


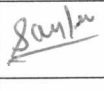
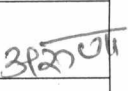


BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS HVDC ENGINEERING & SYSTEMS

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DOCUMENT No.	TB-397-316-019	Rev. No.	00	Prepared	Checked	Approved		
TYPE OF DOC.	TECHNICAL SPECIFICATION	SIGN						
TITLE	NAME		NS	SKS	AG			
CABLE TRENCH MATERIAL		DATE	25/06/19	25/06/19	25/06/19			
		GROUP	HVDC	W.O. No	87009			
CUSTOMER	Patratu Vidyut Utpadan Nigam Ltd. (PVUNL) (A Subsidiary of NTPC in Joint Venture with JBVNL)							
PROJECT	400kV GIS at Patratu Super Thermal Power Project Expansion Phase-I (3 X 800 MW)							
NOA NO.	01/PVUNL-CS-9585-001-2/NOA-FC Dated 08-Mar-2018 01/PVUNL-CS-9585-001-2/NOA-SC Dated 08-Mar-2018 01/PVUNL-CS-9585-001-2/NOA-TC Dated 08-Mar-2018							
Station	Patratu, Jharkhand							
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3	Project Details and General Technical Requirements					1+33		
4	Guaranteed Technical Particulars					1		
5	Checklist					2		
Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
Distribution				To	HVDC	TBMM	TBQM	Vendor
				Copies	1	1	1	4



SECTION-1

Scope, Bill of Quantity, Specific Technical Requirements & Qualifying Requirement

1.1 Scope

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch to site of welded and bolted type cable trench material complete with all accessories as listed below.

No deviation from the requirements specified in various clauses of this specification shall be allowed.

The equipment is required for the following project:

Name of the customer : **Patratu Vidyut Utpadan Nigam Ltd. (PVUNL)**
(A Subsidiary of NTPC in Joint Venture with JBVNL)

Name of the project : **400kV GIS at Patratu Super Thermal Power Project
Expansion Phase –I (3X800 MW)**

Site : **Patratu, Jharkhand**

***Note: The terms used in this specification namely, “Employer/Purchaser” refers to PVUNL , “Contractor” refers to BHEL.**

Refer section-3 of this document for project details and general specification.
Refer section-3 of this document for project details and general specification.

In case of any conflict among the various sections of this specification, the order of precedence shall be section 1, section 2 & the section 3.



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.	310	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.	283	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.	1020	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.	242	As per Annexure 1 of section 1.
5.	Vertical support of Single Channel (C1) of standard length 6.0 m – Bolted Type	7	As per Drawing: PE-DG-405-507-E007 Rev 00 - Sheet 02 Of 12
6.	Vertical support of Double Channel (C2) of standard length 6.0 m - Bolted Type	12	As per Drawing: PE-DG-405-507-E007 Rev 00 - Sheet 02 Of 12
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.	220	As per Drawing: PE-DG-434-507-E007 Rev 00 - Sheet 03 Of 12 and PE-DG-434-507-E007 Rev 00 - Sheet 11 Of 12
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	546	As per Drawing: PE-DG-434-507-E005 Rev 01 - Sheet 02 Of 13
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	60	As per Drawing: PE-DG-434-507-E005 Rev 01 - Sheet 02 Of 13



SN	Item Description	Qty (Nos.)	Remarks
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	32	As per Drawing: PE-DG-434-507-E005 Rev 01 - Sheet 05 Of 13
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	22	As per Drawing: PE-DG-434-507-E005 Rev 01 - Sheet 05 Of 13
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	24	As per Drawing: PE-DG-434-507-E005 Rev 01 - Sheet 09 Of 13
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	40	As per Drawing: PE-DG-434-507-E005 Rev 01 - Sheet 09 Of 13
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	22	As per Drawing: PE-DG-434-507-E005 Rev 01 - Sheet 05 Of 13
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	22	As per Drawing: PE-DG-434-507-E005 Rev 01 - Sheet 05 Of 13
16.	Base Plate For Single Channel (BP1) with 1 No. 10 mm dia (M10) anchor bolts – Bolted Type	13	As per Drawing: PE-DG-434-507-E007 Rev 00 - Sheet 06 Of 12 and PE-DG-434-507-E007 Rev 00 - Sheet 11 Of 12
17.	Base Plate For Double Channel (BP2) with 2 No. 10 mm dia (M10) anchor bolts – Bolted Type	26	As per Drawing: PE-DG-434-507-E007 Rev 00 - Sheet 07 Of 12 and PE-DG-434-507-E007 Rev 00 - Sheet 11 Of 12
18.	Tray Fixing Clamp (TC1) – Bolted Type	572	As per Drawing: PE-DG-434-507-E007



SN	Item Description	Qty (Nos.)	Remarks
			Rev 00 - Sheet 09 Of 12
19.	PVC End Cap	250	As per Drawing: 0350-215-PVE-B-001 Rev 00- Sheet 20 Of 21
20.	Earth Flat Fixing Clamp (Z) – Bolted Type	39	As per Drawing: 0350-215-PVE-B-001 Rev 00- Sheet 18 Of 21
21.	90 deg Angle Fitting LA1	39	As per Drawing: PE-DG-434-507-E007 Rev 01 - Sheet 10 Of 12
22.	90 deg Angle Fitting HL1	65	As per Drawing: PE-DG-434-507-E007 Rev 01 - Sheet 04 Of 12

Note:

1. The quantity for individual items may vary up to any extent, however total quantity may vary $\pm 40\%$ 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.

1.3 Specific Technical Requirements

Refer section 2.

1.4 Type Tests

- 1.4.1** The cable trench material to be supplied shall be of type tested design. During detail engineering, the bidder shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of techno-commercial bid opening i.e 03-Mar-2017. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s)



should have been either conducted at an independent laboratory or should have been witnessed by a client.

- 1.4.2** However if the bidder is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the bidder shall conduct all such tests under this contract at no additional cost to the BHEL either at third party lab or in presence of client/owners representative and submit the reports for approval.
- 1.4.3** All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
- 1.4.4** The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.
- 1.4.5** Details of testing shall be as per Section II of this specification.

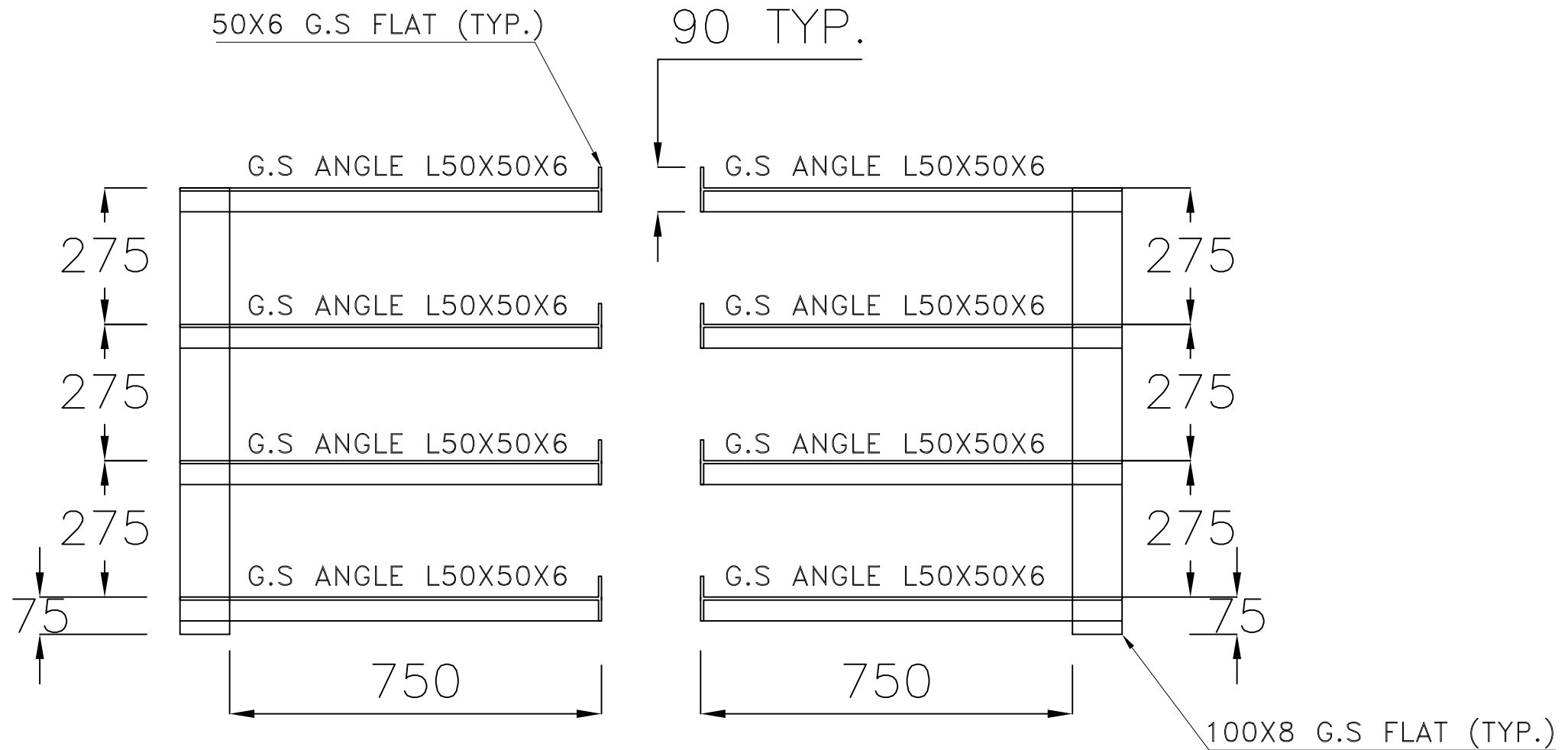
1.5 Quality Plan

Bidder to follow valid NTPC approved quality plan at contract stage. In case the bidder does not have NTPC approved QP, it will be the bidder’s responsibility to get its QP approved from NTPC.

1.6 Deviations

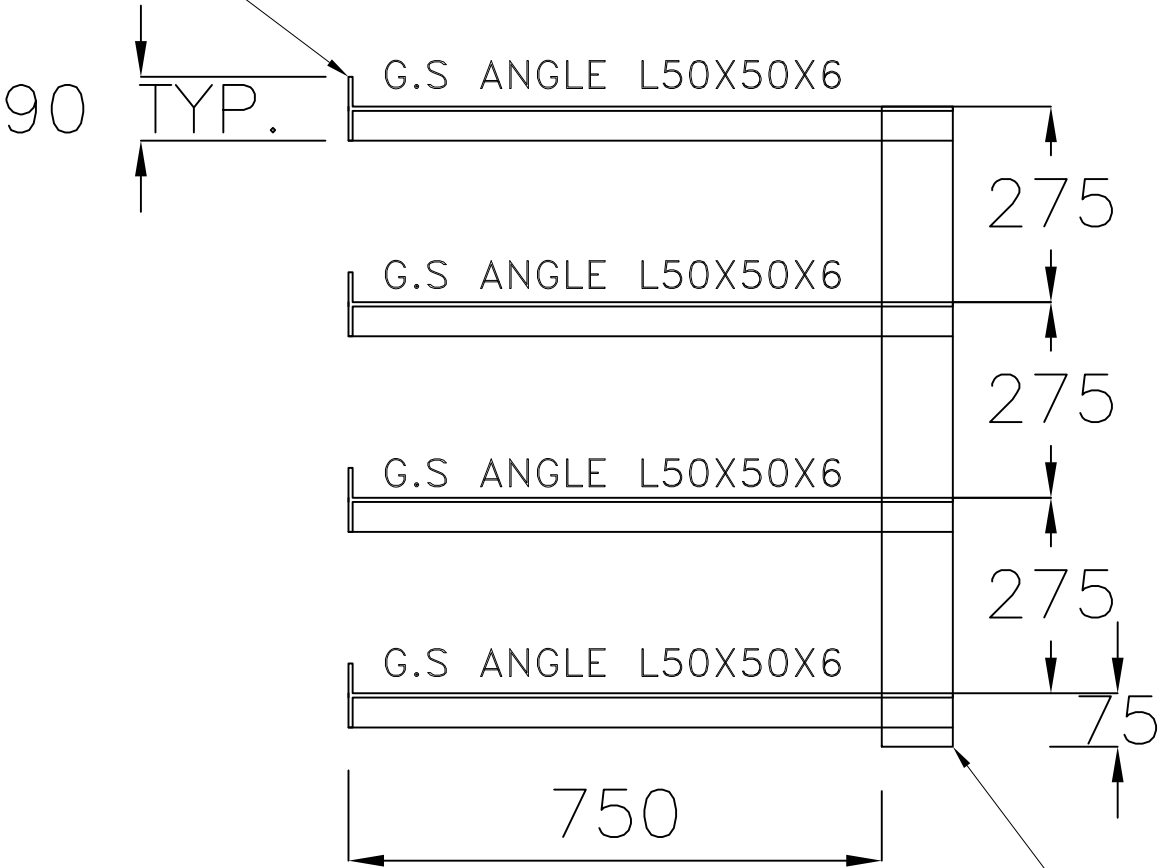
The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

CLAUSE NO.		QUALITY ASSURANCE													<div>एनटीपीसी</div> <div>NTPC</div>	
QUALITY ASSURANCE & INSPECTION MODULE NO. SQE-16																
CABLING, EARTHING, LIGHTNING PROTECTION																
ATTRIBUTES / CHARACTERISTICS		Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per NTPC	
ITEMS/COMPONENTS / SUB SYSTEMS																
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)		Y	Y	Y	Y		Y		Y		Y	Y	Y	Y	Y	
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745)		Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y	
Cable glands(BS-6121)		Y													Y	
Cable lug		Y													Y	
Lighting wire (IS-694)		Y											Y			
Flexible conduits		Y											Y		Y	
Conduits (Galvanise & Epoxy) IS-9537 & IS-2629, 2633, 6745		Y		Y						Y			Y		Y	
RCC Hume Pipe (IS-458)													Y			
Cable termination & straight through joint (IS 13573)		Y											Y		Y	
Cable Trays, bends, tees, crosses, Flexible supports system & accessories IS-513, 2629,2633,6745		Y		Y		Y	Y	Y		Y			Y	Y	Y	
Trefoil clamp		Y													Y	
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)		Y		Y						Y			Y		Y	
GI wire (IS-280)		Y											Y			
Fire Sealing System (BS –476)													Y	Y	Y	
<p>.Note:1.This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.</p> <p>2.* Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the NTPC technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot. This test is not applicable on bends, tees & crosses.</p> <p>3. Make of all items will be subject to NTPC approval.</p>																
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)					TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-9585-001-2					SUB-SECTION-E-35 CABLING, EARTHING, LIGHTNING AND PROTECTION					Page 1 of 1	



SECTION 1-1

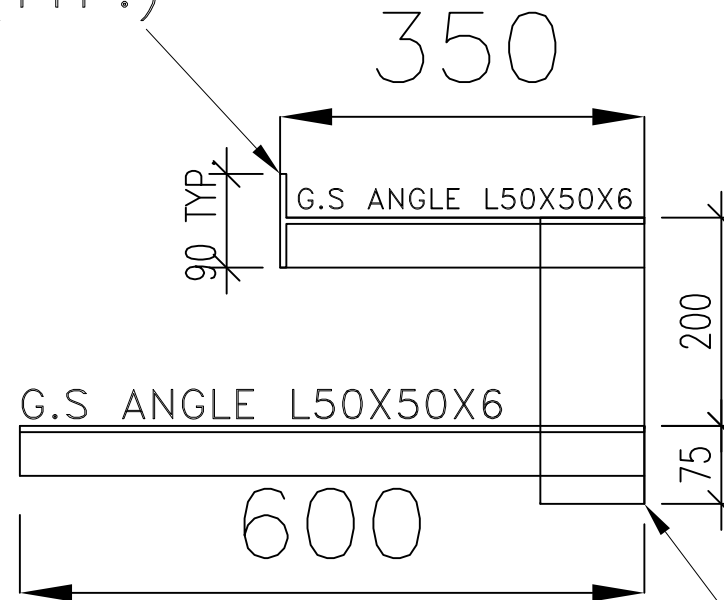
50X6 G.S FLAT (TYP.)



100X8 G.S FLAT (TYP.)

SECTION 2-2

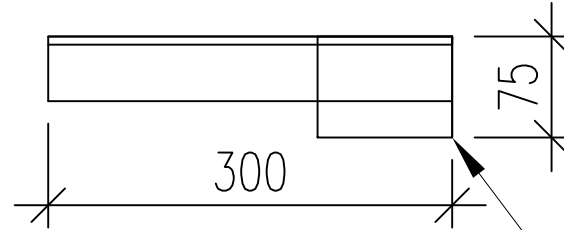
50X6 G.S FLAT (TYP.)



100X8 G.S FLAT (TYP.)

SECTION 4-4

G.S ANGLE L50X50X6



100X8 G.S. FLAT (TYP.)

