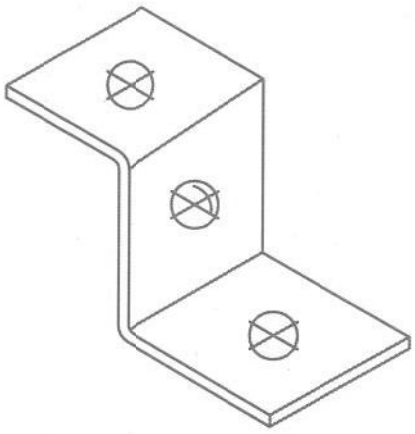
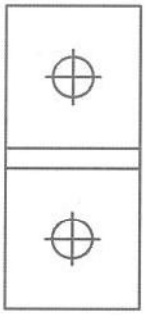
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

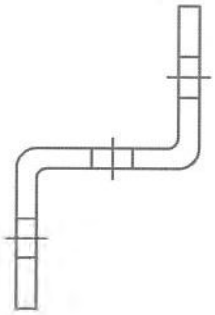
PROJECT: STANDARD

TITLE: 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	[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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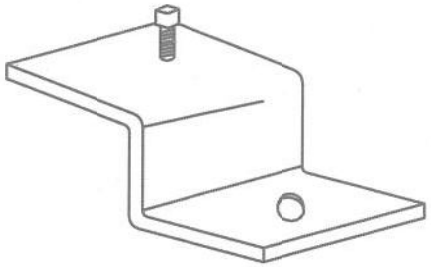
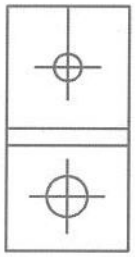
ENGINEERING DIVISION

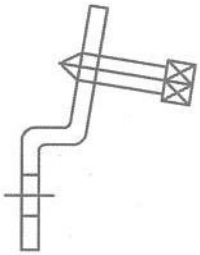
PROJECT: STANDARD

TITLE: BRACKET C1 CHANNEL CLAMP.

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







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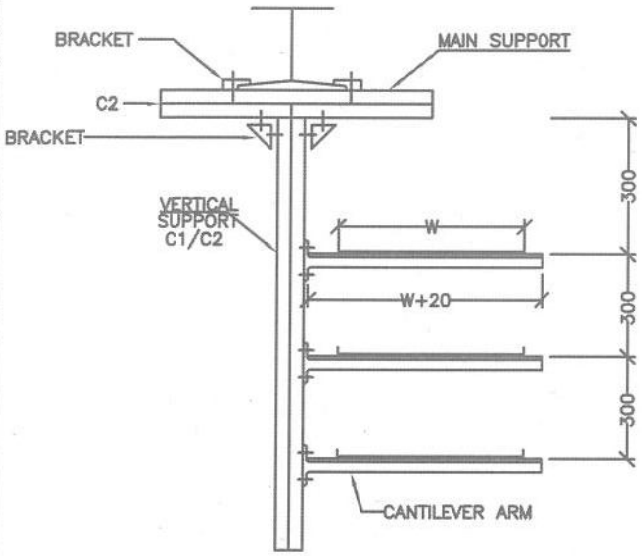
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET BEAM CLAMP

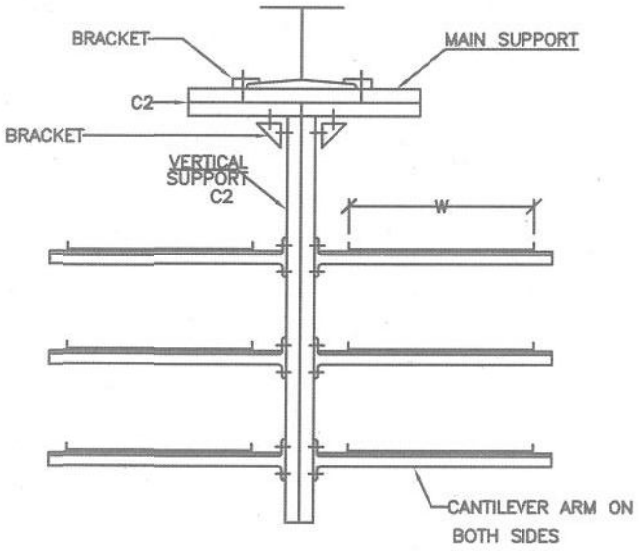
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-026	RC



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–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	M3	M3	PVP	–	W	–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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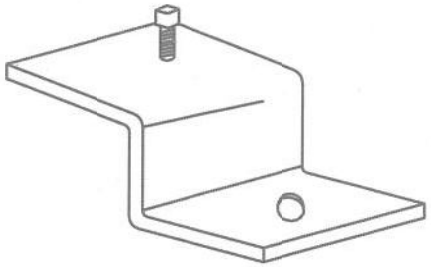
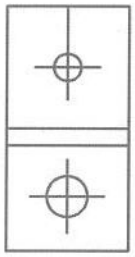
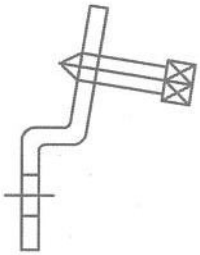
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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







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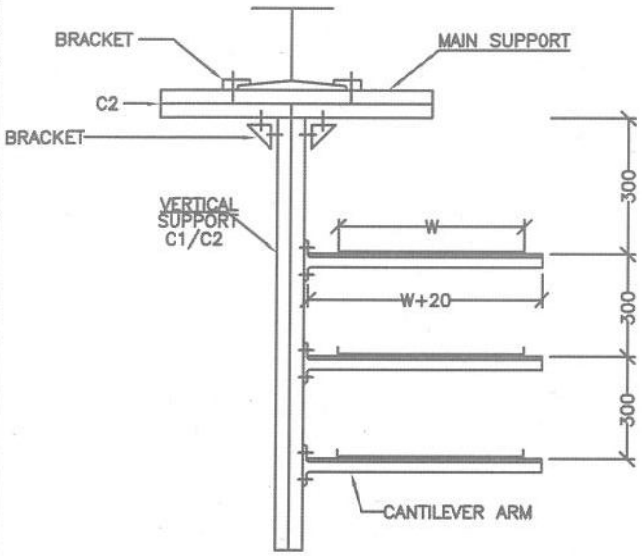
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET BEAM CLAMP

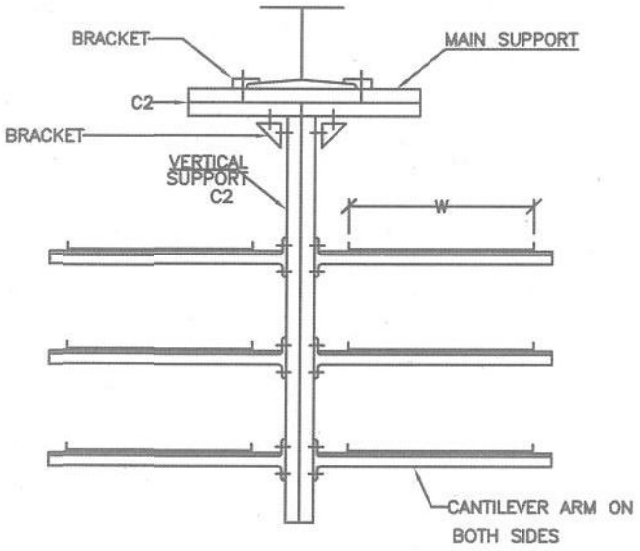
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-026	RC



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–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	M3	M3	PVP	–	W	–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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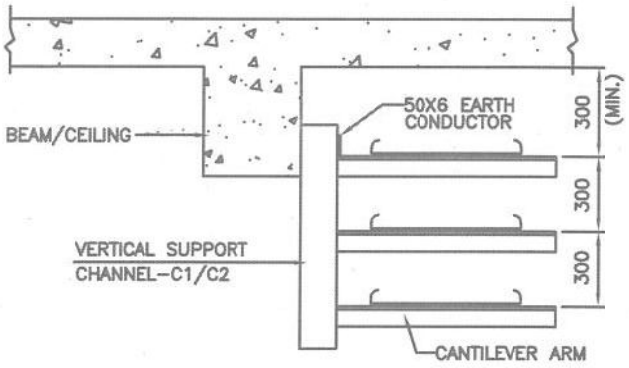
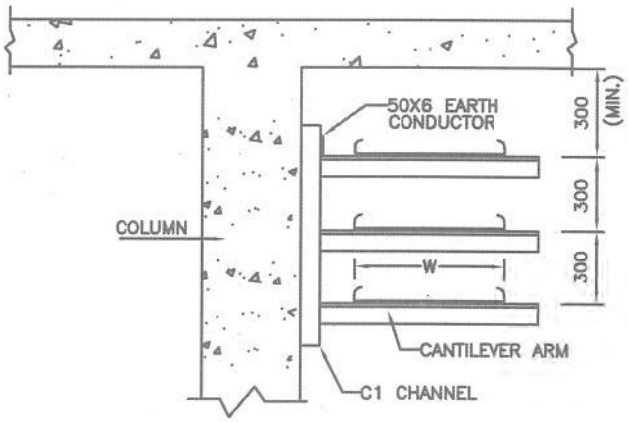
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		03.07.01
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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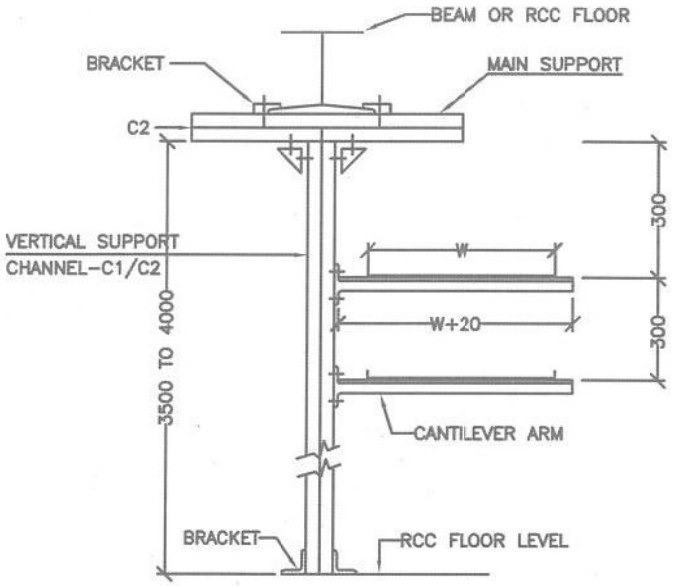
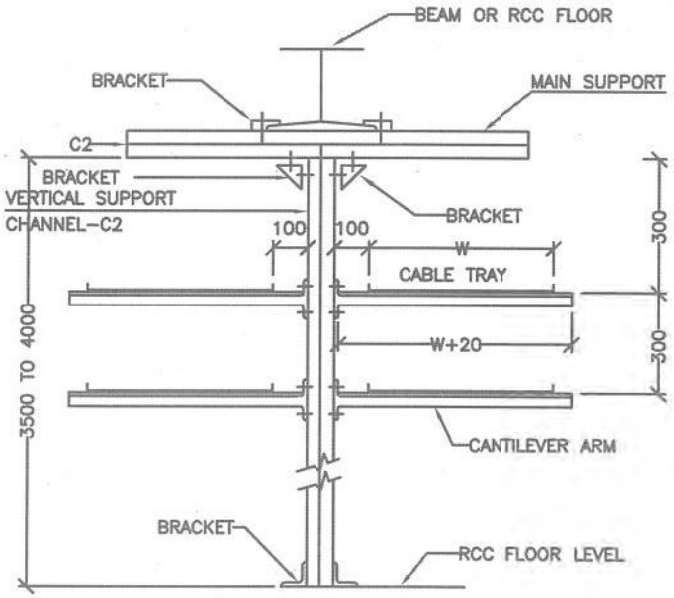
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-031	REV. NO.: 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	[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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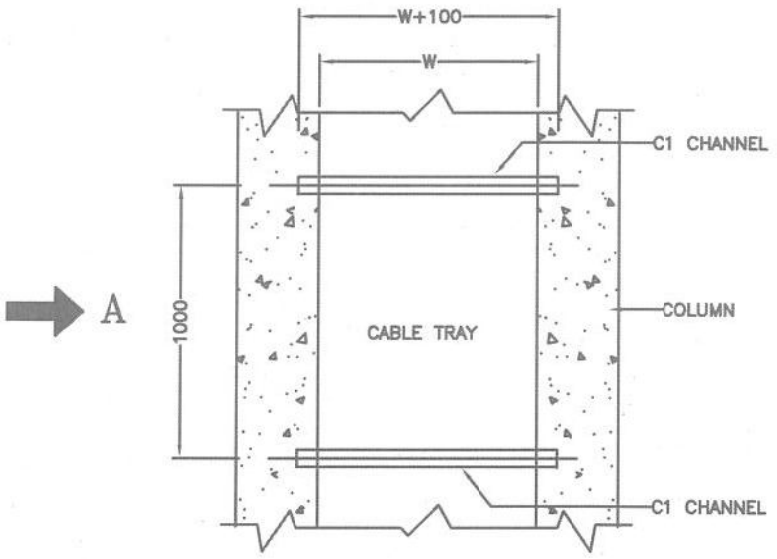
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

