एन टी पी सी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)
(Formerly National Thermal Power Corporation Ltd.)
(केंद्रीय कार्यालय नोएडा)
Corporate Center NOIDA

Reference : CC-ENGG-4540-001-201-PVE-B-175 **Date :** 07/04/2023

From : Subodh Pandit ADDL. GENERAL MANAGER	**To :** BHARAT HEAVY ELECTRICALS LTD NEW DELHI 110049 IN **Cc :** sisodia@bhel.in

Subject : EPC TTPP3 (2x660MW)

Please find enclosed following drawings/ documents for necessary action at your end.

Vendor Drg. No.	:	34690002296
Orgn. Drg. No.	:	4540-001-201-PVE-B-175
Revision No.	:	01
Drg. Title	:	420 KV SHUNT REACTOR- OUTLINE GENERAL ARRANGEMENT
App. Category	:	CATREL
Release Date	:	07/04/2023

Scan to verfiy

Comments : AUTO ARCHIVED IN NTPC REPOSITORY.

FIRST ANGLE PROJECTION (All dimensions are in mm)

	REV.	DATE	ALT.		REV. 01	DATE 04.04.23	ALT.		ADDITIONAL INFORMATION	W.O. 62213-A-517-01
			CHD.				CHD.		STATUS OF DRAWING	
					NTPC Comments incorporated				DISTRIBUTION OF PRINTS	

Note:- It is hereby confirmed that this document meets all the contract requirements including safety and statuary requirements and facilitate ease of operation and maintenance. In case any deviation is found, BHEL shall carry out all required changes/ modifications without any cost implications to NTPC. In addition, Penalty on account of noncompliance of contract specification as deemed fit by NTPC shall be recovered

Client	एन टी पी सी NTPC	N T P C LIMITED
	PROJECT	TALCHER THERMAL POWER PROJECT STAGE-III (2x660MW) EPC PACKAGE
REF.DRG. NO.	PRODUCT	125 MVAr, 420 KV, 3-PHASE SHUNT REACTOR
	PO NO.	CS-4540-001A-2-FC-NOA-7227 DTD. 27/09/2022

SIGN & DATE							NAME	SIGN	DATE
	भीएचईएल BHEL	**BHARAT HEAVY ELECTRICALS LIMITED BHOPAL**				PREP.	SAMRENDRA KUMAR	--SD--	31.03.23
						CKD.	AKSHAY DAVE	--SD--	31.03.23

INVENTORY NO.	DEPT. CODE TRE 406	CARD CODE	GRADE	SCALE NTS	WEIGHT (KG)		REF. TO ASSY. DRG.	ITEM NO.	NO. OF ITEMS
	TITLE **420 KV SHUNT REACTOR- OUTLINE GENERAL ARRANGEMENT**					CARD CODE	BHEL DRAWING NO. **34690002296**		**REV 01**
	NTPC DRAWING NO.					**4540-001-201-PVE-B-175**			

INVENTORY NO. | SIGN.DATE | REF.DRG.NO.

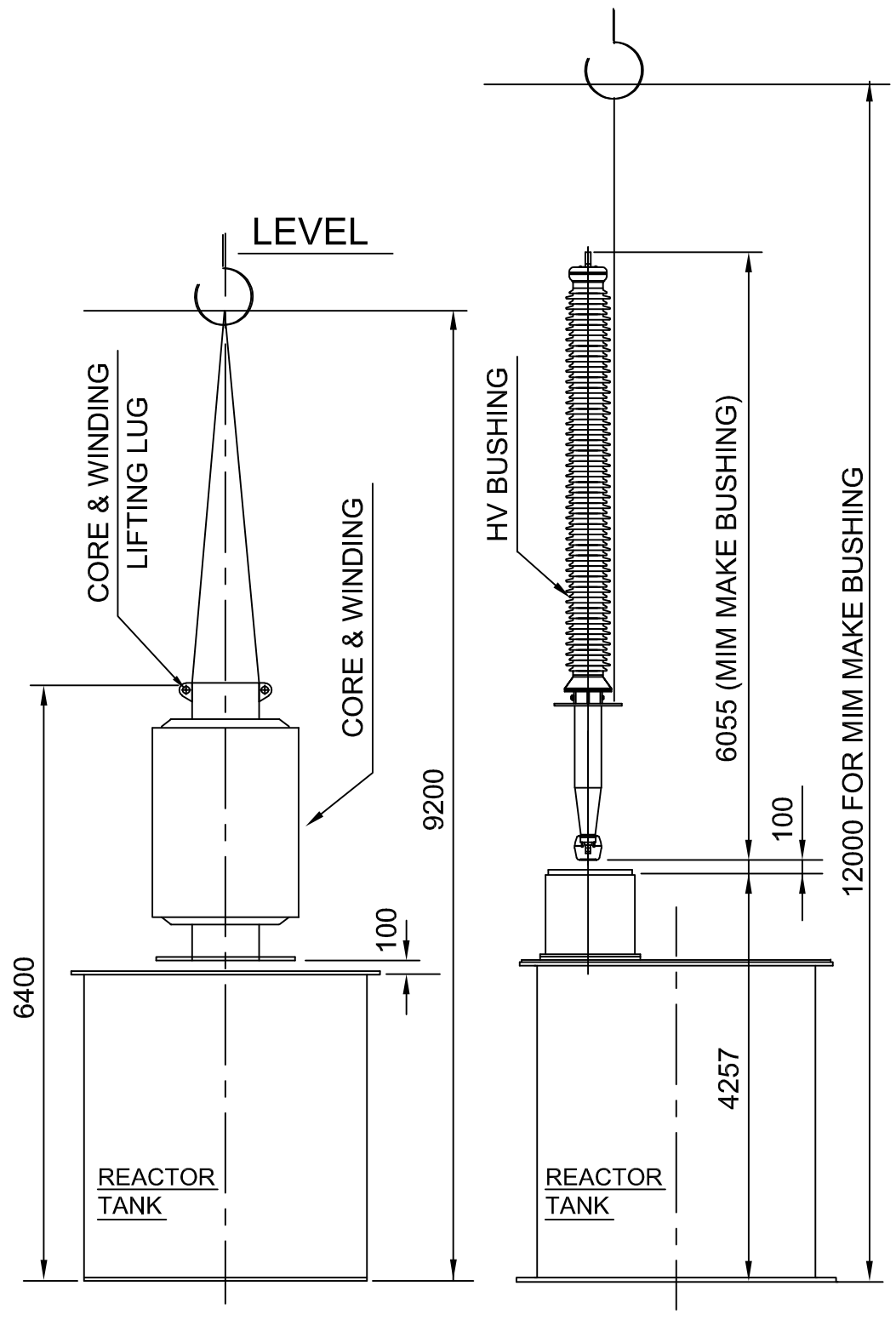
NOTES :-

1. WHEN REFERRING THIS DRAWING PLEASE QUOTE MVAR & W.O. NO.
2. 320 DIA. TWIN BI-DIRECTIONAL ROLLERS MOUNTED AT 1676 mm RAIL GAUGE IN BOTH DIRECTION ARE PROVIDED FOR MOVEMENT OF REACTOR AT SITE AND ROLLERS ARE TO BE REMOVED BEFORE ERECTION .
3. PAINT SHADE SHALL BE RAL 5012 BLUE.
4. WIRING FROM INSTRUMENT CTS. ETC. ARE NOT SHOWN FOR CLARITY.
5. FOUNDATION BOLTS ARE IN THE SCOPE OF BHEL SUPPLY.
6. FOR PART LIST OF OUTLINE GENERAL ARRANGEMENT REFER DRAWING NO. 3 469 00 02296.
7. DIMENSIONS SHOWN THUS ▭ ARE OVERALL SHIPPING DIMENSIONS EXCLUSIVE OF PACKING.
8. DIMENSIONS SHOWN ARE WITH REF.TO PLINTH LEVEL.
9. FOR TANK COVER BOLTED REFER DETAIL 'B' SHEET NO. 03.
10. HV, HVN BUSHING ARE BOUGHT OUT ITEM. HENCE, DIMENSION / WEIGHT RELATED TO THESE BUSHINGS ARE TENTATIVE. IT WILL BE FINALIZED (IF REQUIRED) AFTER VENDOR FINALIZATION.
11. FOR CRITICAL DIMENSIONS TOLERANCES ARE INDICATED IN THE DRAWING. FOR OTHER DIMENSION, GENERAL TOLERANCE MAY BE TREATED AS ±3%.

IMPORTANT NOTE :-

1. THE DESIGN FEATURES SHOWN ON THIS DRAWING (GENERALLY INLINE WITH IS:5553/IEC: 60076-6 APPLICABLE STANDARD & AGREED CUSTOMER SPECIFICATION) MEETS THE STATUTORY, REGULATORY & SAFETY REQUIREMENTS WITH RESPECT TO EARTHING ARRANGEMENT, DANGER & OTHER LABELS, CLEARANCES IN AIR PROVISION FOR PRESSURE RELIEF DEVICE, BUCHHOLZ RELAY AND ANTI-EARTHQUAKE CLAMPING ARRANGEMENT.

MIN. AIR CLEARANCES		
	420 KV	145 KV
PHASE TO PHASE	4000	NA
PHASE TO EARTH	3500	1050



REV	DATE	ALT.			REV	DATE	ALT.	MKP	
		CKD.			01	06.04.2023	CKD.	KD/SK	
		APPD.					APPD.	KD/SK	
ZONE					ZONE	CUSTOMER COMMENTS INCORPORATED.			

NTPC DRAWING NO.	4540-001-110-BP-PVE-B-175
TYPE OF PRODUCT	1X125 MVAR, 420KV, 3-PHASE, SHUNT REACTOR.
PO NO.	CS-4540-001A-2-FC-NOA-7227 DTD. 27/09/2022.
NAME OF CUSTOMER	M/S NTPC TALCHER.

ADDITIONAL INFORMATION
W.O.- 62213-A-517-01
STATUS OF DRAWING "PR"
DISTRIBUTION OF PRINTS
TRE-1, TRM-3

एन टी पी सी लिमिटेड
NTPC LIMITED

PROJECT: तालचर थर्मल पॉवर परियोजना चरण– III (2×660 मेगावॉट) ईपीसी पैकेज।
TALCHER THERMAL POWER PROJECT STAGE-III (2 X 660MW) EPC PACKAGE.

भारत हेवी इलेक्टिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	-----	COMP.SCALE-1:1

TITLE: OUTLINE GENERAL ARRANGEMENT

	NAME	SIGN	DATE
DRN.	MKP		10.03.2023
CHD.	KD/SK		20.03.2023
APPD.	KD/SK		31.03.2023

DRG. NO 3 469 00 02296 REV. 01

SHEET 01 OF 05

Manish

FIRST ANGLE PROJECTION

DRG. NO. 3 469 00 02296

(ALL DIMENSIONS ARE IN mm)

ZONE	REV	DATE	ALT.	CKD. APPD.
	01	06.04.2023	CUSTOMER COMMENTS INCORPORATED.	KD/SK KD/SK

VIEW-B

7985 FOR MIM MAKE BUSHING
5950 FOR MIM MAKE BUSHING
5600 FOR YASH MAKE BUSHING
3700
7400
5070
4000 MIN.
3500 MIN.
2275
2795 (JACK POINT)
1000
BOLTING ARRGT. SEE DETAIL-B
SEE DETAIL-A
SEE DETAIL-C
℄ OF TANK
℄ OF CONS.
℄ OF S.R.
'V'
'U'
'W'

VIEW-A

DETAIL-'B'
TANK COVER
TANK RIM
LABLE FOR GROUNDING (S.S) 1.6X40X50
DETAIL-C NEUTRAL GROUNDING ARRGT
BRAZED JOINT
2XØ14

DETAIL - 'A'
EARTHING ARRGT (DETAIL OF IT..4) SUITABLE FOR 12 X 75 FLAT
EARTHING PAD
COPPER STRIP 12 X 75
2 X M4 BOLT
LOCKING BAR
2 X M12 BOLT
JACKING POINT

NTPC DRAWING NO.	4540-001-110-BP-PVE-B-175
TYPE OF PRODUCT	1X125 MVAR, 420KV, 3-PHASE, SHUNT REACTOR.
PO NO.	CS-4540-001A-2-FC-NOA-7227 DTD. 27/09/2022.
NAME OF CUSTOMER	M/S NTPC TALCHER.

ADDITIONAL INFORMATION
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एन टी पी सी लिमिटेड
NTPC LIMITED

PROJECT: तालचर थर्मल पॉवर परियोजना चरण– III (2×660 मेगावॉट) ईपीसी पैकेज |
TALCHER THERMAL POWER PROJECT STAGE-III (2 X 660MW) EPC PACKAGE.

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	-----	COMP.SCALE-1:1

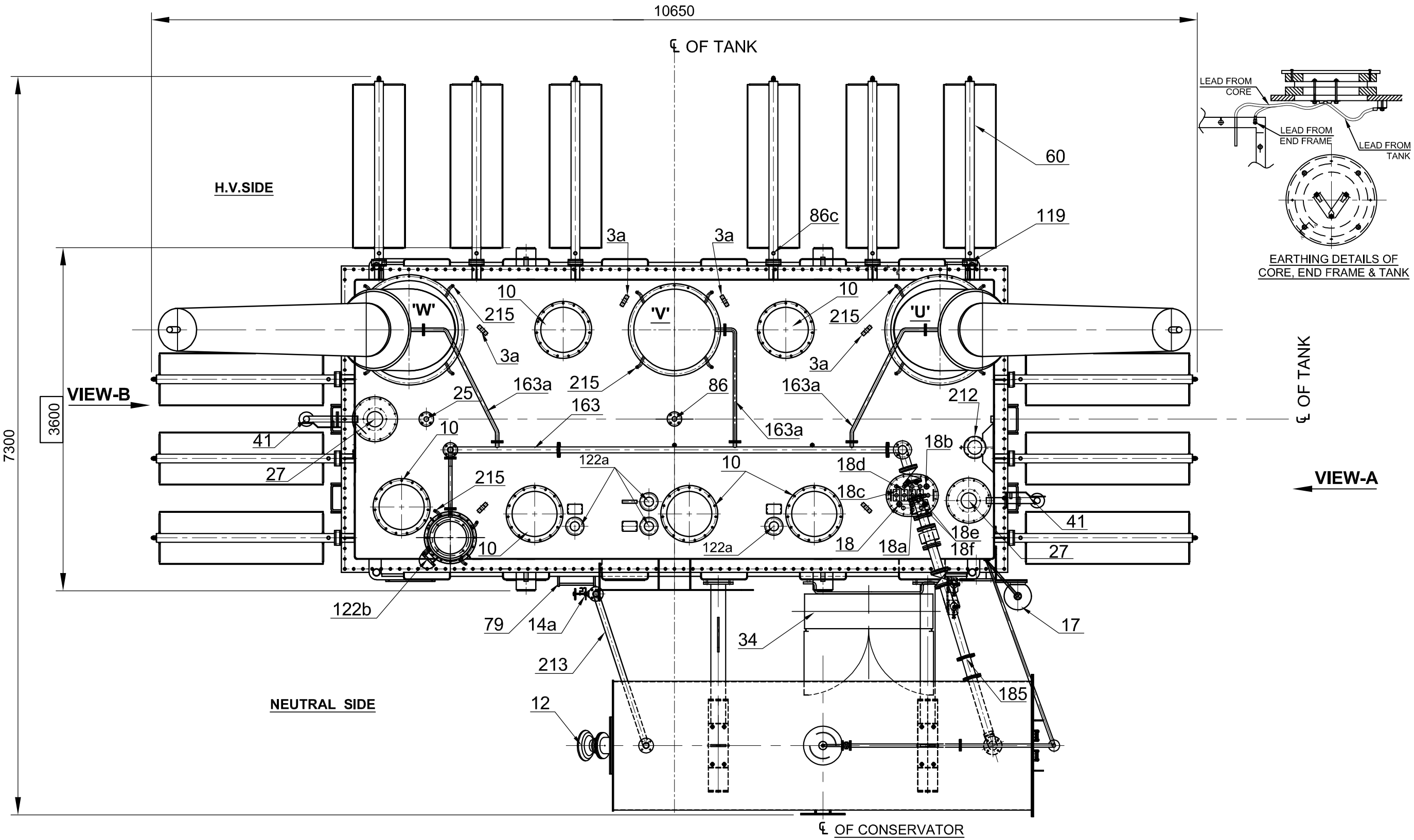
TITLE: OUTLINE GENERAL ARRANGEMENT (ELEVATION VIEW)

DRG. NO 3 469 00 02296 REV. 01
SHEET 02 OF 05

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 469 00 02296



REV	DATE				REV	DATE			
		ALT.					ALT.	MKP	
		CKD.			01	06.04.2023	CKD.	KD/SK	
		APPD.					APPD.	KD/SK	
ZONE					ZONE	CUSTOMER COMMENTS INCORPORATED.			

NTPC DRAWING NO.	4540-001-110-BP-PVE-B-175
TYPE OF PRODUCT	1X125 MVAR, 420KV, 3-PHASE, SHUNT REACTOR.
PO NO.	CS-4540-001A-2-FC-NOA-7227 DTD. 27/09/2022.
NAME OF CUSTOMER	M/S NTPC TALCHER.

ADDITIONAL INFORMATION
W.O.- 62213-A-517-01
STATUS OF DRAWING "PR"
DISTRIBUTION OF PRINTS
TRE-1, TRM-3

एन टी पी सी लिमिटेड
NTPC LIMITED

PROJECT: तालचर थर्मल पॉवर परियोजना चरण- III (2×660 मेगावॉट) ईपीसी पैकेज।
TALCHER THERMAL POWER PROJECT STAGE-III (2 X 660MW) EPC PACKAGE.

भारत हेवी इलेक्टिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	-----	COMP.SCALE-1:1

TITLE: OUTLINE GENERAL ARRANGEMENT (PLAN VIEW)

	NAME	SIGN	DATE
DRN.	MKP		10.03.2023
CHD.	KD/SK		20.03.2023
APPD.	KD/SK		31.03.2023

DRG. NO 3 469 00 02296 REV. 01

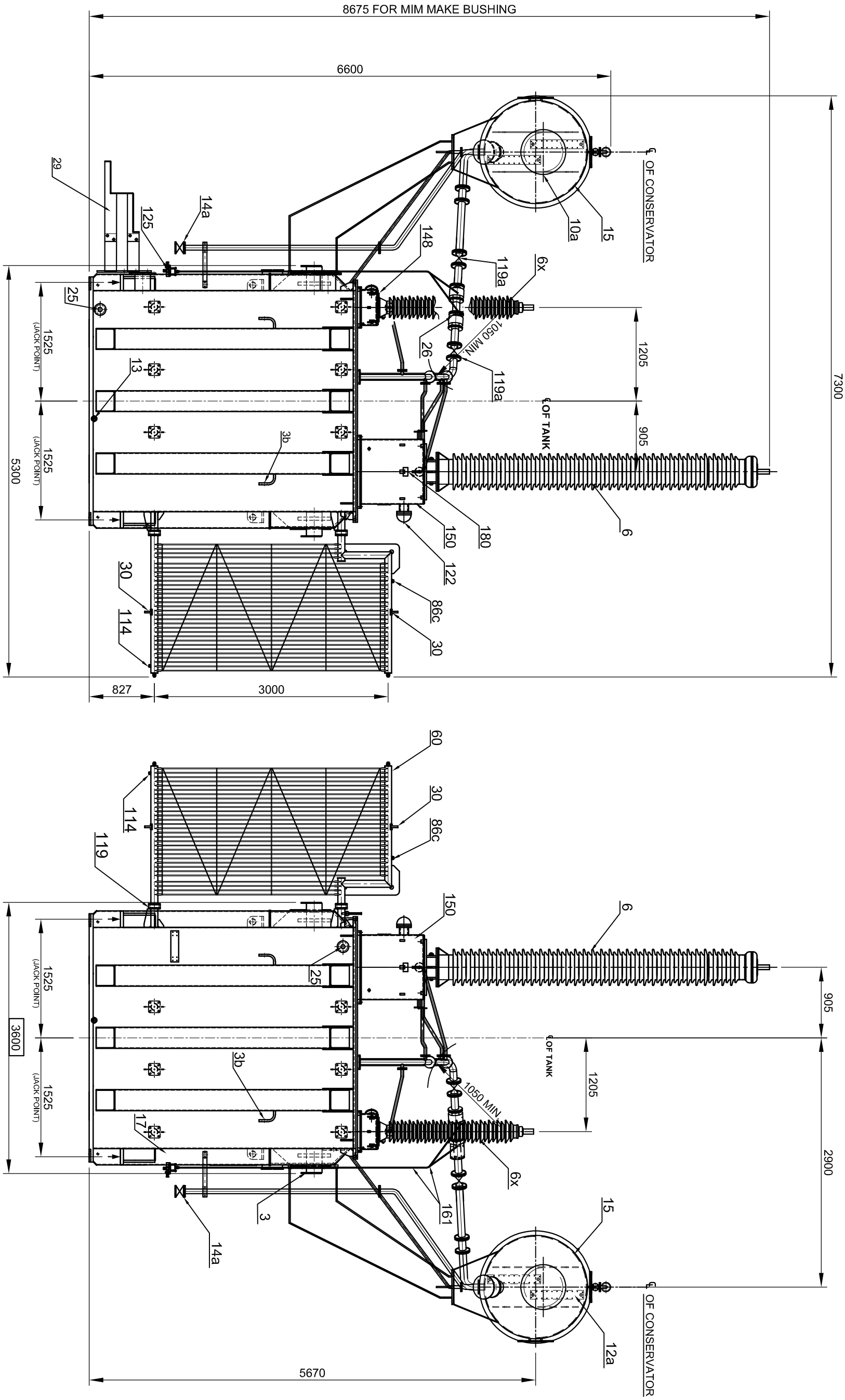
SHEET 03 OF 05

INVENTORY NO. | SIGN.DATE | REF.DRG.NO.

Manish

FIRST ANGLE PROJECTION

DRG. NO. 3 469 00 02296



REV	DATE	ALT.	MKP
		CKD.	KD/SK
		APPD.	KD/SK
01	06.04.2023	CKD.	KD/SK
		APPD.	KD/SK

ZONE: CUSTOMER COMMENTS INCORPORATED.

NTPC DRAWING NO.	4540-001-110-BP-PVE-B-175
TYPE OF PRODUCT	1X125 MVAR, 420KV, 3-PHASE, SHUNT REACTOR.
PO NO.	CS-4540-001A-2-FC-NOA-7227 DTD. 27/09/2022.
NAME OF CUSTOMER	M/S NTPC TALCHER.

		NAME	SIGN	DATE
	DRN.	MKP		10.03.2023
	CHD.	KD/SK		20.03.2023
	APPD.	KD/SK		31.03.2023
DRG. NO.	3 469 00 02296			REV. 01
SHEET	04 OF 05			

ADDITIONAL INFORMATION
W.O.- 62213-A-517-01
STATUS OF DRAWING "PR"
DISTRIBUTION OF PRINTS
TRE-1, TRM-3

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	-----	COMP.SCALE-1:1

TITLE: OUTLINE GENERAL ARRANGEMENT (END VIEW)

एन टी पी सी लिमिटेड
NTPC LIMITED

PROJECT: तालचर थर्मल पॉवर परियोजना चरण- III (2×660 मेगावॉट) ईपीसी पैकेज।
TALCHER THERMAL POWER PROJECT STAGE-III (2 X 660MW) EPC PACKAGE.

(ALL DIMENSIONS ARE IN mm)

APPROXIMATE WEIGHT & OIL QTY.

DESCRIPTION	WT. IN KG	OIL (L)
CORE AND WINDING	97270	
TANK & FITTINGS	28000	44400
BUSHINGS	2100	
RADIATOR & CONSERVATOR PIPE WORK	15680	7100
CONTROL CABNET	350	
TOTAL OIL	44800	51500
TOTAL WEIGHT	188200	

NOTES:-

1. CABLE TRAY ON REACTOR TANK PROVIDED FOR CABLING OF INSTRUMENT.

TABLE OF FITTINGS

COOLING SYSTEM

ITEM NO	DESCRIPTION	QTY	ZONE
30	LIFTING LUGS FOR RADIATORS (LIFTING CAPACITY 1100 KG EACH)	24	405-C
60	RADIATOR BANK	12	405-C
86C	AIR RELEASE PLUGS (3/4"BSP) 12 NOS FOR RADITORS	12	405-C
114	DRAIN PLUGS (3/4"BSP) 12 NOS FOR RADIATORS	12	405-E
119	ISOLATING VALVES FOR RADIATORS (80 NB BUTTERFLY)	24	405-E
161	GAS COLLECTING DEVICE PIPE (6 NB)	2	407-C
163	EQUALISING PIPE (50NB)	1	304-C
163a	EQUALISING PIPE (25NB) FOR TURRETS	4	304-C

TABLE OF FITTINGS

CONSERVATOR AND PIPE WORK

ITEM NO	DESCRIPTION	QTY	ZONE
10a	INSPECTION COVER FOR OIL CONSERVATOR (BOLTED) (20 KG)	1	402-B
12	OIL GAUGE MAGNETIC TYPE WITH LOLA & HOLA	1	304-E
12a	PRISMATIC OIL LEVEL GAUGE (OVER LAPPED)	1	408-B
14a	50 NB DRAIN GATE VALVE FOR OIL CONSERVATOR	1	407-D
15	OIL CONSERVATOR 1300 DIA (ATMOSEAL TYPE)	1	402-B
17	MAINTENANCE FREE BREATHER	1	307-D
26	BUCHHOLZ RELAY (80 NB) (PLUG AND SOCKET TYPE)	2	403-C
27a	CANOPY FOR MOG, PRV, SPR & BUCHHOLZ RELAY	6	204-C
86a	AIR RELEASE PLUG (3/4"BSP) ON CONSERVATOR	2	204-B
86b	AIR RELEASE PLUG (1/4"BSP) FOR CONSERVATOR.	1	204-B
119a	ISOLATING GATE VALVE FOR BUCHHOLZ RELAY(80 NB)	2	403-C
119b	50 NB GATE VALVE FOR VACUUMING	1	205-B
119c	15 NB GATE VALVE FOR BREATHER/VACUUMING	1	205-B
125	GAS COLLECTING DEVICE.	2	402-E
153	CONSERVATOR SUPPORTS	2	204-C
164	BREATHER PIPE (25 NB)	1	206-C
168	CONSERVATOR PIPE (80 NB)	1	205-C
185	FLOW SENSITIVE CONSERVATOR ISOLATION VALVE	1	306-D
206	BHEL MONOGRAM	1	205-B
211	ATMOSEAL ARRANGEMENT (INSIDE THE CONSERVATOR)	1	206-C
211a	AIR CELL RUPTURE RELAY	1	203-B
213	CONSERVATOR DRAIN PIPE (50 NB)	1	304-D

TABLE OF FITTINGS

TURRETS & BUSHINGS

ITEM NO	DESCRIPTION	QTY	ZONE
6	420KV, 1250AMP, H V LINE BUSHINGS	3	202-B
6X	145KV, 1250AMP, H V NEUTRAL BUSHING	1	203-C
122	CONNECTION BOX FOR C T TERMINAL (H V)	3	203-C
122a	CONNECTION BOX FOR C T TERMINAL(H V N) ON COVER	4	304-C
122b	CONNECTION BOX FOR C T TERMINAL (H V N)	1	303-D
148	NEUTRAL TURRET	1	203-C
150	H V TURRETS	3	202-C
157	NEUTRAL GROUNDING STRIPS	1 SET	203-D
157a	22KV POST INSULATOR	3	203-D
180	TERMINAL MARKING PLATE	4	204-C

TABLE OF FITTINGS

REACTOR

ITEM NO	DESCRIPTION	QTY	ZONE
2	RATING AND DIAGRAM PLATE	1	203-D
2a	DO'S & DONT'S INSTRUCTION PLATE	1	203-E
2b	VALVE SCHEDULE PLATE	1	204-D
2c	OIL FILLING INSTRUCTION PLATE	1	204-E
3	LIFTING BOLLARD (60000 KG. EACH)	4	407-D
3a	LIFTING LUGS FOR TANK COVER	6	304-C
3b	LASHING LUG	8	205-D
3c	INSTRUCTION PLATE FOR LIFTING	4	204-D
4	EARTHING TERMINAL DIAGONALLY OPPOSITE (SIZE 20 TK X 50X 120 LG.) (STAINLESS STEEL)	2	206-E
8	NAME PLATES (ENGLISH & HINDI)	1+1	204-D
10	INSPECTION COVERS (6 NOS. ON TANK COVER, 1 NO. ON TANK)	6+1	203-D 305-C
13	DRAIN PLUGS ON TANK 1"BSP	2	202-E
14	100 NB DRAIN GATE VALVE	1	204-E
18	POCKET FOR OTI	1	305-D
18a	POCKET FOR WTI	1	306-D
18b	ORDINARY THERMOMETER WITH POCKET (1 NO ON TANK COVER)	1	306-C
18c	RTD WITH POCKET FOR OTI	1	305-C
18d	RTD WITH POCKET FOR WTI	1	305-C
18e	SPARE POCKET FOR OTI	1	306-C
18f	SPARE POCKET FOR WTI	1	306-C
19	JACKING PADS 70000 KG EACH	4	205-E
21	OIL TEMPERATURE INDICATOR.	1	205-D
22	WINDING TEMPERATURE INDICATOR	1	205-D
25	50 NB GATE VALVE ON TANK AND COVER [2 NOS ON TANK, 1 NO ON COVER]	2+1	303-C 402-D 406-D
27	PRESSURE RELIEF DEVICE (PLUG AND SOCKET TYPE)	2	303-C 306-D
28	15 NB GLOBE VALVE FOR OIL SAMPLING (1SET= 2 IN SERIES)	2 SET	204-E
29	PLATFORM FOR MARSHALLING BOX	1	402-E
34	MARSHALING BOX (TANK MOUNTED)	1	305-D
41	OIL COLLECTING ARRGT. FOR PRV WITH PIPE WORK	2	306-C
79	LADDER WITH LOCKING DEVICE	1	304-D
86	AIR RELEASE PLUG 1/2"BSP.	1	305-C
109	PULLING HOLE DIA 64	8	203-E
212	COVER EARTHING OF CORE AND CORE CLAMPS.	1	306-C
215	EARTHING STRIP 30SQMM FOR TURRET	16	304-C
216	SUDDEN PRESSURE RELAY	1	204-D
216a	40 NB GATE VALVE FOR SUDDEN PRESSURE RELAY	1	204-D

REV	DATE				REV	DATE			
		ALT.					ALT.	MKP	
		CKD.			01	06.04.2023	CKD.	KD/SK	
		APPD.					APPD.	KD/SK	
ZONE					ZONE	CUSTOMER COMMENTS INCORPORATED.			

NTPC DRAWING NO.	4540-001-110-BP-PVE-B-175
TYPE OF PRODUCT	1X125 MVAR, 420KV, 3-PHASE, SHUNT REACTOR.
PO NO.	CS-4540-001A-2-FC-NOA-7227 DTD. 27/09/2022.
NAME OF CUSTOMER	M/S NTPC TALCHER.

ADDITIONAL INFORMATION
W.O.- 62213-A-517-01
STATUS OF DRAWING "PR"
DISTRIBUTION OF PRINTS
TRE-1, TRM-3

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NTPC LIMITED

PROJECT: तालचर थर्मल पॉवर परियोजना चरण– III (2×660 मेगावॉट) ईपीसी पैकेज।
TALCHER THERMAL POWER PROJECT STAGE-III (2 X 660MW) EPC PACKAGE.

भारत हेवी इलेक्टिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	-----	COMP.SCALE-1:1

TITLE: **LIST OF FITTING & ACCESSORIES**

	NAME	SIGN	DATE
DRN.	MKP		10.03.2023
CHD.	KD/SK		20.03.2023
APPD.	KD/SK		31.03.2023

DRG. NO 3 469 00 02296 REV. 01

SHEET 05 OF 05

Manish

फर्स्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION

सभी माप मि॰ मी॰ मे है/ALL DIMENSIONS ARE IN MM

DRG.NO.

SOURCE-1
FROM 11kV STN SWITCH BOARD 2 Bus

SOURCE-2
FROM 11kV STN SWITCH BOARD 2 BC

415V MAIN SWITCH BOARD (LOCATION: LT SWGR. ROOM)

48V DC DISTRIBUTION BOARD (LOCATION: LT SWGR. ROOM)

415V EMERGENCY POWER DB
(LOCATION: LT SWGR. ROOM)

415V MAIN LIGHTING DB-1
(LOCATION: LT SWGR. ROOM)

OUTDOOR BOARD FOR
OIL FILTERATION SOCKETS

415V MAIN LIGHTING DB-2
(LOCATION: LT SWGR. ROOM)

415V EMERGENCY LIGHTING DB
(LOCATION: LT SWGR. ROOM)

220V DC DISTRIBUTION BOARD (LOCATION: LT SWGR. ROOM)

DETAIL (FOR POWER SUPPLY CABLES)

SL. NO.	SIZE OF POWER CABLE	TYPE OF CABLE
1.	3.5CX300SQ.MM	AL/XLPE
2.	1CX150SQ.MM	AL/XLPE
3.	3.5CX70SQ.MM	AL/PVC
4.	3.5CX35SQ.MM	AL/PVC
5.	4CX16SQ.MM	AL/PVC
6.	4CX6SQ.MM	AL/PVC
7.	2CX6SQ.MM	AL/PVC

EQUIPMENT NOMENCLATURES:

SYMBOL	NOMENCLATURE	DESCRIPTION
	ACB	AIR CIRCUIT BREAKER (DRAWOUT TYPE)
4	MCCB	MOULDED CASE CIRCUIT BREAKER
	SFU	POLE SWITCH FUSE UNIT (SFU)
	DP AB SWITCH	DOUBLE POLE AIR BREAK SWITCH
	INTERLOCKING	INTERLOCKING THROUGH CONTACTORS
	MCB	MINIATURE CIRCUIT BREAKER

GENERAL NOTES:

1. BOARD SHALL BE EXTENDABLE ON BOTH SIDES, BY ADDITION OF VERTICAL SECTION AFTER REMOVING END COVERS.
2. BOARD SHALL BE OF UNIFORM HEIGHT NOT EXCEEDING 2450MM.
3. BOARD SHALL BE DUST AND VERMIN PROOF WITH IP-52.
4. NO TWO AC SOURCES SHALL BE PARALLED AT ANY STAGE. INTERLOCK (ELECTRICAL) TO BE PROVIDED BETWEEN INCOMERS (INTERLOCK SCHEME FOR DETAIL SHALL BE FURNISHED ALONG WITH VENDOR DRAWINGS).
5. ORIENTATION OF FEEDERS SHOULD BE VERIFIED TO AVOID CROSS CABLING.
6. PHASOR SEQUENCE OF INCOMER SHOULD BE VERIFIED TO AVOID CHANGE OVER PHASE EQUIPMENT.
7. LOADING OF EACH FEEDER SHOULD BE SUCH THAT AMPACITY OF CABLE IS WITHIN THE LIMITS AND ACCORDINGLY VOLTAGE DROPS SHOULD BE CHECKED .
8. METERING AND PROTECTION REQUIREMENT SHALL BE AS PER TECHNICAL SPECIFICATION .
9. FOR CABLE INTERCONNECTION REFER CABLE SCHEDULE DRAWING.
10. CABLE DETAIL INDICATED ARE TENTATIVE ONLY (INFORMATION PURPOSE)
11. FOR AUTO-CHANGEOVER SCHEME REFER VENDOR SCHEME DETAIL DRAWING(S)
12. FOR OUTGOING FEEDER DETAILS REFER OGA OF RESPECTIVE BOARDS .
13. TRANSDUCER FOR MEASUREMENT OF DC CURRENT AND DC VOLTAGE SHALL BE LOCATED IN RESPECTIVE CHARGER & SAME SHALL BE INTEGRATED TO SAS.
14. IN NORMAL CONDITION WHEN TWO INCOMERS OF DC BOARD IS ON THEN BUS COUPLER AIR BREAK SWITCH SHALL BE OFF CONDITION.
    IN THE CASE OF COMPLETE OUTAGE OF ANY ONE SECTION BATTERY AND CHARGER OUTPUT, BUS COUPLER AIR BREAK SWITCH SHALL BE IN ON CONDITION MANUALLY.
15. THE OFFERED RELAYS SHALL BE NUMERICAL AS PER TECHNICAL SPECIFICATION.
16. OIL FILTERATION RECEPTACLES ARE LOOP IN LOOP OUT TYPE & WILL BE LOCATED IN OUTDOOR YARD.
17. AVCS AND GIS HALL VENTILATION DISTRIBUTION BOARD SHALL BE IN THE RESPECTIVE VENDOR'S SCOPE.
18. ILLUMINATION FEEDERS ARE AS PER FINAL ILLUMINATION DESIGN.
19. MINIMUM INDICATIVE REQUIREMENT OF ANALOG SIGNALS, POTENTIAL FREE CONTACTS AND COMMAND SIGNALS WHICH SHOULD BE AVAILABLE AT RESPECTIVE EQUIPMENT FOR REMOTE INDICATION & CONTROL FROM AUXILIARY BCU LOCATED IN SWYD CONTROL ROOM – SHALL BE PROVIDED AS PER TS.

DESIGN PARTICULARS

1. AMBIENT TEMPERATURE : 50° C
2. ONE MIN. POWER FREQ. WITHSTAND VOLTAGE : 2.5 kV(rms)
3. POWER SUPPLY DETAIL
   a. AC SYSTEM : 3 PHASE , 4 WIRE, SOLIDLY EARTHED, 415V±10%. 50HZ
   b. DC SYSTEM : 2WIRE, UNEARTHED, 220V±10%
4. WIRING : 650/1100V GRADE PVC INSULATED WIRE OF 1.5 SQ.MM CU. FOR CONTROL AND 2.5 SQ.MM.FOR CT CIRCUIT
5. POWER SUPPLY DETAIL
   a. TRIP AND CLOSING COILS 220V DC UNEARTHED
   b. SPRING CHARGING 220V DC UNEARTHED
6. ALL METALLIC CASE LIKE RELAYS, INSTRUMENT & OTHER EQUIPMENT SHALL BE CONNECTED TO EARTH WITH 2.5 SQ.MM. CU WIRE, GREEN COLOUR

S.NO	MIN. CLERANCE (EXCEPT AT TERMINATION)	
1	PHASE TO PHASE	25 MM
2	PHASE TO NEUTRAL	25 MM
3	PHASE TO EARTH	25 MM
4	NEURAL TO EARTH	25 MM

ग्राहक ड्राइंग संख्या CUSTOMER DRAWING NO.	PE-DG-497-565-E001A
ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
कार्य संख्या- JOB NO. 419	परियोजना PROJECT: TALCHER THERMAL POWER PROJECT STAGE-III (2X660MW)
स्थिति STATUS: CONTRACT	
मुद्रण स्केल मीटर में PRINT SCALE IN METRE: 0.4 0.8 1.6 2.5 3.0 4.0 5.0	भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD TRANSMISSION BUSINESS GROUP नोएडा (उ॰प्र॰)/NOIDA (U.P.)

DEPT CODE		नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
M	तैयारकर्ता/DRN	PC		10.02.2023
	डिजाइनकर्ता/DESN	PC		10.02.2023
	जांचकर्ता/CHD	RD		10.02.2023
	अनुमोदनकर्ता/APPD	VK		10.02.2023

प्रतिरूप REV.	दिनांक DATE	परीक्षितकर्ता ALTD	जांचकर्ता CHD	अनुमोदनकर्ता APPD
01	04.03.23	PC	RD	VK

BUSDUCT ADDED IN 415V MSB I/C AS PER NTPC COMMENTS.

शीर्षक/TITLE: SWITCHYARD AUXILIARY AC & DC SYSTEM SLD

विभाग DEPT.	स्केल – SCALE–
हस्ताक्षर SIGN	
दिनांक DATE	

ड्राइंग संख्या / DRAWING NO. PE-DG-497-565-E001A

शीट SHEET 1 OF 1 पुनरीक्षण REV. 01

फार्मेट साइज़ A0
FORMAT SIZE A0

Annexure_CTM

Cable Trench Material - work for BOLTED and Welded TYPE (As applicable) GI Rack / Tray for cable trenches in Switchyard, GIS Hall & Control Room Building as per doc. no. TB-419-316-019 Rev00.

Following works deemed included in the scope and not being payable separately - Welding of racks, installation of cantilever arms, back plate, angle fitting, clamp for single / double channel, cutting of vertical supports C1 and C2 as per requirement ,base plate for single / double channel, beam clamp, tray fixing clamp, screw, nut bolt, anchor bolt, floor / ceiling / beam / columns support, Side runner for cable tray, side coupler, pvc end cap, earthing clamp, tray clamp etc. complete in all respect are deemed included in the scope. Cable rack assembly will be of 1/2/3/4 tier. (Bolted and Welded type Cable Rack/Tray material/Hardware , Nut Bolt, fasteners shall be free issued by BHEL.) Cutting , drilling, punching, minor civil works also included in the scope. Minor welding and application of protective / zinc rich paint on welded surface is also included in the scope.