SECTION 5-5

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES


NTPC DOCUMENT NO: 9585-001-215-PVE-B-003



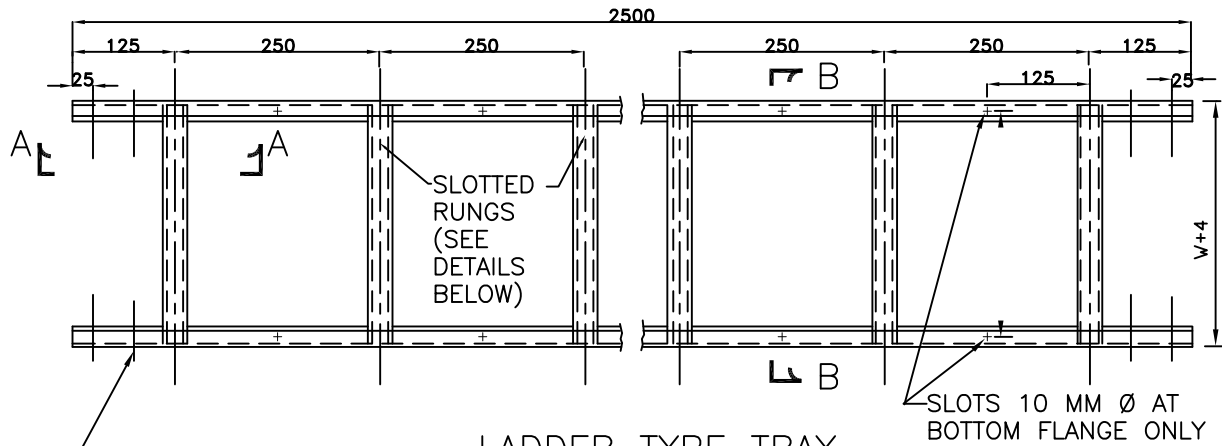
NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT

PATRATU SUPER THERMAL POWER STATION EXPANSION
PHASE - I (3 X 800 MW)

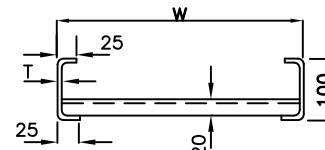
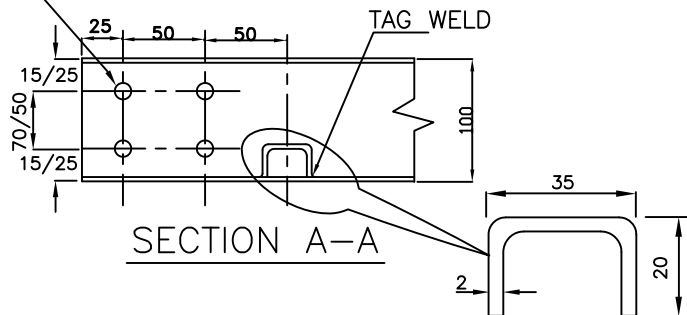
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THE DOCUMENT IS REVISED INLINE WITH THE NTPC COMMENTS RECEIVED VIDE TRANSMITTAL DTD. 08.05.18.							BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA					DPT CODE-E	DSN	MMM	-sd-	09.04.18
													CHD	HK	-sd-	09.04.18
													APP	PD	-sd-	09.04.18
													DWG. NO. PE-DG-434-507-E005			
SHT. 01 OF 13 REV. 01																

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

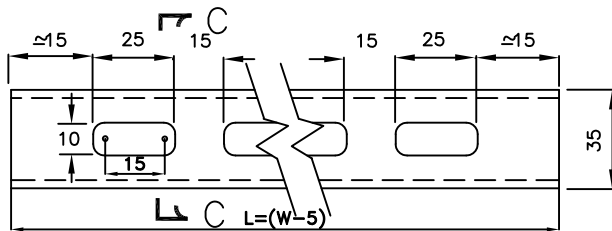


4 HOLES 10mm DIA.

LADDER TYPE TRAY

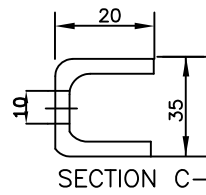


SECTION B-B

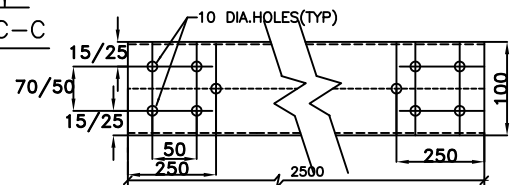


SLOTTED RUNGS

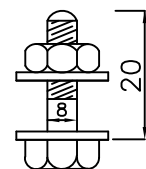
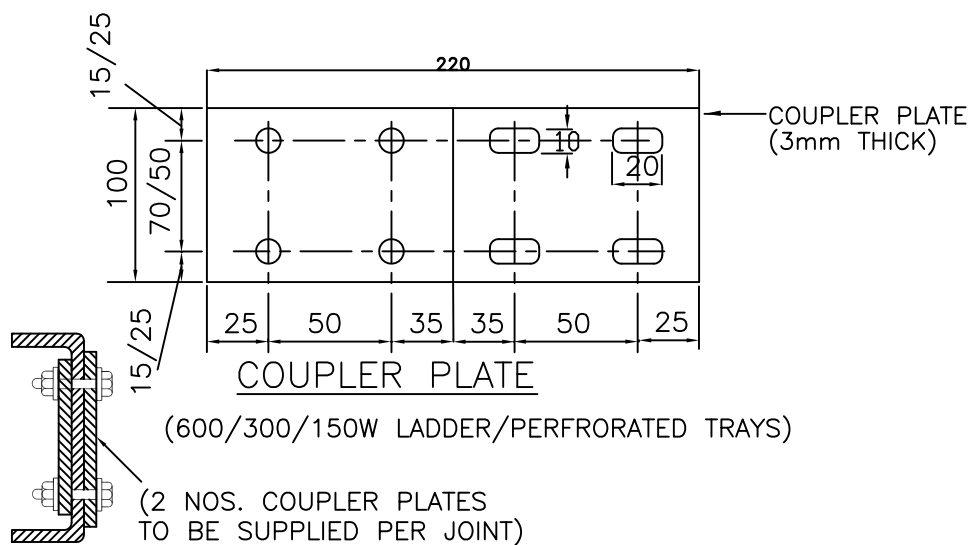
(TO SUIT TRAY WIDTH)



SECTION C-C



SIDE RUNNER



8 NUMBERS BOLTS
8mm DIA 20mm LONG
WITH NUTS AND
WASHERS ARE TO BE
SUPPLIED WITH EACH
COUPLER PLATE



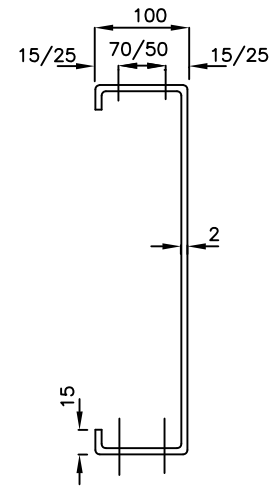
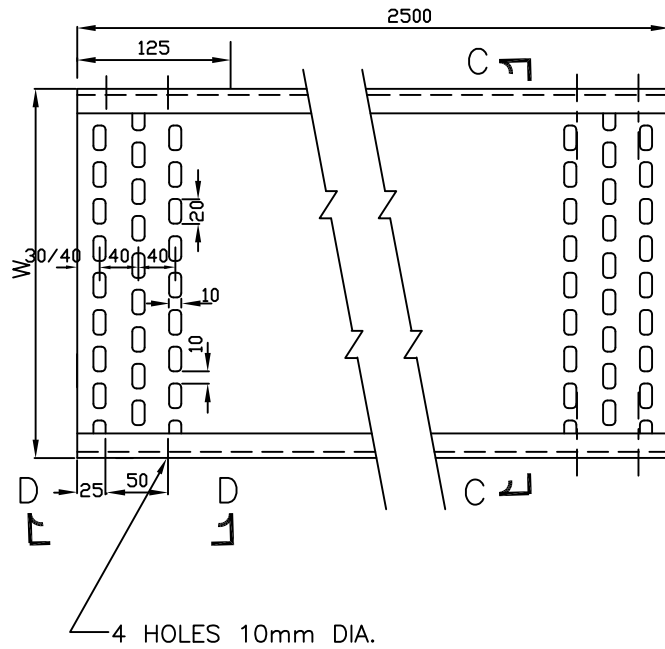
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

DRAWING NO.

PE-DG-434-507-E005

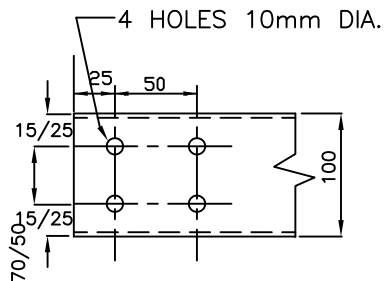
SH 2 OF 13

REV 01



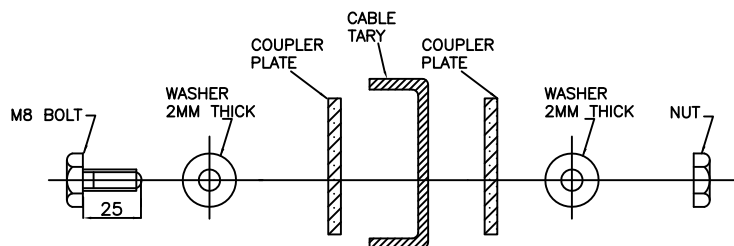
SECTION-CC

600/300/150 TRAYS



SECTION-DD

600/300/150 TRAYS

PERFORATED TYPE TRAYSEQUENCE OF M8 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAYFOR TYPICAL CABLE TRAY JOINT

SEE GENERAL NOTES IN SHEET 13.

TYPICAL DETAILS OF
CABLE TRAYS AND ACCESSORIES

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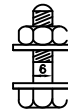
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SH 3 OF 13

REV 01

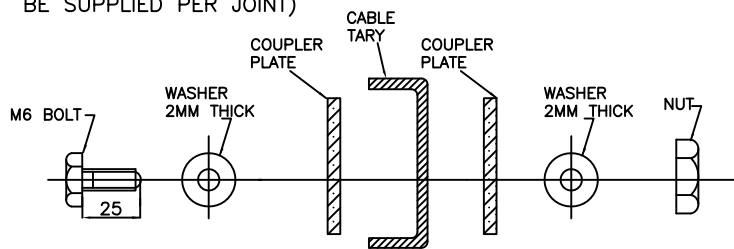


(2 NOS. COUPLER PLATES
OF 3 MM THICKNESS TO
BE SUPPLIED PER JOINT)



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

SEE GENERAL NOTES IN SHEET 13.



TYPICAL DETAILS OF
CABLE TRAYS AND ACCESSORIES

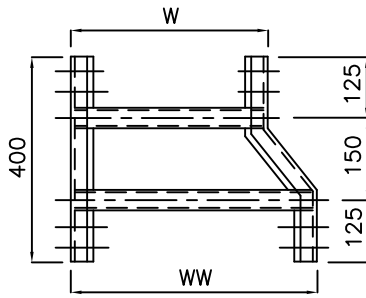
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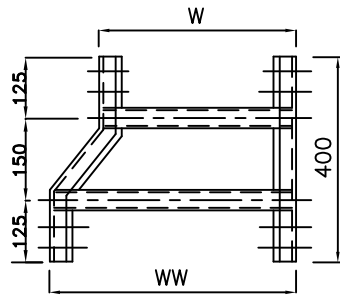
SH 4 OF 13

REV 01

ANNEXURE 2



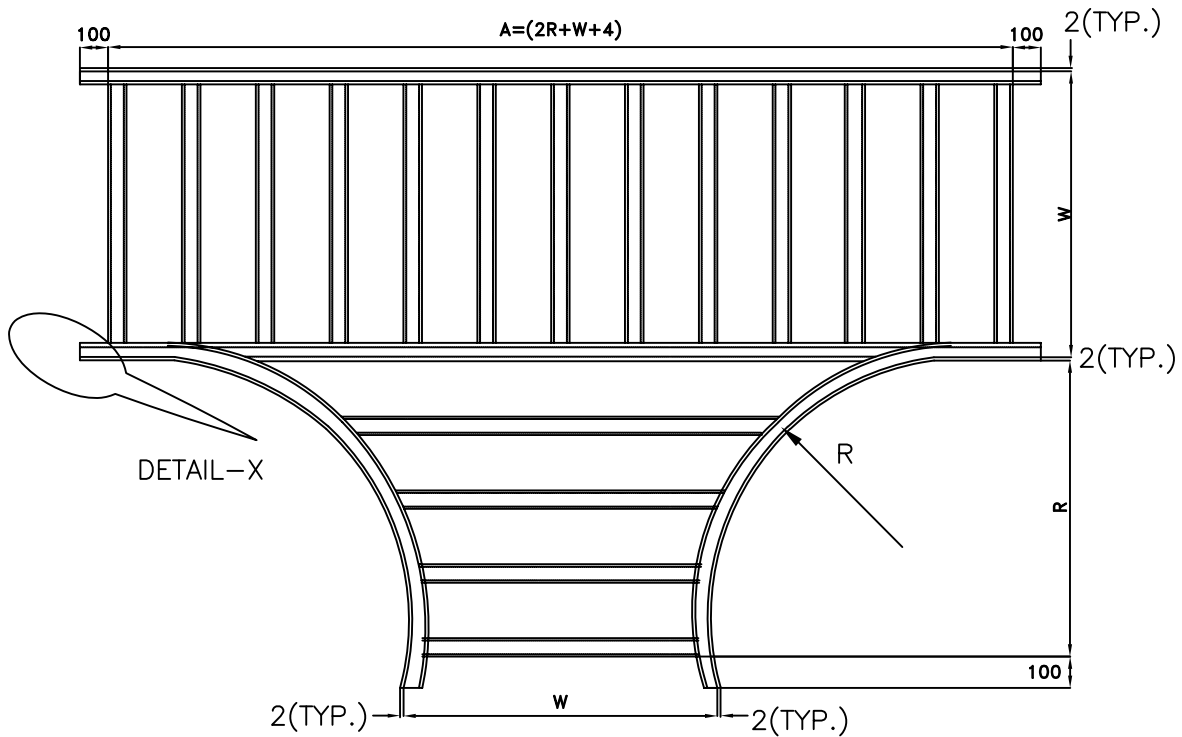
LEFT HAND REDUCER



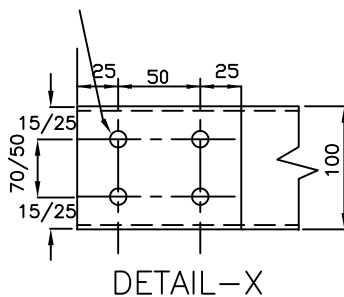
RIGHT HAND REDUCER

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

LADDER TYPE



10mm DIA. HOLES



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

SEE GENERAL NOTES IN SHEET 13.

LADDER TYPE



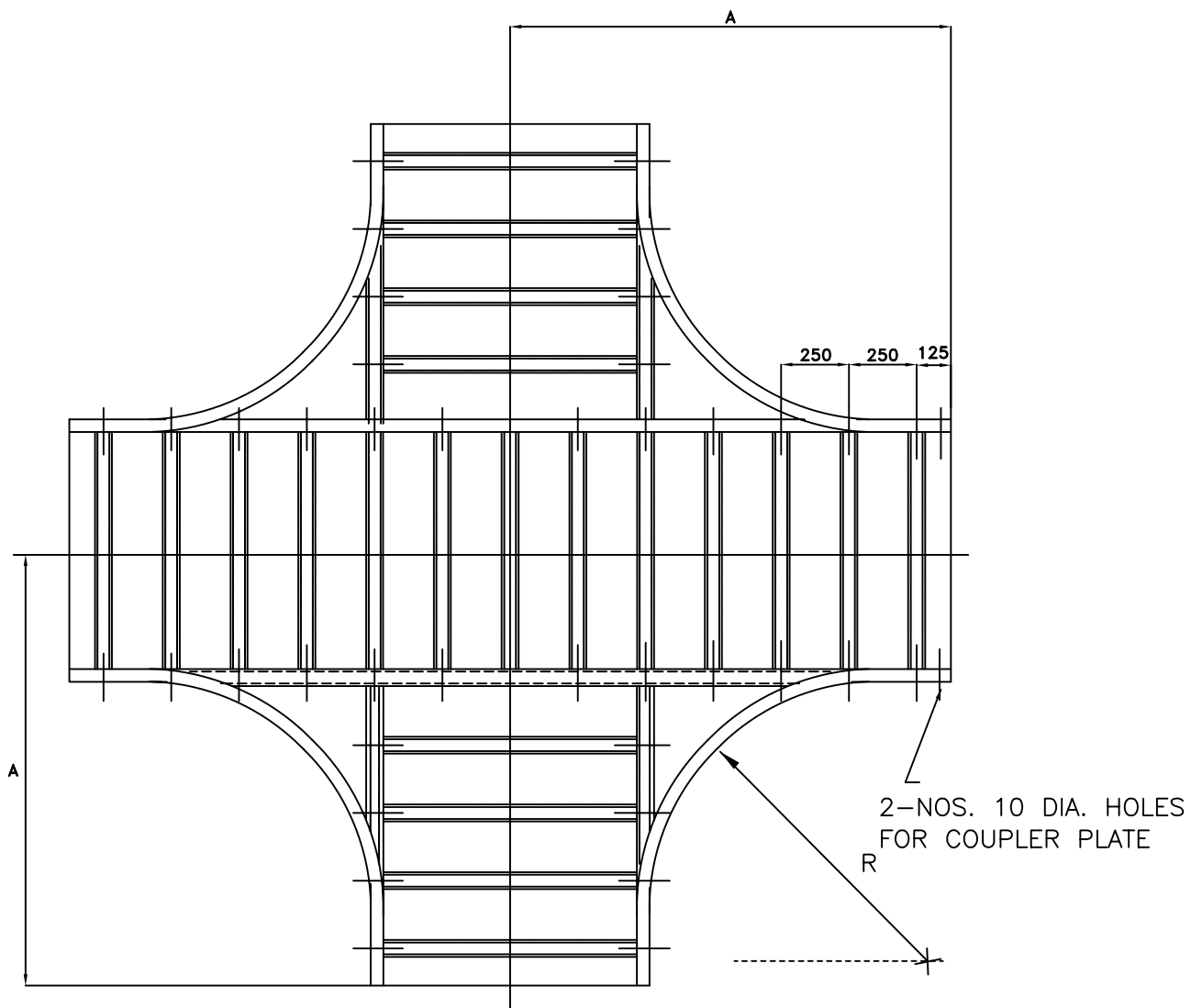
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

DRAWING NO.

PE-DG-434-507-E005

SH 5 OF 13

REV 01



HORIZONTAL CROSS-PLAN

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

SEE GENERAL NOTES IN SHEET 13.



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

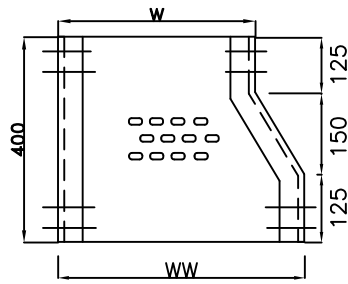
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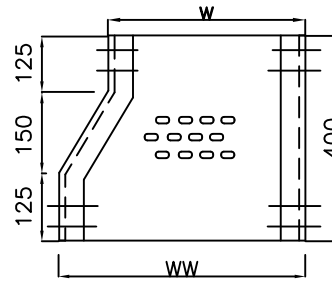
SH 6 OF 13

REV 01

ANNEXURE 2



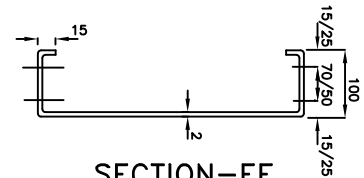
LEFT HAND REDUCER



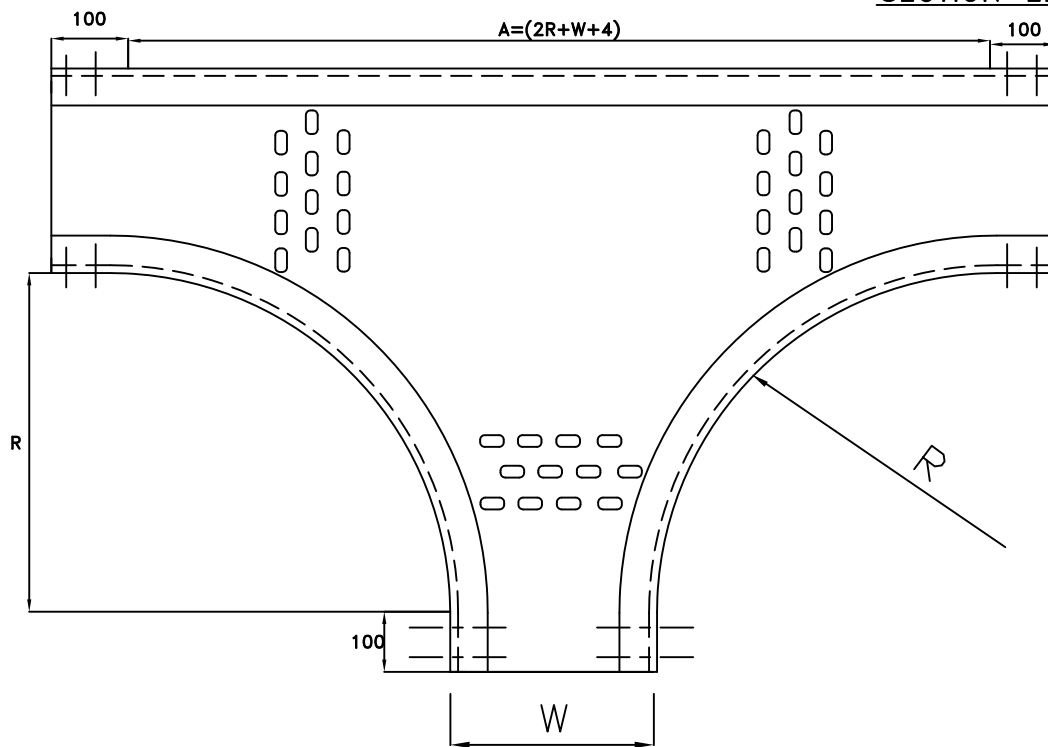
RIGHT HAND REDUCER

PERFORATED TYPE

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



SECTION-EE



TEE

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

SEE GENERAL NOTES IN SHEET 13.