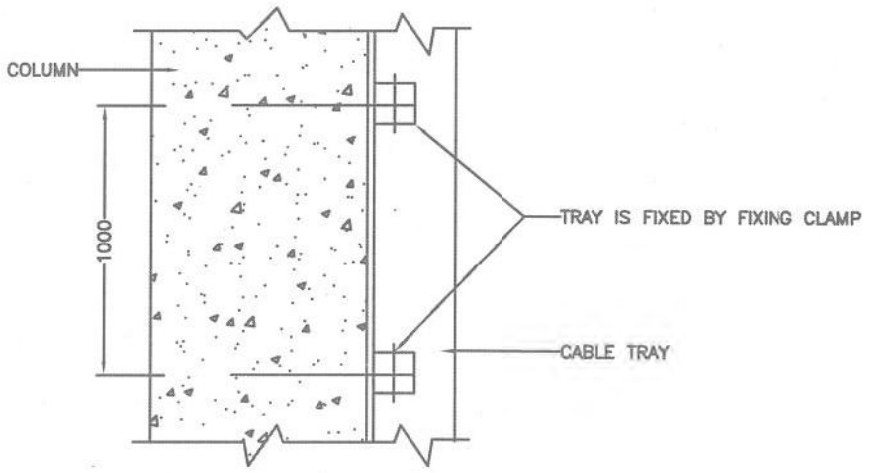
PROJECT: STANDARD

TITLE: STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-032	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				—		—	—	—		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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NTPC LTD.
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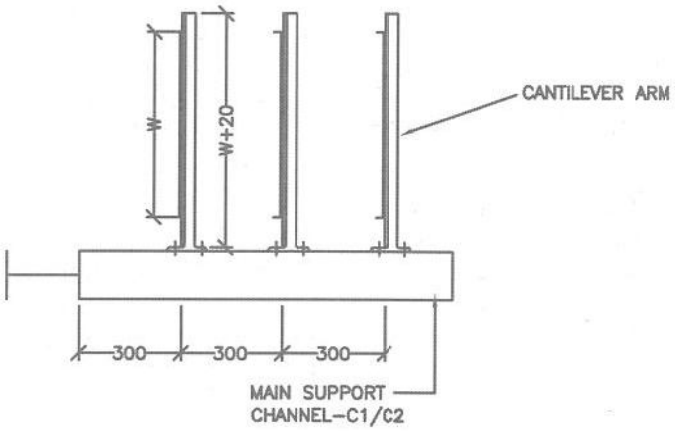
ENGINEERING DIVISION

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

MAIN 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–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&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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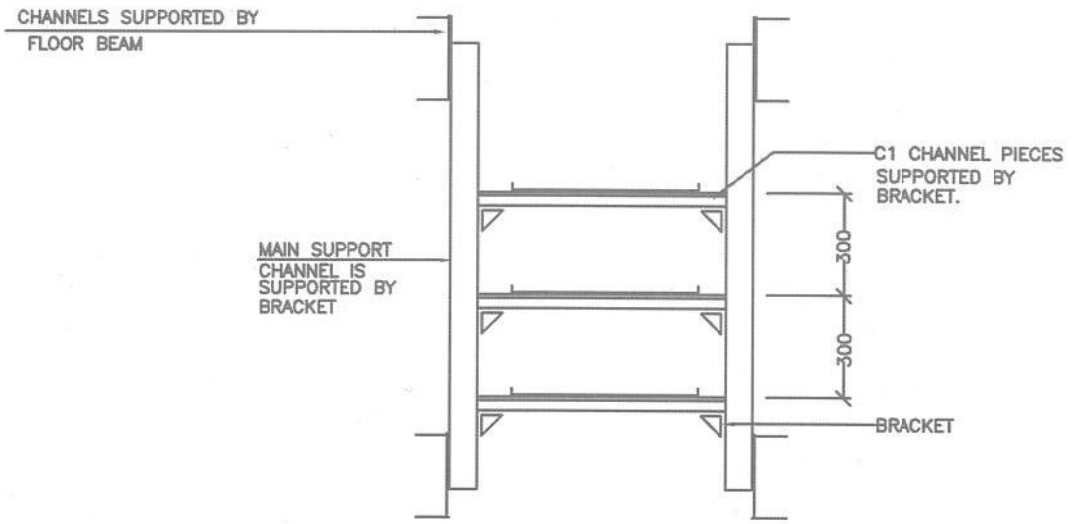
PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-034	REV. NO. RC

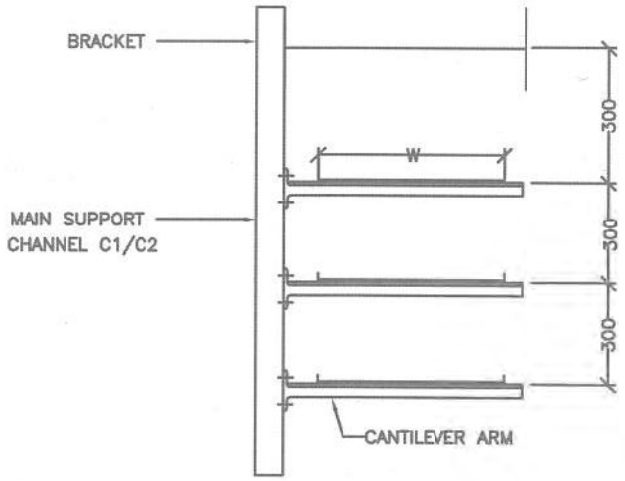


MAIN SUPPORT

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
					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

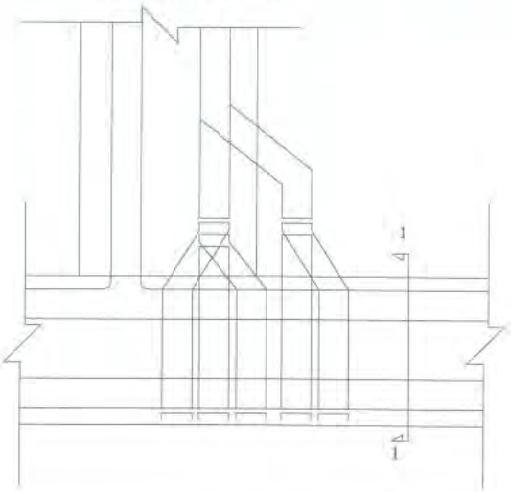
PROJECT: STANDARD

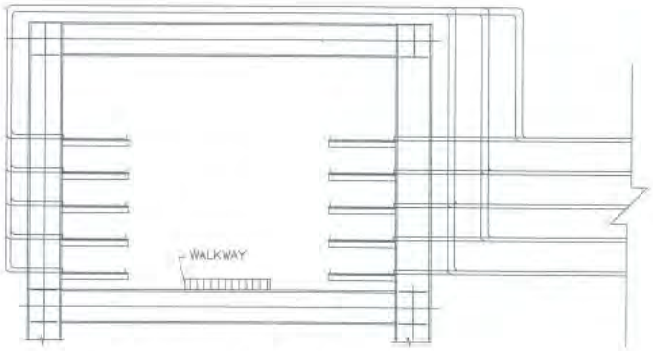
TITLE: STANDARD CABLE SUPPORT ASSEMBLY

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

TRESTLE–1

TRESTLE–2





SECTION 1–1

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

CLEARED BY

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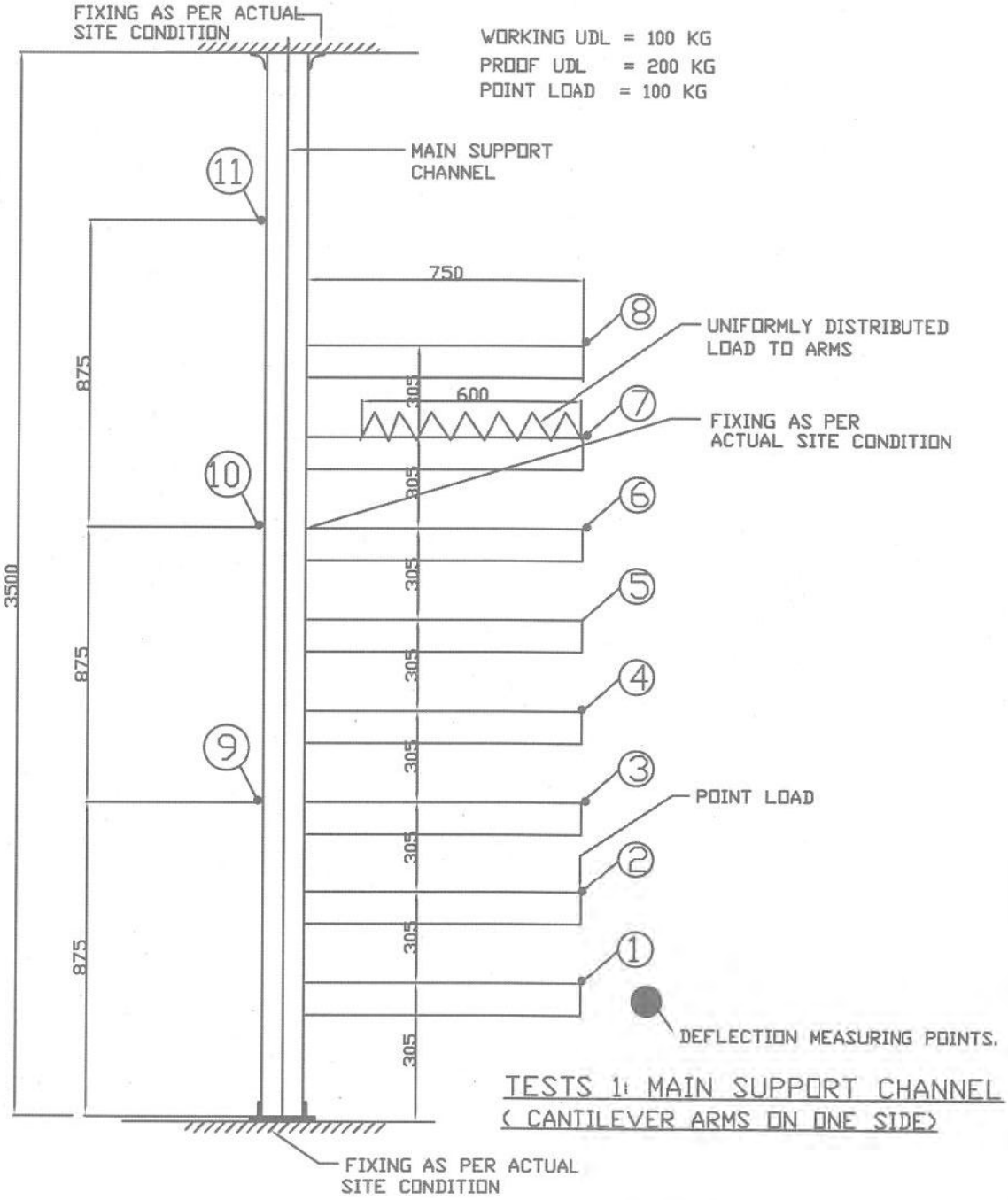
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: TYPICAL INTERCONNECTION DETAILS BETWEEN TWO PERPENDICULAR TRESTLES

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



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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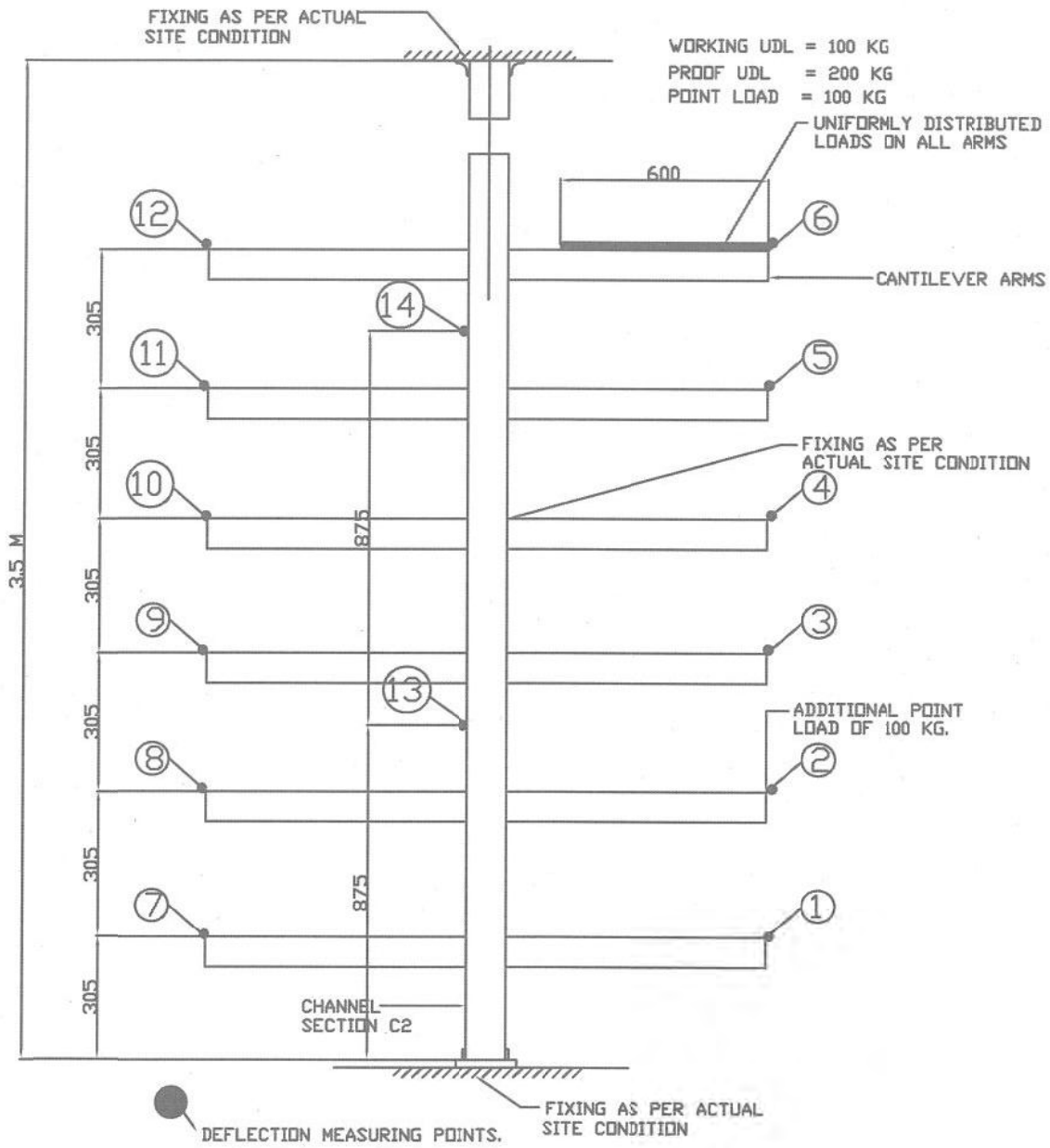
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: **TYPICAL DETAILS OF STRUCTURE FOR TESTING**

