GENERAL/ SCOPE NOTES FOR ETC WORKS FOR NORTH KARANPURA ADDITIONAL SCOPE OF ICT-2

	Following also forms the scope of ETC work in addition to above, but not limited to this.
1	Loading / Unloading, verification, handling, shifting to & from stores, proper storage, assembly, installation, pre-commissioning test and commissioning tests (As per BHEL FQP) are included in the scope.
2	Work mentioned in the BOQ, is of additional order received from NTPC and it includes Erection, testing & commissioning of one no. additional 400kV diameter (comprising of ICT bay, Tie bay & future line bay) and one no. additional 220kV ICT bay at existing LIVE/ CHARGED 400/220kV Switchyard at NTPC North Karanpura STPP.
3	Annexure- B comprising Switchyard Installation notes, site testing & commissioning, cabling, earthing & lightning protection and erection conditions of contract shall be followed for ETC work.
4	All the drawings and documents as per Annexure-1 shall be followed for ETC work.
5	Minor Civil works such as modification of civil foundations (including grouting as per instructions of site incharge), making holes in the trenches/ control room building, grouting, fixing of trench material will be in the scope of ETC contractor. Grouting is to be done with Admixture (Cebex100 - A plasticising grout & hydrogen free grout admixture)
6	Removal of gravel, if gravelling is done, for connection of Equipment earthing strip to the existing mat (wherever earthing mat is already laid), and after completion of earthing , contractor should place the gravel to bring it in original shape.
7	The quantities given in items mentioned in BOQ may undergo a change to any extent.
8	Quoted rates are deemed to be inclusive of miscellaneous works viz erection of clamps and connectors.
9	All paint , welding electrodes & other consumable by contract supplies shall be part of ETC works. Paint /welding electrode make etc. is subject to BHEL/CUSTOMER site incharge approval.
10	Equipment erection (say Isolator) means complete erection, metallics, post insulator, connectors (expansion/rigid tubular for Al.Tube / single/double/quadraple conductor), connection to the next in line (if connected to overhead busbar or droppers) including PG clamps/Tee connectors etc. This will be clear from the enclosed electrical layout drawings.
11	Equipment and tower erection would include supply and erection of miscellanneous items , viz Phase colour discs , labels painting of equipments , phase colour painting , phase marking , bay identification board , danger plates , rubber mats , device number marking on the equipment, keyboard etc as per site requirements. Supply & Mounting of phase color discs & Danger plates shall be as per IS-2551; 1982 & IS 5; 1978.

GENERAL/ SCOPE NOTES FOR ETC WORKS FOR NORTH KARANPURA ADDITIONAL SCOPE OF ICT-2

Following also forms the scope of ETC work in addition to above, but not limited to this.	
12	Welding of Aluminium tubes (supply of welding sleeve excluded) as per Annexure-C is in ETC contractor's scope and joints shall be tested by radiography (X-rays). Welding and Bending machines and any other equipment will be in ETC Contractor scope.
13	Completete ETC package is under the scope of bidder. All work is to be done in existing charged 400/220kV Switchyard. Contractor must ensure adherence to all Statutory Safety/ HSE norms of BHEL/ NTPC. All Tools & Plant including **oil filterating machine, Manlift (to work at hights above 5m), cranes** etc. required to safely complete the job shall be provided by bidder only.
14	Supervision of erection, Testing & commissioning of one no. Isolator of each type shall be done by supplier. Necessary manpower support, tools, tackles etc shall be in the scope of ETC contractor.
15	For specification of Fire Proof Cable Penetration system refer Annexure-D.
16	For specification of Cable Glands, erection hardware and GI Pipe & accessories refer Annexure-E1, E2 & E3 respectively.
17	For procedure of N2 purging/ dryout of Reactor refer Annexure-F.
18	For list of site testing of Transfromer refer Annexure-G.
19	For documents of 30m high Lighting High Mast (to be dismantled & re-erected at new location) refer Annexure-H.
20	Testing istruments (dully calibrated) have to be arranged by ETC Contractor at it's own cost (List is only provided for information , if any other instrument not mentioned below but required for sucessful completion of ETC work shall be in ETC contractor's scope) , (However OMICRON or equivalent kit for Numerical relay testing shall be arranged by BHEL.)
20.1	DCRM (OPERATIONAL ANALYZER)
20.2	Contact Resistance Measurement kit (CRM)
20.3	Capacitance and Tan delta measurement Kit
20.4	Dew Point Measurement kit
20.5	5kV/1kV Megger
20.6	Primary current Injection Kit
20.7	Secondary current/Voltgae Injection kit
20.8	1Ph Variac
20.9	Multimeters
20.10	Clamp on meter
20.1	Relay test kit
21	Erection Materials required for ETC work shall be supplied from Customer/ BHEL approved vendors. List is enclosed as Annexure-4.

891199/2022/TBG-TBG_ENGG

ANNEXURE – 1 (LIST OF DRAWINGS & DOCUMENTS)

Project :	**North Karanpura Super TPP (3x660MW)** **Additional scope of ICT-2 and associated 400kv & 220kV Bays at existing 400/220kV Switchyard at NKSTPP**
Customer :	**NTPC LTD.**
Drawing/Doc/ Annexure Nos.	**Drawing Title**
4410-001-572-PVE-P-0002	400/220kV SWITCHYARD SINGLE LINE DIAGRAM - (NKSTPP & MINE END)
4410-001-572-PVE-F-0013	LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END
4410-001-572-PVE-F-0038	400/220 kV - EQUIPMENT EARTHING PHILOSOPHY & DETAILS
-	NKSTPP_TRENCH LAYOUT FOR ICT-2 (PRESENT SCOPE OF BIDDER)
4410-001-572-PVC-F-0045A	400/220 kV - CABLE TRENCH LAYOUT AT NKSTPP END
ANNEXURE-A	CABLE TRENCH SECTION DETAILS (OUTDOOR)
ANNEXURE-B	SWITCHYARD INSTALLATION GUIDELINES CABLING, EARTHING & LIGHTNING PROTECTION ERECTION CONDITIONS OF CONTRACT
ANNEXURE-C	PROCEDURE FOR WELDING OF ALUMINIUM BUSES
ANNEXURE-D	SPECIFICATION FOR FIRE PROOF CABLE PENETRATION
ANNEXURE-E1	SPECIFICATION FOR CABLE GLANDS
ANNEXURE-E2	SPECIFICATION FOR EQUIPMENT ERECTION HARDWARE
ANNEXURE-E3	SPECIFICATION FOR GI PIPE, BENDS, TEES & SOCKETS
ANNEXURE-F	PROCEDURE OF DRY OUT BY N2 FOR TRANSFORMER/ REACTOR
ANNEXURE-G	LIST OF SITE TESTS APPLICABLE FOR TRANSFORMER/ REACTOR
ANNEXURE-H	DOCUMENTS OF 30m HIGH LIGHTING HIGH MAST
ANNEXURE-3	PROJECT DETAILS
ANNEXURE-4	APPROVED VENDOR LIST FOR SUPPLY ITEMS

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

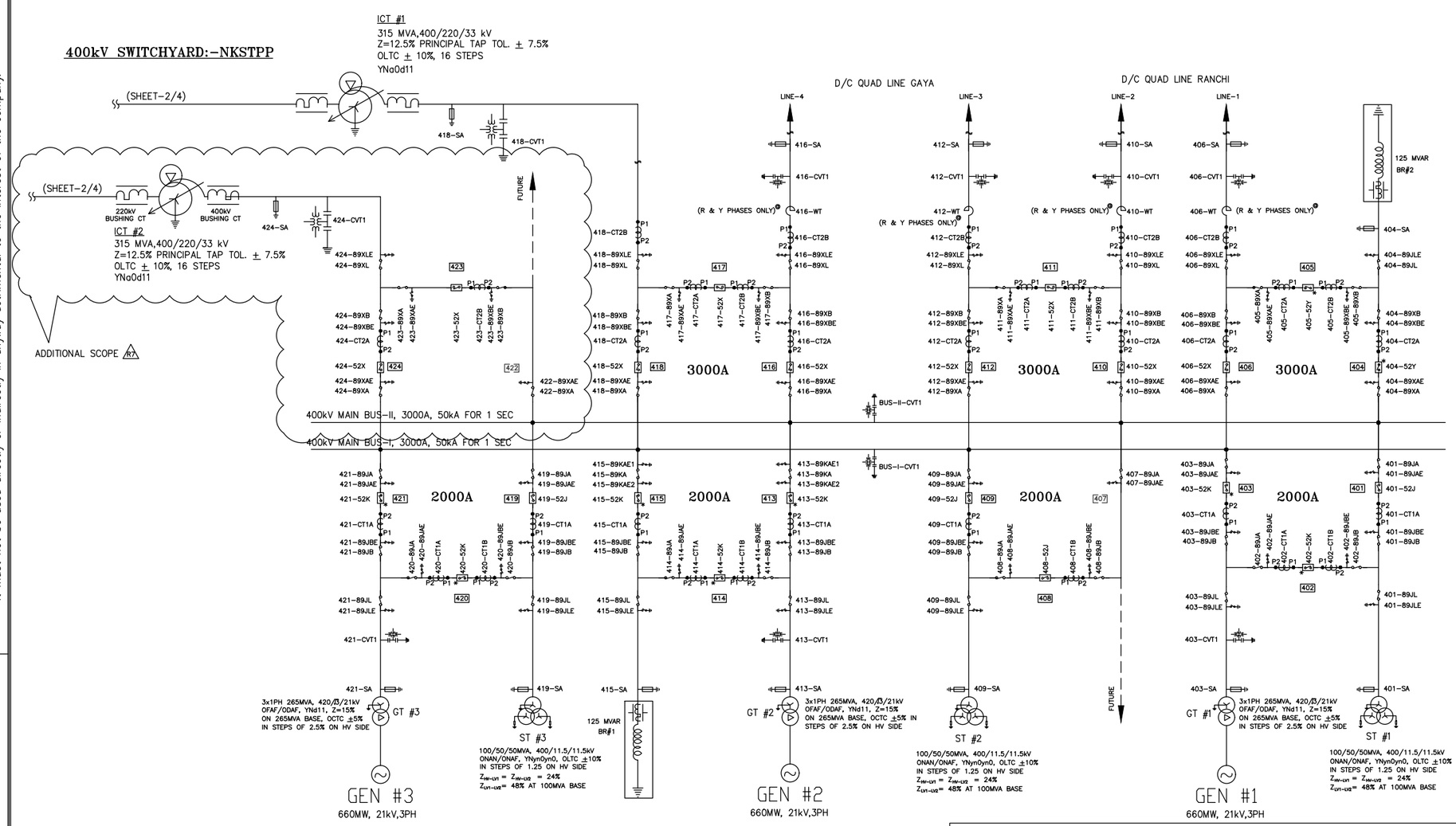
DRG. NO. TB-1-369-510-001

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

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.



NOTES :

1. PRESENT ———————
   FUTURE/ EXISTING – – – – – – – –
2. @ - WAVE TRAP PHASES TO BE CONFIRMED BY NTPC.
3. ⋆ - CB WITH CONTROLLED SWITCHING DEVICE.

REF DRG. NO. 4410-999-POE-J-001 REV. A
(400/220kV SWYD SINGLE LINE DIAGRAM)

NAME OF CUSTOMER: NTPC LIMITED

NAME OF PROJECT : NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

NTPC DRAWING NO. 4410-001-572-PVE-P-0002

REV.	DATE	ALTD.	CHD.	APPD.	INVENTORY NO.
07	30.07.21	AK/RD	VK	AG	SLD REVISED TO INCLUDE ADDITIONAL SCOPE OF 400kV ICT#2 BAY (424), ASSOCIATED 400kV TIE BAY (423) AND 220kV ICT#2 BAY (201) PARAMETERS OF ICT#2 BUSHING CT ADDED.
04	01.01.16	AK	MM/VK	AS	AS PER DISCUSSION WITH NTPC 3-PH LINE CVT IN NK#1 & NK#2 LINES ADDED AT MINE END.

	NAME	SIGN.	DATE
DRAWN	AK	-sd-	04.08.14
CHECKED	MM/VK	-sd-	04.08.14
APPROVED	AS	-sd-	04.08.14

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP

CARD CODE

400/220kV SWITCHYARD SINGLE LINE DIAGRAM – (NKSTPP & MINE END)

NEXT SHEET 02

SHEET No. 01

SCALE NTS | W.O. No. | DRG. No. TB-1-369-510-001 | REV 07

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-1-369-510-001

1 2 3 4 5 6 7

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

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.

BILL OF QUANTITY - 400kV (NKSTPP END)

S.NO	SYMBLE OF EQUIPMENT	CODE	DESCRIPTION	BAY NO /LOCATION	QTY (NOS.)
01		52J	400kV,2000A,50kA FOR 1 SEC , 3-Ph CIRCUIT BREAKER WITHOUT PIR	401-52J, 408-52J, 409-52J, 419-52J	4
02		52K	400kV,2000A,50kA FOR 1 SEC , 3-Ph CIRCUIT BREAKER WITHOUT PIR AND WITH CONTROLLED SWITCHING DEVICE	402-52K, 403-52K, 413-52K, 414-52K, 415-52K, 420-52K, 421-52K	7
03		52X	400kV,3150A,50kA FOR 1 SEC , 3-Ph CIRCUIT BREAKER WITHOUT PIR	406-52X, 410-52X, 411-52X, 412-52X, 416-52X, 417-52X, 418-52X,423-52X, 424-52X	7+2 (R7)
04		52Y	400kV,3150A,50kA FOR 1 SEC , 3-Ph CIRCUIT BREAKER WITHOUT PIR AND WITH CONTROLLED SWITCHING DEVICE	404-52Y, 405-52Y	2
05		89J	400kV,2000A,50kA FOR 1 SEC , 3-Ph HCB ISOLATOR WITH MOTOR OPERATED 1 E/S	401-89JA, 401-89JB, 401-89JL, 402-89JA, 402-89JB, 403-89JA, 403-89JB, 403-89JL, 404-89JL, 407-89JA, 408-89JA, 408-89JB, 409-89JA, 409-89JB, 409-89JL, 413-89JB, 413-89JL, 414-89JA, 414-89JB, 415-89JB, 415-89JL, 419-89JA, 419-89JB, 419-89JL, 420-89JA, 420-89JB, 421-89JA, 421-89JB, 421-89JL	29
06		89K	400kV,2000A,50kA FOR 1 SEC , 3-Ph HCB ISOLATOR WITH MOTOR OPERATED 2 E/S	413-89KA, 415-89KA	2
07		89X	400kV,3150A,50kA FOR 1 SEC , 3-Ph HCB ISOLATOR WITH MOTOR OPERATED 1 E/S	404-89XA, 404-89XB, 405-89XA, 405-89XB, 406-89XA, 406-89XB, 406-89XL, 410-89XA, 410-89XB, 410-89XL, 411-89XA, 411-89XB, 412-89XA, 412-89XB, 412-89XL, 416-89XA, 416-89XB, 416-89XL, 417-89XA, 417-89XB, 418-89XA, 418-89XB, 418-89XL, 422-89XA, 423-89XA, 423-89XB, 424-89XA, 424-89XB, 424-89XL	23+6 (R7)
08		CT1	400kV, 2000A, 50kA FOR 1 SEC, 1-Ph, 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING	401-CT1A, 402-CT1A, 402-CT1B, 403-CT1A, 408-CT1B, 409-CT1A, 413-CT1A, 414-CT1A, 414-CT1B, 415-CT1A, 419-CT1A, 420-CT1A, 420-CT1B, 421-CT1A	42
09		CT2	400kV, 3000A, 50kA FOR 1 SEC, 1-Ph, 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING	404-CT2A, 405-CT2A, 405-CT2B, 406-CT2A, 406-CT2B, 410-CT2A, 410-CT2B, 411-CT2A, 411-CT2B, 412-CT2A, 412-CT2B, 416-CT2A, 416-CT2B, 417-CT2A, 417-CT2B, 418-CT2A, 418-CT2B, 423-CT2B, 424-CT2A	51+6 (R7)
10		SA	336kV, 20kA, 50kA FOR 1 SEC, DISCHARGE CLASS-4, 1-Ph SURGE ARRESTER	401-SA, 403-SA, 404-SA, 406-SA, 409-SA, 410-SA, 412-SA, 413-SA, 415-SA, 416-SA, 418-SA, 419-SA, 421-SA, 424-SA	39+3 (R7)
11		CVT1	400kV, 1-Ph, 8800pF CAPACITIVE VOLTAGE TRANSFORMER	403-CVT1, 413-CVT1, 406-CVT1, 410-CVT1, 412-CVT1, 416-CVT1, 418-CVT1, 421-CVT1, BUS-I-CVT1, BUS-II-CVT1, 424-CVT1	30+3 (R7)
12		WT	400kV, 3150A, 1mH, 1-Ph WAVE TRAP	406-WT, 410-WT, 412-WT, 416-WT	8
13		ICT	315MVA, 400/220/33kV, 3-PH INTERCONNECTING TRANSFORMER WITH YNa0d11, ONAN/ ONAF/ OFAF (40/60/100%), Z=12.5%, (+/-7.5%), OLTC +/- 10%, 16 STEPS	ICT#1, ICT#2	1+1 (R7)
14		BR	125MVAR, 420kV BUS REACTOR	BR#1, BR#2	2

CORE DETAILS OF 400kV CVT

Sno	Particulars	Secondary I	Secondary II	Secondary III
1	Rated Secondary Voltage	110/√3	110/√3	110/√3
2	Application	Protection	Protection	Metering
3	Accuracy	3P	3P	0.2
4	Output Burden (min)	75 VA	75 VA	75 VA

The accuracy of 0.2 on secondary III should be maintained through the entire burden range upto 75 VA on all the three windings without any adjustments during operation.
Capacitance- 8800 pF (nominal)

MAIN SYSTEM PARAMETERS:

1. NOMINAL VOLTAGE - 400kV
2. HIGHEST SYSTEM VOLTAGE - 420kV
3. RATED FREQUENCY - 50 HZ
4. RATED SHORT TIME CURRENT - 50kA FOR 1 SEC
5. POWER FREQUECY WITHSTAND VOLTAGE- 630kV (rms)
6. LIGTHNING IMPULSE WITHSTAND VOLTAGE - ±1425 kV peak
7. SWITCHING IMPULSE WITHSTAND VOLTAGE - ±1050 kV peak
8. CREEPAGE - 25mm/kV (10500 mm)

NOTES:-

1. WAVE TRAPS WOULD BE IN TWO PHASES OF LINES ONLY.
2. # - CORE-WISE APPLICATION DETAILS FOR CT SHALL BE GIVEN IN CONTROL & PROTECTION SCHEMES.

CORE DETAILS OF 400kV CT (3000 A)

Core No.	Application #	Current Ratio(A)	Output Burden(VA)	Accuracy Class as per IEC 185	Min.knee point voltage (V)	Max. CT Sec. wdg. Resistance (ohms)	Max. exciting current in mA at knee point voltage
1	Protection	3000/ 2000/ 1000/1	-	PS	3000/ 2000/ 1000	15/ 10/ 5	20 on 3000/1 TAP 30 on 2000/1 TAP 60 on 1000/1 TAP
2	Protection	3000/ 2000/ 1000/1	-	PS	3000/ 2000/ 1000	15/ 10/ 5	20 on 3000/1 TAP 30 on 2000/1 TAP 60 on 1000/1 TAP
3	Metering	3000/ 2000/ 1000/ 500/1	20 20 20 20	0.2s	-	-	-
4	Protection	3000/ 2000/ 1000/ 500/1	-	PS	6000/ 4000/ 2000/ 1000	15/ 10/ 5/ 2.5	20 on 3000/1 TAP 30 on 2000/1 TAP 60 on 1000/1 TAP 120 on 500/1 TAP
5	Protection	3000/ 2000/ 1000/ 500/1	-	PS	6000/ 4000/ 2000/ 1000	15/ 10/ 5/ 2.5	20 on 3000/1 TAP 30 on 2000/1 TAP 60 on 1000/1 TAP 120 on 500/1 TAP

All relaying CTs shall be of accuracy class PS as per IS:2705.The rated extended primary current of the CTs shall be 120% continuous of 3000 A. ISF for metering core should be less than 5 .

CORE DETAILS OF 400kV CT (2000 A)

Core No.	Application #	Current Ratio(A)	Output Burden(VA)	Accuracy Class as per IEC 185	Min.knee point voltage (V)	Max. CT Sec. wdg. Resistance (ohms)	Max. exciting current in mA at knee point voltage
1	Protection	2000/ 1000/1	-	PS	2000/ 1000	10/ 5	30 on 2000/1 TAP 60 on 1000/1 TAP
2	Protection	2000/ 1000/1	-	PS	2000/ 1000	10/ 5	30 on 2000/1 TAP 60 on 1000/1 TAP
3	Metering	2000/ 1000/ 500/1	20 20 20	0.2s	-	-	-
4	Protection	2000/ 1000/ 500/1	-	PS	4000/ 2000/ 1000	10/ 5/ 2.5	30 on 2000/1 TAP 60 on 1000/1 TAP 120 on 500/1 TAP
5	Protection	2000/ 1000/ 500/1	-	PS	4000/ 2000/ 1000	10/ 5/ 2.5	30 on 2000/1 TAP 60 on 1000/1 TAP 120 on 500/1 TAP

The rated extended primary current of the CTs shall be 120% continuous of 2000 A. ISF for metering core should be less than 5 .

(R7)

315MVA, 400/220/33kV ICT#2

HV Bushing CT

Core No.	Application	Current Ratio(A)	Output Burden (VA)	Accuracy Class as per IEC 185	Min.knee point voltage (V)	Max. CT Sec. wdg. Resistance (ohms)	Max Imag in mA at knee point voltage	ISF
1	REF	1000/1	-	PS	1000	2.5	60	-
2	DIFFERENTIAL	1000/1	-	PS	1000	5	60	-
3	BACK-UP O/C	1000/1	20	5P20	-	-	-	-
4	Metering (EM)	1000-500/1	15	0.2s	-	-	-	≤ 5
5	TEED-2 (H.L)	3000-2000-1000-500/1	-	PS	6000-4000-2000-1000	15-10-5-2.5	20-30-60-120	-
6	TEED-1 (LI.)	3000-2000-1000-500/1	-	PS	6000-4000-2000-1000	15-10-5-2.5	20-30-60-120	-

Neutral Bushing CT

1	REF	1000/1 A	-	PS	1000V	2.5	60	-
2	SEF	600/1 A	20 VA	5P20	-	-	-	-

LV Bushing CT

1	REF	1000/1 A	-	PS	1000V	2.5	60	-
2	SPARE	1000/1 A	-	PS	1000V	2.5	60	-

REF DRG. NO. 4410-999-POE-J-001 REV. A
(400/220kV SWYD SINGLE LINE DIAGRAM)

NAME OF CUSTOMER: NTPC LIMITED

NAME OF PROJECT : NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

NTPC DRAWING NO. 4410-001-572-PVE-P-0002

REV.	DATE	ALTD.	CHD.	APPD.
07	30.07.21	AK/RD	VK	AG

SLD REVISED TO INCLUDE ADDITIONAL SCOPE OF 400kV ICT#2 BAY (424), ASSOCIATED 400kV TIE BAY (423) AND 220kV ICT#2 BAY (201)
PARAMETERS OF ICT#2 BUSHING CT ADDED.

REV.	DATE	ALTD.	CHD.	APPD.
04	01.01.16	AK	MM/VK	AS

AS PER DISCUSSION WITH NTPC 3-PH LINE CVT IN NK#1 & NK#2 LINES ADDED AT MINE END.

	NAME	SIGN.	DATE
DRAWN	AK	-sd-	04.08.14
CHECKED	MM/VK	-sd-	04.08.14
APPROVED	AS	-sd-	04.08.14

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP

CARD CODE

400/220kV SWITCHYARD SINGLE LINE DIAGRAM - (NKSTPP & MINE END)

NEXT SHEET 03

SHEET No. 02

SCALE NTS | W.O. No. | DRG. No. TB-1-369-510-001 | REV 07

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-1-369-510-001

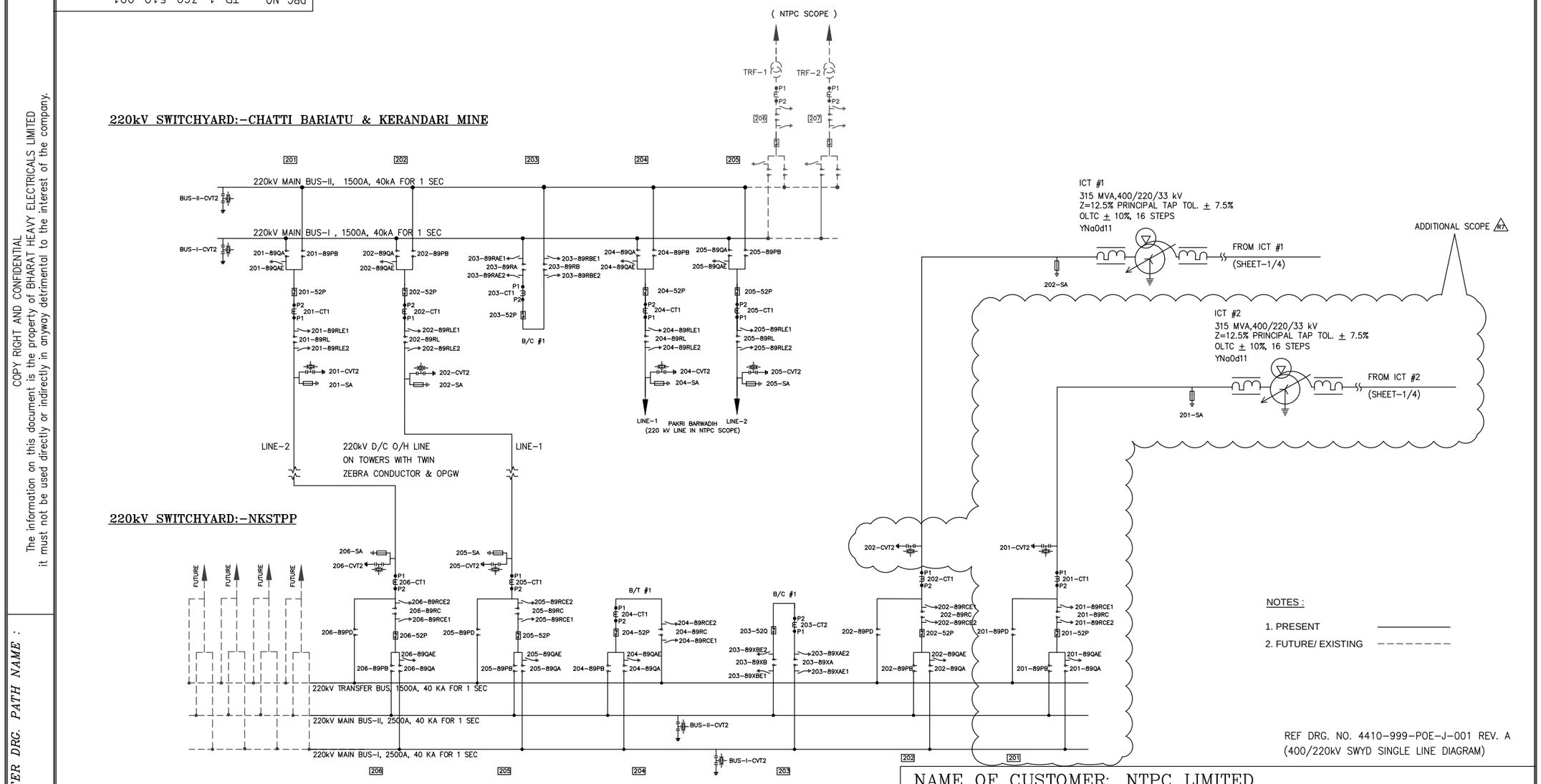
1 2 3 4 5 6 7

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

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.



NOTES :

1. PRESENT ————————
2. FUTURE/ EXISTING – – – – – – – –

REF DRG. NO. 4410-999-POE-J-001 REV. A
(400/220kV SWYD SINGLE LINE DIAGRAM)

NAME OF CUSTOMER: NTPC LIMITED

NAME OF PROJECT : NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

NTPC DRAWING NO. 4410-001-572-PVE-P-0002

REV.	DATE	ALTD.	CHD.	APPD.
07	30.07.21	AK/RD	VK	AG
04	01.01.16	AK	MM/VK	AS

INVENTORY NO.

SLD REVISED TO INCLUDE ADDITIONAL SCOPE OF 400kV ICT#2 BAY (424), ASSOCIATED 400kV TIE BAY (423) AND 220kV ICT#2 BAY (201)

PARAMETERS OF ICT#2 BUSHING CT ADDED.

AS PER DISCUSSION WITH NTPC 3-PH LINE CVT IN NK#1 & NK#2 LINES ADDED AT MINE END.

	NAME	SIGN.	DATE
DRAWN	AK	-sd-	04.08.14
CHECKED	MM/VK	-sd-	04.08.14
APPROVED	AS	-sd-	04.08.14

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP

CARD CODE

400/220kV SWITCHYARD SINGLE LINE DIAGRAM -
(NKSTPP & MINE END)

NEXT SHEET 04

SHEET No. 03

SCALE NTS | W.O. No. | DRG. No. TB-1-369-510-001 | REV 07

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-1-369-510-001

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

COMPUTER DRG. PATH NAME :.

SIGN & DATE

INVENTORY NO.