PERFORATED TYPE



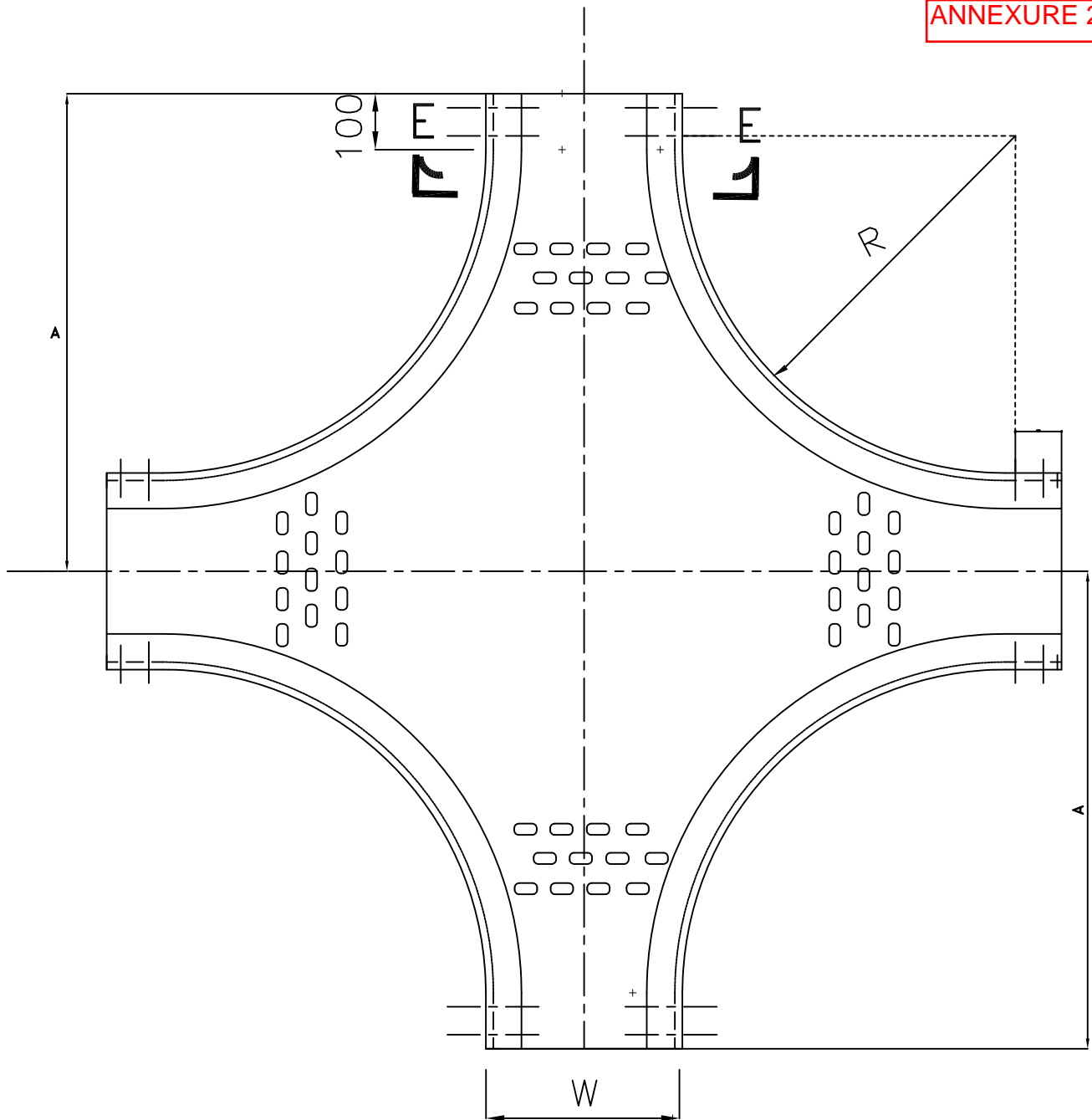
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

DRAWING NO.

PE-DG-434-507-E005

SH 7 OF 13

REV 01



CROSS

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

SEE GENERAL NOTES IN SHEET 13.



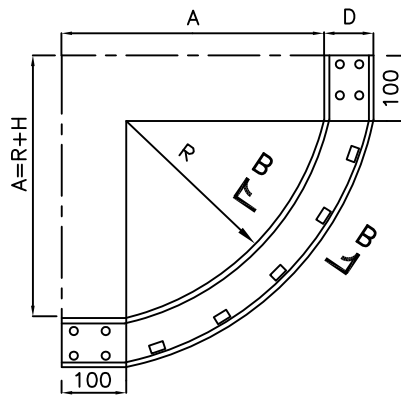
TYPICAL DETAILS OF
CABLE TRAYS AND ACCESSORIES

DRAWING NO.

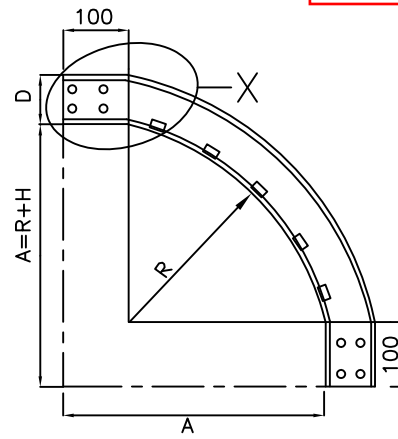
PE-DG-434-507-E005

SH 8 OF 13

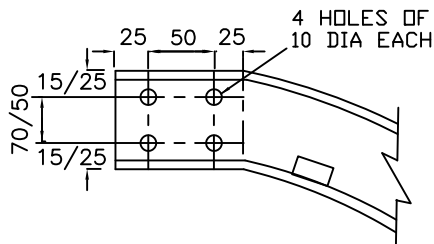
REV 01



INSIDE TYPE



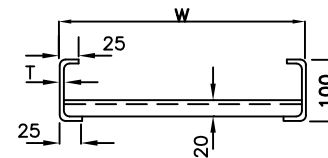
OUTSIDE TYPE



ENLARGED VIEW OF "X"

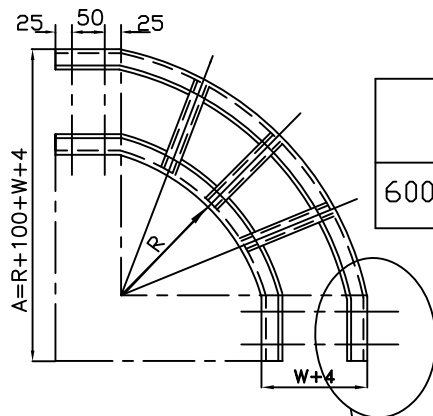
VERTICAL ELBOW 90 DEG UP/DOWN

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



SECTION B-B

90° VERTICAL BEND - LADDER TYPE



LADDER TYPE

X (AS ABOVE)

HORIZONTAL ELBOW 90 DEG

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

90° HORIZONTAL BEND - LADDER TYPE

SEE GENERAL NOTES IN SHEET 13.



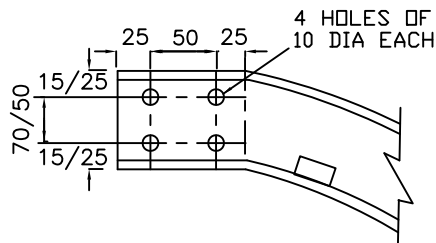
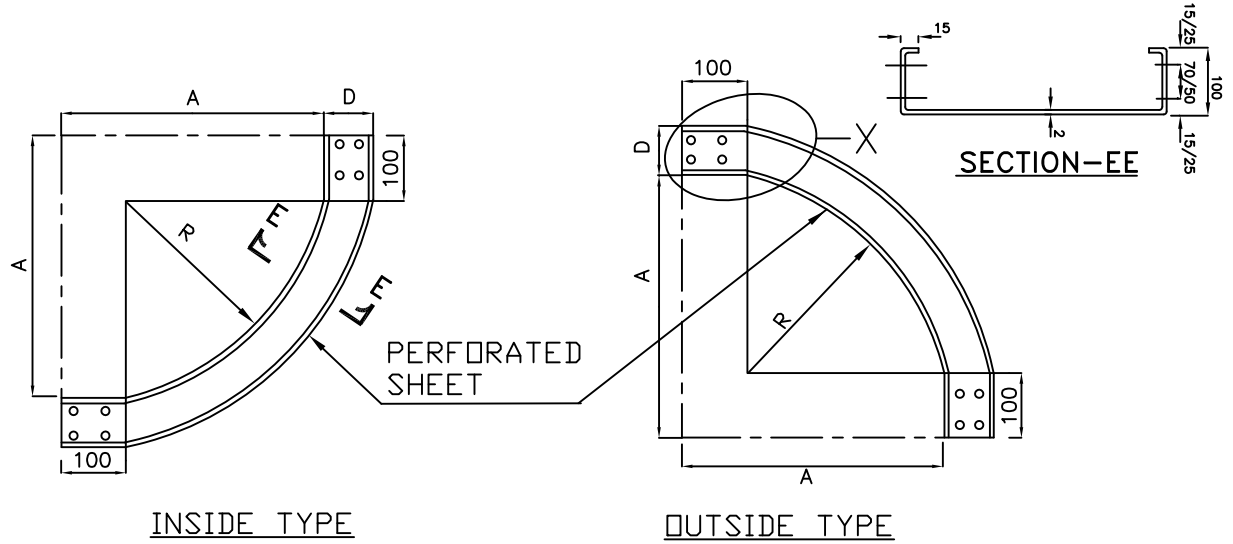
TYPICAL DETAILS OF
CABLE TRAYS AND ACCESSORIES

DRAWING NO.

PE-DG-434-507-E005

SH 9 OF 13

REV 01

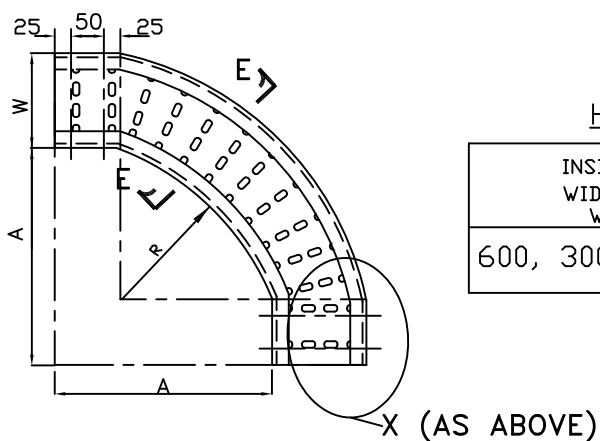


ENLARGED VIEW OF "X"

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		
			150	300	600
600, 300 & 150	600	100	854	1004	1304

90° HORIZONTAL BEND - PERFORATED TYPE

SEE GENERAL NOTES IN SHEET 13.



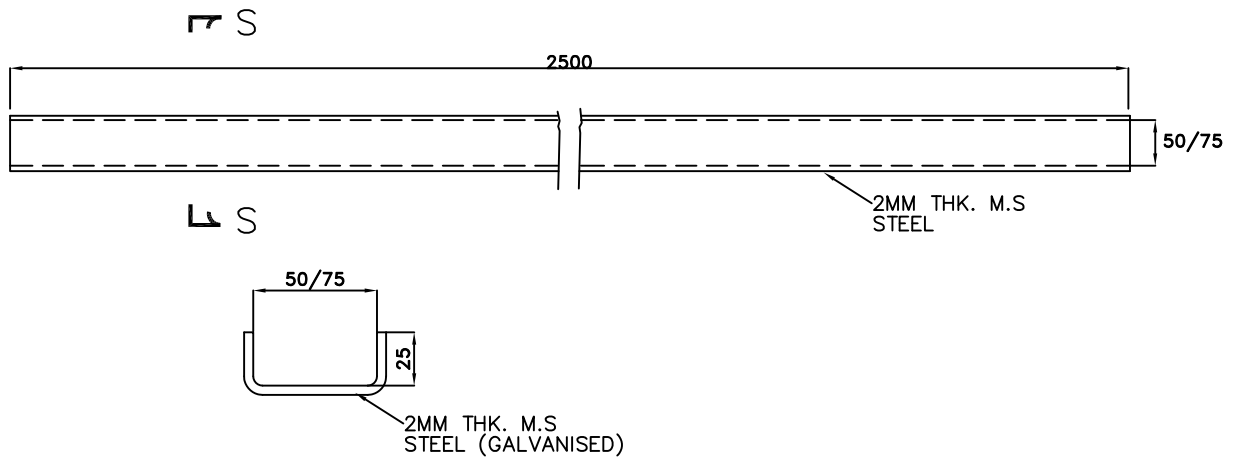
TYPICAL DETAILS OF
CABLE TRAYS AND ACCESSORIES

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PE-DG-434-507-E005

SH 10 OF 13

REV 01



SECTION S-S

CABLE TROUGHS

SEE GENERAL NOTES IN SHEET 13.

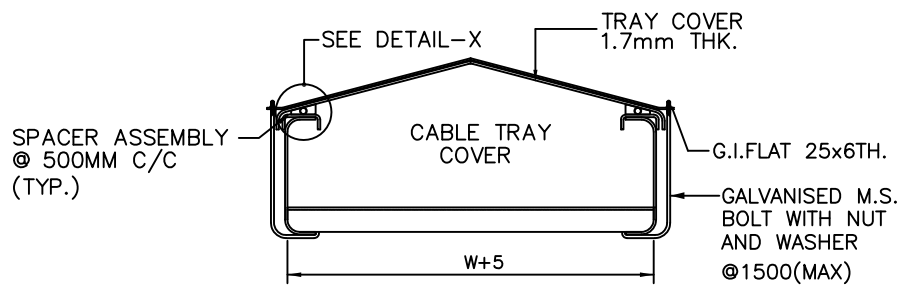


TYPICAL DETAILS OF
CABLE TRAY AND ACCESSORIES

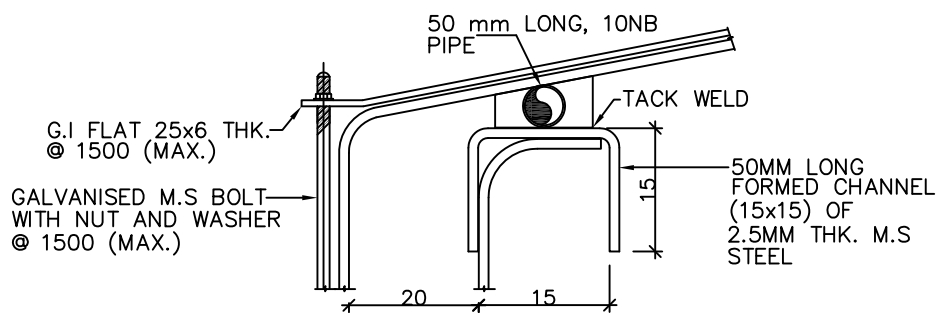
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PE-DG-434-507-E005

SH 11 OF 13

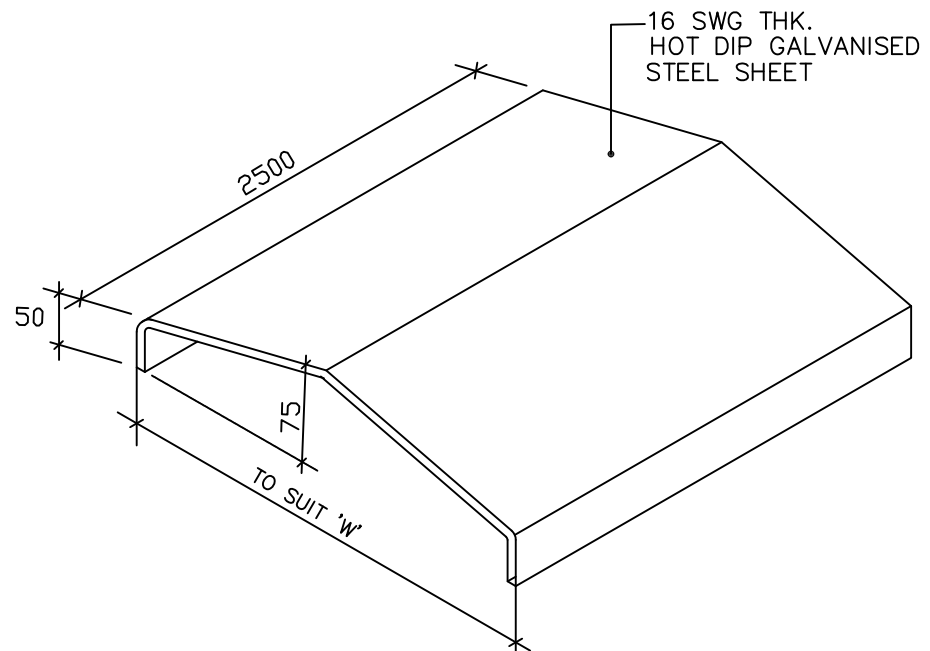
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COVER FIXING (TYP.)



DETAIL-X



CABLE TRAY COVER

SEE GENERAL NOTES IN SHEET 13.



TYPICAL DETAILS OF
CABLE TRAYS AND ACCESSORIES

DRAWING NO.