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



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&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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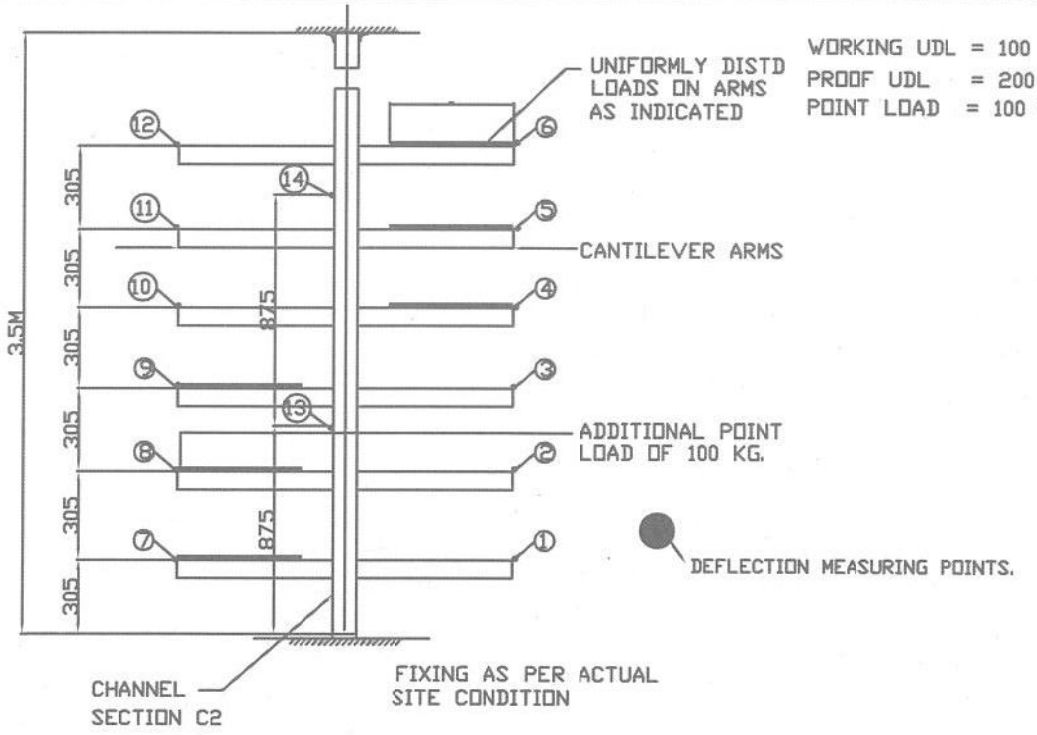
ENGINEERING DIVISION

PROJECT: STANDARD

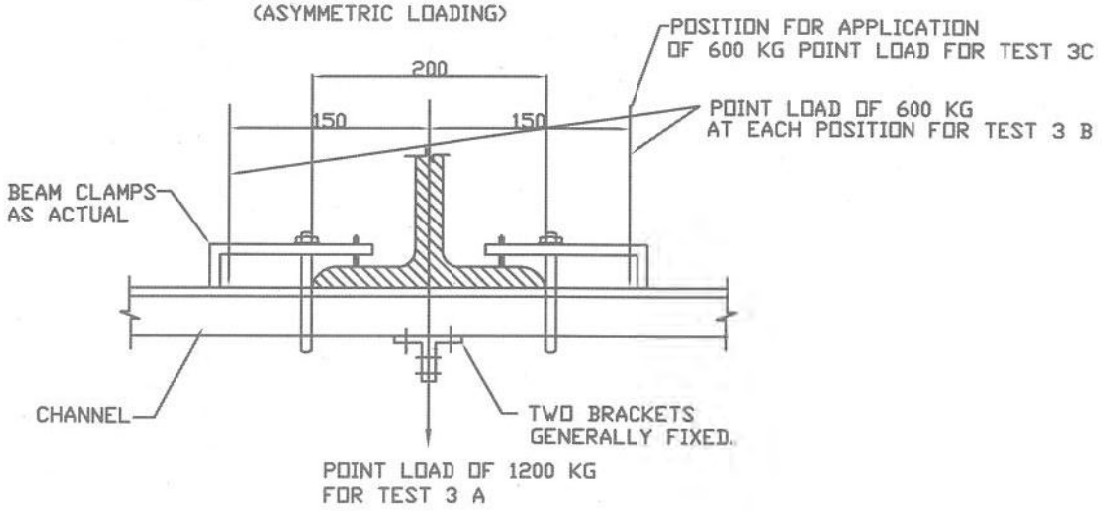
TITLE: TYPICAL DETAILS OF STRUCTURE FOR TESTING

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



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

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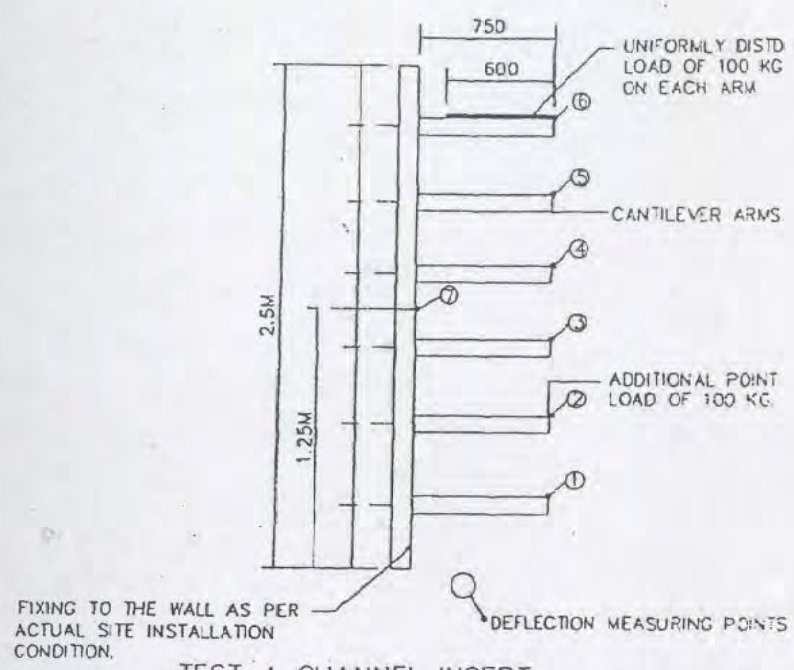
PROJECT: STANDARD

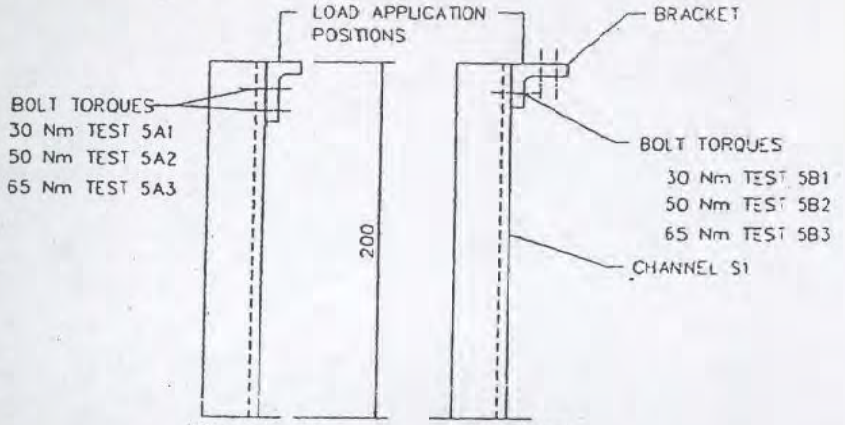
TITLE: TYPICAL DETAILS STRUCTURE FOR TESTING

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

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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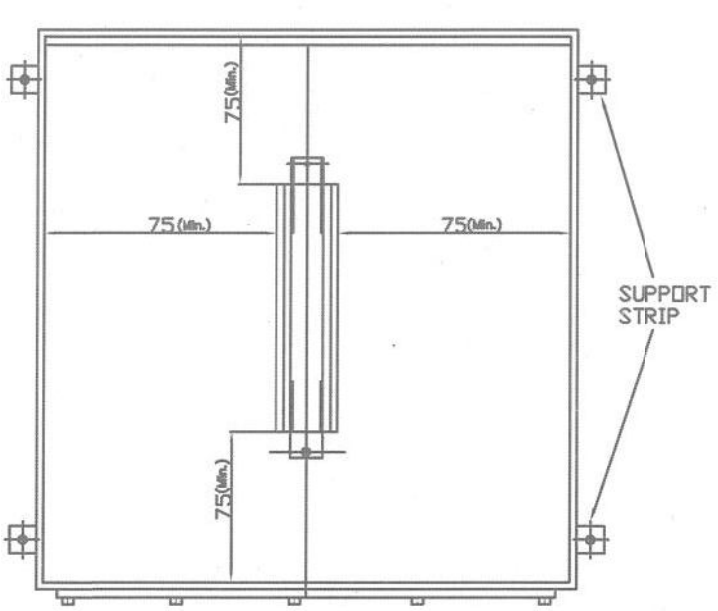
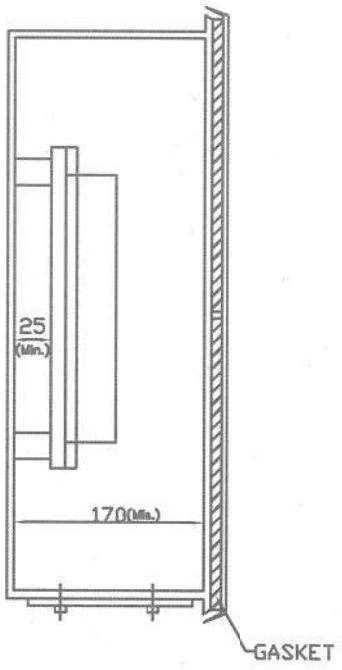
ENGINEERING DIVISION

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



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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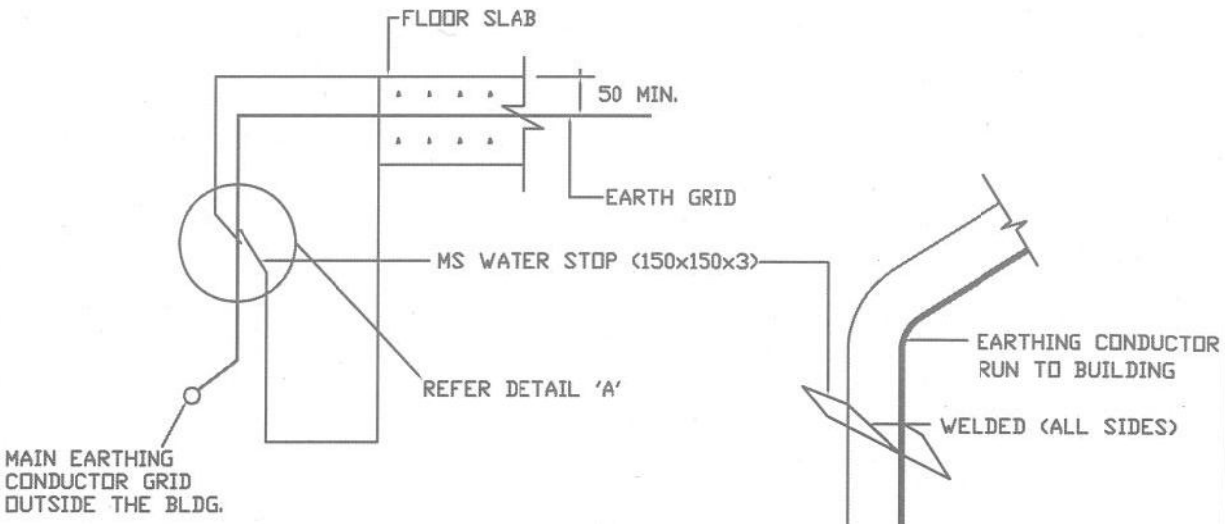
PROJECT: STANDARD

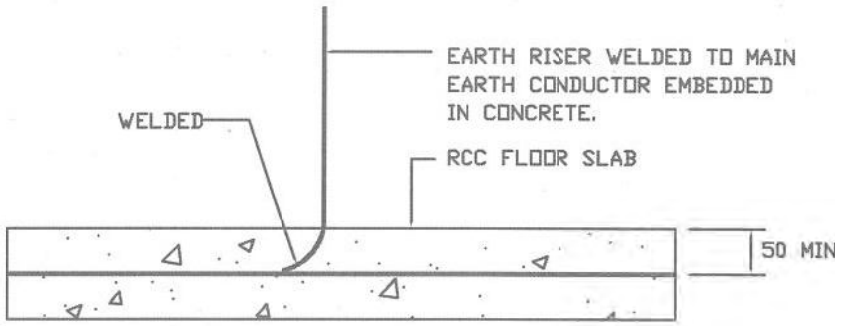
TITLE: TYPICAL DRAWING FOR JUNCTION BOX

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



INSERT IN RETAINING WALL

DETAIL 'A'



EARTH RISER

NOTE.
1. ALL DIMENSIONS ARE IN mm.