BILL OF QUANTITY – 220kV (NKSTPP END)

S.NO	SYMBLE OF EQUIPMENT	CODE	DESCRIPTION	BAY NO /LOCATION	QTY (NOS.)
01		52P	220kV, 1600A, 40kA FOR 1 SEC, 3-Ph CIRCUIT BREAKER	202-52P, 204-52P, 205-52P, 206-52P, 201-52P	4+1 AT
02		52Q	220kV, 2500A, 40kA FOR 1 SEC, 3-Ph CIRCUIT BREAKER	203-52Q	1
03		89P	220kV,1600A,3-PH HCB TANDEM ISOLATOR MECHANICALLY GANGED WTIHOUT E/S	202-89PB, 202-89PD, 204-89PB, 205-89PB, 205-89PD, 206-89PB, 206-89PD, 201-89PB, 201-89PD	7+2 AT
04		89Q	220kV,1600A,3-PH HCB ISOLATOR MECHANICALLY GANGED WITH MOTOR OPERATED 1E/S	202-89QA, 204-89QA, 205-89QA, 206-89QA, 201-89QA	4+1 AT
05		89R	220kV,1600A,3-PH HCB ISOLATOR MECHANICALLY GANGED WITH MOTOR OPERATED 2E/S	202-89RC, 204-89RC, 205-89RC, 206-89RC, 201-89RC	4+1 AT
06		89X	220kV,2500A,3-PH HCB ISOLATOR MECHANICALLY GANGED WITH MOTOR OPERATED 2E/S	203-89XA, 203-89XB	2
07		CT1	220kV,1600A, 40kA FOR 1 SEC, 1-PH, 5-CORE CURRENT TRANSFORMER	202-CT1, 204-CT1, 205-CT1, 206-CT1, 201-CT1	12+3 AT
08		CT2	220kV, 2500A, 40kA FOR 1 SEC, 1-PH, 5-CORE CURRENT TRANSFORMER	203-CT2	3
09		SA	216kV, 10kA, 40kA FOR 1 SEC, DISCHARGE CLASS-3, 1-Ph SURGE ARRESTER	202-SA, 205-SA, 206-SA, 201-SA	9+3 AT
10		CVT2	220kV, 1-Ph, 5575pF CAPACITIVE VOLTAGE TRANSFORMER	205-CVT2, 206-CVT2, BUS-I-CVT2, BUS-II-CVT2, 201-CVT2, 202-CVT2	12+6 AT

CORE DETAILS OF 220kV CVT

Sno	Particulars	Core I	Core II	Core III
1	Rated Secondary Voltage	110/√3	110/√3	110/√3
2	Application	Protection	Protection	Metering
3	Accuracy	3P	3P	0.2
4	Output Burden (min)	75 VA	75 VA	75 VA

The accuracy of 0.2 on secondary III should be maintained through the entire burden range upto 75 VA on all the three windings without any adjustments during operation.
Capacitance- 5575 pF (nominal)

BILL OF QUANTITY – 220kV (MINE END)

S.NO	SYMBLE OF EQUIPMENT	CODE	DESCRIPTION	BAY NO /LOCATION	QTY (NOS.)
01		52P	220kV, 1600A, 40kA FOR 1 SEC, 3-Ph CIRCUIT BREAKER	205-52P, 204-52P, 203-52P, 202-52P, 201-52P	5
02		89P	220kV,1600A,3-PH HCB TANDEM ISOLATOR MECHANICALLY GANGED WTIHOUT E/S	205-89PB, 204-89PB, 202-89PB, 201-89PB	4
03		89Q	220kV,1600A,3-PH HCB ISOLATOR MECHANICALLY GANGED WITH MOTOR OPERATED 1E/S	205-89QA, 204-89QA, 202-89QA, 201-89QA	4
04		89R	220kV,1600A,3-PH HCB ISOLATOR MECHANICALLY GANGED WITH MOTOR OPERATED 2E/S	205-89RL, 204-89RL, 203-89RA, 203-89RB, 202-89RL, 201-89RL	6
05		CT1	220kV,1600A, 40kA FOR 1 SEC, 1-PH, 5-CORE CURRENT TRANSFORMER	205-CT1, 204-CT1, 203-CT1, 202-CT1, 201-CT1	15
06		SA	216kV, 10kA, 40kA FOR 1 SEC, DISCHARGE CLASS-3, 1-Ph SURGE ARRESTER	205-SA, 204-SA, 202-SA, 201-SA	12
07		CVT2	220kV, 1-Ph, 5575pF CAPACITIVE VOLTAGE TRANSFORMER	201-CVT2, 202-CVT2, 204-CVT2, 205-CVT2, BUS-I-CVT2, BUS-II-CVT2	18

MAIN SYSTEM PARAMETERS:

1. NOMINAL VOLTAGE - 220kV
2. HIGHEST SYSTEM VOLTAGE - 245kV
3. RATED FREQUENCY - 50 HZ
4. RATED SHORT TIME CURRENT - 40kA FOR 1 SEC
5. POWER FREQUECY WITHSTAND VOLTAGE- 460kV (rms)
6. LIGTHNING IMPULSE WITHSTAND VOLTAGE - ±1050 kV peak
7. CREEPAGE - 25mm/kV (6125 mm)

NOTES:-

1. # - CORE-WISE APPLICATION DETAILS FOR CT SHALL BE GIVEN IN CONTROL & PROTECTION SCHEMES.

CORE DETAILS OF 220kV CT (1600 A)

Core No.	Application #	Current Ratio(A)	Output Burden (VA)	Accuracy Class as per IEC 185	Min.knee point voltage (V)	Max. CT Sec. wdg. Resistance (ohms)	Max. exciting current in mA at knee point voltage
1	Protection	1600/800/1	-	PS	1600/800	8/4	30 / 60
2	Protection	1600/800/1	-	PS	1600/800	8/4	30 / 60
3	Metering	1600/800/400/200/1	20/20/20/20	0.2s	-	-	-
4	Protection	1600/800/400/200/1	-	PS	3200/1600/800/400	8/4/2/1	30/60/120/240
5	Protection	1600/800/400/200/1	-	PS	3200/1600/800/400	8/4/2/1	30/60/120/240

* The rated extended primary current of the CTs shall be 120% continuous of 1600 A. ISF for metering core should be less

CORE DETAILS OF 220kV CT (2500 A)

Core No.	Application #	Current Ratio(A)	Output Burden (VA)	Accuracy Class as per IEC 185	Min.knee point voltage (V)	Max. CT Sec. wdg. Resistance (ohms)	Max. exciting current in mA at knee point voltage
1	Protection	2500/1250/1	-	PS	2500/1250	12.5/6.25	30 / 60
2	Protection	2500/1250/1	-	PS	2500/1250	12.5/6.25	30 / 60
3	Metering	2500/1250/1	20/20	0.2s	-	-	-
4	Protection	2500/1250/1	-	PS	2500/1250	12.5/6.25	30 / 60
5	Protection	2500/1250/1	-	PS	2500/1250	12.5/6.25	30 / 60

* The rated extended primary current of the CTs shall be 120% continuous of 2500 A. ISF for metering core should be less than 5 .

REF DRG. NO. 4410-999-POE-J-001 REV. A
(400/220kV SWYD SINGLE LINE DIAGRAM)

NAME OF CUSTOMER: NTPC LIMITED

NAME OF PROJECT : NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

NTPC DRAWING NO. 4410-001-572-PVE-P-0002

REV.	DATE	ALTD.	CHD.	APPD.
07	30.07.21	AK/RD	VK	AG

SLD REVISED TO INCLUDE ADDITIONAL SCOPE OF 400kV ICT#2 BAY (424), ASSOCIATED 400kV TIE BAY (423) AND 220kV ICT#2 BAY (201)
PARAMETERS OF ICT#2 BUSHING CT ADDED.

REV.	DATE	ALTD.	CHD.	APPD.
04	01.01.16	AK	MM/VK	AS

AS PER DISCUSSION WITH NTPC 3-PH LINE CVT IN NK#1 & NK#2 LINES ADDED AT MINE END.

	NAME	SIGN.	DATE
DRAWN	AK	-sd-	04.08.14
CHECKED	MM/VK	-sd-	04.08.14
APPROVED	AS	-sd-	04.08.14

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP

400/220kV SWITCHYARD SINGLE LINE DIAGRAM –
(NKSTPP & MINE END)

CARD CODE

NEXT SHEET -

SHEET No. 04

SCALE NTS | W.O. No. | DRG. No. TB-1-369-510-001 | REV 07

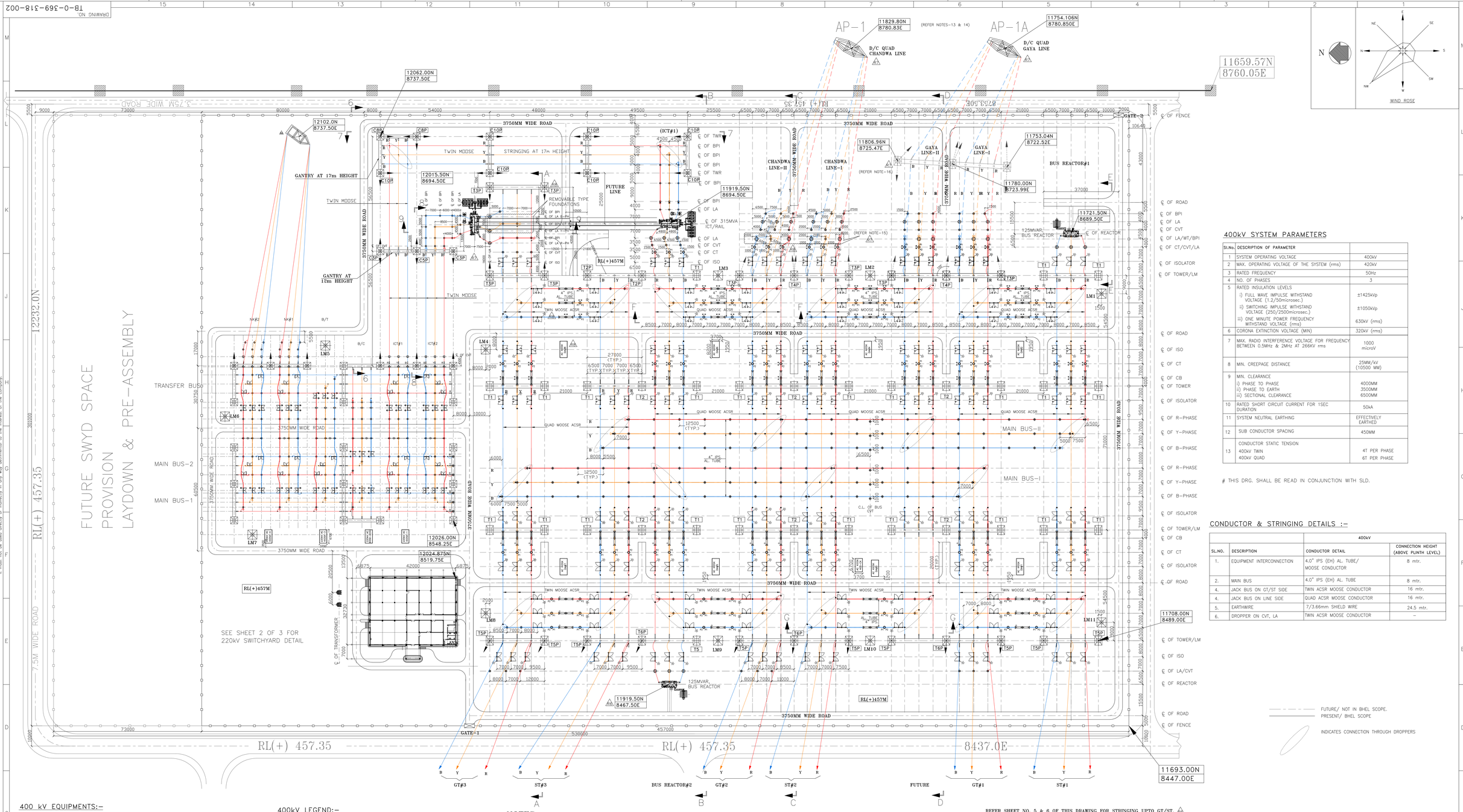
DRAWING NO. TB-0-369-318-002

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

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

ELECTRONIC FILE NAME:



400kv SYSTEM PARAMETERS

Sl.No.	DESCRIPTION OF PARAMETER	
1	SYSTEM OPERATING VOLTAGE	400kV
2	MAX. OPERATING VOLTAGE OF THE SYSTEM (rms)	420kV
3	RATED FREQUENCY	50Hz
4	NO. OF PHASES	3
5	RATED INSULATION LEVELS i) FULL WAVE IMPULSE WITHSTAND VOLTAGE (1.2/50microsec.) ii) SWITCHING IMPULSE WITHSTAND VOLTAGE (250/2500microsec.) iii) ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE (rms)	 ±1425kVp ±1050kVp 630kV (rms)
6	CORONA EXTINCTION VOLTAGE (MIN)	320kV (rms)
7	MAX. RADIO INTERFERENCE VOLTAGE FOR FREQUENCY BETWEEN 0.5MHz & 2MHz AT 266KV rms	1000 microV
8	MIN. CREEPAGE DISTANCE	25MM/kV (10500 MM)
9	MIN. CLEARANCE i) PHASE TO PHASE ii) PHASE TO EARTH iii) SECTIONAL CLEARANCE	 4000MM 3500MM 6500MM
10	RATED SHORT CIRCUIT CURRENT FOR 1SEC DURATION	50kA
11	SYSTEM NEUTRAL EARTHING	EFFECTIVELY EARTHED
12	SUB CONDUCTOR SPACING	450MM
13	CONDUCTOR STATIC TENSION 400kV TWIN 400kV QUAD	 4T PER PHASE 6T PER PHASE

THIS DRG. SHALL BE READ IN CONJUNCTION WITH SLD.

CONDUCTOR & STRINGING DETAILS :-

SL.NO.	DESCRIPTION	400kV CONDUCTOR DETAIL	400kV CONNECTION HEIGHT (ABOVE PLINTH LEVEL)
1.	EQUIPMENT INTERCONNECTION	4.0" IPS (EH) AL. TUBE/ MOOSE CONDUCTOR	8 mtr.
2.	MAIN BUS	4.0" IPS (EH) AL. TUBE	8 mtr.
4.	JACK BUS ON GT/ST SIDE	TWIN ACSR MOOSE CONDUCTOR	16 mtr.
4.	JACK BUS ON LINE SIDE	QUAD ACSR MOOSE CONDUCTOR	16 mtr.
5.	EARTHWIRE	7/3.66mm SHIELD WIRE	24.5 mtr.
6.	DROPPER ON CVT, LA	TWIN ACSR MOOSE CONDUCTOR	–

FUTURE/ NOT IN BHEL SCOPE.
PRESENT/ BHEL SCOPE
INDICATES CONNECTION THROUGH DROPPERS

400 kV EQUIPMENTS:-

SYMBOL	EQUIPMENT
	400kV, 2000A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR
	400kV, 2000A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR, WITH CONTROLLED SWITCHING DEVICE
	400kV, 3150A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR
	400kV, 3150A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR, WITH CONTROLLED SWITCHING DEVICE
	400kV, 3150A, 50kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 1 E/S
	400kV, 2000A, 50kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 1 E/S
	400kV, 2000A, 50kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 2 E/S
	400kV, 3000A, 50kA FOR 1s, 1-PH, 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RAITING
	400kV, 2000A, 50kA FOR 1s, 1-PH, 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RAITING
	400kV, 1-PH CAPACITOR VOLTAGE TRANSFORMER
	336 kV, 20kA, 50kA FOR 1 SEC, DISCHARGE CLASS-4, 1-PH SURGE ARRESTER
	400kV, 3150A, 1mH, 1-PH WAVE TRAP
	400 kV, 1 PHASE, SOLID CORE BUS POST INSULATOR

400kV LEGEND:-

	TOWER WITH PEAK
	TOWER WITHOUT PEAK
	LIGHTNING MAST
	SUSPENSION INSULATOR STRING (1X25 DISCS)
	DOUBLE TENSION INSULATOR STRING (2X25 DISCS)
	AL. TUBE
	R-PHASE ACSR MOOSE CONDUCTOR
	Y-PHASE ACSR MOOSE CONDUCTOR
	B-PHASE ACSR MOOSE CONDUCTOR
	END CAP/CORONA BELL FOR BUSBAR
	SHIELD WIRE (10.98MM)/ OPGW

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL STRUCTURE/CONDUCTOR HEIGHTS ARE ABOVE PLINTH LEVEL. PLINTH LEVEL IS 300 MM ABOVE F.G.L.
3. WAVE TRAP FOUNDATION SHALL BE PROVIDED FOR ALL THREE PHASE OF THE LINE AND SHALL BE SUITABLE FOR BPI ALSO. HOWEVER WAVE TRAP SHALL BE INSTALLED ON TWO PHASES ONLY. BPI SHALL BE PROVIDED FOR ONE PHASE WHEREVER WAVETRAP IS NOT INSTALLED.
4. TYPE OF GANTRY STRUCTURES SHALL BE AS PER APPROVED STRUCTURAL LAYOUT DRAWING.
5. LOCATION OF LM SHALL BE AS PER APPROVED DSLP LAYOUT
6. SA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE / ANY EQUIPMENT KEPT NEAR LIGHTING ARRESTER AND BHEL SHALL ENSURE THE SAME DURING ERECTION AT SITE.
7. FOR DETAILED PLAN LAYOUT OF 220kV BAYS REFER SHEET No. 02.
8. FOR SECTION DETAILS REFER SHEET No. 03.
9. STRINGING UPTO GT & ST BAYS SHOWN IN SHEET 5 & 6 OF THIS DRAWING.
10. LOCATION, SIZE & NUMBER OF AC KIOSKS IS TENTATIVE. REFER CIVIL FOUNDATION LAYOUT FOR FINAL LOCATIONS.
11. REFER CONTROL ROOM BUILDING CIVIL DRAWINGS FOR DETAILS OF CRB.
- ⚠6. LOCATION OF DEAD END TOWERS (AP-1 & AP-1A) AND THE 400kV LINE SIDE PHASE SEQUENCE IS SHOWN AS PER THE INPUTS RECEIVED FROM NTPC.
- ⚠7. SUPPLY AND STRINGING OF 400kV LINE CONDUCTOR, SHIELD WIRE, INSULATOR AND HARDWARE BETWEEN 400kV DEAD END TOWER AND SWITCHYARD TERMINAL GANTRY (INTERMEDIATE GANTRY FOR GAYA LINE) ARE NOT IN BHEL SCOPE. HOWEVER, JUMPERING FOR THE RESPECTIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
- ⚠8. 400kV LINE NOMENCLATURE AND LOCATION OF DEAD END TOWERS CHANGED AS PER NTPC NKTL DRAWING NO. A12-OD-001.
- ⚠9. AS PER NTPC MAIL DATED 06.08.2021, PHASES OF WAVE TRAPS CHANGED TO R & B PHASES IN CHANDWA LINE-1 & 2.
10. 400kV INTERMEDIATE TAKE-OFF GANTRY FOR GAYA D/C LINE IS SHOWN AS PER NKTL DRAWING NO. A12-OD-001 & IS NOT IN BHEL SCOPE. STRINGING WORK INCLUDING SUPPLY OF CONDUCTOR & HARDWARE FROM SWITCHYARD TAKE-OFF GANTRY TO THE PROPOSED NEW GANTRY & UPTO DEAD END TL TOWER IS ALSO NOT IN BHEL SCOPE. HOWEVER, JUMPERING FOR THE RESPECTIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
- ⚠11. LOCATION OF CHANDWA LINE 1 WAVE TRAP HAS BEEN SHIFTED BY 2M TOWARDS SOUTH AS PER DISCUSSION WITH NTPC TO MEET THE NECESSARY ELECTRICAL CLEARANCE. CONNECTION OF LINE EQUIPMENT TO BE DONE ONLY AFTER GETTING CONFIRMATION FROM NTPC SITE & NTPC ENGINEERING.
- ⚠12. LOCATION OF LA & BPI IN FRONT OF ICT#2 ARE TENTATIVE AND SHALL BE FINALIZED AFTER APPROVAL OF GA & FOUNDATION DRAWING OF ICT FROM BHEL BHOPAL. FOUNDATIONS OF THOSE LA & BPI SHALL BE THUS KEPT ON HOLD.

REFER SHEET NO. 5 & 6 OF THIS DRAWING FOR STRINGING UPTO GT/ST. ⚠4

REV.	DATE	ALTD	CHD	APPD
08	11.01.22	AK	AK	VK

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. LAYOUT ARRANGEMENT OF ICT#2 BAYS (BOTH 400kV & 220kV) REVISED TO CHANGE PHASE SEQUENCE OF ICT#2 SIMILAR TO THAT OF ICT#1.
2. CHANDWA LINE-2 R-PH WT SHIFTED BY 2M AS PER NTPC RECOMMENDATION.

REV.	DATE	ALTD	CHD	APPD
07	18.08.21	PK	AK	VK

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. ICT#2 AND ASSOCIATED BAYS.
2. REVISED 400kV LINE TOWERS & CONNECTIONS TO SWYD.
TAKE-OFF GANTRIES.

REV.	DATE	ALTD	CHD	APPD
06	06.10.17	AK	DKM	RS

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. STRINGING THROUGH ACC UPTO GT/ST INCLUDED.
2. LOCATION OF ISOLATOR & CVT IN SWYD. GT/ST BAYS TOWARDS ACC FINALIZED.
3. LOCATION OF 220kV DEAD END TOWER & LINE EQUIP. MARKED.

REV.	DATE	ALTD	CHD	APPD
05	17.01.17	AK	AK	RS

DRAWING REVISED TO INCORPORATE FOLLOWING:
400kV OUTDOOR CT LOCATION CHANGED AS PER REVISED SLD.
HOLD ON ICT AREA EQUIPMENT RELEASED.
400kV LINE SIDE EQUIPMENT LOCATION MARKED AS PER DEAD END TOWERS.
LOCATION OF CRB MATCHED WITH CIVIL FOUNDATION LAYOUT.

REV.	DATE	ALTD	CHD	APPD
04	12.12.16	AK	MM	AS

DRAWING REVISED TO INCORPORATE FOLLOWING:
400kV OUTDOOR CT ADDED IN LAYOUT ON HV SIDE OF ICT.

REV.	DATE	ALTD	CHD	APPD
02	11.08.15	AK	MM	AS

DRAWING REVISED TO INCORPORATE NTPC COMMENTS DATED 08.04.15.
REVISED CONTROL ROOM BUILDING DRAWING INCORPORATED.
PHASE SEQUENCE OF GT & ST BAYS MATCHED.

REFERENCE DRGS.

SN	NTPC Drg. No.	DESCRIPTION
1	4410-001-999-POC-F-001 (Rev-02)	PLOT PLAN
2	4410-001-572-PVE-P-0002 (Rev-02)	400/220kV SWITCHYARD SINGLE LINE DIAGRAM

NTPC DRG. No. 4410-001-572-PVE-F-0013

JOB NO.	83011
STATUS	CONTRACT
DISTRIBUTION TO	
NO. OF	

PROJECT: NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

QBTQM

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
TRANSMISSION BUSINESS GROUP
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN.	DM	-sd-	27.01.15
	DESN.	AK	-sd-	27.01.15
	CHD	MM	-sd-	27.01.15
	APPD	AS	-sd-	27.01.15

TITLE: LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END

DEPT. | SCALE | SIGN | DATE

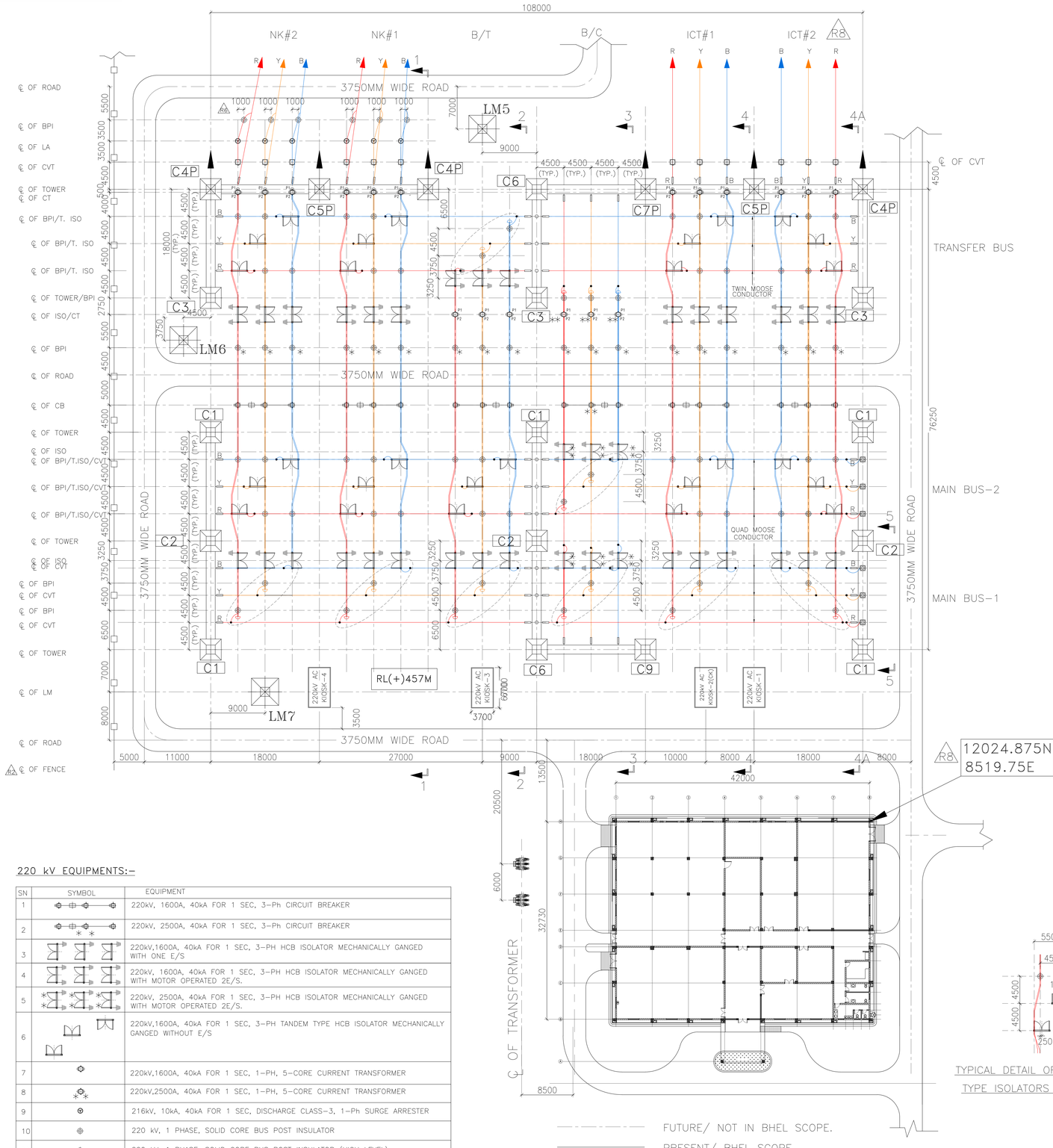
DRAWING NO. TB-0-369-318-002

SHEET 01 OF 06 REV. 08

FORMAT SIZE A0

DRAWING NO. TB-0-369-318-002

FIRST ANGLE PROJECTION | ALL DIMENSIONS ARE IN MM



220kV SYSTEM PARAMETERS

Sl.No.	DESCRIPTION OF PARAMETER	
1	SYSTEM OPERATING VOLTAGE	220kV
2	MAX. OPERATING VOLTAGE OF THE SYSTEM (rms)	245kV
3	RATED FREQUENCY	50Hz
4	NO. OF PHASES	3
5	RATED INSULATION LEVELS i) IMPULSE WITHSTAND VOLTAGE (1.2/50microsec.) ii) SWITCHING IMPULSE WITHSTAND VOLTAGE DRY & WET (250/2500microsec.) iii) ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE (rms)	±1050kVp – 460kV (rms)
7	MAX. RADIO INTERFERENCE VOLTAGE FOR FREQUENCY BETWEEN 0.5MHz & 2MHz AT 156KV rms	1000 micro V
8	MIN. CREEPAGE DISTANCE	25mm/kV (6125 mm)
9	MIN. CLEARANCE i) PHASE TO PHASE ii) PHASE TO EARTH iii) SECTIONAL CLEARANCE	2100mm 2100mm 5000mm
10	RATED SHORT CIRCUIT CURRENT FOR 1SEC DURATION	40kA
11	SYSTEM NEUTRAL EARTHING	EFFECTIVELY EARTHED
12	SUB CONDUCTOR SPACING	250MM
13	CONDUCTOR STATIC TENSION 220kV TWIN/ SINGLE 220kV QUAD	2T PER CONDUCTOR 1.5T PER CONDUCTOR

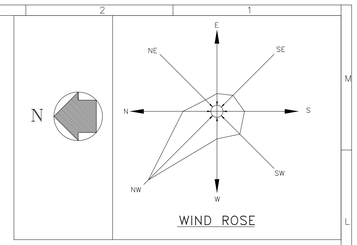
THIS DRG. SHALL BE READ IN CONJUNCTION WITH SLD.

220kV LEGEND:–

	TOWER WITH PEAK
	TOWER WITHOUT PEAK
	LIGHTNING MAST
	SINGLE SUSPENSION INSULATOR STRING (1X15 DISCS)
	DOUBLE TENSION INSULATOR STRING (2X15 DISCS)
	4" IPS AL. TUBE
	R–PHASE ACSR MOOSE CONDUCTOR
	Y–PHASE ACSR MOOSE CONDUCTOR
	B–PHASE ACSR MOOSE CONDUCTOR
	END CAP/CORONA BELL FOR BUSBAR
	SHIELD WIRE (10.98MMø)/ OPGW

CONDUCTOR & STRINGING DETAILS :–

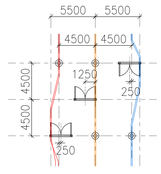
		220kV	
SL.NO.	DESCRIPTION	CONDUCTOR DETAIL	CONNECTION HEIGHT (ABOVE PLINTH LEVEL)
1.	EQUIPMENT INTERCONNECTION	4.0" IPS (EH) AL. TUBE	6 mtr.
2.	MAIN BUS	QUAD ACSR MOOSE CONDUCTOR	12 mtr.
3.	TRANSFER BUS	TWIN ACSR MOOSE CONDUCTOR	12 mtr.
4.	JACK BUS (BUS COUPLER BAY)	QUAD ACSR MOOSE CONDUCTOR	17 mtr.
5.	EARTHWIRE	OPGW/ 7/ 3.66mm SHIELD WIRE	25.5 mtr.
6.	DROPPER ON CVT, LA	SINGLE ACSR MOOSE CONDUCTOR	–
7.	DROPPER ON ISO	TWIN ACSR MOOSE CONDUCTOR	–
8.	DROPPER ON CT	QUAD ACSR MOOSE CONDUCTOR	–



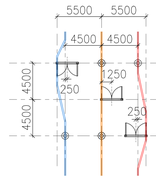
WIND ROSE

220 kV EQUIPMENTS:–

SN	SYMBOL	EQUIPMENT
1		220kV, 1600A, 40kA FOR 1 SEC, 3–Ph CIRCUIT BREAKER
2		220kV, 2500A, 40kA FOR 1 SEC, 3–Ph CIRCUIT BREAKER
3		220kV,1600A, 40kA FOR 1 SEC, 3–PH HCB ISOLATOR MECHANICALLY GANGED WITH ONE E/S
4		220kV, 1600A, 40kA FOR 1 SEC, 3–PH HCB ISOLATOR MECHANICALLY GANGED WITH MOTOR OPERATED 2E/S.
5		220kV, 2500A, 40kA FOR 1 SEC, 3–PH HCB ISOLATOR MECHANICALLY GANGED WITH MOTOR OPERATED 2E/S.
6		220kV,1600A, 40kA FOR 1 SEC, 3–PH TANDEM TYPE HCB ISOLATOR MECHANICALLY GANGED WITHOUT E/S
7		220kV,1600A, 40kA FOR 1 SEC, 1–PH, 5–CORE CURRENT TRANSFORMER
8		220kV,2500A, 40kA FOR 1 SEC, 1–PH, 5–CORE CURRENT TRANSFORMER
9		216kV, 10kA, 40kA FOR 1 SEC, DISCHARGE CLASS–3, 1–Ph SURGE ARRESTER
10		220 kV, 1 PHASE, SOLID CORE BUS POST INSULATOR
11		220 kV, 1 PHASE, SOLID CORE BUS POST INSULATOR (HIGH LEVEL)
12		220kV, 1–Ph, 5575pF CAPACITIVE VOLTAGE TRANSFORMER



TYPICAL DETAIL OF 3 PH. HCB TANDEM TYPE ISOLATORS EXCEPT ICT#2 BAY



TYPICAL DETAIL OF 3 PH. HCB TANDEM TYPE ISOLATORS FOR ICT#2 BAY
R8

FUTURE/ NOT IN BHEL SCOPE.