PE-DG-434-507-E005

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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.
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. PREFERABLY SINGLE MS PERFORATED SHEET SHALL BE USED AS BASE OF ALL PERFORATED TYPE TRAY ACCESSORIES. HOWEVER, IF USE OF PIECES OF PERFORATED SHEET IS UNAVOIDABLE 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 OF ± 2 MM.
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 FOR SIZES UPTO 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 LENGTH OF RESPECTIVE SIZES AS REQUIRED. GALVANISATION DAMAGED DURING CUTTING/WELDING OPERATIONS 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.
16. 600MM WIDE CABLE TRAY SHALL BE SUITABLE FOR WEIGHT OF 100KG/M INCLUDING LIVE LOAD OF RUNNING LENGTH OF CABLE TRAY.
17. MAKE OF ALL ITEMS SHALL BE AS PER NTPC QA APPROVAL.
18. CABLE TROUGHS OR 50/75MM WIDE PERFORATED TYPE SHALL BE USED FOR LOCAL CABLING/BRANCHING OUT FEW CABLES FROM MAIN ROUTE.
19. AMOUNT OF ZN DEPOSIT OVER THREADED PORTION OF BOLTS, NUTS, SCREWS AND WASHERS SHALL BE AS PER IS 1367.
20. MASS OF ZN COATING SHALL BE 610gm PER SQ METER.



TYPICAL DETAILS OF
CABLE TRAYS AND ACCESSORIES



DRAWING NO.

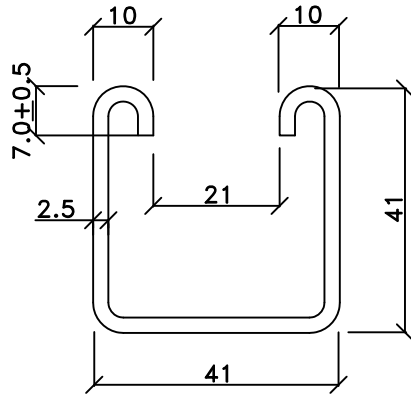
PE-DG-434-507-E005

SH 13 OF 13

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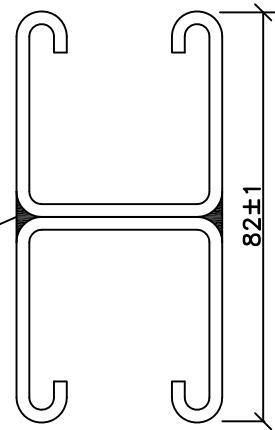
CABLE TRAY SUPPORT SYSTEM–DETAILS & DRAWINGS FOR CHANNELS, ARMS, BRACKETS AND OTHER HARDWARE

REV. 01	DATE 10.07.18	ALTD MMM	CHD HK	APPD PD	NTPC DRAWING NO. 9585-001-215-PVE-B-005					
The document is revised based on NTPC comments received vide transmittal dated. 09.05.18					 NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)					
					PROJECT PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE - I (3 X 800 MW)					
434					 BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA	DEPT CODE	DRN	NAME MMM	SIGN -SD-	DATE 09.04.18
CONTRACT						E	DSGN	MMM	-SD-	09.04.18
							CHD	HK	-SD-	09.04.18
DISTRIBUTION					E	APPD	PD	-SD-	09.04.18	
						DRAWING NO. PE-DG-434-507-E006				
TITLE TYPICAL DETAILS FOR CABLE TRAY SUPPORT SYSTEM					SHEET 01 OF 12 REV. 01					



SINGLE CHANNEL C1

25MM TAC WELD @450MM



DOUBLE CHANNEL C2

TWO LENGTHS OF SINGLE CHANNELNOTE:

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : 2.5MM THK MS SHEET HOT/COLD ROLLED M.S. AS PER RELEVANT IS.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. PROFILE TOLERANCE ± 0.5 mm
6. ZINC COATING SHALL BE MIN. 75 MICRON /610 g/sq. mm
7. MAKE SHALL BE AS PER NTPC QA APPROVAL.



TITLE:

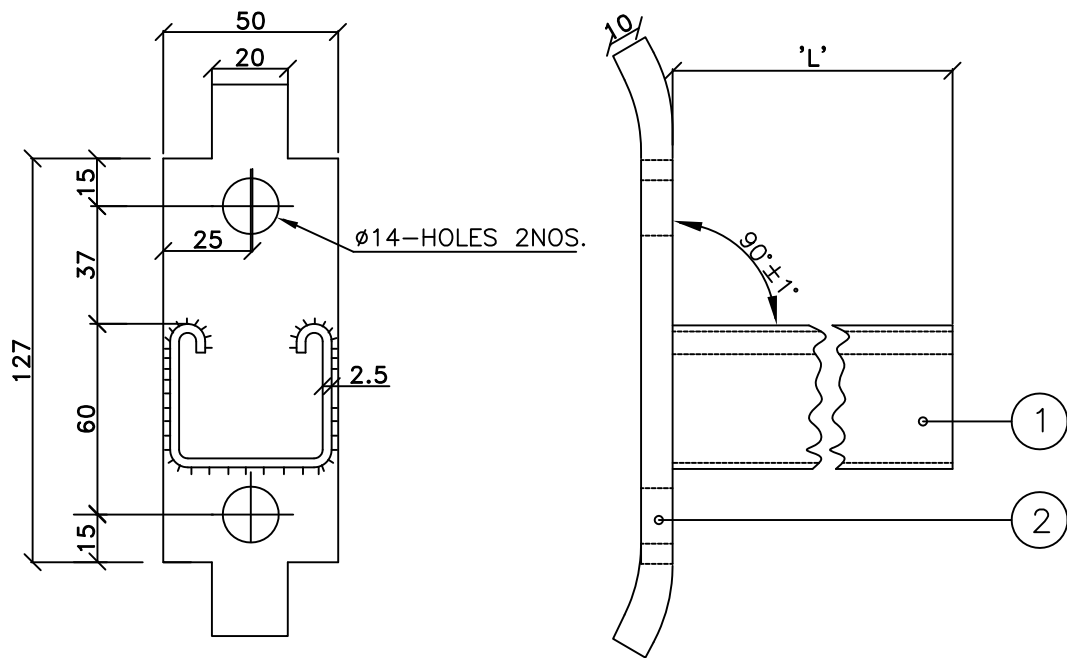
**TYPICAL DETAILS FOR
CABLE TRAY SUPPORT SYSTEM**

DRG. NO.

PE-DG-405-507-E007

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SH 2 OF 12



CANTILEVER ARMS

CANTILEVER ARM		
DESCRIPTION	TRAY WIDTH IN MM	CANTILEVER ARM LENGTH (L) IN MM
CA1	600	620 & 750
CA2	300	320
CA3	150	170

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 1079
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS IS AS PER IS:1852
6. PROFILE TOLERANCES ARE $\pm 0.5\text{mm}$
7. ZINC COATING SHALL BE MIN. 75MICRON /610 g/sq.mm
8. THICKNESS OF MATERIAL SHALL BE 10MM.
9. MAKE SHALL BE AS PER NTPC QA APPROVAL.



TITLE:

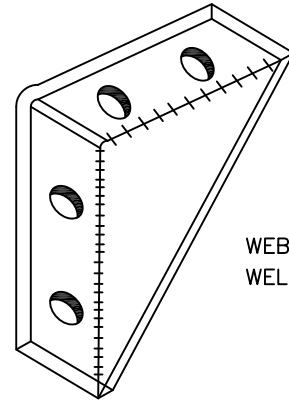
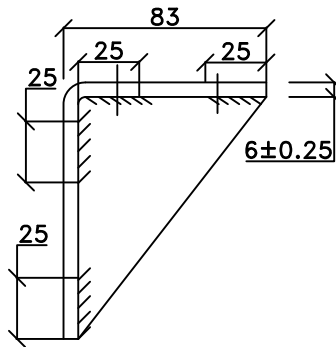
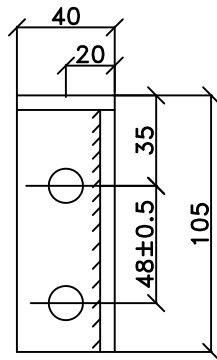
**TYPICAL DETAILS FOR
CABLE TRAY SUPPORT SYSTEM**

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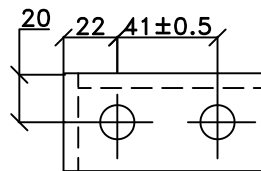
PE-DG-434-507-E007

REV. 01

SH 3 OF 12



WEB 3 ± 0.25 mm
WELED 6mm FILLET



90° ANGLE FITTING HL1

NOTES :

1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES ± 1.0 mm
3. MATERIAL :MILD STEEL AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS AS PER IS:1852
6. ZINC COZTING SHALL BE MIN. 75 MICRON / 610 g/sq.mm
7. MAKE SHALL BE AS PER NTPC QA APPROVAL.
8. SHEET THICKNESS= $3 \pm .25$ mm.



TITLE:

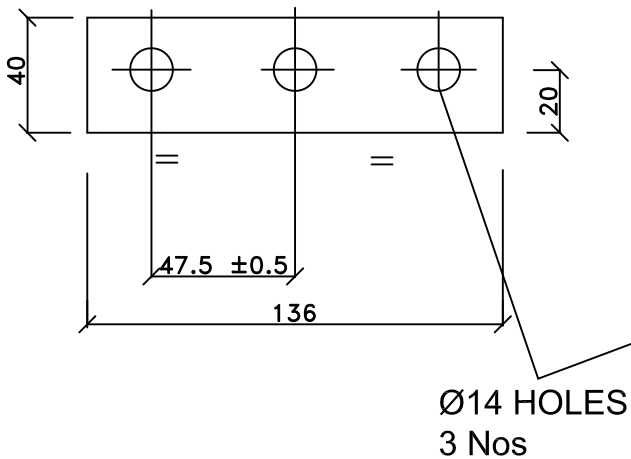
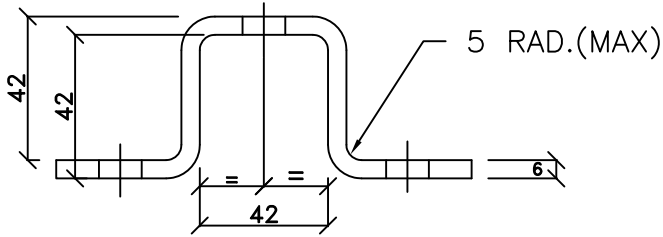
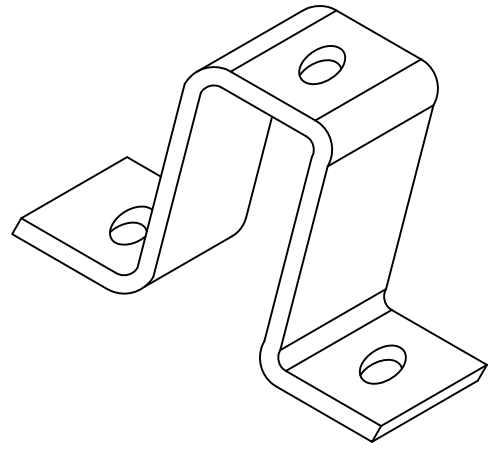
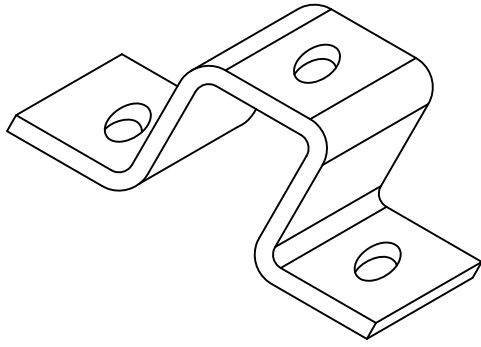
**TYPICAL DETAILS FOR
CABLE TRAY SUPPORT SYSTEM**

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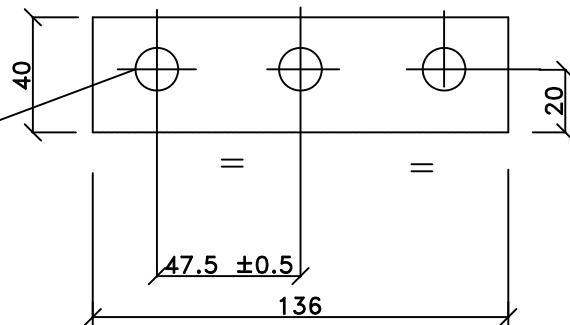
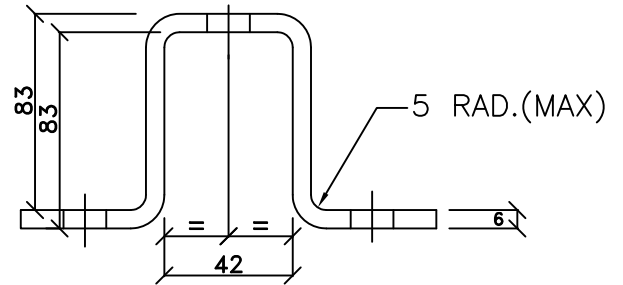
PE-DG-434-507-E007

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CLAMP FOR SINGLE CHANNEL C1



CLAMP FOR DOUBLE CHANNEL C2

NOTES

1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES ± 1.0 mm
3. MATERIAL : MILD STEEL AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS AS PER IS:1852
6. ZINC COZTING SHALL BE MIN. 75 MICRON /610 g/sq.mm
7. THICKNESS SHALL BE 6MM.
8. MAKE SHALL BE AS PER NTPC QA APPROVAL.



TITLE:

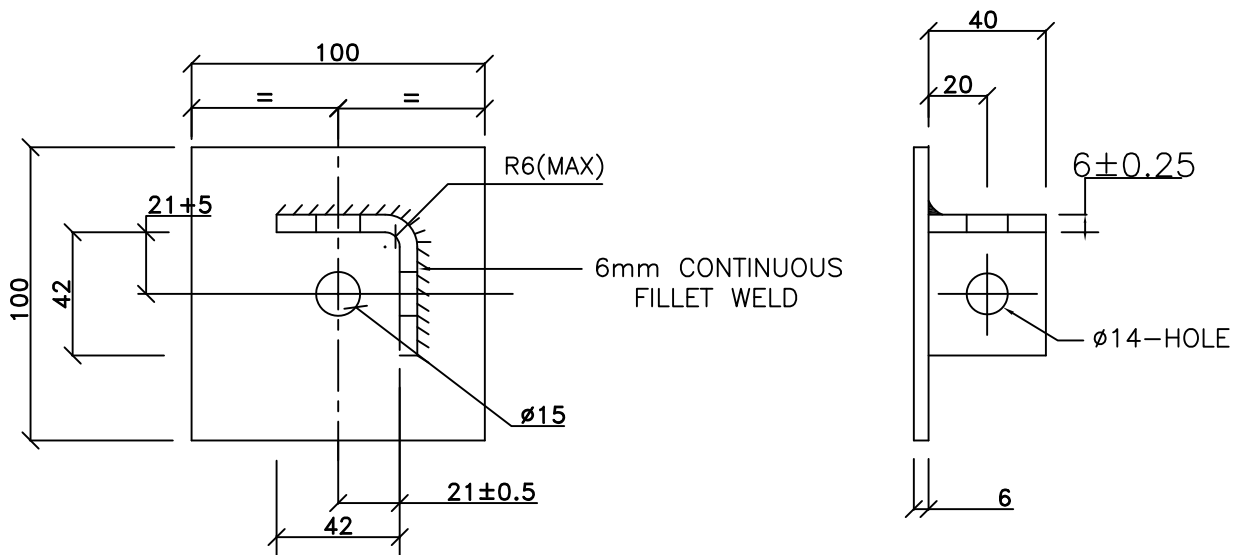
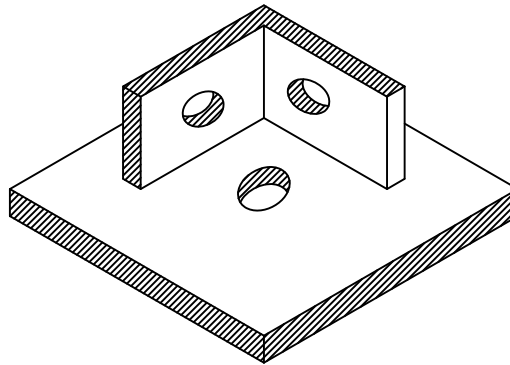
**TYPICAL DETAILS FOR
CABLE TRAY SUPPORT SYSTEM**

DRG. NO.

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BASE PLATE FOR SINGLE CHANNEL BP1

NOTE

1. ALL DIMENSIONS ARE IN MM.
2. ALL FABRICATION TOLERANCES $\pm 1.0\text{mm}$.
3. MATERIAL :MILD STEEL AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS AS PER IS:1852
6. ZINC COATING SHALL BE MIN. 75MICRON /610 g/sq.mm
7. MAKE SHALL BE AS PER NTPC QA APPROVAL.



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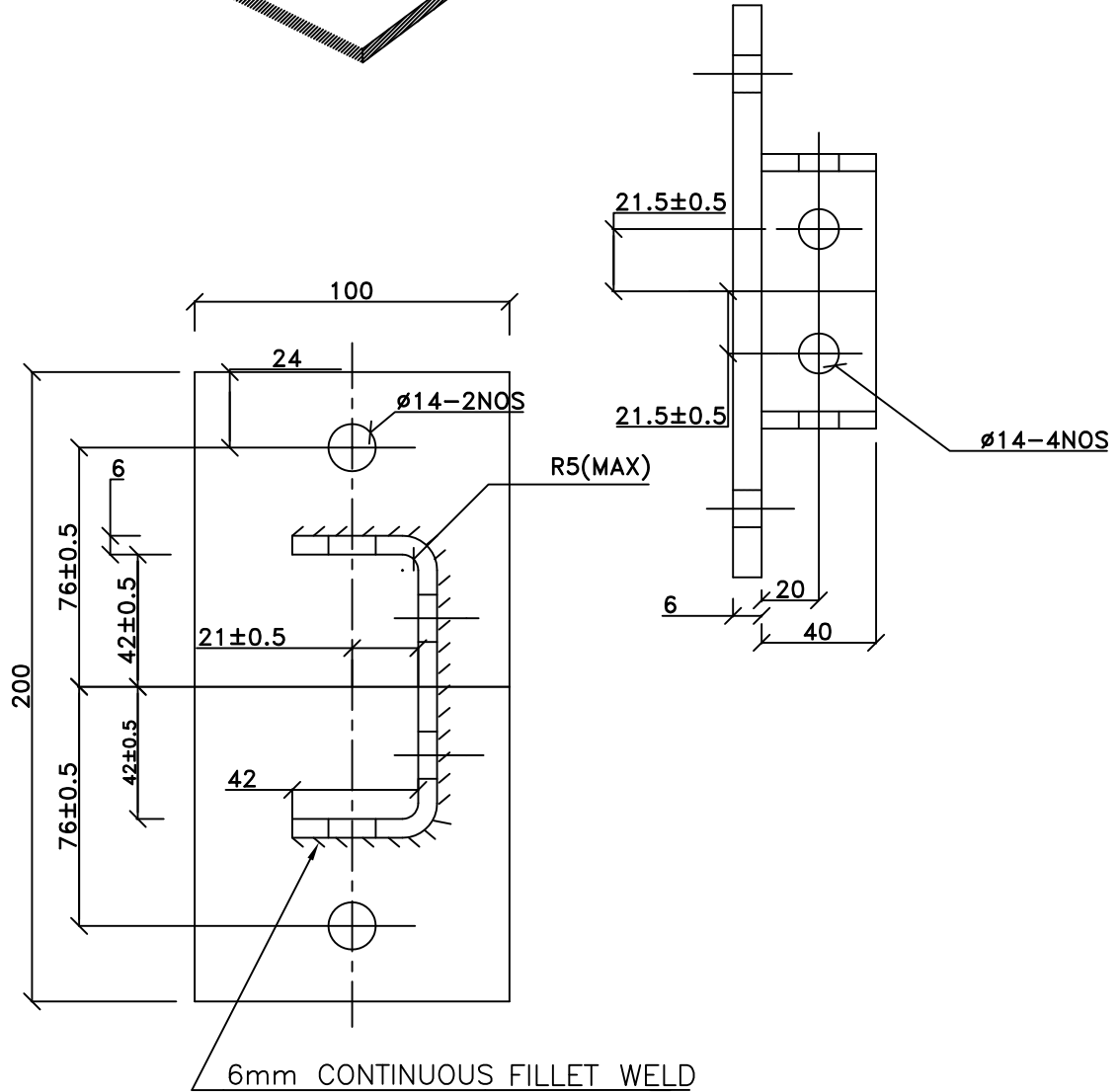
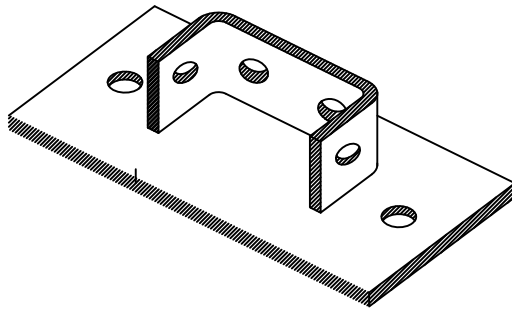
**TYPICAL DETAILS FOR
CABLE TRAY SUPPORT SYSTEM**

DRG. NO.