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

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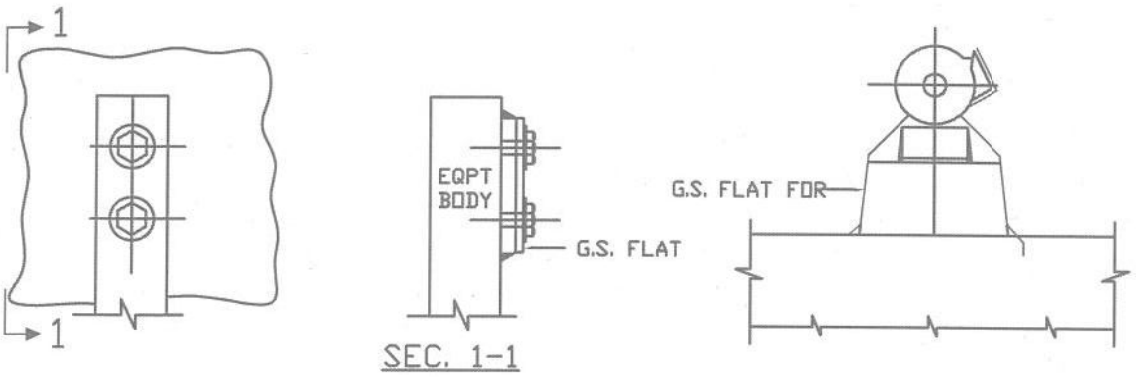
ENGINEERING DIVISION

PROJECT: STANDARD

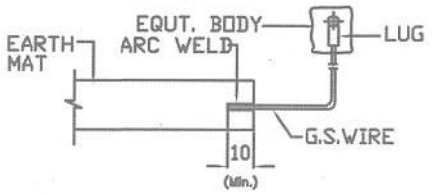
TITLE: EARTHING DETAILS

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

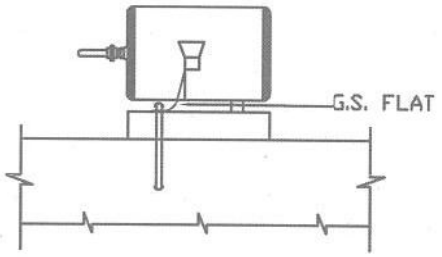


SEC. 1-1

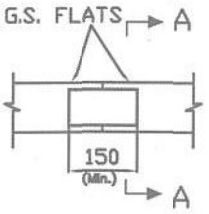
EQUIPMENT GROUNDING WITH G.S. FLAT



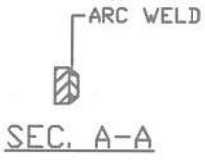
EQUIPMENT GROUNDING WITH G.S. WIRE



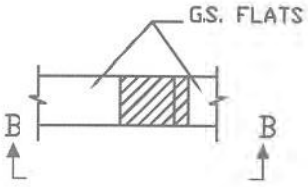
MOTOR TERMINAL BOX GROUNDING DETAIL

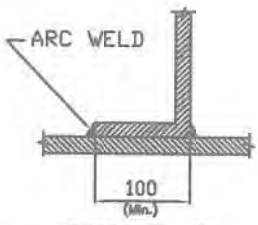


LAP JOINTS BETWEEN G.S. FLATS



SEC. A-A





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				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	30.11.2009
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.06.2009

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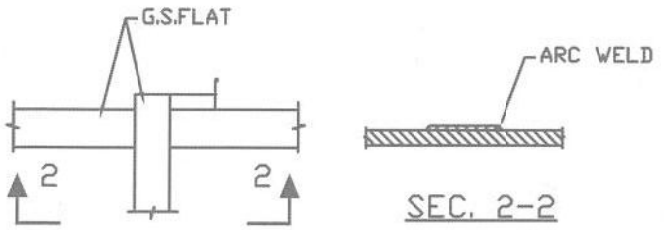
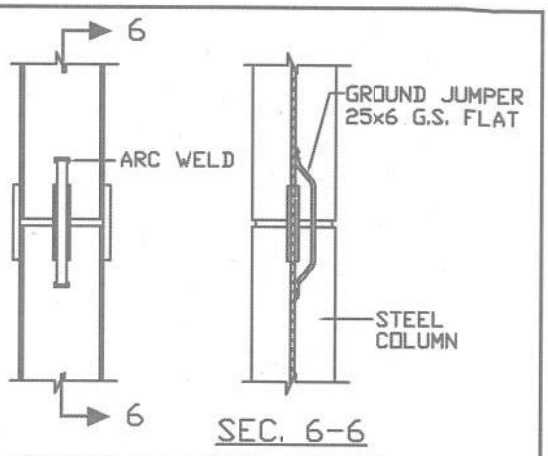
PROJECT	STANDARD		
TITLE	EARTHING DETAILS		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-042	REV. NO. RC



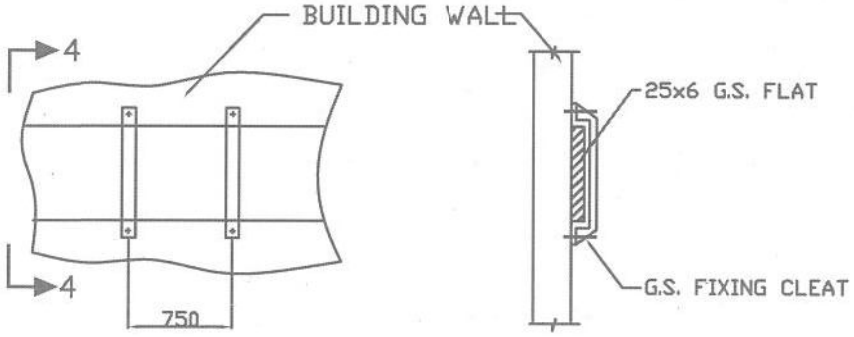
SEC. 2-2

CROSS JOINTS BETWEEN FLATS



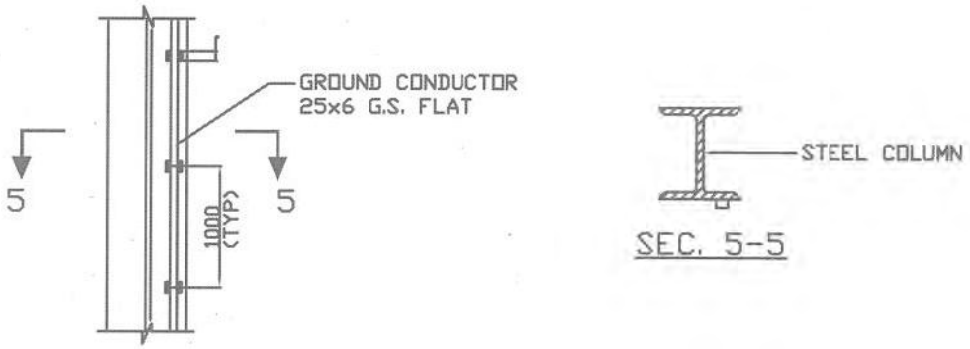
SEC. 6-6

BONDING OF STEEL COLUMN



SEC. 4-4

GROUND CONDUCTOR ALONG BUILDING WALL



SEC. 5-5

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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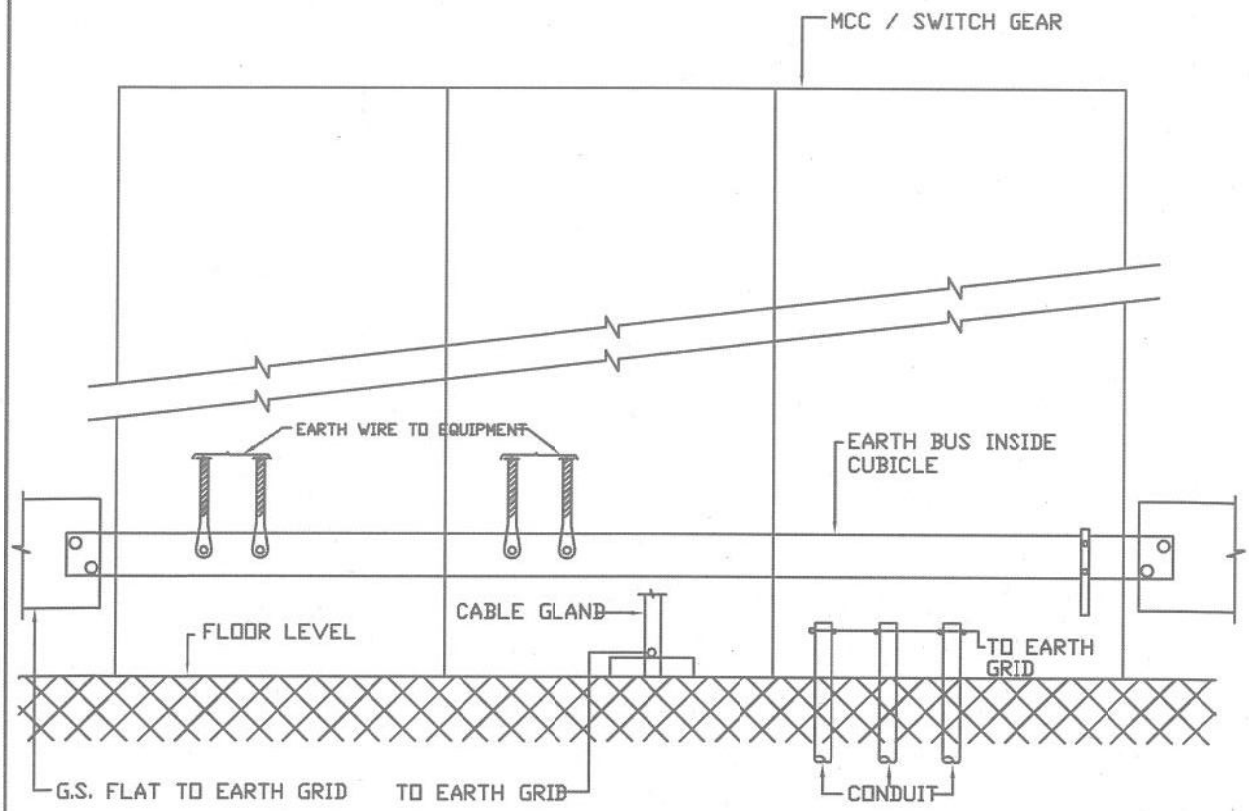
ENGINEERING DIVISION