PRESENT/ BHEL SCOPE

INDICATES CONNECTION THROUGH DROPPERS

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL STRUCTURE/CONDUCTOR HEIGHTS ARE ABOVE PLINTH LEVEL. PLINTH LEVEL IS 300 MM ABOVE F.G.L.
3. TYPE OF GANTRY STRUCTURES SHALL BE AS PER APPROVED STRUCTURAL LAYOUT DRAWING.
4. SA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE/ ANY EQUIPMENT KEPT NEAR LIGHTING ARRESTER
5. REFER CONTROL ROOM BUILDING CIVIL DRAWINGS FOR DETAILS OF CRB.
6. LOCATION OF LM SHALL BE AS PER APPROVED DSLP LAYOUT.
7. LOCATION, SIZE & NUMBER OF AC KIOSKS IS SHALL BE AS PER THE APPROVED TRENCH & FOUNDATION LAYOUT DRAWING.

REFERENCE DRGS.

SN	NTPC Drg. No.	DESCRIPTION
1	4410–001–999–POC–F–001 (Rev–02)	PLOT PLAN
2	4410–001–572–PVE–P–0002 (Rev–02)	400/220kV SWITCHYARD SINGLE LINE DIAGRAM

NTPC DRG. No. 4410–001–572–PVE–F–0013

REV.	DATE	ALTD	CHD	APPD	VK
08	11.01.22	AK	AK	VK	

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. LAYOUT ARRANGEMENT OF ICT#2 BAYS (BOTH 400kV & 220kV) REVISED TO CHANGE PHASE SEQUENCE OF ICT#2 SIMILAR TO THAT OF ICT#1.
2. 400kV LINE CVT, 2 Ø–Ph WT SHIFTED BY 2M AS PER NTPC RECOMMENDATION.
3. TANDEM ISOLATOR DETAILS ADDED.

REV.	DATE	ALTD	CHD	APPD	VK
07	18.08.21	PK	AK	VK	

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. ICT#2 AND ASSOCIATED BAYS.
2. REVISED 400kV LINE TOWERS & CONNECTIONS TO SWTD. TAKE–OFF GANTRIES.

REV.	DATE	ALTD	CHD	APPD	DKM
06	06.10.17	AK	DKM	RS	

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. STRINGING THROUGH ACC UPTO GT/ST INCLUDED.
2. LOCATION OF ISOLATOR & CVT IN SWTD. GT/ST BAYS TOWARDS ACC FINALIZED.
3. LOCATION OF 220kV DEAD END TOWER & LINE EQUIP. MARKED.

REV.	DATE	ALTD	CHD	APPD	RS
05	17.01.17	AK	AK	RS	

DRAWING REVISED TO INCORPORATE FOLLOWING:
400kV OUTDOOR CT LOCATION CHANGED AS PER REVISED SLD.
HOLD ON ICT AREA EQUIPMENT RELEASED.
400kV LINE SIDE EQUIPMENT LOCATION MARKED AS PER DEAD END TOWERS.
LOCATION OF CRB MATCHED WITH CIVIL FOUNDATION LAYOUT.

REV.	DATE	ALTD	CHD	APPD	MM
04	12.12.16	AK	MM	AS	

DRAWING REVISED TO INCORPORATE FOLLOWING:
400kV OUTDOOR CT ADDED IN LAYOUT ON HV SIDE OF ICT.

REV.	DATE	ALTD	CHD	APPD	MM
02	11.08.15	AK	MM	AS	

DRAWING REVISED TO INCORPORATE NTPC COMMENTS DATED 08.04.15.
REVISED CONTROL ROOM BUILDING DRAWING INCORPORATED.
PHASE SEQUENCE OF GT & ST BAYS MATCHED.

JOB NO. 83011
STATUS CONTRACT
DISTRIBUTION
TO
No. OF

	DEPT CODE	NAME	SIGN	DATE
DRN	M	DM	-sd-	27.01.15
DES		AK	-sd-	27.01.15
CHD		MM	-sd-	27.01.15
APPD		AS	-sd-	27.01.15

PROJECT: NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)
OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)
OBTGM: BHARAT HEAVY ELECTRICALS LTD POWER SECTOR TRANSMISSION BUSINESS GROUP NOIDA

TITLE: LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END

DEPT. | SCALE | DRAWING NO. TB–0–369–318–002
SIGN | DATE
SHEET 02 OF 06 REV. 08

FORMAT: SIZE A0

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

ELECTRONIC FILE NAME:

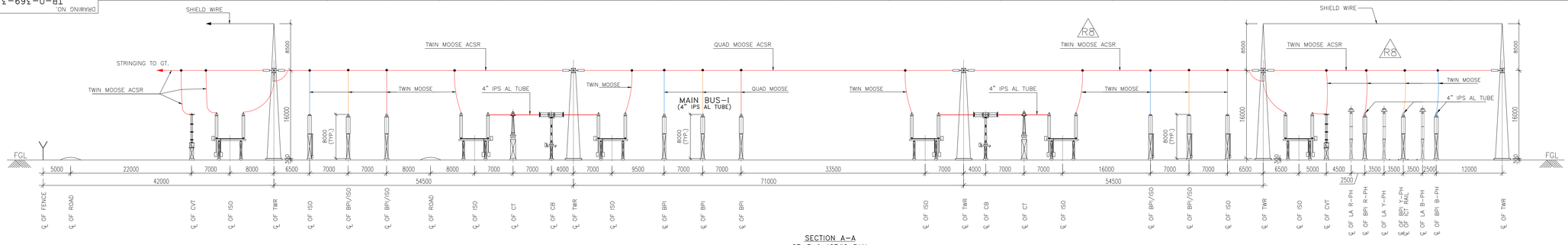
DRAWING NO. TB-0-369-318-002

FIRST ANGLE PROJECTION

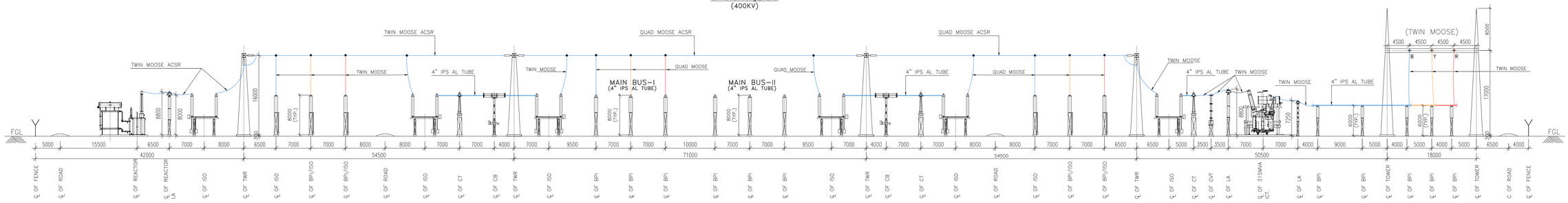
ALL DIMENSIONS ARE IN MM

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

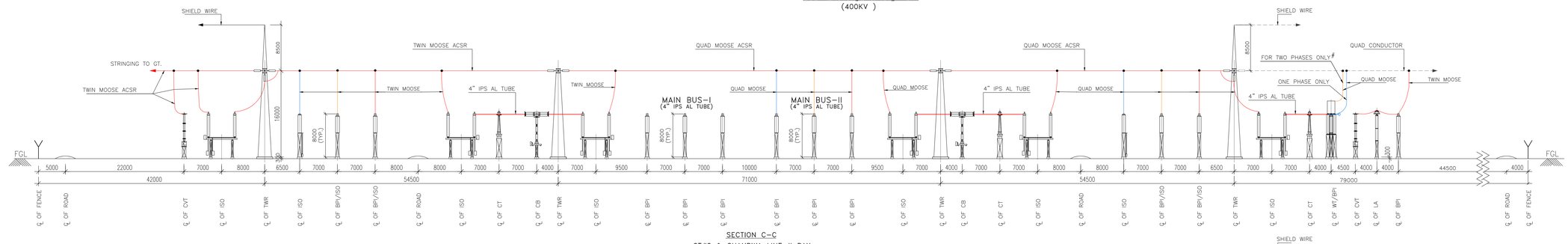
ELECTRONIC FILE NAME:



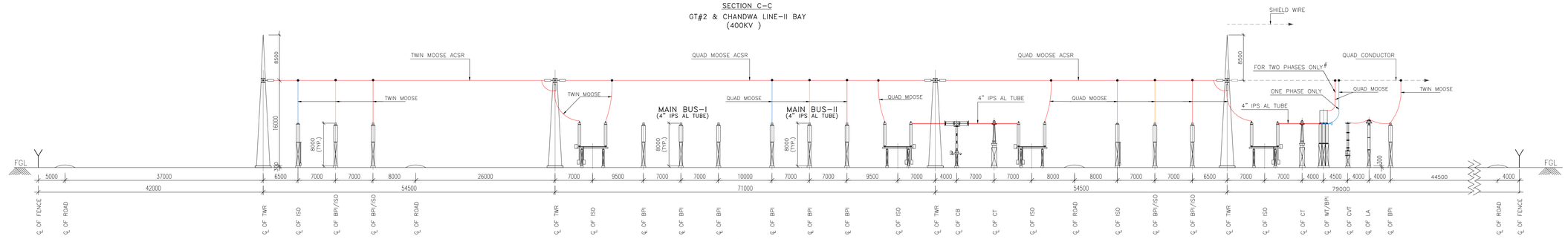
SECTION A–A
GT–3 & ICT#2 BAY
(400KV)



SECTION B–B
BUS REACTOR#2 & ICT#1 BAY
(400KV)

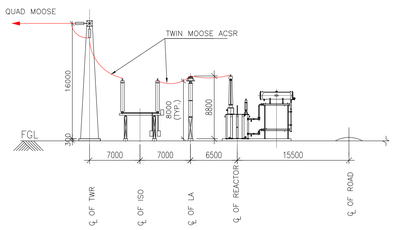


SECTION C–C
GT#2 & CHANDWA LINE–II BAY
(400KV)

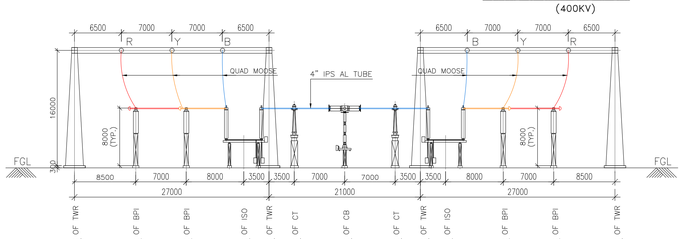


SECTION D–D
FUTURE & GAYA LINE–II BAY
(400KV)

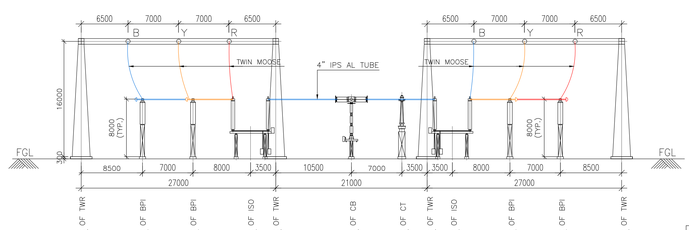
TYPICAL PLINTH LEVEL



SECTION E–E
400KV REACTOR



SECTION F–F
ICT–1 & CHANDWA LINE–II TIE BAY
(400KV)



SECTION G–G
ST–2 & FUTURE TIE BAY
(400KV)

LEGENDS:–

NOT IN BHEL SCOPE

BHEL SCOPE

NOTES:–

1. FGL OF SWICHYARD IS RL(+)457M.
2. ALL HEIGHTS ARE WITH RESPECT TO PLINTH LEVEL UNLESS OTHERWISE SPECIFIED.
3. # – WAVE TRAP PHASES SHALL BE PROVIDED BY NTPC.

REFERENCE DRGS.

SN	NTPC Drg. No.	DESCRIPTION
1		
2		

REV.	DATE	ALTD	CHD	APPD	DESCRIPTION
08	11.01.22	AK	AK	VK	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. LAYOUT ARRANGEMENT OF ICT#2 BAYS (400KV, 400MVA, 220kV) REVISED TO INCORPORATE SUBSEQUENT ICT#2 SIMILAR TO THAT OF ICT#1. 2. CHANDWA LINE–2 R–PH WT SHIFTED BY 2M AS PER NTPC RECOMMENDATION.
07	18.08.21	PK	AK	VK	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. ICT#2 AND ASSOCIATED BAYS. 2. REVISED 400kV LINE TOWERS & CONNECTIONS TO DAYD. TAKE–OFF GANTRIES.
06	06.10.17	AK	DKM	RS	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. STRINGING THROUGH ACC UPTO GT/ST INCLUDED. 2. LOCATION OF ISOLATOR & CVT IN SWYD. GT/ST BAYS TOWARDS ACC FINALIZED. 3. LOCATION OF 220kV DEAD END TOWER & LINE EQUIP. MARKED.
05	17.01.17	AK	AK	RS	DRAWING REVISED TO INCORPORATE FOLLOWING: 400kV OUTDOOR CT LOCATION CHANGED AS PER REVISED SLD. HOLD ON ICT AREA EQUIPMENT RELEASED. 400kV LINE SIDE EQUIPMENT LOCATION MARKED AS PER DEAD END TOWERS. LOCATION OF CRB MATCHED WITH CIVIL FOUNDATION LAYOUT.
04	12.12.16	AK	MM	AS	DRAWING REVISED TO INCORPORATE FOLLOWING: 400kV OUTDOOR CT ADDED IN LAYOUT ON HV SIDE OF ICT.

JOB NO.	83011
STATUS	CONTRACT
DISTRIBUTION	
TO	
No. OF	

PROJECT	NTPC DRG. No. 4410–001–572–PVE–F–0013 NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)
OWNER	NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)
QBTQM	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR TRANSMISSION BUSINESS GROUP NOIDA

DEPT		NAME	SIGN	DATE
CODE	DRN	DM	–sd–	27.01.15
M	DESN	AK	–sd–	27.01.15
	CHD	MM	–sd–	27.01.15
	APPD	AS	–sd–	27.01.15

TITLE: LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END

DEPT. SCALE

SIGN

DATE

DRAWING NO. TB–0–369–318–002

SHEET 03 OF 06 REV. 08

FORMAT SIZE A0

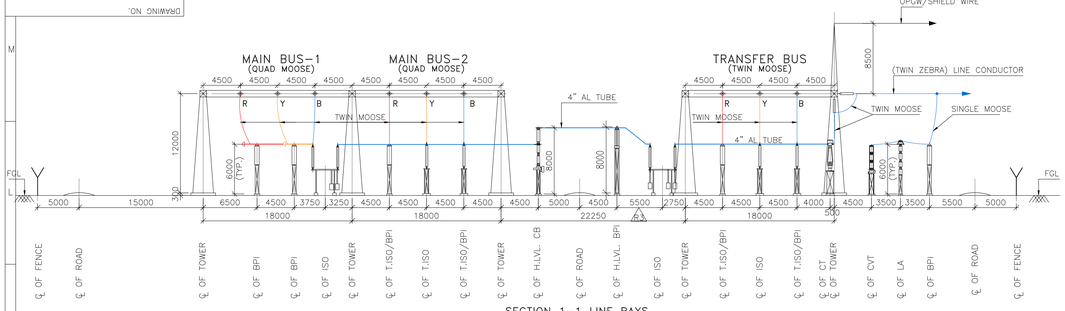
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

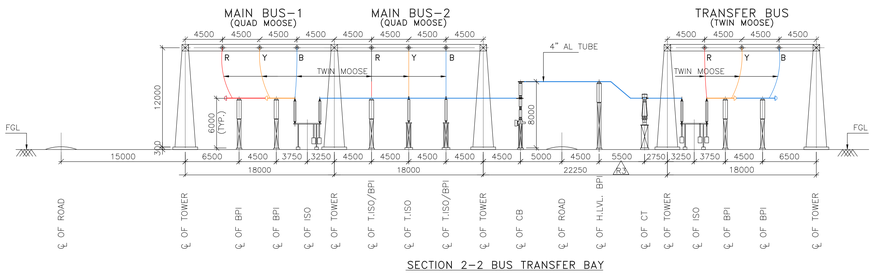
DRAWING NO.

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

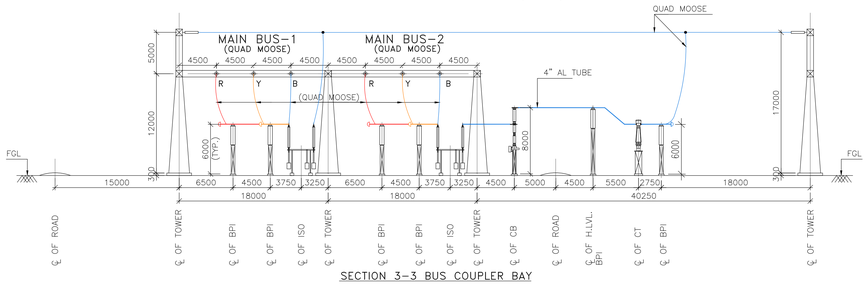
ELECTRONIC FILE NAME:



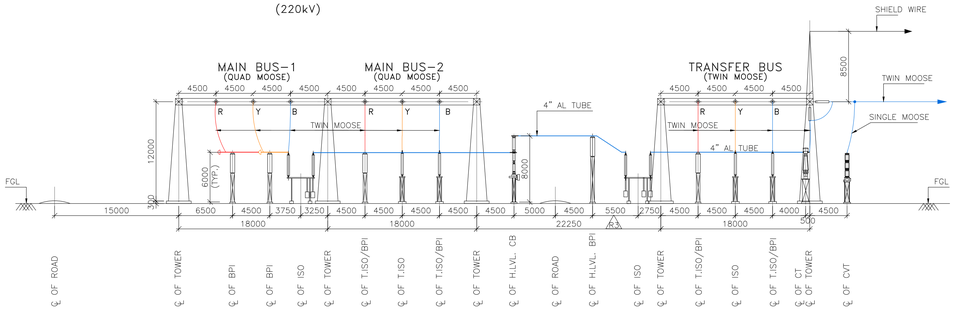
SECTION 1-1 LINE BAYS
(220kV)



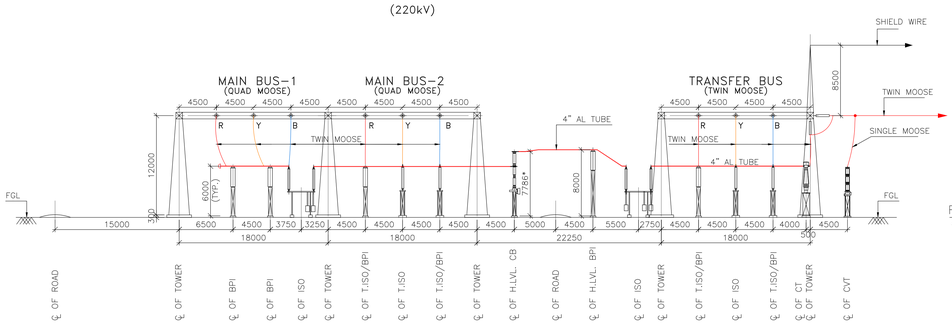
SECTION 2-2 BUS TRANSFER BAY
(220kV)



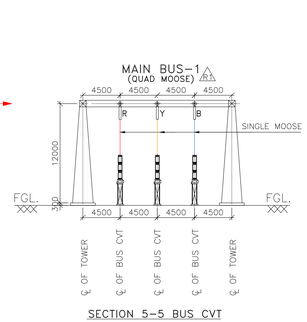
SECTION 3-3 BUS COUPLER BAY
(220kV)



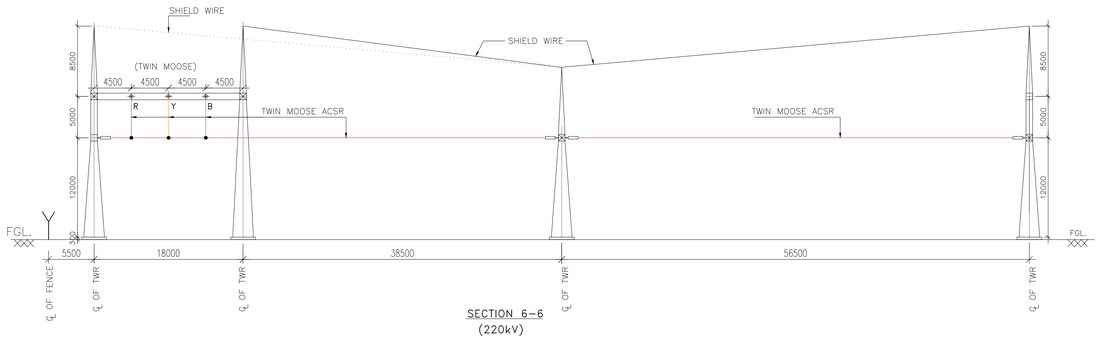
SECTION 4-4 ICT#1 & ICT#2 BAYS
(220kV)



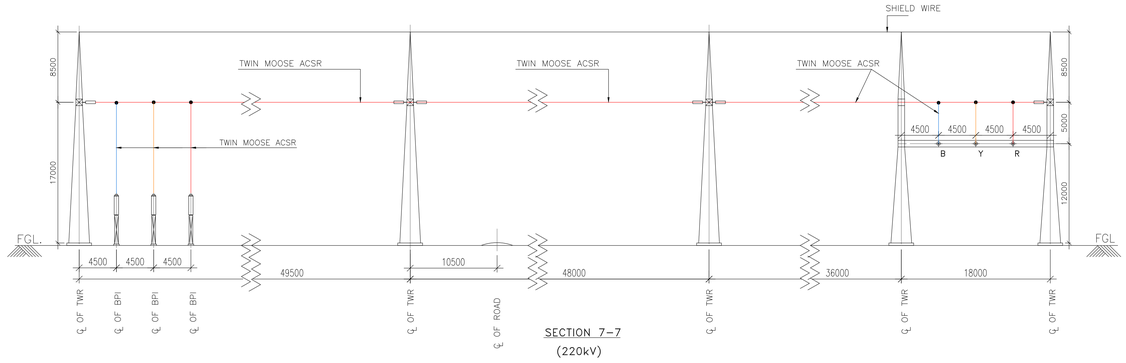
SECTION 4A-4A ICT#2 BAY
(220kV) R8



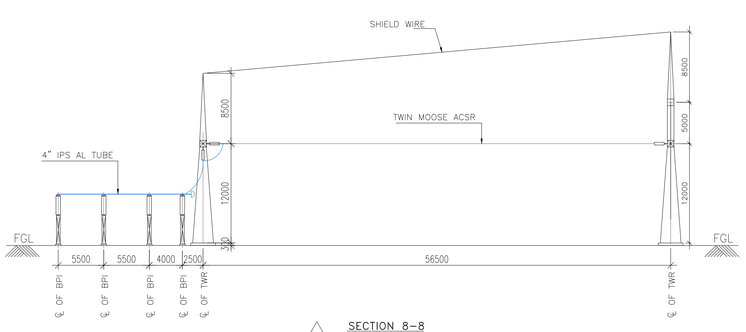
SECTION 5-5 BUS CVT
(220kV)



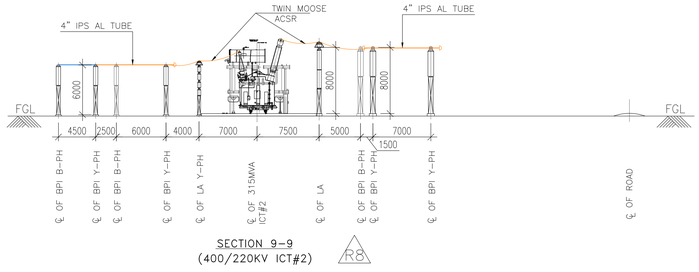
SECTION 6-6
(220kV)



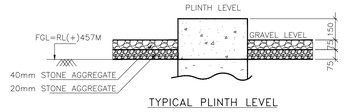
SECTION 7-7
(220kV)



SECTION 8-8
(220kV) R8



SECTION 9-9
(400/220KV ICT#2)



TYPICAL PLINTH LEVEL

LEGENDS:-

NOT IN BHEL SCOPE

BHEL SCOPE

NOTES:-

1. FGL OF SWICHYARD IS RL(+)457M.
2. ALL HEIGHTS ARE WITH RESPECT TO PLINTH LEVEL UNLESS OTHERWISE SPECIFIED.
3. "*" - HEIGHT OF 220kV CIRCUIT BREAKER SHALL BE AS PER THE APPROVED VENDOR DRAWING.

REFERENCE DRGS.

SN	NTPC Drg. No.	DESCRIPTION
1		
2		

NTPC DRG. No. 4410-001-572-PVE-F-0013

REV.	DATE	ALTD	CHD	APPD	DESCRIPTION
08	11.01.22	AK	AK	VK	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. LAYOUT ARRANGEMENT OF ICT#2 BAYS (BOTH 400kV & 220kV) REVISED TO CHANGE PHASE SEQUENCE OF ICT#2 SIMILAR TO THAT OF ICT#1. 2. CHANDWA LINE-2 R-PH WT SHIFTED BY 2M AS PER NTPC RECOMMENDATION.
07	18.08.21	PK	AK	VK	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. ICT#2 AND ASSOCIATED BAYS. 2. REVISED 400kV LINE TOWERS & CONNECTIONS TO SWYD. TAKE-OFF GANTRIES.
06	06.10.17	AK	DKM	RS	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. STRINGING THROUGH ACC UPTO GT/ST INCLUDED. 2. LOCATION OF ISOLATOR & CVT IN SWYD, GT/ST BAYS TOWARDS ACC FINALIZED. 3. LOCATION OF 220kV DEAD END TOWER & LINE EQUIP. MARKED.
05	17.01.17	AK	AK	RS	DRAWING REVISED TO INCORPORATE FOLLOWING: 400kV OUTDOOR CT LOCATION CHANGED AS PER REVISED SLD. HOLD ON ICT AREA EQUIPMENT RELEASED. 400kV LINE SIDE EQUIPMENT LOCATION MARKED AS PER DEAD END TOWERS. LOCATION OF CRB MATCHED WITH CIVIL FOUNDATION LAYOUT.
04	12.12.16	AK	MM	AS	DRAWING REVISED TO INCORPORATE FOLLOWING: 400kV OUTDOOR CT ADDED IN LAYOUT ON HV SIDE OF ICT.