1.2 Bill of Quantities

SN	Item Description	Qty (Nos.)	Remarks
1.	4 Tier Double Side Galvanized Cable Rack Assembly With 50X50X6 thick MS Angle as per Section 1-1 – Welded Type.	210	As per Annexure 1 of section 1.
2.	4 Tier Single Side Galvanized Cable Rack Assembly With 50X50X6 thick MS Angle as per Section 2-2 – Welded Type.	189	As per Annexure 1 of section 1.
3.	2 Tier Galvanized Cable Rack Assembly With 50X50X6 thick MS Angle as per Section 4-4 – Welded Type.	680	As per Annexure 1 of section 1.
4.	1 Tier Galvanized Cable Rack Assembly With 50X50X6 thick MS Angle as per Section 5-5 – Welded Type.	161	As per Annexure 1 of section 1.
5.	Vertical support of Single Channel (C1) of standard length 6.0 m – Bolted Type	5	As per Drawing: PE-DG-497-507-E006 Rev00 -Sheet 02 Of 37
6.	Vertical support of Double Channel (C2) of standard length 6.0 m - Bolted Type	8	As per Drawing: PE-DG-497-507-E006 Rev00 -Sheet 02 Of 37
7.	Horizontal support of cantilever arm CA1 each with 2 nos. 12 mm dia (M12) bolts with spring nuts and washers as well as 2 nos. 6 mm dia (M6) pan head screws with long spring nuts and washers for fixing on vertical support single/double (C1/C2) suitable for ladder type cable tray 600 mm wide – Bolted Type.	147	As per Drawing: PE-DG-497-507-E006 Rev00 -Sheet 03 Of 37 and PE-DG-497-507-E006 Rev00 -Sheet 11 Of 37
8.	Ladder type cable tray 600 mm wide, 100 mm high, 2 mm thick (min.) galvanised iron slotted rung 2.5 m long each with 2 Nos. coupler plate, 3 mm thick (min.) along with 8 mm dia (M8) bolts with nuts and washers for coupling two trays – **Bolted Type**	375	As per Drawing: PE-DG-497-507-E041 Rev01- Sheet 02 Of 14
9.	Ladder type cable tray 150 mm wide, 100 mm high, 2 mm thick (min.) galvanised iron slotted rung 2.5 m long each with 2 Nos. coupler plate, 3 mm thick (min.) along with 8 mm dia (M8) bolts with nuts and washers for coupling two trays – **Bolted Type**	40	As per Drawing: PE-DG-497-507-E041 Rev01 -Sheet 02 Of 14
10.	Horizontal TEE For Ladder type cable tray 2.5 m long, 600 mm wide, 100 mm high, 2 mm thick, having slotted rung - **Bolted Type**	20	As per Drawing: PE-DG-497-507-E041 Rev01 -Sheet 06 Of 14
11.	Horizontal TEE For Ladder type cable tray 2.5 m long, 150 mm wide, 100 mm high, 2 mm thick, having slotted rung - **Bolted Type**	10	As per Drawing: PE-DG-497-507-E041 Rev01 -Sheet 06 Of 14
12.	Horizontal Elbow(90 deg Bend) for Ladder type cable tray 2.5 m long, 600 mm wide, 100 mm high, 2 mm thick, having slotted rung – **Bolted Type**	15	As per Drawing: PE-DG-497-507-E041 Rev01 -Sheet 08 Of 14

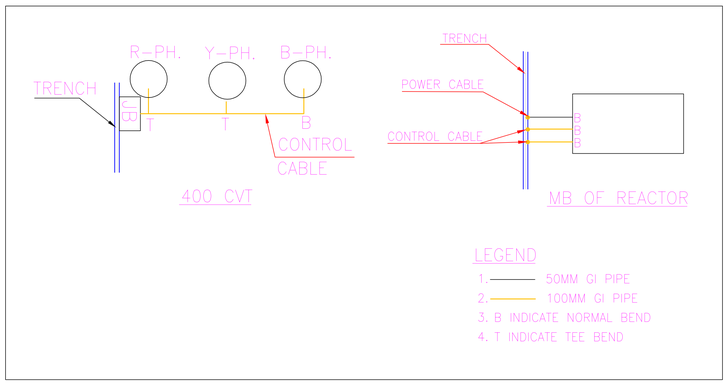
SN	Item Description	Qty (Nos.)	Remarks
13.	Vertical Elbow(90 deg Bend) for Ladder type cable tray 2.5 m long, 600 mm wide, 100 mm high, 2 mm thick, having slotted rung - **Bolted Type**	10	As per Drawing: PE-DG-497-507-E041 Rev01 -Sheet 08 Of 14
14.	Left Hand Reducer for Ladder type cable tray 600 mm wide To 150 mm Wide, 100 mm high, 2 mm thick, having slotted rung - **Bolted Type**	15	As per Drawing: PE-DG-497-507-E041 Rev01 -Sheet 06 Of 14
15.	Right Hand Reducer for Ladder type cable tray 600 mm wide To 150 mm Wide, 100 mm high, 2 mm thick, having slotted rung - **Bolted Type**	15	As per Drawing: PE-DG-497-507-E041 Rev01 -Sheet 06 Of 14
16.	Base Plate For Single Channel (BP1) with 1 No. 10 mm dia (M10) anchor bolts – **Bolted Type**	9	As per Drawing: PE-DG-497-507-E006 Rev00 -Sheet 06 Of 37 and PE-DG-497-507-E006 Rev00 -Sheet 11 Of 37
17.	Base Plate For Double Channel (BP2) with 2 No. 10 mm dia (M10) anchor bolts – **Bolted Type**	17	As per Drawing: PE-DG-497-507-E006 Rev00 -Sheet 07 Of 37 and PE-DG-497-507-E006 Rev00 -Sheet 11 Of 37
18.	Tray Fixing Clamp (TC1) – **Bolted Type**	381	As per Drawing: PE-DG-497-507-E006 Rev00 -Sheet 09 Of 37
19.	PVC End Cap	167	As per Drawing: 0350-215-PVE-B-001 Rev00- Sheet 20 Of 21
20.	Earth Flat Fixing Clamp (Z) – Bolted Type	26	As per Drawing: 0350-215-PVE-B-001 Rev00- Sheet 18 Of 21
21.	90 deg Angle Fitting LA1	26	As per Drawing: PE-DG-497-507-E006 Rev00 -Sheet 10 Of 37
22.	90 deg Angle Fitting HL1	44	As per Drawing: PE-DG-497-507-E006 Rev00 -Sheet 04 Of 37

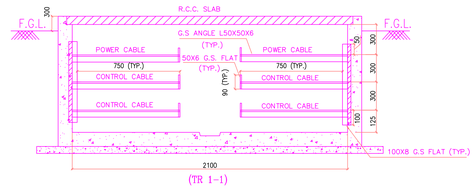
Note:

1. The quantity for individual items may vary up to any extent, however total quantity may vary ± 40% during contract execution stage.
2. All items mentioned above shall be as per NTPC specification drawings attached in Section-2.
3. Minor fabrication detail changes which do not affect the material/dimensional aspect of the equipment, shall be subject to BHEL's/Owner's approval without any commercial implication.
4. 2% Extra Hardware shall be supplied along with all the applicable items in the BOQ.

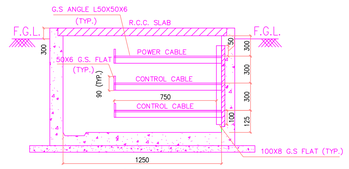
ANNEXURE-I

GI PIPE DETAILS OF 400 kV EQUIPMENTS

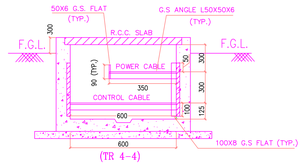




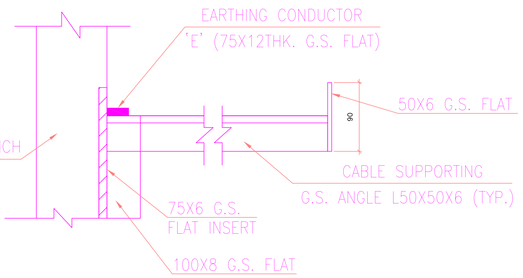
(TR 1-1)



(TR 2-2)

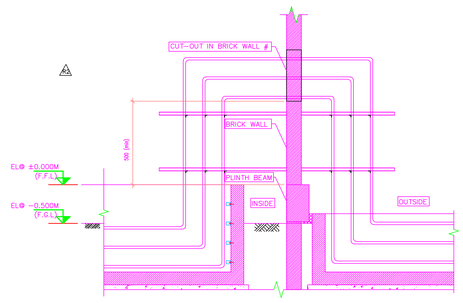


(TR 4-4)



TYP. CABLE SUPPORT EARTH CONDUCTOR 'E' RUNS ON TOP TIERS ONLY

JB/ MUP FIXING DETAIL ON TRENCH
A & B DIMENSIONS ARE AS PER JB/ MUP DRAWINGS.
X=TRENCH WALL THICKNESS.



(TYP. ARRANGEMENT OF CABLE ENTRY TO CONTROL BUILDING, GIS HALL & VENTILLATION FAN ROOM)

CUT-OUT SIZE IN BRICK WALL:
a) Height 600 mm
b) Width as per individual Trench Section

Cut-outs shall be filled with POP after completion of cable laying.

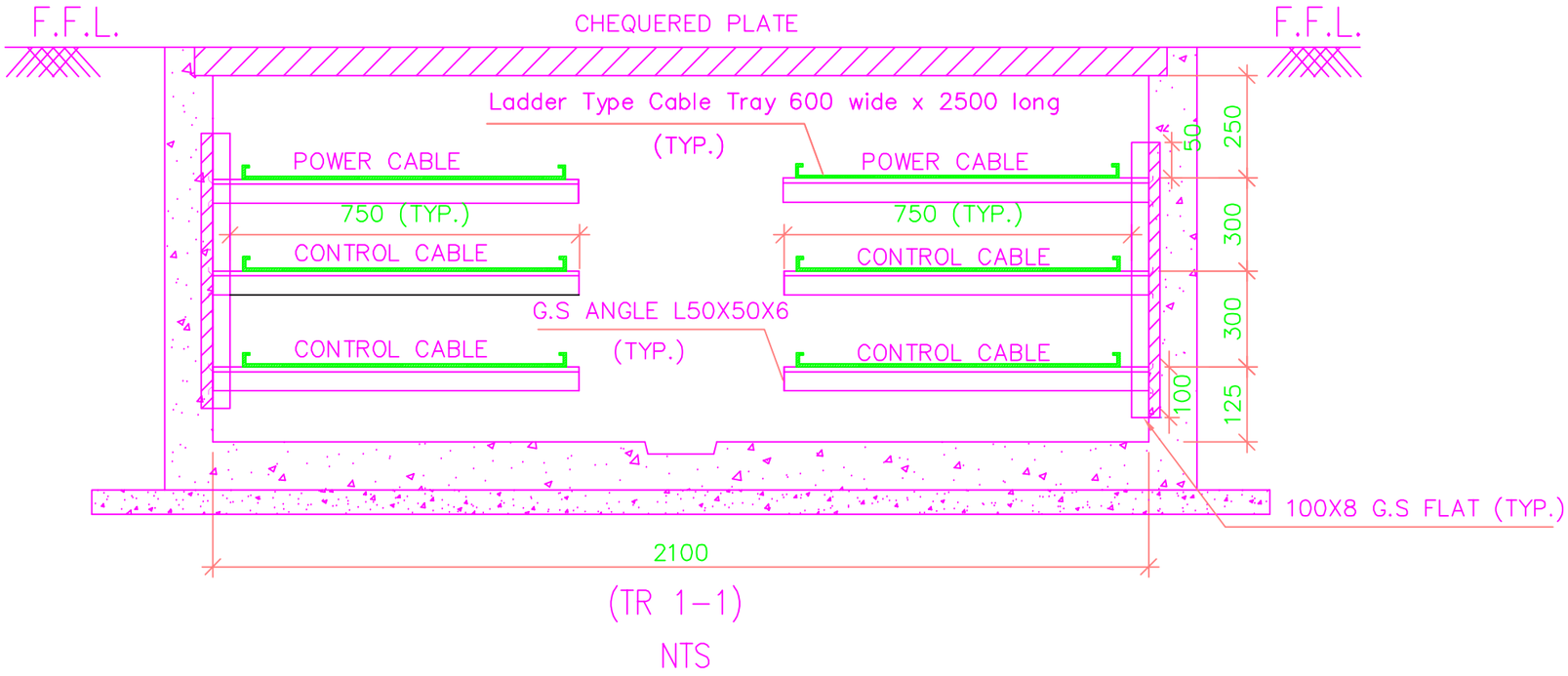
0.0														
पुनरीक्षण REV.	दिनांक DATE	परीक्षित/ ALTD	संचालन/ CHD	स्वीकृत/ APPD	पुनरीक्षण REV.	दिनांक DATE	परीक्षित/ ALTD	संचालन/ CHD	स्वीकृत/ APPD	पुनरीक्षण REV.	दिनांक DATE	परीक्षित/ ALTD	संचालन/ CHD	स्वीकृत/ APPD
					02	23.11.23	PC	RD	VK	01	14.08.23	PC	RD	VK
						DOCUMENT REVISED IN LINE WITH NTPC COMMENTS DT 25.08.23					DOCUMENT REVISED IN LINE WITH NTPC COMMENTS DT 09.06.23			

ग्राहक ड्राइंग संख्या CUSTOMER DRAWING NO.	4540-001-230-PVE-F-022
ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
परियोजना PROJECT	TALCHER THERMAL POWER PROJECT STAGE-III (2X660MW)
कार्य संख्या- JOB NO. 419	
स्थिति STATUS CONTRACT	
मुद्रण स्केल मीटर में PRINT SCALE IN METRE 0.2 4 6 8 10 20 30 40 50	भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD TRANSMISSION BUSINESS GROUP नोएडा (उ.प्र.)/NOIDA (U.P.)
शीर्षक/TITLE	400kV GIS SWITCHYARD OUTDOOR CABLE TRENCH ARRANGEMENT LAYOUT (ELECTRICAL DRAWING)
ड्राइंग संख्या/ DRAWING NO.	4540-001-230-PVE-F-022
शीट SHEET 2 OF 2	पुनरीक्षण REV. 02

DEPT. CODE		नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
M	डिजाइन/DSN	PC	Sd/-	19.05.2023
	डिजाइनकर्ता/DESN	PC	Sd/-	19.05.2023
	जांचकर्ता/CHD	RD	Sd/-	19.05.2023
	अनुमोदनकर्ता/APPD	VK	Sd/-	19.05.2023

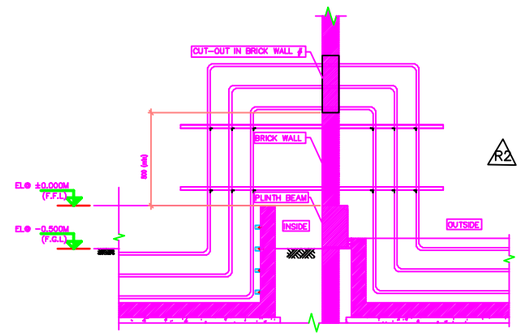
विभाग DEPT. — स्केल SCALE —
इंजीनियर SIGN
दिनांक DATE

ANNEXURE-I



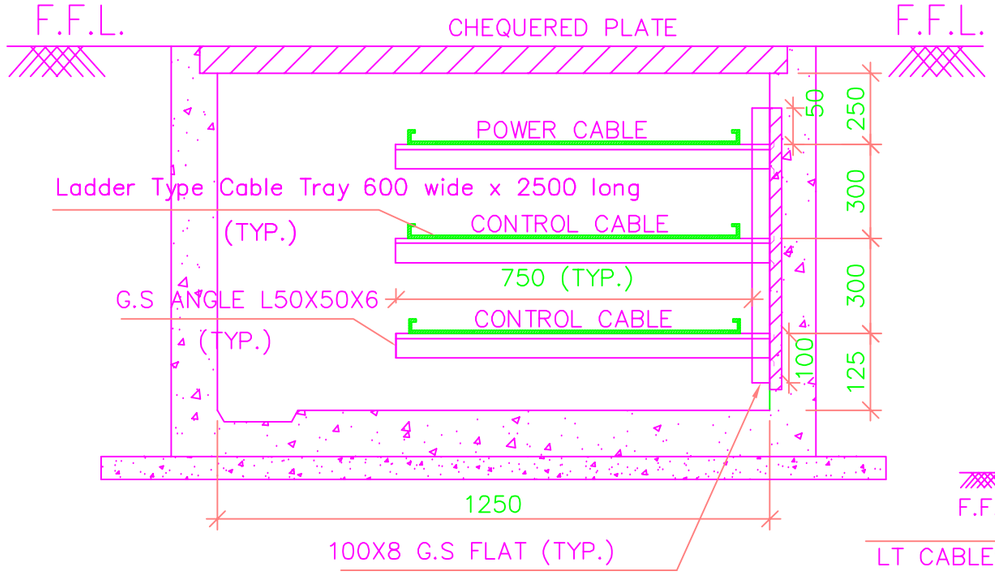
(TR 1–1)

NTS



(TYP. ARRANGEMENT OF CABLE ENTRY TO CONTROL BUILDING, GIS HALL & VENTILLATION FAN ROOM)

NTS



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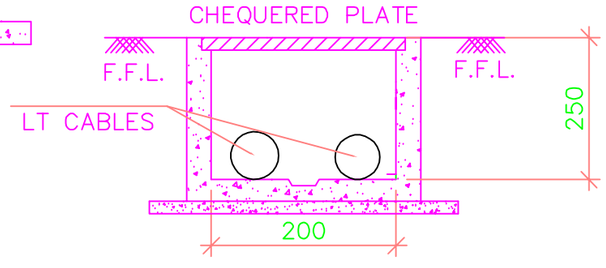
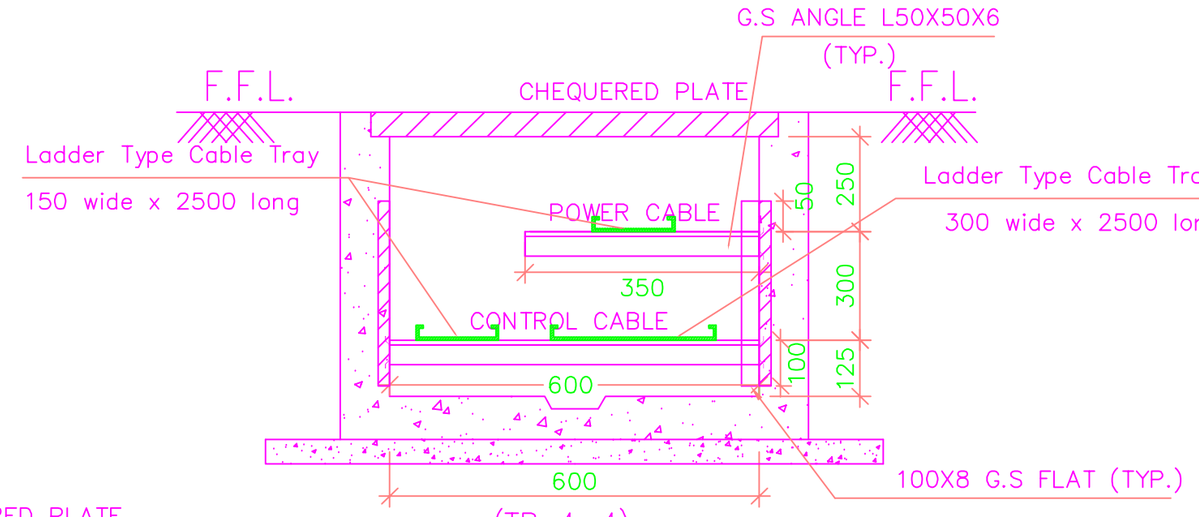


CABLE SLIT (AHU ROOM)

NTS



(TR 4–4)

NTS

NTPC DRG. No. 4540-001-230-PVE-F-001					
PROJECT	TALCHER THERMAL POWER PROJECT STAGE-III (2X660MW)				
W.O. NO. 419	OWNER	NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)			
STATUS CONTRACT					
DISTRIBUTION					
TO	BHARAT HEAVY ELECTRICALS LTD TRANSMISSION BUSINESS GROUP NOIDA	DEPT CODE M		NAME	SIGN	DATE
No. OF			DRN	PC	–sd–	19.05.23
REV. 02 / DATE 23.11.23 / ALTD PC / CHD RD / APPD VK			CHD	RD	–sd–	19.05.23
DRAWINGS REVISED IN LINE WITH NTPC COMMENTS DT 25.06.23			APPD	VK	–sd–	19.05.23
TITLE: INDOOR CABLE TRENCH LAYOUT FOR SWITCHYARD CONTROL ROOM BUILDING (ELECTRICAL DRAWING)						
DEPT. / SIGN / DATE	SCALE NTS	DRAWING NO. 4540-001-230-PVE-F-001				
		SHEET 02 OF 02	REV. 02			

ELECTRONIC FILE NAME:

FORMAT SIZE A3

ANNEXURE-II

"We confirm that this document meets all the contract requirements including safety and statuary requirements and facilitate ease of operation and maintenance. In case any deviation is found, the Contractor shall carry out all required changes/ modifications without any cost implications to NTPC. In addition, Penalty on account of noncompliance of contract specification as deemed fit by the Employer shall be recovered.

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

REV	ALTD	CHD	APPD	DATE
01	VKS	AnA	SL	04.01.2023

NTPC DOCUMENT NO: 4540-001-215-PVE-B-045

DRAWING IS REVISE AS PER CUSTOMER COMMENTS DATED 31.12.2022.
HOLE LOCATION ON SIDE RUNNER UPDATED.
CHANGES ARE MARKED AS ⚠1

CUSTOMER: एन टी पी सी NTPC — एन टी पी सी लिमिटेड N T P C LIMITED

PROJECT: 2X660MW TALCHER THERMAL POWER PROJECT LTD. STAGE-III

JOB NO. 497

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA(U.P) INDIA

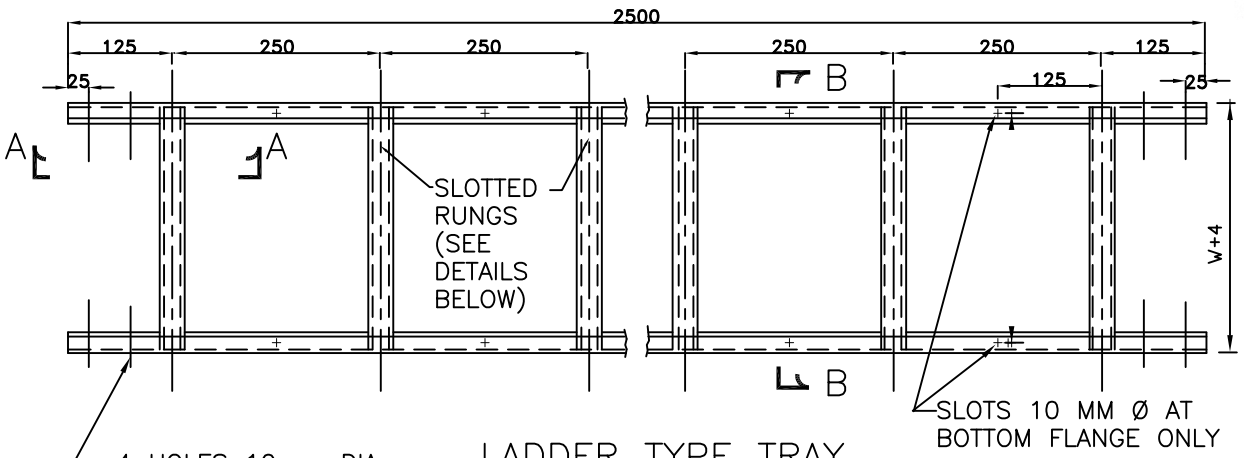
DPT CODE-E

	NAME	SIGN	DATE
DRN	SKS	-sd-	13.12.22
DSN	SKS	-sd-	13.12.22
CHD	AS	-sd-	13.12.22
APP	SL	-sd-	13.12.22

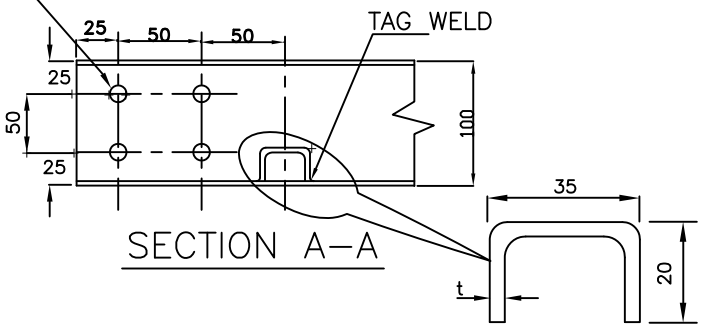
DWG. NO. PE-DG-497-507-E041

SHT. 01 OF 14 REV.01

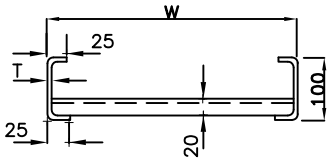
ANNEXURE-II



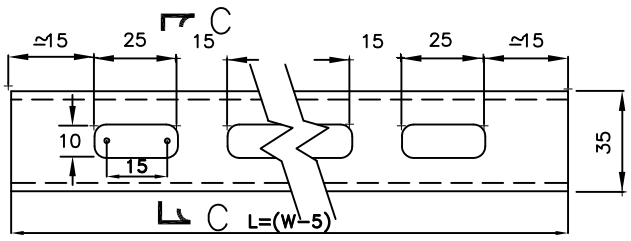
LADDER TYPE TRAY



SECTION A–A

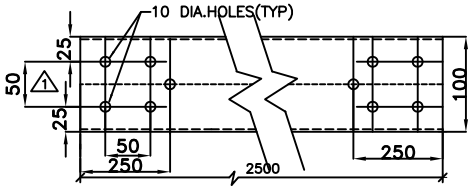


SECTION B–B

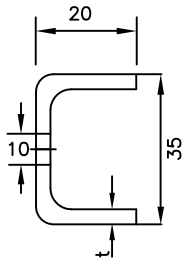


SLOTTED RUNGS

(TO SUIT TRAY WIDTH)



SIDE RUNNER



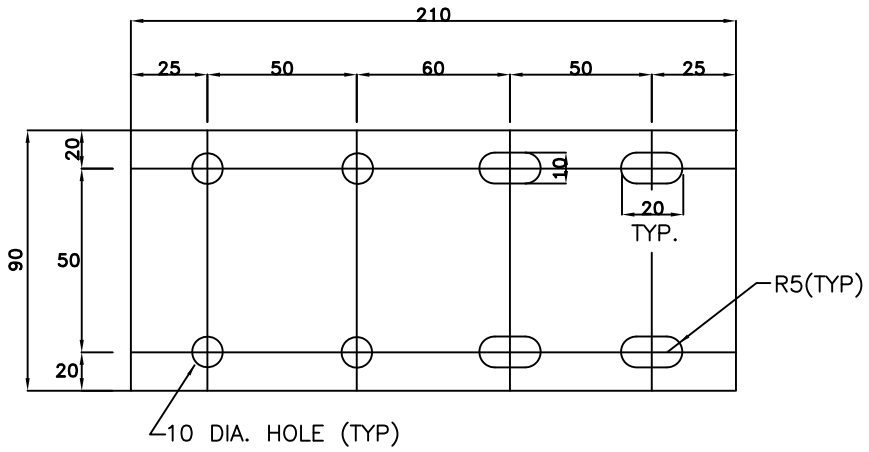
SECTION C–C

W	150	300	600
L	145	295	595
T	2	2	2
t	2	2	2

FOR GENERAL NOTES REFER SHEET 14 OF 14

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540–001–215–PVE–B–045
	BHEL DWG. NO. PE–DG–497–507–E041
	SHT. 02 OF 14 REV.01

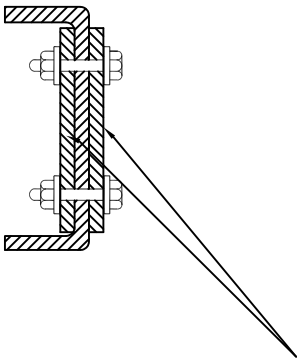
ANNEXURE-II



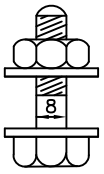
SIDE COUPLER PLATE FOR LADDER/PERFORATED TYPE TRAYS

(600/300/150W TRAYS)

QTY. REQUIRED/TRAY SECTION : 4 NOS.

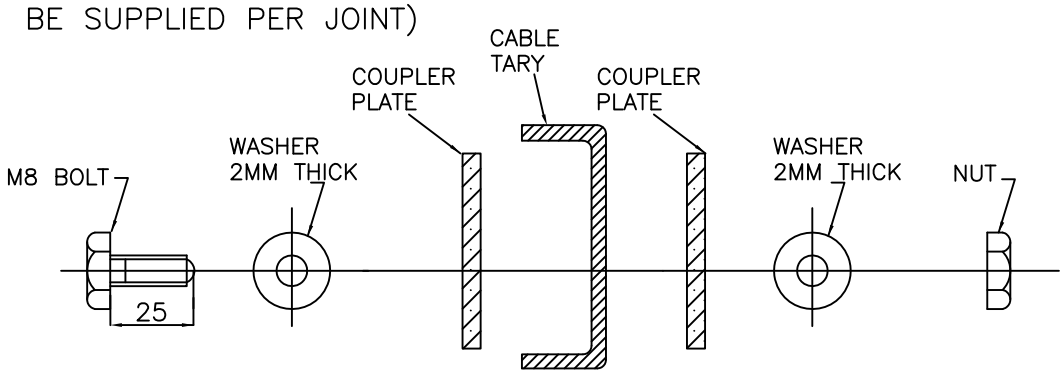


(2 NOS. COUPLER PLATES OF 3 MM THICKNESS TO BE SUPPLIED PER JOINT)



QTY. REQD/TRAY SECTION

A) 16 NOS. M8 BOLTS
B) 16 NOS. NUTS
C) 32 NOS. WASHERS



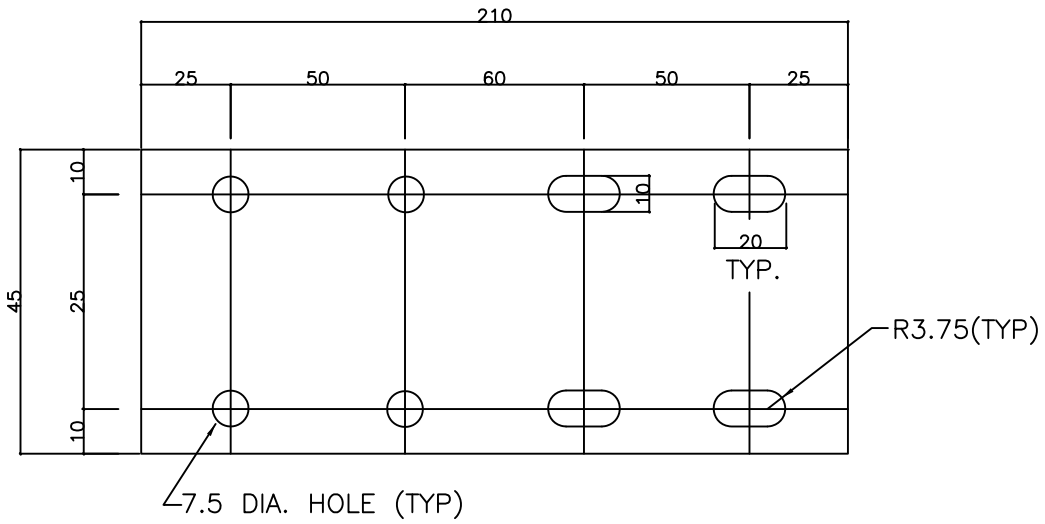
SEQUENCE OF M8 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY

FOR TYPICAL CABLE TRAY JOINT

FOR GENERAL NOTES REFER SHEET 14 OF 14

BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540-001-215-PVE-B-045 BHEL DWG. NO. PE-DG-497-507-E041 SHT. 03 OF 14 REV.01

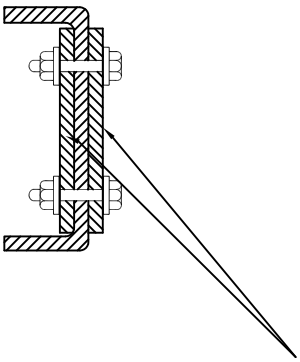
ANNEXURE-II



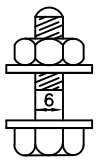
SIDE COUPLER PLATE FOR PERFORATED TYPE TRAYS

(100/50W TRAYS)

QTY. REQUIRED/TRAY SECTION : 4 NOS.

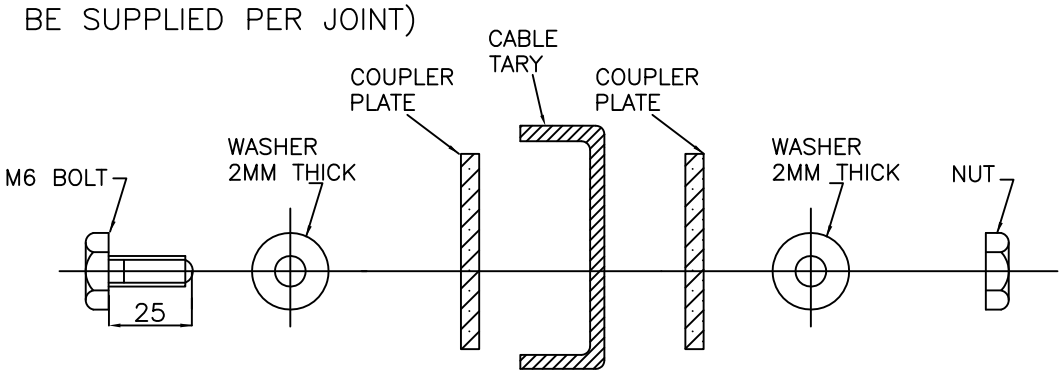


(2 NOS. COUPLER PLATES OF 3 MM THICKNESS TO BE SUPPLIED PER JOINT)



QTY. REQD/TRAY SECTION

A) 16 NOS. M6 BOLTS
B) 16 NOS. NUTS
C) 32 NOS. WASHERS



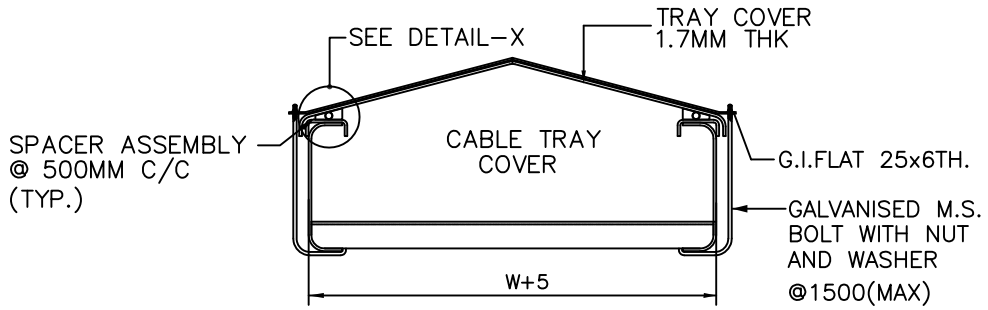
SEQUENCE OF M6 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY

FOR TYPICAL CABLE TRAY JOINT

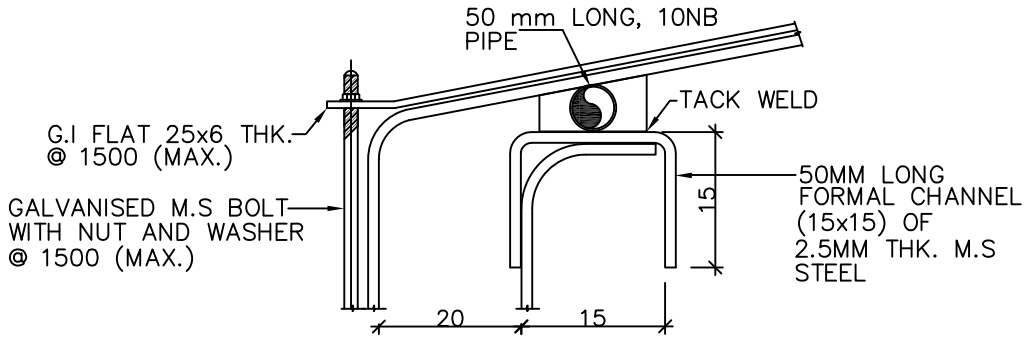
FOR GENERAL NOTES REFER SHEET 14 OF 14

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540-001-215-PVE-B-045
	BHEL DWG. NO. PE-DG-497-507-E041
	SHT. 04 OF 14 REV.01

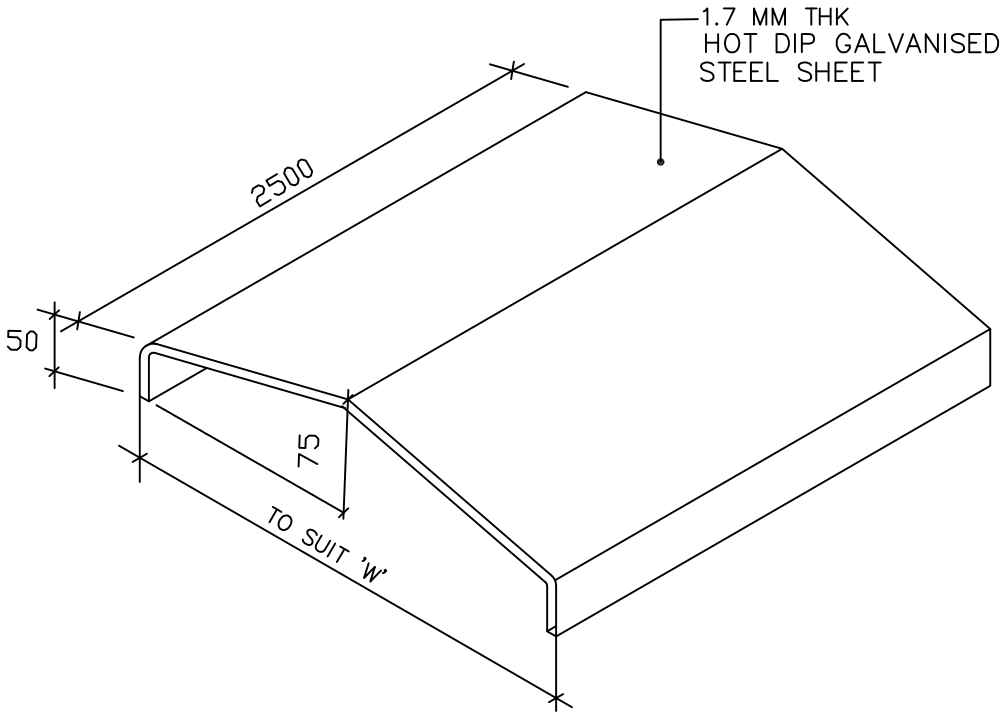
ANNEXURE-II



COVER FIXING (TYP.)