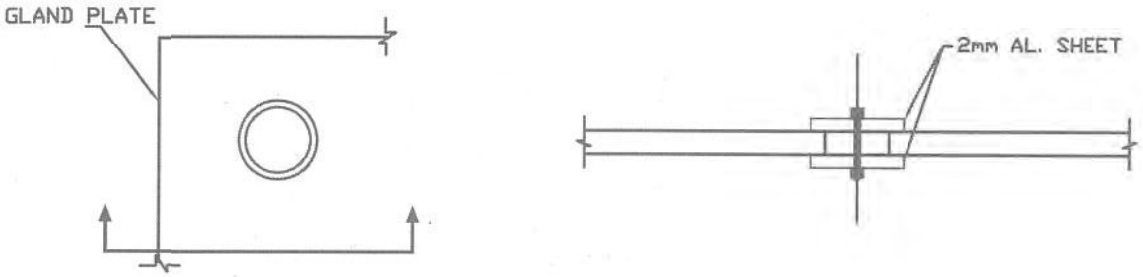
PROJECT: STANDARD

TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-043	RC



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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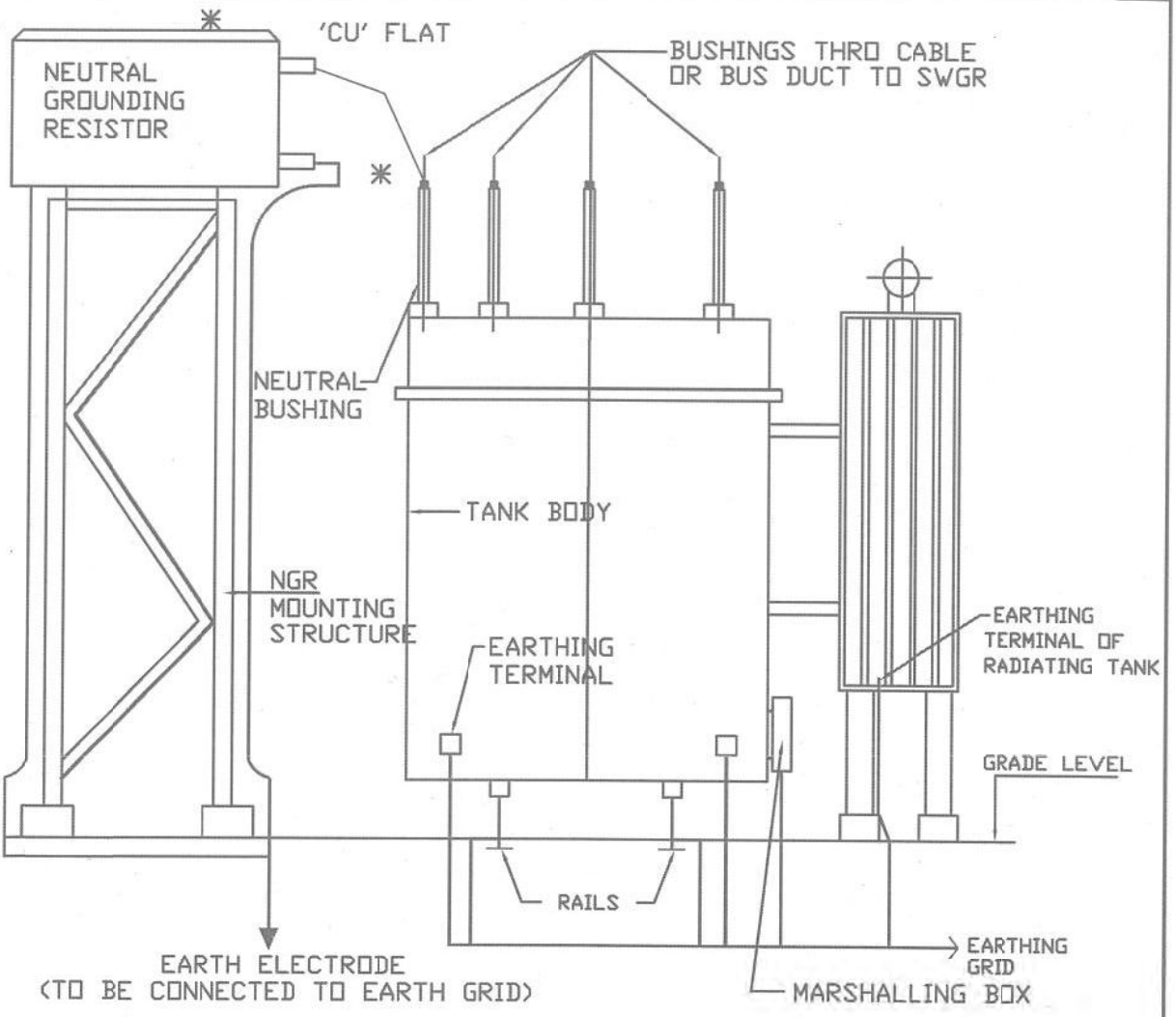
ENGINEERING DIVISION

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				–		–	–	–		05-07-10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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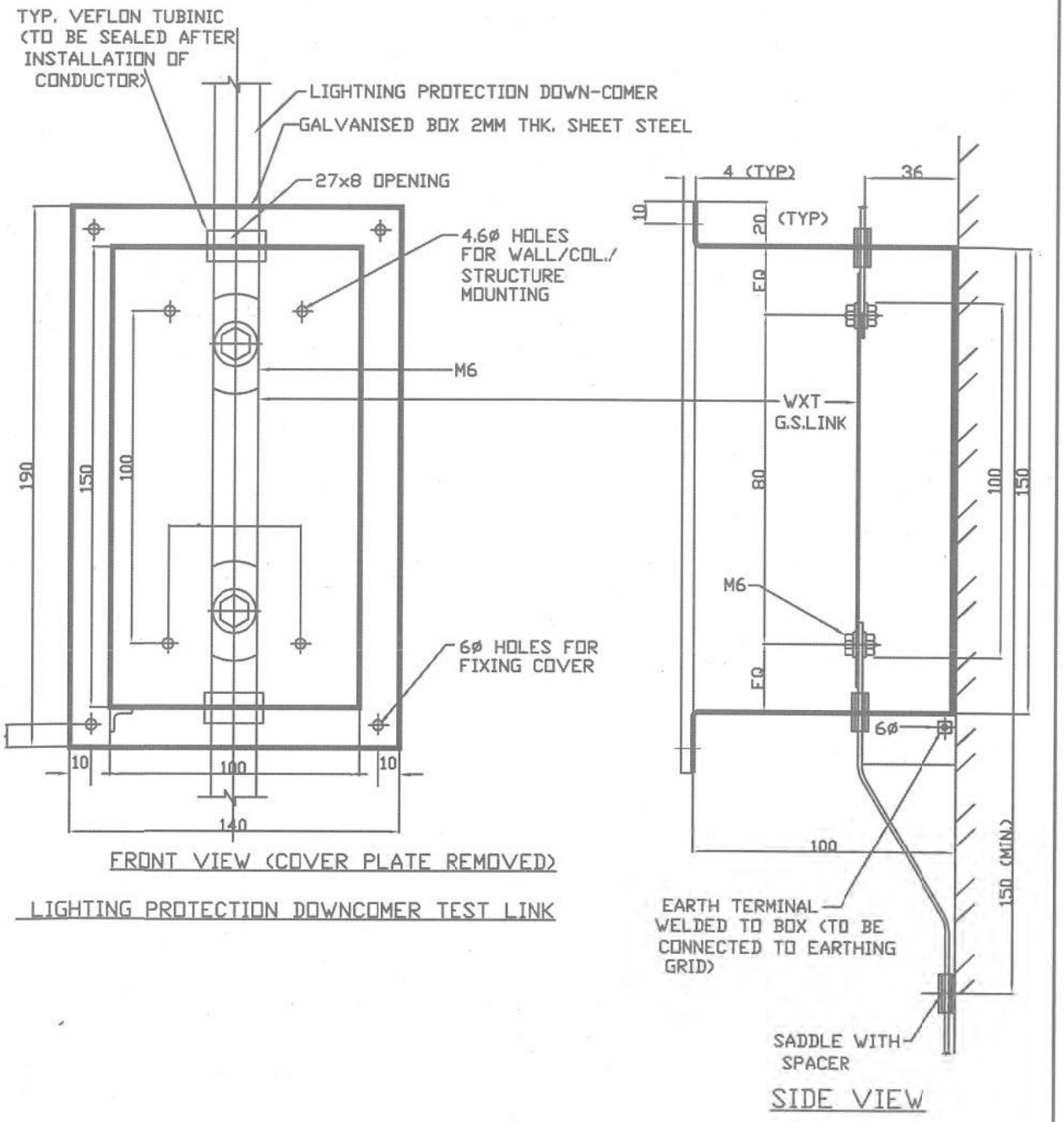
ENGINEERING DIVISION

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



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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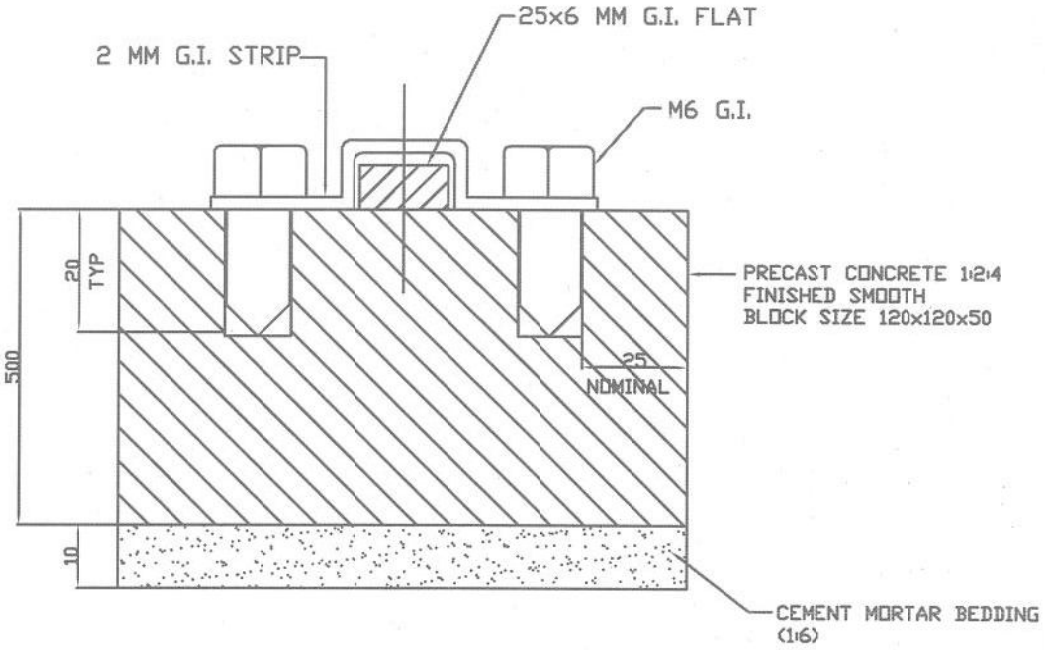
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	LIGHTNING PROTECTION DETAILS.		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-047	REV. NO.: 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	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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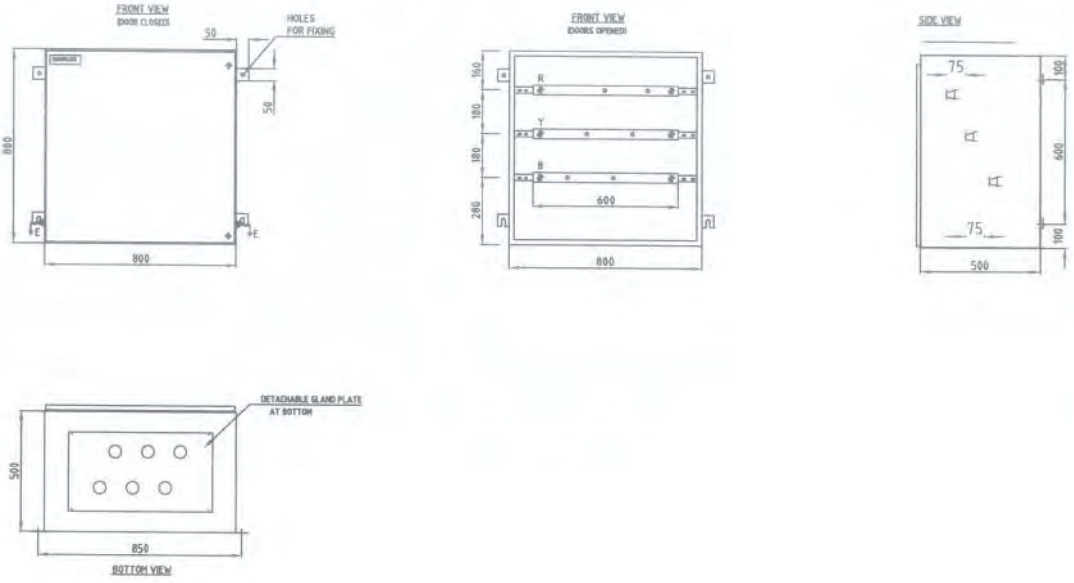
PROJECT	STANDARD		
TITLE	LIGHTNING PROTECTION DETAILS		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-048	REV. NO. RC



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	RKP		W					15.06.12
					CLEARED BY						