JOB NO.	83011
STATUS	CONTRACT
DISTRIBUTION	
TO	
No. OF	

PROJECT: NORTH KARANPURA
SUPER THERMAL POWER PROJECT (3x660MW)

OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

QBTQM

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
TRANSMISSION BUSINESS GROUP
NOIDA

DEPT		NAME	SIGN	DATE
CODE	DRN	DM	-sd-	27.01.15
M	DCSN	AK	-sd-	27.01.15
	CHD	MM	-sd-	27.01.15
	APPD	AS	-sd-	27.01.15

TITLE: LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END

DEPT. SCALE

SIGN

DATE

DRAWING NO. TB-0-369-318-002

SHEET 04 OF 06 REV. 08

FORMAT SIZE A0

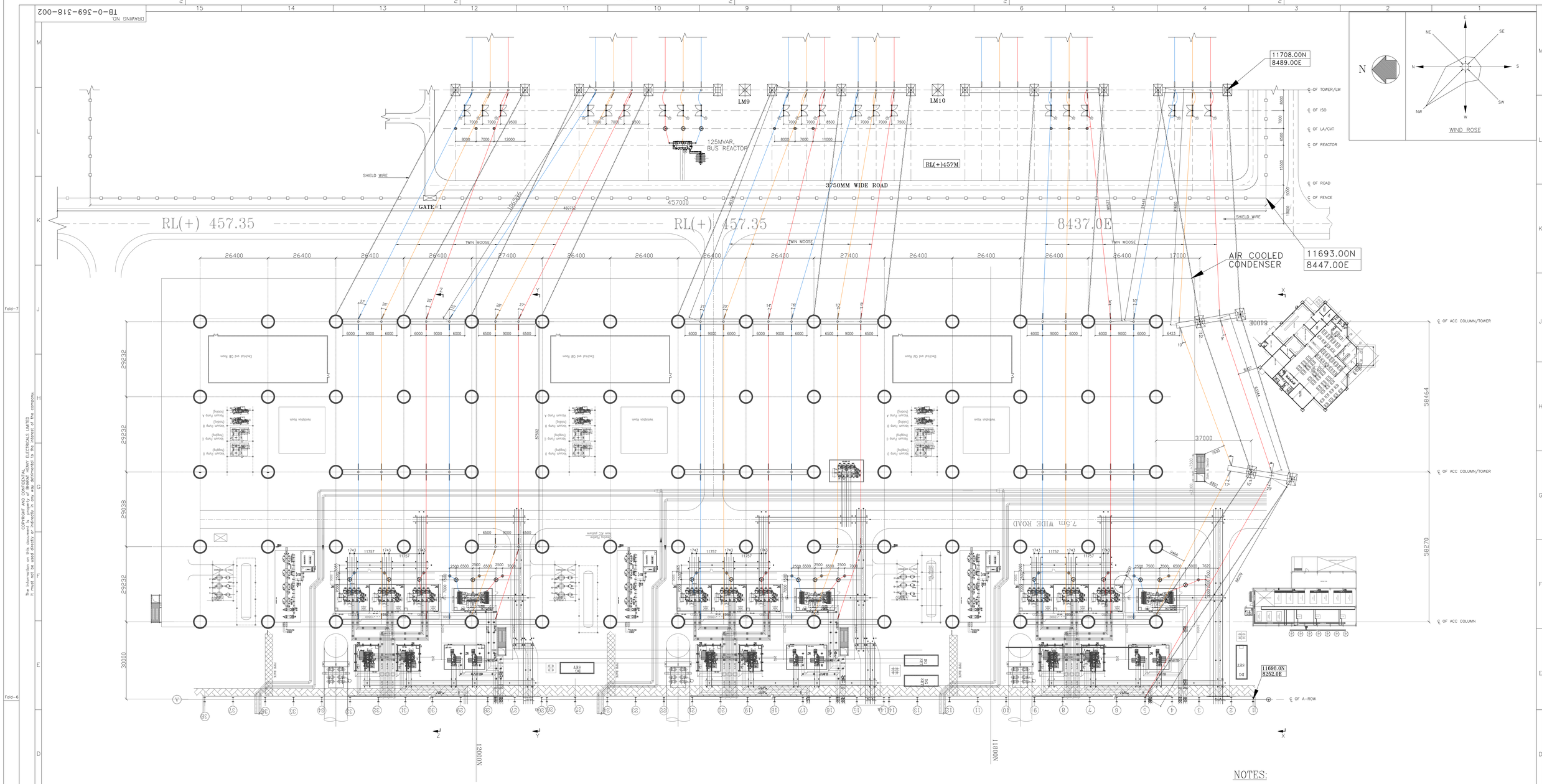
DRAWING NO. TB-0-369-318-002

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

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

ELECTRONIC FILE NAME:



400 kV EQUIPMENTS:–

SYMBOL	EQUIPMENT
	336 kV, 20kA, 50kA FOR I SEC, DISCHARGE CLASS–4, 1–PH SURGE ARRESTER
	400 kV, 1 PHASE, SOLID CORE BUS POST INSULATOR

CONDUCTOR & STRINGING DETAILS :–

		400kV	
SL.NO.	DESCRIPTION	CONDUCTOR DETAIL	CONNECTION HEIGHT (ABOVE TRANSFORMER YARD FGL)
1.	STRINGING FROM SWYD. TO GT/ST	TWIN ACSR MOOSE CONDUCTOR	25 mtr.
2.	EARTHWIRE	7/3.66mm SHIELD WIRE	33.5 mtr.
3.	DROPPER ON BPI, LA & GT/ST	TWIN ACSR MOOSE CONDUCTOR	–

400kV LEGEND:–

	TOWER WITH PEAK
	SUSPENSION INSULATOR STRING (1X25 DISCS)
	DOUBLE TENSION INSULATOR STRING (2X25 DISCS)
	R–PHASE ACSR MOOSE CONDUCTOR
	Y–PHASE ACSR MOOSE CONDUCTOR
	B–PHASE ACSR MOOSE CONDUCTOR
	SHIELD WIRE (10.98MM²)

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. TYPE OF GANTRY STRUCTURES SHALL BE AS PER APPROVED STRUCTURAL LAYOUT DRAWING.
3. SA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE / ANY EQUIPMENT KEPT NEAR LIGHTING ARRESTER AND BHEL SHALL ENSURE THE SAME DURING ERECTION AT SITE.
4. FOR SECTION DETAILS REFER SHEET No. 06.
5. THIS DRAWING IS MEANT ONLY TO REFER THE STRINING FROM SWITCHYARD UPTO GT/ST THROUGH ACC & LOCATION OF LA, BPI & TOWERS. DETAILS OF TRANSFORMER YARD & AIR COOLED CONDENSER SHALL BE REFERRED FROM SEPARATE DRAWINGS.
   4410–001–200–PGE–F–001 LAYOUT OF TRANSFORMER YARD
   4410–001–110–PVM–B–022A AIR COOLED CONDENSER GA
6. NECESSARY INSERTS/EMBEDMENTS FOR FIXING OF BEAMS/CONDUCTOR AND SHIELD WIRE SHALL BE PROVIDED ON ACC COLUMNS BY ACC VENDOR.

REFERENCE DRGS.

SN	NTPC Drg. No.	DESCRIPTION
1	4410–001–999–POC–F–001 (Rev–02)	PLOT PLAN
2	4410–001–572–PVE–P–0002 (Rev–02)	400/220kV SWITCHYARD SINGLE LINE DIAGRAM

NTPC DRG. No. 4410–001–572–PVE–F–0013

REV.	DATE	ALTD	CHD	APPD	REMARKS
08	11.01.22	AK	VK		DRAWING REVISED TO INCORPORATE FOLLOWING: 1. LAYOUT ARRANGEMENT OF ICT#2 BAYS (BOTH 400kV & 220kV) REVISED TO CHANGE PHASE SEQUENCE OF ICT#2 SIMILAR TO THAT OF ICT#1. 2. CHANDWA LINE–2 R–PH WT SHIFTED BY 2M AS PER NTPC RECOMMENDATION.
07	18.08.21	PK	AK	VK	DRAWING REVISED TO INCORPORATE FOLLOWING. 1. ICT#2 AND ASSOCIATED BAYS. 2. REVISED 400kV LINE TOWERS & CONNECTIONS TO SWYD. TAKE–OFF GANTRIES.
06	18.08.21	AK	DKM	RS	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. STRINGING THROUGH ACC UPTO GT/ST INCLUDED. 2. LOCATION OF ISOLATOR & CVT IN SWYD. GT/ST BAYS TOWARDS ACC FINALIZED. 3. LOCATION OF 220kV DEAD END TOWER & LINE EQUIP. MARKED.
05	17.01.17			RS	DRAWING REVISED TO INCORPORATE FOLLOWING: 400kV OUTDOOR CT LOCATION CHANGED AS PER REVISED SLD. HOLD ON ICT AREA EQUIPMENT RELEASED. 400kV LINE SIDE EQUIPMENT LOCATION MARKED AS PER DEAD END TOWERS. LOCATION OF CRB MATCHED WITH CIVIL FOUNDATION LAYOUT.
04	12.12.16	AK	MM	AS	DRAWING REVISED TO INCORPORATE FOLLOWING: 400kV OUTDOOR CT ADDED IN LAYOUT ON HV SIDE OF ICT.
03					DRAWING REVISED TO INCORPORATE NTPC COMMENTS DATED 08.04.15. REVISED CONTROL ROOM BUILDING DRAWING INCORPORATED. PHASE SEQUENCE OF GT & ST BAYS MATCHED.
02	11.08.15	AK	MM	AS	
01					

JOB NO. 83011
STATUS CONTRACT
DISTRIBUTION
TO
No. OF

PROJECT: NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

QBTGM

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
TRANSMISSION BUSINESS GROUP
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	DM	–sd–	27.01.15
	DESN	AK	–sd–	27.01.15
	CHD	MM	–sd–	27.01.15
	APPD	AS	–sd–	27.01.15

TITLE: LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END

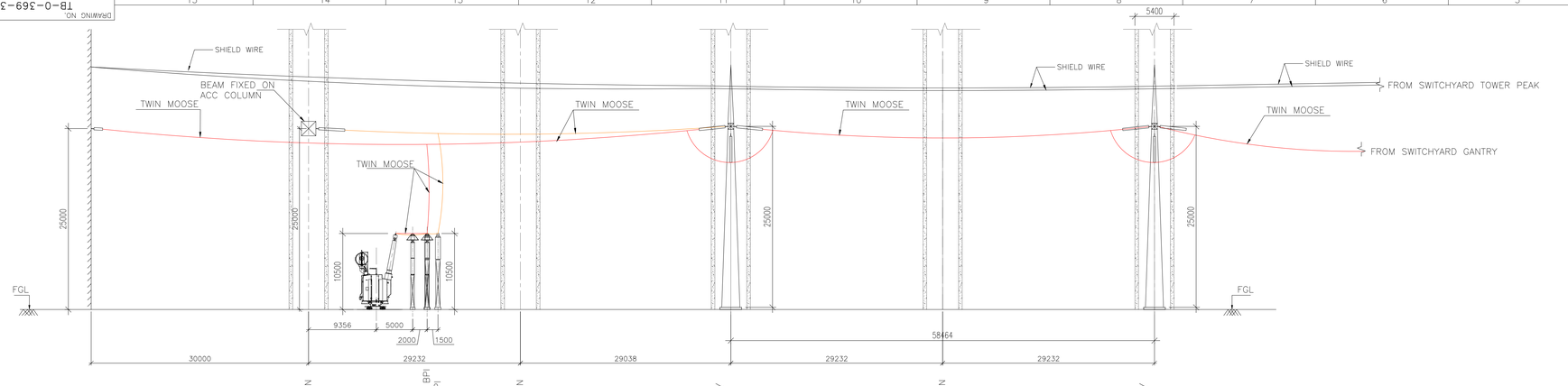
DEPT. SCALE
SIGN
DATE

DRAWING NO. TB–0–369–318–002

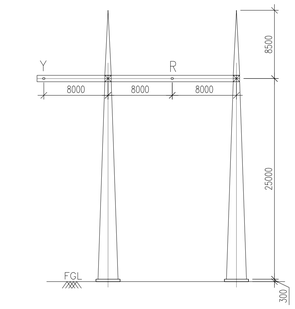
SHEET 05 OF 06 REV. 08

FORMAT SIZE A0

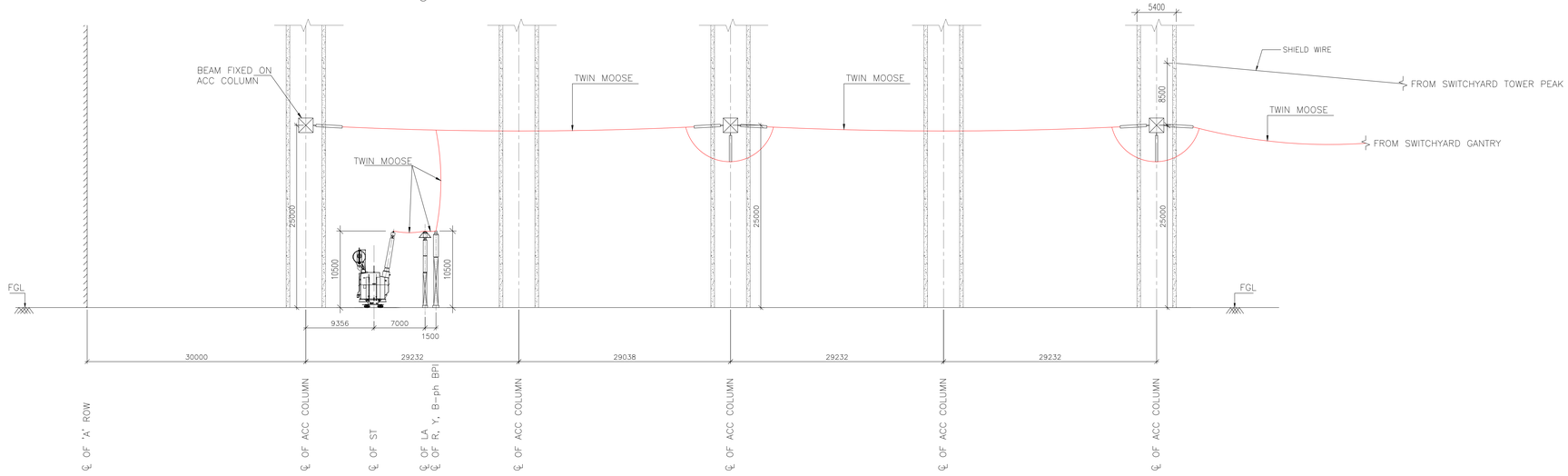
DRAWING NO. TB-0-369-318-002



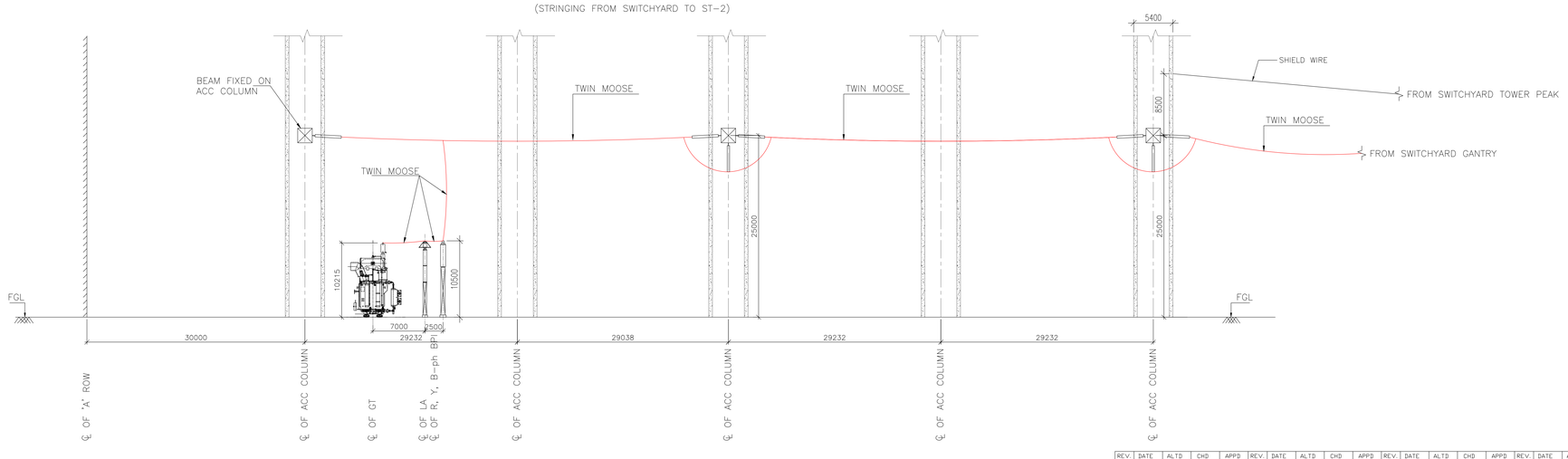
SECTION X-X
(STRINGING FROM SWITCHYARD TO ST-1)



TYP. SECTION OF 400KV INTERMIDIATE GANTRY TOWER (DETAIL-X)



SECTION Y-Y
(STRINGING FROM SWITCHYARD TO ST-2)



SECTION X-X
(STRINGING FROM SWITCHYARD TO GT-3)

NOTES:-

1. FGL OF TRANSFORMER YARD MAY BE REFERED FROM TRANSFORMER YARD LAYOUT.

REFERENCE DRGS.

SN	NTPC Drg. No.	DESCRIPTION
1	4410-001-110-PVM-B-022A	AIR COOLED CONDENSER GA
2	4410-001-200-PGE-F-001	LAYOUT OF TRANSFORMER YARD

NTPC DRG. No. 4410-001-572-PVE-F-0013

REV.	DATE	ALTD	CHD	APPD
08	11.01.22	AK	AK	VK

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. LAYOUT ARRANGEMENT OF ICT#2 BAYS (BOTH 400kV & 220kV) REVISED TO CHANGE PHASE SEQUENCE OF ICT#2 SIMILAR TO THAT OF ICT#1.
2. CHANDWA LINE-2 R-PH AT SHIFTED BY 2M AS PER NTPC RECOMMENDATION.

REV.	DATE	ALTD	CHD	APPD
07	18.08.21	PK	AK	VK

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. ICT#2 AND ASSOCIATED BAYS.
2. REVISED 400kV LINE TOWERS & CONNECTIONS TO SWYD. TAKE-OFF GANTRIES.

REV.	DATE	ALTD	CHD	APPD
06	06.10.17	AK	DKM	RS

DRAWING REVISED TO INCORPORATE FOLLOWING:
1. STRINGING THROUGH ACC UPTO GT/ST INCLUDED.
2. LOCATION OF ISOLATOR & CVT IN SWYD. GT/ST BAYS TOWARDS ACC FINALIZED.

REV.	DATE	ALTD	CHD	APPD
05	17.01.17	AK	AK	RS

DRAWING REVISED TO INCORPORATE FOLLOWING:
400kV OUTDOOR CT LOCATION CHANGED AS PER REVISED SLD.
HOLD ON ICT AREA EQUIPMENT RELEASED.
400kV LINE SIDE EQUIPMENT LOCATION MARKED AS PER DEAD END TOWERS.
LOCATION OF CRB MATCHED WITH CIVIL FOUNDATION LAYOUT.

REV.	DATE	ALTD	CHD	APPD
04	12.12.16	AK	MM	AS

DRAWING REVISED TO INCORPORATE FOLLOWING:
400kV OUTDOOR CT ADDED IN LAYOUT ON HV SIDE OF ICT.

JOB NO. 83011
STATUS CONTRACT
DISTRIBUTION
TO
No. OF

PROJECT: NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)
OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)
QBTGM

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
TRANSMISSION BUSINESS GROUP
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	DM	-sd-	27.01.15
	DESN	AK	-sd-	27.01.15
	CHD	MM	-sd-	27.01.15
	APPD	AS	-sd-	27.01.15

TITLE: LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END

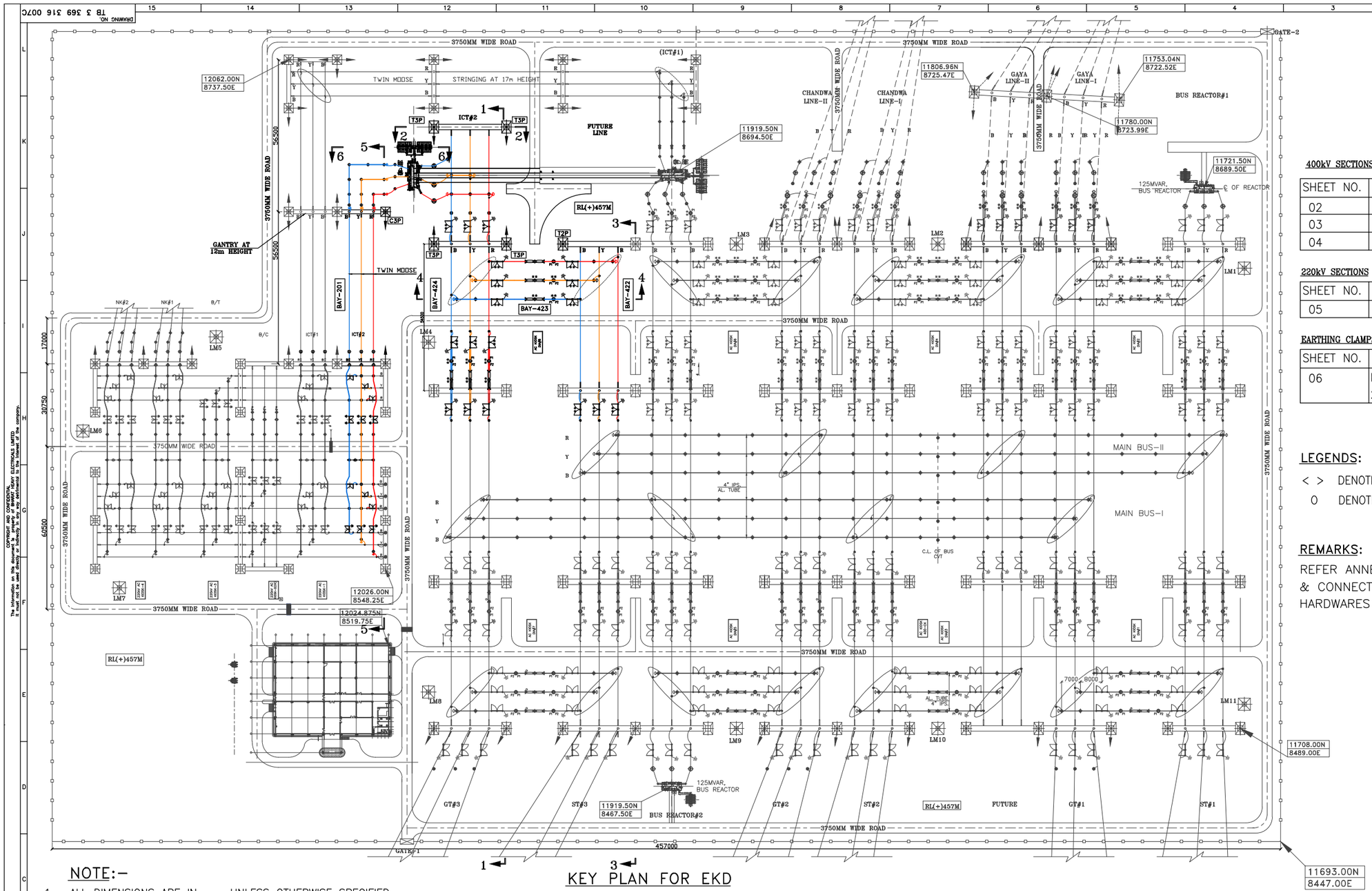
DEPT. | SCALE | DRAWING NO. TB-0-369-318-002
SIGN | DATE | SHEET 06 OF 06 | REV. 08

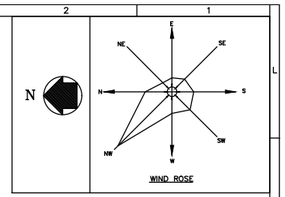
FORMAT SIZE A0

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

ELECTRONIC FILE NAME:

DRAWING NO. TB 3 369 316 007C





400kV SECTIONS

SHEET NO.	SECTION	BAY NO.
02	1–1, 2–2	424
03	3–3	422
04	4–4	423

220kV SECTIONS

SHEET NO.	SECTION	BAY NO.
05	5–5, 6–6	201

EARTHING CLAMPS

SHEET NO.	SECTION
06	EARTH CLAMPS FOR 400kV & 220kV TOWERS

LEGENDS:

< > DENOTES AL. TUBE CUT-LENGTH

0 DENOTES EQUIPMENT IDENTIFICATION NOS.

REMARKS:

REFER ANNEXURE-1 FOR BOQ OF CLAMPS & CONNECTOR INCLUDING STRING HARDWARES

KEY PLAN FOR EKD

NOTE:-

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. RIGID/FLEXIBLE SPACERS WILL BE PROVIDED AS SPECIFIED.
3. ALL THE JUMPERS SHALL BE ALLOWED TO TAKE NATURAL CATENARY WITHOUT ANY ADDITIONAL PULL. JUMPERS SHALL BE SHORTEST POSSIBLE SO THAT PHASE TO EARTH CLEARANCE SHALL BE MAINTAINED FOR ALL THE
4. IF THERE ARE 2 OR 3 SHIELD WIRE TERMINATING ON PEAK TOWER THEN THREE WAY P.G. CLAMP SHALL BE USED FOR INTERCONNECTION.
5. SHIELD WIRE CUT LENGTH SHALL BE TAKEN SUCH THAT STARTING FROM BOTTOM OF ONE PEAK TOWER – TENSION CLAMP OF BOTH PEAK TOWER – TERMINATING TO BOTTOM OF OTHER PEAK TOWER/UP TO P.G. CLAMP OF OTHER TOWER.
6. FOR EXPANSION/EXPANSION, RIGID/EXPANSION, RIGID/RIGID TYPE CONNECTOR SUITABLE FOR AL. TUBE, BREAK IN AL TUBE SHALL BE PROVIDED AT THE CONNECTOR.
7. CUSTOMER SHALL TERMINATE 400kV LINES WITH TENSION INSULATORS.
8. UNLESS OTHERWISE SPECIFIED FLEXIBLE CONDUCTOR SHALL BE CONTINUOUSLY STRUNG BETWEEN MULTIPLE SPANS.
9. SEPARATE DRAWINGS TO BE REFERRED FOR REST OF SWITCHYARD EKD (NTPC DRG. NO. 4410-001-572-PVE-F-0013).

REF. DWG.

LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END	–	4410-001-572-PVE-F-0013
400/220kV SWITCHYARD SINGLE LINE DIAGRAM	–	4410-001-572-PVE-P-0002
400/220kV-EKD-PLAN, SECTION & BOM AT NKSTPP END	–	4410-001-572-PVE-F-0023

REV.	DATE	ALTD	CHD	APPD

NTPC DRG. No. 4410-001-572-PVE-F-0023A

PROJECT: NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

QSTOM

BHARAT HEAVY ELECTRICALS LTD POWER SECTOR TRANSMISSION BUSINESS GROUP NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DSN	PK		03.03.22
	DESN	AK		08.03.22
	CHD	DKS		10.03.22
	APPD	YK		10.03.22

JOB NO. 83011
STATUS CONTRACT
DISTRIBUTION
TQ
No. OF

TITLE: 400/220kV – EKD – ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

DEPT. SCALE

DRAWING NO. TB 3 369 316 007C

SIGN

DATE

SHEET 01 OF 06 REV. 00

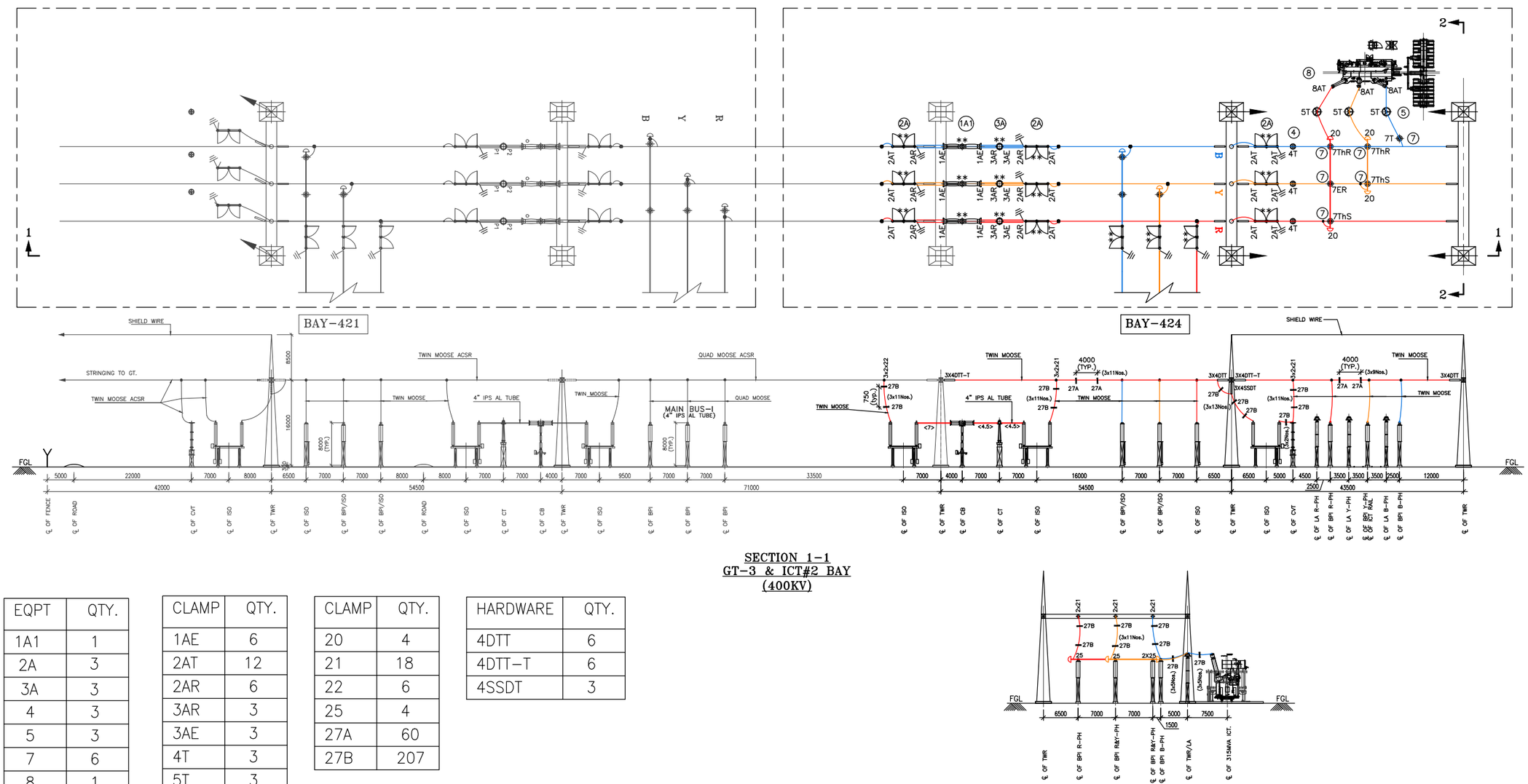
COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be lent, reproduced or disclosed to third parties without its consent.

ELECTRONIC FILE NAME:

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB 3 369 316 007C

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



SECTION 1-1
GT-3 & ICT#2 BAY
(400KV)

EQPT	QTY.
1A1	1
2A	3
3A	3
4	3
5	3
7	6
8	1

CLAMP	QTY.
1AE	6
2AT	12
2AR	6
3AR	3
3AE	3
4T	3
5T	3
7ThR	2
7ThS	2
7ER	1
7T	1
8AT	3

CLAMP	QTY.
20	4
21	18
22	6
25	4
27A	60
27B	207

HARDWARE	QTY.
4DTT	6
4DTT-T	6
4SSDT	3

SECTION 2-2

COMPUTER DRG. PATH NAME :

REF. DRG. No.

SIGN. & DATE

INVENTORY No.

ADDITIONAL INFORMATION
W.O.No. 83011

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

NTPC DRAWING. NO. 4410-001-572-PVE-F-0023A

ग्राहक/परियोजना का नाम NORTH KARANPURA STPP (3X660MW)

NAME OF CUSTOMER/PROJECT NTPC LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

	NAME	SIGN.	DATE
DRAWN	PK		03.03.22
CHECKED	AK		09.03.22
APPROVED	DKS		10.03.22

REV.	DATE	ALTERED / CHECKED / APPROVED

ZONE

DEPT.