PE-DG-434-507-E007

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NOTES

BASE PLATE FOR DOUBLE CHANNEL BP2

1. ALL DIMENSIONS ARE IN MM
2. ALL FABRICATION TOLERANCES $\pm 1.0\text{mm}$
3. MATERIAL : MILD STEEL AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS AS PER IS:1852
6. ZINC COATING SHALL BE MIN. 75 MICRON /610 g/sq.mm
7. MAKE SHALL BE AS PER NTPC QA APPROVAL.



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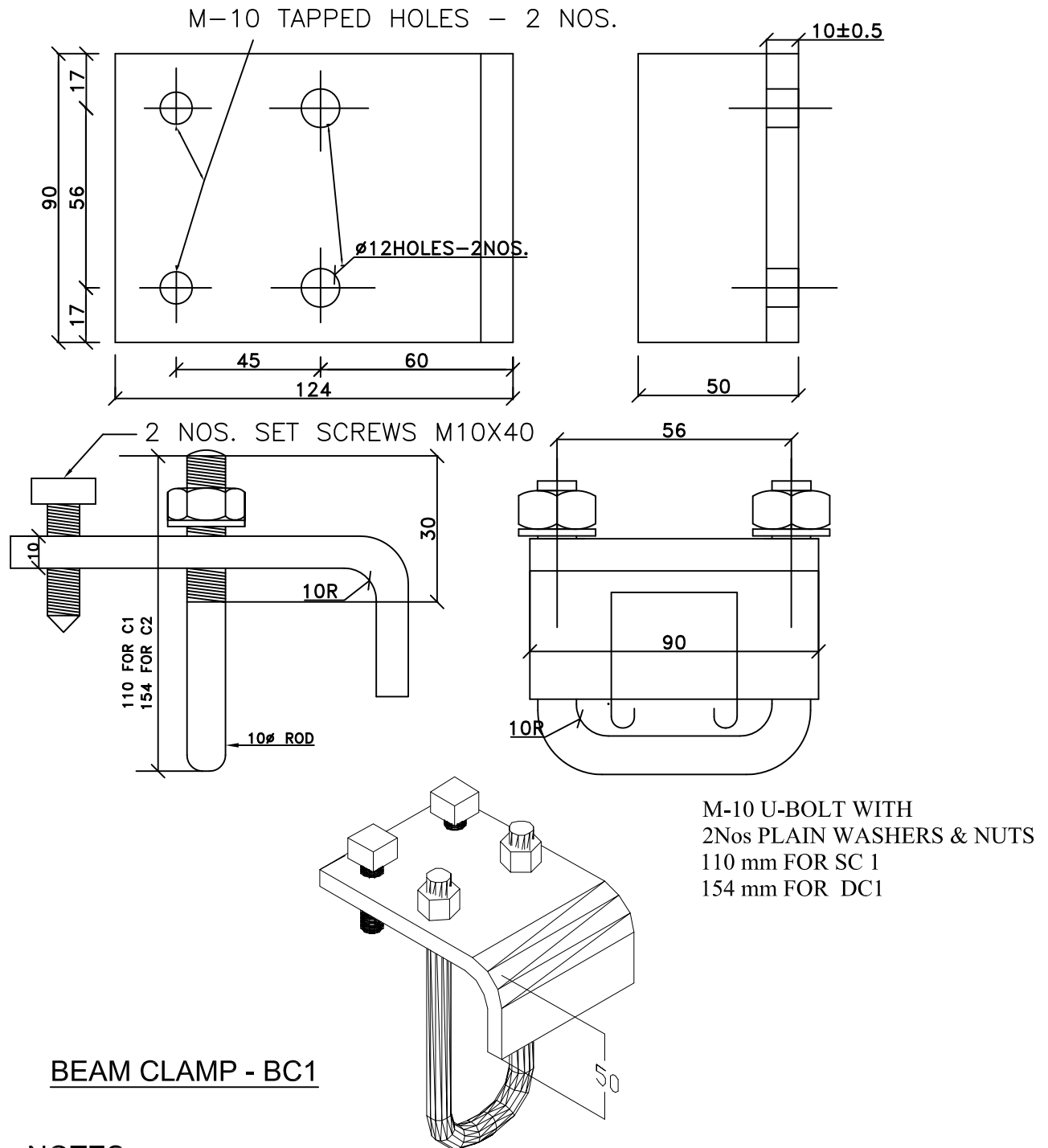
**TYPICAL DETAILS FOR
CABLE TRAY SUPPORT SYSTEM**

DRG. NO.

PE-DG-434-507-E007

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**NOTES**

1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES $\pm 1.0\text{mm}$
3. MATERIAL : MILD STEEL AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS AS PER IS:1852
6. ZINC COATING SHALL BE MIN. 75MICRON /610 g/sq.mm
7. MAKE SHALL BE AS PER NTPC QA APPROVAL.



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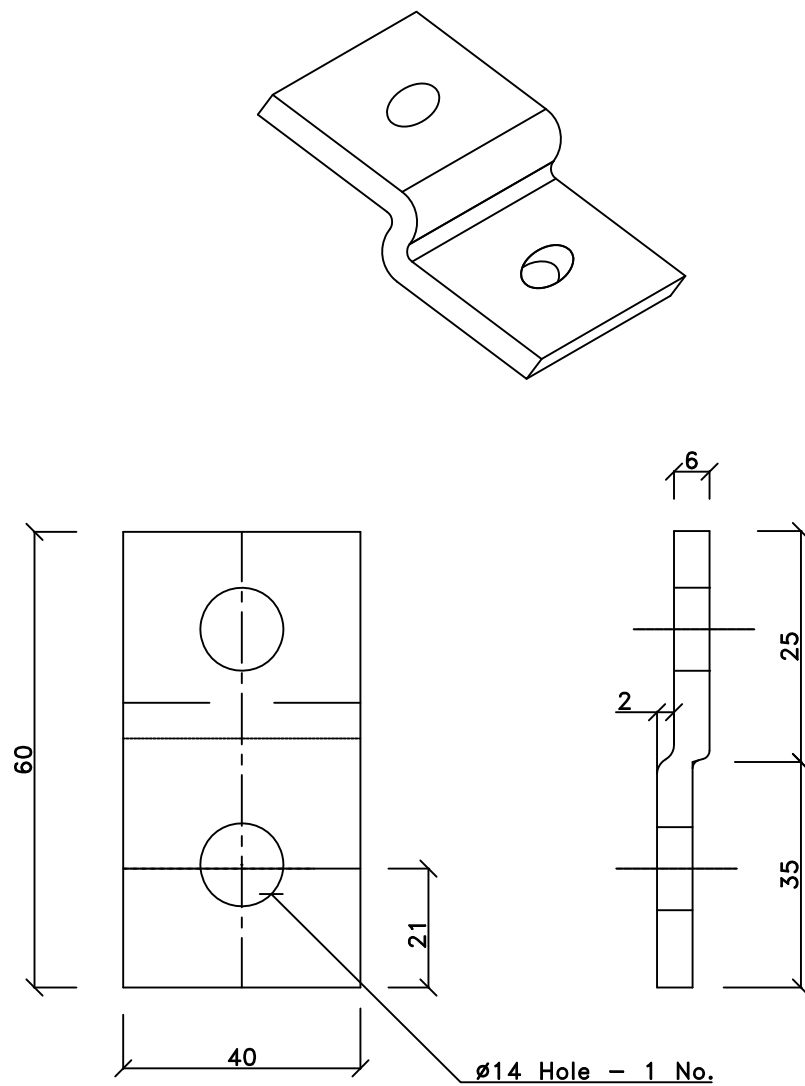
**TYPICAL DETAILS FOR
CABLE TRAY SUPPORT SYSTEM**

BHEL DRAWING NO.

PE-DG-434-507-E007

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TRAY FIXING CLAMP - TC1

NOTES

1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES : $\pm 1.0\text{mm}$
3. MATERIAL : MILD STEEL AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. TOLERANCE ON THICKNESS AS PER IS:1852
6. ZINC COATING SHALL BE MIN. 75MICRON /610 g/sq.mm
7. MAKE SHALL BE AS PER NTPC QA APPROVAL.



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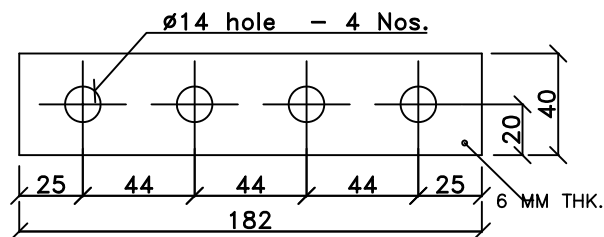
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CABLE TRAY SUPPORT SYSTEM**

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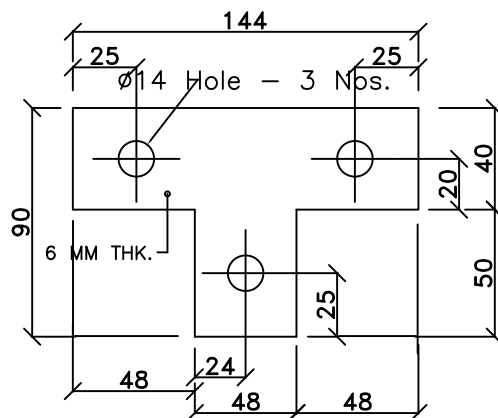
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REV. 01

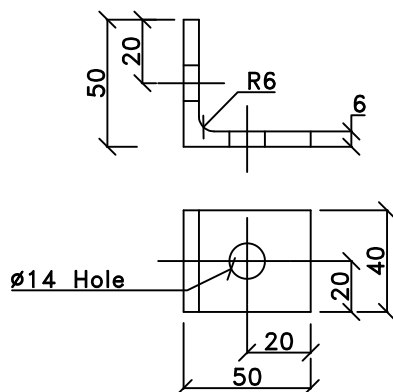
SH 9 OF 12



FLAT PLATE STRAIGHT FITTING PF2



FLAT PLATE TEE FITTING PF1



90° ANGLE FITTING LA1

NOTES

1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES ± 1.0 mm
3. MATERIAL :MILD STEEL AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. ZINC COATING SHALL BE MIN. 75MICRON /610 g/sq.mm
6. MAKE SHALL BE AS PER NTPC QA APPROVAL.



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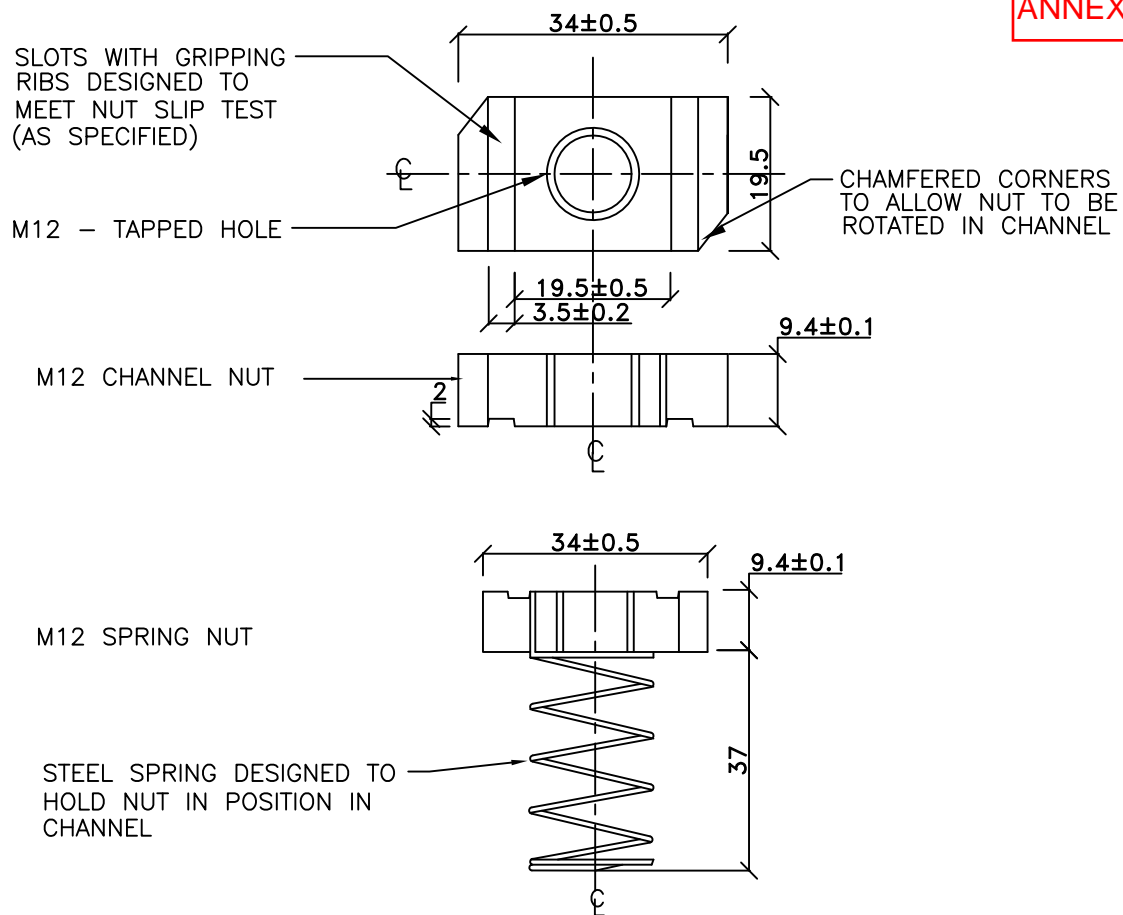
TYPICAL DETAILS FOR
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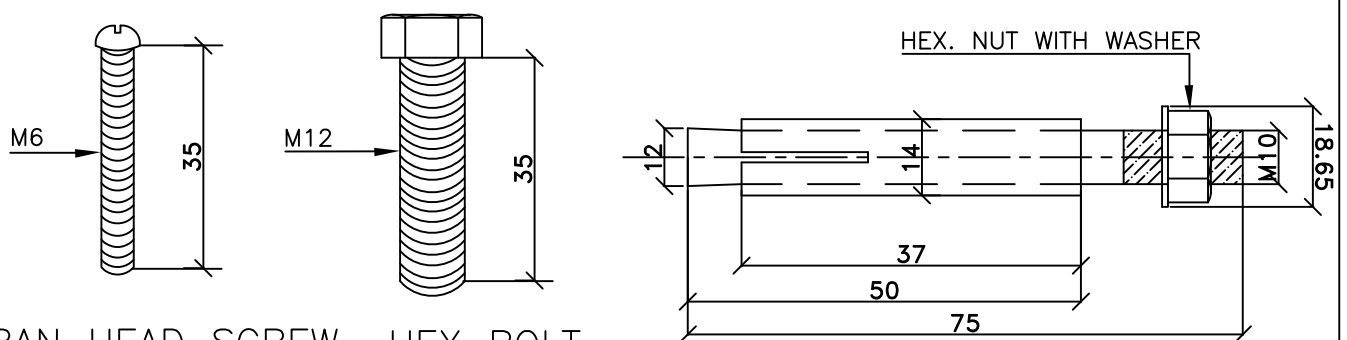
PE-DG-434-507-E007

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SPRING NUT ASSEMBLY



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, 20MICRON THICK.
5. ALL DIMENSIONS ARE IN MM.
6. BOLTS SHALL BE HOT DIP GALVANISED.
7. MAKE SHALL BE AS PER NTPC QA APPROVAL.