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NTPC LTD.
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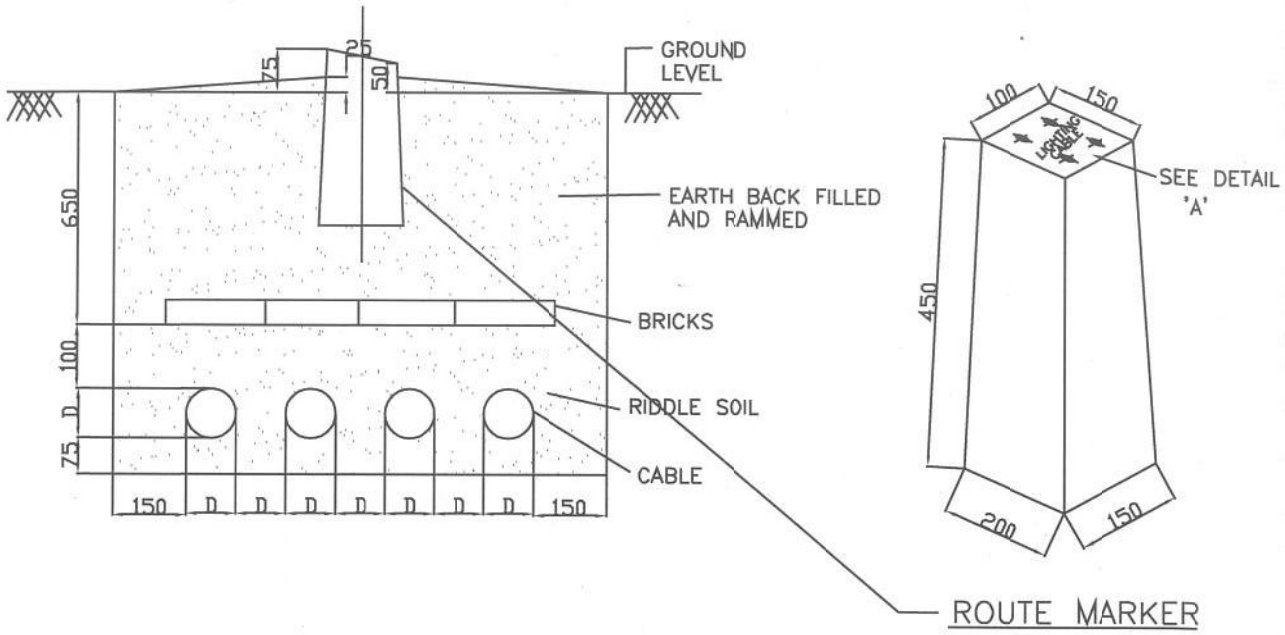
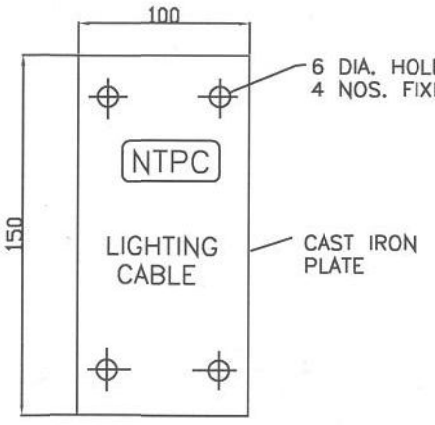
PROJECT: STANDARD

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				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	28.11.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2006

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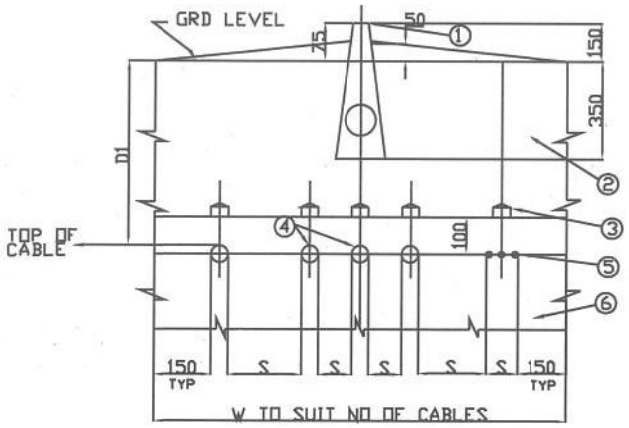
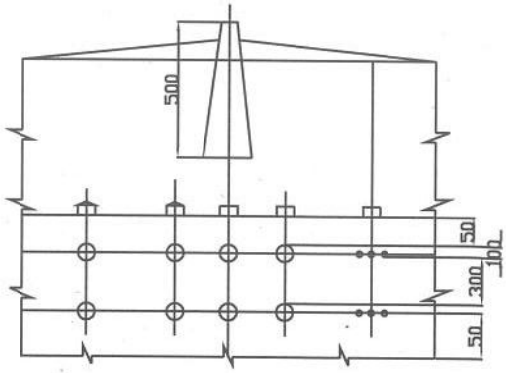
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	BURIED CABLE TRENCH DETAILS FOR LIGHTING		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-049	REV. NO.: 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 (BETWEEN HORIZONTAL OR VERTICAL SPACED)	= 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	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.12.07
RB	FOR TENDER PURPOSE	RKG	RKG	SG	–	SS	–	–	–	AS	25.11.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2006

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NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
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

2X800 MW NTPC KARIMNAGAR TELANGANA STPP PHASE-I
(SG ISLAND PACKAGE)

CABLE ERECTION PHILOSOPHY

BHEL DOCUMENT NO. PE–DC–424–507–E004

NTPC DWG NO: 9572-102-162-PVE-U-004

REVISION 01

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, UP [INDIA]

1.0 Scope

1.1 This document is intended to cover the aspects of cable raceway design and installation, laying and termination of various types of cables for the project.

1.2 Design calculations for cable sizing and selection are covered in a separate document.

1.3 Latest revisions of all drawings / documents shall be referred.

1.4 Reference standard

i) IS: 1255 (Code of practice for installation and maintenance of power cables).

1.5 Exclusions: The following areas / systems are excluded from the scope of this document.

a) Cable Routes other than SG area

2.0 Cable Raceway System

2.1 Cables shall generally be laid in galvanised MS cable trays in multi-tier arrangement. The trays shall in turn be supported on flexible cable tray support systems in SG Building, cable vaults, along structural members/ concrete surfaces inside plant buildings, cable trenches below switchboards/ MCCs in auxiliary plant buildings, and interconnecting pipe-cum-cable trestles. The trays shall be fixed to supports by means of bolting. Clamping of trays to the cantilever arms shall be resorted to where due to fabrication mismatches, there are misalignments between the respective locations of holes in trays and the cantilever arms.

2.2 Cable trays shall be oriented horizontally in all areas, except in areas subject to coal dust or ash deposition (such as boiler platforms, raceways along C-row of Main Power House area, interconnecting overhead cable tray paths between boiler area and ESP area, etc). Cable trays may be oriented vertically in other areas also if so required due to reasons such as space restriction, accessibility, plant aesthetics, operational clearances, etc. as per approved layout drawings. Branching of cables from main route shall be done through cable slits.

2.3 Cable trays shall have standard width of 150mm, 300mm & 600mm and standard lengths of 2.5m. Minimum thickness of mild steel sheets used for fabrication of cable trays shall be 2mm. Minimum thickness of side coupler pate shall be 3 mm. Cable trays shall be ladder type for power and control cables, while perforated type cable trays shall be used for instrumentation cables.

2.4 Main support channel and cantilever arms shall be fabricated out of minimum 2.5mm thick rolled steel sheet conforming to IS. Cantilever arms for various cable tray sizes shall be as follows:

S.No.	Cable tray Width	Cantilever Arm size for overhead trays	Cantilever Arm size for trays in trench
a)	150 mm	170 mm	170 mm
b)	300 mm	320 mm	320 mm
c)	600 mm	620 mm	750 mm

2.5 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. 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 relevant IS.

2.6 Suitable cable tray accessories such as horizontal and vertical bends, crosses, tees, reducers etc. shall be used in conjunction with straight runs of cable trays wherever required as per approved layout drawings to ensure a continuous and break-free tray support system for cables.

Cable tray accessories shall be factory fabricated for use at site as per approved drawing titled "TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES", (drawing no. PE–DG–424–507–E005). For specific site requirements (e.g. irregular angle bends such as 30°/60° bends, etc) as per layout conditions, tray accessories shall be fabricated at site from the straight length of respective sizes as required. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

2.7 The flexible cable tray support system shall comprise of galvanised MS single channel (C1: having provision of supporting cable trays on one side) or double channel (C2: having provision of supporting cable trays on both sides) members as main supports, cantilever arms, various brackets, clamps, floor plates, all hardware 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.

2.8 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 galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.Running lengths of single / double channels shall be cut to required lengths for installation. Any cutting or welding of galvanised surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.

2.9 Horizontally running cable trays shall be clamped by bolting to cantilever arms at an interval of 2000 mm. 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. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted.Spacing between cable trays shall normally be kept 300mm for cable laying convenience and effective heat dissipation. However, wherever layout constraints do not permit this spacing, the same may be reduced to 250mm, for trays carrying control and instrumentation cables.

2.10 All cable way sections shall have identification, designations as per cable way layout drawings and painted/ stencilled at each end of cable way and where there is branch connection to another cable way. Minimum height of letter shall not be less than 75mm. For long lengths of cable trays, the identification shall be painted at every 10m. Risers shall additionally be painted / stencilled with identification numbers at every floor.

2.11 The cable trays and supports system shall be type tested, of approved makes, and conforming to their respective approved drawings.

2.12 Cable trays shall be grounded as per the provisions of the approved grounding document for the project.

2.13 For laying cables along building steel structures or masonry structures, the cables shall be fixed by clamping with GI saddles screwed to the GI flats welded/ embedded to the structures.

2.14 For laying cables along concrete walls, ceilings etc., the cables shall be clamped with GI saddles screwed to the GI flats welded to the inserts. Where inserts are not available the saddles may be directly fixed to the walls using anchor bolts and MS flat spacers of minimum 6mm thickness.

2.15 Directly buried cables

a) Cable trenches shall be constructed for directly buried cables. Construction of cable 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.

2.16 For outside cable trench to inside cable trench connection, pipe sleeves in walls as under will be provided for each cable tray for transiting the cables from one side to the other.

a) For each 600mm wide tray: 3 nos. 200 diameter PVC pipes.

b) For each 300mm wide tray: 2 nos. 200 diameter PVC pipes.

c) For each 150mm wide tray: 1 no. 200mm diameter PVC pipes.

The trays shall be stopped approximately 200mm short of the wall on both sides and cables passed through the pipe sleeves as above, the pipe sleeves being aligned horizontally with the respective cable trays. This method is adopted for smooth passage of cables and effective sealing of cable openings.

For cable entry to pump house / building, outside cable trays running on walls / structure shall enter by means of wall opening. Alternatively, cable pull pit shall be provided outside and shall connect to cable trench inside by means of pipe sleeves as indicated above.

Where cables cross roads/ rail tracks, the cables shall be laid in hume pipe/PVC pipe.

2.17 Local cabling in various auxiliary plants or pump houses from the main tray runs to equipment terminal boxes shall be through notches in floor, which will be filled up with sand and then provided with lean concrete covering matching with the floor after completion of cable laying.

2.18 Cable troughs shall be used for branching out few cables from main cable route. These shall be U-shaped, fabricated of mil steel sheets of thickness 2 mm and shall be hot dip galvanized. Troughs shall be standard width of 50mm & 75 mm with depth of 25 mm

3.0 **General Philosophy of Cable Installation**

3.1 Cable runs shall be uniformly spaced, properly supported and protected. All bends in runs shall be as per specification and made with due consideration to avoid sharp bending and kinking of cable. The bending radius of various types of cables shall not be less than those specified by cable manufacturers or that specified in IS: 1255.

3.2 For the purpose of cable laying, the cables are categorised as under:

a) HT: Power cables of 11KV / 3.3KV grade

b) LT: Power cables of 415KV grade, catering to loads at 415V AC/ 230V AC/ 220V DC / 24V DC

c) Control: Control cables of 1.1KV grade generally carrying control signals at 220V DC / 110V AC.

d) Instrumentation: (Also called screened control cables): Screened cables of cross-sections 1.5sqmm or lower generally carrying very low voltage very low current signals.

3.3 All cables shall be provided with identification tags indicating the cable numbers in accordance with the cable circuit schedule. Cable tags shall be fixed at terminal ends, at tray intersection / bend and at each side of floor/ wall/ duct crossings etc and at every 20m in cable trench/tray or buried run.

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, cable tags can be made of nylon, cable marking ties with cable number heat stamped on the cable tags.

3.4 Single core cables for a. c. three phase circuits, when laid on trays, shall be in trefoil formation (each trefoil with RYB phases formation), with distance of four times the diameter of cable between trefoil centrelines. The trefoil formation shall be duly secured to the cable tray by means of trefoil clamps of nonmagnetic material at every 2000mm interval. All multicore cables shall be laid touching formation.

3.5 Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables as defined in clause 3.2 above. 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.

3.6 1100 V grade multi-core power cables carrying continuous current when laid on trays shall be placed in single layer, touching and clamped by means of cable ties/clamps.

The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyester 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.

Cables of sizes indicated below, shall be clamped individually.

(a)	Single core cables	:	500 sq mm or higher (when not laid in trefoil formation- e.g. dc circuits)/ neutral cables)
(b)	Multi core cables	:	95 sq mm or higher

3.7 Control and instrumentation cables shall be laid in multi layers, but not exceeding three layers in any section. Special purpose cables (e.g. IPB, WAN etc.) shall be laid as per system manufacturer/ supplier recommendations with due regard to segregation of routes for redundant circuits.

3.8 While power, control and instrumentation cables shall generally be laid in separate trays, low current carrying power cables (valve/ damper actuator power cables) may be laid along with control cables. In most such cases, the cable sizes shall be 2.5 sq mm; however, in exceptional cases higher sizes as per approved cable sizing calculations (required due to voltage drop criterion) may be used.

3.9 Cables shall be placed on trays on the basis of their types and functions as under for horizontal formations:

a) HT cables: in the top tier(s).

b) LT power cables: in the tray(s) below the HT cable trays.

c) Control cables: in the tray(s) next below to the LT power cable tray(s).

d) Instrumentation cables (screened control cables): in the bottom most perforated tray(s).