CODE

SCALE 1 : 460

CARD CODE

TITLE
400/220kV – EKD – ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

DRAWING NO. TB 3 369 316 007C

REV. 00

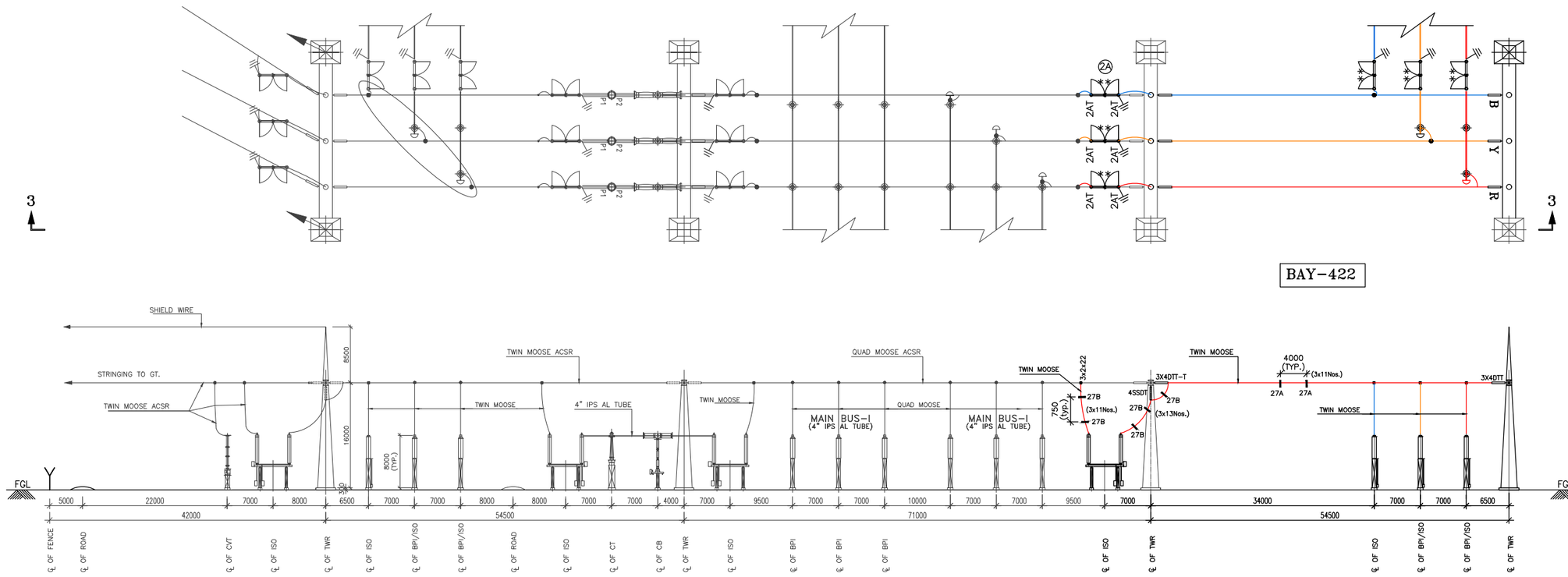
SHEET No. 02 OF 06

891199/2022/TBG-TBG_ENGG

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB 3 369 316 007C

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



SECTION 2–2
ST#3 & FUTURE LINE BAY

EQPT	QTY.
2A	1

CLAMP	QTY.
2AT	6

CLAMP	QTY.
20	4
22	6
27A	33
27B	72
29	9

HARDWARE	QTY.
4DTT	6
4DTT–T	6
4SSDT	3

COMPUTER DRG. PATH NAME :

REF. DRG. No.

SIGN. & DATE

INVENTORY No.

ADDITIONAL INFORMATION
W.O.No. 83011

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

REV.	DATE	
		ALTERED
		CHECKED
		APPROVED

ZONE

NTPC DRAWING. NO. 4410–001–572–PVE–F–0023A

ग्राहक/परियोजना का नाम NORTH KARANPURA STPP (3X660MW)
NAME OF CUSTOMER/PROJECT NTPC LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

	NAME	SIGN.	DATE
DRAWN	PK		03.03.22
CHECKED	AK		09.03.22
APPROVED	DKS		10.03.22

DEPT.
CODE
SCALE 1 : 460
CARD CODE

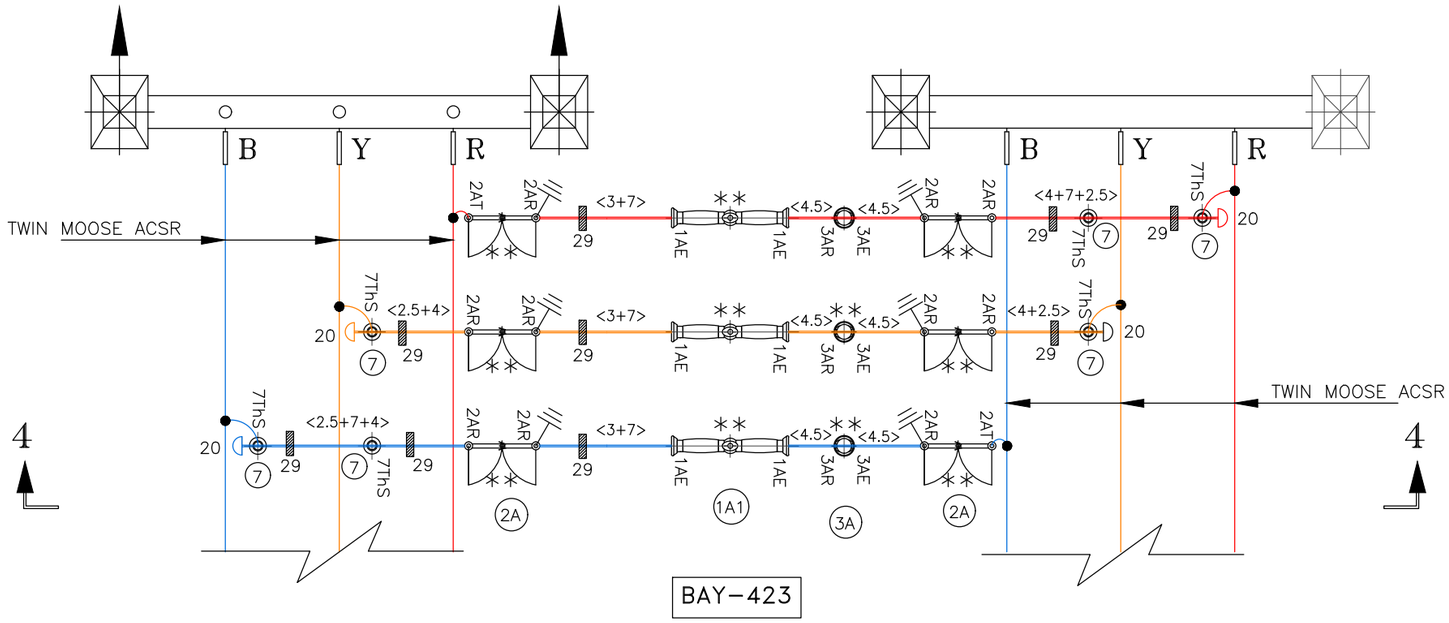
TITLE
400/220kV – EKD – ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

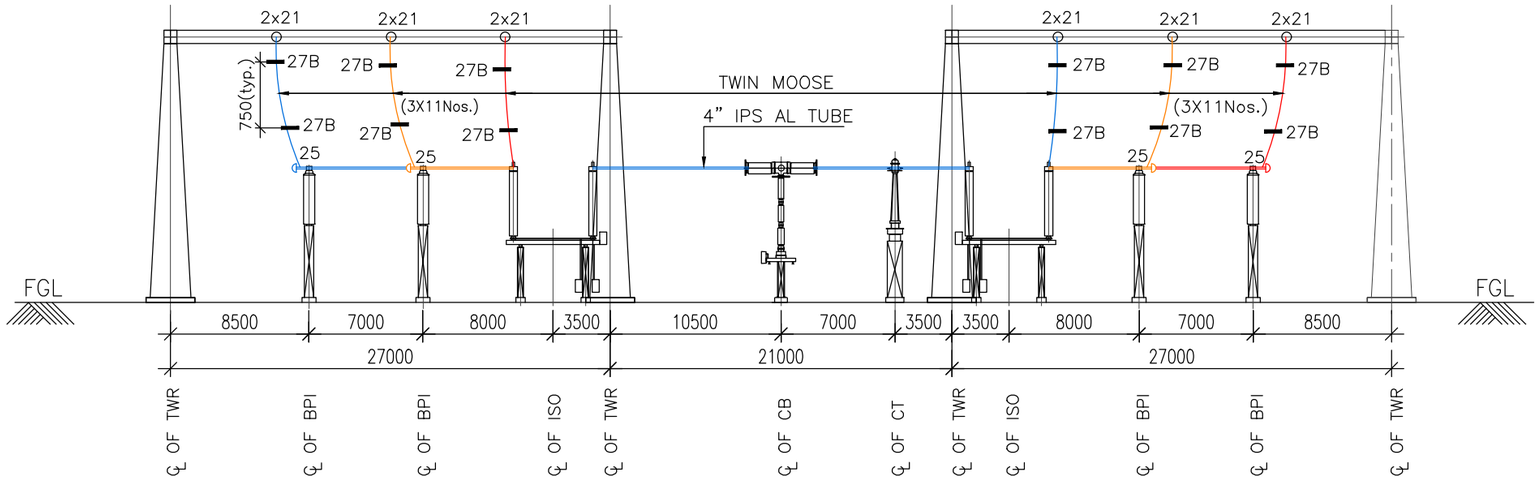
DRAWING NO. TB 3 369 316 007C
REV. 00
SHEET No. 03 OF 06

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB 3 369 316 007C

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





SECTION 4–4
(400KV)

EQPT	QTY.
1A1	1
2A	2
3A	3
7	6

CLAMP	QTY.
21	12
25	4
27B	66

CLAMP	QTY.
1AE	6
2AT	2
2AR	10
3AR	3
3AE	3
7ThS	6

ADDITIONAL INFORMATION
W.O.No. 83011

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

NTPC DRAWING NO. 4410–001–572–PVE–F–0023A

ग्राहक/परियोजना का नाम NORTH KARANPURA STPP (3X660MW)

NAME OF CUSTOMER/PROJECT NTPC LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

	NAME	SIGN.	DATE
DRAWN	PK		03.03.22
CHECKED	AK		09.03.22
APPROVED	AS		10.03.22

REV.	DATE	
		ALTERED
		CHECKED
		APPROVED

ZONE

DEPT.

CODE

SCALE 1 : 460

CARD CODE

TITLE
400/220kV – EKD – ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

DRAWING NO. TB 3 369 316 007C

REV. 00

SHEET No. 04 OF 06

COMPUTER DRG. PATH NAME :

REF. DRG. No.

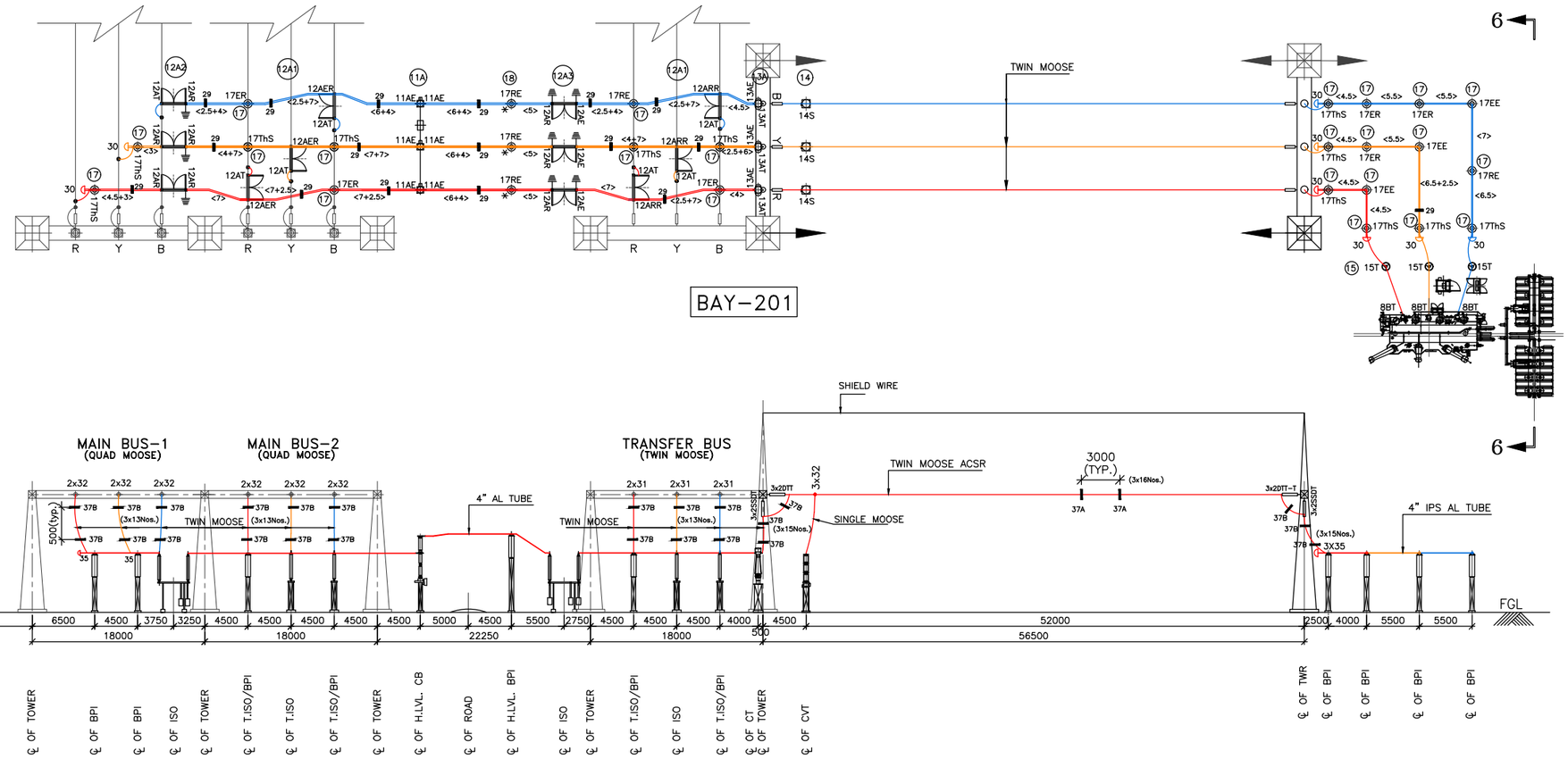
SIGN. & DATE

INVENTORY No.

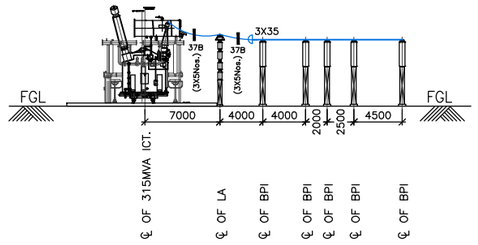
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB 3 369 316 007C

COPY RIGHT AND CONFIDENTIAL
The information in this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
It may not be used, reproduced or disclosed to others without the written consent of the company.



SECTION 5–5 ICT#2 BAY



SECTION 6–6

EQPT	QTY.
11A	1
12A1	2
12A2	1
12A3	1
13A	3
14	3
15	3
17	23
18	3

CLAMP	QTY.
11AE	6
12AT	7
12AR	8
12AE	3
12AER	3
12ARR	3
13AE	3
13AT	3
14S	3
15T	3
17ThS	12
17ER/17RE	11
17EE	3
8BT	3

CLAMP	QTY.
29	17
30	8
31	6
32	15
35	8
37A	48
37B	237

HARDWARE	QTY.
2DTT	3
2DTT–T	3
2SSDT	6

ICT#1 BAY ADDITIONAL CVT:

EQPT/ CLAMP	QTY.
14	3
14S	3
32	3

ADDITIONAL INFORMATION
W.O.No. 83011

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

NTPC DRAWING. NO. 4410–001–572–PVE–F–0023A

ग्राहक/परियोजना का नाम NORTH KARANPURA STPP (3X660MW)
NAME OF CUSTOMER/PROJECT NTPC LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

	NAME	SIGN.	DATE
DRAWN	PK		03.03.22
CHECKED	AK		09.03.22
APPROVED	AS		10.03.22

REV.	DATE	
		ALTERED
		CHECKED
		APPROVED

DEPT.
CODE
ZONE
SCALE 1 : 460
CARD CODE

TITLE
400/220kV – EKD – ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

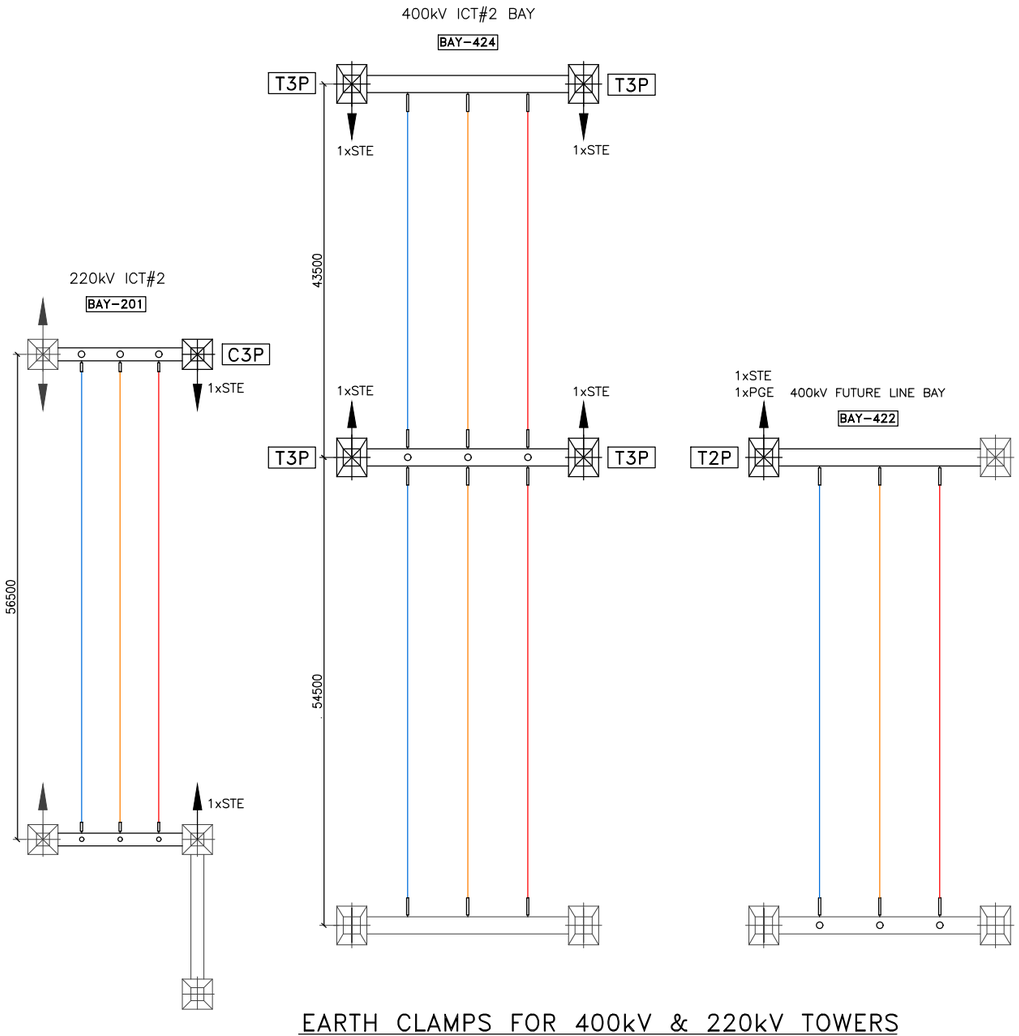
DRAWING NO. TB 3 369 316 007C
REV. 00
SHEET No. 05 OF 06

COMPUTER DRG. PATH NAME :
REF. DRG. No.
SIGN. & DATE
INVENTORY No.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

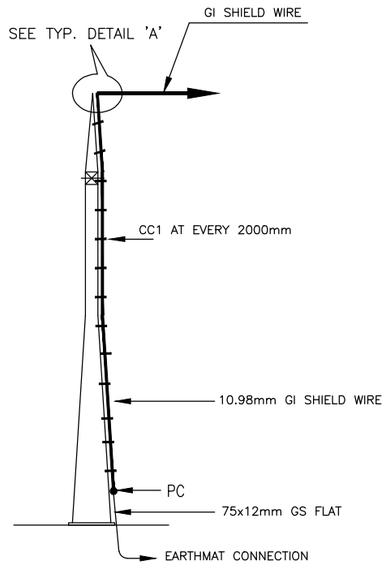
DRAWING No. TB 3 369 316 007C

COPY RIGHT AND CONFIDENTIAL
The information in this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It may not be used, reproduced or disclosed to others without the company's
written permission. It is the property of the company and is issued in strict confidence.

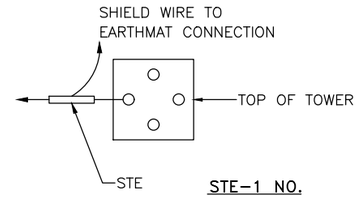


EARTH CLAMPS FOR 400kV & 220kV TOWERS

TERMINATION DETAIL OF SINGLE SHIELD WIRE AT A TOWER



VIEW-X



STE-1 NO.

NOTE: –

SINGLE SHIELD WIRE TERMINATING AT A TOWER, SHALL BE TAKEN DOWN FROM A STRAIN CLAMP AT TOP OF THE TOWER TO PAD TYPE CLAMP AT IT'S BOTTOM.

DETAIL-A

← GS EARTH/SHIELD WIRE (10.98mm DIA)

EW CLAMPS	QTY
STE	7
PGE	1

ADDITIONAL INFORMATION W.O.No.	83011	NTPC DRAWING. NO.	4410-001-572-PVE-F-0023A
STATUS OF DRAWING		ग्राहक/परियोजना का नाम NAME OF CUSTOMER/PROJECT	NORTH KARANPURA STPP (3X660MW) NTPC LIMITED
DISTRIBUTION OF PRINTS		BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP	

	NAME	SIGN.	DATE
DRAWN	PK		
CHECKED	AK		
APPROVED	DKS		

REV.	DATE	
01	03.03.17	ALTERED / CHECKED / APPROVED

DEPT. | CODE | ZONE | SCALE 1 : 460 | CARD CODE

TITLE: 400/220kV – EKD – ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

DRAWING NO. TB 3 369 316 007C | REV. 00

SHEET No. 06 OF 06

COMPUTER DRG. PATH NAME :

REF. DRG. No.

SIGN. & DATE

INVENTORY No.

891199/2022/TBG-TBG_ENGG

Project: 3x660MW North Karanpura STPP (400/220kV Switchyard)
Customer: NTPC Ltd.
Doc. No. : 4410-001-572-PVE-F-0023A
Doc. Title - 400/220kV - EKD - ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

ANNEXURE-1
Rev-00

BILL OF QUANTITY OF 400KV CLAMPS AND CONNECTORS FOR ICT-2 ADITIONAL SCOPE

BOQ Item No.	CONNECTOR TYPE	Current rating (A)	Unit	ICT-2 400kV Bay	Future Line Bay	ICT-2 & Future Line Tie Bay	Total for ICT-2 scope	Commissioning Spare	Total Pl Quantity incl spare
	BAY NO. ---------->			**424**	**422**	**423**			
	SECTION---------->			**1-1, 2-2**	**3-3**	**4-4**			
1AE	Expansion type connector for 400kV,3150A, 50kA fo 1 s, SF6 Circuit Breaker suitable for 4" IPS Al Tube	3150	Nos.	6		6	12	1	13
2AR	Rigid type connector suitable for 4" IPS Al Tube on 400kV, 3150A, 50kA FOR 1s, HCB ISOLATORS	3150	Nos.	6		10	16	2	18
2AT	Connector suitable for Twin ACSR Moose Conductor on 400kV, 3150A, 50kA FOR 1s, HCB ISOLATORS	3150	Nos.	12	6	2	20	2	22
3AR	Rigid type connector suitable for 4" IPS Al Tube on 400kV 3000A, 50kA FOR 1s Current Transformer, WITH 120% EXTENDED CURRENT RATING	3600	Nos.	3		3	6	1	7
3AE	Expansion type connector suitable for 4" IPS Al Tube on 400kV 3000A, 50kA FOR 1s Current Transformer, WITH 120% EXTENDED CURRENT RATING	3600	Nos.	3		3	6	1	7
4T	Connector for 400 kV CVT,8800 pF suitable for twin moose ACSR conductor (universal approach)	NA	Nos.	3			3	0	3
5T	Connector for 336 kV Surge Arrester suitable for twin moose ACSR conductor (universal approach)	NA	Nos.	3			3	0	3
7ThS	400kV Buspost insulator clamp suitable for 4" IPS Al.Tube Through/sliding	NA	Nos.	2		6	8	1	9
7ThR	400kV Buspost insulator clamp suitable for 4" IPS Al.Tube Through/rigid	NA	Nos.	2			2	0	2
7T	400kV Buspost insulator clamp suitable for twin moose ACSR conductor (horizontal approach) THROUGH type	2000	Nos.	1			1	0	1
7ER	400kV Buspost insulator clamp suitable for 4" IPS Al.Tube RIGID & EXPANSION TYPE WITH TUBE BREAK	3150	Nos.	1			1	0	1
8AT	400kV Connector for 315MVA, 400/220kV ICT suitable for twin moose ACSR conductor for HT Bushing	2000	Nos.	3			3	0	3
20	Corona bell to suit 4" IPS Al. Tube (nos.)	NA	Nos.	4		4	8	1	9
21	TEE Connector (400 kV s/s) Single ACSR Moose to Single ACSR Moose	1000	Nos.	18	0	12	30	3	33
22	TEE Connector (400 kV s/s) Twin ACSR Moose to Single ACSR Moose	1000	Nos.	6	6	0	12	1	13
25	TEE Connector (400 kV s/s) for 4" IPS Al. Tube to twin moose ACSR conductor	2000	Nos.	4	0	4	8	1	9
27A	400kV Flexible (for main stringing) Spacers for 'Twin Moose' ACSR with 450mm sub-conductor spacing	NA	Nos.	60	33		93	9	102
27B	400kV Rigid (for jumpers) Spacers for 'Twin Moose' ACSR with 450mm sub-conductor spacing	NA	Nos.	207	72	66	345	35	380
29	Welding sleeves for 4" IPS Al. Tube	NA	Nos.			9	9	1	10
	String Insulator Hardware Quantity								
4DTT	420 kV Double Tension string insulator (120 kN per string) with double anchoring points with 2X25 nos antifog disc with all hardware accessories including **Corona Ring** and tension clamp suitable for Twin Moose with 450mm sub conductor spacing without turn buckle								
a	Disc Insulators		Nos.	300	150	0	450	50	500
b	Hardware		Sets	6	3	0	9	1	10

891199/2022/TBG-TBG_ENGG

Project: 3x660MW North Karanpura STPP (400/220kV Switchyard) **ANNEXURE-1**
Customer: NTPC Ltd. **Rev-00**
Doc. No. : 4410-001-572-PVE-F-0023A
Doc. Title - 400/220kV - EKD - ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

BILL OF QUANTITY OF 400KV CLAMPS AND CONNECTORS FOR ICT-2 ADITIONAL SCOPE

BOQ Item No.	CONNECTOR TYPE	Current rating (A)	Unit	ICT-2 400kV Bay	Future Line Bay	ICT-2 & Future Line Tie Bay	Total for ICT-2 scope	Commissioning Spare	Total Pl Quantity incl spare
	BAY NO. ---------->			**424**	**422**	**423**			
	SECTION---------->			**1-1, 2-2**	**3-3**	**4-4**			
4DTT-T	420 kV Double Tension string insulator (120 kN per string) with double anchoring points with 2X25 nos antifog disc with all hardware accessories including **Corona Ring** and tension clamp suitable for Twin Moose with 450mm sub conductor spacing with turn buckle								
a	Disc Insulators		Nos.	300	150	0	450	50	500
b	Hardware		Sets	6	3	0	9	1	10
4SSDT	420 kV Single Suspension string insulator (120 kN) assembly with 1x25 nos antifog disc with all hardware accessories including **Corona Ring** with Drop clamp set suitable for Twin Moose with 450 mm sub conductor spacing								
a	Disc Insulators		Nos.	75	75	0	150	25	175
b	Hardware		Sets	3	3	0	6	1	7
1A1	400kV, 3150A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR with operating mechanism and marshalling box and associated structures	3150	Nos.	1		1	2		2
2A	400kV, 3150A, 50kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 1 E/S complete with operating mechanism	3150	Nos.	3		2	5		5
	400kV Post insulators for above isolators		Nos.	18	0	12	30		30
3A	400kV, 3000A, 50kA FOR 1s, 1-PH, 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING	3600	Nos.	3		3	6		6
	Junction boxes for CT		Nos.	1	0	1	2		2
4	400kV, 8800 picoFarad, 1-PH CAPACITOR VOLTAGE TRANSFORMER	NA	Nos.	3			3		3
	Junction boxes for CVT		Nos.	1	0	0	1		1
5	336 kV, 20kA, 50kA FOR 1s, 1-PH SURGE ARRESTER (Gapless type) with surge monitors and terminal connectors, etc.	NA	Nos.	3			3		3
7	400 kV, 8kN Solid Core Bus Post Insulator	NA	Nos.	6		6	12		12
8	315MVA, 400/220/33kV, 3-PH ICT		Nos.	1			1		1

Project: 3x660MW North Karanpura STPP (400/220kV Switchyard) **ANNEXURE-1**

Customer: NTPC Ltd. **Rev-00**

Doc. No. : 4410-001-572-PVE-F-0023A

Doc. Title - 400/220kV - EKD - ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