DETAIL–X

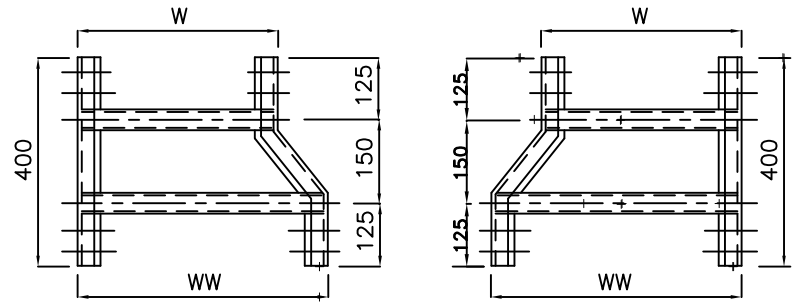


CABLE TRAY COVER

FOR GENERAL NOTES REFER SHEET 14 OF 14

BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540–001–215–PVE–B–045
		BHEL DWG. NO. PE–DG–497–507–E041
		SHT. 05 OF 14 REV.01

ANNEXURE-II

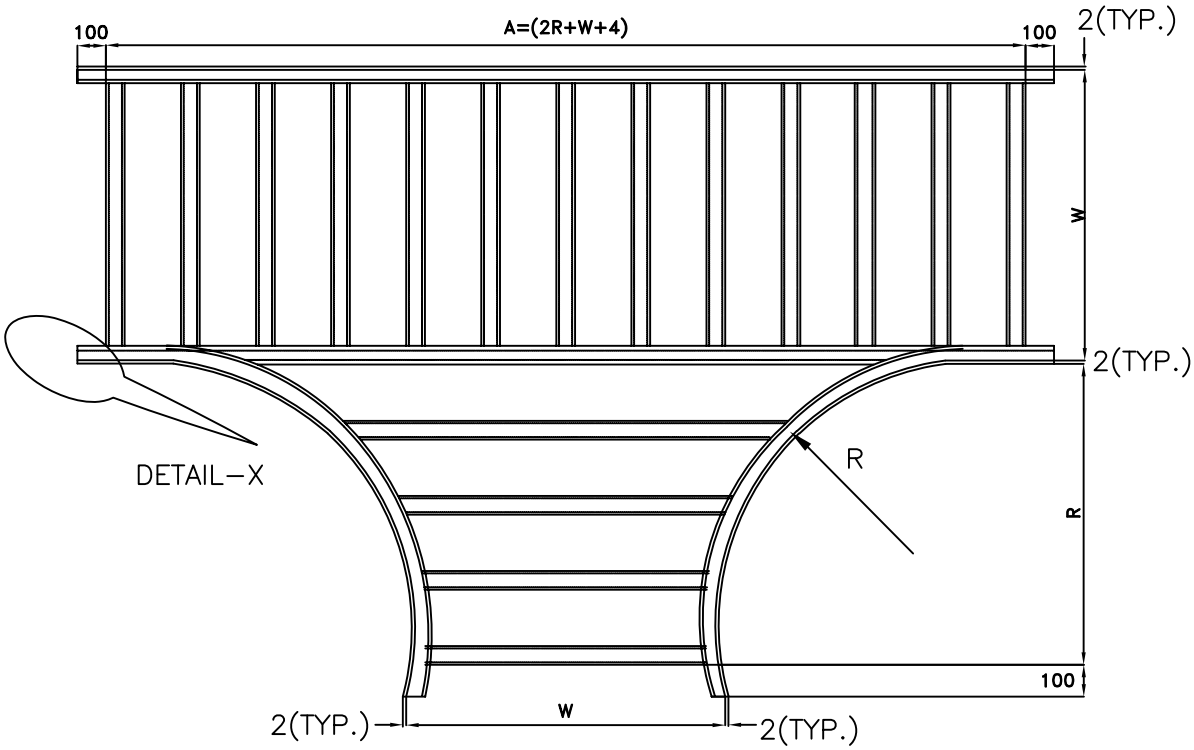


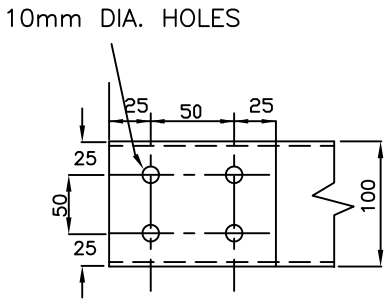
WW	W	DEPTH
600	300	100
600	150	100
300	150	100

LEFT HAND REDUCER

RIGHT HAND REDUCER

LADDER TYPE





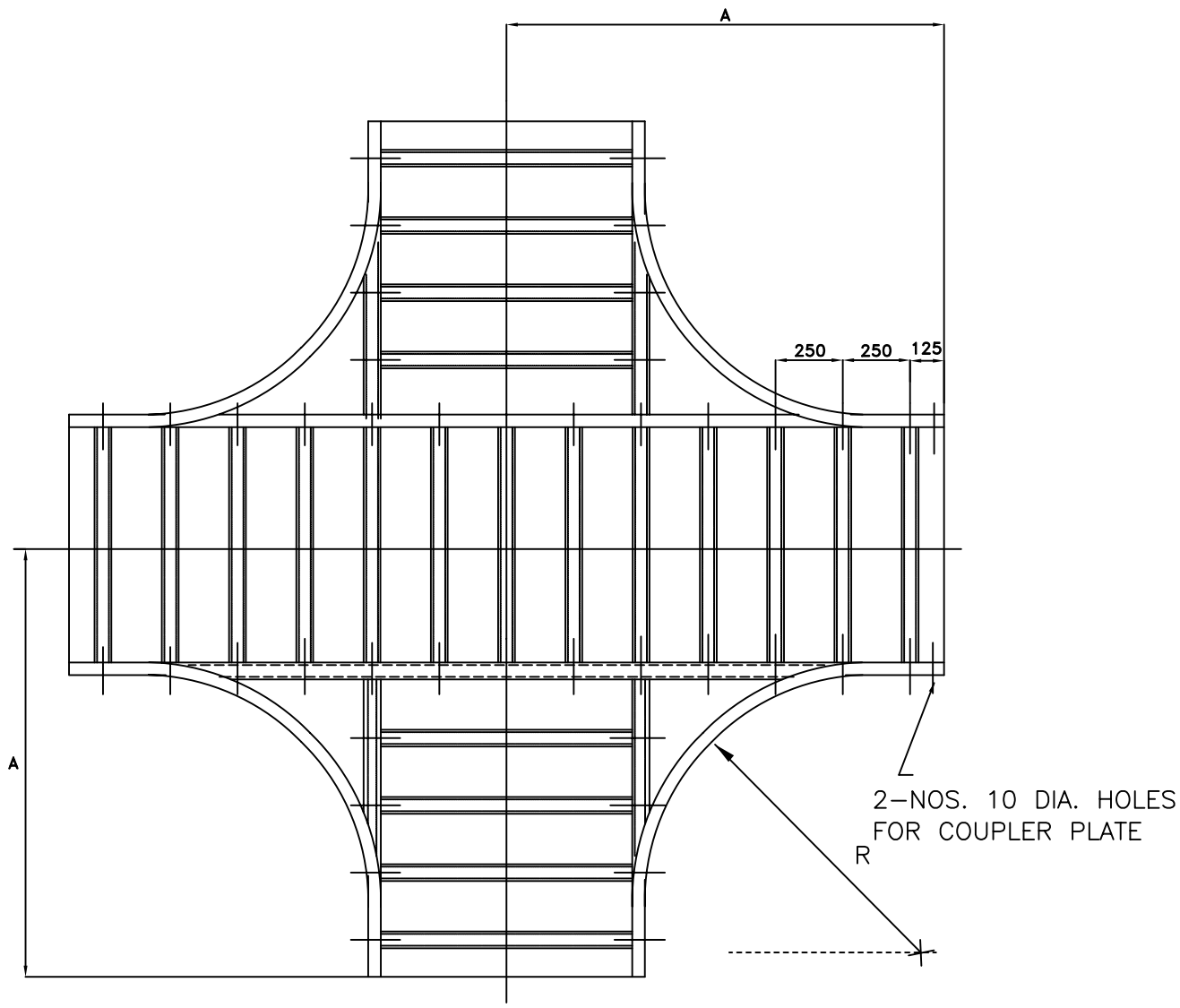
WIDTH W	BENDING RADIUS R	DEPTH	A		
			W		
			150	300	600
150, 300, 450 & 600	600	100	1354	1504	1804

LADDER TYPE

FOR GENERAL NOTES REFER SHEET 14 OF 14

बीएचईएल BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540–001–215–PVE–B–045 BHEL DWG. NO. PE–DG–497–507–E041 SHT. 06 OF 14 REV.01

ANNEXURE-II



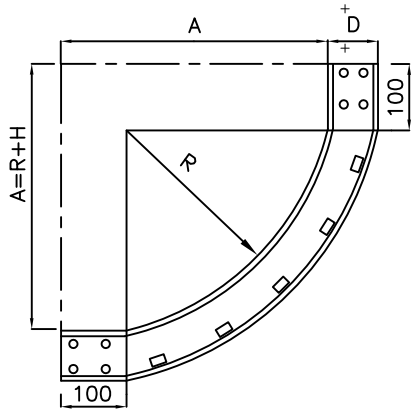
HORIZONTAL CROSS–PLAN

WIDTH W	BENDING RADIUS R	A=R+W/2+100
600	600	1000
300	600	850

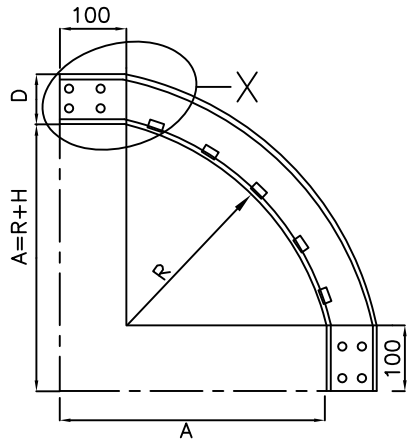
FOR GENERAL NOTES REFER SHEET 14 OF 14

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540–001–215–PVE–B–045
	BHEL DWG. NO. PE–DG–497–507–E041
	SHT. 07 OF 14 REV.01

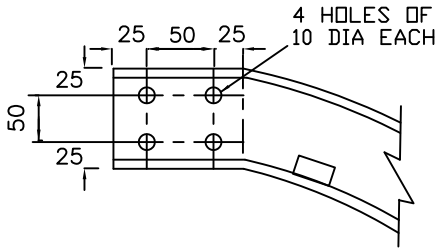
ANNEXURE-II



INSIDE TYPE



OUTSIDE TYPE

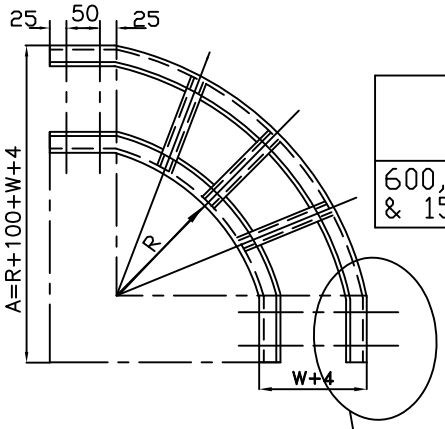


ENLARGED VIEW OF "X"

VERTICAL ELBOW 90 DEG UP/DOWN

INSIDE WIDTH W	BENDING RADIUS R	DEPTH	A
600, 300 & 150	600	100	700

90° VERTICAL BEND - LADDER TYPE



LADDER TYPE

X (AS ABOVE)

HORIZONTAL ELBOW 90 DEG

INSIDE WIDTH W	BENDING RADIUS R	DEPTH	A		
			W		
			150	300	600
600, 300 & 150	600	100	854	1004	1304

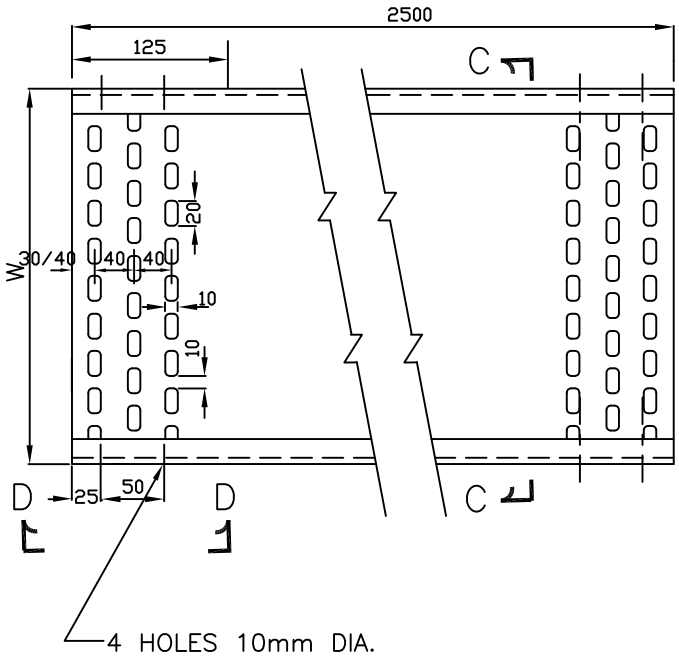
90° HORIZONTAL BEND - LADDER TYPE

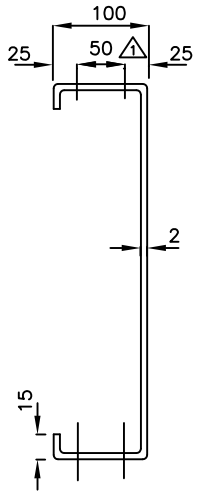
LADDER TYPE ACCESSORIES

FOR GENERAL NOTES REFER SHEET 14 OF 14

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540-001-215-PVE-B-045
	BHEL DWG. NO. PE-DG-497-507-E041
	SHT. 08 OF 14 REV.01

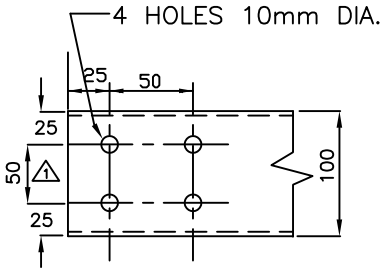
ANNEXURE-II





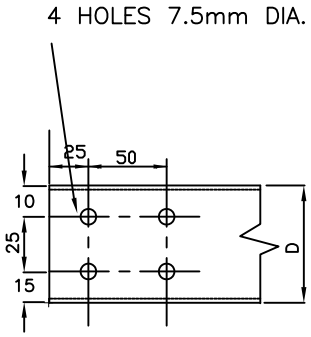
SECTION–CC

600/300/150 TRAYS



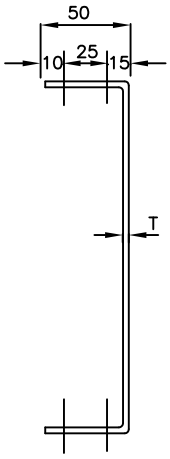
SECTION–DD

600/300/150 TRAYS



SECTION–DD

100/50 TRAYS



SECTION–CC

(100/50 TRAYS)

TRAY WIDTH W (mm)	600	300	150	100	50
TRAY DEPTH D (mm)	100	100	100	50	50
T (mm)	2	2	2	2	2

PERFORATED TYPE TRAY

FOR GENERAL NOTES REFER SHEET 14 OF 14

बीएचईएल BHEL

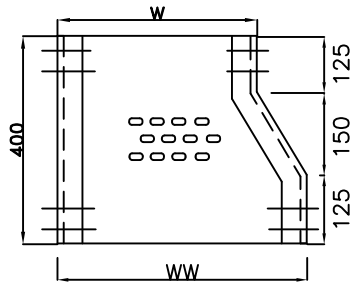
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

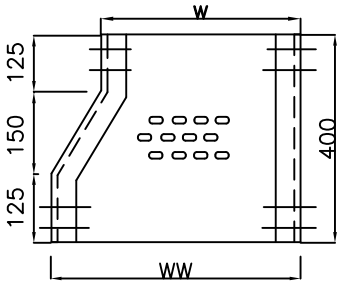
NTPC DOCUMENT NO:
4540-001-215-PVE-B-045

BHEL DWG. NO.
PE-DG-497-507-E041

SHT. 09 OF 14 REV.01

ANNEXURE-II

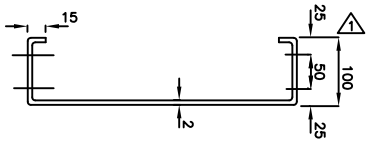




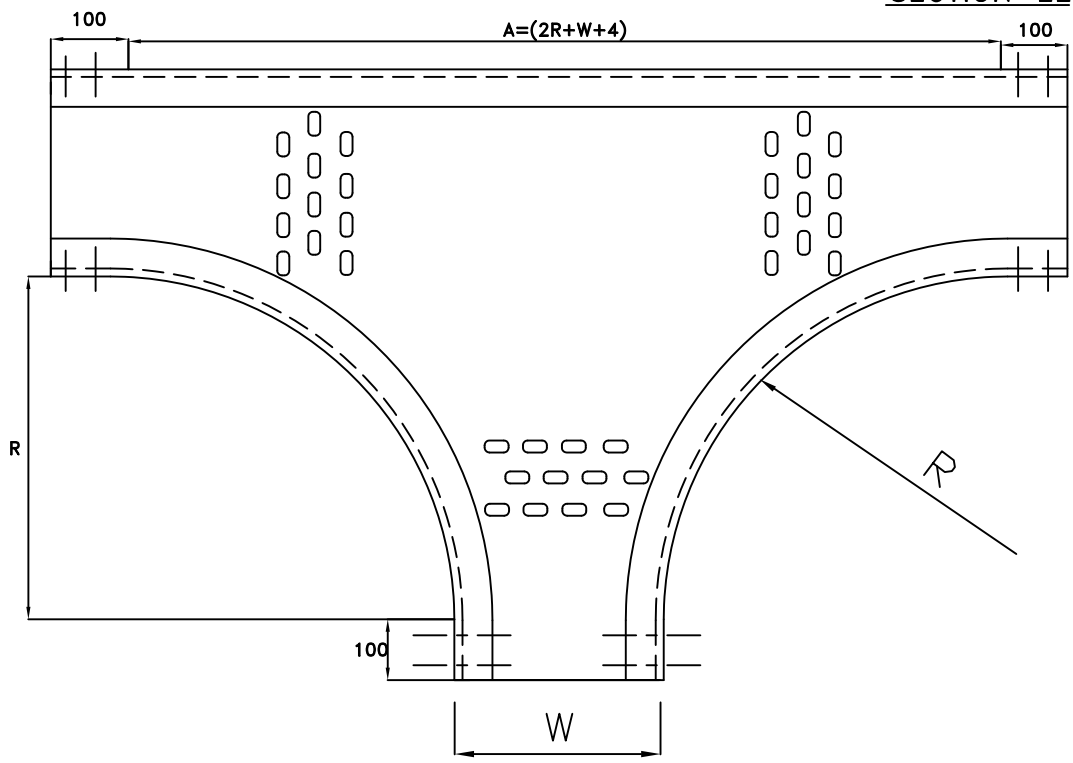
WW	W	DEPTH
600	300	100
600	150	100
300	150	100

LEFT HAND REDUCER RIGHT HAND REDUCER

PERFORATED TYPE



SECTION–EE



TEE

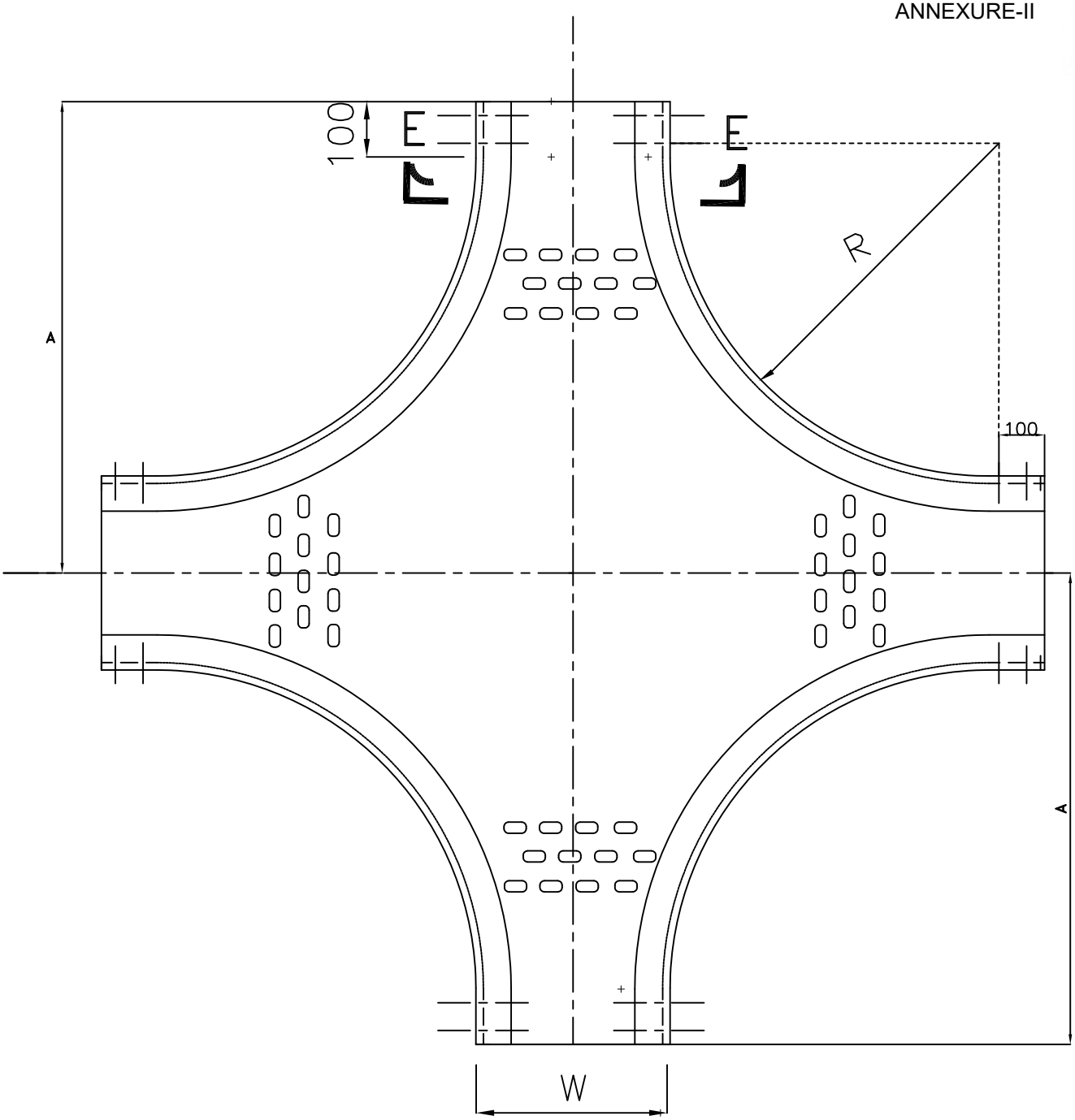
WIDTH W	BENDING RADIUS R	DEPTH	A		
			W		
			150	300	600
150, 300 & 600	600	100	1354	1504	1804

PERFORATED TYPE

FOR GENERAL NOTES REFER SHEET 14 OF 14

BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540–001–215–PVE–B–045 BHEL DWG. NO. PE–DG–497–507–E041 SHT. 10 OF 14 REV.01

ANNEXURE-II



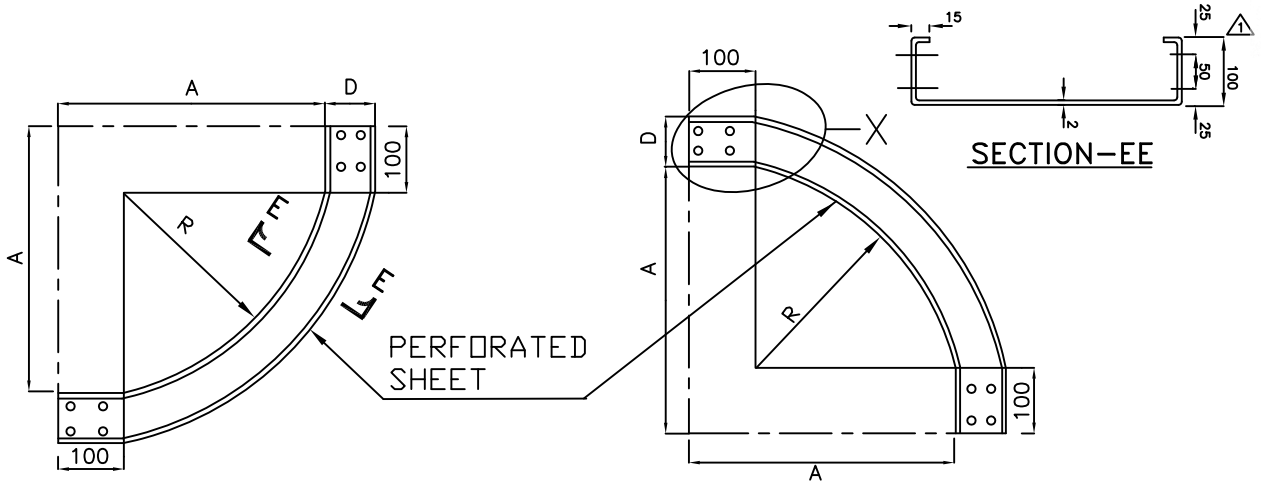
CROSS

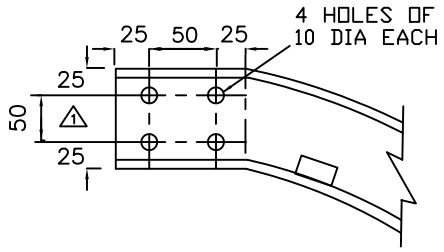
WIDTH W	BENDING RADIUS R	A=R+W/2+100
600	600	1000
300	600	850

FOR GENERAL NOTES REFER SHEET 14 OF 14

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540-001-215-PVE-B-045
	BHEL DWG. NO. PE-DG-497-507-E041
	SHT. 11 OF 14 REV.01

ANNEXURE-II



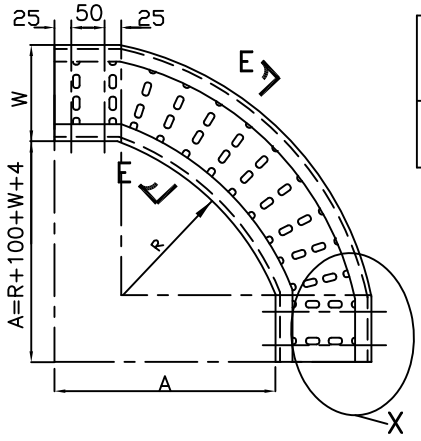


ENLARGED VIEW OF "X"

VERTICAL ELBOW 90 DEG UP/DOWN

INSIDE WIDTH W	BENDING RADIUS R	DEPTH	A
600, 300 & 150	600	100	700

90° VERTICAL BEND – PERFORATED TYPE



HORIZONTAL ELBOW 90 DEG

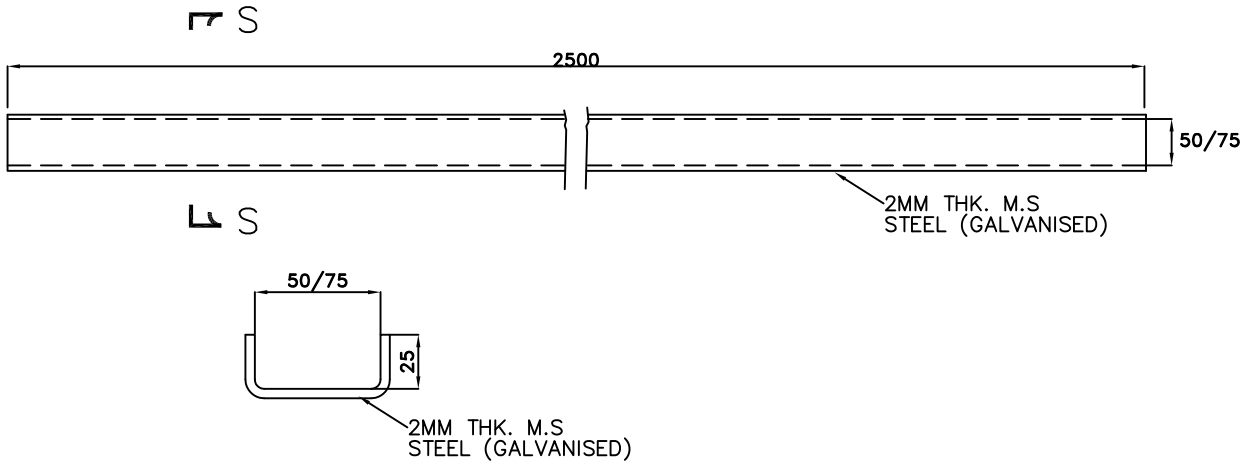
INSIDE WIDTH W	BENDING RADIUS R	DEPTH	A		
			W		
			150	300	600
150, 300 & 600	600	100	854	1004	1304

90° HORIZONTAL BEND – PERFORATED TYPE

FOR GENERAL NOTES REFER SHEET 14 OF 14

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540–001–215–PVE–B–045	
	BHEL DWG. NO. PE–DG–497–507–E041	
	SHT. 12 OF 14	REV.01

ANNEXURE-II



SECTION S–S

CABLE TROUGHS

FOR GENERAL NOTES REFER SHEET 14 OF 14

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540–001–215–PVE–B–045
	BHEL DWG. NO. PE–DG–497–507–E041
	SHT. 13 OF 14 REV.01

ANNEXURE-II

NOTES:-

1. THE CABLE TRAYS AND ACCESSORIES SHALL BE MADE OF 2mm HOT ROLLED M.S.SHEET CONFIRMING TO IS:1079. ALL THE COUPLER PLATE SHALL BE OF 3 MM THICK.
2. THE CABLE TRAYS AND ACCESSORIES SHALL BE HOT DIP GALVANISED AS PER IS 2629. THE MASS OF ZINC COATING SHALL BE 610 gm/sqm FOR 2MM THICK PRODUCT AND 460 gm/sqm FOR 1.7 MM THICK PRODUCT. THICKNESS SHALL BE 75 MICRONS (MINIMUM), 86 MICRONS (AVERAGE) FOR 2.0 MM THICK PRODUCT AND 55 MICRONS (MINIMUM), 65 MICRONS (AVERAGE) FOR 1.7 MM THICK PRODUCT .
3. FOR LADDER TYPE CABLE TRAYS AND ACCESSORIES, ALL RUNGS SHALL BE SLOTTED.
4. PERFORATED TRAYS SHALL BE FABRICATED OUT OF A SINGLE M.S. SHEET.
5. THE DIMENSIONS OF ALL BENDS, TEES, CROSSES, ETC. FOR PERFORATED CABLE TRAYS SHALL BE THE SAME AS FOR LADDER TYPE TRAY FITTINGS.
6. SIDE CHANNELS OF PERFORATED TRAY ACCESSORIES SHALL BE WELDED WITH THE PERFORATED SHEET AT INTERVALS OF 100mm.
7. LENGTH OF WELDING SHALL NOT BE LESS THAN 25mm. WELDING SHALL BE AS PER IS 9595.
8. PREFERABALY SINGLE MS PERFORATED SHEET SHALL BE USED AS BASE OF ALL PERFORATED TYPE TRAY ACCESSORIES. HOWEVER, IF USE OF PIECES OF PERFORATED SHEET IS UNAVIODABLE FOR BASE, PIECES SHALL BE WELDED WITH EACH OTHER IN LINE WITH THE ABOVE.
9. ALL TRAY CORNERS SHALL BE FREE OF SHARP EDGES & SMOOTH.
10. THE DEPTH, WIDTH AND LENGTH OF TRAYS AND ACCESSORIES SHALL BE WITHIN A TOLERANCE AS PER RELEVANT IS
11. TO FACILITATE ASSEMBLY, ALL ACCESSORIES AT ENDS SHALL HAVE 100mm STRAIGHT PORTION.
12. ALL NUTS, BOLTS, WASHERS ETC., SHALL BE HOT DIP GALVANISED AS PER IS 1367 FOR SIZES ABOVE 12MM AND ELECTROPLATED/ELECTROGALVANISED FROM SIZE BELOW 12MM.
13. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
14. TRAY ACCESSORIES SHOWN IN THIS DRAWING SHALL BE FACTORY FABRICATED FOR USE AT SITE AS PER APPROVED LAYOUT DRAWINGS. FOR SPECIFIC SITE REQUIREMENTS (E.G. IRREGULAR ANGLE BENDS SUCH AS 30°/60° BENDS, ETC) AS PER SITE LAYOUT CONDITIONS, TRAY ACCESSORIES SHALL BE FABRICATED AT SITE FROM THE STRAIGHT LENGHT OF RESPECTIVE SIZES AS REQUIRED. GALVANISATION DAMAGED DURING CUTTING/WELDING OPEARTIONS SHALL BE BRUSHED AND RED LEAD PRIMER, OIL PRIMER AND ALUMINIUM PAINT SHALL BE APPLIED BEFORE INSTALLATION OF THE ACCESSORIES.
15. WIDTH OF CABLE TRAYS PROPOSED TO BE USED FOR PROJECT ARE AS UNDER :
    LADDER TYPE CABLE TRAY (MM) : 600, 300 & 150.
    PERFORATED TYPE CABLE TRAY (MM) : 600, 300, 150, 100 & 50.
16. 600MM WIDE CABLE TRAY SHALL BE SUITABLE FOR WEIGHT OF 100KG/M INCLUDING LIVE LOAD OF RUNNING LENGTH OF CABLE TRAY.
17. CABLE TROUGHS OR 50/100MM WIDE PERFORATED TYPE TRAY SHALL BE USED FOR LOCAL CABLING/BRANCHING OUT FEW CABLES FROM MAIN ROUTE.

भेल BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	NTPC DOCUMENT NO: 4540-001-215-PVE-B-045 BHEL DWG. NO. PE-DG-497-507-E041 SHT. 14 OF 14 REV.01

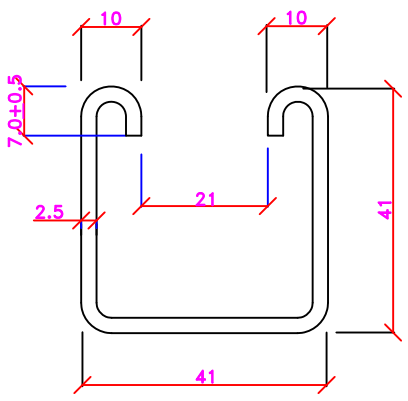
ANNEXURE-II

"We confirm that this document meets all the contract requirements including safety and statuary requirements and facilitate ease of operation and maintenance. In case any deviation is found, the Contractor shall carry out all required changes/ modifications without any cost implications to NTPC. In addition, Penalty on account of noncompliance of contract specification as deemed fit by the Employer shall be recovered.

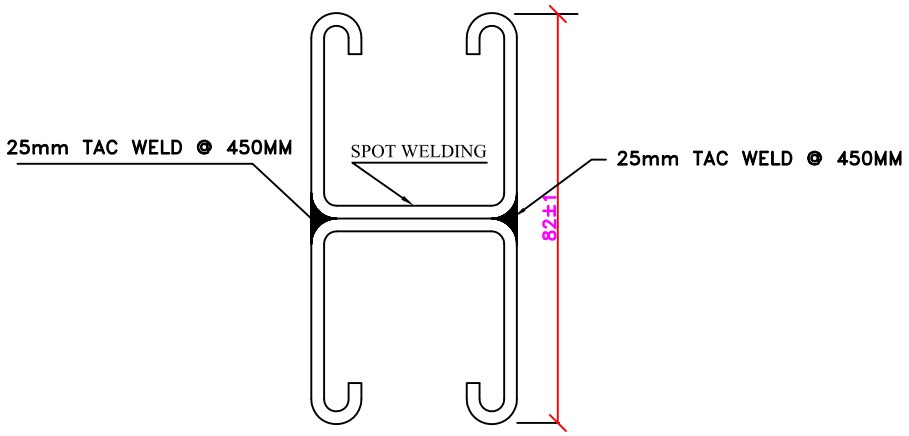
TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM

NTPC DOCUMENT NO: 4540-001-215-PVE-C-046						
CUSTOMER	एन टी पी सी NTPC — एन टी पी सी लिमिटेड N T P C LIMITED					
PROJECT	TALCHER THERMAL POWER PROJECT STAGE-III (2x660MW) EPC PACKAGE					
JOB NO. 497	BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA	DPT CODE-E	DRN	NAME VKS	SIGN -sd-	DATE 17.01.23
			DSN	VKS	-sd-	17.01.23
			CHD	AnA/AS	-sd-	17.01.23
			APP	SL	-sd-	17.01.23
		DWG. NO. PE-DG-497-507-E006				
		SHT. 01 OF 37 REV.0				

ANNEXURE-II



SINGLE CHANNEL SC1



DOUBLE CHANNEL DC1

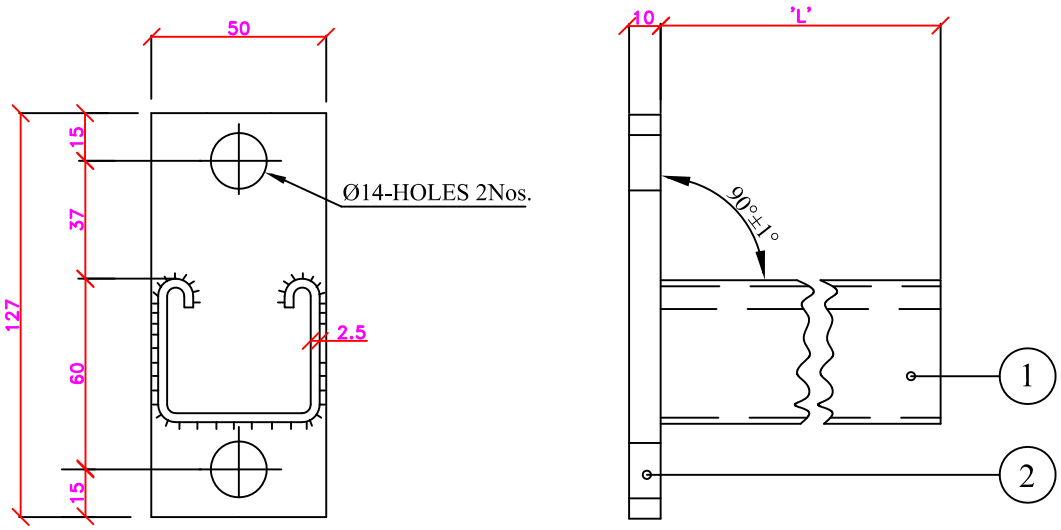
TWO LENGTHS OF SINGLE CHANNEL
SPOT WELDED BACK TO BACK
AT 75MM C/C

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : 2.5MM THICK HOT/ COLD ROLLED M.S. AS PER IS:1079.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

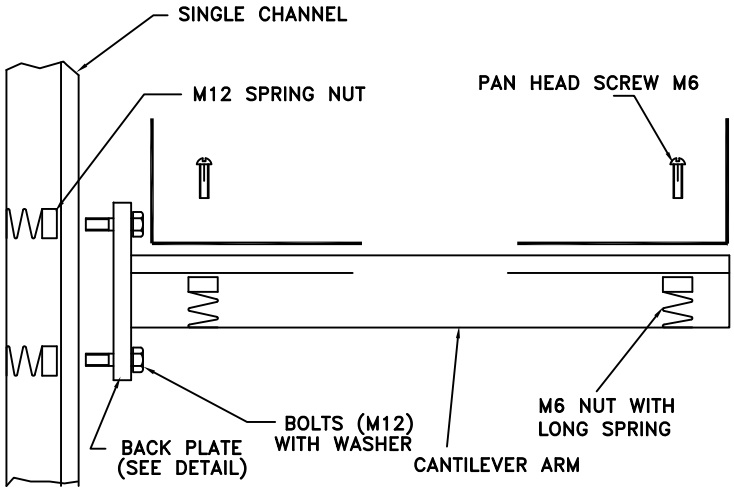
BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 02 OF 37

ANNEXURE-II



CANTILEVER ARMS

TRAY WIDTH IN MM	CANTILEVER ARM LENGTH (L) IN MM
150	170 (FOR OVERHEAD TRAYS)
300	320 (FOR OVERHEAD TRAYS
600	620 (FOR OVERHEAD TRAYS)
600	750 (FOR TRENCH)



TYPICAL ASSEMBLY OF CHANNEL SUPPORTS AND CABLE TRAY

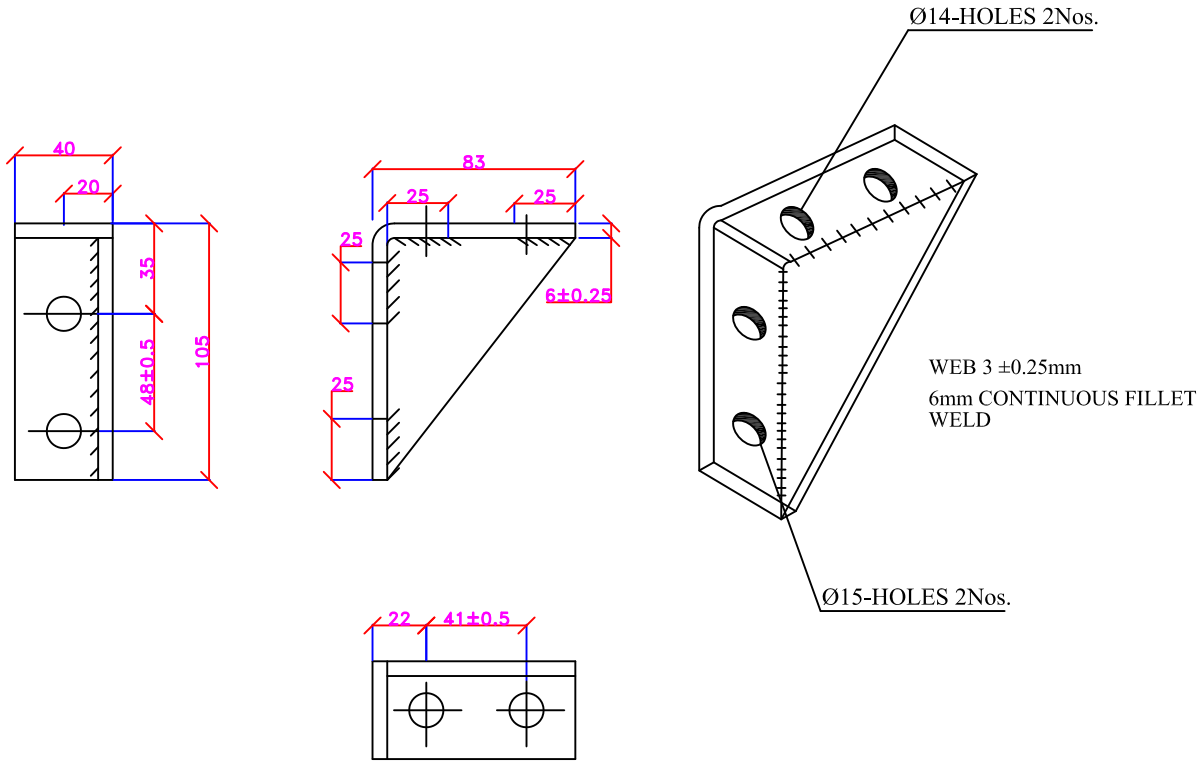
M12 HEX BOLT & WASHER–2NOs.
M12 SPRING NUTS–2NOs.
M6 PAN HEAD SCREWS & WASHER–2NOs.
M6 SPRING NUTS–2NOs.