TITLE:

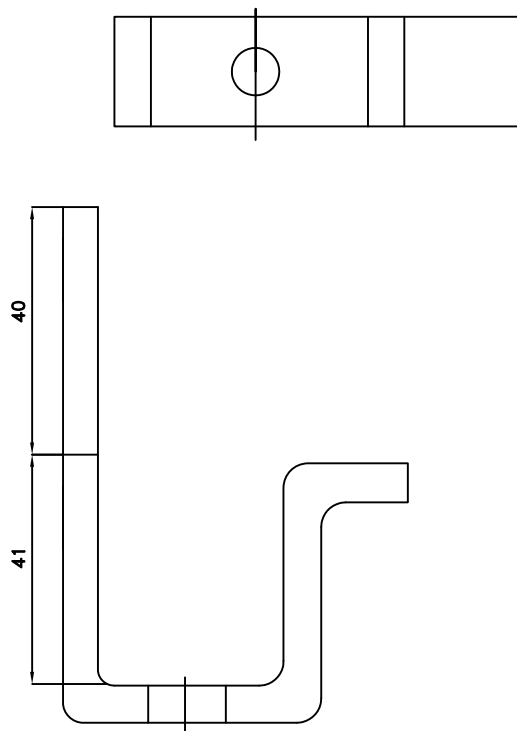
**TYPICAL DETAILS FOR
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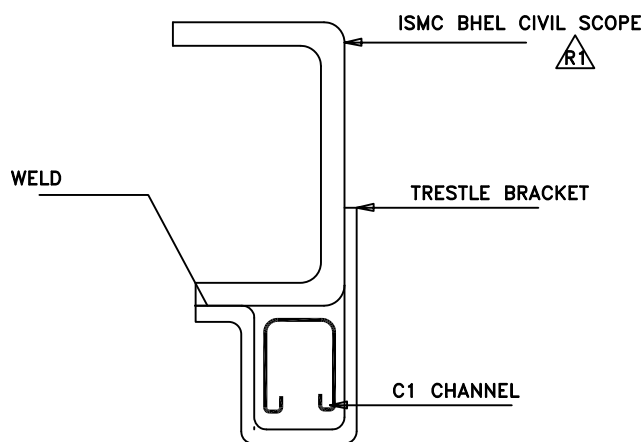
PE-DG-434-507-E007

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TRESTLE BRAKET



FIXING ARRANGMENT OF TRESTLE BRACKET

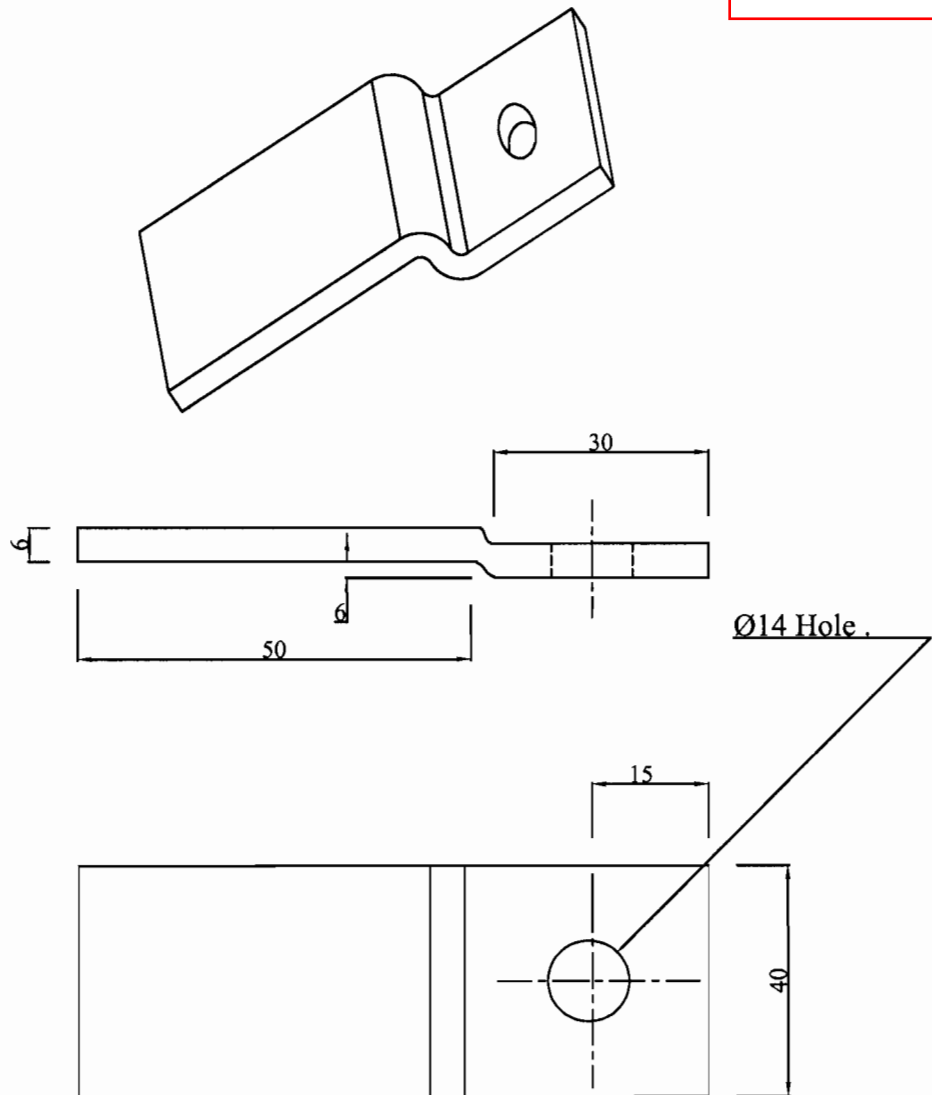
NOTES

1. ALL DIMENSIONS ARE IN mm.
2. ALL FABRICATION TOLERANCES ± 1.0 mm
3. MATERIAL :MILD STEEL AS PER IS-2062
4. FINISH : HOT DIP GALVANISED AS PER IS:2629
5. ZINC COATING SHALL BE MIN. 75MICRON /610 g/sq.mm
6. MAKE SHALL BE AS PER NTPC QA APPROVAL.



TITLE:
TYPICAL DETAILS FOR
CABLE TRAY SUPPORT SYSTEM

BHEL DRAWING NO. PE-DG-434-507-E007	
REV. 01	SH 12 OF 12



Z CLAMP FOR FIXING OF EARTH FLAT

NOTES:

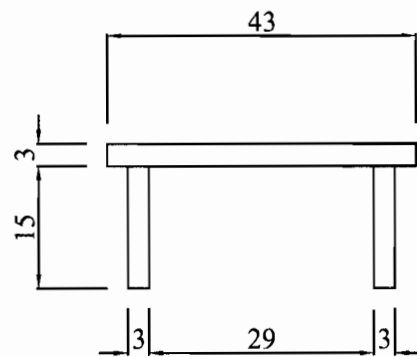
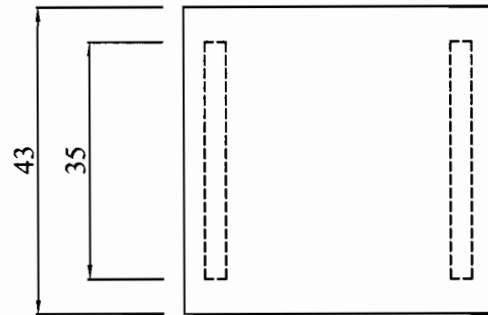
- 1.ALL DIMENSIONS ARE IN MM.
- 2.PROFILE TOLERANCE $\pm 0.5\text{mm}$
- 3.MATERIAL - 6mm THK. MILD STEEL AS PER IS-2062
- 4.FINISH - HOT DIP GALVANISED AS PER IS:2629/2633
- 5.TOLERANCES AS PER IS:1852
- 6.ZINC COATING-86 MICRONS(610 gm/sq.m) AS PER IS:4759
- 7.MAKE SHALL BE AS PER NTPC QA APPROVAL

TITLE : Z-CLAMP FOR FIXING OF EARTH FLAT

NTPC DRG NO: 0350-215-PVE-B-001

SHEET NO. 18 OF 21

REV. 00



PVC END CAP

NOTES:

- 1.ALL DIMENSIONS ARE IN MM.
- 2.PROFILE TOLERANCE $\pm 0.5\text{mm}$
- 3.MATERIAL - PVC
- 4.MAKE SHALL BE AS PER NTPC QA APPROVAL

TITLE : PVC END CAP

NTPC DRG NO: 0350-215-PVE-B-001

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REV. 00



SECTION-2

STANDARD SPECIFICATION

2.1 GENERAL

This section covers the general technical requirements of Cable Trench Material. In case of any discrepancies between the requirements mentioned in this section and those specified in other sections of this specification, the latter shall prevail and shall be treated as binding requirements.

Please refer attached NTPC Patratu SUB SECTION- B-09 CABLING, EARTHING & LIGHTNING PROTECTION specification and extract of SUB-SECTION B-14 SWITCHYARD.

2.1.1 TECHNICAL PARAMETERS

A. Horizontal Cable Rack Assembly (In Trenches) – Welded Type

Material of cable racks	:	MS
Whether Galvanised or Painted	:	Galvanised
Mass of Zinc coating	:	610 g/sqm.
Size and material of cable rack assemblies	:	50 x 50 x 6 (thick) mm MS angles & 100x8mm/ 50x6mm GS Flat
Reference Drawings	:	Annexure 1

B. Cable Trays – Bolted Type

Material of cable trays	:	MS
Whether Galvanised or Painted	:	Galvanised
Width (mm)	:	As per BOQ
Mass of Zinc coating	:	610 g/sqm.
Thickness of sheet metal for trays	:	2 mm
Whether perforated or ladder type	:	Ladder Type
Length of Single Cable Tray Piece	:	2.5 m
Accessories	:	Coupler plates & associated Hardware
Reference Drawing	:	As per Annexure 2 and drawing references in BOQ.



C. Under Hanger Assembly (In Control Room) – Bolted Type

Material of cable racks	:	MS
Whether Galvanised or Painted	:	Galvanised
Mass of Zinc coating	:	610 g/sqm.
Size and material of cable rack assemblies	:	Main Channel C1/C2 and Cantilever Channel CA1 as per drawing PE-DG-405-507-E007 Rev 00 Sh 2 of 12 and PE-DG-434-507-E007 Rev 01 Sh 3 of 12
Reference Drawings	:	As per Annexure 2 and drawing references in BOQ.

Notes:

1. Cable trench material and fittings shall be supplied as per the technical particulars and reference drawings as specified in this specification.
2. All finished galvanized MS structural members for cable tray supports shall be free from sharp edges, corners, burs and unevenness.
3. Necessary fasteners shall be provided with each cable trench material (as applicable) as specified in enclosed drawings.
4. All welded joints in cable trench material shall be smooth enough to provide a good appearance and shall not cause any injury to working personnel. All welding work shall be done by skilled personnel.
5. Coupler plates shall be provided for connecting tray ends to other straight trays, horizontal elbows, vertical elbows, tees, reducers etc. The number of coupler plates, washers, nuts and bolts to be supplied shall be as per the specification and drawings.
6. Cable trays shall be complete with all necessary hot dip galvanized sheet steel accessories such as coupler plates and associated nuts, bolts, washers, hangers, clamps etc.
7. All fittings like horizontal/vertical elbow, reducer, horizontal tee etc., should be pre-fabricated. Each fitting shall be provided with two no. hot dip galvanized side coupler plates and associated bolts, nuts and washers on each side.
8. Necessary fasteners shall be provided along with each length of cable tray as specified drawings enclosed.
9. The width of tray covers, if applicable, shall be suitable for width of trays. Suitable bolting arrangement shall be supplied for attaching the cover to the cable trays, elbows, reducers, tees etc. as per drawings enclosed.



2.2 APPLICABLE STANDARDS

The Cable Trench Material shall conform to latest revision of the following Indian Standards:

Steel for general structural purpose	:	IS:2062-1999
Hot Rolled Carbon Steel Sheets and Strips specification	:	IS:1079
Mechanical Testing of Metals - Tensile Testing	:	IS:1068
Dimensions for steel plates, sheets strips and flats for general engineering purpose	:	IS:1730
Method of Tensile Testing of sheet steel and strip of thickness 0.5 to 3 mm	:	IS:1608
General technical delivery requirements for steel and steel products	:	IS:8910
Method of chemical analysis of pig iron, cast iron and plain carbon and low alloy steel , Part-1	:	IS:228
Method for testing uniformity of coating on Zinc coated articles	:	IS:2633-1986
Recommended practice for hot dip galvanising on iron & steel	:	IS:2629-1985
Hot dip Zinc coating on structural steel and other allied products	:	IS:4759-1984
Method for determination of mass of zinc coating on zinc coated iron and steel articles	:	IS:6745-1972
Rolled steel beams, channel and angles	:	IS:808-1989
Rolling and Cutting tolerances for rolled steel products	:	IS:1852-1985



Recommended practice for red oxide : IS:2074-1992
And zinc chromate on iron & steel

2.3 TECHNICAL REQUIREMENTS

- 2.3.1 The material (Mild Steel) used for the supply shall be in sound condition and of recent manufacture, free from defects, loose mill scale, slag, pitting, rust, etc.
- 2.3.3 Galvanising of the rack assembly shall be done. The min. thickness of zinc at any spot shall not be less than 85 microns. Coating shall be adherent, smooth and reasonably bright, continuous and free from such imperfection as flux, ash, bare and black spot, pimples, lumpiness, rust stains, bulky white deposits and blisters and zinc chromate/red oxide shall conform to IS : 2074-1992.
- 2.3.4 The trays and rack assemblies shall not have sharp edges cuts, abrasions etc. and the zinc coating shall be adherent, smooth and reasonably bright, continuous and free from such imperfections as flux, ash, bare and black spot, pimples, lumpiness, rust stains.
- 2.3.5 All drilling, cutting, bending etc. of fabricated steel work shall be carried out before galvanising.
- 2.3.6 All angles shall be cut with shearing machine / power hack-saw, cutting with gas welding is not permitted.
- 2.3.7 Bolts and nuts shall be of steel with hexagonal head by approved supplier. All bolts shall be galvanised including threaded portions. The threaded portions of all bolts shall be cleared of smear by spinning / brushing. All the washers and nuts shall also be galvanised but threading of nuts shall be oiled/greased.
- 2.3.8 The bidder shall indicate in his offer, the final weight of the rack after punching and galvanising.

2.4 TESTS

In addition to tests requirement as mentioned in enclosed NTPC specification, following test details shall also be noted:


1. Dimensional and visual examination - As per BHEL approved drawing.
2. Mass of Galvanisation - IS: 6745: 1972
3. Test for galvanising (Acceptance Test)
The test shall be done as per approved standards
4. Uniformity of zinc coating - IS: 2633: 1986
5. Mass of zinc coating – IS: 6745:1972
6. Chemical composition test -As per IS:2062-1999.
7. Tensile - As per IS:2062-1999.
8. Bending test -As per IS:2062-1999.
9. Deflection Test


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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.		
10.05.03	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.		
10.05.04	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.		
b)	Where, assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense. The contractor shall strictly follow manufacturer's recommendations for handling and erection of equipment.		
c)	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.		
d)	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.		
e)	Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.		
f)	For cleaning the inside and outside of hollow insulators only Muslin or leather cloth shall be used.		
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.		
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10.07.03	Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the ground. In the case of equipment located away from cable trench either pipe inserts shall be embedded in the ground connecting the cable trench and the equipment or in case the distance is small, notch/opening shall be provided. In all these cases necessary bending radii as recommended by the cable supplier shall be maintained.			
10.07.04	Cabling in the control room shall be done on ladder type cable trays with supports at an interval of 2000mm.			
10.07.05	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.			
ii.	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.			
iii.	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.			
iii.)	The enclosure of the GIS shall be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections should be provided for each of circuit breaker, transformer terminals, cable terminals, surge arrestors, earth switches and at each end of the bus bars. The grounding continuity between each enclosure shall be effectively interconnected with links or straps to bridge the flanges. Subassembly-to-subassembly bonding shall be provided to provide gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main grounding bus of the GIS.			
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SUB-SECTION – B-09