BILL OF QUANTITY FOR 220KV CLAMPS AND CONNECTORS FOR ICT-2 ADITIONAL SCOPE

BOQ Item No.	CONNECTOR TYPE	Current rating (A)	Unit	ICT-2 Bay	ICT-1 Bay	Total for ICT-2 scope	Commissioning Spare	Total Pl Quantity incl spare
	BAY NO. ---------->			**201**	**202**			
	SECTION---------->			**5-5, 6-6**				
11AE	Expansion type connector for 220kV,1600A, 40kA fo 1 s, SF6 Circuit Breaker suitable for 4" IPS Al Tube	1600	Nos.	6		6	1	7
12AT	Connector suitable for Twin ACSR Moose Conductor on 220kV, 1600A, 40kA FOR 1s HCB ISOLATORS	1600	Nos.	7		7	1	8
12AR	Rigid type connector suitable for 4" IPS Al Tube on 220kV, 1600A, 40kA FOR 1s HCB ISOLATORS	1600	Nos.	8		8	1	9
12AE	Expansion type connector suitable for 4" IPS Al Tube on 220kV, 1600A, 40kA FOR 1s HCB ISOLATORS	1600	Nos.	3		3	0	3
12AER	Expansion - Rigid type (with tube break) connector suitable for 4" IPS Al Tube on 220kV, 1600A, 40kA FOR 1s HCB ISOLATORS	1600	Nos.	3		3	0	3
12ARR	Rigid - Rigid type (with tube break) connector suitable for 4" IPS Al Tube on 220kV, 1600A, 40kA FOR 1s HCB ISOLATORS	1600	Nos.	3		3	0	3
13AE	Expansion type connector suitable for 4" IPS Al Tube on 220kV, 1600A, 40kA FOR 1s, CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING	1920	Nos.	3		3	0	3
13AT	Connector suitable for twin moose ACSR conductor (horizontal approach) on 220kV, 1600A, 40kA FOR 1s, CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING	1920	Nos.	3		3	0	3
14S	Connector for 220 kV CVT, 5575 pF suitable for single moose ACSR conductor (universal approach)	-	Nos.	3	3	6	1	7
15T	Connector for 216 kV Surge Arrester suitable for Twin moose ACSR conductor (universal approach through type)	1600	Nos.	3		3	0	3
17ThS	Buspost insulator clamp suitable for 4" IPS Al.Tube Through/sliding	NA	Nos.	12		12	1	13
17RE/ 17ER	Buspost insulator clamp suitable for 4" IPS Al.Tube RIGID & EXPANSION TYPE WITH TUBE BREAK	1600	Nos.	11		11	1	12
17EE	Buspost insulator clamp suitable for 90 deg bend of 4" IPS Al.Tube EXPANSION & EXPANSION TYPE WITH TUBE BREAK	1600	Nos.	3		3	0	3
8BT	220kV Connector for 315MVA, 400/220kV ICT suitable for twin moose ACSR conductor for LV Bushing	1600	Nos.	3		3	0	3
30	220kV End Cap/ Corona bell to suit 4" IPS Al. Tube (nos.)	NA	Nos.	8		8	1	9
31	TEE Connector (220 kV s/s) Single ACSR Moose to Single ACSR Moose	1000	Nos.	6		6	1	7
32	TEE Connector (220 kV s/s) Twin ACSR Moose to Single ACSR Moose	1000	Nos.	15	3	18	2	20
35	TEE Connector (220 kV s/s) for 4" IPS Al. Tube to twin moose ACSR conductor	2000	Nos.	8		8	1	9
37A	220kV Flexible (for main stringing) Spacers for 'Twin Moose' ACSR with 250mm sub-conductor spacing	NA	Nos.	48		48	5	53
37B	220kV Rigid (for jumpers) Spacers for 'Twin Moose' ACSR with 250mm sub-conductor spacing	NA	Nos.	237		237	24	261
29	Welding sleeves for 4" IPS Al. Tube	NA	Nos.	17		17	2	19
	String Insulator Hardware Quantity							

Project: 3x660MW North Karanpura STPP (400/220kV Switchyard) **ANNEXURE-1**

Customer: NTPC Ltd. **Rev-00**

Doc. No. : 4410-001-572-PVE-F-0023A

Doc. Title - 400/220kV - EKD - ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

BILL OF QUANTITY FOR 220KV CLAMPS AND CONNECTORS FOR ICT-2 ADITIONAL SCOPE

BOQ Item No.	CONNECTOR TYPE	Current rating (A)	Unit	ICT-2 Bay	ICT-1 Bay	Total for ICT-2 scope	Commissioning Spare	Total Pl Quantity incl spare
	BAY NO. ---------->			**201**	**202**			
	SECTION---------->			**5-5, 6-6**				
2DTT	220 kV Double Tension string insulator (120 kN per string) with double anchoring points with 2X15 nos antifog disc with all hardware accessories including **Corona Ring** and tension clamp suitable for Twin Moose with 250mm sub conductor spacing without turn buckle							
a	Disc Insulators		Nos.	90	0	90	0	90
b	Hardware		Sets	3		3	0	3
2DTT-T	220 kV Double Tension string insulator (120 kN per string) with double anchoring points with 2X15 nos antifog disc with all hardware accessories including **Corona Ring** and tension clamp suitable for Twin Moose with 250mm sub conductor spacing with turn buckle							
a	Disc Insulators		Nos.	90	0	90	0	90
b	Hardware		Sets	3		3	0	3
2SSDT	220 kV Single Suspension string insulator (120 kN) assembly with 1x15 nos antifog disc with all hardware accessories including **Corona Ring** with Drop clamp set suitable for Twin Moose with 250 mm sub conductor spacing							
a	Disc Insulators		Nos.	90	0	90	15	105
b	Hardware		Sets	6		6	1	7
11A	220kV, 1600A, 40kA FOR 1s, 3-PH CIRCUIT BREAKER with operating mechanism and marshalling box and associated structures	1600	Nos.	1		1		1
12A1	220kV, 1600A, 40kA FOR 1s, 3-PH HCB TANDEM ISOLATORS, MOTOR OPERATED WITHOUT E/S complete with operating mechanism	1600	Nos.	2		2		2
12A2	220kV, 1600A, 40kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 1 E/S complete with operating mechanism	1600	Nos.	1		1		1
12A3	220kV, 1600A, 40kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 2 E/S complete with operating mechanism	1600	Nos.	1		1		1
	220kV Post insulators for above isolators		Nos.	24	0	24		24
13A	220kV, 1600A, 40kA FOR 1s, 1-PH, 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING	1920	Nos.	3		3		3
	Junction boxes for CT			1	0	1		1
14	220kV, 5575 picoFarad, 1-PH CAPACITOR VOLTAGE TRANSFORMER	NA	Nos.	3	3	6		6
	Junction boxes for CVT			1	1	2		2
15	216 kV, 10kA, 40kA FOR 1s, 1-PH SURGE ARRESTER (Gapless type) with surge monitors and terminal connectors, etc.	NA	Nos.	3		3		3
17	220 kV, 6kN Solid Core Bus Post Insulator - Low Level (6m)	NA	Nos.	23		23		23
18	220 kV, 6kN Solid Core Bus Post Insulator - High Level (8m)	NA	Nos.	3		3		3

Project: 3x660MW North Karanpura STPP (400/220kV Switchyard)
Customer: NTPC Ltd.
Doc. No. : 4410-001-572-PVE-F-0023A
Doc. Title - 400/220kV - EKD - ICT#2 ADDITIONAL SCOPE: PLAN, SECTION & BOM

ANNEXURE-1
Rev-00

BILL OF QUANTITY FOR BUS BAR MATERIAL & EARTHING CLAMPS FOR ICT-2 ADITIONAL SCOPE

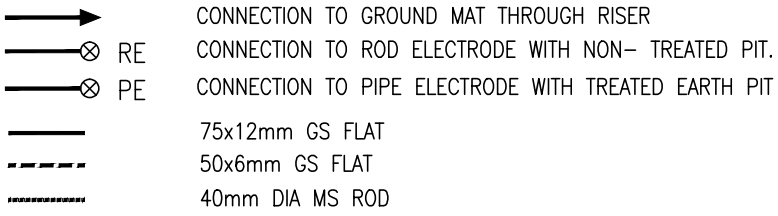
BOQ Item No.	Bus bar material for 400/220kV Switchyard at NKSTPP	Unit	Total quantity
1	ACSR Moose Conductor (in m)	m	2600
2	4 inch Al. Tube (in m)	m	450
BOQ Item No.	**Earthing clamps for 400/220kV Switchyard at NKSTPP**		
STE	Earthwire Strain/ tension clamps (Bolted type) with D-Shackle assembly	Nos.	7
PGE	PG-clamp for GS earthwire of 10.98mm dia	Nos.	1
CC1	Cleat type clamps for Earthing down conductor (10.98mm dia)	Nos.	90
CC2	Cleat type clamps for 75 x 12mm G.S. flat for equipment structure	Nos.	450
PC	Pad type clamp For connecting 10.98mm dia. G.I. wire on one side and 75x12mm GS strips on other side	Nos.	10

NOTE: 1. All above quantities are for only ICT-2 additional scope bays of 400/220kV Switchyard at NKSTPP end.
2. Quantities for rest of 400/220kV Switchyard bays & 220 kV Sub-station at Mine end and connection from 400kV Switchyard to GT/ ST are indicated in their respective Erection Key Diagrams.

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO. TB-4-369-316-009

LEGEND



CONNECTION TO GROUND MAT THROUGH RISER
CONNECTION TO ROD ELECTRODE WITH NON- TREATED PIT.
CONNECTION TO PIPE ELECTRODE WITH TREATED EARTH PIT
75x12mm GS FLAT
50x6mm GS FLAT
40mm DIA MS ROD

GENERAL NOTES:

1 EARTH STRIP CLEATED TO LATTICE /PIPE TYPE STRUCTURE AT AN INTERVAL OF 1.0M SUITABLE PROVISION SHALL BE MADE WITH SUPPORT STRUCTURE.
2 ALL EARTH STRIPS SHALL BE TAKEN ALONG EDGE OF STRUCTURE. ALL DRAWING SHOWS TYPICAL ARRANGEMENT ONLY.
3 ALL STRUCTURES/EQUIPMENTS SHALL BE EARTHED AS SHOWN IN THE FOLLOWING SHEETS.
4 BOLT SIZE FOR CONNECTING EARTHING FLAT TO THE EQPT/STRUCTURE SHALL BE TO SUIT RESPECTIVE HOLE SIZE.
5. ALL EARTHING SHALL BE DONE IN ACCORDANCE WITH IS:3043 UNLESS OTHERWISE STATED IN TECHNICAL SPECIFICATION
6 EACH RISER OF A PARTICULAR EQUIPMENT SHALL BE CONNECTED TO A DIFFERENT EARTHROD (EITHER HORIZONTAL OR VERTICAL CONDUCTORS OF MAIN EARTHMAT).
7 FOR WELDING DETAILS REFER SHEET #20 & 21
8 E/WIRE DOWN CONDUCTOR SHALL BE CLEATED AT AN INTERVAL OF 2.0 M ALONG WITH STRUCTURE .

SHEET NO. DESCRIPTION

01. TITLE
1A. NOTES
02. 400kV & 220kV SF6 CIRCUIT BREAKER
3A. 400kV & 220KV LINE CVT (WITH LMU)
3B. 400kV & 220KV CVT (WITHOUT LMU)
04. 400kV & 220kV POST INSULATOR (SOLID CORE TYPE)
05. 336kV & 216kV LIGHTNING ARRESTER
06. MARSHALLING KIOSK
7A. 400kV HORIZONTAL CENTER BREAK ISOLATOR WITH ONE EARTH SWITCH (TYPICAL)
7B. 400kV HORIZONTAL CENTER BREAK ISOLATOR WITH TWO EARTH SWITCH (TYPICAL)
7C. 220kV HORIZONTAL CENTER BREAK ISOLATOR WITH TWO EARTH SWITCH (TYPICAL)
7D. 220kV HORIZONTAL CENTER BREAK ISOLATOR WITH ONE EARTH SWITCH (TYPICAL)
7E. 220kV HORIZONTAL CENTER BREAK ISOLATOR WITHOUT EARTH SWITCH (TYPICAL)
08A. TOWER WITH PEAK
08B. TOWER WITHOUT PEAK
08C. LIGHTENING MAST (LM)
09. 400kV & 220kV CURRENT TRANSFROMER
10. CABLE TRENCH
11. PIPE EARTH ELECTRODE WITH TREATED PIT
12A. ROD ELECTRODE WITHOUT TEST PIT
12B. ROD ELECTRODE WITH TEST PIT

SHEET NO. DESCRIPTION

13. RAIL BONDING
14A. AUTO TRANSFORMER
14B. BUS REACTOR.
14C. SWITCHYARD SERVICE TRANSFORMER
15. AUXILIARY EARTH MAT FOR ISOLATOR MAIN MECH.,E/S MECH. BOX
16 CONTROL AND RELAY PANELS/BATTERY CHARGER/ AC DC BOARDS/MLDB
17 400KV WAVE TRAP
18 GATE/FENCE POST
19 TYPICAL ARRANGEMENT OF BOLTED JOINTS
20 WELDING DETAILS
21 WELDING DETAILS

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

FILE NAME : 100_MG3BRD

NTPC DRG. No. 4410-001-572-PVE-F-0038

PROJECT: NORTH KARNPURA
SUPER THERMAL POWER PROJECT (3X660MW)

OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

QBTGM: BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DESN	AK		12.06.15
	CHD	AS		19.06.15
	APPD	AS		19.06.15

JOB NO. 401
STATUS CONTRACT
DISTRIBUTION
TO
No. OF

REV.	DATE	ALTD	CHD	APPD
01	26.04.18	AK	AK	DKM

DRAWING REVISED TO INCORPORATE NTPC COMMENTS ON ROD.

TITLE: 400/220 kV – EQUIPMENT EARTHING PHILOSOPHY & DETAILS

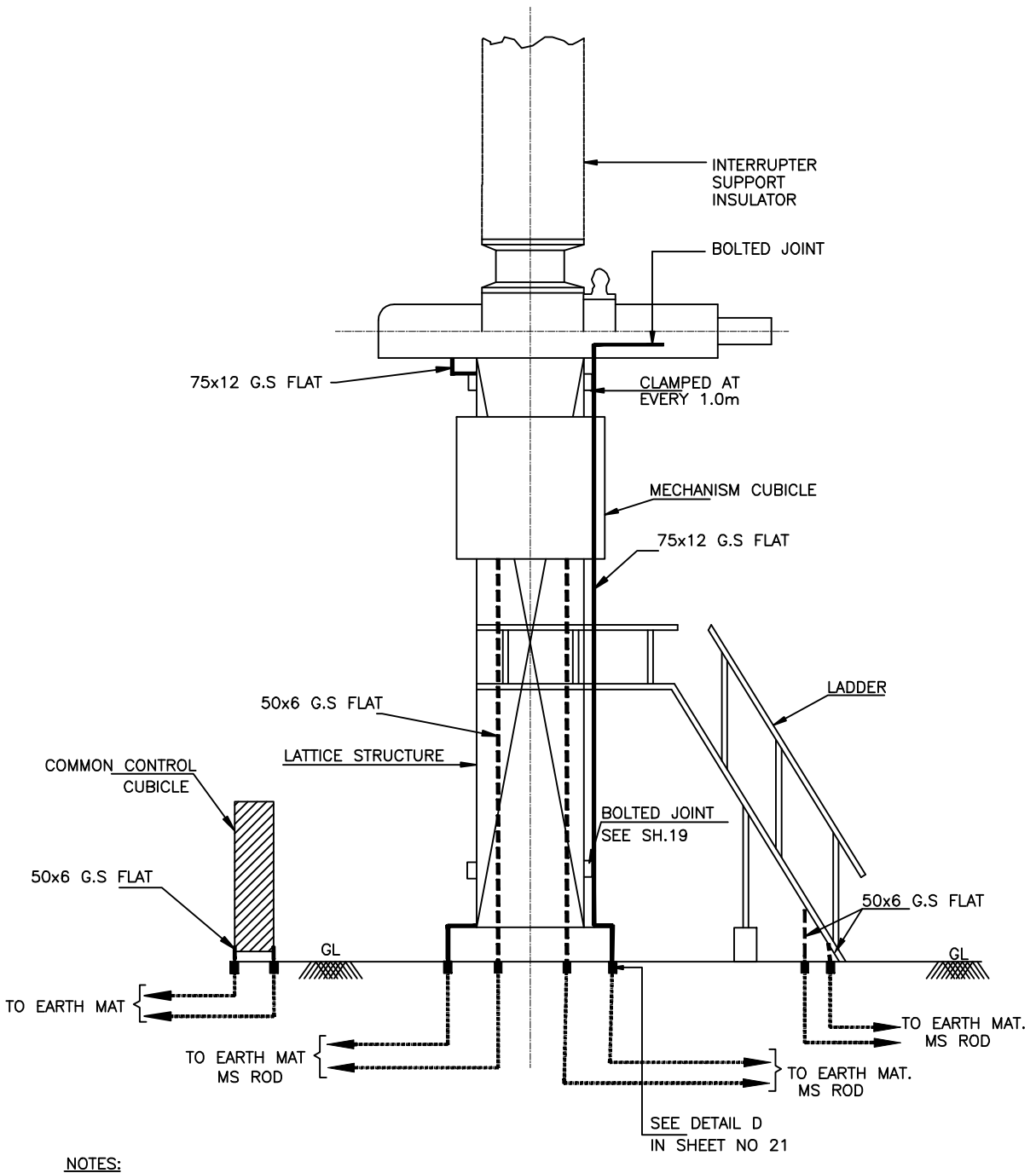
DEPT. SCALE
SIGN
DATE

DRAWING NO. TB-4-369-316-009
SHEET OF REV. 01

FORMAT SIZE A4

1. RISER FROM THE EARTH GRID SHALL BE 40MM DIAMETER MILD STEEL ROD. RISER SHALL RISE FROM THE GROUND ALONG THE NEAREST EQUIPMENT FOUNDATION/BUILDING COLUMN/WALL TO AVOID ANY OBSTRUCTION TO MOVEMENT OF PERSONNEL.
2. CONNECTION TO ALL EQUIPMENT AND TOWERS SHALL BE BY BOLTED JOINTS. CONTACT SURFACES SHALL BE THOROUGHLY CLEANED BEFORE CONNECTIONS. EQUIPMENT BOLTED CONNECTIONS AFTER BEING TESTED AND CHECKED SHALL BE PAINTED WITH ANTI CORROSIVE PAINT/COMPOUND.
3. 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.
   THE SURFACES TO BE WELDED SHALL BE CLEANED OF DIRT, OIL, GREASE AND OXIDES BEFORE WELDING.
   ANY OXIDE FILMS THAT MAY HAVE FORMED DURING WELDING MUST BE REMOVED FROM THE WELDED JOINT.
4. EARTHING CONDUCTOR FOR EQUIPMENT SHALL BE OF GALVANISED M.S. OF SIZE 75x12/50x6 mm.
   THE CONDUCTOR BELOW THE GROUND LEVEL SHALL BE 40 mm DIA BLACK MS ROD.
5. IN THE ATTACHED DRAWINGS GL REPRESENTS GROUND LEVEL.
6. ALL EQUIPMENT STRUCTURES, CABLE TRENCHES & TOWERS SHALL BE EARTHED AT TWO POINTS WITH 75x12 mm. G.S. FLAT EVEN THOUGH THEY ARE SHOWN OR NOT IN THE DRAWING DUE TO CLARITY.
7. ALL JUNCTION BOXES, MECHANISM BOXES, GROUND MOUNTED CONTROL CABINETS, CUBICLES, PANELS, MBs ETC. SHALL BE EARTHEDAT TWO POINTS WITH 50x6mm G.S. FLAT BY TWO SEPARATE AND DISTINCT EARTH CONNECTERS.
8. EARTHING CONDUCTORS FROM EQUIPMEMT STRUCTURES SHALL BE CONNECTED TO THE NEAREST POSSIBLE EARTH MAT RISER. EQUIPMENT EARTHING SHALL BE AS PER IS 3043.
9. ALL JOINTS BETWEEN 40 DIA M.S. ROD AND 75x12 mm. G.S. FLAT SHALL BE BELOW GROUND LEVEL.
10. FOR WELDED JOINTS LOW HYDROGEN CONTENT ELECTRODES SHALL BE USED.
11. METTALIC SHEATHS/SCREENS, AND ARMOUR OF MULTI CORE CABLES SHALL BE EARTHED AT BOTH ENDS.
    METTALIC SHEATHS AND ARMOUR OF SINGLE CORE CABLES SHALL BE EARTHED AT SWITCHGEAR END ONLY UNLESS OTHERWISE INSTRUCTED BY THE EMPLOYER.
12. EQUIPMENT BOLTED CONNECTIONS AFTER BEING TESTED AND CHECKED SHALL BE PAINTED WITH ANTI CORROSIVE PAINT/COMPOUND.
13. LOCATION OF EARTHING CONDUCTORS/RISERS SHOWN IN THE EARTHING DRAWING MAY CHANGE TO SUIT THE SITE CONDITION.
14. FOR SURGE ARRESTER, EARTHING LEAD FROM SURGE COUNTER TO MAIN EARTHMAT SHALL BE SHORTEST IN LENGTH AS PRACTICALLY AS POSSIBLE.
15. AN ADDITIONAL AUXILIARY GRID OF 1500MMX1500MM COMPRISING OF CLOSELY SPACED(300MMX300MM) 40 DIA CONDUCTORS AT A DEPTH OF 300MM FROM FINISHED GROUND LEVEL SHALL BE PROVIDED BELOW THE OPERATING HANDLE OF ISOLATORS AND EARTH SWITCHES. THIS GRID SHALL BE CONNECTED TO THE MAIN GROUND GRID.
    THE EARTH CONNECTION TO OPERATING HANDLE SHALL BE MADE OF FLEXIBLE CONNECTION. THE MOM BOX OF THE ISOLATOR TO BE CONNECTED TO THIS AUX. GRID.
16. ALL NON CURRENT CARRYING METALIC PARTS SHALL BE EARTHED AT TWO DIFFERENT PLACES.
17. ALL EQUIPMENT DRAWINGS SHOWN ARE INDICATIVE ONLY.
18. WELDING OF EARTHING CONDUCTOR SHALL BE CONNECTED IN VERTICAL PLANE WHEREVER POSSIBLE.
19. ALL GROUND CONNECTIONS SHALL BE MADE BY ELECTRIC ARC WELDING.
20. BENDING OF LARGE DIAMETER CONDUCTORS SHALL BE DONE PREFERABLY BY GAS HEATING.

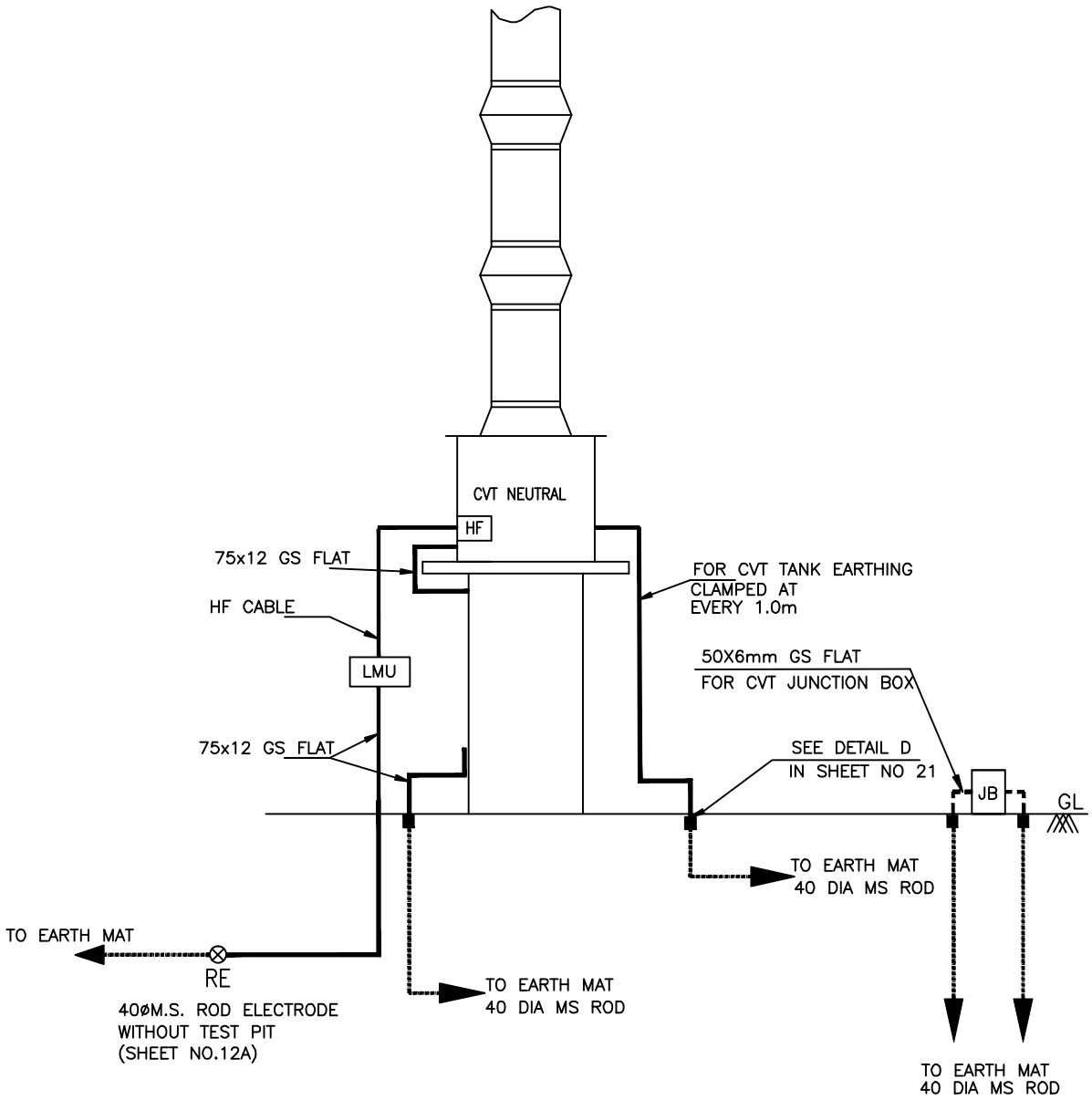
BHEL	EQUIPMENT EARTHING DETAILS NOTES	
	DRG. No. TB−4−369−316−009	SHEET No. 1A



NOTES:

1. NO. OF RISERS FOR CIRCUIT BREAKER = 2 Nos./PHASE
2. NO. OF RISERS FOR MECHANISM CUBICLE = 2 Nos.
3. NO. OF RISERS FOR LADDER = 2 Nos.
4. NO. OF RISERS FOR CONTROL CUBICLE = 2 Nos.