NOTES :

1. ALL DIMENSIONS ARE IN mm.
2. ITEM NO.1 MATERIAL : HOT/ COLD ROLLED M.S. AS PER RELEVANT IS.
3. ITEM NO.2 MATERIAL : M.S AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS IS AS PER IS:1852
6. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
7. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540–001–215–PVE–C–046
		BHEL DRWG NO: PE–DG–497–507–E006
		REV.0 / SH 03 OF 37

ANNEXURE-II



90 ANGLE FITTING HL1 (HEAVY DUTY TYPE)

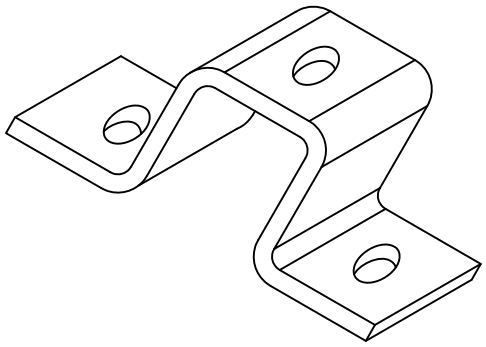
ANCHOR FASTENER–2NOs.
SPRING NUT & WASHER–2NOs.

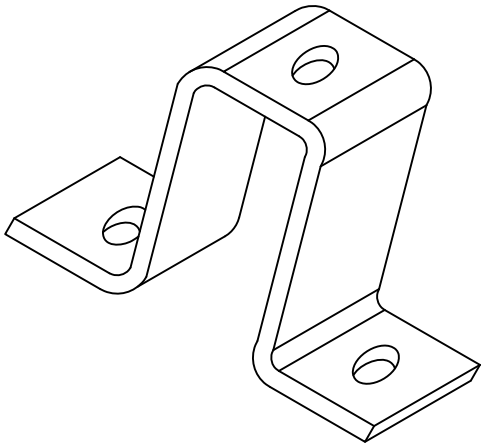
NOTES :

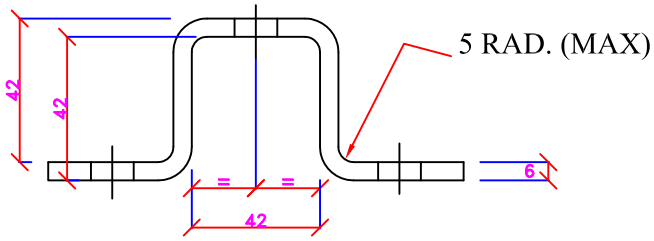
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :MILD STEEL AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS:2629
4. TOLERANCE ON THICKNESS AS PER IS:1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

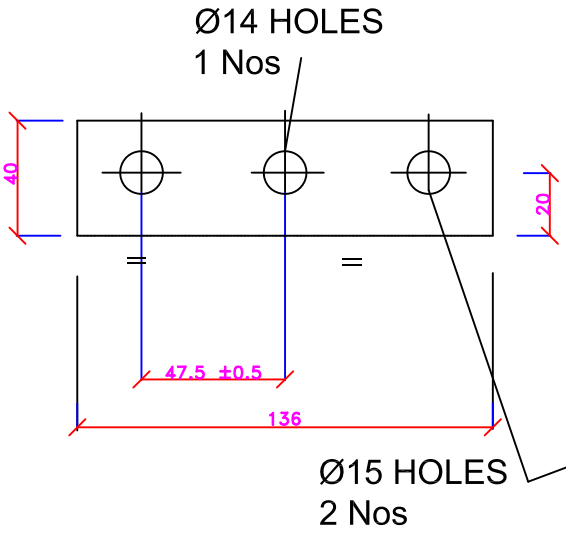
बीएचईएल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540–001–215–PVE–C–046
		BHEL DRWG NO: PE–DG–497–507–E006
		REV.0 / SH 04 OF 37

ANNEXURE-II

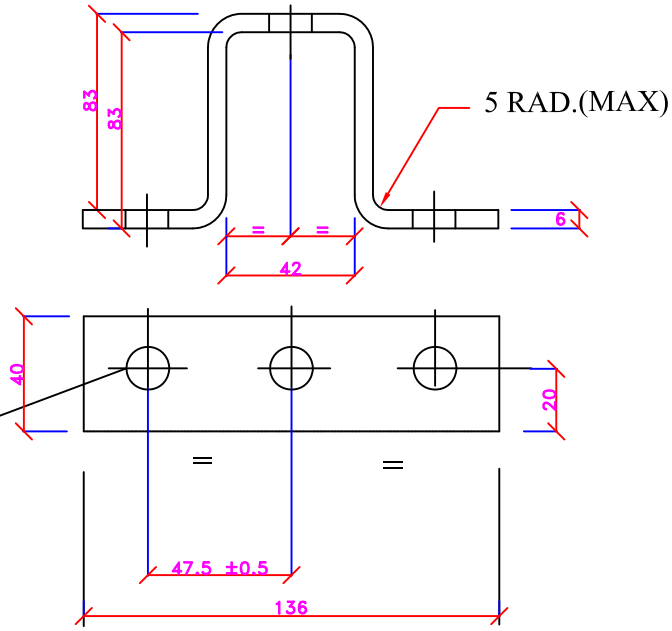








CLAMP FOR SINGLE CHANNEL CC1



CLAMP FOR DOUBLE CHANNEL CC2

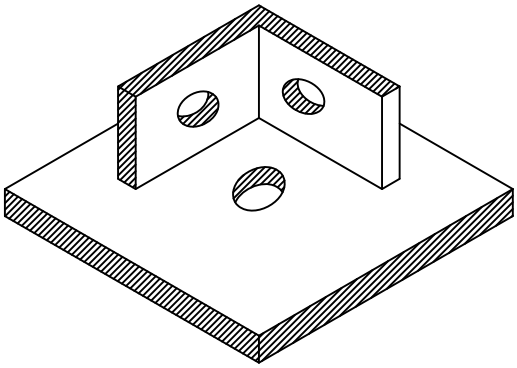
NOTES

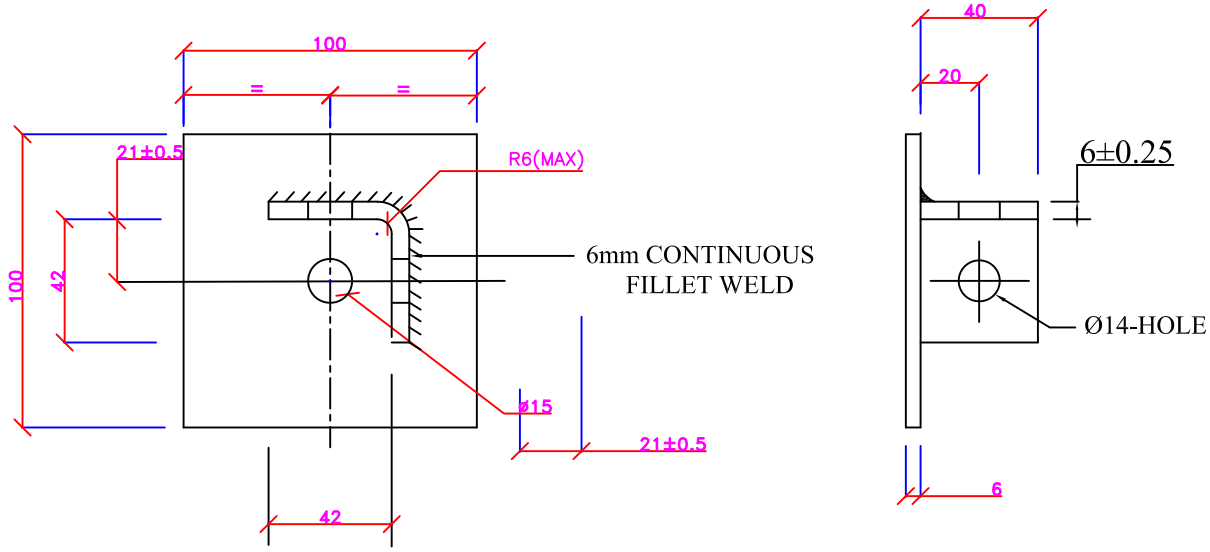
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :MILD STEEL AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS:2629
4. TOLERANCE ON THICKNESS AS PER IS:1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

ANCHOR FASTENER–2NOs.
SPRING NUT & WASHER–1NO.

BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540–001–215–PVE–C–046
		BHEL DRWG NO: PE–DG–497–507–E006
		REV.0 / SH 05 OF 37

ANNEXURE-II





BASE PLATE FOR SINGLE CHANNEL BP1

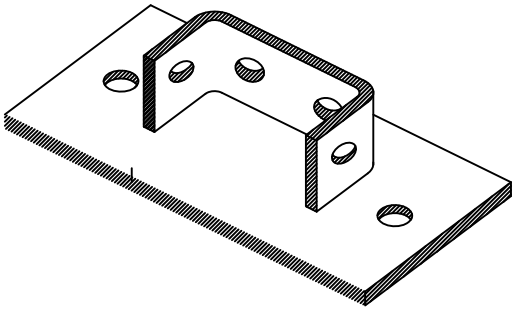
NOTE

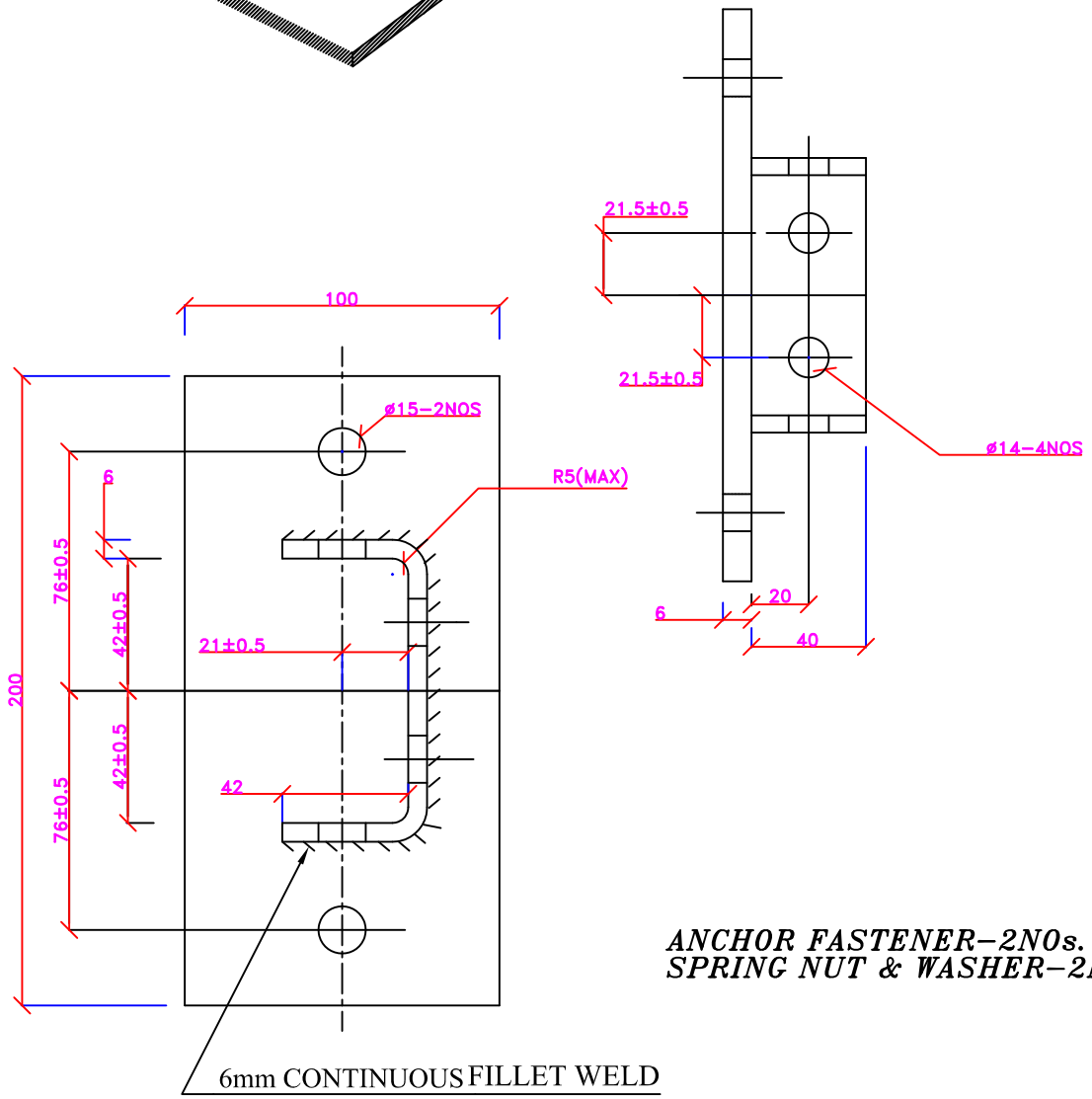
ANCHOR FASTENER–1NO.
SPRING NUT & WASHER–1NO.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :MILD STEEL AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS:2629
4. TOLERANCE ON THICKNESS AS PER IS:1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

BHEL	**TITLE:** TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540–001–215–PVE–C–046
		BHEL DRWG NO: PE–DG–497–507–E006
		REV.0 / SH 06 OF 37

ANNEXURE-II





ANCHOR FASTENER–2NOs.
SPRING NUT & WASHER–2NOs.

6mm CONTINUOUS FILLET WELD

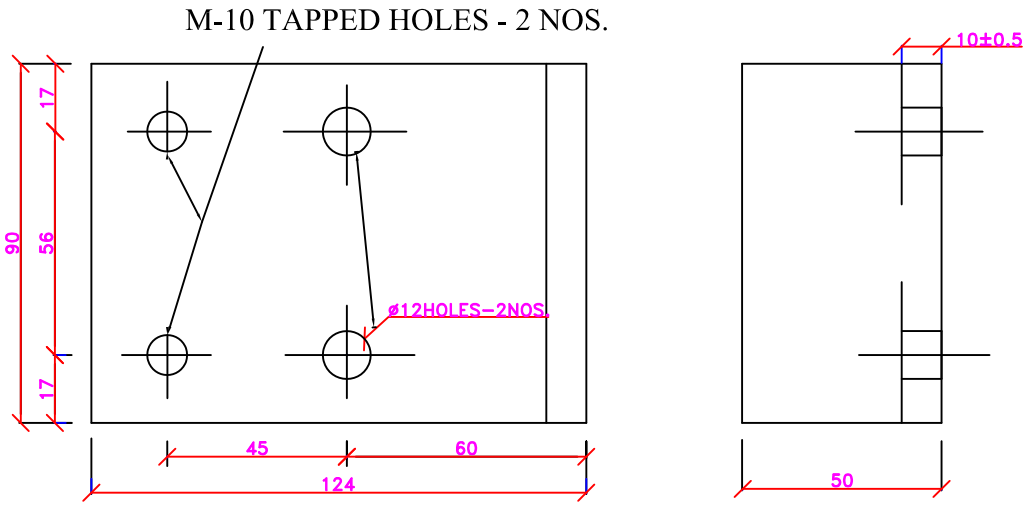
BASE PLATE FOR DOUBLE CHANNEL BP2

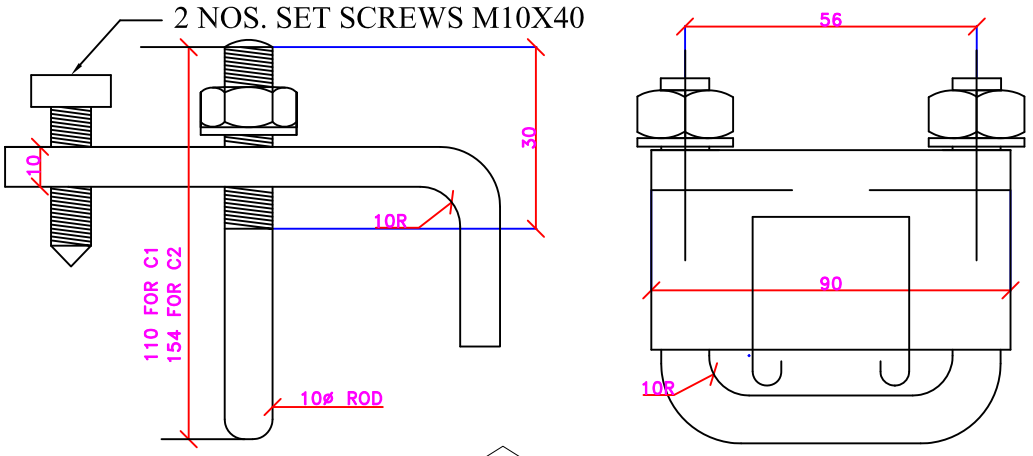
NOTE

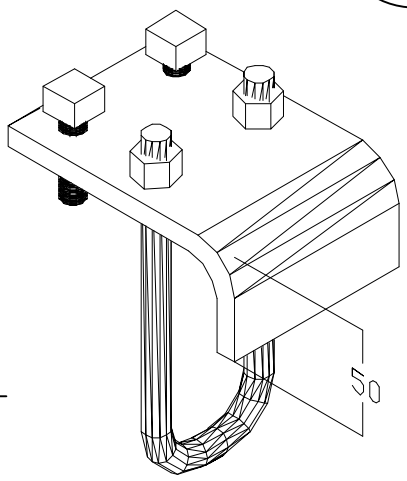
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :MILD STEEL AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS:2629
4. TOLERANCE ON THICKNESS AS PER IS:1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540–001–215–PVE–C–046
		BHEL DRWG NO: PE–DG–497–507–E006
		REV.0 / SH 07 OF 37

ANNEXURE-II







BEAM CLAMP - BC1

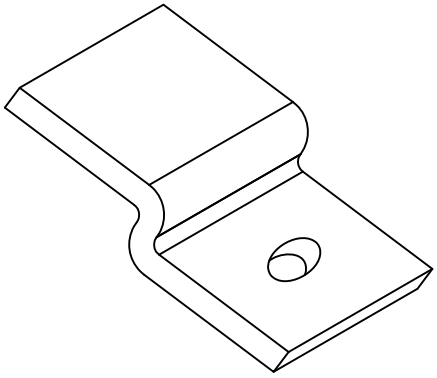
M-10 U-BOLT WITH
2Nos PLAIN WASHERS & NUTS
110 mm FOR SC 1
154 mm FOR DC1
2 NOs. SET SCREWS M10X40

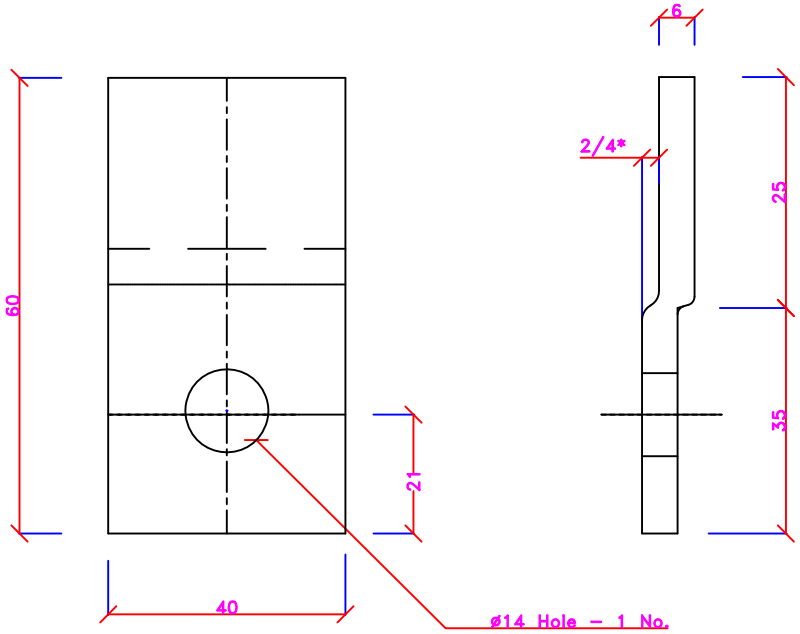
NOTES

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :MILD STEEL AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS:2629
4. TOLERANCE ON THICKNESS AS PER IS:1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 | SH 08 OF 37

ANNEXURE-II





TRAY FIXING CLAMP - TC1

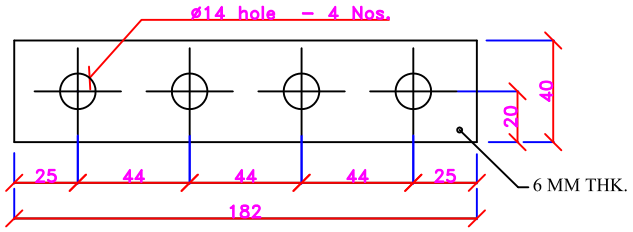
NOTES

SPRING NUT & WASHER–1NO.
** :–2MM FOR TRAY FIXING CLAMP TC1*
4MM FOR FRP–TRAY FIXING CLAMP

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :MILD STEEL AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS:2629
4. TOLERANCE ON THICKNESS AS PER IS:1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

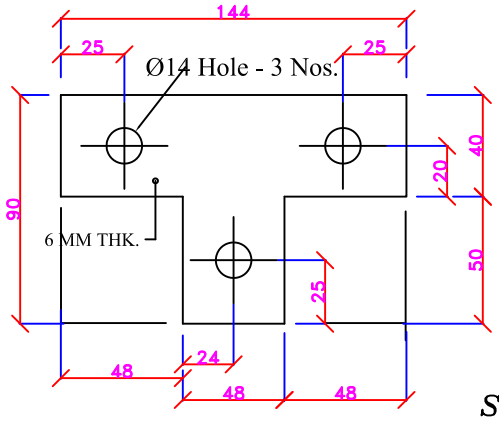
बीएचईएल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540–001–215–PVE–C–046
		BHEL DRWG NO: PE–DG–497–507–E006
		REV.0 / SH 09 OF 37

ANNEXURE-II



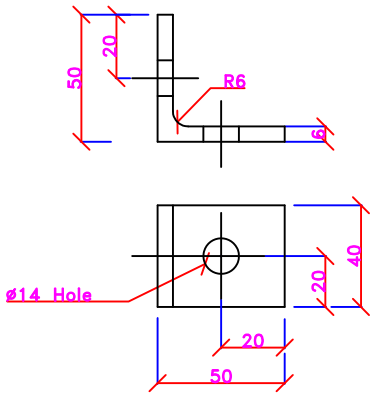
SPRING NUT & WASHER–4NOs.

FLAT PLATE STRAIGHT FITTING PF2



SPRING NUT & WASHER–3NOs.

FLAT PLATE TEE FITTING PF1



SPRING NUT & WASHER–2NOs.

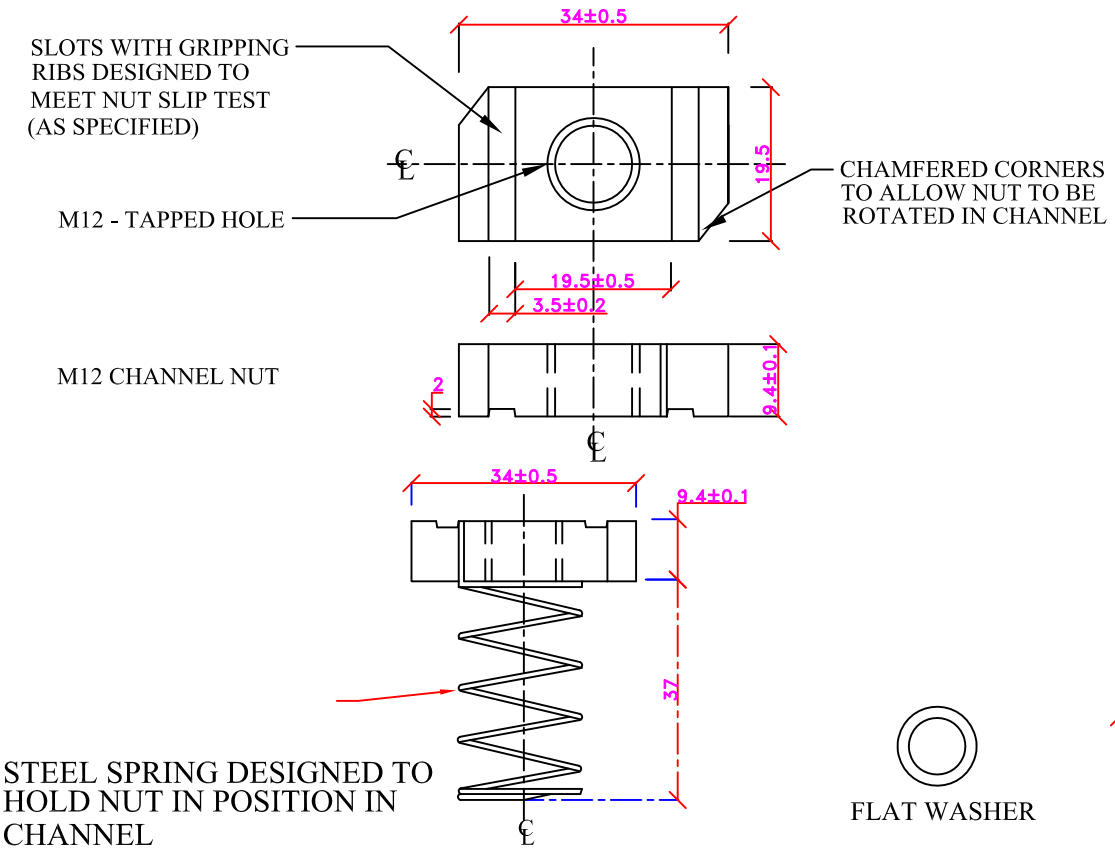
90^0 ANGLE FITTING LA1

NOTES

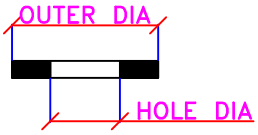
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :MILD STEEL AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS:2629
4. TOLERANCE ON THICKNESS AS PER IS:1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540–001–215–PVE–C–046
		BHEL DRWG NO: PE–DG–497–507–E006
		REV.0 | SH 10 OF 37

ANNEXURE-II



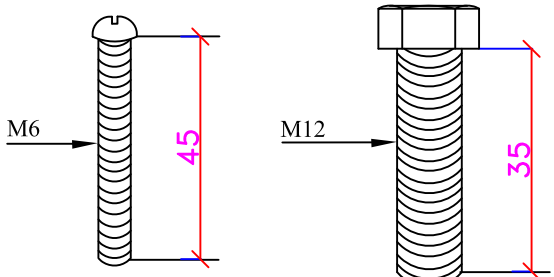
SPRING NUT ASSEMBLY



TYPICAL DETAILS OF WASHER

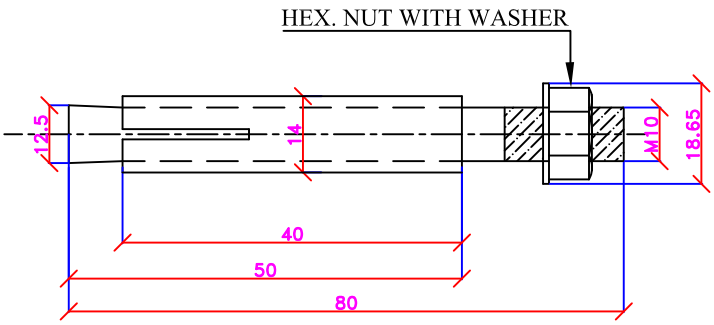
WASHER SIZE DETAILS

Sl.No.	BOLT/SCREW SIZE	HOLE DIA (IN MM)	OUTER DIA (IN MM)	WAHER THICKNESS (IN MM)
1	M6 PAN HEAD SCREW	6.4	12	1.6
2	M12 HEXA BOLT	13	24	2.5



PAN HEAD SCREW

HEX BOLT



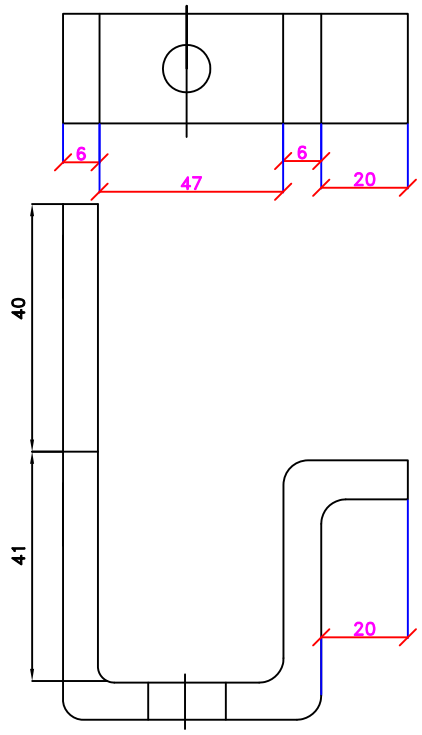
ANCHOR BOLT M10

NOTES:

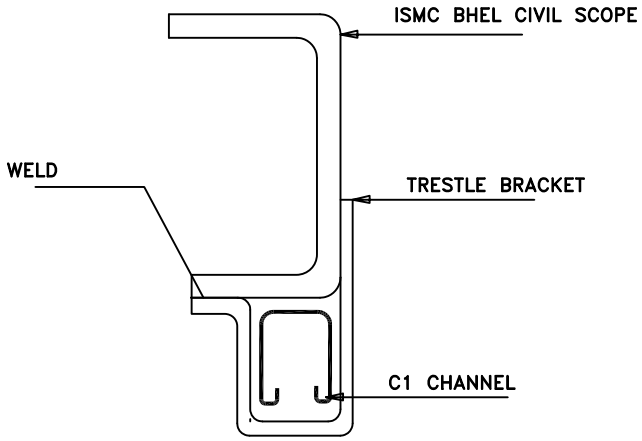
1. MATERIAL - MS AS PER IS - 2062.
2. M6 CHANNEL NUT DIMENSIONAL SIMILAR TO M12. EXCEPT HOLE DRILLED AND TAPPED TO M6 PAN HEAD SCREWS.
3. TAPPED HOLE THREADING TO MATCH WITH THREADING OF BOLTS.
4. SURFACE PROTECTION ELECTROGALVANISED / CADMIUM PLATED.
5. ALL DIMENSIONS ARE IN MM.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

BHEL	**TITLE:** TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 11 OF 37

ANNEXURE-II



TRESTLE BRAKET



FIXING ARRANGMENT OF TRESTLE BRACKET

NOTES

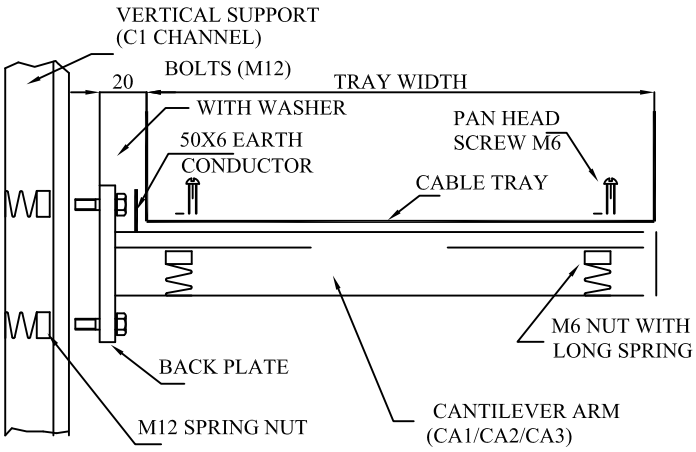
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :MILD STEEL AS PER IS-2062
3. FINISH : HOT DIP GALVANISED AS PER IS:2629
4. TOLERANCE ON THICKNESS AS PER IS:1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRONS/ 610 G/SQ. M.

TITLE:	TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 12 OF 37

ANNEXURE-II

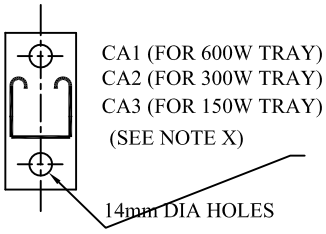
INDEX

ANNEXURE-II

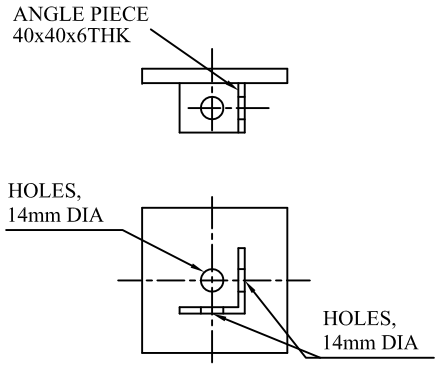


TYPICAL ASSEMBLY OF CHANNEL SUPPORTS AND CABLE TRAY

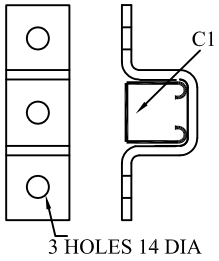
1) 600mm TRAY-1 T0 6 TIER -C2
2) 300mm TRAY-1 T0 3 TIER -C1
3) 300mm TRAY-4 T0 6 TIER -C2
4) 150mm TRAY-1 T0 6 TIER -C1



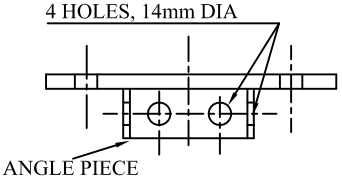
END VIEW OF CANTILEVER ARM

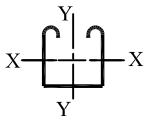


BASE PLATE FOR SINGLE CHANNEL (BP1)

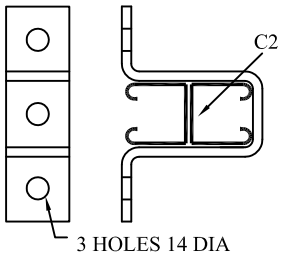


C1 CHANNEL CLAMP (CC1)

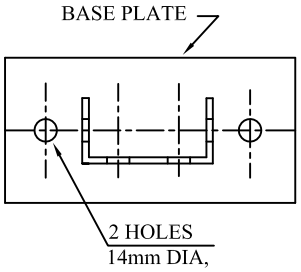




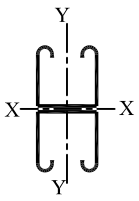
SECTION OF C1 (SINGLE CHANNEL)



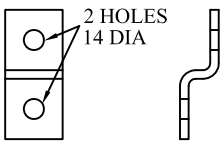
C2 CHANNEL CLAMP (CC2)



BASE PLATE FOR DOUBLE CHANNEL (BP2)



SECTION OF C2 (DOUBLE CHANNEL)

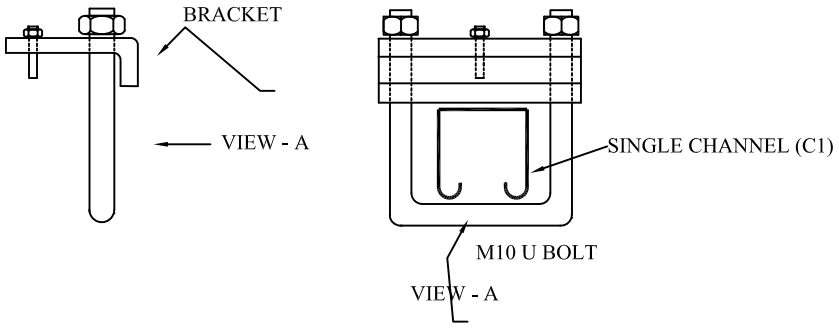


TRAY CLAMP (TC1)
(SEE NOTE VI)

TYPICAL SUPPORT SYSTEM ELEMENTS

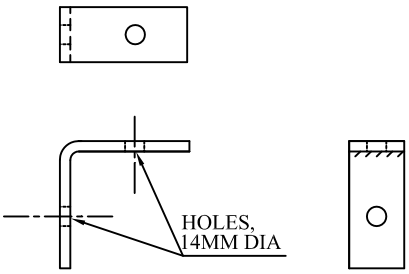
BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 14 OF 37

ANNEXURE-II

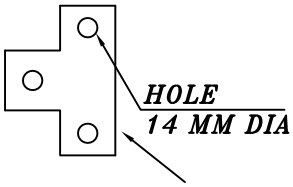


BEAM CLAMP (BC1)

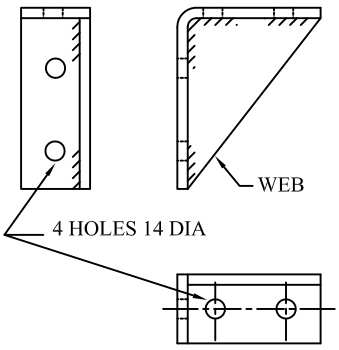
(SEE FIXING DETAIL ON SHEET 30)



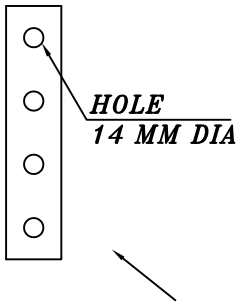
ANGLE FITTING (LA1)



FLAT PLATE TEE FITTING (PF1)



HEAVY DUTY RIGHT ANGLE FITTING HL1

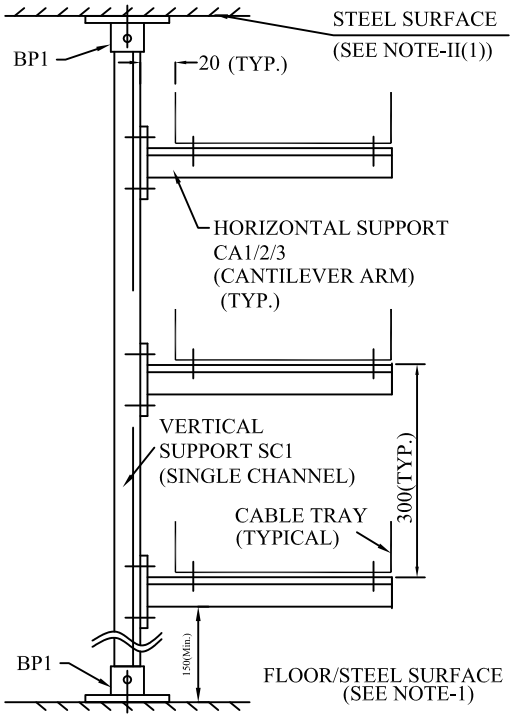


FLAT PLATE STRAIGHT FITTING PF2

TYPICAL SUPPORT SYSTEM ELEMENTS

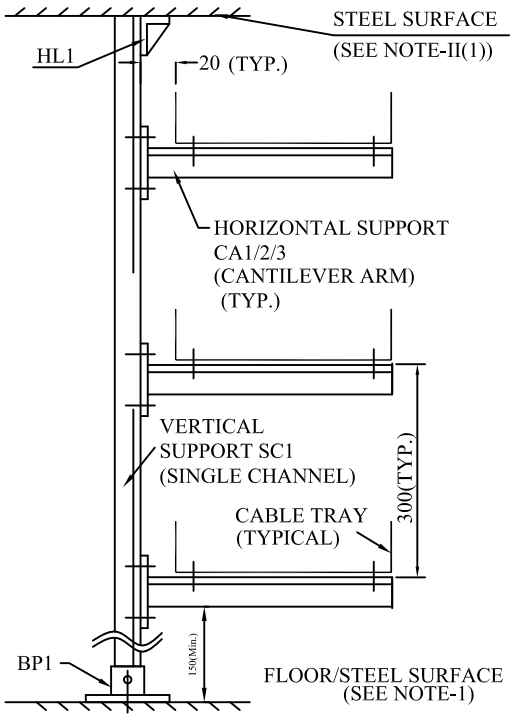
TITLE:	TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 15 OF 37

ANNEXURE-II



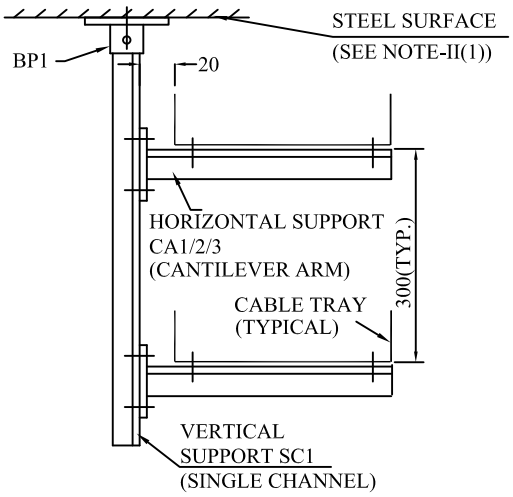
INSTALLATION DETAIL TYPE SB1:
SINGLE CHANNEL SUPPORT INSTALLATION
BOTH ENDS FIXED, TRAYS ON SINGLE SIDE
WITH BP1 AT TOP BOTTOM
APPLICABLE FOR THREE TRAYS AND MORE