HT Power, LT Power and LT Control/Instrumentation cables shall be separated from each other by at least 300mm.

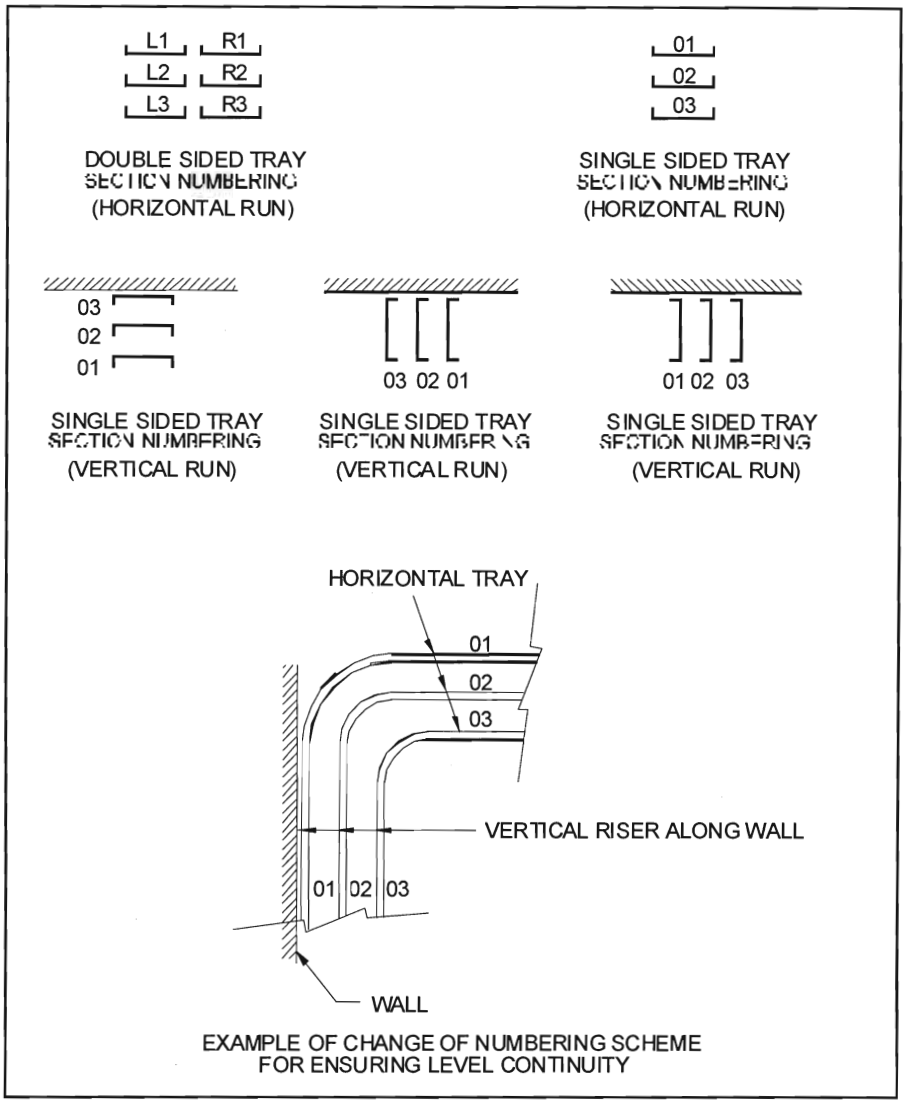
3.10 For vertical formations, the outermost tray shall be considered as the topmost tray and the order indicated in clause 3.9 shall be followed. In rare cases, where there is no clear distinction of bottom/ top trays, the order convenient for linking the horizontal and vertical formations avoiding criss-crossing, or exit of cables shall be followed.

Typical examples of tray numbering are given overleaf.

3.11 Wherever it is not possible to accommodate cables as per the criteria indicated in the clauses 3.9 & 3.10 (due to layout constraints) for very short field runs, control cables may be laid in the same tray with the instrumentation cables with clear minimum gap of 100mm between the two types of cables.

3.12 All cables associated with the unit shall be segregated from cables of other units. Interplant cables of station auxiliaries shall be laid 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 ac or dc drives shall be laid in segregated routes. Cable route for one set of auxiliaries of same unit shall be segregated from the other set. Segregation means physical isolation to prevent fire jumping or minimum one hour fire rating. Cables of 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. In switchyard, control cables of each bay shall be laid on separate racks / trays.

3.13 To facilitate pulling of cables in GI conduits, powdered soft stone, plastic soap or other dry inert lubricant may be used. However any material harmful to the cable sheaths shall not be used.



EXAMPLE OF CHANGE OF NUMBERING SCHEME FOR ENSURING LEVEL CONTINUITY

3.14 No single core cable shall pass through a GI conduit/ pipe or duct singly except DC single core cables. AC single core cables shall pass through GI conduit/ pipe in trefoil formation only, or through PVC pipes. Conduit/pipe occupancy shall not exceed 40% of the conduit/pipe cross-section area. Pipes / conduits if used in corrosive areas shall have anti-corrosive coating both inside & outside.

3.15 Wherever specific cable routes are not shown in cable schedules, cables may be laid through the shortest route as per the above criteria, as directed by site Engineer.

3.16 Power and control cables shall be secured fixed to trays/support with self-locking type clamps/ties. 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 individual multicore power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.

3.17 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.

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3.18 Two separate cable routes one on each side shall be provided for each boiler unit. Cables for one set of auxiliaries such as ID, FD, PA fan & half of the coal mills shall be routed in one route & for other set of auxiliaries through other route.

3.19 Cables shall be laid on cable trays strictly in line with cable schedule.

3.20 For road/rail crossings, buried RCC hume pipes (at a depth of minimum 1000mm) shall be used. Alternatively, RCC duct banks may also be used as per site condition.

3.21 If required the necessary modification in cable tray layout shall be made at site to suite condition i.e. to avoid fouling of cable trays with beam, columns, steel structure, pipes etc. with prior approval from project manager. Wherever accessories like bends, elbow, tees, crosses etc are required in cable trays installation a pre-fabricated type of accessories in line with technical specification requirement shall be used.

3.22 Recommended tightening torque shall be used for dowels and bolts.

4.0 Trefoil Clamps

The cable trefoil clamps shall be used for clamping of MV & LV single core cables to be routed in trefoil formation using trefoil clamps 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.

LT SWITCHGEARS & LT BUSDUCTS

TELANGANA SUPER THERMAL POWER PROJECT PHASE-I (2X800 MW) STEAM GENERATOR ISLAND PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC.NO.: CS-9591-101-2

1.00.00 **DESIGN PHILOSOPHY / PRACTICE FOR LV BOARD SIZING**

The sizing of LV boards shall be primarily dependent on the following conditions such as total load connected onto a Board, diversity factors for various loads connected, Fault Level and Voltage Regulation Considerations.

As far as practicable the system shall provide segregated supplies to main and standby auxiliaries so that failure of supply to main auxiliary shall in no way jeopardize the standby auxiliary feed. Automatic changeover at critical switchgear/ MCC sections shall be provided as necessary to prevent the loss of a unit or to ensure the equipment safety.

1.01.00 **Design Considerations:**

1.01.01 **Sizing of LT boards**

a) Input KVA for a Drive = (Rating KW X Load Factor) / (Efficiency X Power Factor) where values of load factor , power factor and efficiency are defined below:

b) Load (service) factor for 415 V loads is taken as 0.85

c) Power factor 415 V Uni-Directional drives is taken as 0.8 and efficiency as 0.85

d) Power factor of 415 V bidirectional drive Loads is taken as 0.65 and efficiency as 0.8 for motor rating less than 15 KW For motor ratings above 15 KW and above the corresponding values are 0.75 and 0.8.

e) The Finally selected Bus Bar ratings for switchboards, MCC s and ACDB and Busduct shall include a 10 % margin over the calculated values.

f) The LDB' s shall be considered to be loaded to 70 % of their KVA rating Lighting load of 100KVA shall be considered on each section of main switchgears with incomer from transformer as indicated in the tender SLD.

g) A spare capacity of about 10 % shall be kept for addition of loads during detail engineering as many of the LT loads cannot be predicted during the Rating selection of the Board.

h) Busbar Ratings of valves/dampers boards shall be derived by summing up to 5% of the total KVA load connected. With the largest Value /damper Connected.

i) ESP consumption for 100 % BMCR operation shall be considered and further this load shall be uniformly divided among ESP Switchgears.

1.02.00 **Layout Criteria**

The switchboards can be split into two sections based on layout constraints in case of long switchboards to optimize Switchgear room layouts. The two sections of the split shall be connected by Bus duct/Cable as per layout requirements.

1.03.00 **Spare capacity and Future Requirements**

Each of the LV switchboards shall be designed for 1.1 times the required rating as a spare capacity. Further all LV Switchboard shall be provided with 20% spare modules of each rating and type of module.

1.04.00 **Standardization**

The LV Boards shall be fed through either LT auxiliary transformers. MCC, and Distributed boards are fed further through these main boards. The Standard rating of the main boards fed through Unit Auxiliary Service Transformers shall be 4000 Amp .Other Standard ratings used shall be 3000,2500, 2000 Amp, 1600 Amp, 1000 Amp, 600 Amp, 400 & 250 Amp.

Preferred ratings for LV Busduct rating are 4000 Amp, 3000 Amp, 2500 Amp and 1600 amp. It shall be preferred to have all LV Switchboards for the entire plant from a One/Two/Three manufacturer from maintainability and spares management point of view.

It shall be preferred to follow a standardization of Terminal Numbers across all LV Modules for ease of Interconnection and standardization.

1.05.00 **Plant control cable Interconnections**

a) Standard control cable sizes shall preferably be 3CX1.5, 5CX1.5, 7CX1.5 & 10CX1.5
b) Cable size for motor space heater application shall be 2CX2.5
c) Interconnections for Current Transformer terminals shall use two cores of 1.5mm^2 size per phase
d) Core identification shall be using core color for up to 5-core cable and core number for cable with more cores
e) Separate control cables shall be used for current transformers.
f) At least one spare core shall be made available in each of the control cable

1.00.00 **CODES AND STANDARDS**

1.1.00 All equipment shall, generally, comply with the updated issues of

(a.) Applicable Indian Standards

(b.) Indian Electricity Act.

(c.) Indian electricity rules

1.2.00 Equipment complying with any other authoritative / internationally recognized standards such as IEC, British, U.S.A., German, etc. will also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases the contractor shall clearly indicate the standard adopted and furnish the copy of latest English version of the same along with the bid and bring out the salient features for comparison.

1.3.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as published one month prior to the date of opening of bids. 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 codes and standards.

IS: 5	Colors for ready-mixed paints and enamels.
IS: 694	PVC insulated cables for working voltages upto and including 1100V.
IS: 722	A.C. Electricity Meters
IS: 1248	Electrical Indicating instruments
IS/IEC: 60947–1	Degree of protection provided by enclosures for low voltage Switchgear and Control gear
IS/IEC: 60947-2	A.C. circuit Breakers
IS: 2551	Danger Notice Plates
IS: 2629	Hot dip galvanising
IS: 2705	Current Transformers
IS/IEC: IEC-60947-4-1	Contactors and motors starter for voltages not exceeding 1000 V AC or 1200 V DC
IS: 3043	Code of practice for earthing.
IS: 3072	Code of practice for installation and maintenance of Switchgear
IS: 3156	Voltage Transformers
IS: 3202	Code of practice for climate proofing of electrical equipment.
IS: 3231	Electrical relays for power system protection.
IS/IEC 60947	Air-Break Switches, air break disconnectors, air break disconnector and fuse combination units for voltages not exceeding 1000V AC or 1200 V DC.
IS/IEC 60947-1 / IEC-60947-1	General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V.