CABLING, EARTHING AND LIGHTNING PROTECTION


CLAUSE NO.	TECHNICAL REQUIREMENTS																																													
1.00.00	CODES AND STANDARDS																																													
1.01.00	<p>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 .</p> <table><tr><td>IS:513</td><td>Cold rolled low carbon steel sheets and strips.</td></tr><tr><td>IS:802</td><td>Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.</td></tr><tr><td>IS:1079</td><td>Hot Rolled carbon steel sheet & strips</td></tr><tr><td>IS:1239</td><td>Mild steel tubes, tubulars and other wrought steel fittings</td></tr><tr><td>IS:1255</td><td>Code of practice for installation and maintenance of power cables upto and including 33 KV rating</td></tr><tr><td>IS:1367 Part-13</td><td>Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).</td></tr><tr><td>IS:2147</td><td>Degree of protection provided by enclosures for low voltage switchgear and control gear</td></tr><tr><td>IS:2309</td><td>Code of Practice for the protection of building and allied structures against lightning.</td></tr><tr><td>IS:2629</td><td>Recommended practice for hot dip galvanising of iron & steel</td></tr><tr><td>IS:2633</td><td>Method for testing uniformity of coating on zinc coated articles.</td></tr><tr><td>IS:3043</td><td>Code of practice for Earthing</td></tr><tr><td>IS:3063</td><td>Fasteners single coil rectangular section spring washers.</td></tr><tr><td>IS:6745</td><td>Methods for determination of mass of zinc coating on zinc coated iron & steel articles.</td></tr><tr><td>IS:8308</td><td>Compression type tubular in- line connectors for aluminium conductors of insulated cables</td></tr><tr><td>IS:8309</td><td>Compression type tubular terminal ends for aluminium conductors of insulated cables.</td></tr><tr><td>IS:9537</td><td>Conduits for electrical installation.</td></tr><tr><td>IS:9595</td><td>Metal - arc welding of carbon and carbon manganese steels - recommendations.</td></tr><tr><td>IS:13573</td><td>Joints and terminations for polymeric cables.</td></tr><tr><td>BS:476</td><td>Fire tests on building materials and structures</td></tr><tr><td>IEEE:80</td><td>IEEE guide for safety in AC substation grounding</td></tr><tr><td>IEEE:142</td><td>Grounding of Industrial & commercial power systems</td></tr></table>				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
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	DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.	
	DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors	
	BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.	
		Indian Electricity Act.	
		Indian Electricity Rules.	
1.02.00	Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.		
2.00.00	DESIGN AND CONSTRUCTIONAL FEATURE		
2.01.00	Inter Plant Cabling		
2.01.01	Interplant cabling for main routes shall be laid along overhead trestles/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly buried cables, if essential ,shall not have concentration of more than 4 cables in one route. All buried cables, Cables for switchyard and CHP shall be armoured		
2.01.02	Transformer yard		
	In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing.		
2.01.03	Trenches		
	PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.		
2.01.04	No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.		
2.01.05	Cable Vault		
	Clear access passage of at least 750mm wide & 2.1 mt clear heights shall be provided at entrances and along the cable trays in cable vault. Wherever the passage is through cable routes & across the cable tray the clear height shall not be less than 1.5 mts.		
	Cable vaults shall be provided with adequate drainage facilities for drainage of fire water.		
	Each cable vault should have at least two doors.		
	Exit signs shall be provided near doors for personnel escape in case of emergency.		
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2.01.06	<p>Boiler Area</p> <p>Two separate cable routes one on each side shall be provided for each boiler unit. Cables for on set of auxiliaries such as ID, FD, PA fan & half of the coal mills shall be routed in one route & for other set of auxiliaries through other route.</p> <p>Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor.</p> <p>Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.</p>	
2.01.07	<p>Turbine Hall Area</p> <p>a)Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.</p>	
2.01.08	<p>OffSite Area</p> <p>In offsite pumphouses, overhead cable tray arrangement shall be followed. However cable trenches may be considered below switchgear/mcc.</p> <p>Trestle In fuel oil pump house, overhead cable tray arrangement shall be provided. RCC trenches provided in MCC room shall be separated from fuel oil area to avoid oil accumulation.</p>	
2.01.09	<p>The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.</p>	
2.01.10	<p>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.</p>	
2.01.11	<p>Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:</p> <ul style="list-style-type: none">Meet all safety requirementsSafeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc	
3.00.00	<p>EQUIPMENT DESCRIPTION</p>	
3.01.00	<p>Cable trays, Fittings & Accessories</p>	
3.01.01	<p>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.</p>	
3.01.02	<p>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.</p>	
3.01.03	<p>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.</p>	
3.01.04	<p>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</p>	
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<div data-bbox="162 295 255 320">3.02.00</div> <div data-bbox="162 356 255 383">3.02.01</div> <div data-bbox="162 448 255 474">3.02.02</div> <div data-bbox="162 1830 255 1856">3.02.03</div>	<p data-bbox="355 201 1453 259">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</p> <p data-bbox="355 295 766 320">Support System for Cable Trays</p> <p data-bbox="355 356 1453 414">Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.</p> <p data-bbox="355 448 1453 591">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</p> <ol data-bbox="355 602 1453 1798" style="list-style-type: none"> 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. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanised. 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 galvanised surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation. 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. 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. Support system shall be able to withstand <ul style="list-style-type: none"> 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. <p data-bbox="355 1830 1453 1982">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</p>	
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	<p>the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.</p>		
3.03.04	<p>FOR COAL HANDLING PLANT THE FOLLOWING SHALL ALSO BE APPLICABLE:</p> <p>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.</p> <p>b) Cable trenches shall be provided only in Switchgear/MCC rooms.</p> <p>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.</p> <p>d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.</p>		
3.04.00	<p>Pipes, Fittings & Accessories</p>		
3.03.01	<p>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</p>		
3.03.02	<p>GI Pipes shall be of medium duty as per IS: 1239</p>		
3.03.03	<p>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.</p>		
3.03.04	<p>Hume pipes shall be NP3 type as per IS 458.</p>		
3.04.00	<p>Junction Boxes</p>		
3.04.01	<p>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:-</p> <p>(a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102</p> <p>(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.</p> <p>(c) Class of protection shall be IP 55.</p>		
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	<p>(d) HV test.</p>	
3.04.02	Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.	
3.05.00	Terminations & Straight Through Joints	
3.05.01	Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter)..	
3.05.02	Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design	
3.05.03	1.1 KV grade Straight Through Joint shall be of proven design.	
3.06.00	Cable glands	
3.06.01	Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.	
3.07.00	Cable lugs/ferrules	
3.07.01	Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating	
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	<p>sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards.</p>			
3.08.00	Trefoil clamps			
3.08.01	<p>Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the peak value of maximum system short circuit current.</p>			
3.09.00	Cable Clamps & Ties			
3.09.01	<p>The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyester coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.</p>			
3.10.00	Receptacles			
3.10.01	<p>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 polyimide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable adjustable mA sensitivity ranging from 30-300 mA</p>			
3.12.00	Cable Drum Lifting Jack			
	<p>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.</p>			
3.13.00	Galvanising			
3.13.01	<p>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.</p>			
3.13.02	<p>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</p>			
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3.14.00	Welding		
3.14.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595		
4.00.00	INSTALLATION		
4.01.00	Cable tray and Support System Installation		
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.		
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.		
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.		
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.		
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.		
4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.		
4.02.00	Conduits/Pipes/Ducts Installation		
4.02.01	The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.		
4.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.		
4.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>									
4.02.04	<p>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</p> <table><tr><th>Conduit /pipe size (dia).</th><th>Spacing</th></tr><tr><td>Upto 40 mm</td><td>1 M</td></tr><tr><td>50 mm</td><td>2.0 M</td></tr><tr><td>65-85 mm</td><td>2.5 M</td></tr><tr><td>100 mm and above</td><td>3.0 M</td></tr></table>	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
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	<p>For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.</p>										
4.03.00	<p>Junction Boxes Installation</p>										
4.03.01	<p>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.</p>										
4.04.00	<p>Cable Installation</p>										
4.04.01	<p>Cable installation shall be carried out as per IS:1255 and other applicable standards.</p>										
4.04.02	<p>For Cable unloading, pulling etc following guidelines shall be followed in general:</p> <div><div>a)</div><div>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.</div></div> <div><div>b)</div><div>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.</div></div>										
4.04.03	<p>Cables shall be laid on cable trays strictly in line with cable schedule . Where specific cable layouts are not shown on drawings, Contractor shall route these as directed by the Project Manager</p>										
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4.04.04	<p>Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend. Fibre Optical cable shall be laid in trenches/trays or as decided by Employer.</p>	
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	<p>Separation</p> <p>At least 300mm clearance shall be provided between:</p> <ul style="list-style-type: none">- HT power & LT power cables,- LT power & LT control/instrumentation cables,	
4.04.14	<p>Segregation</p> <ol style="list-style-type: none">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	
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4.04.15	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.										
	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:											
	<table><tr><td>No. of cores in cable</td><td>No. of spare cores</td></tr><tr><td>2C,3C</td><td>NIL</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-10C</td><td>2</td></tr><tr><td>14C and above</td><td>3</td></tr></table>			No. of cores in cable	No. of spare cores	2C,3C	NIL	5C	1	7C-10C	2	14C and above
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											
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	shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.								
4.05.02	Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.								
4.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.								
4.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.								
4.05.05	All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.								
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.								
5.00.00	EARTHING SYSTEM								
5.01.00	Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts. Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All off-site areas shall be interconnected together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system.								
5.02.00	The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects								
5.03.00	The material of the earthing conductors shall be as follows : 1) Conductors above ground level and in built up trenches. - Galvanized steel 2) Conductors buried in earth - Mild steel 3) Earth electrodes - Mild steel rod								
5.04.00	The sizes of earthing conductors for various electrical equipments shall be as below: <table><tr><td>Equipment</td><td>Earth conductor buried in earth</td><td>Earth conductor above ground level & in built-up trenches</td></tr><tr><td></td><td></td><td></td></tr></table>	Equipment	Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches					
Equipment	Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches							
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	a)	Main earth grid	40 mm dia. MS rod	65 x 8mm GS flat
	b)	33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	---	65 x 8mm GS flat
	c)	415 V MCC/ Distribution boards / Transformers	---	50 x 6mm GS flat
	d)	LT Motors above 125 KW	---	50 x 6mm GS flat
		25 KW to 125 KW	---	25 x 6mm GS flat
		1KW to 25 KW	---	25 x 3mm GS flat
		Fractional House power motor	---	8 SWG GS wire
	e)	Control panel & control desk	---	25 x 3 mm GS flat
	f)	Push button station / Junction Box	---	8 SWG GI wire
	g)	Columns, structures, cable trays and bus ducts enclosures	---	50 x 6mm GS flat
5.05.00	h)	Crane, rails, rail tracks & other non-current carrying metal parts		25 x 6mm GS flat
	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.			
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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 along with 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:												
	<table> <tr> <td>Standard/Code</td><td>IEEE 80, IS 3043</td></tr> <tr> <td>Earthing System</td><td></td></tr> <tr> <td>Life expectancy</td><td>40 Years</td></tr> <tr> <td>System Fault Level</td><td>As per system requirement (B0)</td></tr> <tr> <td>Soil resistivity</td><td>Actual as per site conditions.</td></tr> <tr> <td>Min. Steel corrosion</td><td>0.12mm/year</td></tr> </table>	Standard/Code	IEEE 80, IS 3043	Earthing System		Life expectancy	40 Years	System Fault Level	As per system requirement (B0)	Soil resistivity	Actual as per site conditions.	Min. Steel corrosion	0.12mm/year
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Earthing System													
Life expectancy	40 Years												
System Fault Level	As per system requirement (B0)												
Soil resistivity	Actual as per site conditions.												
Min. Steel corrosion	0.12mm/year												
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS- 9585-001-2												
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	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 IS:2309 .		
6.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system		
6.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.		
6.02.00	Down Conductors		
	1.	Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.	
	2.	Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.	
	3.	All joints in the down conductors shall be welded type.	
	4.	Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.	
	5.	Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm.	
	6.	All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.	
	7.	Lightning conductors shall not pass through or run inside GI Conduits.	
	8.	Testing link shall be made of galvanized steel of size 25x 6mm.	
	9.	Pulser system for lightning shall not be accepted	
	10.	Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.	
7.00.00	TESTS		
7.01.01	All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS- 9585-001-2	SUB SECTION- B-09 CABLING, EARTHING & LIGHTNING PROTECTION
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CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>	
	<p>specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p>		
7.01.02	<p>However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.</p>		
7.01.03	<p>All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p>		
7.01.04	<p>The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.</p>		
7.02.00	<p>Type Test reports shall be furnished for the following</p>		
7.02.01	<p>Type tests on Cable Trays support system</p> <p>a) Test 1A:</p> <p>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:</p> <div><div>i)</div><div>Working load</div></div> <div><div>ii)</div><div>Working load + point load</div></div> <div><div>iii)</div><div>Off load</div></div> <div><div>iv)</div><div>Proof load + point load</div></div> <div><div>v)</div><div>Off load</div></div> <p>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.</p> <p>B) Test 1B:</p> <p>Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides</p> <p>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.</p> <div><div>i)</div><div>Working load</div></div> <div><div>ii)</div><div>Working load + Point load</div></div> <div><div>iii)</div><div>Off load</div></div> <div><div>iv)</div><div>Proof load + Point load</div></div> <div><div>v)</div><div>Off load</div></div> <p>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</p> <p>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.</p> <p>Test 3 : Tests on Channel Fixed on Beam/Floor</p> <p>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</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Test 4 : Channel Insert Test</p> <p>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</p>			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS- 9585-001-2	SUB SECTION- B-09 CABLING, EARTHING & LIGHTNING PROTECTION	Page 17 of 20

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>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.</p> <div><div>i)</div><div>Working Load</div></div> <div><div>ii)</div><div>Working Load + Point Load</div></div> <div><div>iii)</div><div>Off Load</div></div> <div><div>iv)</div><div>Proof Load + Point Load</div></div> <div><div>v)</div><div>Off load</div></div> <p>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</p> <p>Test 5 : Channel nut slip characteristics (what ever applicable)</p> <p>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.</p> <p>A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.</p> <p>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.</p> <p>A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM.</p> <p>Test 6 Weld Integrity Test</p> <p>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.</p>	
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	<p>Routine Tests</p> <div><div>a)</div><div>Routine tests as per specification and applicable standards shall be carried out on all requirements/items covered in the specification.</div></div>	
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
7.03.02	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.				
	Acceptance Test					
	a)	Galvanising Tests as per applicable standards				
	b)	Welding checks				
	c)	Deflection tests on cable trays:				
	d)	One piece each of 2.5m length of cable tray of 300mm & above shall be taken as sample from each offered lot. It shall be supported at both end & loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm.				
	d)	Proof load tests on cable tray support system				
	i)	Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test.				
8.00.00	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.				
	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.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.02.00	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.		
	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.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS- 9585-001-2		SUB SECTION- B-09 CABLING, EARTHING & LIGHTNING PROTECTION
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SECTION-3

Refer document

General Technical Requirements – TB-397-316-000 Rev 00.

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CUSTOMER: PATRATU VIDYUT UTPADAN NIGAM LTD. (PVUNL) (A Subsidiary of NTPC in Joint Venture with JBVNL)	
Technical Specification	TB-397-316-000 Rev 00
Section-3: Project Details and General Specification	

SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

3.1 PROJECT DETAILS

	Particular	Details															
a)	Customer	Patratu Vidyut Utpadan Nigam Ltd (PVUNL) – A Subsidiary of NTPC in Joint Venture with JBVNL.															
b)	Engineer/Consultant/ Inspector	NTPC Ltd.															
c)	Project Title	Patratu Super Thermal Power Project Expansion Phase – I (3X 800MW) – 400kV GIS Switchyard at Patratu STPP															
d)	Project Location	Place: Patratu District: Ramgarh State: Jharkhand															
e)	Latitude & Longitude	Latitudes and Longitudes of the site are as follows: <table border="1" style="margin-top: 5px;"> <thead> <tr> <th>Corner name</th><th>Latitude</th><th>Longitude</th></tr> </thead> <tbody> <tr> <td>Top Corner</td><td>23° 38 ' 60'' N</td><td>85° 17' 51.5" E</td></tr> <tr> <td>Bottom Corner</td><td>23° 38 ' 12.5'' N</td><td>85° 17' 27" E</td></tr> <tr> <td>Left Corner</td><td>23° 38 ' 22.5'' N</td><td>85° 17' 10.6'' E</td></tr> <tr> <td>Right Corner</td><td>23° 38 ' 40'' N</td><td>85° 17' 57'' E</td></tr> </tbody> </table>	Corner name	Latitude	Longitude	Top Corner	23° 38 ' 60'' N	85° 17' 51.5" E	Bottom Corner	23° 38 ' 12.5'' N	85° 17' 27" E	Left Corner	23° 38 ' 22.5'' N	85° 17' 10.6'' E	Right Corner	23° 38 ' 40'' N	85° 17' 57'' E
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Left Corner	23° 38 ' 22.5'' N	85° 17' 10.6'' E															
Right Corner	23° 38 ' 40'' N	85° 17' 57'' E															
f)	Nearest Railway Station	Patratu – At a distance of about 4 km on Barkakhana-Barwadih Railway Line.															
g)	Distance of project location from the Railway station	4 km (approx.)															
h)	Nearest Major Town	Ranchi															
i)	Distance of the town from the project site	45 km															
j)	Nearest commercial airport	Birsa Munda Airport, Ranchi.															
k)	Distance of airport from the project site	45 km															
	<u>SITE CONDITIONS</u> (for design purposes)																
a)	Design ambient temperature	50°C															
b)	Maximum Relative humidity	95 %															
c)	Height above mean sea level	Less than 1000 meters															
d)	Pollution Severity	Heavily polluted															

PROJECT: PATRATU SUPER THERMAL POWER PROJECT EXPANSION PHASE-I (3X 800MW)	
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e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3)
f)	Basic Wind speed “Vb” at ten meters above the mean ground level.	39 m/ sec
g)	Category of terrain	Cat -2
h)	Risk Coefficient “K1”	1.06

3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV
1	Highest system voltage	420 kV rms
2	Lightning Impulse voltage	±1425kVp
3	Switching impulse voltage	±1050kVp
4	Power frequency withstand for 1 min (rms)	650 kV(rms)
5	Max. fault level (1 sec.)	63 kA
6	Minimum creepage distance	10500 mm

3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50 (+3% -5%)	3Phase , 4 Wire	Solidly Earthed
2	240V	±10%	50 (+3% -5%)	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Design fault level of 415V system shall be restricted to 50kA rms for 1 second.

The operational limits for variation of DC voltage are (+) 10% to (-) 15%.

3.1.3 The various minimum heights of the AIS switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	Line Take Off Gantry Height	Peak
400kV	8000mm	23000mm	8500mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2550mm.

The minimum height of intermediate gantry tower for 400kV wherever required shall be 25 m and the peak (s) shall be of 8.5 m. The gantry width for 400kV AIS shall be minimum 27m or as required to meet the specified clearances.

3.1.4 The minimum clearances for 400kV switchyards shall be as given below:

	400kV
Phase to earth clearance	3500 mm
Phase to phase clearance	4000 mm
Section clearance	6500 mm

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3.2 INSTRUCTION TO BIDDERS:

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

The supplier should be approved by Employer. If not, it is the responsibility of the vendor to be assessed and approved Employer, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Bidder may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Purchaser. Sufficient amount of information for justifying such proposals shall be furnished to Purchaser alongwith the bid to enable the Purchaser to determine the acceptability of these proposals.

Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood to be indicative of the function and quality desired and not restrictive. Other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 CODES AND STANDARDS

In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following :

- a) Indian Electricity Act
- b) Indian Electricity Rules

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- c) Indian Explosives Act
- d) Indian Factories Act and State Factories Act
- e) Indian Boiler Regulations (IBR)
- f) Regulations of the Central Pollution Control Board, India
- g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- h) Pollution Control Regulations of Department of Environment, Government of India
- i) State Pollution Control Board.
- (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
- (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996
- (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998
- (m.) Explosive Rules, 1983
- (n.) Petroleum Act, 1984
- (o.) Petroleum Rules, 1976,
- (p.) Gas Cylinder Rules, 1981
- (q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981
- (r.) Workmen's Compensation Act, 1923
- (s.) Workmen's Compensation Rules, 1924
- (t.) NTPC Safety Rules for Construction and Erection
- (u.) NTPC Safety Policy
- (v.) Any other statutory codes / standards / regulations, as may be applicable.

Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening: 03-March-2017), of the codes and standards given below shall also apply:

- a) Bureau of Indian standards (BIS)
- b) Japanese Industrial Standards (JIS)
- c) American National Standards Institute (ANSI)
- d) American Society of Testing and Materials (ASTM)
- e) American Society of Mechanical Engineers (ASME)

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- f) American Petroleum Institute (API)
- g) Standards of the Hydraulic Institute , U.S.A.
- h) International Organization for Standardization (ISO)
- i) Tubular Exchanger Manufacturer's Association (TEMA)
- j) American Welding Society (AWS)
- k) National Electrical Manufacturers Association (NEMA)
- l) National Fire Protection Association (NFPA)
- m) International Electro-Technical Commission (IEC)
- n) Expansion Joint Manufacturers Association (EJMA)
- o) Heat Exchange Institute (HEI)
- p) IEEE standard
- q) JEC standard

Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

As regards highly standardized equipment such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.

In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

In case of any change in codes, standards & regulations between 03-March-2017 and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions.

All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all

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external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow (not applicable for this project), short circuit etc for the equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the bidder (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

After the approval of the drawings, further work by the bidder shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

The review of these document/data/drawings by the purchaser will cover only general conformance of the document/data/drawings to the specification and contract, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect plan layout. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. The review and/or approval by the purchaser shall not be considered by the bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing, fabrication and execution of work in connection with the equipment/system prior to the approval of the drawings shall be at the bidder's risk. The bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Purchaser. However, if some changes are necessitated in the design of the equipment/system at a later date, the bidder may do so, but such changes shall promptly be brought to the notice of the Purchaser indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. Approval of bidder's drawing or work by the Purchaser shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity with technical specification, unless otherwise expressly requested by the purchaser in writing.

3.5.2 Bidder's Drawing Submission and Approval Procedure

The following procedure for submission and review/approval of the drawings, data reports, information, etc. shall be followed by the bidder:

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- a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for Employer's information/interface and/or review and approval are referred by the general term "drawings".
- b. The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be furnished by the bidder. This list shall be updated if required at suitable interval during detailed engineering.
- c. All drawings (including those of sub-vendor) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The bidder shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance.
- d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.
- e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved, subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

- f. Bidder shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).
- g. In case Bidder does not agree with any specific comment, he shall furnish the explanation for the same to Employer for consideration. In all such cases Bidder shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.
- h. It is the responsibility of the Bidder to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
- i. Bidder shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Bidder shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**
- j. As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Bidder will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per clause 3.5.5.