(SEE NOTE IX)



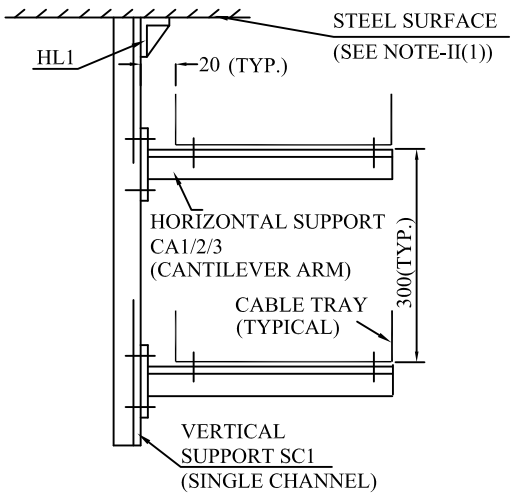
INSTALLATION DETAIL TYPE SB2:
SINGLE CHANNEL SUPPORT INSTALLATION
BOTH ENDS FIXED, TRAYS ON SINGLE SIDE
WITH HL1 AT TOP & BP1 AT BOTTOM
APPLICABLE FOR THREE TRAYS AND MORE

(SEE NOTE IX)



INSTALLATION DETAIL TYPE SS1:
SINGLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED, TRAYS ON SINGLE SIDE
WITH BASEPLATE BP1 AT TOP
APPLICABLE FOR UPTO & INCLUDING TWO TRAYS

(SEE NOTE IX)

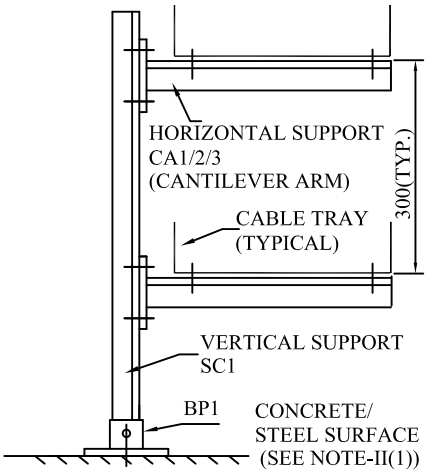


INSTALLATION DETAIL TYPE SS2:
SINGLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED, TRAYS ON SINGLE SIDE
WITH ANGLE FITTING HL1 AT TOP
APPLICABLE FOR UPTO & INCLUDING TWO TRAYS

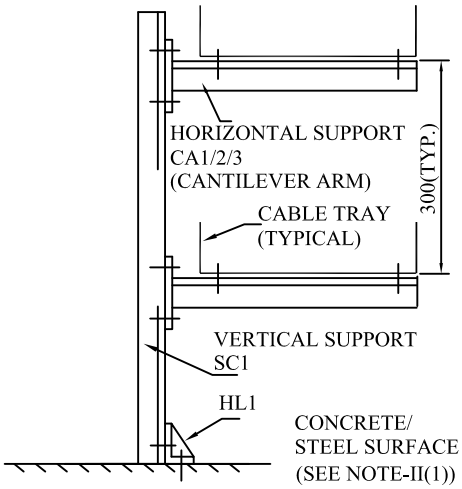
(SEE NOTE IX)

भेल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 16 OF 37

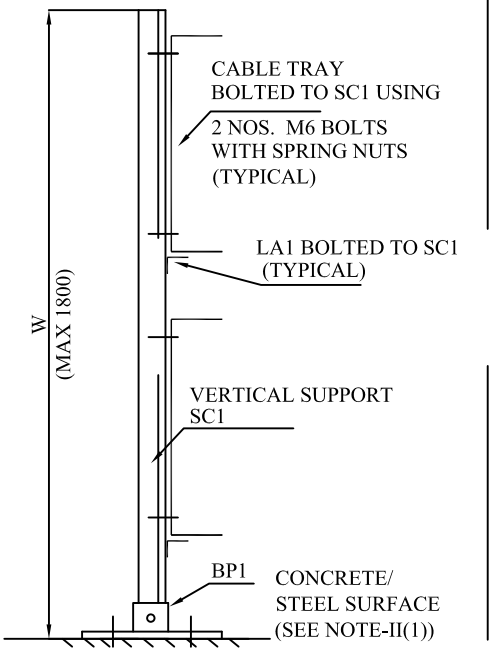
ANNEXURE-II



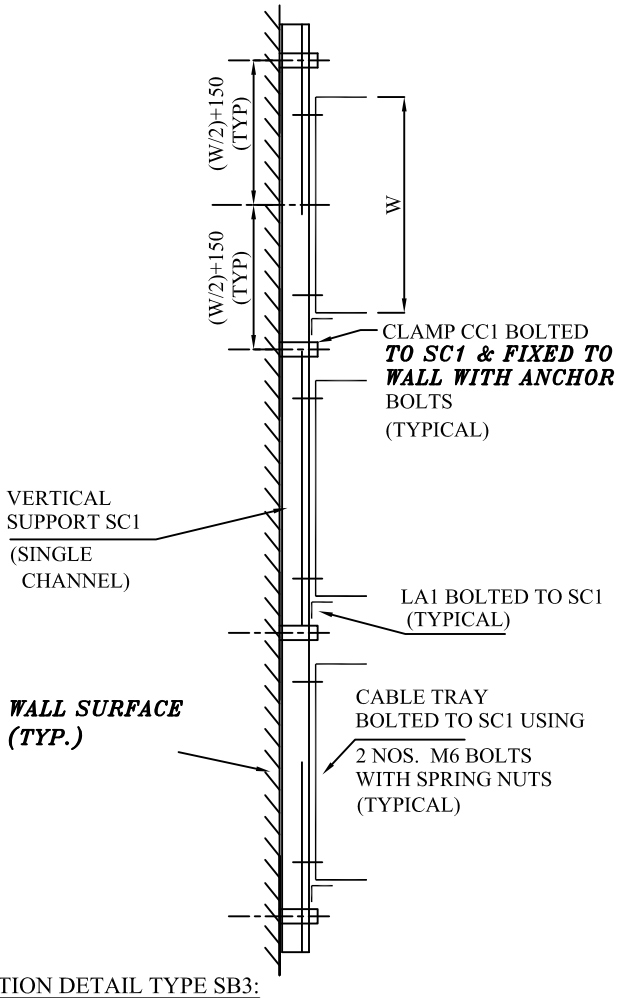
INSTALLATION DETAIL TYPE SS3:
SINGLE CHANNEL SUPPORT INSTALLATION
ONLY BOTTOM END FIXED TRAYS ON SINGLE SIDE
BASEPLATE BP1 AT BOTTOM
APPLICABLE FOR UPTO & INCLUDING TWO TRAYS



INSTALLATION DETAIL TYPE SS4:
SINGLE CHANNEL SUPPORT INSTALLATION
ONLY BOTTOM END FIXED TRAYS ON SINGLE SIDE
WITH ANGLE FITTING HL1 AT BOTTOM
APPLICABLE FOR UPTO & INCLUDING TWO TRAYS



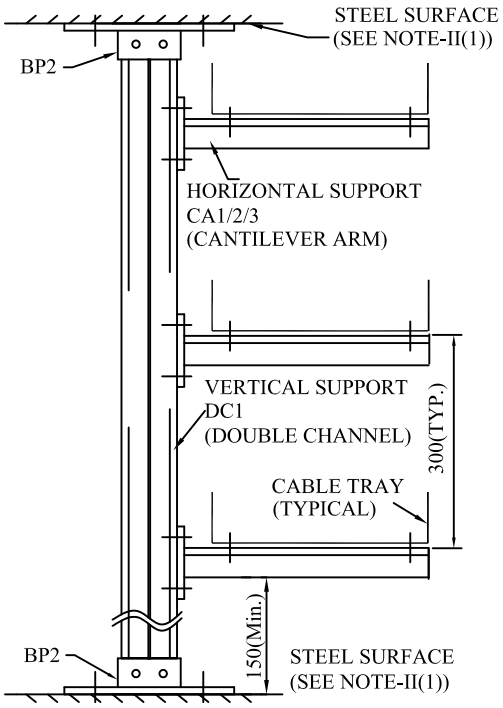
INSTALLATION DETAIL TYPE SS5:
SINGLE CHANNEL SUPPORT INSTALLATION
ONLY BOTTOM END FIXED,
TRAYS ORIENTED VERTICALLY
BASEPLATE AT BOTTOM
APPLICABLE FOR UPTO &
INCLUDING TWO TRAYS



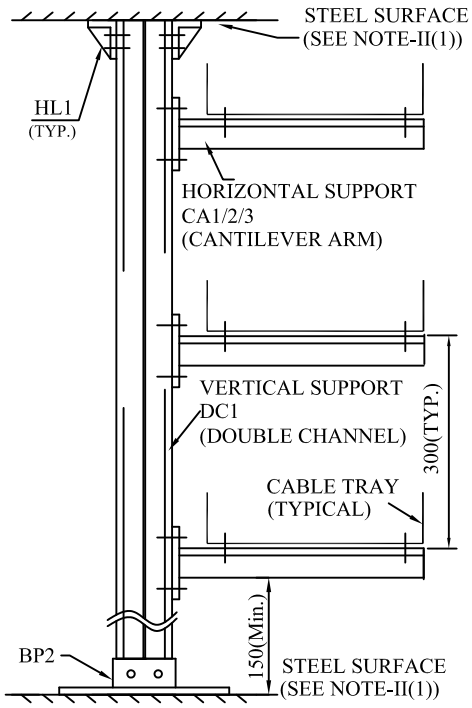
INSTALLATION DETAIL TYPE SB3:
SINGLE CHANNEL SUPPORT INSTALLATION, BOTH ENDS FIXED
TRAYS ON SINGLE SIDE, APPLICABLE FOR SUPPORTING TRAYS
IN VERTICAL ORIENTATION ALONG BUILDING WALLS

बीएचईएल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 17 OF 37

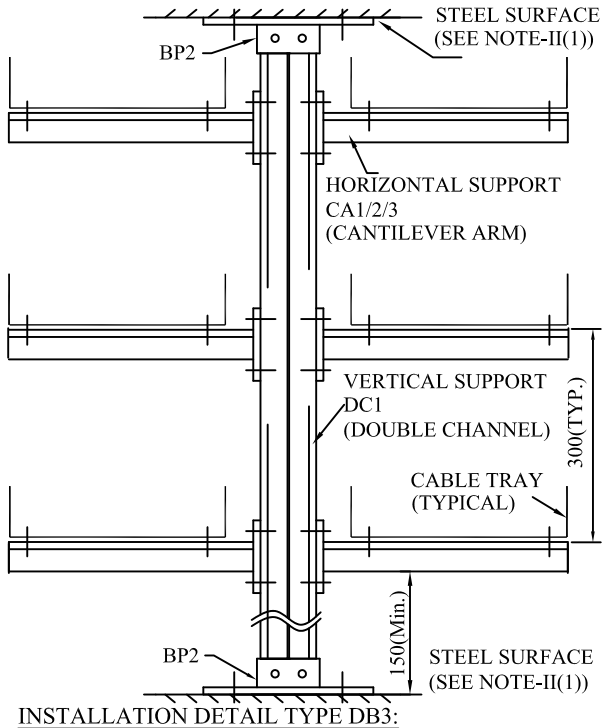
ANNEXURE-II



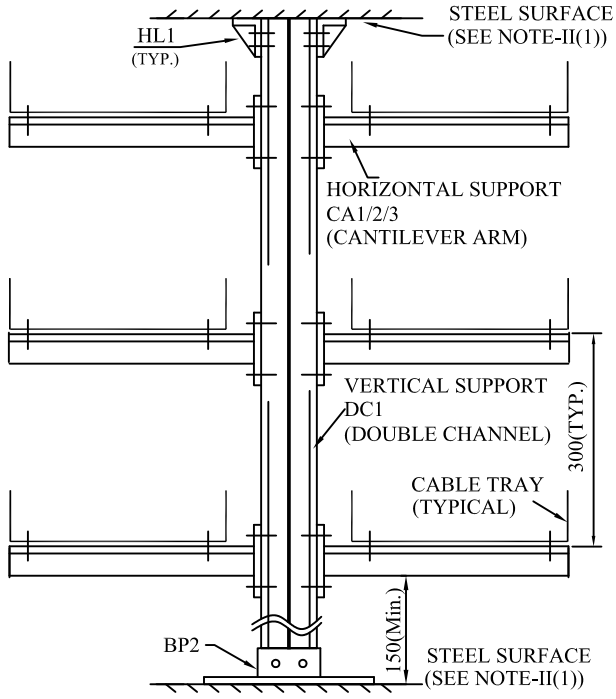
INSTALLATION DETAIL TYPE DB1:
DOUBLE CHANNEL SUPPORT INSTALLATION
BOTH ENDS FIXED, TRAYS ON SINGLE SIDE
WITH BASEPLATE BP2 AT TOP & BOTTOM
APPLICABLE FOR MORE THAN THREE TRAYS
(SEE NOTE IX)



INSTALLATION DETAIL TYPE DB2:
DOUBLE CHANNEL SUPPORT INSTALLATION
BOTH ENDS FIXED, TRAYS ON SINGLE SIDE
WITH HL1 AT TOP & BP2 AT BOTTOM
APPLICABLE FOR MORE THAN THREE TRAYS
(SEE NOTE IX)



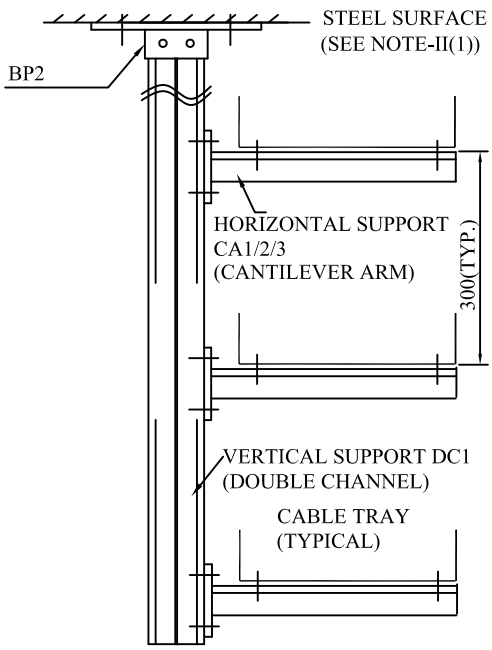
INSTALLATION DETAIL TYPE DB3:
DOUBLE CHANNEL SUPPORT INSTALLATION
BOTH ENDS FIXED, TRAYS ON BOTH SIDES
WITH BASEPLATE BP2 AT TOP & BOTTOM
(SEE NOTE IX)



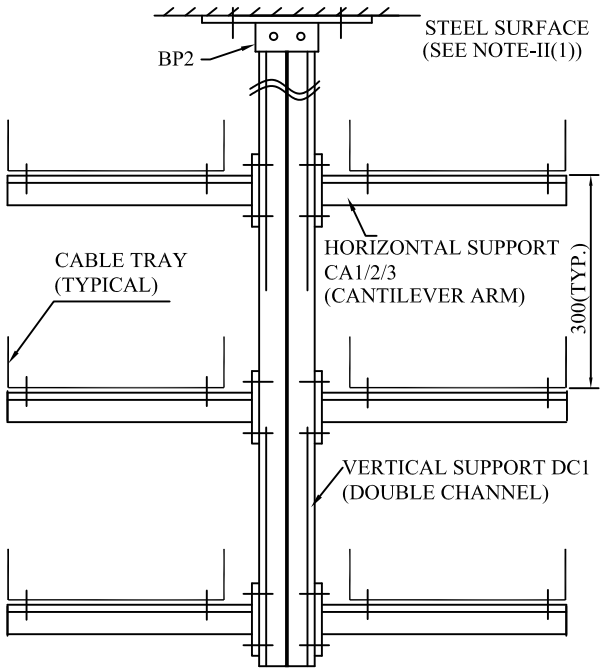
INSTALLATION DETAIL TYPE DB4:
DOUBLE CHANNEL SUPPORT INSTALLATION
BOTH ENDS FIXED, TRAYS ON BOTH SIDES
WITH HL1 AT TOP & BP2 AT BOTTOM
(SEE NOTE IX)

भेल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 SH 18 OF 37

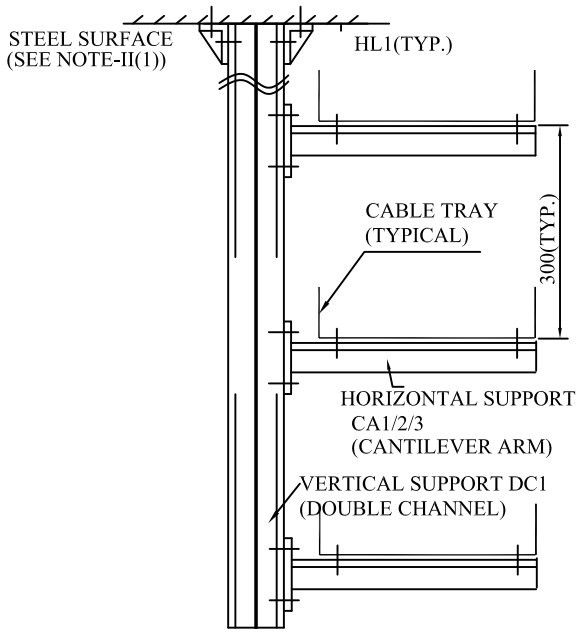
ANNEXURE-II



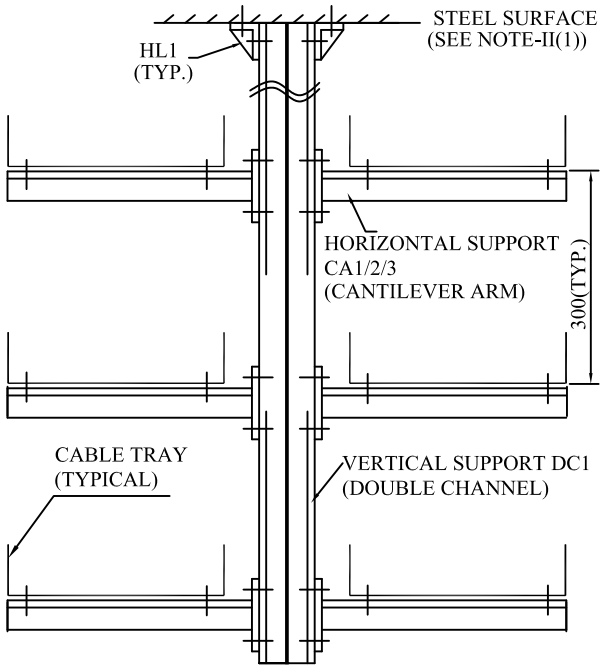
INSTALLATION DETAIL TYPE DS1:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED
BASEPLATE AT TOP
APPLICABLE FOR THREE TRAYS ON SINGLE SIDE
(SEE NOTE IX)



INSTALLATION DETAIL TYPE DS2:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED
BASEPLATE AT TOP
APPLICABLE FOR UPTO THREE TRAYS ON BOTH SIDES
(SEE NOTE IX)



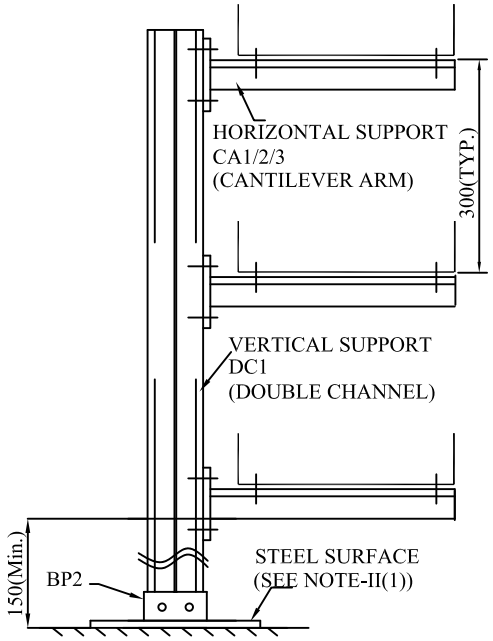
INSTALLATION DETAIL TYPE DS3:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED
WITH ANGLE FITTING HL1 AT TOP
APPLICABLE FOR MORE THAN TWO TRAYS
ON SINGLE SIDE
(SEE NOTE IX)



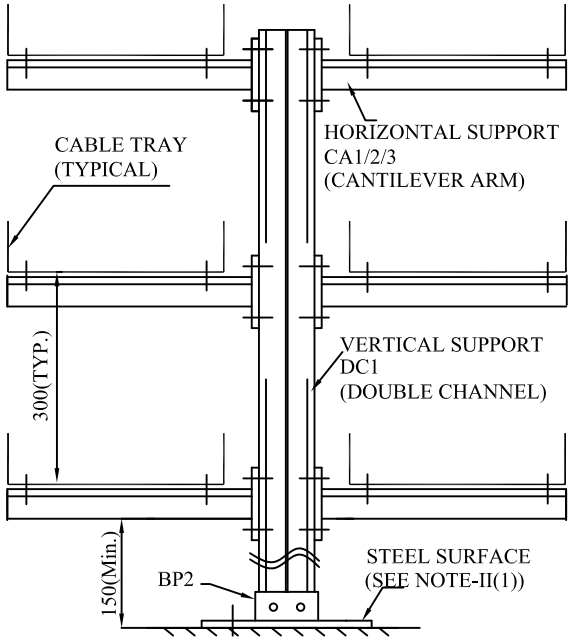
INSTALLATION DETAIL TYPE DS4:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED
WITH ANGLE FITTING HL1 AT TOP
APPLICABLE FOR UPTO THREE TRAYS ON BOTH SIDES
(SEE NOTE IX)

बीएचईएल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 SH 19 OF 37

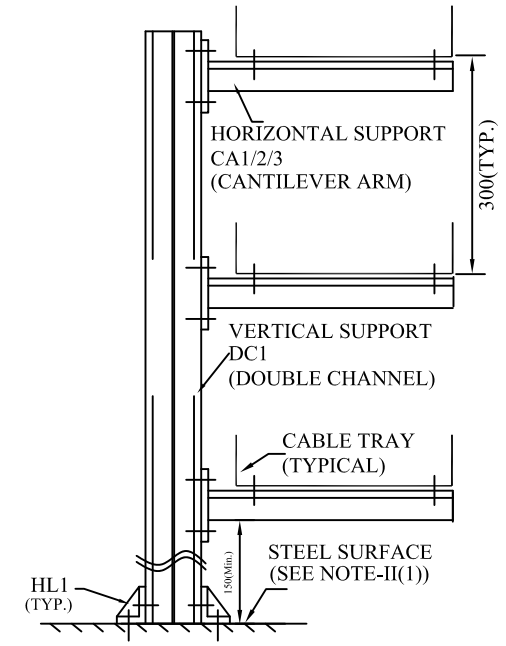
ANNEXURE-II



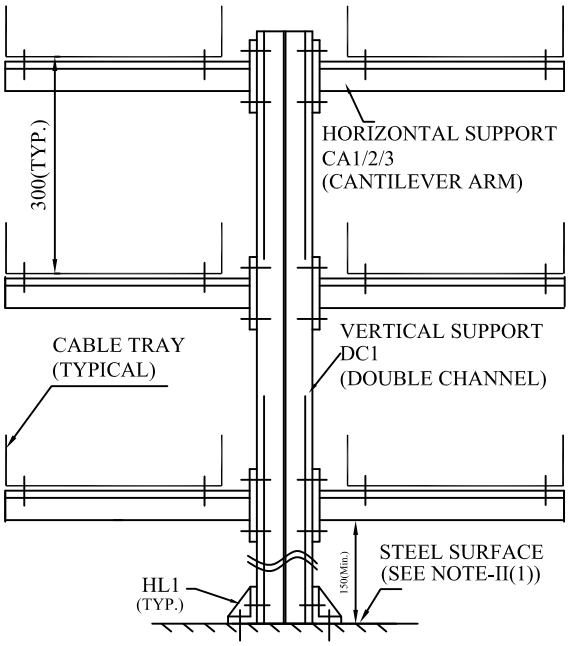
INSTALLATION DETAIL TYPE DS5:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY BOTTOM END FIXED TRAYS ON SINGLE SIDE
BASEPLATE AT BOTTOM



INSTALLATION DETAIL TYPE DS6:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY BOTTOM END FIXED
UPTO THREE TRAYS ON BOTH SIDES
BASEPLATE AT BOTTOM



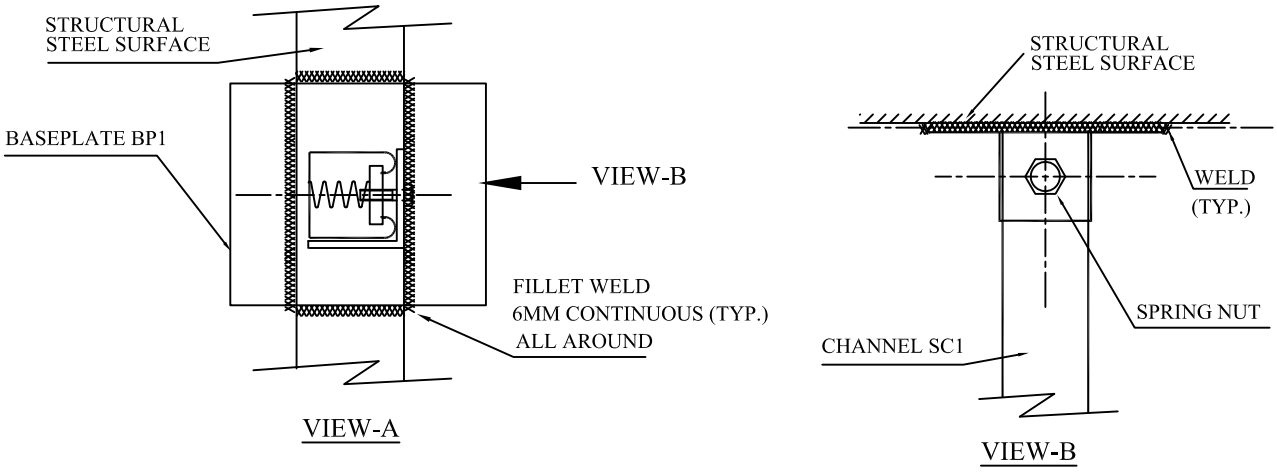
INSTALLATION DETAIL TYPE DS7:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY BOTTOM END FIXED TRAYS ON SINGLE SIDE
WITH ANGLE FITTING HL1 AT BOTTOM

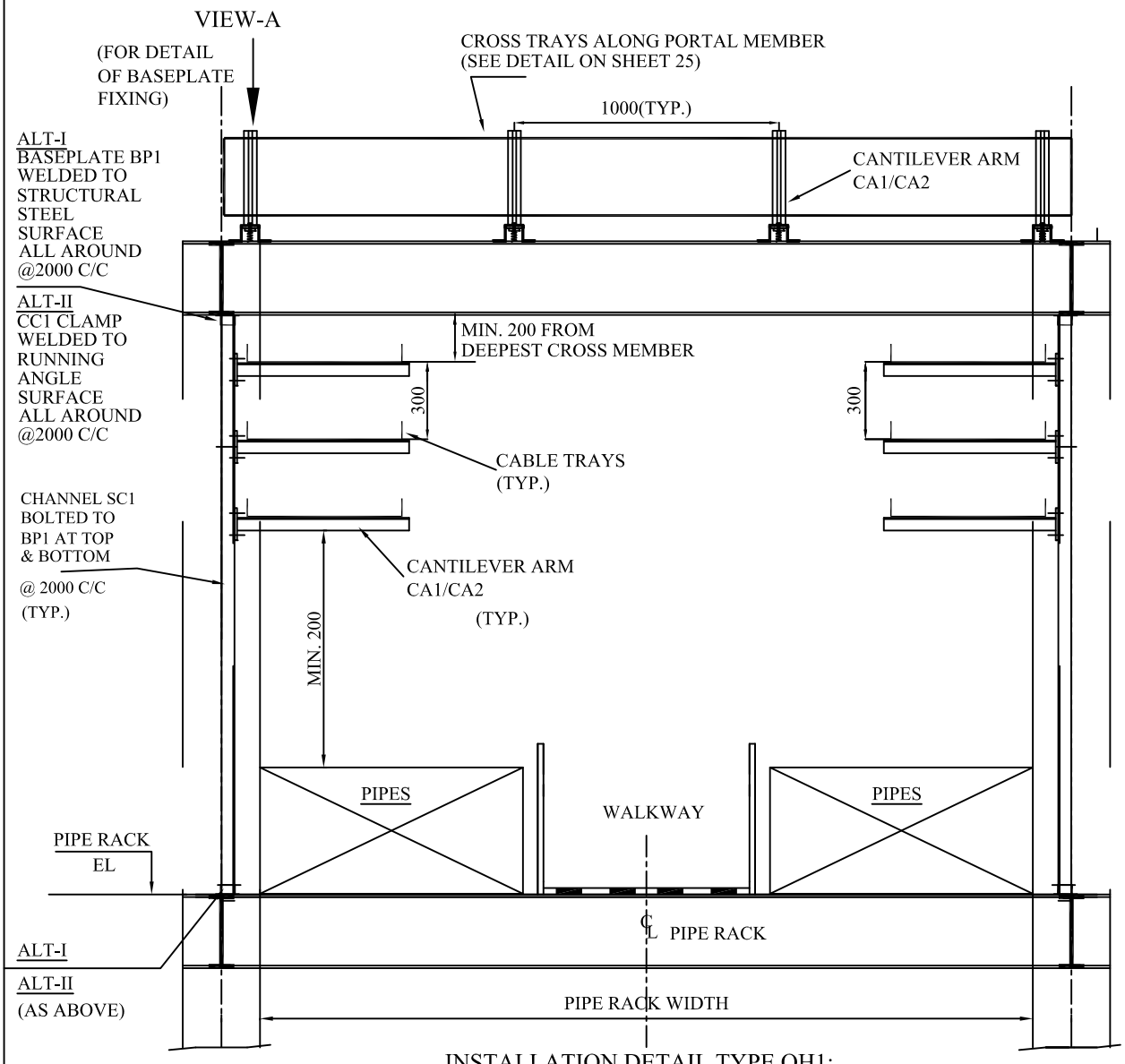


INSTALLATION DETAIL TYPE DS8:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY BOTTOM END FIXED
UPTO THREE TRAYS ON BOTH SIDES
WITH ANGLE FITTING HL1 AT BOTTOM

बीएचईएल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 20 OF 37

ANNEXURE-II

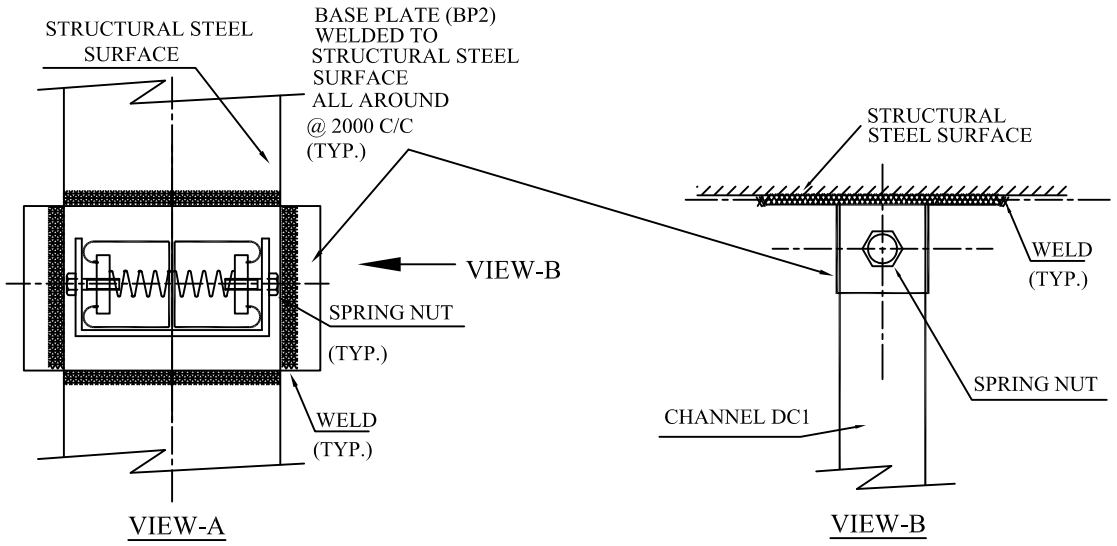


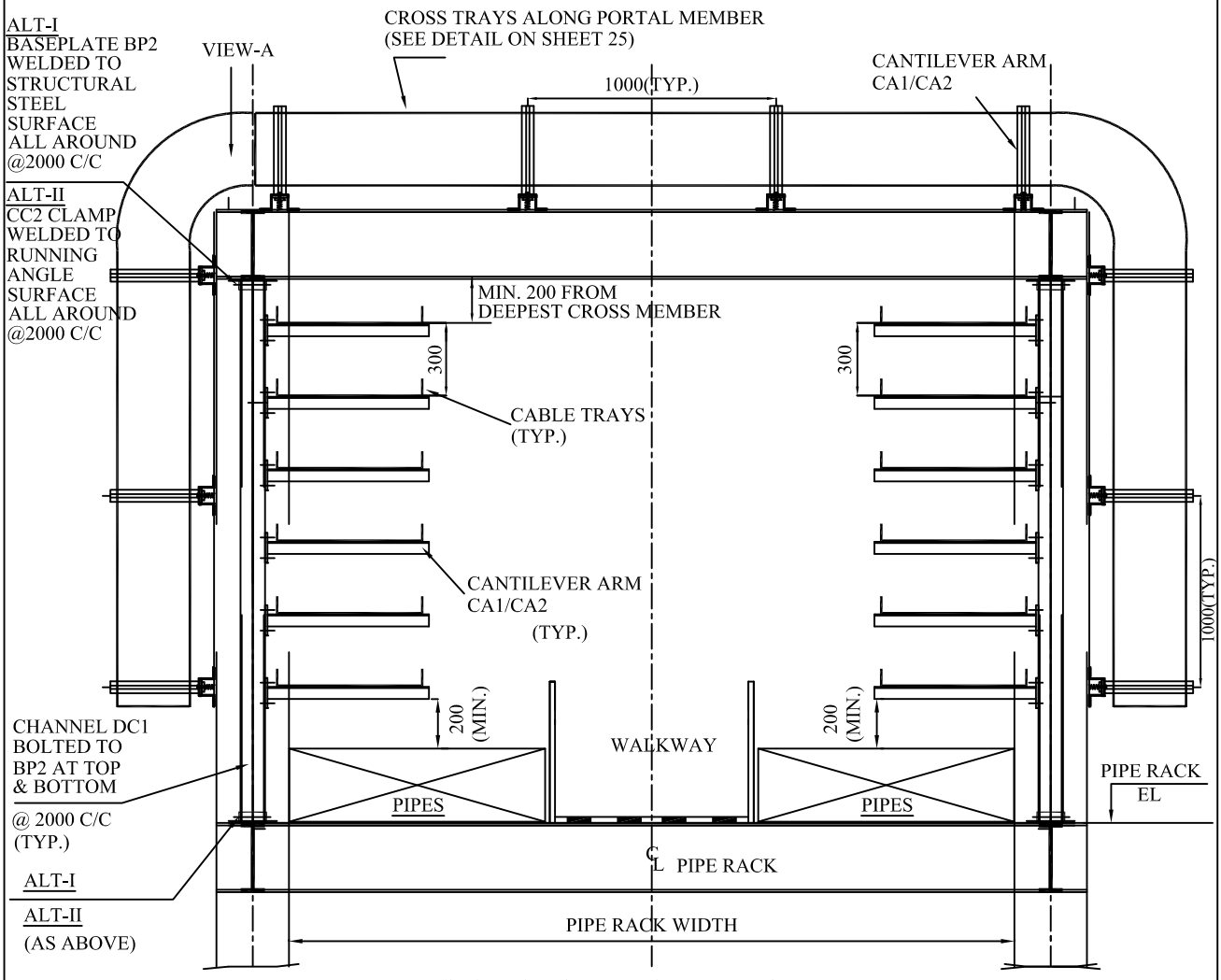


INSTALLATION DETAIL TYPE OH1:
TYPICAL TRAY SUPPORT ARRANGEMENT ALONG PIPERACK
(UPTO AND INCLUDING THREE TRAYS) (SEE NOTE IX)

BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 21 OF 37

ANNEXURE-II

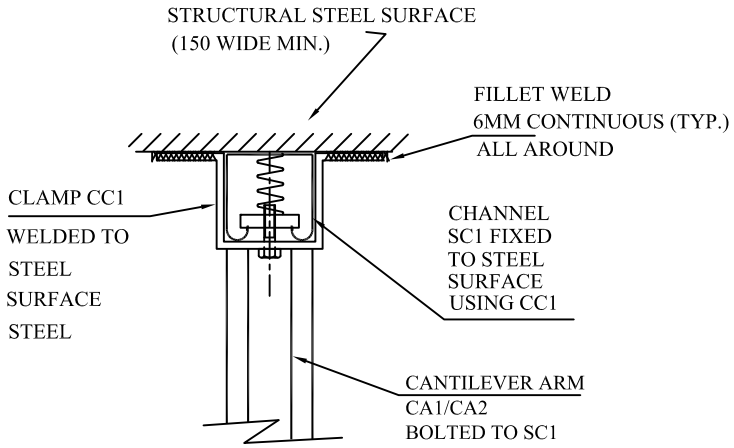




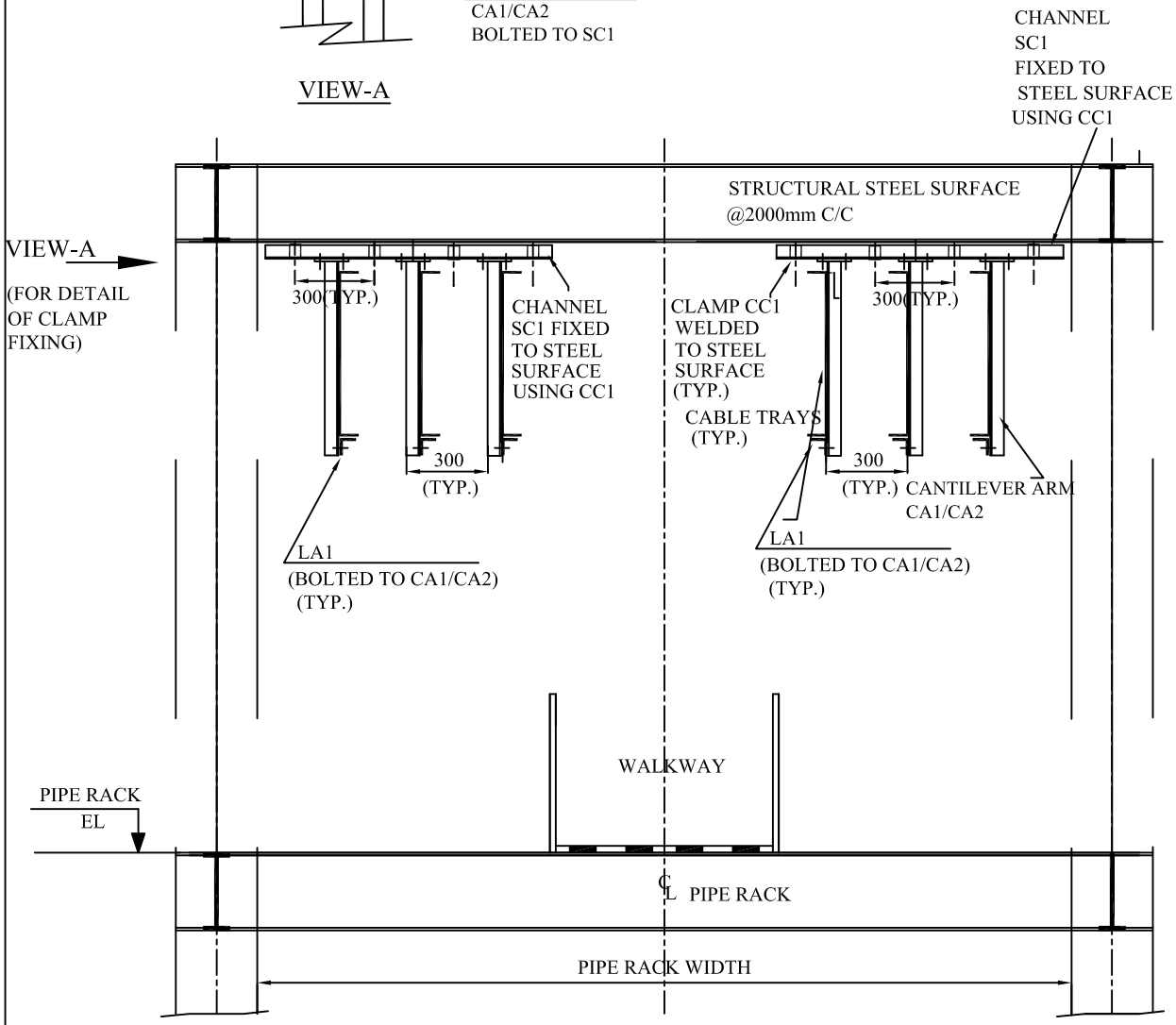
INSTALLATION DETAIL TYPE OH2:
TYPICAL TRAY SUPPORT ARRANGEMENT ALONG PIPERACK
(MORE THAN THREE TRAYS)
(SEE NOTE IX)