IS: 5082	Wrought Aluminum and Aluminum alloys for electrical purposes.
IS: 6005	Code of practice of phosphating of iron and steel.
IS/IEC 60947-5-1 / IEC-60947-5-1	LV switchgear and Control gear Control current devices and switching element.
IS: 8623 (3 parts) / IEC: 60439	Specification for factory built assemblies of Switchgear & Control gear for voltages upto and including 1000 V AC & 1200 V DC.
IS: 8686	Static Relays
IS: 13703 / IEC: 60269	HRC Cartridge fuses
IS: 10118 (4 parts)	Code of practice for selection, installation and maintenance of switchgear and control gear.
IS: 11171	Specification for dry type transformers.
IEC: 60255	Electrical Relays
IEC: 61850	Communication networks and systems in substations
IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals
IS: 12021	Specification of control transformers for switchgear and Control gear for voltage not exceeding 1000V AC.
IEC: 60947-7-1	Terminal blocks for copper conductors
IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips
IEC 60439(1&2)/ IS 8623(1&2)	Bus trunking system (sandwich busduct)

2.00.00 TECHNICAL PARAMETERS

2.1.00 **POWER SUPPLY**

2.1.1 **AC SYSTEM**

1)	Voltage	415 V ± 10%,3 Phase, 4 wire, solidly earthed
2)	Frequency	50 Hz +/- 5%
3)	Combined variation (in volts & frequency)	10% absolute sum
4)	Fault Level	50KA(RMS)

2.1.2 **DC SYSTEM**

1)	System Voltage	240VDC 2-Wire, Unearthed
2)	Fault Level	20 KA

2.1.3 **CONTROL SUPPLY VOLTAGE**

1)	Trip & closing coil of circuit breaker	240V DC/120V DC
2)	Spring charging motor	240V DC/120V DC
3)	MCC control supply	110V AC Neutral solidly earthed
4)	Space heater & lighting	240V AC Neutral solidly earthed

2.2.00 **CUBICLE DATA**

Busbar Rating

1)	Continuous Current rating	As per requirement
2)	Short time rating where	
	a) CB is used as incomer	50KA(RMS) for one sec
	b) Fuse protection is used in Incomer	Prospective current of 50KA(RMS) for the fuse clearing time

	3) Dynamic Rating where	
	a) CB is used as incomer	105KA(PEAK)
	b) Fuse Protection is used in incomer	Prospective current of 105KA (PEAK) as limited by fuse
	4) Busbar insulation	
	a) For switchgear	PVC Sleeve insulated
	b) For MCC	PVC Sleeve insulated
	c) ACDB	PVC Sleeve insulated
	d) DCDB	PVC Sleeve insulated
	e) For fuse boards	PVC Sleeve insulated/ epoxy coated
2.3.00	**CIRCUIT BREAKER**	
	1) Type	Air break spring charged stored energy type
	2) Operating duty	B-3 MIN-MB-3 MIN-MB
	3) Symmetrical interrupting	50KA(RMS)
	4) Short circuit rating	105KA(PEAK)
	5) Short Circuit Breaking current	
	a) AC Component	50KA(RMS)
	b) DC Component	As per IS/IEC 60947
	6) Short time withstand	50KA(RMS) for one sec
	7) No of aux. contacts	4 NO + 4 NC for DDCMIS interface

2.4.00 **METERS**

1)	Accuracy class	2.0
2)	One min. power frequency withstand test voltage	2.0 KV (rms)

2.5.00 **CURRENT TRANSFORMERS**

1)	Type	Cast Resin Bar Primary
2)	Voltage class and frequency	650 V, 50 HZ
3)	Class of insulation	E or better
4)	Accuracy class & burden	
	a) For protection	5P20, 5VA
		PS Class for REF
	b) For metering	class 1.0, 5VA (min)
		class 0.2s, 5VA (min) for feeders indicated in SLD ,if any
5)	Short time withstand	
	a) For CT Associated with circuit breaker	50KA(RMS) for 1 sec
	b) For CT Associated with fuse protected feeders	Prospective current of 50KA(RMS) for the Fuse clearing time
6)	Dynamic withstand	
	a) For CTs Associated with circuit breaker	105KA(PEAK)
	b) For CT Associated with fuse protected feeders	Prospective current of 105KA(PEAK) as Limited by fuse

2.6.00 **BUSDUCT**

1)	Type	Non-Segregated
2)	One minute power frequency withstand voltage	2.5 kV
3)	One second short ckt withstand current	50KA(RMS)
4)	Momentary dynamic current withstand	105KA(PEAK)

BUSDUCT (SANDWICH TYPE)

1)	Type	Bus Trunking
2)	Rated Insulation voltage	1000V
3)	One second short ckt withstand current	50KA(RMS)
4)	Momentary dynamic current withstand	105KA(PEAK)
5)	Power frequency withstand voltage	3.5kv
6)	Impulse withstand voltage	8kV
7)	Insulation	Class F

2.7.00 **VOLTAGE TRANSFORMERS**

1)	Type	Cast Resin
2)	Voltage Ratio	415 / 110 V for line PT
		415/√3 / 110/√3 V for Bus PT
3)	Method of Construction	Vee Vee
4)	Accuracy Class	0.5
		0.2 for feeders indicated in SLD ,if any
5)	Rated Voltage factor	1.1continuous, 1.5 for 30 sec.
6)	Class of insulation	E or better

	7)	One minute power frequency withstand voltage	2.5 KV
2.8.00	**HRC FUSES**		
	1)	Voltage Class	650 Volts
	2)	Rupturing capacity	80 KA (rms) for AC ckt. 20 KA for DC ckt.
2.9.00	**CONTACTORS**		
		Type	Air break electro magnetic
	2)	Utilising Category	AC3 of IS/IEC 60947 for non reversible AC4 of IS/IEC 60947 for reversible drives
2.10.00	**RELAYS**		
	1)	Power frequency withstand voltage	2.5KV for 1 sec. or 2.0 KV for 1 min.
2.11.00	**CONTROL TRANSFORMERS**		
	1)	Type	Dry / Cast Resin
	2)	Voltage Ratio	415 / 110 with taps $\pm$ 5% in steps of 2.5%
	3)	Class of insulation	Class-B or better
	4)	One minute power frequency withstand voltage	2.5 KV
	5)	Rating	1.5 x Adequate for application.
2.12.00	**LIGHTING TRANSFORMER / WELDING TRANSFORMER**		
	1)	Type & Rating	Dry type / 100 KVA
	2)	Voltage Ratio	415/415V, +/- 5% taps in steps of 2.5%

	3) Class of insulation	B or better
	4) One minute power frequency withstand voltage	2.5 KV
	5) Enclosure protection	IP-42
2.13.00	**TRANSDUCERS**	
	1) Current transducers	
	a) Input	0-1 A (CT secondary)
	b) Rated frequency	50HZ
	c) Output	4-20 mA (2 Nos. decoupled)
	d) Over current	Transducer for motor current ammeters shall be capable of withstanding min. 6 times CT sec. current of 1A for a min period of 30 seconds
	e) Accuracy	1.0
	2) Voltage Transducers	
	a) Input	110 V(VT secondary) ,50 HZ (for AC)/240 V DC (for DC)
	b) Output	4-20 mA (2 Nos. decoupled)
	c) Accuracy	1.0
2.14.00	**MCCB**	
	1) Rated voltage	415V
	2) Rated insulation level	690V
	3) Rated ultimate &Service S.C. breaking capacity	50KA

	4)	Rated making capacity	105KA
	5)	Utilization category	A

3.00.00 **CONSTRUCTIONAL DETAILS OF SWITCHBOARDS**

3.1.00 All Switchboards i.e., 415 V Switchgears, Motor Control Centres (MCCs), AC Distribution Boards (ACDBs), 220 V DC Distribution Boards (DCDBs) and Solenoid Valve Distribution Boards, shall be of metal enclosed, indoor, floor-mounted, free-standing type.

3.2.00 All switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.

3.3.00 All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.

3.4.00 The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cutouts shall be true in shape and devoid of sharp edges.

3.5.00 All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS/IEC 60947. However, the busbar chambers having a degree of protection of IP: 42 are also acceptable where continuous busbar rating is 1600A and above. Provision shall be made in all compartments for providing IP: 5X degree of protection, when circuit - breaker or module trolley has been removed. All cutouts shall be provided with EPDM / Neoprene gaskets.

3.6.00 Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating is 1600 A and above.

The enclosure for outdoor oil filteration panels shall be constructed of stainless steel sheets in order to have protection against corrosion.The Degree of protection for outdoor panels shall be IP:65.The panels shall be mounted on a pedestal at a height of 500mm from ground level.

3.7.00 All switchboards shall be of uniform height not exceeding 2450 mm.

3.8.00 Switchboards shall be easily extendable on both sides by the addition of vertical sections after removing the end covers.

3.9.00 Switchboards shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) to be done by Contractor after erection of the switchboards does not obstruct the movement of doors, covers, withdraw able modules etc.

3.10.00 All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments:

(a.) BUSBAR COMPARTMENT

A completely enclosed bus bar compartment shall be provided for the horizontal and vertical bus bars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power bus bars shall be in separate compartments.

(b.) SWITCHGEAR / FEEDER COMPARTMENT

All equipment associated with an incomer or outgoing feeder shall be housed in a separate compartment of the vertical section. Two-tier breaker arrangement in a vertical section shall be offered for outgoing breaker feeders of rating up to 1600A. The design of the vertical section for such an arrangement shall ensure ease of termination of power cables of size & quantity as specified in clause 42.00.00.The compartment shall be sheet steel enclosed on all sides with the withdraw able units in position or removed. Insulating sheet at rear of the compartment is also acceptable. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure.

(c.) CABLE COMPARTMENT OR CABLE ALLEY

A full-height vertical cable alley of minimum 250mm width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley shall be designed to meet the Form IVb Type 7 (as per IEC 60439) for safety purpose. The termination for each module shall have its own integral glanding facility. Wherever cable alleys are not provided for distribution boards, segregated cable boxes for individual feeders shall be provided at the rear for direct termination of cables. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley. Cable alley door shall be hinged.

(d.) CONTROL COMPARTMENT

A separate compartment shall be provided for relays and other control devices associated with a circuit breaker.

3.11.00 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. EPDM / Neoprene gasket shall be provided between the panel sections to avoid ingress of dust into panels.

3.12.00 After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary

	shrouding arrangement shall be provided for this purpose. Wherever two breaker compartments are provided in the same vertical section insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.
3.13.00	All 415V switchgear (circuit-breaker) panels shall be of single-front type. MCCs and DBs shall be of single-front / double-front construction as per the requirements. All single-front switch boards shall be provided with single-leaf, hinged or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 deg or more. In case of double-front MCCs, if this cannot be achieved for panels adjacent to a breaker panel, suitable dummy panel shall be provided by the Contractor wherever necessary.
3.14.00	All ACDBs, DCDBs and Solenoid Valve DBs shall be of fixed module type. All 415V circuit-breaker modules and contactor controlled motor modules shall be of fully draw out type having distinct 'Service' and 'Test' positions. The equipment pertaining to a draw out type incomer or feeder module shall be mounted on a fully withdrawable chassis which can be drawn out without having to unscrew any wire or cable connection. Suitable arrangement with cradle/ rollers, guides along with tool/lever operated racking in/out mechanism shall be provided for smooth and effortless movement of the chassis. For modules of size more than half the panel height, double guides shall be provided for smooth removal or insertion of module. All identical module chassis of same size shall be fully interchangeable without having to carryout any modifications. Suitable interlock shall be provided in DCDB for prevention of opening of Isolator (Incomer) when the bus coupler is open and vice-versa.
3.15.00	All disconnecting contacts for power and control circuits of drawout modules shall be of robust and proven design, fully self aligning and spring-loaded. Both fixed and moving contacts shall be silver-plated and replaceable. The spring-loaded power and control drawout contacts shall be on withdrawable chassis and the same on fixed portion shall not be accepted. Detachable plug and socket type control terminals shall also be acceptable.
3.16.00	Individual opening in the vertical bus enclosure shall permit the entry of moving contacts from the drawout modules into vertical droppers.
3.17.00	As indicated in schematic drawings of DDCMIS controlled modules, contractor shall supply & mount two (2) coupling relays in the corresponding modules.
3.18.00	All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to Employer's approval. The Contractor shall submit dimensional drawings showing complete internal details of busbars and module components, for each type and rating for approval of Employer.
3.19.00	Employer reserves the right to alter the cable entries, if required during detailed engineering, without any additional commercial implication.

3.20.00	Each switchboard shall be provided with undrilled, removable type gland plate, which shall cover the entire cable alley. Contractor shall ensure that sufficient cable glanding space is available for all the cables coming in a particular section through gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall preferably be provided in two distinct parts for the easy of terminating addition cables in future. The gland plate shall be provided with gasket to ensure enclosure protection. Recommended drilling chart of gland plates for all power and control cables in the vertical panels shall be indicated by the Contractor in the respective G.A. drawings of the boards.
3.21.00	The Contractor shall consider layout of panels in a switchboard consisting of various feeder modules in a straight line, unless specified otherwise. The actual composition and disposition of various modules in a switchboard shall be finalised during detailed engineering. The Contractor shall provide adopter panel / dummy panel required to meet various configuration / arrangement of busbars adopted by the Contractor. The Switchboards fed from indoor transformer will be flange connected to the same and the same shall be located as close as desirable to the transformer. The details of transformer flanges for those transformers not being supplied under this package shall be given to the contractor for matching the connections. The switchboards fed from outdoor transformers of rating 1MVA and above shall preferably be connected through busducts. Busduct connections wherever applicable shall be preferably in a straight line alignment. The centre line of the busduct will be finalized during detailed engineering. Adopter panels and dummy panels shall be provided wherever required.
3.22.00	Adequate space in a separate compartment shall be identified for mounting of Ethernet Switch (19" rack mounting) in all switchgears provided with numerical relays. Further, mounting of Ethernet switch in the above compartment and inter-panel wiring of Ethernet cable for connection of numerical relays to Ethernet switch shall be in the contractor's scope. Arrangement to provide required control supply to Ethernet switch shall be made in the switchgear.
3.23.00	**CLEARANCES** The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars and bus-link connections at circuit-breaker shall be 25 mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be atleast ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal and vertical busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars upto switch / fuses shall be fully shrouded / insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits.
4.00.00	**CONSTRUCTIONAL DETAILS OF AC & DC FUSE BOARDS**
4.1.00	All fuse boards shall be metal enclosed, fixed type, non-compartmentalized construction, suitable for indoor/ outdoor mounting on wall or steel structure.