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- k. Approval of drawings will not in any way relieve the Bidder of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

3.5.3 Erection Drawings.

- a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.
- b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

3.5.4 Instruction Manual

- a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, commissioning, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.
- b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted.
- c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.
- d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets.
- e. The manuals shall include the following
 - a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
 - b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.
- f. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or break down.
- g. A collection of the manufacturer's standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

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The Instruction Manuals shall comprise of the following:

3.5.4.1 Erection Manuals

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

- a) Erection strategy.
- b) Sequence of erection.
- c) Erection instructions.
- d) Critical checks and permissible deviation/tolerances.
- e) List of tool, tackles, heavy equipments like cranes, dozers, etc.
- f) Bill of Material
- g) Procedure for erection and General Safety procedures to followed during erection/installation.
- h) Procedure for initial checking after erection.
- i) Procedure for testing and acceptance norms.
- j) Procedure / Check list for pre-commissioning activities.
- k) Procedure / Check list for commissioning of the system.
- l) Safety precautions to be followed in electrical supply distribution during erection.

3.5.4.2 Operation and Maintenance Manuals

- a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.
- b) The arrangement and contents of O & M manuals shall be as follows :
 - 1) Chapter 1 - Plant Description : To contain the following sections specific to the equipment/system supplied
 - (a) Description of operating principle of equipment / system with schematic drawing / layouts.
 - (b) Functional description of associated accessories / controls. Control interlock protection write up.

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- (c) Integrated operation of the equipment along-with the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).
 - (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment along-with its accessories and auxiliaries.
 - (e) Design data against which the plant performance will be compared.
 - (f) Master list of equipment, Technical specification of the equipment/ system and approved data sheets.
 - (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).
 - (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).
- 2) Chapter 2 - Plant Operation : To contain the following sections specific to the equipment supplied
- (a) Protection logics provided for the equipment along-with brief philosophy behind the logic, Drawings etc.
 - (b) Limiting values of all protection settings.
 - (c) Various settings of annunciation/interlocks provided.
 - (d) Start-up and shut down procedure for equipment along-with the associated systems in step mode.
 - (e) Do's and Don'ts related to operation of the equipment.
 - (f) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.
 - (g) Parameters to be monitored with normal value and limiting values.
 - (h) Equipment isolating procedures.
 - (i) Trouble shooting with causes and remedial measures.
 - (j) Routine testing procedure to ascertain healthiness of the safety devices along-with schedule of testing.
 - (k) Routine Operational Checks, Recommended Logs and Records
 - (l) Change over schedule if more than one auxiliary for the same purpose is given.
 - (m) Preservation procedure on long shut down.
 - (n) System/plant commissioning procedure.

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- 3) Chapter 3 - Plant Maintenance : To contain the following sections specific to the equipment supplied
- (a) Exploded view of each of the equipments. Drawings along-with bill of materials including name, code no. & population.
 - (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.
 - (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.
 - (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.
 - (e) Preventive Maintenance schedules linked with running hours/calendar period along-with checks to be carried out.
 - (f) Overhauling schedules linked with running hours/calendar period along-with checks to be done.
 - (g) Long term maintenance schedules
 - (h) Consumables list along-with the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.
 - (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.
 - (j) Tolerance for fitment of various components.
 - (k) Details of sub vendors with their part no. in case of bought out items.
 - (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.
 - (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.
 - (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.
 - (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in table below. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

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If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in table below:

S.No.	Description of Drgs/Docs	No. of Prints	No. of CD ROMs/DVDs/Portable Hard Disk
1	Erection Manual	4 Sets	2
2	Operation & Maintenance manual i) First Submission	1 Set	1
	ii) Final Submission	4 Sets	2

3.5.5 Final Submission of drawings and documents:

The Bidder shall furnish the following after approval of all drawings /documents and test reports:

- List of drawings bearing the Employer's and Contractor's drawing number.
- Six (6) bound sets along-with two (2) sets of CD-ROMs/ DVD/Portable hard disk of all final drawings/documents.
- Bidder shall also furnish six (6) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish two (2) sets of CD-ROMs/ DVD/Portable hard disk of all as-built drawings as decided by the Employer.
- The Bidder shall also furnish four (4) copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of instruction/ operations & maintenance manuals (after approval) for all the equipments.

3.5.6 TEST REPORTS

Two (2) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval six (6) bound copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of all type and routine test reports shall be submitted to Employer.

3.6 MATERIAL /WORKMANSHIP

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be

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designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.7 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity' heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

SPACE HEATERS

The heaters shall be suitable for continuous operation at 240 V as supply voltage. On –off switch and fuse shall be provided.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

Control cubicles installed in air-conditioned area need not be provided with space heaters. These cubicles shall, however, have space heaters in case of storage of cubicles for long duration.

FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

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Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

Degree of Protection

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

- a. Installed outdoor: IP- 55
- b. Installed indoor in air conditioned area: IP-32
- c. Installed in covered area: IP-52
- d. Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41.
- e. For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

PRESERVATIVE SHOP COATING

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.

Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

3.8 RATING PLATES, NAME PLATES AND LABELS

- 3.8.1 Each equipment shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
- 3.8.2 Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
- 3.8.3 Each equipment shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.

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- 3.8.4 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
- 3.8.5 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
- 3.8.6 Each switch shall have a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.
- 3.8.7 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.
- 3.8.8 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

3.9 GALVANISING:

- 3.9.1 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, clean, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at bidder's cost.
- 3.9.2 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area or a minimum of 30 microns. The threads shall have extra deposit of zinc which shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have the required deposits of zinc on them as specified.

3.10 PAINTING

Unless explicitly stated in relevant chapters of the specification, the painting of all electrical equipment shall be as follows:

Epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. Paint shade shall be as per technical specification.

3.11 QUALITY ASSURANCE PROGRAMME

- 3.11.1 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his subcontractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001.

A quality assurance programme of the contractor shall generally cover the following:

- i. His organisation structure for the management and implementation of the proposed quality assurance programme.
- ii. Quality System Manual

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- iii. Design Control System
- iv. Documentation Data Control System
- v. Qualification data for Bidder's key Personnel.
- vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- vii. System for shop manufacturing and site erection controls including process controls and fabrication and assembly controls.
- viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
- ix. Inspection and test procedure both for manufacture and field activities.
- x. Control of calibration and testing of measuring testing equipments.
- xi. System for Quality Audits.
- xii. System for identification and appraisal of inspection status.
- xiii. System for authorising release of manufactured product to the Employer.
- xiv. System for handling storage and delivery.
- xv. System for maintenance of records, and
- xvi. Furnishing quality plans for manufacturing detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed as Annexure-I.

3.12 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 3.12.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval.
- 3.12.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.
- 3.12.3 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.
- 3.12.4 These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.

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- 3.12.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC).
- 3.12.6 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 3.12.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.
- 3.12.8 All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 3.12.9 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- 3.12.10 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
- 3.12.11 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- 3.12.12 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 3.12.13 No welding shall be carried out on cast iron components for repair.
- 3.12.14 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 3.12.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40mm shall be ultrasonically tested.
- 3.12.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the subcontractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Employer, shall be subject to Employer's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process

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capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified subcontractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

- 3.12.17 For components/equipment procured by the Bidders for the purpose of the contract, after obtaining the written approval of the Employer, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.
- 3.12.18 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-contractor's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 3.12.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 3.12.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 3.12.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 3.12.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
- 3.12.23 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the Bidder / sub – contractor should meet the following.

1. The Bidder / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

Or

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In case the Bidder / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

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

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

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

Burn In Test Cycle

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

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

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

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

The Bidder / Sub-contractor shall carry out routine test on 100% item at Bidder's / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

3.13 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (✓) mark.

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Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

3.13.1 Typical contents of Quality Assurance Document are as below:-

- i) Quality Plan,
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- v) Heat Treatment Certificate/Record (Time- temperature Chart)
- vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- viii) Certificate of Conformance (COC) whoever applicable.
- ix) MDCC

3.13.2 Before dispatch/ commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- iii) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.14 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer on release of QA Documentation by Inspector. One set of quality document

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shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery similarly as stated above.

3.15 INSPECTION, TESTING & INSPECTION CERTIFICATE

- 3.15.1 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- 3.15.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.
- 3.15.3 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- 3.15.4 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 3.15.5 When the factory tests have been completed at the Bidder's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 3.15.6 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-contractor, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

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- 3.15.7 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
- 3.15.8 To facilitate advance planning of inspection in addition to giving inspection notice, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 3.15.9 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

3.16 PACKAGING & TRANSPORTATION

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

3.17 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

- 3.17.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.
- 3.17.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.
- 3.17.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.
- 3.17.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.
- 3.17.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

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- 3.17.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.
- 3.17.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till erection time.

3.18 SPACERS

- 3.18.1 Spacers shall conform to IS: 10162. They shall be of non-magnetic material except nuts and bolts, which shall be of hot dip galvanised mild steel.
- 3.18.2 Spacers shall generally meet the requirements of clamps and connectors as specified above. Its design shall take care of fixing and removing during installation and maintenance.
- 3.18.3 In addition to the type tests as per IS: 10162, clamp slip test should have been conducted. In this test the sample shall be installed on test span of twin/quad bundle string at a tension of 44.2kN (4500 kg). One of the clamps when subjected to a longitudinal pull of 2.5kN (250 kg) parallel to the axis of conductor shall not slip, i.e. permanent displacement between conductor and clamp after test shall not exceed 1.0 mm. This test should have been performed on all other clamps of the sample.

3.19 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC INSULATORS

- 3.19.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC62155/IS 5284. The support insulators shall be manufactured and tested as per IS: 2544/IEC 60168/IEC 60273. The insulators shall also conform to IEC 60815 as applicable having alternate long and short sheds.
Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 3.19.2 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- 3.19.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.
- 3.19.4 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.
- 3.19.5 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.
- 3.19.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

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3.19.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.

3.19.8 In accordance with the requirement stipulated elsewhere, bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/sample test in accordance with relevant standards.

3.20 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.

3.20.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:60439 as applicable.

3.20.2 They shall be of Stainless steel or Aluminium. The thickness of Stainless steel shall be minimum 1 mm. The thickness of aluminium shall be minimum 3 mm and shall provide rigidity. Top of the boxes shall be sloped towards the rear of the box.

3.20.3 BAY MARSHALLING BOX

Bay Marshaling Box located at a convenient location to receive and distribute cables shall be provided as required. It shall meet all the requirements as specified for cabinets/boxes.

It shall have three separate distinct compartments for following purposes:

- To receive two incoming 415V, three phase, AC supplies controlled by 100A four pole MCBs with auto changeover provision, and to distribute five (5) three phase ac supplies controlled by 32A four pole MCBs. It shall also be provided with 63A, 3 phase 4 pin industrial grade receptacle with rotary switch.

- To receive three phase incoming from first compartment and to distribute ten (10) single phase ac supplies controlled by 16A two pole MCBs.

- 150 nos. terminal blocks in vertical formation for interlocking facility.

3.20.4 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

- a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
- b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
- c) Heat run test on contacts
- d) IR/HV test, etc.

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3.21 CABLE GLANDS AND LUGS/FERRULES

- 3.21.1 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.
- 3.21.2 Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards.

3.22 CONDUITS, PIPES AND ACCESSORIES

- 3.22.1 The bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.
- 3.22.2 The size of the conduit/pipe shall be selected to limit the fill to a maximum of 40%. 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 in an approved manner to prevent damage to threaded portions and entrance of moisture and foreign materials.
- 3.22.3 PVC conduits shall be of high impact, heavy gauge (at least class 2) conduit conforming to BS-4607.
- 3.22.4 The outer surface of the steel conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanized. All rigid conduits/pipes shall be of a reputed make.
- 3.22.5 The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS-458. All tests on hume pipes shall be conducted as per IS-458.
- 3.22.6 Flexible conduits shall be of heat-resistant lead coated steel, water-leak, fire and rust proof.

3.23 MOTORS

The voltage level for motors shall be as follows:

- | | |
|----------------------------------|--|
| a) Upto 0.2 KW | : Single phase 240V AC / 3 phase 415V AC |
| b) Above 0.2 KW and upto 200 KW | : 3 phase, 415V AC |
| c) Above 200 KW and upto 1500 KW | : 3 phase, 3.3 kV AC |
| d) Above 1500 KW | : 11 kV |

The bidder may adopt 415V/3.3 KV for the drives rated in the range of 160-210 KW.

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The voltage rating of the drives indicated above is for basic guideline.

- 3.23.1 All motors shall conform to IEC-60034-5 / IS Standard and with principal dimensions in accordance with IEC 60072-1 (1991), IEC 60072-2 (1990) and IEC 60072-3 (1994).
- 3.23.2 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification
- 3.23.3 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.
- 3.23.4 Degree of Protection

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

Indoor motors - IP 54
Outdoor motors - IP 55
Cable box-indoor area - IP 54
Cable box-Outdoor area - IP 55

- 3.23.5 Type:

AC Motors:

- a) Squirrel cage induction motor suitable for direct-on-line starting.
- b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30.
- c) Crane duty motors shall be squirrel cage Induction motor as per the requirement.
- d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

DC Motors Shunt wound

3.24 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

- a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
- b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
- c) Heat run test on contacts
- d) IR/HV test, etc.

3.25 LAMPS AND SOCKETS

3.25.1 Lamps:

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

3.25.2 Sockets

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All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

3.25.3 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

3.26 SWITCHES & FUSES:

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units. Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal Protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

All control switches shall be of rotary type. Toggle/piano switches shall not be accepted.

3.27 TYPE, ROUTINE & ACCEPTANCE TESTS:

3.10.1 TYPE TEST REQUIREMENTS FOR EQUIPMENTS OTHER THAN GIS

- a) All equipments to be supplied shall be of type tested design. During detail engineering, the bidder shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of techno-commercial bid opening (03-March-2017). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.
- b) However if contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of techno-commercial bid opening (03-March-2017)., or in the case of type test report(s) are not found to be meeting the specification requirements, the bidder shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.
- c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

3.28 CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:

- a) The corona and RIV tests shall confirm to the requirements as per Annexure A.
- b) The seismic withstand test shall conform to requirements as per Annexure B.

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3.29 Enclosures:

1. ANNEXURE- A - CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
2. ANNEXURE- B - SEISMIC WITHSTAND TEST
3. ANNEXURE- I – MQP (NTPC format)
4. ANNEXURE- II – QUALITY ASSURANCE FOR SWITCHYARD

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ANNEXURE – A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors where applicable shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and measurement of radio interference voltage (RIV).

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV (400kV):

3.1 RIV tests shall be made according to measuring circuit as per International Special committee on Radio Interference (CISPR) Publication 16 -1 (1993) Part – I. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequencies in the range of 0.5 MHZ to 2 MHz may be used, the measuring frequency being recorded. The result shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107 – 1964 except otherwise noted herein.

3.3 In measurement of RIV temporary additional external corona shielding may be provided. In measurement of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400kV, 220kV & 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendations or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to the voltage read by the noise meter.

4.0 Test Methods for visible Corona (400kV AIS only)

The purpose of this test is to determine the corona extinction voltage of the apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130 % of RIV test voltage

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ANNEXURE – A

and maintained there for five minutes. In case corona inception does not take place at 130 %, the voltage level shall be raised till inception of corona or rated voltage whichever is lower. The voltage will then be decreased slowly until all visible corona disappears. The test procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which the visible corona (negative or positive polarity) disappears.

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ANNEXURE – B


SEISMIC WITHSTAND TEST (400kV AIS only)

- a.) The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.
- b.) The supplier shall arrange to transport the structure from his purchaser's premises / owner's sites for purpose of seismic withstand test only.
- c.) The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment and at any other point as agreed by the owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the purchaser.

ANNEXURE-I

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV.NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: OF....	

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

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS ' W"	 FOR NTPC USE	DOC. NO.:		REV..... CAT.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER						
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL	

FORMAT NO.: QS-01-QAI-P-09/F1-R1

1/1


ENGG. DIV./QA&I

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO.: CS-9585-001-2	GENERAL TECHNICAL REQUIREMENT	PAGE 78 OF 111
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ANNEXURE-II

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS	FIELD QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV. NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: OF....	

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

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

FORMAT NO.: QS-01-QAI-P-09/F2-R1

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SECTION-4
GUARANTEED TECHNICAL PARTICULARS
(To be submitted by the supplier at the contract execution stage)

- | | | |
|------|---|---|
| 1.0 | Name of the Project | : |
| 2.0 | Tenderer's Name and Address | : |
| 3.0 | Manufacturer's Name and Address | : |
| 4.0 | Material Specification | : |
| 5.0 | Applicable Standards | : |
| 6.0 | Thickness of sheet metal for Cable
Trays, fittings etc. | : |
| 7.0 | Max. Permissible loading for a
2.5m long simply supported at
Both ends. | : |
| 8.0 | Corresponding deflection at centre for
The loading as in 7.0 above | : |
| 9.0 | Weight of Zinc coating | : |
| 10.0 | Min. Thickness of Zinc deposit at any
spot | : |
| 10.0 | Dimension of angle used for fabricating
Racks assembly | : |
| 10.0 | Max. Permissible loading at another end
Of trays | : |

Name of the firm:-----

Signature of the Tenderer:-----

Designation:-----

Date:

Place:



SECTION-5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER OFFER REFERENCE:

(1) S.No.	(2) Parameter	(3) Requirement	(4) Yes / No	(5) Remarks in case reply in Col (4) is <i>NO</i>
A)	Horizontal Cable Rack Assembly (In Trenches) – Welded Type	As per Annexure 1		
B)	Under Hanger Assembly (In Control Room) – Bolted Type	As per Annexure 2		
1	Weight of Zinc Coating	610 gm/m ²		
2	Min. thickness of zinc coating at any spot	85 microns		
C)	Trays:			
1.	Type	Ladder type	YES / NO	
2.	Material	Rolled mild sheet steel	YES / NO	
3.	Thickness (minimum)	2mm for trays 3mm for coupler plates	YES / NO	
D)	Galvanization:			
1.	Type	Hot dip galvanization	YES / NO	
2.	Weight of zinc coating	610 gm/m ²	YES / NO	
3.	Min. thickness of zinc coating	85 microns	YES / NO	
E)	Following hardware not limited to this is included in scope			
1.	All Hardware for fixing of accessories	Included	YES / NO	
2.	For fixing horizontal cantilever arms to vertical support channel as per specification	Included	YES / NO	



3.	2 % extra hardware mentioned in Section-1 of specification	Included	YES / NO	
----	--	----------	----------	--

TESTS

ROUTINE TESTS

Whether during manufacture and on completion, all items are subjected to the routine tests in accordance with latest IS/IEC and are in line with section-2 of this specification.

(YES)

TYPE TESTS

i) Whether valid type test reports of all the tests as per relevant IS/IEC & section-2 of this specification, conducted earlier on identical material/ equipment are available (test reports shall be of the tests conducted not earlier than 10 (ten) years from the date of bid opening 03-Mar-2017.

(YES/NO)

ii) If the valid type test reports are not available with the bidder then the mentioned tests shall be conducted by the bidder without any cost/ delivery implication to BHEL/ NTPC.

(YES)