TITLE:	TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 22 OF 37

ANNEXURE-II



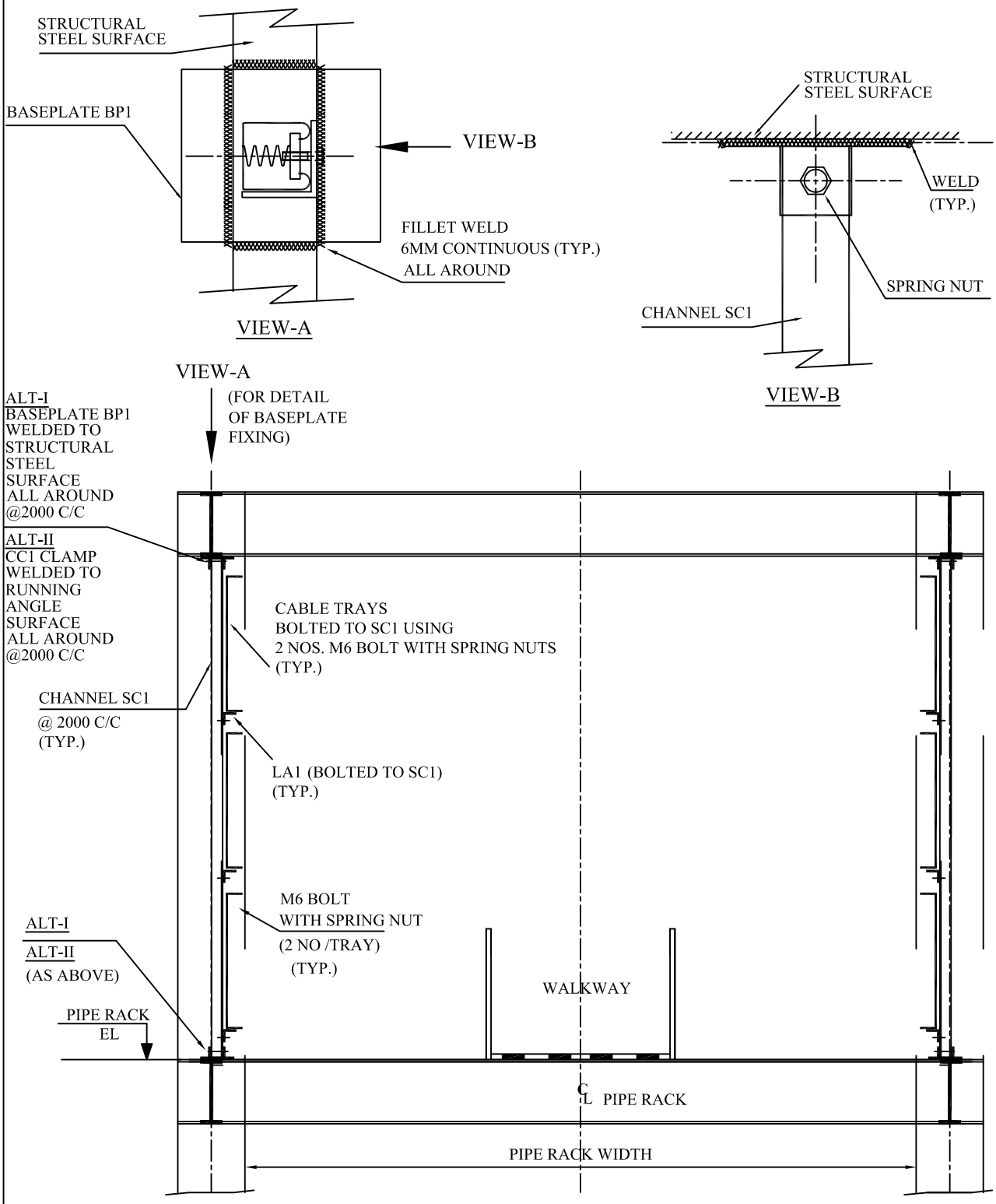
VIEW-A



INSTALLATION DETAIL TYPE OV1
TYPICAL VERTICALLY ORIENTED TRAY SUPPORT ARRANGEMENT ALONG PIPERACK

TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046	
	BHEL DRWG NO: PE-DG-497-507-E006	
	REV.0	SH 23 OF 37

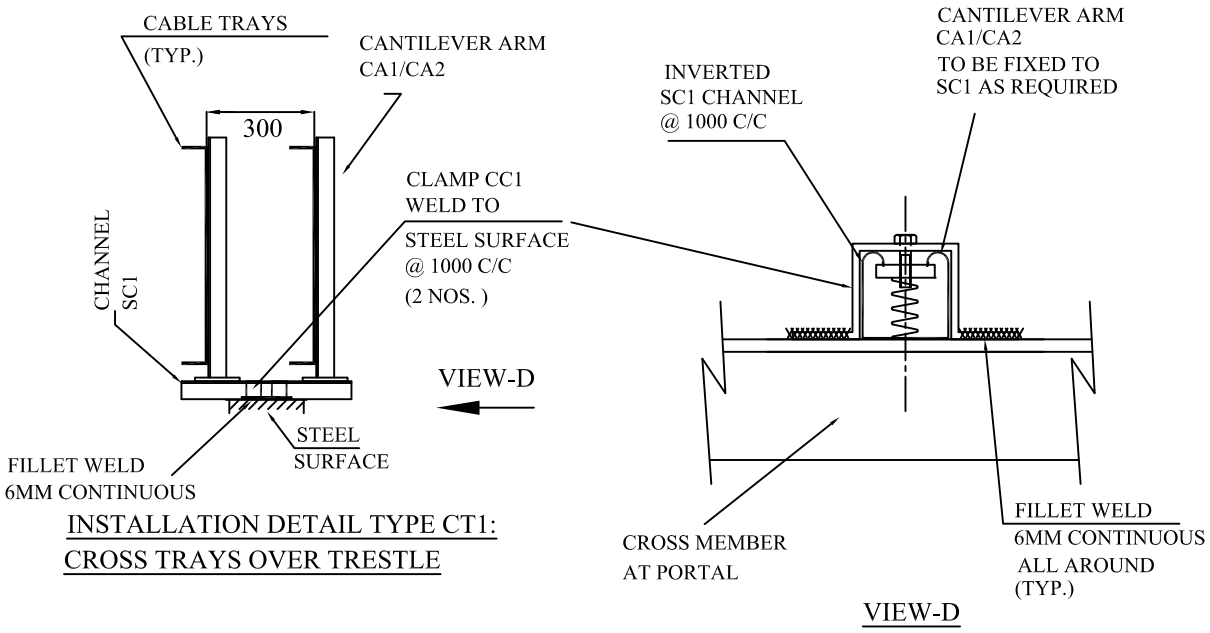
ANNEXURE-II



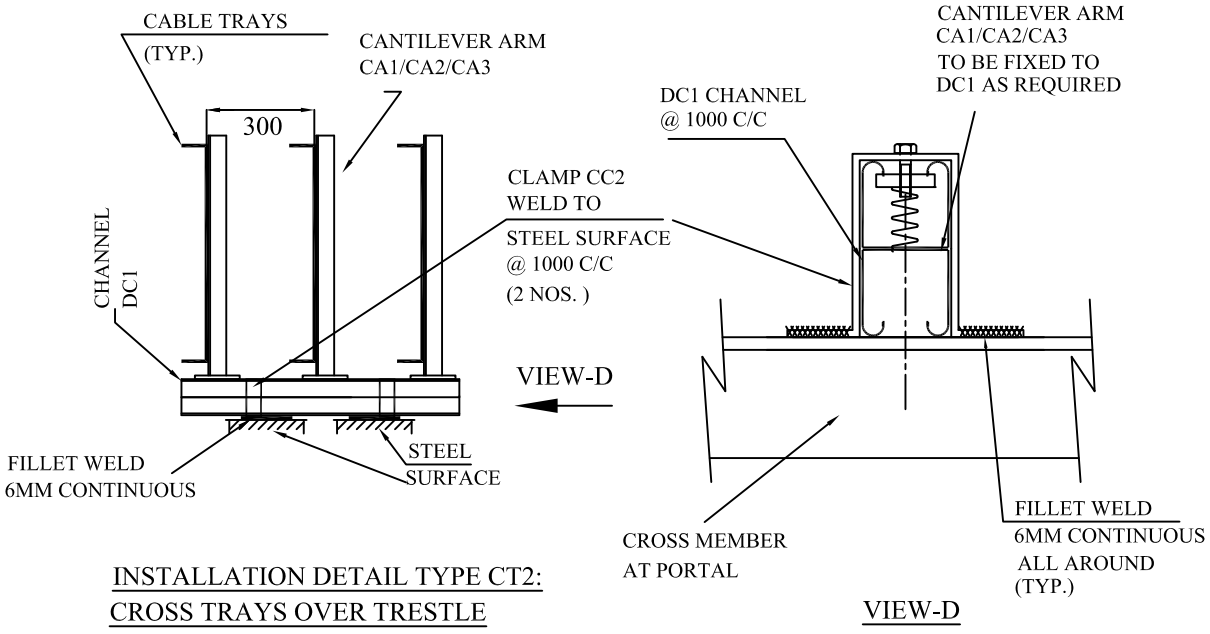
INSTALLATION DETAIL TYPE OV2:
VERTICALLY ORIENTED TRAY SUPPORT ARRANGEMENT ALONG PIPERACK (USING BP1)
(SEE NOTE IX)

TITLE:	TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 24 OF 37

ANNEXURE-II

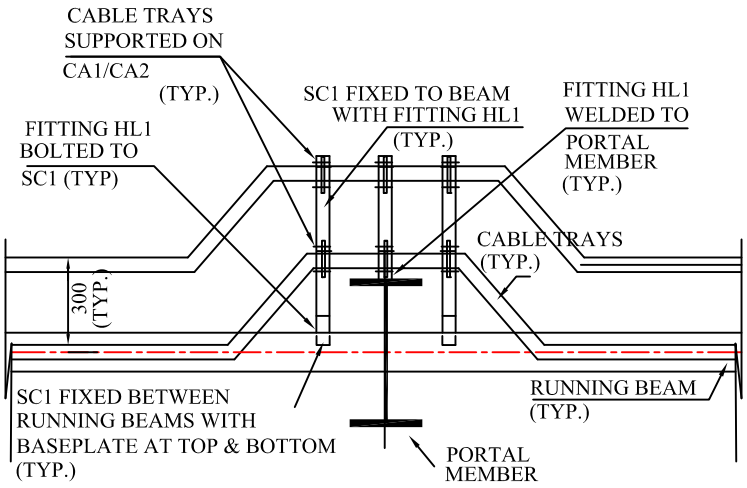


INSTALLATION DETAIL TYPE CT1:
CROSS TRAYS OVER TRESTLE

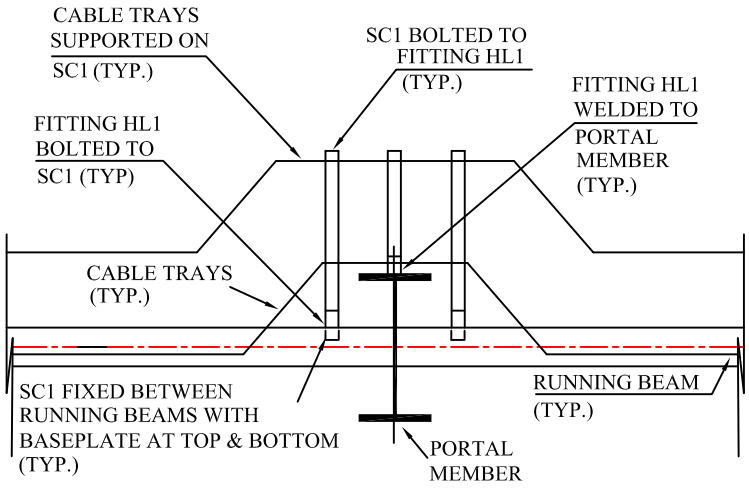


INSTALLATION DETAIL TYPE CT2:
CROSS TRAYS OVER TRESTLE

बीएचईएल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
		BHEL DRWG NO: PE-DG-497-507-E006
		REV.0 / SH 25 OF 37



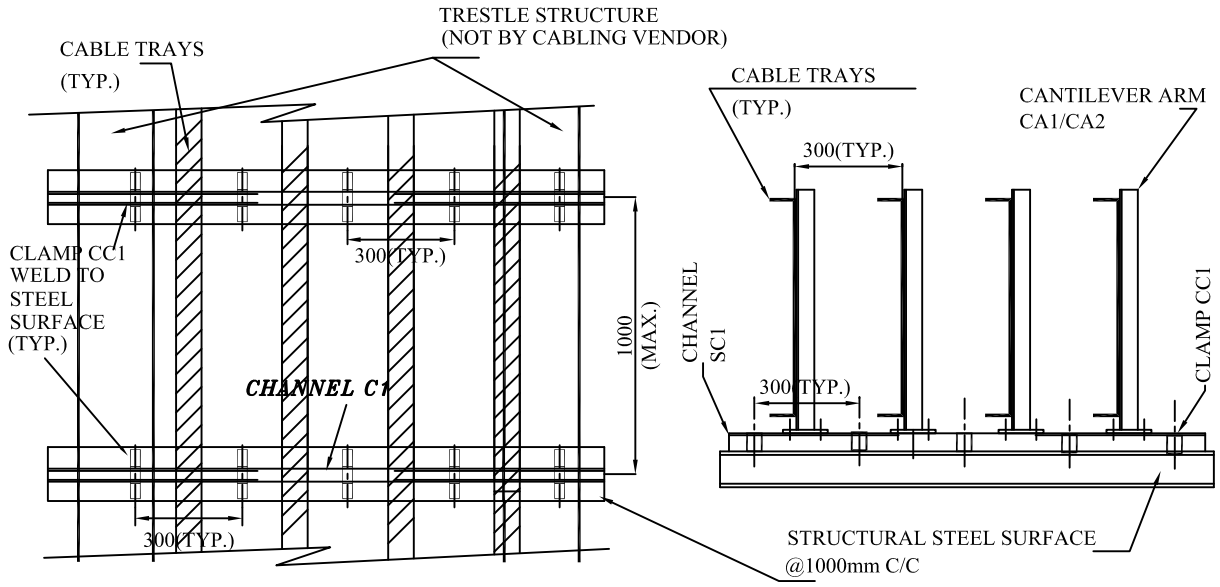
INSTALLATION DETAIL TYPE PM1:
CABLE TRAYS ROUTED AROUND PORTAL MEMBER
FOR VERTICALLY ORIENTED TRAYS
(SEE NOTE-III(3))



INSTALLATION DETAIL TYPE PM2:
CABLE TRAYS ROUTED AROUND PORTAL MEMBER
FOR HORIZONTALLY ORIENTED TRAYS
(SEE NOTE-III(3))

TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046	
	BHEL DRWG NO: PE-DG-497-507-E006	
	REV.0	SH 26 OF 37

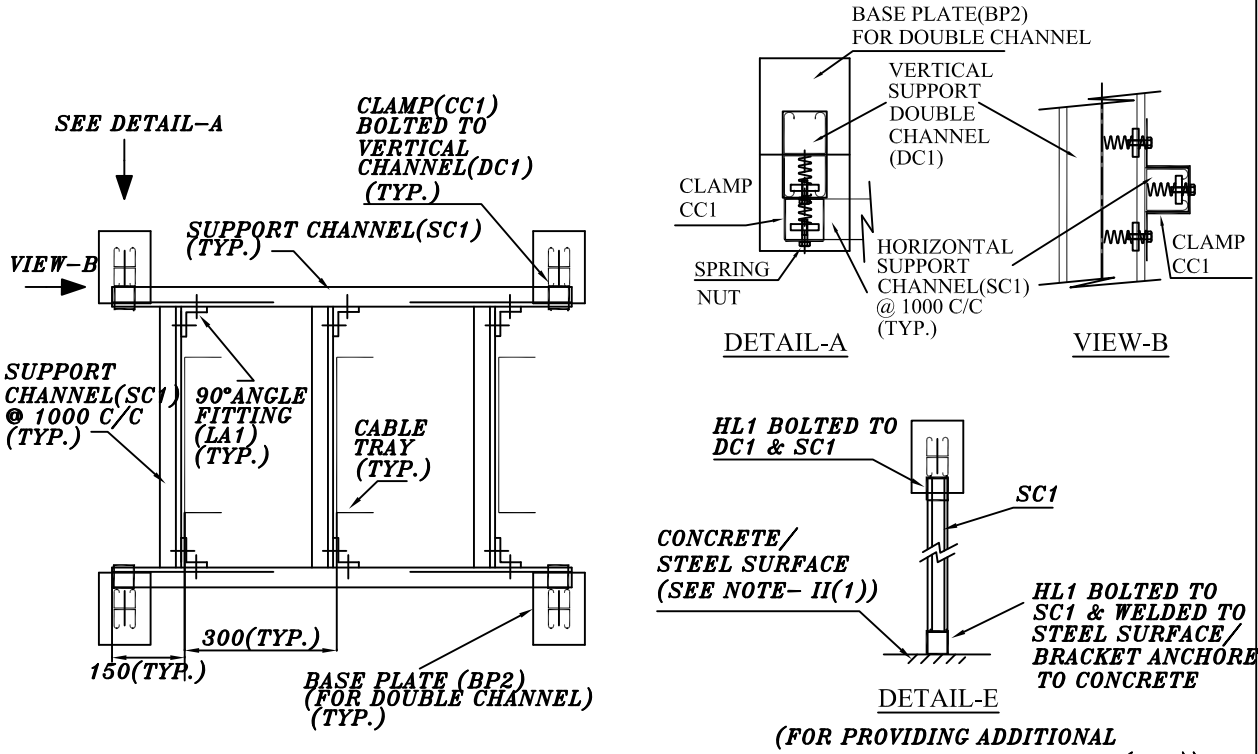
ANNEXURE-II



ELEVATION

PLAN

INSTALLATION DETAIL TYPE CR1:
RISER ALONG STRUCTURAL STEEL



DETAIL-A

VIEW-B

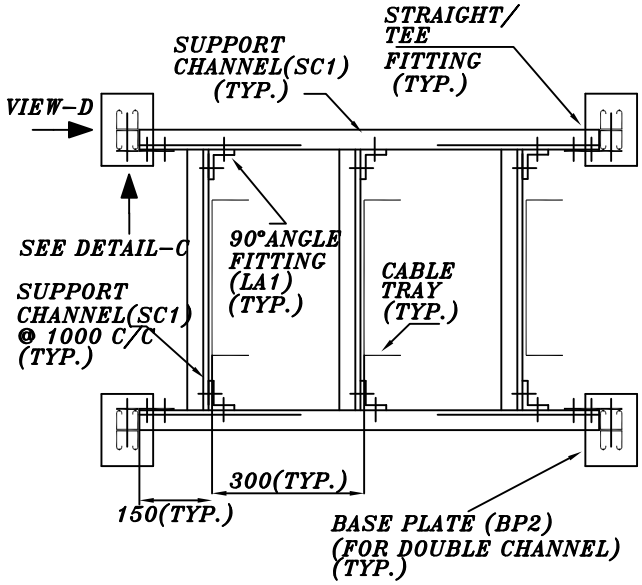
DETAIL-E

(FOR PROVIDING ADDITIONAL
SUPPORT TO RISER COLUMN (DC1))
(SEE NOTE– V)

INSTALLATION DETAIL TYPE CR2:
(USING CC1 CLAMPS UPTO 3 TRAYS)

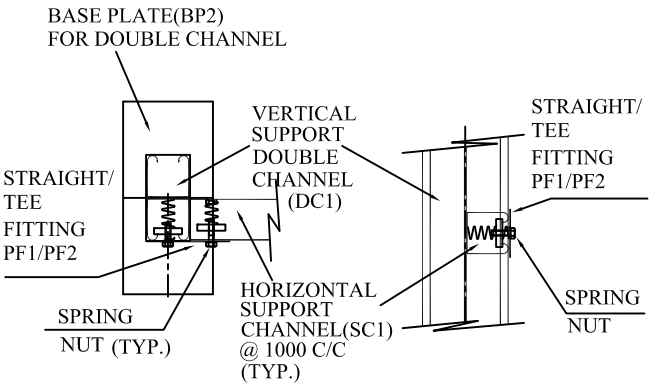
(TYPICAL CHANNEL FRAME WORK FOR CABLE TRAY RISER
UPTO & INCLUDING THREE CABLE TRAYS)

भेल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540–001–215–PVE–C–046
		BHEL DRWG NO: PE–DG–497–507–E006
		REV.0 / SH 27 OF 37

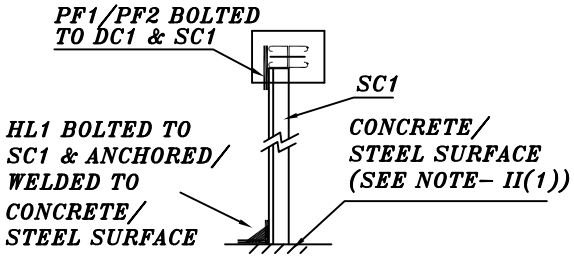


INSTALLATION DETAIL TYPE CR3:
(USING FITTINGS PF1/PF2)

(TYPICAL CHANNEL FRAME WORK FOR CABLE TRAY RISER UPTO & INCLUDING THREE CABLE TRAYS)



DETAIL-C VIEW-D



DETAIL-F

(FOR PROVIDING ADDITIONAL SUPPORT TO RISER COLUMN (DC1))
(SEE NOTE- V)

BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
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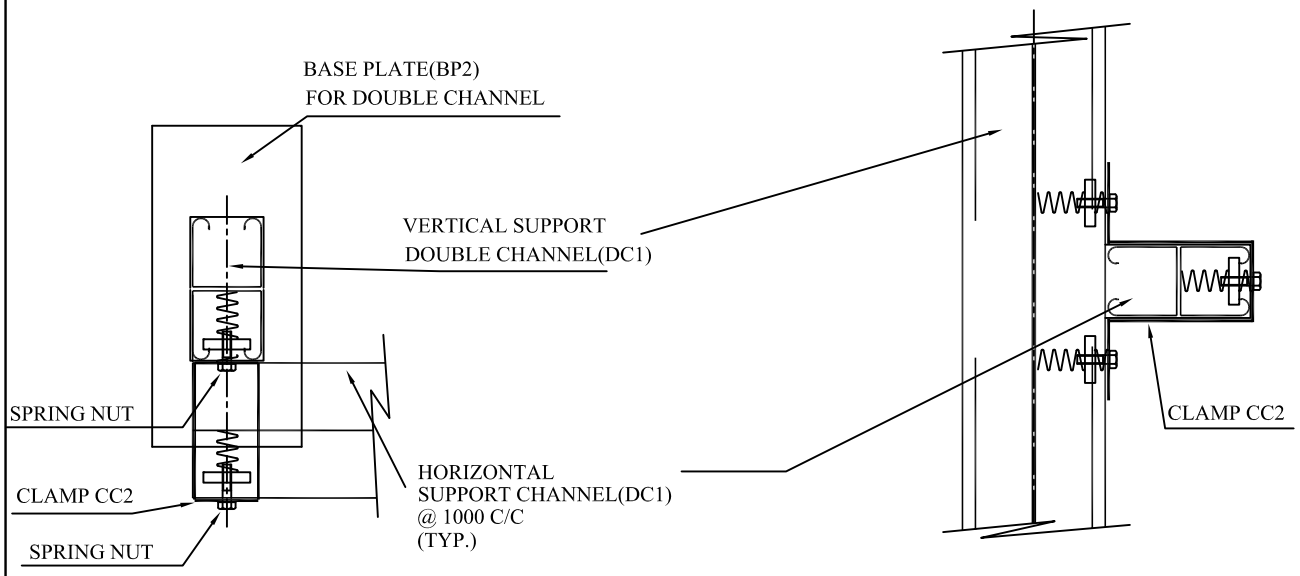
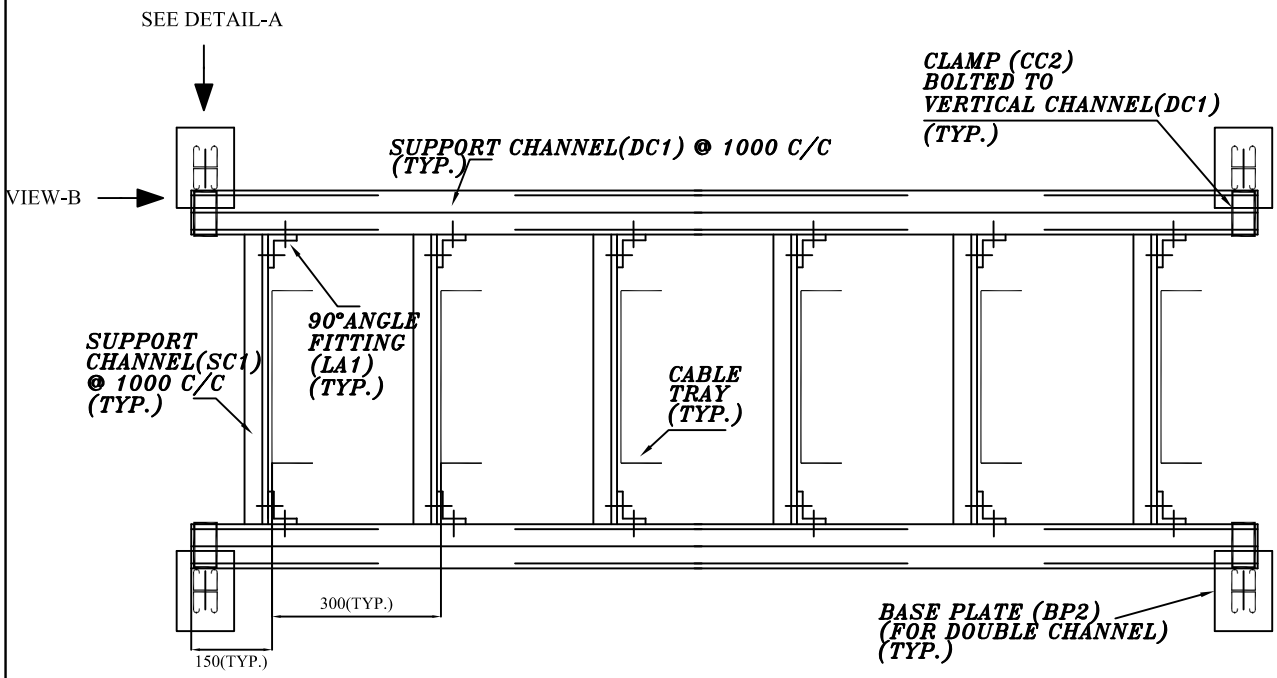
ANNEXURE-II





INSTALLATION DETAIL TYPE CR4:
TYPICAL CHANNEL FRAME WORK FOR CABLE TRAY RSIER
(FOR MORE THAN THREE CABLE TRAYS)

भेल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
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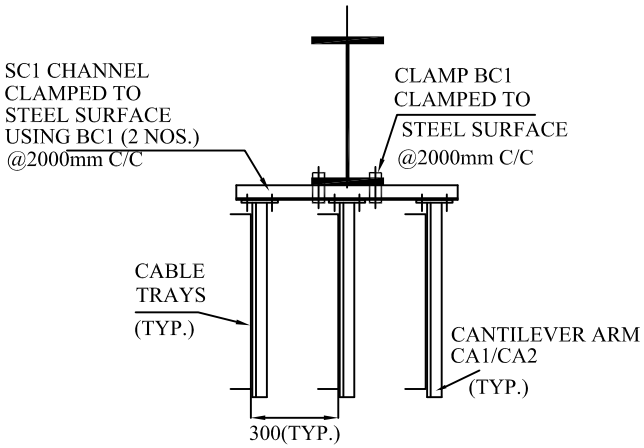
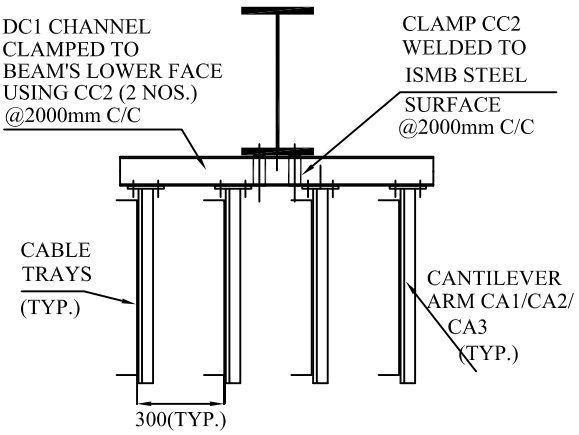
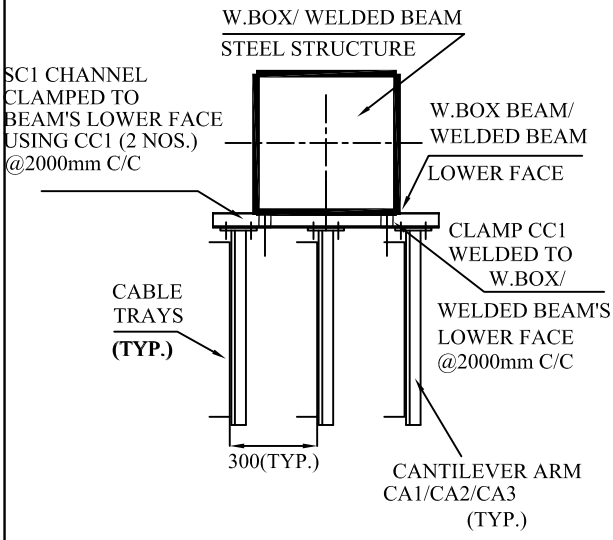
ANNEXURE-II



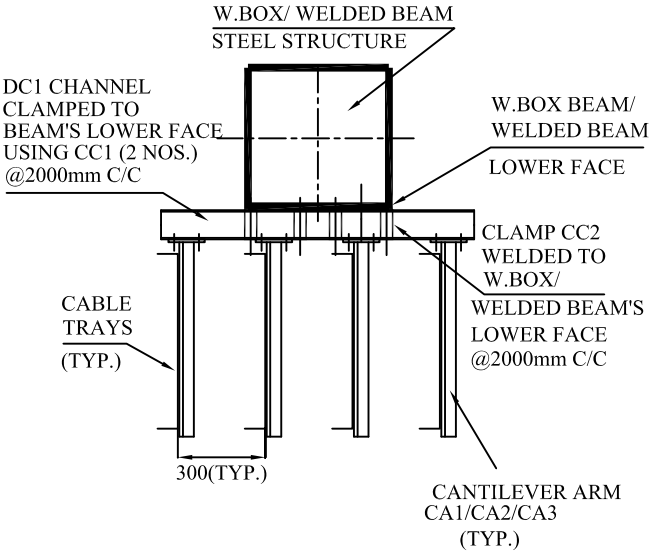
INSTALLATION DETAIL TYPE BB1:
CABLE TRAYS BELOW I-BEAMS
(UPTO & INCLUDING THREE TRAYS)



INSTALLATION DETAIL TYPE BB2:
CABLE TRAYS BELOW I-BEAMS
(MORE THAN THREE TRAYS)



INSTALLATION DETAIL TYPE BB3:
CABLE TRAYS BELOW W. BOX/
WELDED BEAM'S (APPLICABLE FOR
UPTO & INCLUDING THREE TRAYS)



INSTALLATION DETAIL TYPE BB4:
CABLE TRAYS BELOW W. BOX/
WELDED BEAM'S (APPLICABLE FOR
MORE THAN THREE TRAYS)

बीएचईएल BHEL	TITLE: TYPICAL INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	NTPC DOC. NO: 4540-001-215-PVE-C-046
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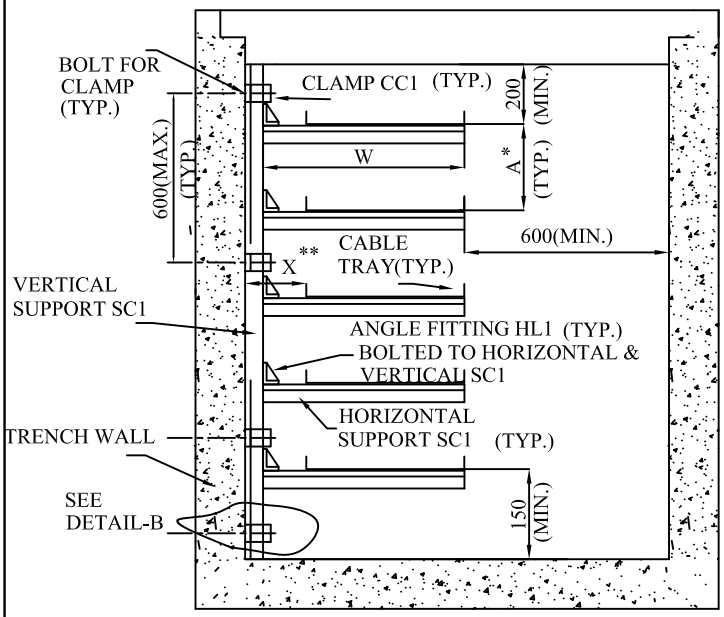
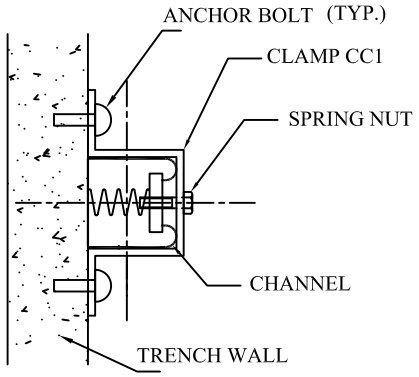
ANNEXURE-II



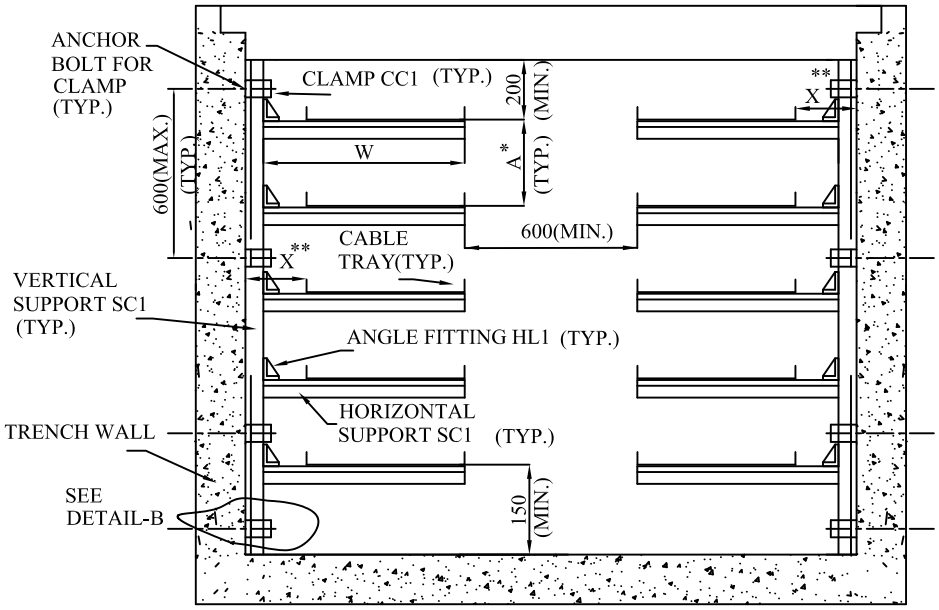
* A : MIN. 300 FOR POWER CABLES
MIN. 250 FOR CONTROL & SCREENED CABLES

** X=100 : CLEAR GAP BETWEEN TRENCH WALL & TRAY FOR PASSAGE OF CABLES APPLICABLE BELOW SWITCHGEAR/ CONTROL PANELS ONLY.



DETAIL-B

INSTALLATION DETAIL TYPE TR1:
SUPPORTING ARRANGEMENT IN CABLE TRENCH, TRAYS ON SINGLE SIDE



* A : MIN. 300 FOR POWER CABLES
MIN. 250 FOR CONTROL & SCREENED CABLES

** X=100 : CLEAR GAP BETWEEN TRENCH WALL & TRAY FOR PASSAGE OF CABLES APPLICABLE BELOW SWITCHGEAR/ CONTROL PANELS ONLY.

TRAY WIDTH	W (MM)
600MM	750
300MM	320
150MM	170

INSTALLATION DETAIL TYPE TR2:
SUPPORTING ARRANGEMENT IN CABLE TRENCH
TRAYS ON BOTH SIDE

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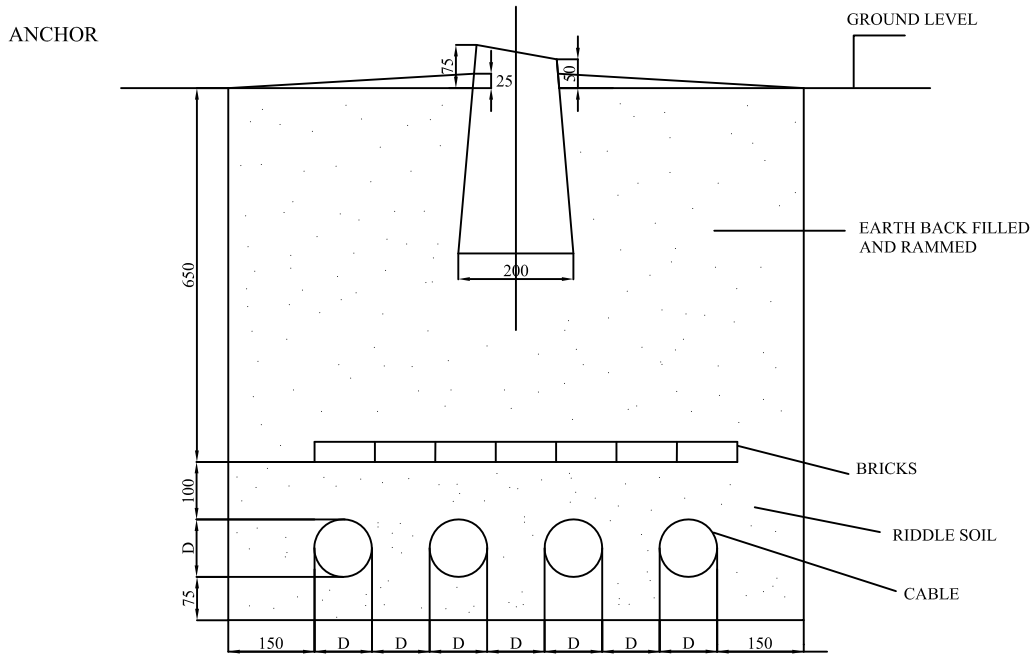
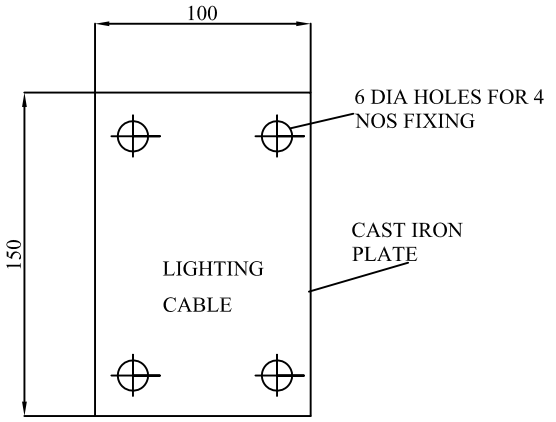
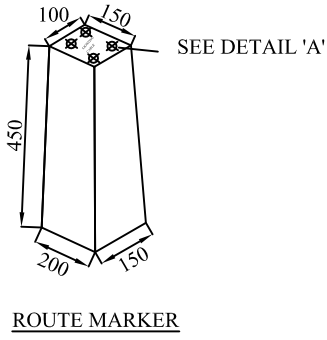
ANNEXURE-II







ROUTE MARKER

NOTES:

1. ALL DIMENSION 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.

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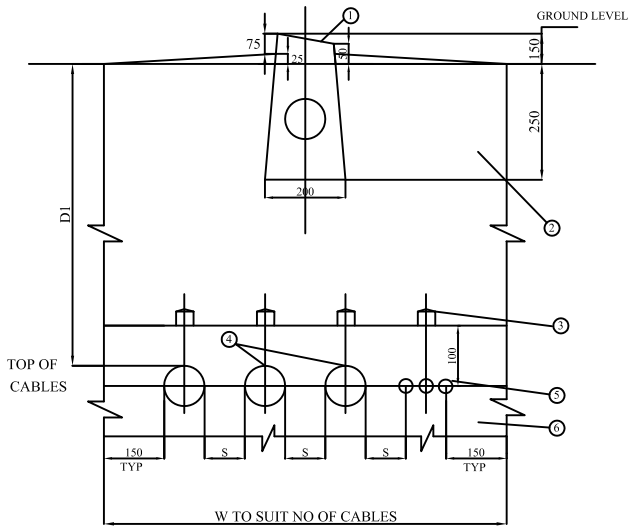
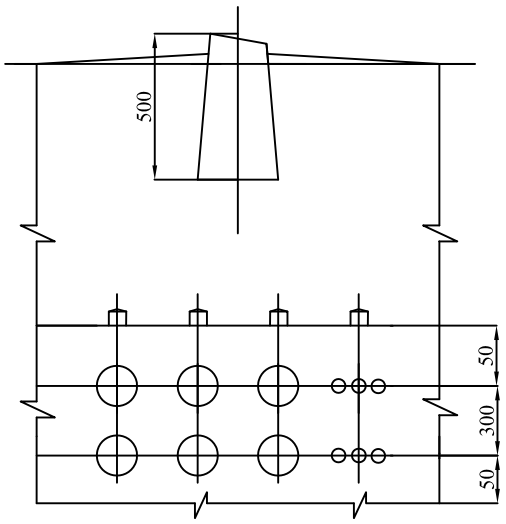
ANNEXURE-II



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.) BRICK 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	= d BETWEEN CABLES OF SAME CLASS = *300MM BETWEEN CABLES OF DIFFERENT 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.

* = SPACING SHALL BE TAKEN BOTH HORIZONTALLY AND VERTICALLY

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 CLARENCE AS INDICATED IN 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 FRO THE PROJECT.
5. ALL DIMENSION ARE IN MM.

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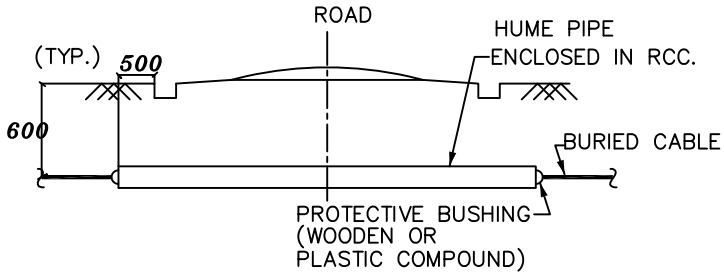
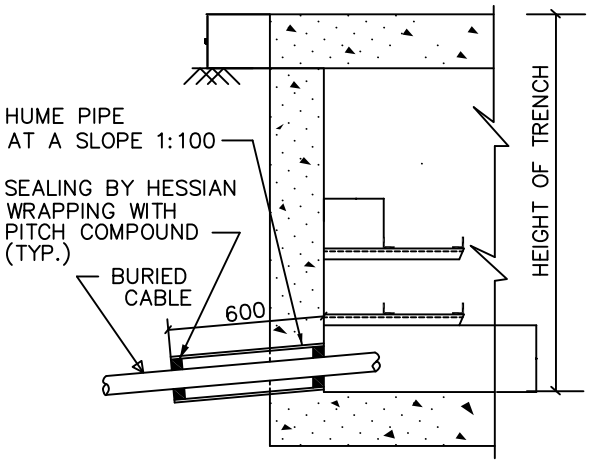
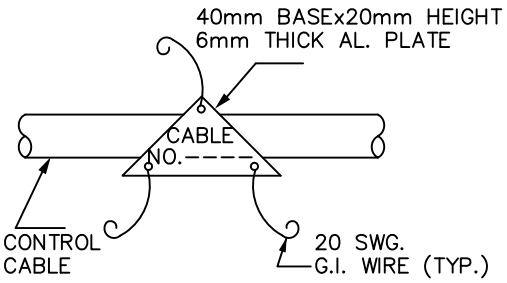


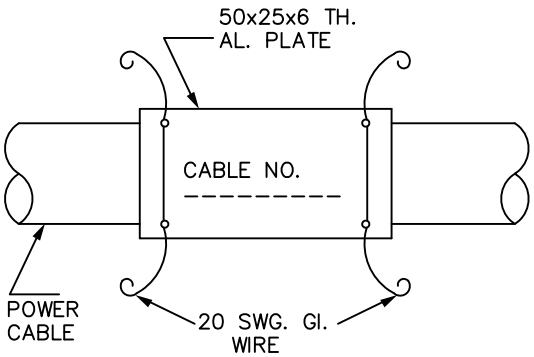
ROAD CROSSING OF BURIED CABLE



TYP. DETAILS OF BURIED CABLE ENTRY TO BLDG. OR CABLE TRENCH



CABLE TAG CONTROL CABLE



CABLE TAG POWER CABLE

NOTE:

1. ALL DIMENSIONS ARE IN 'MM'.
2. BURIED CABLE DETAILS ARE SUBJECT TO CHANGE AS PER LAYOUT OF RESPECTIVE AREA.

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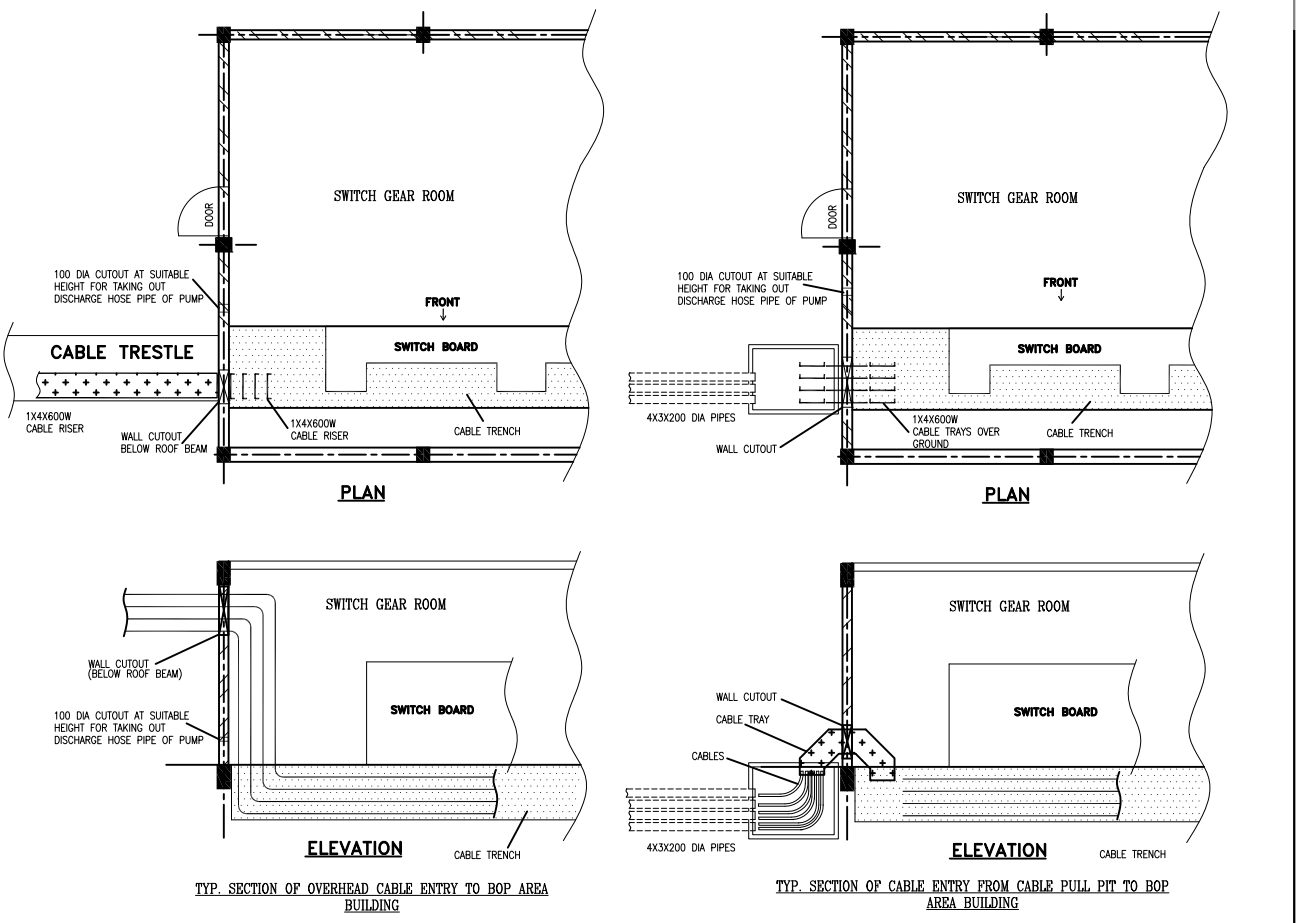
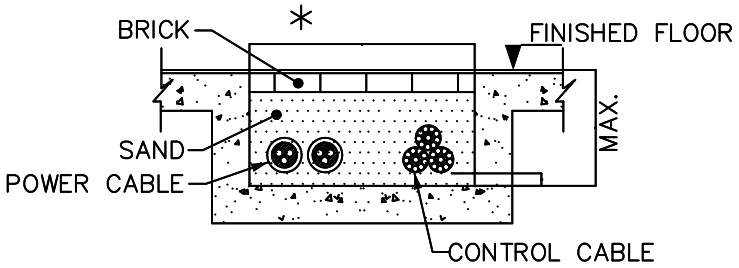


TYP. SECTION OF OVERHEAD CABLE ENTRY TO BOP AREA BUILDING

TYP. SECTION OF CABLE ENTRY FROM CABLE PULL PIT TO BOP AREA BUILDING



CABLE LAYING IN SHALLOW TRENCH (INDOOR)

NOTE:

1. ALL DIMENSIONS ARE IN 'MM'.
2. ABOVE DETAILS ARE SUBJECT TO CHANGE AS PER LAYOUT OF RESPECTIVE AREA.
3. THE PORTION OF FLOOR ABOVE THE TRENCH MARKED ' * ' SHALL BE FINISHED WITH WEAK MORTER.

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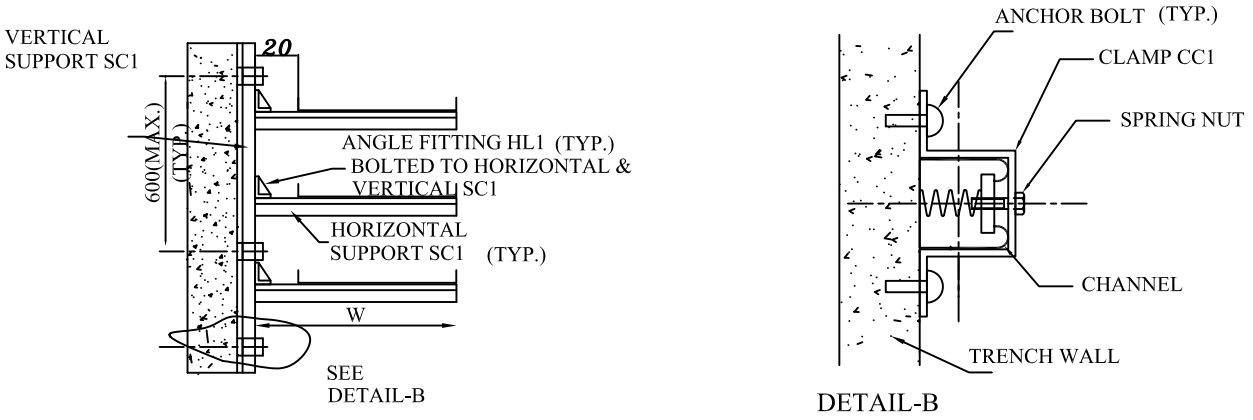
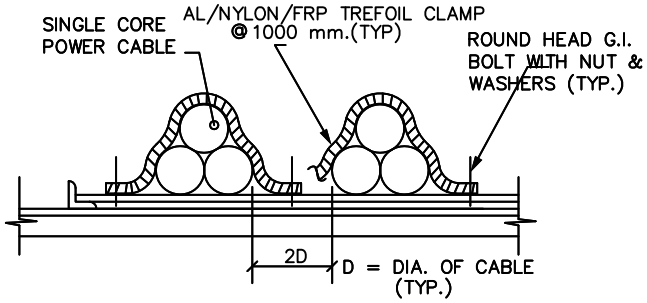
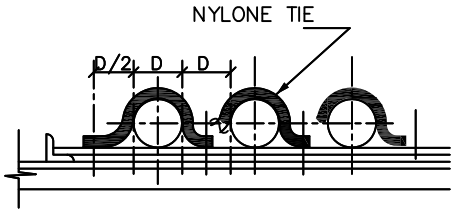


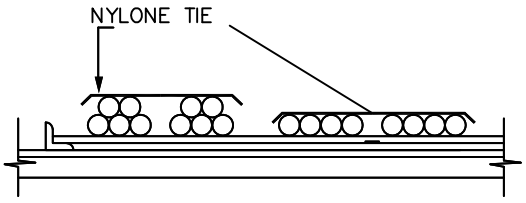
SUPPORTING ARRANGEMENT FOR BRICK OR CONCRETE WALL/COLUMN



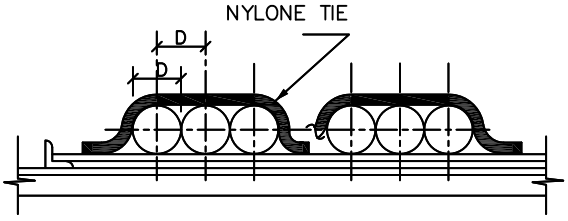
CABLE CLAMPS IN TREFOIL FORMATION FOR SINGLE CORE POWER CABLES



CABLE CLAMPS FOR MULTICORE POWER CABLES (NOT TOUCHING EACHOTHER)



CLAMPING ARRANGEMENT OF CONTROL CABLES



CABLE CLAMPS FOR MULTICORE POWER CABLES (TOUCHING EACHOTHER)

NOTE:

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 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.

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ANNEXURE-II

NOTES:–

I. THIS DRAWING SHALL BE REFERRED ONLY FOR INSTALLATION OF CABLE TRAY SUPPORT SYSTEM.

II. SUPPORTING ARRANGEMENT IN CABLE VAULTS

1. BASEPLATES/ANGLE FITTINGS SHALL BE CONTINUOUSLY WELDED ALL ROUND TO STEEL MEMBERS/ PLATE INSERTS PROVIDED. BRACKETS/ CLAMPS SHALL BE WELDED TO STEEL SURFACE WITH CHANNEL SC1/DC1 (AS APPLICABLE) IN POSITION TO ENSURE ALIGNMENT OF CLAMPS/CHANNEL. WELD THICKNESS SHALL BE 6MM MINIMUM. IN CASE STEEL SURFACE IS NOT AVAILABLE FOR WELDING, ANCHOR BOLTS SHALL BE USED FOR FIXING THE BASEPLATE/ANGLE FITTING.
2. MAIN SUPPORTS FOR ALL LONGITUDINAL CABLE TRAY RUNS IN THE CABLE VAULTS SHALL BE FIXED AT BOTH ENDS AT THE TOP AS WELL AS AT THE BOTTOM AS OUTLINED ABOVE, FOR MORE THAN THREE TRAYS.
3. SINGLE CHANNEL SUPPORT SC1 WHEREVER SUPPORTED FROM TOP ONLY SHALL BE USED FOR UPTO AND INCLUDING TWO TRAYS ONLY. WHEREVER MORE THAN TWO TRAYS ARE TO BE SUPPORTED IN THIS FASHION, DOUBLE CHANNEL DC1 SHALL BE USED.
4. GALVANISATION DAMAGED DUE TO WELDING/CUTTING SHALL BE BRUSHED & RED LEAD PRIMER, OIL PRIMER AND ALUMINIUM PAINT SHALL BE APPLIED.

III. SUPPORTING ARRANGEMENT ALONG PIPERACK

1. BRACKETS/CLAMPS SHALL BE WELDED TO STEEL SURFACE WITH CHANNEL C1/C2 (AS APPLICABLE) IN POSITION TO ENSURE ALIGNMENT OF CLAMPS/CHANNEL. WELD THICKNESS SHALL BE 6MM MINIMUM.
2. GALVANISATION DAMAGED DUE TO WELDING/CUTTING SHALL BE REPAIRED WITH COLD GALVANISING PAINT.
3. WHEREVER PORTAL MEMBERS ARE ENCOUNTERED IN THE PATH OF THE TRAYS, THE TRAYS SHALL BE BENT INWARDS SUFFICIENTLY TO CLEAR THE OBSTRUCTION. FOR THIS PURPOSE, THE CANTILEVER ARMS PRECEDING & SUCCEEDING IMMEDIATELY THE PORTAL MEMBERS SHALL BE REPLACED BY SUITABLE LENGTHS OF HORIZONTAL SC1 CHANNEL FIXED TO THE VERTICAL SUPPORT BY MEANS OF ANGLE FITTING LA1. ADDITIONAL SUPPORT ALONG PORTAL MEMBER CAN SIMILARLY BE PROVIDED USING THE SC1 CHANNEL & LA1 COMBINATION.
4. ALONG OVERHEAD CABLE TRAY ROUTES TRAYS SHALL BE ORIENTED VERTICALLY IN AREAS PRONE TO COAL DUST/ ASH (E.G. BOILER AREA & ESP AREA). ALONG OTHER ROUTES TRAYS SHALL GENERALLY BE ORIENTED HORIZONTALLY. HOWEVER IF SO REQUIRED DUE TO LAYOUT/ AESTHETIC CONSIDERATIONS, TRAYS MAY BE ORIENTED VERTICALLY IN OTHER AREAS ALSO. EXACT ORIENTATION SHALL BE AS PER APPROVED LAYOUT DRAWINGS.

IV. SUPPORTING ARRANGEMENT IN TRENCHES

1. CHANNEL SUPPORT SHALL BE PROVIDED AT 2.0M SPACING & SHALL BE FIXED AGAINST TRENCH WALL FOR EVERY TWO TRAYS USING CLAMPS (SPACED AT 600MM MAX.) AS SHOWN.
2. 2NOS.-M12, ANCHOR BOLTS & 1NO.- SPRING NUT SHALL BE USED WITH EACH CLAMP FOR THE ARRANGEMENT SHOWN.
3. ARRANGEMENT TR1 & TR2 SHALL BE USED

V. CHANNEL FRAME WORK FOR RISERS

IN ADDITION TO THE SUPPORT FROM GROUND, THE RISER FRAMEWORK SHALL BE CONNECTED TO THE AVAILABLE BUILDING STEEL AT HIGHER ELEVATIONS WHEREVER AVAILABLE. THIS SHALL BE DONE BY USING ANGLE FITTINGS BOLTED TO THE RISER STRUCTURE ON ONE END & WELDED WITH SUITABLE STRUCTURAL STEEL MEMBER ON THE OTHER WHICH IN TURN SHALL BE WELDED TO BUILDING STEEL. IN CASE CONCRETE SURFACE IS AVAILABLE IN PLACE OF STEEL NECESSARY CONNECTION WILL BE REALISED BY USE OF BRACKETS/ CLAMPS FIXED TO CONCRETE SURFACE WITH ANCHOR FASTENERS.

VI. CABLE TRAYS SHALL NORMALLY BE FIXED TO CANTILEVER ARMS BY MEANS OF PAN HEAD SCREW & NUT SUPPLIED AS PART OF CANTILEVER ARMS. TRAY CLAMP TC1 SHALL BE USED FOR CLAMPING THE TRAY TO CANTILEVER ARM WHEREVER DUE TO MANUFACTURING/ERECTION/SITE LIMITATIONS, THE CENTER LINES OF CANTILEVER ARM AND THE HOLES IN TRAY BOTTOMS ARE NOT MATCHED.

VII. WHEREVER DIFFERENT ALTERNATIVES FOR SIMILAR SUPPORT ARRANGEMENT ARE SHOWN, SITE SHALL DECIDE THE EXACT ALTERNATIVE TO BE USED DEPENDING UPON SITE CONDITIONS.

VIII. WHEREVER CANTILEVER ARM CANNOT BE USED FOR DIRECT SUPPORTING OF TRAYS DUE TO LAYOUT CONSTRAINTS (E.G. BENDING OF TRAYS TO AVOID OBSTRUCTION), SUFFICIENT LENGTHS OF SC1 SHALL BE USED AS DIRECT SUPPORT IN PLACE. THESE SHALL BE FIXED BY MEANS OF ANGLE FITTING LA1.

IX. BEAM CLAMP SHALL BE USED WHEREVER STRUCTURAL BEAM OF SUITABLE SECTION & ORIENTATION IS AVAILABLE.

X. FOR INSTALLATION DETAIL TYPE DB3, DB4, DS2, DS4, DS6 & DS8 WHEREVER DISSIMILAR TYPE OF CABLES ARE INSTALLED AT THE SAME LEVEL ON EITHER SIDE OF THE MAIN SUPPORT (e.g. LTP & HTP, LTP & CONTROL, CONTROL & SCREENED CABLE), MINIMUM 300MM OF HORIZONTAL CLEARANCE SHALL BE ENSURED BETWEEN SUCH TRAYS BY USING LOWER SIZE TRAYS.

XI. TRAY SUPPORTS SHALL BE PROVIDED @2.0M SPACING FOR HORIZONTAL RUNS AND @1.0M FOR CABLE SHAFTS/ RISERS.

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10.05.02 ~~Lightning protection System down conductors shall not be connected to other conductors above ground level. Also no intermediate earthing connection shall be made to Surge arrester, Voltage Transformer, earthing leads for which shall be directly connected to rod electrode.Every down conductor shall be provided with a test joint at about 150mm above ground level. The test joint shall be directly connected to the earthing system. The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.~~

~~10.06.00~~ ~~**EQUIPMENT ERECTION NOTES**~~

~~a)~~ ~~All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity. The contractor shall strictly follow manufacturer's recommendations for handling and erection of equipment.~~

~~b)~~ ~~The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment, sling ropes etc. should be tested before erection and periodically thereafter for strength.~~

~~c)~~ ~~Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation~~.

10.07.00 **CABLING**

10.07.01 Cabling shall be on cable racks, in trenches, vertical shafts, excavated trenches for direct burial, pulled through pipes and conduits run clamped on steel structures etc. in accordance with the requirements specified elsewhere in the specification.

10.07.02 Cables inside the switchyard shall be laid on bolted GI angle supports at 600mm spacing with separate tiers for control and power cables. The GI angles shall be bolted / welded to galvanized insert plates inside RCC trenches.

10.07.03 Cabling in the control room shall be done on ladder type cable trays with supports at an interval of 2000mm.All interpole cables (both power & control circuit) for equipments shall be laid in cable trenches/G.I. Conduit Pipe of NB 50/100mm which shall be buried in the ground at a depth of 300mm.

ANNEXURE-II

a) ~~**EARTHING NOTES FOR SWITCHYARD**~~
~~**GENERAL**~~

~~i)~~ ~~Earthing of operating boxes, cubicles shall be done by 50 X 6 mm GS flat while cable trenches and structure by 75 X 12 mm GS flat. Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipments and extraneous metal works associated with electric system shall be connected to a single earthing system unless stipulated otherwise.i. Earthing system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.~~

~~**b)**~~ ~~**EARTHING OF GIS**~~

~~i)~~ ~~The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-mechanical interferences.~~

~~ii.)~~ ~~The GIS contractor shall define clearly what constitutes the main grounding bus of the GIS. The GIS contractor must supply, commission the entire grounding work of GIS viz conductor, clamps, joints, bimetallic strips (for connection between different type of earthing materials), operating and safety platforms etc.~~

SUB-SECTION-B – 10

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 buried cables, if essential, shall not have concentration of more than 4 cables in one route. Cables crossing Railway line (if applicable) shall be laid underground through nearest culvert. Necessary statutory clearance if required shall be taken by Bidder. All HT, LT and control cable 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**~~
~~The cable vault/ / cable spreader room space below the HT / LT switchgear room, Control Rooms, unit control equipment room, Programmer room, UPS, Charger & Battery Rooms, shall have **800 mm wide** and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables~~

~~Cable vaults shall be provided with adequate drainage facilities for drainage of fire water.~~
~~Each cable vault should have at least two doors.~~
~~Exit signs shall be provided near doors for personnel escape in case of emergency~~

~~2.01.06~~ ~~**Boiler Area**~~
~~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~~ ~~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 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.

3.01.05 The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1).
Tolerance Class: - Coarse

3.02.00 **Support System for Cable Trays**

3.02.01 Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.

3.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised.

c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied

d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation.

e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below:
The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079.

f. Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.

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

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

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

3.02.05 FOR COAL HANDLING PLANT/**FGD PLANT/ ESP AREA** 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.

3.03.00 **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.

3.03.05 TERNE Coated Flexible Steel Conduits shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures

3.03.06 HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.

~~3.04.00~~ ~~**Junction Boxes**~~

~~3.04.01~~ ~~Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:-~~

~~(a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102~~

~~(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.~~

~~(c) Class of protection shall be IP 55.~~

~~(d) HV test.~~

~~3.04.02~~ ~~Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire~~.

~~3.05.00~~ ~~**Terminations & Straight Through Joints**~~

~~3.05.01~~ ~~Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless~~

crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened ~~that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables.~~

~~3.05.02~~ ~~Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design~~

~~3.05.03~~ ~~1.1 KV grade Straight Through Joint shall be of proven design~~.

~~3.06.00~~ ~~**Cable glands**~~

~~3.06.01~~ ~~Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.~~

~~3.07.00~~ ~~**Cable lugs/ferrules**~~

~~3.07.01~~

~~Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections.~~

~~Crimping tool for crimping (from 1.5sqmm cable to 630sqmm cables) above mentioned lugs shall be of Hexagonal Type crimp profile, with suitable die of crimp match code.~~
~~Characteristics of crimping tool:~~

~~1) To should generate enough pressure to pass pull out test as per IEC 61238-1. Relevant type test to be produced for the sizes specified in the tender.~~
~~2) Tool die shall be replaceable for assorted sizes and crimp code to be mentioned on both part the die.~~
~~3) Tool should be compliant of testing according to IEC, UL and GS standards.~~

~~Tool shall have features such as:~~

- ~~Auto retraction system~~
- ~~Manual retraction stop.~~
- ~~Feedback signals for improper pressure~~
- ~~Better battery capacity and with status display~~
- ~~Flexible and rotating head for easy crimping.~~

~~3.08.00~~ ~~**Trefoil clamps**~~

~~3.08.01~~ ~~Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.~~

~~3.09.00~~ ~~**Cable Clamps & Ties**~~

~~3.09.01~~ ~~The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement~~

~~& shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.~~

~~3.10.00~~ ~~**Receptacles**~~

~~3.10.01~~ ~~Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with RCCB/RCD of 30mA sensitivity having facility for manual testing/checking of operation of RCCB/RCD. Location and Minimum no of RC type receptacle TG and SG area shall be provided as per Annex-I attached.~~

~~3.11.00~~ ~~**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~~.

3.12.00 **Galvanising**

3.12.01 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.

3.12.02 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

3.13.00 **Welding**

3.13.01 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.

4.01.07 In fire prone areas, like Boiler, TG, fuel oil area and any other strategic location etc, fire retardant paint to be applied after installation cables.

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 one metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend.
Fibre Optical cable shall be laid in trenches/trays or as decided by Employer.

4.04.05 Bending radii for cables shall be as per manufacturer's recommendations and IS:1255.

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

4.04.07 No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.

4.04.08 In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

4.04.09 Wherever few cables are branching out from main trunk route troughs shall be used.

4.04.10 Wind loading shall be considered for designing support as well Cable trays wherever required.

4.04.11 Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.

4.04.12 The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

4.04.13 **Separation**

At least 300mm clearance shall be provided between:

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

4.04.14 **Segregation**

1) Segregation means physical isolation to prevent fire jumping.
2) All cables associated with the unit shall be segregated from cables of other units.
3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.
4) In switchyard, control cables of each bay shall be laid on separate racks/trays.

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

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

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

4.04.16 **Directly Buried Cables**

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

b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground

and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

4.04.17 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables.

4.04.18 While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.

4.05.00 **Cable Terminations & Connections**

4.05.01 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

4.05.02 Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.

4.05.03 The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.

4.05.04 Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.

4.05.05 All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.

4.05.06 All cable terminations shall be appropriately tightened to ensure secure and reliable connections.

5.00.00 EARTHING SYSTEM

5.01.00 Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts

The earthing system shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 63 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 maximum 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. Ring type earthing around the offsite building shall be provided with interconnection of with main grid at minimum two points.

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

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

and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.

5.06.00 Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground

5.07.00 Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors.

5.08.00 Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.

5.09.00 Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.

5.10.00 Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.

5.11.00 Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.

5.12.00 Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.

5.13.00 Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.

5.14.00 Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.

5.15.00 A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.

5.16.00 Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.

5.17.00 Earth pit shall be of treated type & shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal as per IS:3043. Test links shall be

provided with bolted arrangement alongwith each earth pit, in order to facilitate measurement of earth resistance as & when required.

5.18.00 On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.

5.19.00 Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.

5.20.00 Other Requirements of Earthing System:

Standard/Code	IEEE 80, IS 3043
Earthing System	
Life expectancy	40 Years
System Fault Level	System Fault Level 63 KA for 1 sec
Soil resistivity	Actual as per site conditions.
Min. Steel corrosion	0.12mm/year
Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.
Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.

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

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

6.00.00 LIGHTNING PROTECTION SYSTEM

6.01.01 Lightning protection system shall be in strict accordance with IEC : 62305 and latest IS standards.

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**

7.02.00 **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:

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.

9.00.00 ELECTRICAL LAYOUT PHILOSOPHY:

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

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

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

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

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

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

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

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

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

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

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

b) Layout requirements for Electrical MCC/switchgear rooms

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

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

a.) Front Clearance

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

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

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

c.) Side Clearance

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

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

a.) Front Clearance

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

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

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

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

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

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

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

5. Cable trench/Cable vault

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

c) Minimum clear working space around the equipment 1200mm

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

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

f) Wash basin with mirror shall be provided in battery room.

Annexure-I

1.0 LOCATION OF LP3 :-

One number LP3 to be located in boiler MCC room at 28.0m in BC bay to supply RC receptacles in TG area.

Location of RC Receptacles in Turbine hall

Sl. No.	Name	Location of RC	No. of RC
1	Hot Well	0m (Near CEP)	2
2	Main Oil Tank	8.5m (AB Bay)	1
3	NGT Cubicle/ Gen Bushing	8.5m (AB Bay)	2
4	LAVT	7.5m (AB Bay)	2
5	HP-IP Turbine	17.0m (AB Bay)	2
6	LP Turbine	17.0m (AB Bay)	1
7	TD BFP	17.0m (AB Bay)	1
8	HP Heater - 5	17.0m (BC Bay)	2
9	Deaerator	38.0m (BC Bay)	2
10	LP Heater- 2	8.5m (BC Bay)	1
11	Valve Room	8.5m (AB Bay)	2

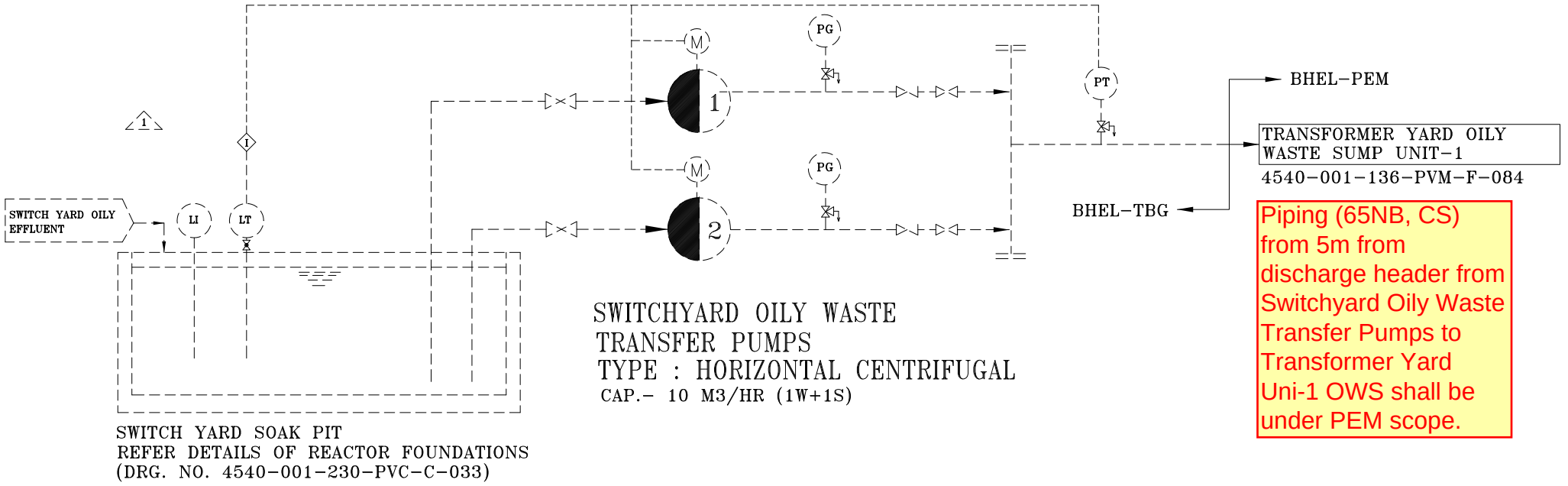
Total - 18 nos. RC Receptacles in Turbine Hall.

2.0 LOCATION OF RC RECEPTACLES

Location of Receptacles and Socket in Boiler area

FLOOR	63A WELDING RECEPTACLES		20A, 240V AC INDUSTRIAL SOCKET RA		20A, 24V AC INDUSTRIAL SOCKET RC	
	PROPOSED		PROPOSED		PROPOSED	
	QTY	LOCATION	QTY	LOCATION	QTY	LOCATION
GL-200	10	S7L,R MILL-B,E,G S17 P3L,R ID-A,B	7	S8L,R S21L, P3L,R ID-A,B	4	P2L,R ID-A,B
4710	3	MILL-A,D,J	3	MILL-A,D, MILL-J	8	MILL-A,B,C,D,F,G,H,J
8900	1	S18	1	S18, S14R	1	S12L
9700	2	S7L,R	2	S9L,R	2	S8L,R
11450	2	S8L,R	3	S9L,R S21	4	S10L,R S22L,R
17600					1	P1L
20500(APH BOTTOM), 21850	4	S18(2) S19L,R	7	S9L,R S17, S19L,R S6L,R	7	S9L,R S12L,R S18, S20L,R
21700(FEEDER FLOOR)	2	FEEDER A,J	4	FEEDER-A,C,F,J	4	FEEDER-A,C,F,J
23000	1	S17	2	S13L, S19		
25000(BURNNER BOTTOM, SPRAY STATION)	4	S8L,R S11L,R	5	S1L,R S11L,R S17	5	S1L,R S11L,R S17
28000(APH)	2	S19L,R	2	S19L,R	2	S19L,R
29200(APH, WIND BOX's	4	S20L,R S9L,R	4	S9L,R S20L,R	4	S8L,R S10L,R
32200	2	S9L,R	2	S9L,R		
33400	2	S12L,R	2	S8L,R S19L,R	2	S19L,R
38500	2	S9R, S10L				
42500	2	S10L,R	3	S9L,R S17	3	S9L,R S17
45300	2	S10L,R	4	S9L,R S11L,R	4	S8L,R S10L,R
48000	1	S1R	2	S14R S15L	2	S9L,R
48900	4	S18(2) S12L,R	4	S11L,R S12L,R	2	S11L,R
53600	2	S5L,R	3	S14R S10L,R	2	S5L,R
58000	4	S11L,R S14L S15R	4	S14R S15L S11L,R	2	S11L,R
59200(TRIPPER FLOOR)	2	LEFT, RIGHT	2	L,R		
61400	4	S11L,R S14L S15R	3	S14R S11L,R	2	S11L,R
68100	2	S11L,R	2	S9L,R		
77300	2	S10L,R	4	S9L,R S11L,R	2	S4L,R
83500	2	S10L,R	2	S12L,R		
86700	2	S3L,R	2	S11L,R	2	S11L,R
88600	1	S11L	2	S6L,R	2	S8L,R
95900	1	S1R	1	S1L		
ESP/FG I/L DUCT	4		2		4	
ESP/FG O/L DUCT	2		1		2	
ESP AT MANHOLE DOOR FLOOR	4	IN BETWEEN TWO PASS	4		4	
ESP AT TOP	2		1			
ESP AT -200	2	AT FRONT SIDE BOTH L&R	2			
TOTAL	86		92		77	

Annexure-ETP



Piping (65NB, CS) from 5m from discharge header from Switchyard Oily Waste Transfer Pumps to Transformer Yard Uni-1 OWS shall be under PEM scope.

The Tentative BoQ of the system shall be as below:

1.Horizontal Centrifugal Pump (10m3/hr)-2Nos.

2.Butterfly valve/gate valve -4nos.

2.Three-way valve-3nos.

3.NRV/check valve -2nos.

4.Pressure gauge-2nos.

5.Pressure transmitter/ switch-1No.

6. Level gauge-2nos.,

7.Level transmitter/

switch-2nos.

8.Piping works (65NB as per IS 1239)-20Mtrs

Any other item for the completeness of the system as shown in the schematic may be considered by the bidder.

DATASHEET A

1.	**TG UNIT-1A FLOOR WASH WATER SUMP (E1A)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	12 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	1. Floor wash from TG UNIT 1 containing oil traces 2. Oily effluent from TDBFP-A Unit-1 & MDBFP Unit-1 area
2.	**TG UNIT-1A FLOOR WASH WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash from TG UNIT 1 containing oil traces 2. Oily effluent from TDBFP-A Unit-1 & MDBFP Unit-1 area
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	25
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
3.	**TG UNIT-1B FLOOR WASH WATER SUMP (E1B)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	12 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	1. Floor wash from TG UNIT 1 containing oil traces 2. Oily effluent from TDBFP-A Unit-1 & MDBFP Unit-1area 3. Oily effluent from COT/DOT area
4.	**TG UNIT-1B FLOOR WASH WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash from TG UNIT 1 containing oil traces 2. Oily effluent from TDBFP-B Unit-1 & MDBFP Unit-1 area 3. Oily effluent from COT/DOT area
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	25
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316

5.	**COT/DOT WASTE WATER COLLECTION SUMP (E1C)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	1 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	1. Oily effluent from COT/DOT area
6.	**COT/DOT WASTE WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Horizontal Screw type
c)	Location	Outdoor
d)	Fluid to be handled	1. Oily effluent from COT/DOT area
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	2
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
7.	**TG UNIT-2A FLOOR WASH WATER SUMP (E2A)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	12 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	1. Floor wash from TG UNIT 2 containing oil traces 2. Oily effluent from TDBFP-A Unit-2 & MDBFP Unit-2 area
8.	**TG UNIT-2A FLOOR WASH WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash from TG UNIT 2 containing oil traces 2. Oily effluent from TDBFP-A Unit-2 & MDBFP Unit-2 area
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	25
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
9.	**TG UNIT-2B FLOOR WASH WATER SUMP (E2B)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	12 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom

e)	Type of fluid to be handled	1. Floor wash from TG UNIT 1 containing oil traces 2. Oily effluent from TDBFP-B Unit-2 & MDBFP Unit-2 area
10.	**TG UNIT-2B FLOOR WASH WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos..
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash from TG UNIT 1 containing oil traces 2. Oily effluent from TDBFP-B Unit-2 & MDBFP Unit-2 area
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	25
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
11.	**FUEL OIL HANDLING AREA OILY WASTE SUMP (E3)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	As specified in FOHS area
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	Oily effluent from FOHS area
12.	**FUEL OIL AREA WASTE TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	Oily effluent from FOHS area
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	10
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
13.	**TRANSFORMER YARD OILY WASTE SUMP UNIT-1 (E4)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	As specified in Transformer area Oil Water Separator
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	Oily effluent from Transformer area Oil Water Separator
14.	**TRANSFORMER YARD UNIT-1 OILY WASTE TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor

d)	Fluid to be handled	Oily effluent from Transformer area Oil Water Separator
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	10
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
15.	**TRANSFORMER YARD OILY WASTE SUMP UNIT-2 (E5)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	As specified in Transformer area Oil Water Separator
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	Oily effluent from Transformer area Oil Water Separator
16.	**TRANSFORMER YARD UNIT-2 OILY WASTE TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	Oily effluent from Transformer area Oil Water Separator
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	10
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
17.	**MRS WASTE WATER SUMP UNIT-1 (E6)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	10 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	1. Floor wash waste (containing coal laden particles) from MRS area Unit-1 2. Waste water (containing coal laden particles) from Feeder and Tripper Floor Unit-1
18.	**MRS UNIT-1 OILY WASTE WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Centrifugal type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash waste (containing coal laden particles) from MRS area Unit-1 2. Waste water (containing coal laden particles) from Feeder and Tripper Floor Unit-1
e)	Duty	Intermittent

f)	Rated capacity, each m3/ hr.	10
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260, S-0.1 (max.) P-0.15 (max.)
	• Stuffing box, Gland	2.5% Ni CI IS:210 GR. FG 260
	• Impeller	ASTM A351 CF8M
	• Shaft, Shaft coupling, shaft sleeves	SS 410
	• Column pipe & discharge pipe, shaft enclosing	CS as per IS:2062 or eq.
	• Gland packing	TIWA
	• Gasket	Neoprene Rubber
	• Bolts & nuts	SS
	• Base plate and soleplate	CS (min. 10 thick)
19.	**MRS WASTE WATER SUMP UNIT-2 (E7)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	10 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	1. Floor wash waste (containing coal laden particles) from MRS area Unit-2 2. Waste water (containing coal laden particles) from Feeder and Tripper Floor Unit-2
20.	**MRS UNIT-2 OILY WASTE WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Centrifugal type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash waste (containing coal laden particles) from MRS area Unit-1 2. Waste water (containing coal laden particles) from Feeder and Tripper Floor Unit-1
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	10
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260, S-0.1 (max.) P-0.15 (max.)
	• Stuffing box, Gland	2.5% Ni CI IS:210 GR. FG 260
	• Impeller	ASTM A351 CF8M
	• Shaft, Shaft coupling, shaft sleeves	SS 410
	• Column pipe & discharge pipe, shaft enclosing	CS as per IS:2062 or eq.
	• Gland packing	TIWA

	• Gasket	Neoprene Rubber
	• Bolts & nuts	SS
	• Base plate and soleplate	CS (min. 10 thick)
21.	**SG UNIT-1 FLOOR WASH WATER SUMP (E8)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	100 M3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	1. Floor wash from SG UNIT 1 containing oil traces 2. Floor wash from APH UNIT 1 containing ash traces
22.	**SG UNIT-1 FLOOR WASH WATER TRANSFER PUMPS**	
a)	Number required	Two (2W) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash from SG UNIT 1 containing oil traces 2. Floor wash from APH UNIT 1 containing ash traces
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	100
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
23.	**SG UNIT-2 FLOOR WASH WATER SUMP (E9)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	100 M3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	1. Floor wash from SG UNIT 1 containing oil traces 2. Floor wash from APH UNIT 1 containing ash traces
24.	**SG UNIT-2 FLOOR WASH WATER TRANSFER PUMPS**	
a)	Number required	Two (2W) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash from SG UNIT 1 containing oil traces 2. Floor wash from APH UNIT 1 containing ash traces
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	100
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316

25.	**ESP UNIT-1 FLOOR WASH WATER SUMP (E10)**	
f)	Number required	One (1) nos.
g)	Effective Capacity, m3	50 M3
h)	Material of Construction	RCC (IN BHEL SCOPE)
i)	Type	Underground, Rectangular with Flat bottom
j)	Type of fluid to be handled	Floor wash from ESP UNIT 1 containing ash traces
26.	**ESP UNIT-1 FLOOR WASH WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	Floor wash from ESP UNIT 1 containing ash traces
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	50
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
27.	**ESP UNIT-2 FLOOR WASH WATER SUMP (E11)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	50 M3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	Floor wash from ESP UNIT 2 containing ash traces
28.	**ESP UNIT-2 FLOOR WASH WATER TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical Screw type
c)	Location	Outdoor
d)	Fluid to be handled	1. Floor wash from ESP UNIT 2 containing ash traces
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	50
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316
29.	**WASTE SERVICE WATER SUMP (WSWS) (E12)**	
a)	Number required	One (1) nos. (In two compartments)
b)	Effective Capacity (each compartment), m3	250m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Rectangular with Flat bottom, under ground
e)	Inlet arrangement	Inlet & Outlet chamber with interconnecting gates

f)	Oil removal arrangement	Two (2x100%) numbers Drum Type Oil skimmers and Two (2x100%) numbers trolley mounted Portable Oil Centrifuge.
g)	Oil collection drum (type/ capacity)	One (1) nos. MS Oil Drum (capacity: 200 litre)
h)	Oil Skimmer (each to be installed in each compartment of WSWS)	Type: Drum Capacity: As per system requirements Inlet Oil Level: 50ppm Oil Outlet guarantee: <5ppm MOC: As per system requirements Accessories: Power pack, motor, valves, control panel as required.
i)	Portable Oil Centrifuge	Type: Trolley Mounted Portable Oil Centrifuge Capacity: As per system requirements MOC: As per system requirements Accessories: motor, valves, control panel as required. Purpose: To collect and purify the oil of the WSWS
30.	**WSWS TRANSFER PUMPS**	
a)	Number required	Three (2W+1S) nos.
b)	Type	Vertical Centrifugal type
c)	Location	Outdoor
d)	Fluid to be handled	Effluent from WSWS
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	125
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260, S-0.1 (max.) P-0.15 (max.)
	• Stuffing box, Gland	2.5% Ni CI IS:210 GR. FG 260
	• Impeller	ASTM A351 CF8M
	• Shaft, Shaft coupling, shaft sleeves	SS 410
	• Column pipe & discharge pipe, shaft enclosing tube	CS as per IS:2062 or eq. (Min. Thickness 8 mm)
	• Gland packing	TIWA
	• Gasket	Neoprene Rubber
	• Bolts & nuts	SS
	• Base plate and soleplate	CS (min. 10 thick)
31.	**LAMELLA CLARIFIER/ TUBE SETTLER**	
a)	Number required	Two (1W+1S) nos.
b)	Material of Construction	RCC (IN BHEL SCOPE)
c)	Design Flow (Net Output of each clarifier), m3/hr	250
d)	Basis design and components	As per manufacturer standard
e)	Sludge Consistency	2% (minimum)
f)	Type	Counter Flow / Cross Flow
g)	Design Flow velocity	Not more than 5m3/hr/m2
h)	Flash Mixer tank & Flocculator tank	1x100% Flash Mixer Tank and 1x100% flocculation tank (for each Lamella Clarifier/ Tube Settler)
i)	No. of Flash Mixer (for each Lamella Clarifier/ Tube Settler)	One (1) number with required agitator Min. 1-minute storage for Flash Mixer Tank
j)	MOC of Agitator	SS 316

k)	No. of Flocculation Chamber (for each Lamella Clarifier/ Tube Settler)	One (1) number with required Flocculator Min. 10-minute storage for Flocculation Chamber
l)	MOC of Flocculator	SS 316
m)	Type of Fluid to be handled	Wastewater containing traces of oil, suspended solids.
n)	Accessories	Suitable sampling lines for performance monitoring
32.	**CENTRAL MONITORING BASIN (CMB) (E13)**	
a)	Number required	One (1) nos. (In two compartments)
b)	Effective Capacity (each compartment), m3	250m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Rectangular with Flat bottom, Above ground
e)	Inlet arrangement	Inlet & Outlet chamber with interconnecting gates
33.	**CENTRAL MONITORING BASIN TRANSFER PUMPS**	
a)	Number required	Three (2W+1S) nos.
b)	Type	Horizontal Centrifugal type
c)	Location	Outdoor
d)	Fluid to be handled	Effluent from WSWS
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	125
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260, S-0.1 (max.) P-0.15 (max.)
	• Stuffing box, Gland	2.5% Ni CI IS:210 GR. FG 260
	• Impeller	ASTM A351 CF8M
	• Shaft, Shaft coupling, shaft sleeves	SS 410
	• Column pipe & discharge pipe, shaft enclosing tube	CS as per IS:2062 or eq. (Min. Thickness 8 mm)
	• Gland packing	TIWA
	• Gasket	Neoprene Rubber
	• Bolts & nuts	SS
	• Base plate and soleplate	CS (min. 10 thick)
34.	**TROLLEY MOUNTED SCREW PUMPS WITH SLOPE OIL TANK**	
a)	Number required	Two (2W) nos. (1 Set for each unit)
b)	Type	Trolley Mounted Screw type with Slope oil tank and Power station
c)	Location	Outdoor
d)	Fluid to be handled	Oily effluent from Transformers
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	10
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	15 mwc
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260
	• Impeller/Rotor	ASTM A351 CF8M
	• Shaft	SS 316

j)	Slope Oil Tank	Capacity: 1m3 MOC: MSEP
35.	**SLUDGE SUMP (E14)**	
a)	Number required	One (1) nos. (In two compartments).
b)	Effective Capacity, m3 (each compartment)	6.25m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Rectangular with Flat bottom, under ground
e)	Inlet arrangement	Inlet & Outlet chamber with interconnecting gates
36.	**SLUDGE SUMP TRANSFER PUMPS**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical sump type (Open Impeller, Non-clog type)
c)	Location	Outdoor
d)	Fluid to be handled	Effluent from WSWS
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	12.5
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260, S-0.1 (max.) P-0.15 (max.)
	• Stuffing box, Gland	2.5% Ni CI IS:210 GR. FG 260
	• Impeller	ASTM A351 CF8M
	• Shaft, Shaft coupling, shaft sleeves	SS 410
	• Column pipe & discharge pipe, shaft enclosing tube	CS as per IS:2062 or eq. (Min. Thickness 8 mm)
	• Gland packing	TIWA
	• Gasket	Neoprene Rubber
	• Bolts & nuts	SS
	• Base plate and soleplate	CS (min. 10 thick)
37.	**CHEMICAL DOSING FOR LAMELLA CLARIFIER/ TUBE SETTLER**	
48.1	**ALUM DOSING SYSTEM (DOSING RATE = 70 PPM)**	
A.	**ALUM DOSING TANK**	
a)	Numbers required	Two (2) nos.
b)	Type	Vertical rectangular with flat bottom
c)	Type of fluid to be handled	10 % w/w Alum Solution.
d)	Effective capacity of each tank, m^3	Adequate to hold the quantity required for twelve (12) hours of operation for treatment of overall waste in LAMELLA CLARIFIER/ TUBE SETTLER + 20% margin excluding free board
e)	Design Pressure, Kg/sq. cm (g)	Atmospheric
f)	Material of Construction	RCC (IN BHEL SCOPE).
g)	Protection	
	• Internal	Acid Proof Tile Lining
	• External	Not applicable
h)	Agitator along with drive motor and all other accessories	
	• Number	One (1) per Tank
	• Material of Construction	SS 316

i)	Dissolving Basket	
	• Number	One (1) per Tank
	• Material of Construction	SS 316
B.	**ALUM SOLUTION DOSING PUMPS**	
a)	Number	Two (2) Number [1W+1S] for LAMELLA CLARIFIER/ TUBE SETTLER.
b)	Type of Pump	Positive displacement and Simplex Hydraulically operated diaphragm type with auto stroke adjustment.
c)	Location	Outdoor
d)	Fluid to be handled	10 % w/w Alum Solution.
e)	Service	To dose Alum solution to LAMELLA CLARIFIER/ TUBE SETTLER.
f)	Duty	Continuous and suitable for parallel operation
g)	Suction Condition	Flooded
h)	Rated Capacity, m^3/hr	100 % requirement at full load condition of the plant
i)	Range of Operation (%)	10 – 100
j)	Pump Speed, (RPM)	1500 (max.)
k)	Pump Stroke speed per minute	100 (max.)
l)	Material of construction	
	• Liquid end (Pump head Valve, valve spring, Housing, etc.)	AISI 316
	• Diaphragm, Packing	PTFE
	• Shaft	Hardened steel (EN8-BS-970)/ AISI-316
m)	Accessories	Pumps shall be provided with accessories such as Y-type suction strainers, check valves, pressure dampeners, Pressure Gauge, safety relief valves along with recirculation to tank etc
n)	Type of drive	Electrical Motor
48.2	**LIME DOSING SYSTEM (DOSING RATE = 30 PPM)**	
A.	**LIME DOSING TANK**	
a)	Numbers required	Two (2) nos.
b)	Type	Vertical rectangular with flat bottom
c)	Type of fluid to be handled	6 % w/w Lime Solution.
d)	Effective capacity of each tank, m^3	Adequate to hold the quantity required for twelve (12) hours of operation for treatment of overall waste in LAMELLA CLARIFIER/ TUBE SETTLER + 20% margin excluding free board
e)	Design Pressure, Kg/sq. cm (g)	Atmospheric
f)	Design Temperature, 0C	80
g)	Material of Construction	RCC (IN BHEL SCOPE) with 2 coats of Bitumastic paint over 2 coats of primer.
h)	Protection	
	• Internal	Acid Proof Tile Lining
	• External	Not applicable
i)	Agitator along with drive motor and all other accessories	
	• Number	One (1) per Tank
	• Material of Construction	SS 316
j)	Dissolving Basket	
	• Number	One (1) per Tank
	• Material of Construction	SS 316
B.	**LIME SOLUTION DOSING PUMPS**	
a)	Number	Two (2) Number [1W+1S] for LAMELLA CLARIFIER/ TUBE SETTLER.

b)	Type of Pump	Screw type
c)	Location	Outdoor
d)	Fluid to be handled	6 % w/w Lime Solution.
e)	Service	To dose Lime solution to LAMELLA CLARIFIER/ TUBE SETTLER.
f)	Duty	Continuous and suitable for parallel operation
g)	Suction Condition	Flooded
h)	Rated Capacity, m^3/hr	100 % requirement at full load condition of the plant
i)	Range of Operation (%)	10 – 100
j)	Pump Speed, (RPM)	1500 (max.)
k)	Material of construction	
	Pump casing	2.5% Ni-Cast Iron to IS 210 FG 260
	Stator	EPDM rubber
	Impeller/Rotor	CF8M
	Shaft and shaft sleeve	SS 410
l)	Accessories	Pumps shall be provided with accessories such as Y-type suction strainers, check valves, pressure dampeners, Pressure Gauge, safety relief valves along with recirculation to tank etc
m)	Type of drive	Electrical Motor
38.	**AIR BLOWER FOR SLUDGE SUMP**	
a)	Number	Two (2) (2X100 %) for Sludge Sump
b)	Type	Rotary Twin Lobe Type
c)	Duty	Intermittent
d)	Capacity & Head	As required
e)	MOC of casing, cover, stator	CI as per IS 210 FG 260
f)	MOC of shaft	Carbon steel to BS-970 En-8/ANSI-I045
g)	Impeller/Lobes	Carbon steel to BS-970, EN9 Forged
h)	Accessories Required	Acoustic Enclosures, Suction Filter, Silencer, relief Valve etc
i)	Location	Outdoor
39.	**CHEMICAL STORAGE SPACE (In industrial shed)**	
48.1	**STORAGE AREA OF CHEMICALS**	15 days
48.2	**WEIGHING SCALE**	
a)	Type	Platform & dial type/Electronic Type
b)	Number	One (1)
c)	Capacity	0-500 Kgs
48.3	**ELECTRIC HOIST**	
a)	Type	Electric monorail in chemical dosing area
b)	Number	One (1)
c)	Capacity	1 Ton
48.4	**Safety arrangement**	
a)	**Safety shower and Eye wash fountain**	One (1) number safety shower and two (2) numbers eye wash fountain shall be provided by bidder
b)	**Personal protection**	Two sets of safety equipment each comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall be provided by the bidder.
40.	**OVERHEAD SERVICE WATER (E15)**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	To cater the requirement of chemical preparation for Alum and Lime dosing for 24 hrs and flushing requirement of equipment.
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Rectangular with Flat bottom, Over head on EQMS Room
41.	**FLUSHING PUMPS**	

a)	Number required	Two (1W+1S) nos.
b)	Type	Horizontal Centrifugal type
c)	Location	Outdoor
d)	Fluid to be handled	Service Water
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	10
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	2.5% Ni CI IS:210 GR. FG 260, S-0.1 (max.) P-0.15 (max.)
	• Stuffing box, Gland	2.5% Ni CI IS:210 GR. FG 260
	• Impeller	ASTM A351 CF8M
	• Shaft, Shaft coupling, shaft sleeves	SS 410
	• Column pipe & discharge pipe, shaft enclosing tube	CS as per IS:2062 or eq. (Min. Thickness 8 mm)
	• Gland packing	TIWA
	• Gasket	Neoprene Rubber
	• Bolts & nuts	SS for coming in water contact else CS
	• Base plate and soleplate	CS (min. 10 thick)
42.	**BELT TYPE OIL SKIMMER**	
a)	Type	Portable Belt Type Oil Skimmer
b)	Location	To be used portably in TG Area sumps E1A, E1B, E2A, E2B
c)	Capacity	To Cater the requirements for either above mentioned TG Area sumps
d)	MOC	As per system requirements
43.	**PRE-FILTER BACKWASH WATER SUMP UNIT-1**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	30 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	Pre-Filter Backwash Water (DM Waste water) form CPU Unit-1
44.	**PRE FILTER BACKWASH WATER PUMPS UNIT-1**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical sump type (Open Impeller)
c)	Location	Outdoor
d)	Fluid to be handled	Pre-Filter Backwash Water (DM Waste water) form CPU Unit-1
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	12.5
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	ASTM A743 CF3M (SS316L)
	• Discharge /Column Pipe	ASTM A743 CF3M (SS316L)
	• Impeller / Shaft	ASTM A743 CF3M (SS316L)
	• Shaft coupling, shaft	SS 410

	sleeves	
	• Bolts & nuts	SS 316L (wetted)
	• Base plate and soleplate	CS (min. 10mm thick)
45.	**PRE-FILTER BACKWASH WATER SUMP UNIT-2**	
a)	Number required	One (1) nos.
b)	Effective Capacity, m3	30 m3
c)	Material of Construction	RCC (IN BHEL SCOPE)
d)	Type	Underground, Rectangular with Flat bottom
e)	Type of fluid to be handled	Pre-Filter Backwash Water (DM Waste water) form CPU Unit-2
46.	**PRE FILTER BACKWASH WATER PUMPS UNIT-2**	
a)	Number required	Two (1W+1S) nos.
b)	Type	Vertical sump type (Open Impeller)
c)	Location	Outdoor
d)	Fluid to be handled	Pre-Filter Backwash Water (DM Waste water) form CPU Unit-2
e)	Duty	Intermittent
f)	Rated capacity, each m3/ hr.	12.5
g)	Pump Speed, RPM (max.)	1500
h)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
i)	Material of Construction	
	• Casing	ASTM A743 CF3M (SS316L)
	• Discharge /Column Pipe	ASTM A743 CF3M (SS316L)
	• Impeller / Shaft	ASTM A743 CF3M (SS316L)
	• Shaft coupling, shaft sleeves	SS 410
	• Bolts & nuts	SS 316L (wetted)
	• Base plate and soleplate	CS (min. 10mm thick)
47.	**PIPING**	All the piping shall generally be conforming to the requirements specified in the Chapter titled "General Technical Requirement Of Low Pressure Piping" considering the following aspects as minimum requirement:

Raw water & Clarified water	Carbon Steel: IS: 1239 Part-I (Heavy grade-Black), ASTM-A-53 Type-E Grade B / ASTM A 36 /IS: 3589 - Grade 410; / IS-2062 Gr.-B (for fabricated from plates) / Equivalent
Coagulant (Alum)	CPVC as per ASTM F441 CPVC 4120 Schedule 80
Lime slurry/Solution/ Suspensions	CPVC as per ASTM F441 CPVC 4120 Sch. 80
Sludge	1) GRP as per ASTM D3517/ AWWA C950-88/AWWA M45 2) HDPE as per ASTM D3350 CL 34543C, FM Class 150/ IS:4984 or Equivalent for buried portion 3) Cast Iron Class A as per IS 1536 (for only from Lamella Clarifier/Tube Settler to Sludge Sump)
Chemical Waste from vessels and tanks	1) HDPE as per ASTM D3350 CL 34543C, FM Class 150/ IS: 4984 or Equivalent for buried portion.
Demineralised Water (Pre-Filter Backwash Water)	Stainless Steel: Stainless steel to ASTM A312, Gr. 304 Sch.40s.

48.	**VALVES**	All the valves shall generally be conforming to the requirements specified in the Chapter titled "General Technical Requirement of Low-Pressure Piping" considering the following aspects as minimum requirement:
48.1	Coagulant (Alum) Services	i. Type of Valves <u>For Isolation</u> a) Saunder's Patented Diaphragm Valves b) Ball Valves in CPVC pipes <u>For non-return / Check</u> Swing Check type /Dual Plate type
		ii. Material of Construction Valves <u>Diaphragm Valves</u> a) Body shall be Cast Iron to IS: 210 Gr FG 260/ ASTM A 48 Cl.40; BS: 1452 Gr.220/Equivalent. OR Cast Steel to ASTM. A 216GR. WCB and Body shall be internally lined with Soft Natural rubber, Ebonite or Polypropylene b) Diaphragm shall be shall be of reinforced rubber /Hypalon/ approved equivalent c) Stem, Compressor & Bush shall be Stainless steel Construction Ball Valves in CPVC Pipe lines a) Body, Ball & stem shall be of CPVC b) Seat ring & Packing shall be EPDM / or equivalent <u>Check Valves</u> a) Body & Cover, Hinge Disk/Door shall be Cast Iron to IS: 210 Gr FG 260/ ASTM A 48 Cl.40; BS: 1452 Gr.220 or Eqvt and shall be lined with natural Rubber, PTFE or Viton or Stainless Steel – 316 b) Hinge Pin and Door/Disc Pin shall be of Cast steel ASTM A 216 Gr. WCB and shall be coated with PVDF, or suitable elastomer or Stainless Steel – 316 c) Disc facing ring and Body Seat rings shall be Stainless Steel d) Bearing bushes shall be SS – 316 e) Material of construction of spring in dual type valve shall be of INCONEL or better
48.2	Lime slurry/Solution/ Suspensions	i. Type of Valves <u>For Isolation</u> Non-lubricated Plug Valves <u>For non-return / Check</u> Swing Check type /Dual Plate type
		ii. Material of Construction Valves <u>Plug Valves</u> a) Body shall be Cast Iron to IS: 210 Gr FG 260 / ASTM A 48 Cl.40; BS: 1452 Gr.220 or Eqvt b) Plug shall be Stainless steel to AISI 316 c) Body Sleeve & Seat shall be PTFE d) Gland & Gland nut shall be SS 304/316 e) Cover shall be of Cast Steel to ASTM A 216 Gr WCB <u>Check Valves</u> a) Body & Cover, Hinge Disk/Door shall be Cast Iron to IS: 210 Gr FG 260 / ASTM A 48 Cl.40; BS: 1452 Gr.220 or Eqvt and shall be lined

		with natural Rubber, PTFE or Viton or Stainless Steel – 316 b) Hinge Pin and Door/Disc Pin shall be of Cast steel ASTM A 216 Gr. WCB and shall be coated with PVDF, or suitable elastomer or Stainless Steel – 316 c) Disc facing ring and Body Seat rings shall be Stainless Steel d) Bearing bushes shall be SS-316 e) Material of construction of spring in dual type valve shall be of INCONEL or better
48.3	Sludge	i. Type of Valves <u>For Isolation</u> Gate or Sluice or Knife edge type Slide Valves <u>For non-return / Check</u> Swing Check type /Dual Plate type
		ii. Material of Construction <u>Gate / Sluice / Knife Edge Slide Valve</u> a) Body,Disc : Cast Iron b) Stem : Stainless Steel AISI 420 d) Packing : PTFE e) Gland & Gland nut : AISI 420 f) Hand wheel : Cast Iron <u>Check Valves</u> a) Body & Cover, Hinge Disk/Door shall be Cast Iron BS:1452 Gr.220 or Eqvt b) Hinge Pin and Door/Disc Pin shall be of Cast steel ASTM A 216 Gr. WCB / High tensile Brass or BS: 2872 equivalent. c) Disc facing ring and Body Seat rings shall be Stainless Steel. d) Bearing bushes shall be Leaded tin Bronze. e) Material of construction of spring in dual type valve shall be of INCONEL or better
48.4	Demineralised Water (Pre-Filter Backwash Water)	i. Type of Valves <u>For Isolation</u> a) Butterfly type <u>For non-return / Check</u> a) Lift Check type/Swing Check /Dual Plate type for sizes upto 40 mm NB b) Swing Check or Dual Plate type valve for sizes 50 mm NB & above
		ii. Material of Construction Valves <u>Butterfly Valves</u> a) Body shall be of Stainless Steel-316 b) Disc shall be of Stainless Steel-316. c) Shaft shall be of Stainless steel to ASTM. A 296 Gr. CF8M/AISI 316/ AISI 420 /BS:970 Gr.316; BS: 970 Gr.420 S45. d) Seat rings shall be Nitrile rubber /Hypalon/Eqvt. <u>Check Valves</u> a) Body & Cover, Hinge Disk/Door -Stainless Steel – 316 b) Hinge Pin and Door/Disc Pin shall be of Stainless Steel – 316 c) Disc facing ring and Body Seat rings shall be Stainless Steel

		d) Bearing bushes shall be SS – 316. e) Material of construction of spring in dual type valve shall be of INCONEL or better
48.5	For normal water (portable/service water) & Waste Water	i. Type of Valves For Isolation a) Butterfly or Saunder's Patented Diaphragm Valves upto 200 mm NB b) Butterfly type for Sizes 250 mm NB & above For non-return / Check a) Lift Check type/Swing Check /Dual Plate type for sizes upto 40 mm NB b) Swing Check or Dual Plate type valve for sizes 50 mm NB & above
		ii. Material of Construction Valves Diaphragm Valves The Diaphragm shall conform to following requirement i) Design standard: BS: 5156 or equivalent of required rating/ class. (Minimum rating of valves shall be PN 10). Type: Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type. a) Body , Bonnet: Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB b) Body lining : Soft natural rubber, ebonite , Polypropylene c) Hand wheel : Cast Iron d) Compressor : Stainless Steel e) Stem and Bush : Stainless Steel Butterfly Valves Butterfly valves shall be of Lugged-wafer type of low leakage rate confirming to AWWA-C-504 class 150 (min.) or BS:5155 PN 10 (min.) a) Body: ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated. b) Disc: SS 316. c) Shaft: BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better. d) Seat rings: 18-8 Stainless steel e) Seal: Nitrile rubber, EPDM, Hypalon All the butterfly valves shall be provided with Hand wheel or lever as per the requirements. All the butterfly valves shall be provided with an indicator to show the position of the disc. Flanges shall conform to ANSI B 16.5 Cl.150 (min). Ball Valves a) Type :Full bore b) Rating: PN 10 (min). c) Body: ASTM A216 Gr. WCB d) Ball: ASTM A276 TYPE 316 e) Seat ring: PTFE

		f) Stem: ASTM A276 TYPE 316 g) Seat: Nitrile rubber, PTFE <u>Check Valves</u> Body – Cast iron IS 210 Gr. FG 260 or equivalent Disc/ door –ASTM A351 Gr. CF8 Hinged pin – SS 316 Piston – SS 316
	Other Requirements: 1) Butterfly valves shall conform to design standard latest revision of AWWA C-504/EN 593/equivalent standard of required class/rating. 2) Plug valves shall be designed as per BS: 5353 Cl.150 or equivalent. 3) Valves for alum solution shall be Saunders's patented Diaphragm type designed as per BS: 5156 or approved equivalent standard. 4) Sluice/Gate Valves shall conform to BS: 5150 (BS: 5163 PN 16) PN16, IS:14846 of rating PN 1.0 (min.). Stem, seat ring and wedge facing ring shall be of stainless-steel construction. Other parts shall be as per IS: 14846 /BS:5163). Flanges shall be designed as per ANSI B 16.5 Cl. 150 (min.) to meet with the piping flanges. Valves shall be of outside screw and rising stem type. Gate valves for sizes below 50 NB and below shall conforms to IS:778 Class-2/ANSI B16.34 straight, rising stem; without side screw. 5) Sluice/Isolation gates shall be provided with the following accessories in addition to the standard items: a. Hand wheel b. Manual Gear reduction unit operator for valves 200 NB and above c. Bypass valve for valve of sizes 350 NB and above. d. Draining arrangement wherever required. e. Arrow indicating flow direction. f. Position indicator. g. Sluice/Isolation gates shall be provided with back seating bush to facilitate gland renewal during full open condition. 6) Design standard for Gates shall be IS: 3042 or Equivalent. Material of Construction a. Frame and Door: Cast Iron IS:210 Gr.260 b. Spindles, bolts & nuts: M.S. to IS:2062 c. Face & seat rings: Gun metal (as per IS: 3042). 7) All the parts of gates shall be applied with the coats of heavy duty bitumastic paint. Each of the gates shall be provided with hand wheel and a position indicator. 8) Sluice valve/knife edge type slide valves shall design by IS 14846. Plug valves shall be used for the application of lime slurry/lime solutions conforming to BS: 5353 Class 150 or Equivalent. 9) Valves will be used to start/stop or control flow. Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too. However, contractor can provide either isolation gates or butterfly valves in various RCC (IN BHEL SCOPE) tanks/pits/sumps such as sludge pit, etc. Sample valves will be used in sample collection lines. Unless otherwise specified all the valves shall be supplied with counter flanges by the Contractor. 10) All valves shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required to operate. All the valves shall be of standard pressure rating of the relevant design standard. Nonstandard pressure rating shall not be accepted. The pressure and temperature rating of the valve shall not be less than the maximum expected pressure and temperature plus 5% additional margin of the system in which valves are proposed to be installed. The pressure rating of individual piping system components such as valves, flanges etc. shall however be not less than that specified.	

BOQ for receipt of material at Site, Unloading, Inspection, Verification, Storage, up -keeping, Safety & Security, Material Handling. ETC works shall be provided by the equipment supplier.
Indicative BOM of the supplies is attached as below which may be changed during engineering stage.

SN	ITEM DESCRIPTION	Unit	QTY
1	Supply & ETC of Main Lighting Distribution Board (MLDB) (Comprising of 415V, 3-Ph, 4-wire bus and one number 100kVA Lighting transformer, 160A Incomer TPN MCCB (including 160/1A CT, Current & Voltage Transducers, Ammeter & Voltmeter with selector switches etc.); Ougoing feeders 6 Nos. 63A TPN SFU	Nos.	2
2	Supply & ETC of Emergency Lighting Distribution Board (ELDB) (Comprising of 415V, 3-Ph, 4-wire bus and one number 100kVA Lighting transformer, 160A Incomer TPN MCCB (including 160/1A CT, Current & Voltage Transducers, Ammeter & Voltmeter with selector switches etc.); Ougoing feeders 4 Nos. 63A TPN SFU	Nos.	1
3	Supply & ETC of Indoor Lighting Panel - Type LP-1	Nos.	3
4	Supply & ETC of Indoor Lighting Panel - Type LP-2	Nos.	2
5	Supply & ETC of Indoor DC Lighting Panel DCLP	Nos.	1
6	Supply & ETC of Outdoor Lighting Panel - Type LP-1	Nos.	2
7	Supply & ETC of Outdoor Lighting Panel - Type LP-2	Nos.	2
8	Supply & ETC of Switchboard - Type SWB-1	Nos.	20
9	Supply & ETC of Switchboard - Type SWB-2	Nos.	25
10	Supply & ETC of Switchboard - Type SWB-3	Nos.	3
11	Supply & ETC of Switchboard - Type SWB-4	Nos.	1
12	Supply & ETC of Switchboard - Type SWB-5	Nos.	1
13	Supply & ETC of MCB Box (I/C: 415V, 3-PH, 32A TPN MCB; O/G: 5 Nos. 1-PH, 6A MCB)	Nos.	1
14	Supply & ETC of Receptacle - 6/16A (Decorative) RB type	Nos.	10
15	Supply & ETC of Receptacle - 20A (Industrial) RA type	Nos.	10
16	Supply & ETC of Receptacle - 20A (Industrial) RC type - Flameproof	Nos.	2
17	Supply & ETC of Receptacle - 415 V, 63A, 3-PH (Industrial) Indoor Receptacle	Nos.	5
18	Supply & ETC of Receptacle - 63A, 415V, 3-Phase, 4-Pin Interlocked industrial grade rotatry switch socket, Outdoor Receptacle (Necessary arrangement for looping incoming supply cables shall be provided)	Nos.	2
19	Supply & ETC of Receptacle - 415V, 250A. 3-Phase, 4-Pin TPN MCCB Industrial type Outdoor Receptacle with earthing contacts - for Oil filtration machine (Necessary arrangement for looping incoming supply cables shall be provided)	Nos.	1
20	Supply & ETC of Outdoor Junction box	Nos.	3
21	Supply & ETC of Indoor lighting fixtures - LED Decorative recess mounted lighting fixture Type FC30	Nos.	80
22	Supply & ETC of Indoor lighting fixtures - LED Industrial batten surface mounted lighting fixture Type FC06	Nos.	40
23	Supply & ETC of Indoor lighting fixtures - Capsule LED corrosion proof lighting fixture Type FC81	Nos.	5
24	Supply & ETC of Indoor lighting fixtures (GIS Building) - LED High bay lighting fixture Type SB03	Nos.	15
25	Supply & ETC of Emergency DC lighting fixtures - DC Industrial bulkhead lighting fixture for Non-false Ceiling Areas	Nos.	10
26	Supply & ETC of Emergency DC lighting fixtures - DC Downlighter for False Ceiling Areas	Nos.	10
27	Supply & ETC of Street lighting fixtures - LED Street light fixture Type SS63	Nos.	35
28	Supply & ETC of Flood lighting fixtures - LED Flood light fixture Type SF66	Nos.	75
29	Supply & ETC of LED Post Top Lantern fixture - Outdoor type	No.	5
30	Supply & ETC of Marine type luminaires 100W lamp with accessories	No.	1
31	Supply & ETC of Aviation light for High mast	Nos.	5
32	Supply & ETC of Occupancy based Infra Red Sensors	Nos.	10
33	Supply & ETC of Exit Sign Boards	Nos.	5
34	Supply & ETC of Exhaust fans - with metal sheet crawl & bird screen for Toilets	Nos.	3
35	Supply & ETC of Exhaust fans - with metal sheet crawl & bird screen for Pantry	Nos.	1
36	Supply & ETC of Ceiling fans 1200mm sweep with electronic regulator, fan hook, suspension rod etc.	Nos.	3
37	Supply & ETC of Wall mounted fans 400mm sweep	Nos.	10
38	Supply of Free-standing Aluminium Ladder, height adjustable (from 5m to 10m height)	Nos.	1
39	Supply, Civil works & ETC of 30m high Lighting High Mast with Lantern Carriage (Winch type) for Switchyard Lighting along with feeder pillar & junction box	Nos.	2
40	Supply, Civil works & ETC of 8m High Lighting Pole (including JB) for Street Lighting	Nos.	30
41	Supply, Civil works & ETC of 4m high Lighting Pole (including JB) for Post-top Lantern	Nos.	5
42	Supply & ETC of Galvanized rigid conduit of 20mm size with accessories	Mtr.	2000
43	Supply & ETC of Galvanized rigid conduit of 25mm size with accessories	Mtr.	500
44	Supply & ETC of Galvanized heavy duty steel conduit of 25mm size with accessories with additional epoxy coating for corrosive areas	Mtr.	50
45	Supply & ETC of Galvanized rigid conduit of 40mm size with accessories	Mtr.	10

SN	ITEM DESCRIPTION	Unit	QTY
46	Supply & ETC of 20mm Flexible conduits made with bright, cold rolled annealed and electro galvanized mild steel strips and coated with PVC	Mtr.	50
47	Supply & ETC of 1C, 1.5 sqmm PVC insulated stranded Cu. Wire Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number). Colour coded.	Mtr.	1000
48	Supply & ETC of 1C, 2.5 sqmm PVC insulated stranded Cu. Wire Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number). Colour coded.	Mtr.	2500
49	Supply & ETC of 1C, 4 sqmm PVC insulated stranded Cu. Wire Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number). Colour coded.	Mtr.	500
50	Supply & ETC of 2C, 2.5 sqmm PVC insulated stranded Cu. Wire	Mtr.	500
51	Supply & ETC of 1C, 10 sqmm PVC insulated stranded Al. Wire	Mtr.	500
52	Supply & ETC of Earthing Material - 25x6mm GI Flat	Mtr.	100
53	Supply & ETC of Earthing Material - GI wire for Earthing of size 16 SWG	Mtr.	2000
54	Supply & ETC of Portable 24V halogen lamp unit	Nos.	1
55	Supply & ETC of 5A, 24V industrial type sockets	Nos.	1
56	Supply & ETC of Temperature Transducer	Nos.	5
57	Supply & ETC of Telephone points- single outlet telephone socket including cable/wire and accessories	Nos.	10
58	Supply & ETC of Telephone JB suitable for 20 pair Indoor type	Nos.	1
59	Supply & ETC of Supply & ETC of 2 wire telephone cable (ISI marked).	Mtr.	200
60	Supply & ETC of LAN points incudiung accessories	Nos.	5
61	Supply & ETC of LAN Cable	Mtr.	200
62	Supply & ETC of Erection hardwares for indoor like 3 way, G.I.,circular J.B.(20mm and 25mm), 4 way,G.I.,circular J.B.(20mm and 25mm), 90deg,G.I.,Inspection Bend (20mm and 25mm), 90deg,G.I.,Normal Bend (20mm and 25mm), Heavy duty, Saddle with base (20mm and 25mm), Heavy duty, Saddle without base (20mm and 25mm), M4X25mm, steel screw with nut and washer, G.I. check nut/lock nut (20mm and 25mm), PVC Rawl plug, 6mm,Wooden screw, 35mm,Earth clip/clamp (20mm and 25mm), Cleat fabrication out of 25x6mm M.S. flat (for hanging conduit in false ceiling areas, Anchor fastner (M10x75mm for cleats, M12x75mm for lighting panels), Rubber bush (20mm and 25mm), 20mm PVC, flexible conduit, 25mm, PVC conduit, Coupling, Swing out braket, 20mm, Heavy duty, ball socket, Machine screw (for fixing surface mounting fixtures on circular J.B.), PVC closure (20mm and 25mm), Reducer (20mm and 25mm), GI wire/ FRLSH cu wire for earthing, lugs & glands for wires/cables, indoor junction box etc, as required, for completion of switch yard indoor illumination system	Lot	1
63	Supply & ETC of Erection hardwares for outdoor like 20x1.5mm Aluminium flat, M12x40mm, G.I. Bolt with nut and washer for fixing outdoor lighting panels, M6x30mm, G.I. Bolt with nut and washer for fixing control gear boxes, M8x30mm, G.I. Bolt with nut and washer for fixing outdoor J.B.s, SLP, M10x35mm, G.I. Bolt with nut and washer for fixing outdoor lighting fixtures, Earth wire from J.B. to lighting fixtures, Mounting brackets for outdoor lighting fixtures, GI wire for earthing, lugs & glands for wires/cables etc, as required, for completion of switch yard outdoor illumination system	Lot	1
64	Services of Illumination System Design - Lux Level Design Calculations for Indoor & Outdoor area	Lot	1
65	Services of Illumination System Design -Lighting Layout for indoor & Outdoor area	Lot	1
66	Services of Illumination System Design -Conduit Layout for indoor areas	Lot	1
67	Services of Illumination System Design -Cable Schedule, Power Distribution scheme, Control Schemes, any other drawing, document, design, Preparation of BOQ required for complete illumination system	Lot	1
68	Services of Site Test - Lux Level Measurement and demonstration to customer at site including arrangement of necessary test equipment on returnable basis	Lot	1
69	Laying, Testing & Commissioning of 2C, 2.5 sq mm PVC insulated, Armoured Cu. Cable	Mtr.	4000
70	Laying, Testing & Commissioning of 2C, 6 sq mm PVC insulated, Armoured Al. Cable	Mtr.	500
71	Laying, Testing & Commissioning of 4C, 6 sq mm PVC insulated, Armoured Al. Cable	Mtr.	500
72	Laying, Testing & Commissioning of 4C, 16 sq mm PVC insulated, Armoured Al. Cable	Mtr.	3000
73	Laying, Testing & Commissioning of 3.5C, 70 sq mm PVC insulated, Armoured Al. Cable	Mtr.	2000
74	Laying, Testing & Commissioning of 3.5C, 240 sq mm XLPE insulated, Armoured Al. Cable	Mtr.	250
75	Laying of 50 mm GI conduits at a depth of 300 mm including excavation, backfilling, making & repairing of walls in trenches, cutting, threading, fixing of sockets/bends where required etc to complete. Also between pull pit boxes to JB/LP	Mtr.	250
76	Laying of 100 mm GI conduits at a depth of 300 mm including excavation, backfilling, making & repairing of walls in trenches, cutting, threading, fixing of sockets/bends where required etc to complete. Also between pull pit boxes to JB/LP	Mtr.	250

SN	ITEM DESCRIPTION	Unit	QTY
77	Construction of Pull Pit Boxes of sizes 400 mm x 400 mm x 400 mm at the free ends and turning of GI pipes if pipe length exceeds 4M	No.	5
78	Earthing using 50x6 mm GI Flat	Mtr.	250
79	Earthing using 75x12 mm GI Flat	Mtr.	250
80	Earthing using 40mm Dia, 3m long MS Rod	Mtr.	180
81	Type Test of LED Lighting Fixture - High Bay Fixture	Lot	1
82	Type Test of LED Lighting Fixture - Well Glass Fixture	Lot	1
83	Type Test of LED Lighting Fixture - Street Light Fixture	Lot	1
84	Type Test of LED Lighting Fixture - Surface mounted type Fixture	Lot	1
85	Type Test of LED Lighting Fixture - Recessed mounted type Fixture	Lot	1