BHEL	EQUIPMENT EARTHING DETAILS 400kV & 220kV SF6 CIRCUIT BREAKER	
COMPUTERREF.NO.	DRG. No. TB-4-369-316-009	SHEET No. 2



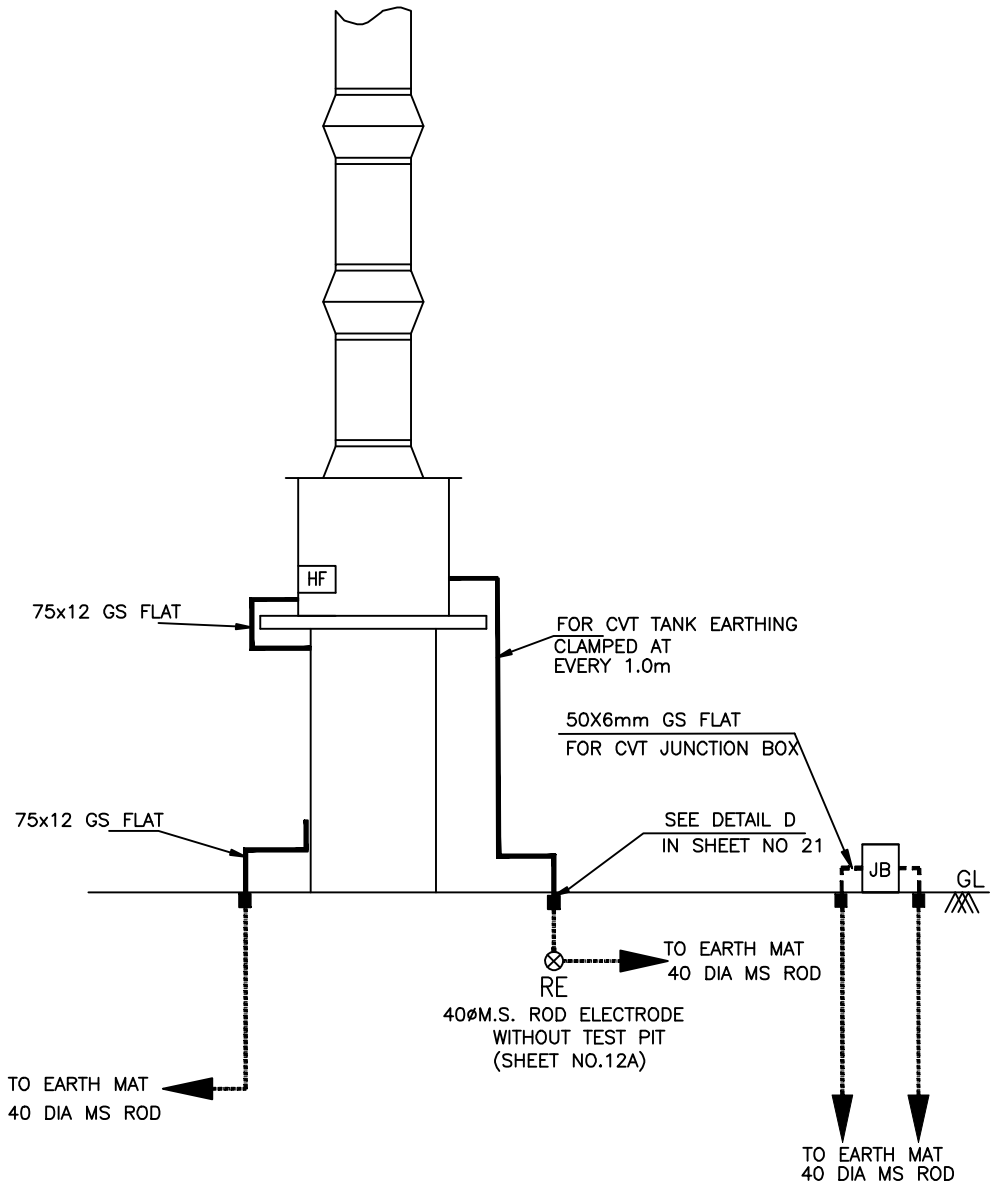
NOS.OF RISERS

= 2 NOS. PER PHASE
+ 2 NOS. FOR CVT JUNCTION BOX

ROD ELECTRODE = 1 NO. PER CVT (NEUTRAL IS CONNECTED TO GROUND VIA LMU)

EQUIPMENT EARTHING DETAILS
400kV & 220KV LINE CVT (WITH LMU)

COMPUTERREF.NO.	DRG. No. TB-4-369-316-009	SHEET No. 3A



NOS.OF RISERS

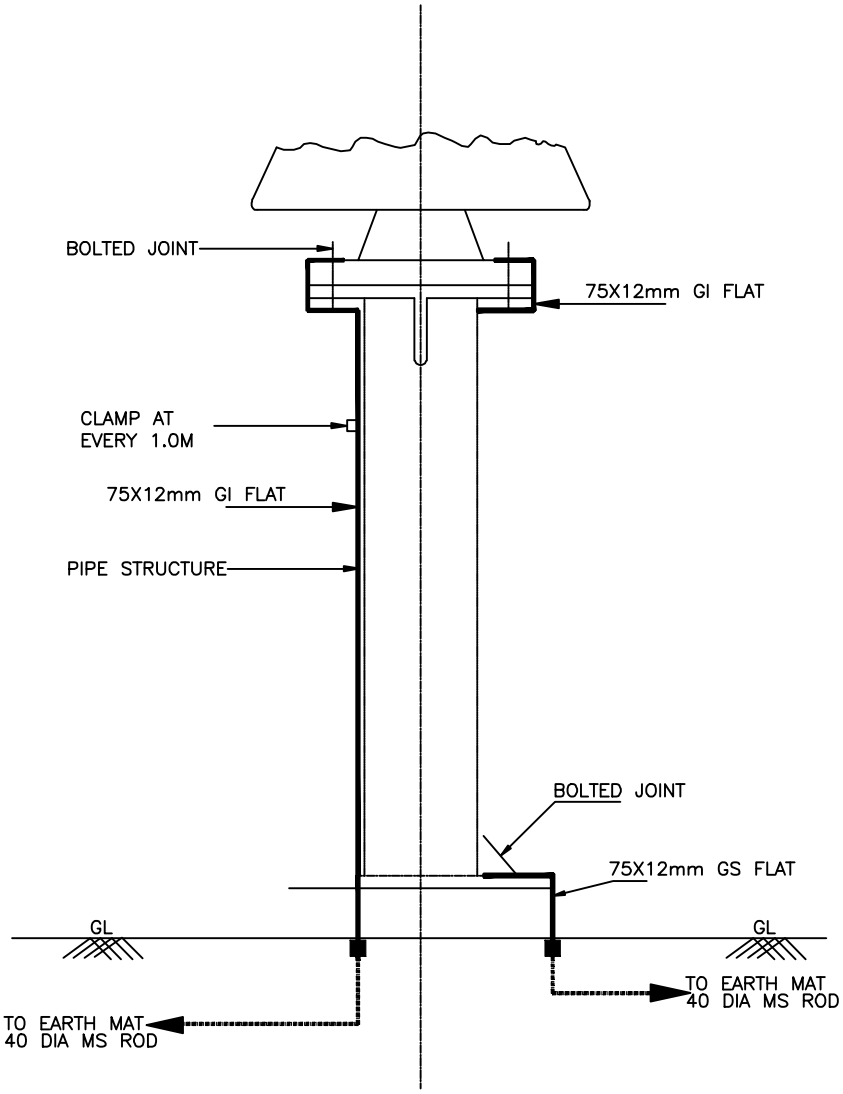
= 2 NOS. PER PHASE

+ 2 NOS. FOR CVT JUNCTION BOX

ROD ELECTRODE = 1 NO. PER CVT

EQUIPMENT EARTHING DETAILS
400kV & 220KV CVT (WITHOUT LMU)

COMPUTERREF.NO.	DRG. No. TB-4-369-316-009	SHEET No. 3B



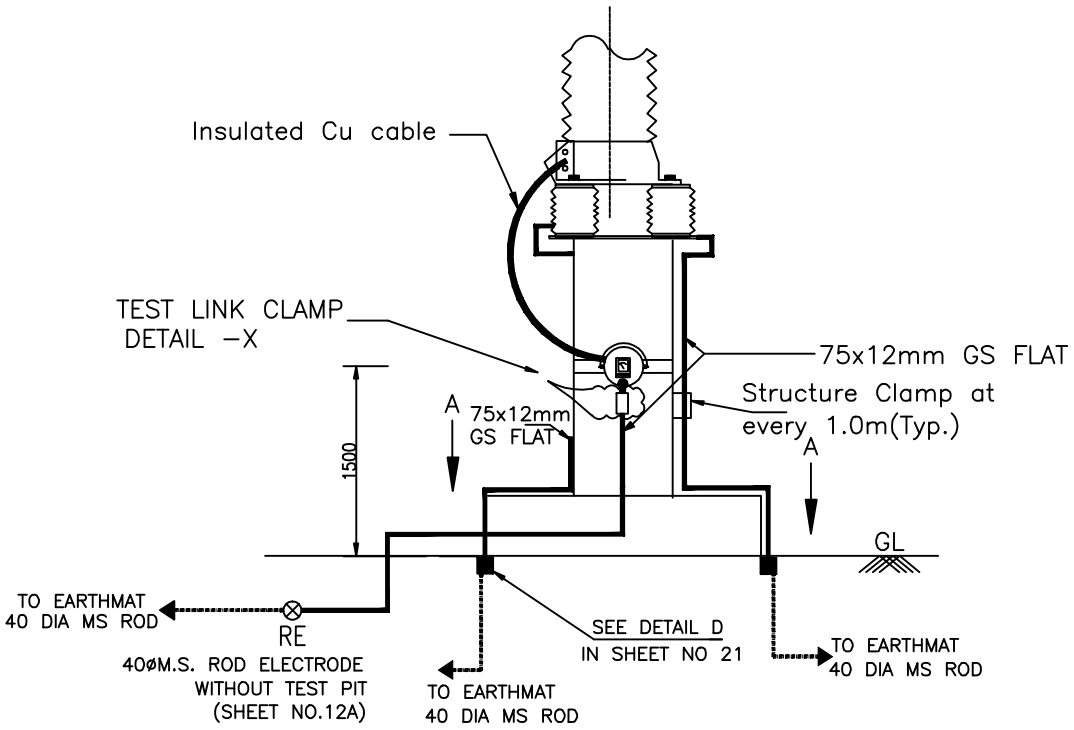
NOS.OF RISERS = 2 NOS.

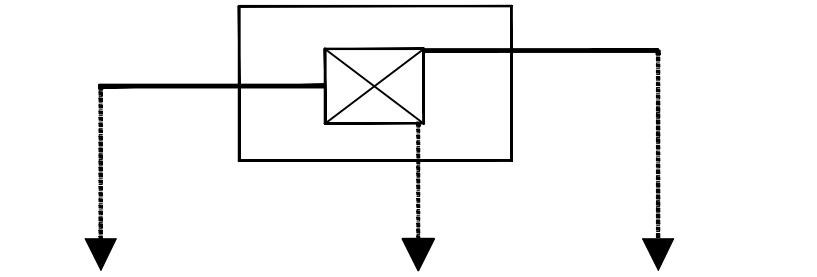
BHEL

EQUIPMENT EARTHING DETAILS
400kV & 220kV POST INSULATOR (SOLID CORE TYPE)

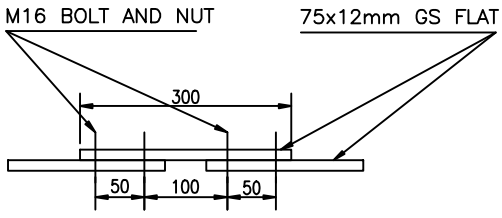
DRG. No. TB-4-369-316-009

SHEET No. 4





VIEW A–A

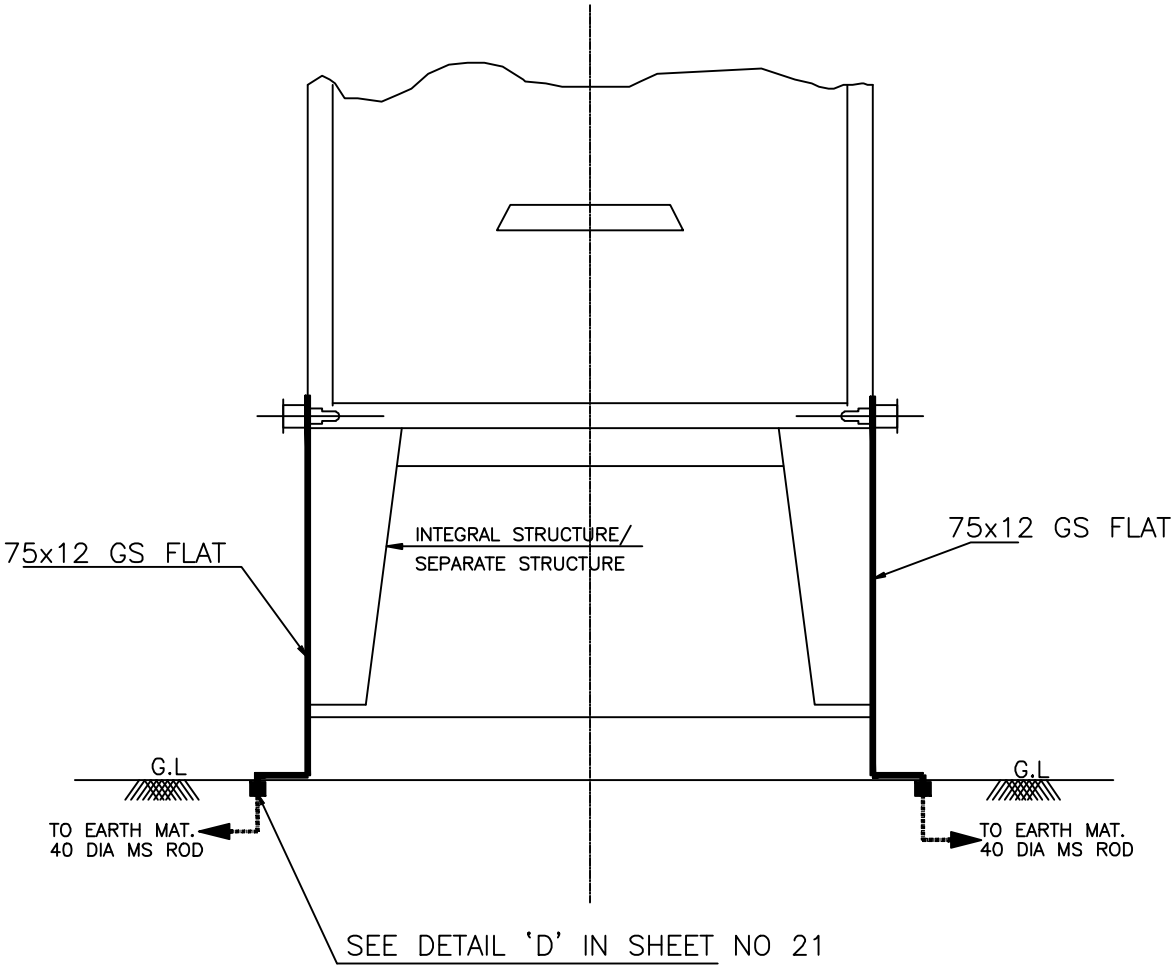


(DETAIL –X)

NOTES;

1. LA SHALL BE EARTHED THROUGH EARTH TERMINAL OF SURGE COUNTER
2. NO. OF ROD ELECTRODE : 1 NO.
   NO OF RISERS = 3 NOS.
3. TEST LINK SHALL HAVE PROVISION TO BOLT TEST LEAD BEFORE ISOLATING THE MAIN EARTHING CONNECTIONS (AS PER SKETCH ABOVE) = 1NO.

BHEL	EQUIPMENT EARTHING DETAILS 336kV & 216kV LIGHTNING ARRESTER	
COMPU. DRG. REF.	DRG.NO. TB–4–369–316–009	SHEET No. 5



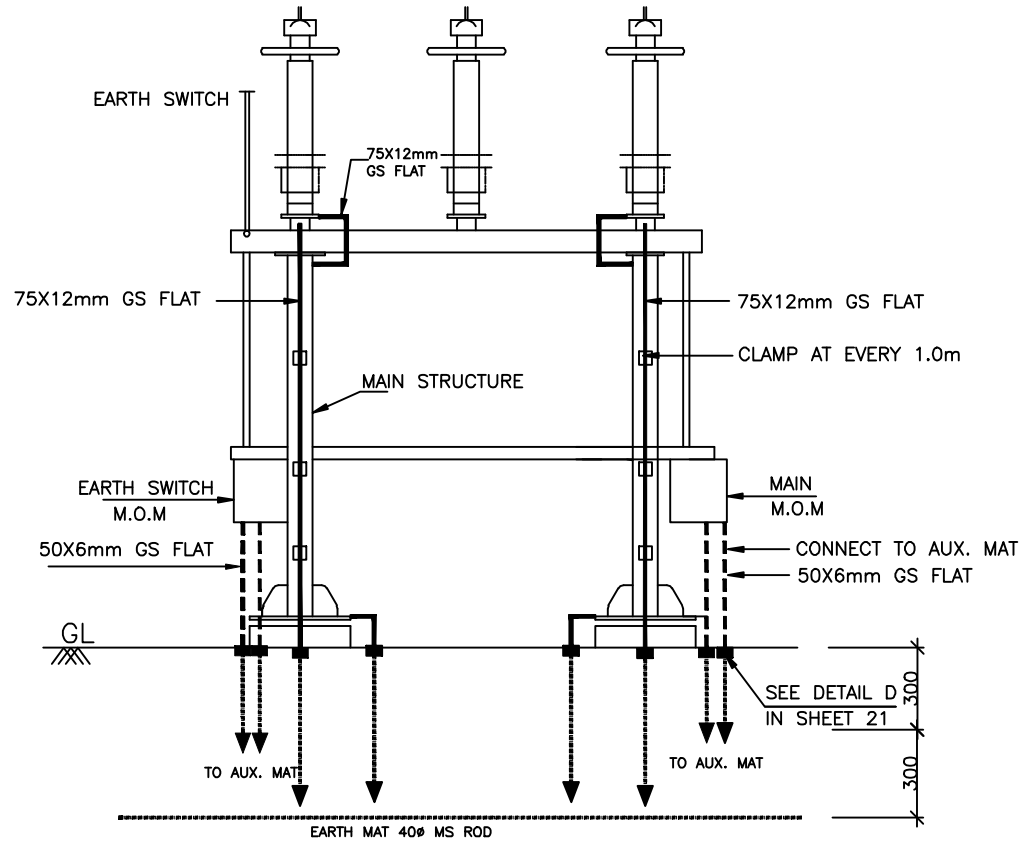
NOS.OF RISERS = 2 NOS.

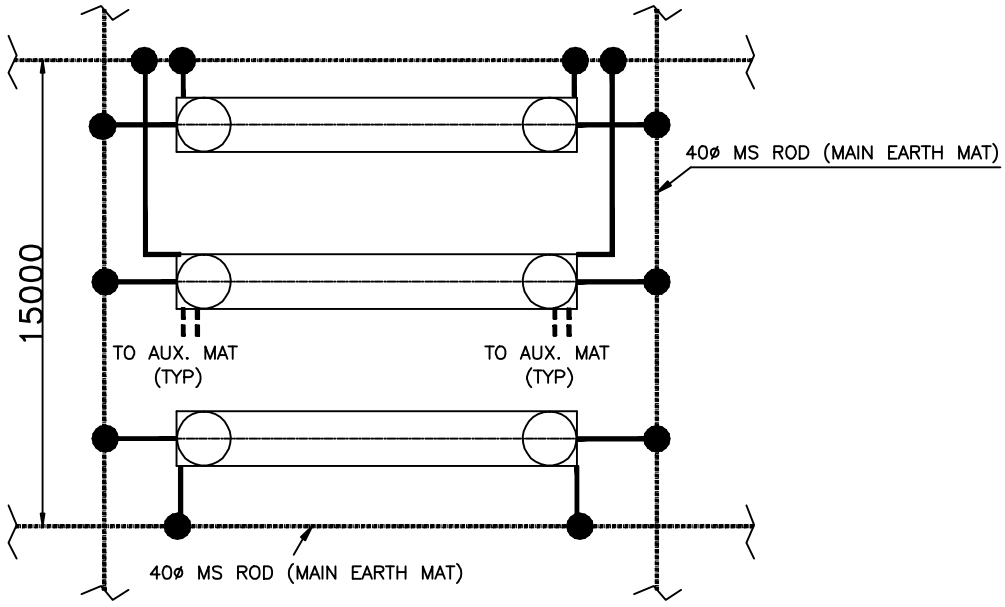
BHEL

EQUIPMENT EARTHING DETAILS

MARSHALLING KIOSK

COMPUTERREF.NO.	DRG. No. TB-4-369-316-009	SHEET No. 6

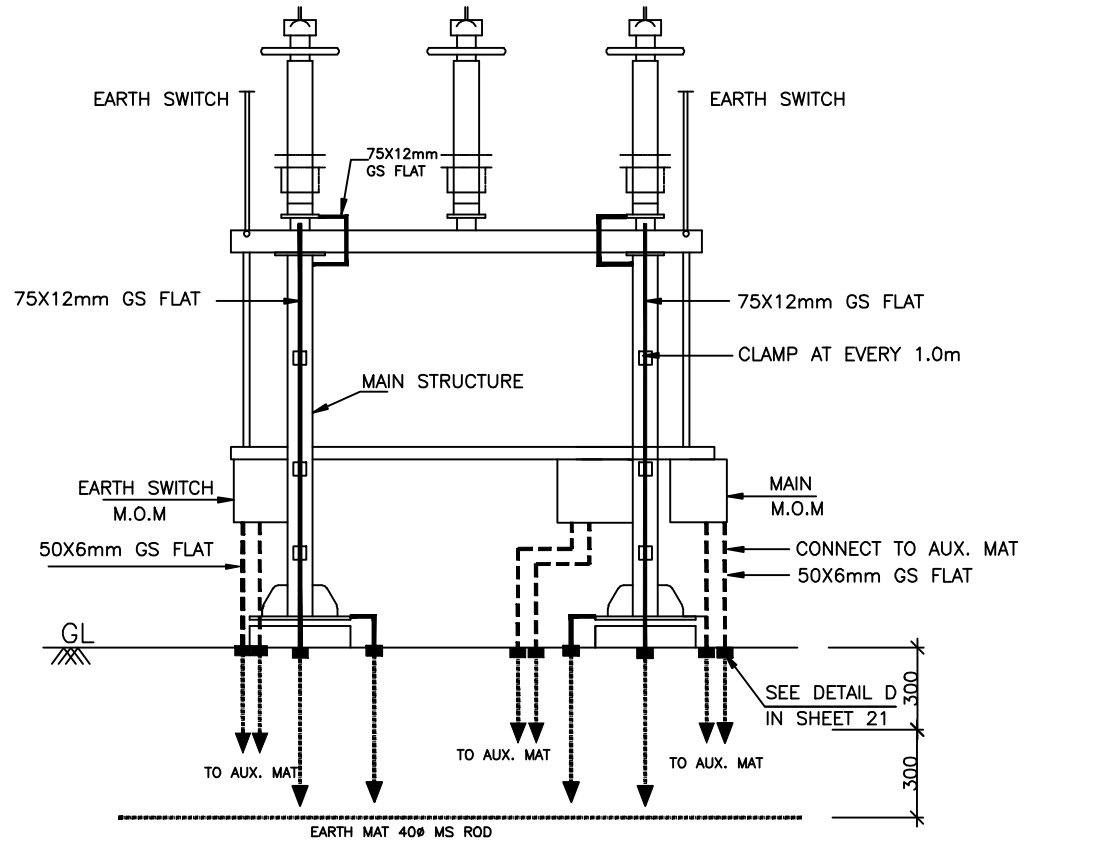


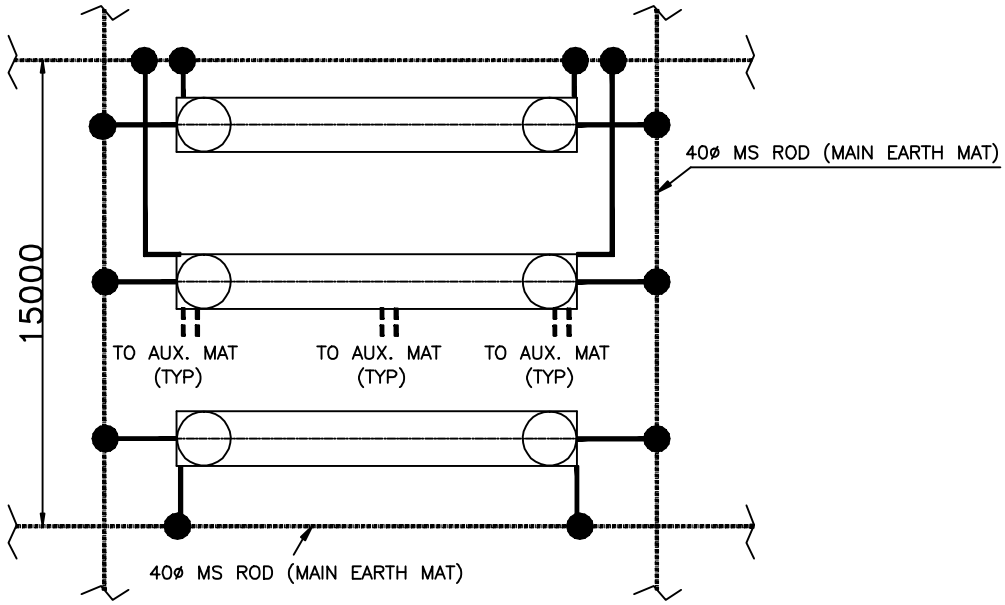


NOTES:

1. NO. OF RISER FOR EQUIPMENT = 4 Nos./PHASE
2. NO. OF RISER FOR MECHANISM BOX = 2 Nos./BOX
3. NO. OF AUXILIARY MAT = 1 No./BOX

BHEL	EQUIPMENT EARTHING DETAILS 400kV HORIZONTAL CENTER BREAK ISOLATOR (TYPICAL) WITH ONE EARTHSWITCH	
COMPUTERREF.NO.	DRG. No. TB–4–369–316–009	SHEET No. 7A

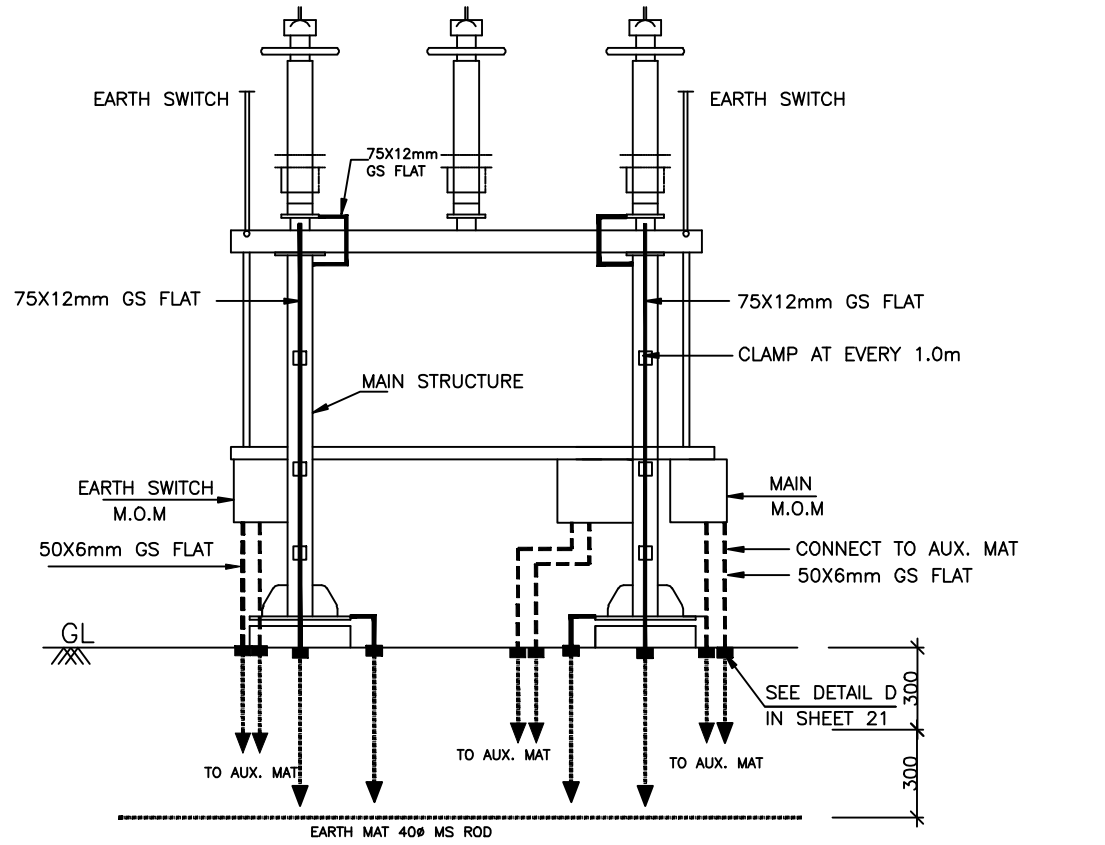


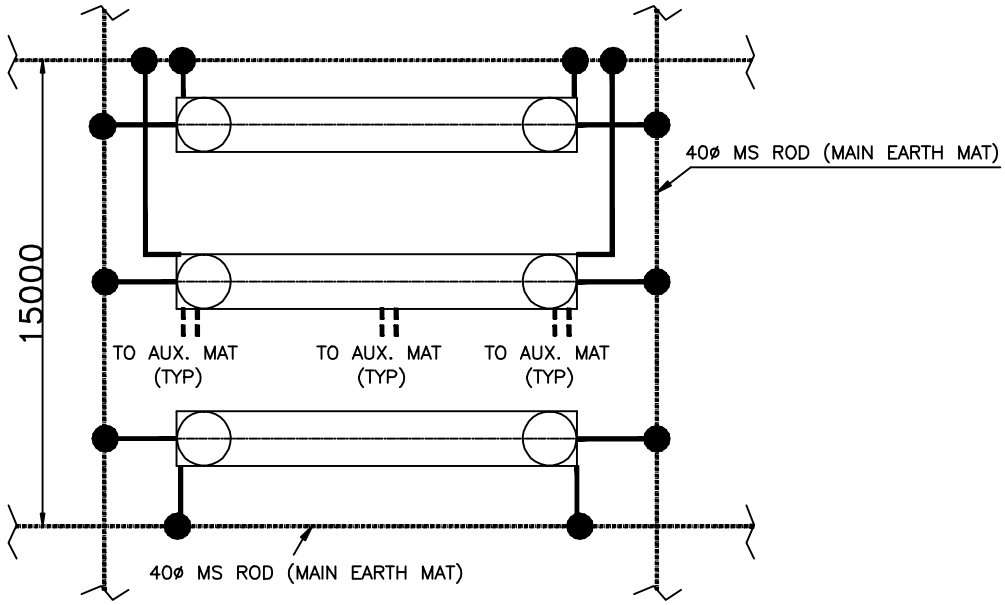


NOTES:

1. NO. OF RISER FOR EQUIPMENT = 4 Nos./PHASE
2. NO. OF RISER FOR MECHANISM BOX = 2 Nos./BOX
3. NO. OF AUXILIARY MAT = 1 No./BOX

भीएचईएल BHEL	EQUIPMENT EARTHING DETAILS 400kV HORIZONTAL CENTER BREAK ISOLATOR (TYPICAL) WITH TWO EARTHSWITCH	
COMPUTERREF.NO.	DRG. No. TB–4–369–316–009	SHEET No. 7B

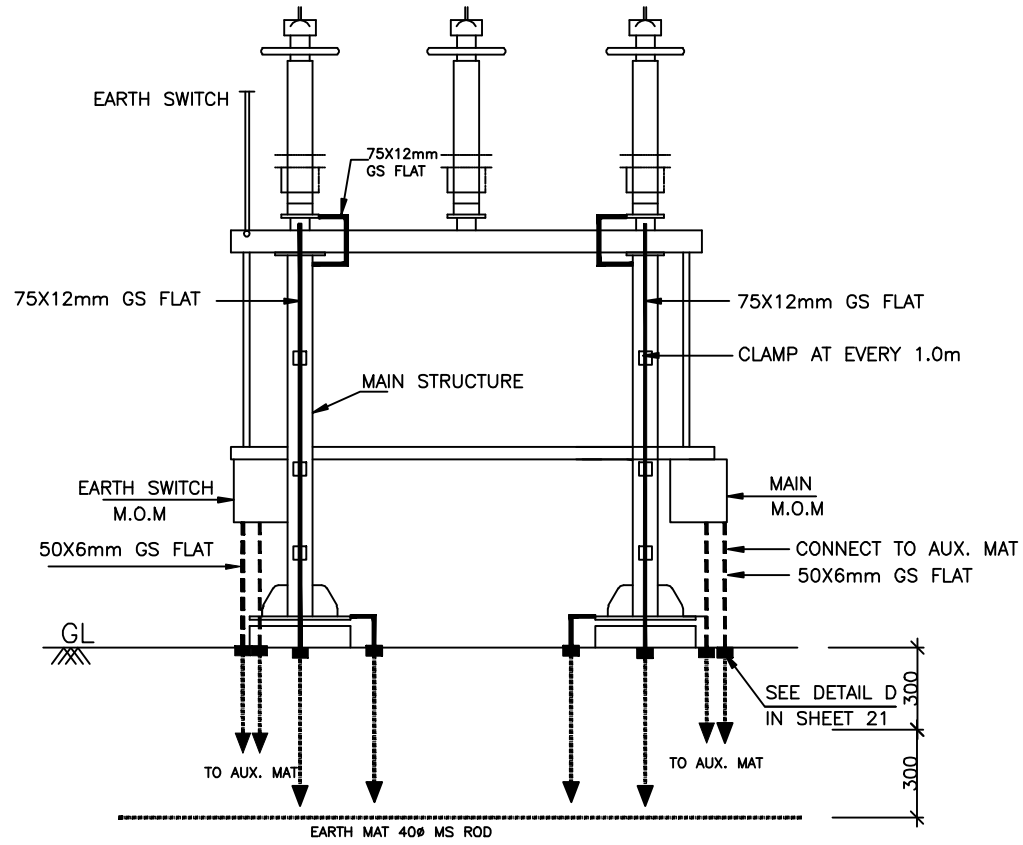


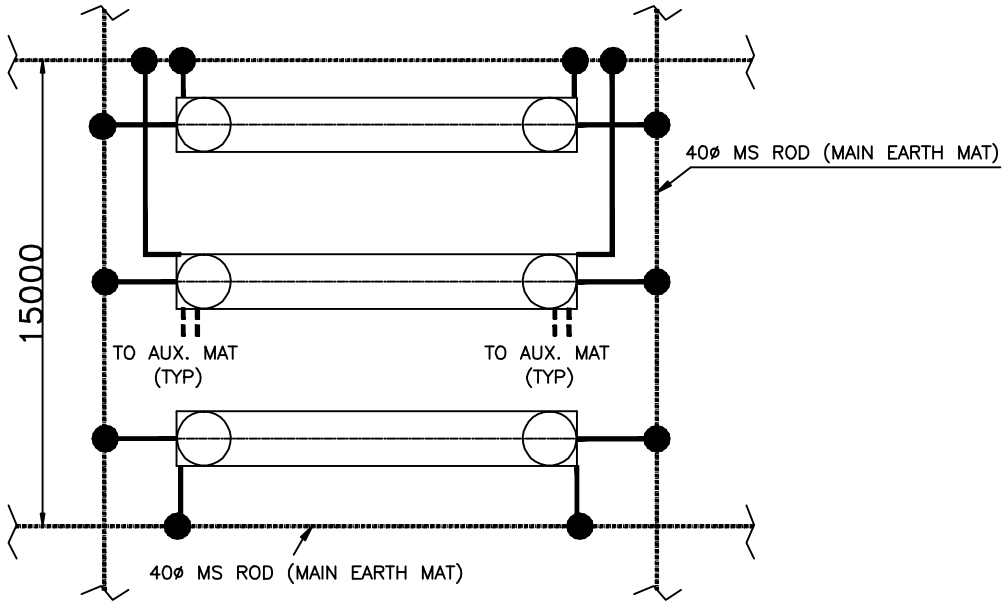


NOTES:

1. NO. OF RISER FOR EQUIPMENT = 4 Nos./PHASE
2. NO. OF RISER FOR MECHANISM BOX = 2 Nos./BOX
3. NO. OF AUXILIARY MAT = 1 No./BOX

भीएचईएल BHEL	EQUIPMENT EARTHING DETAILS 220KV HORIZONTAL CENTER BREAK ISOLATOR (TYPICAL) WITH TWO EARTHSWITCH	
COMPUTERREF.NO.	DRG. No. TB–4–369–316–009	SHEET No. 7C

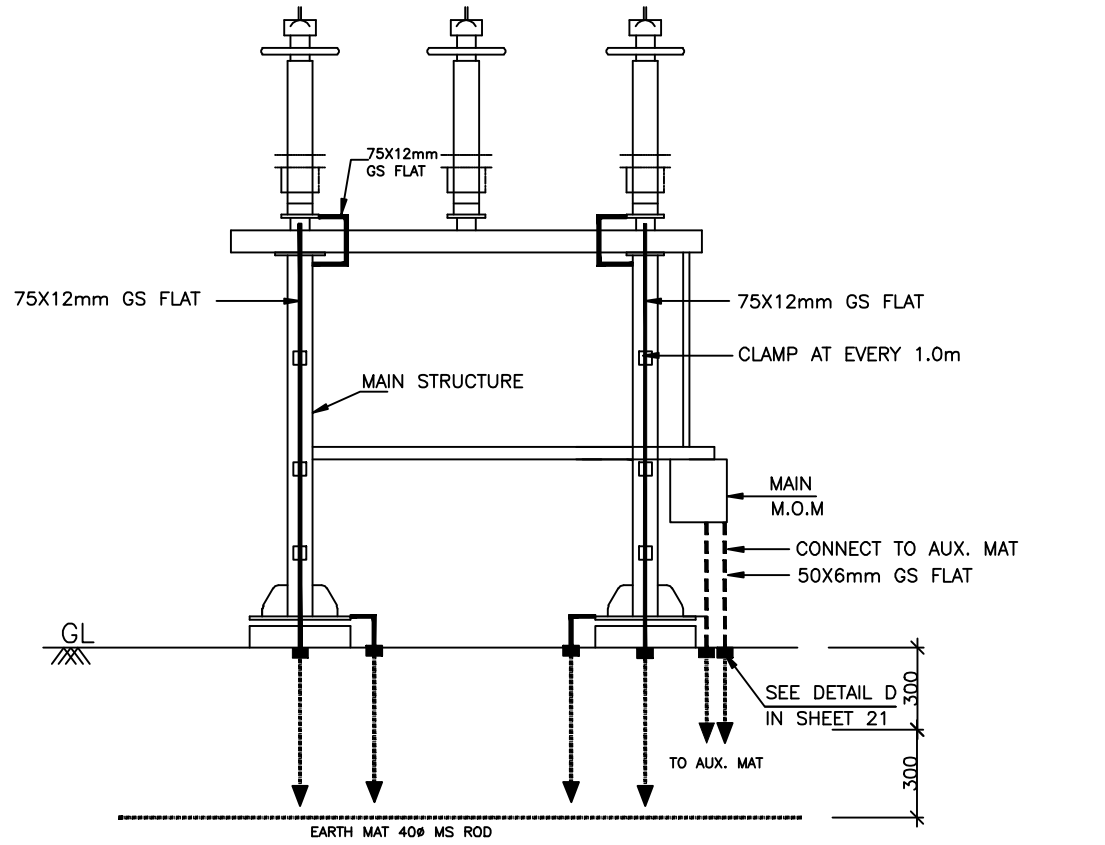


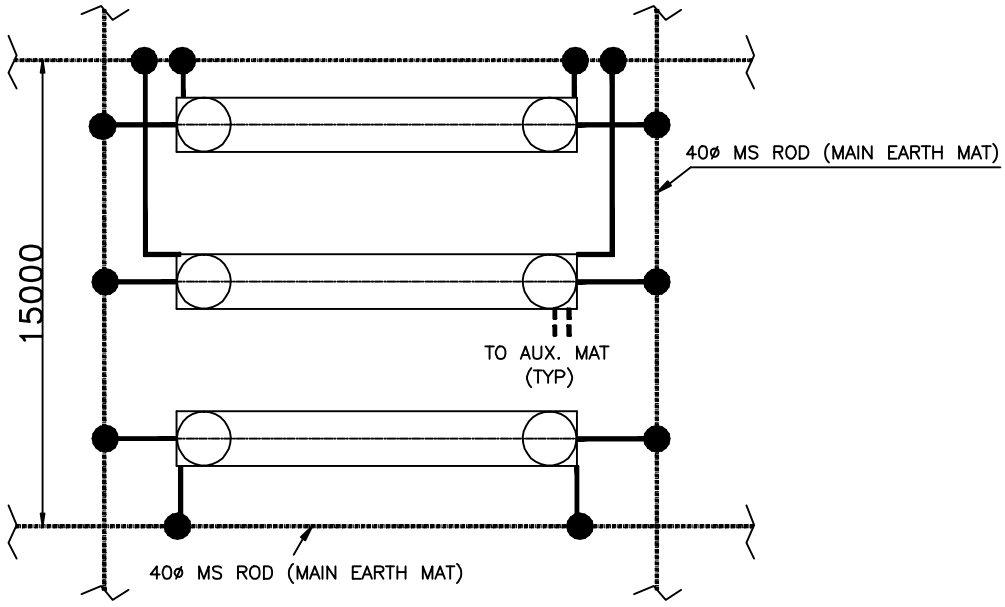


NOTES:

1. NO. OF RISER FOR EQUIPMENT = 4 Nos./PHASE
2. NO. OF RISER FOR MECHANISM BOX = 2 Nos./BOX
3. NO. OF AUXILIARY MAT = 1 No./BOX

BHEL	EQUIPMENT EARTHING DETAILS 220KV HORIZONTAL CENTER BREAK ISOLATOR (TYPICAL) WITH ONE EARTHSWITCH	
COMPUTERREF.NO.	DRG. No. TB–4–369–316–009	SHEET No. 7D

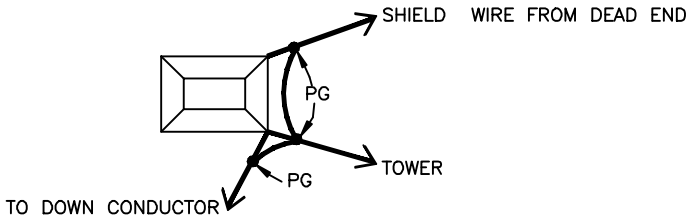




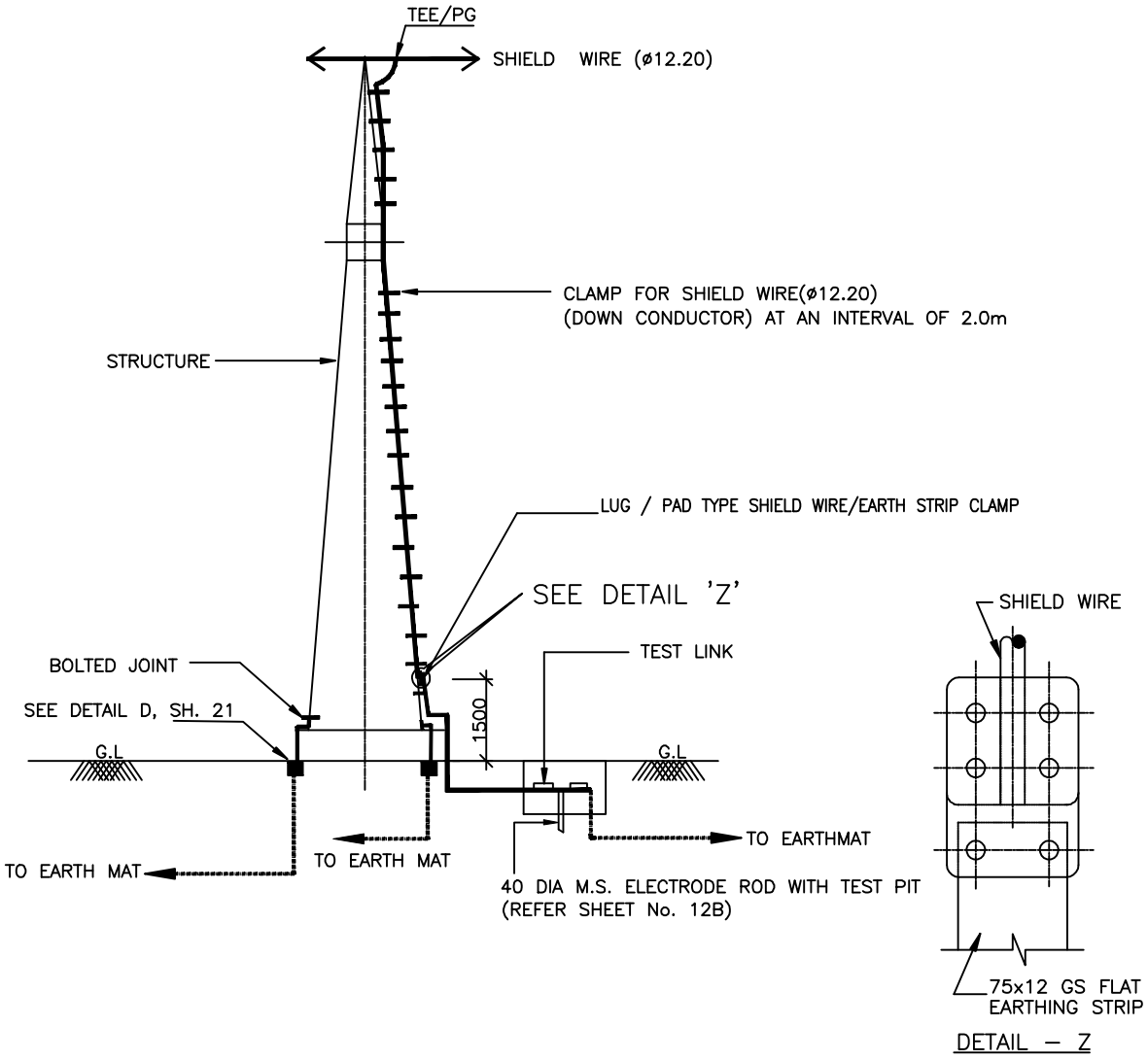
NOTES:

1. NO. OF RISER FOR EQUIPMENT = 4 Nos./PHASE
2. NO. OF RISER FOR MECHANISM BOX = 2 Nos./BOX
3. NO. OF AUXILIARY MAT = 1 No./BOX

BHEL	EQUIPMENT EARTHING DETAILS 220KV HORIZONTAL CENTER BREAK ISOLATOR (TYPICAL) WITHOUT EARTHSWITCH	
COMPUTERREF.NO.	DRG. No. TB–4–369–316–009	SHEET No. 7E



DETAIL WHEN 2 E/WIRES TERMINATES A TOWER

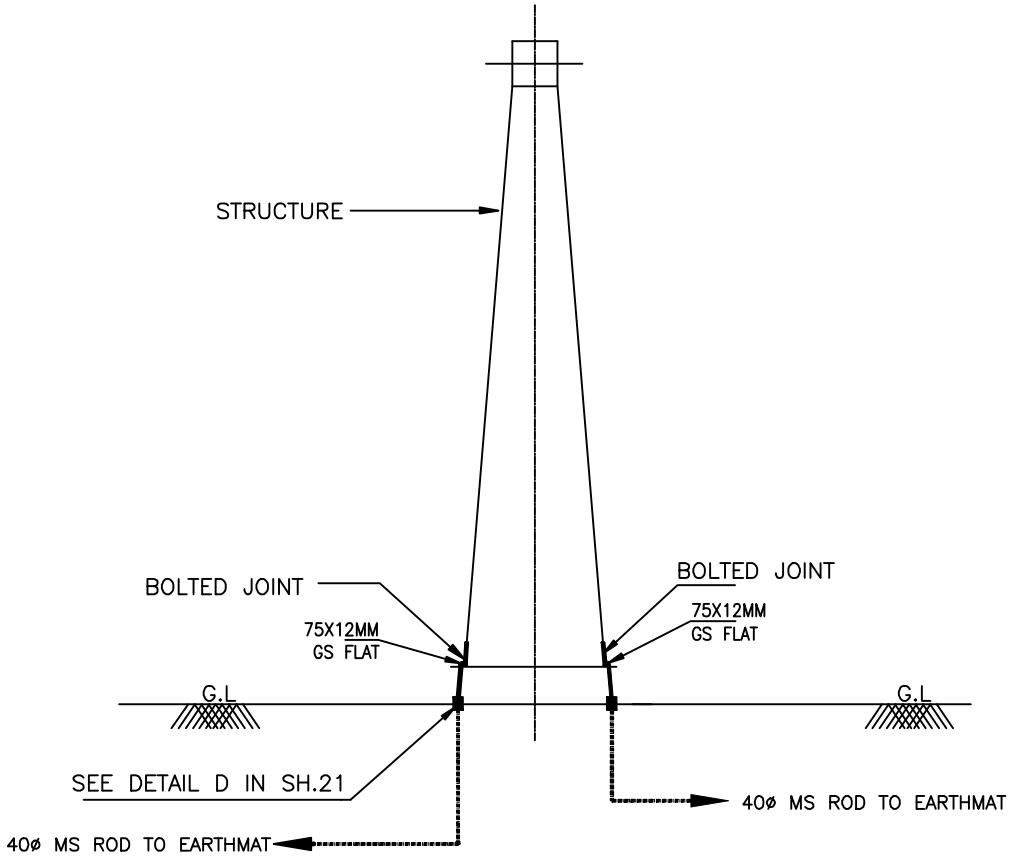


DETAIL – Z

NOTE:

1. TWO EARTHING STRIP SHALL BE CONNECTED TO ONE RISER.
2. NO. OF ROD ELECTRODE : 1 NO. PER TOWER WITH DOWN CONDUCTOR.
3. NO. OF RISERS = 2 NOS.

BHEL	EQUIPMENT EARTHING DETAILS TOWER WITH PEAK	
COMPUTERREF.NO.	DRG. No. TB–4–369–316–009	SHEET No. 8A

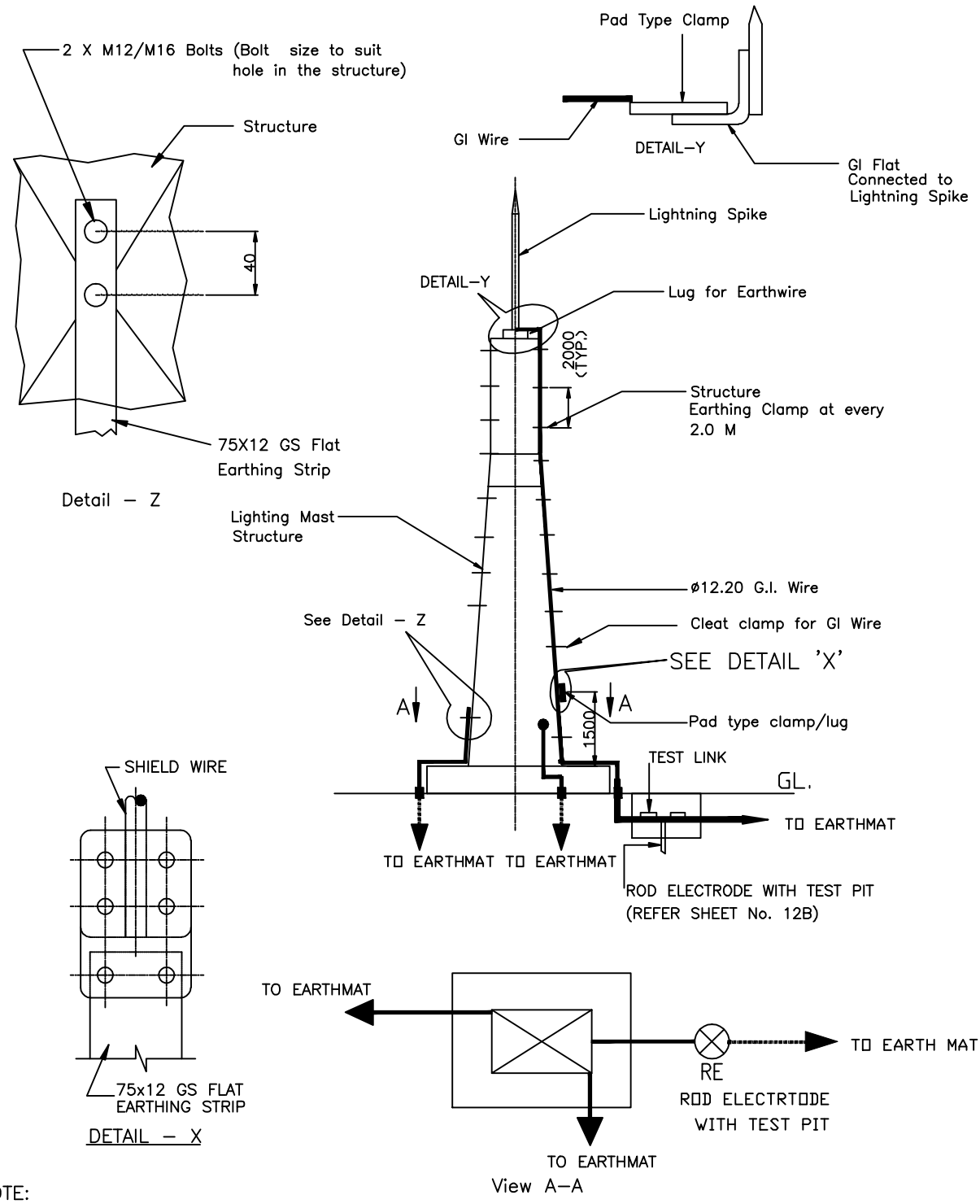


NOS.OF RISERS = 2 NOS. PER TOWER

EQUIPMENT EARTHING DETAILS

TOWER WITHOUT PEAK

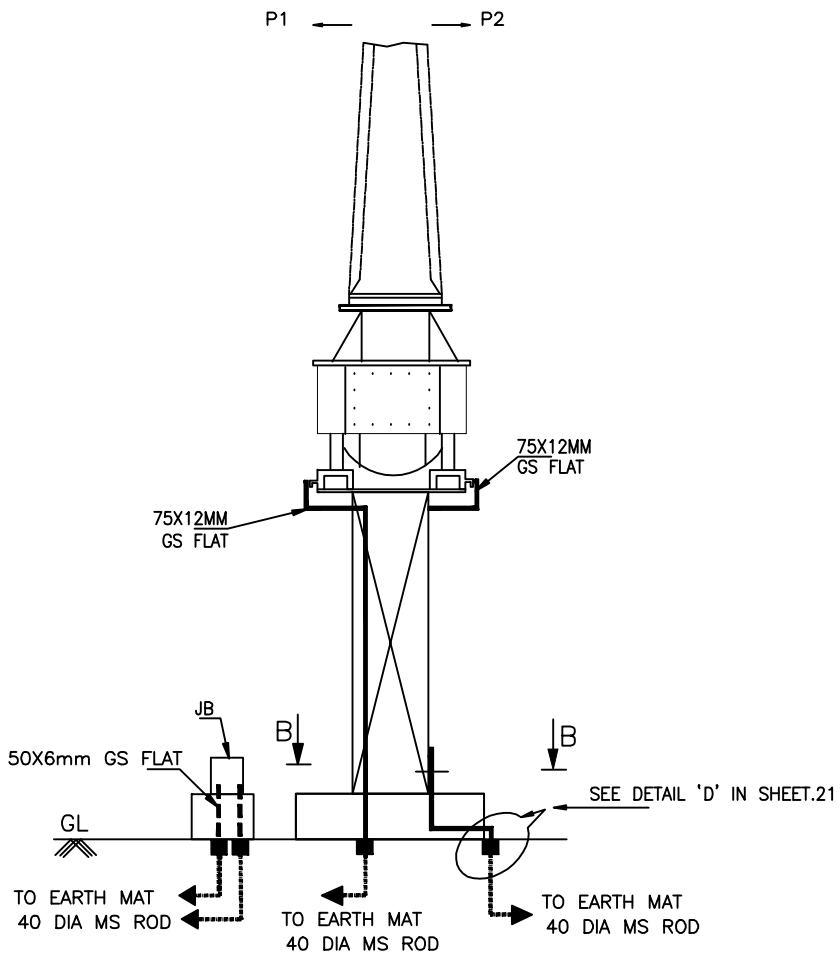
COMPUTERREF.NO.	DRG. No.	SHEET No.
	TB-4-369-316-009	8B

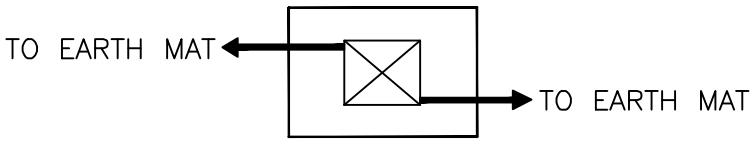


NOTE:

1. TWO EARTHING STRIP SHALL BE CONNECTED TO ONE RISER.
2. NO. OF ROD ELECTRODE WITH TEST PIT : 1 NO.
3. PAD TYPE CLAMP 1 NOS.
4. THE DOWN CONDUCTORS (E/WIRE) SHALL BE CONNECTED TO EARTH ELECTRODE.

BHEL	EQUIPMENT EARTHING DETAILS LIGHTENING MAST (LM)	
COMPU. DRG. REF.	DRG.NO. TB–4–369–316–009	SHEET No. 8C



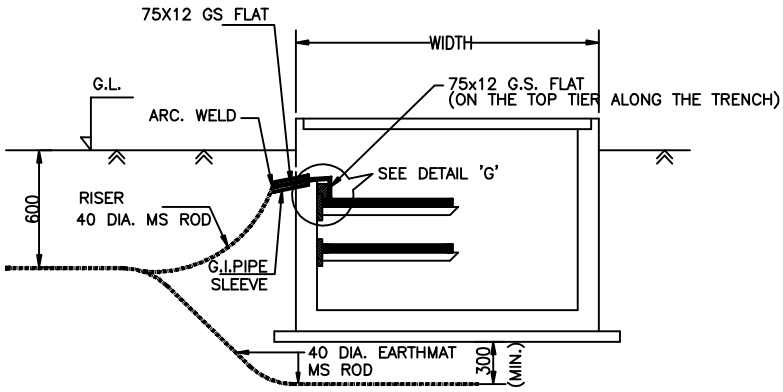


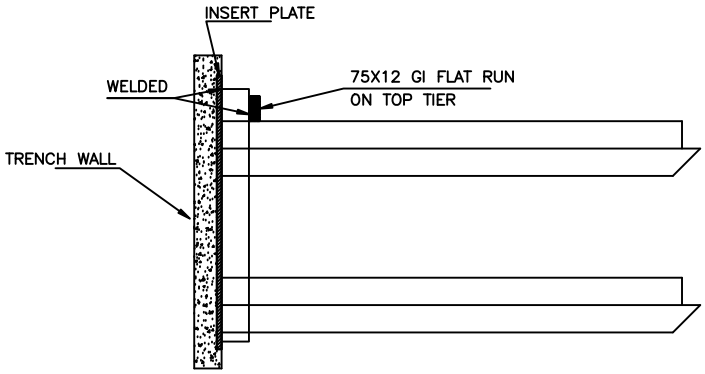
View B–B

NOS.OF RISERS

= 2 NOS. PER PHASE FOR CT
+ 2 NOS. FOR CT JB

बीएचईएल BHEL	EQUIPMENT EARTHING DETAILS 400kV & 220kV CURRENT TRANSFORMER	
COMPU. DRG. REF.	DRG.NO. TB–4–369–316–009	SHEET No. 9





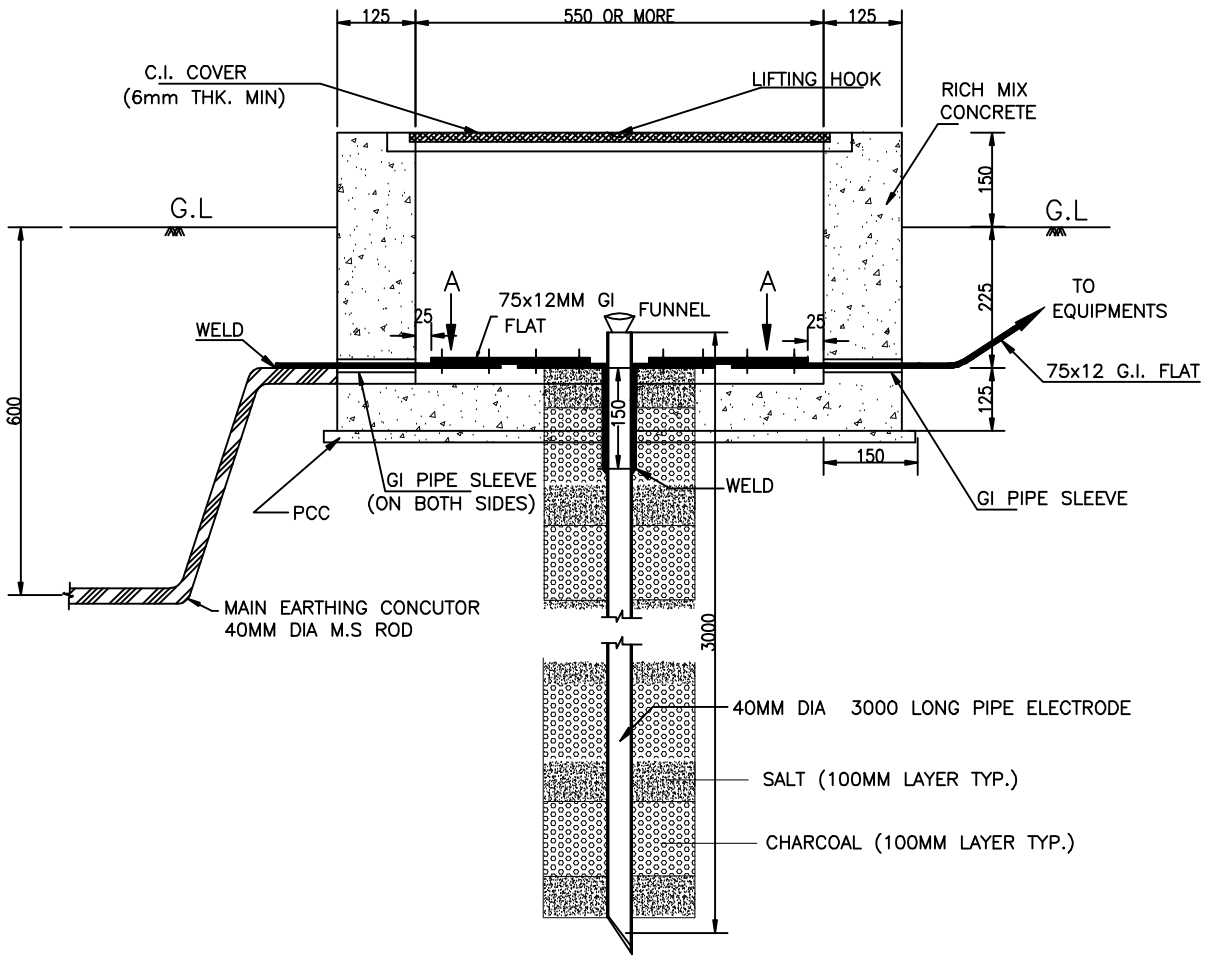
DETAIL 'G'

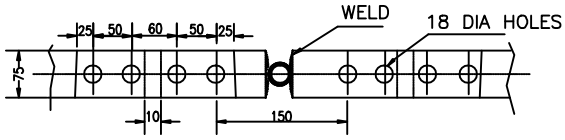
DETAIL FOR CONNECTING GI FLAT RUNNING
ON TOP TIER TRENCH TO EMBEDDED PLATE.

NOTE:

1. RISERS SHALL BE PROVIDED AT AN INTERVAL OF 20M ALONG THE LENGTH OF TRENCH.
2. THE EARTH STRIP (75x12 G.S. FLAT) SHALL BE WELDED/CLEATED TO TOP RACK ALONG THE TRENCH RUN AT EVERY 0.75M.
3. WHERE THE CABLE RACKS ARE PROVIDED ON BOTH SIDES OF THE TRENCH, BOTH SIDES SHALL BE EARTHED AS PER ABOVE.
4. CABLE & CABLE TRAY EARTHING SHALL BE DONE AS PER SPECIFICATION.

BHEL	EQUIPMENT EARTHING DETAILS CABLE TRENCH	
COMPU. DRG. REF.	DRG. NO. TB-4-369-316-009	SHEET 10



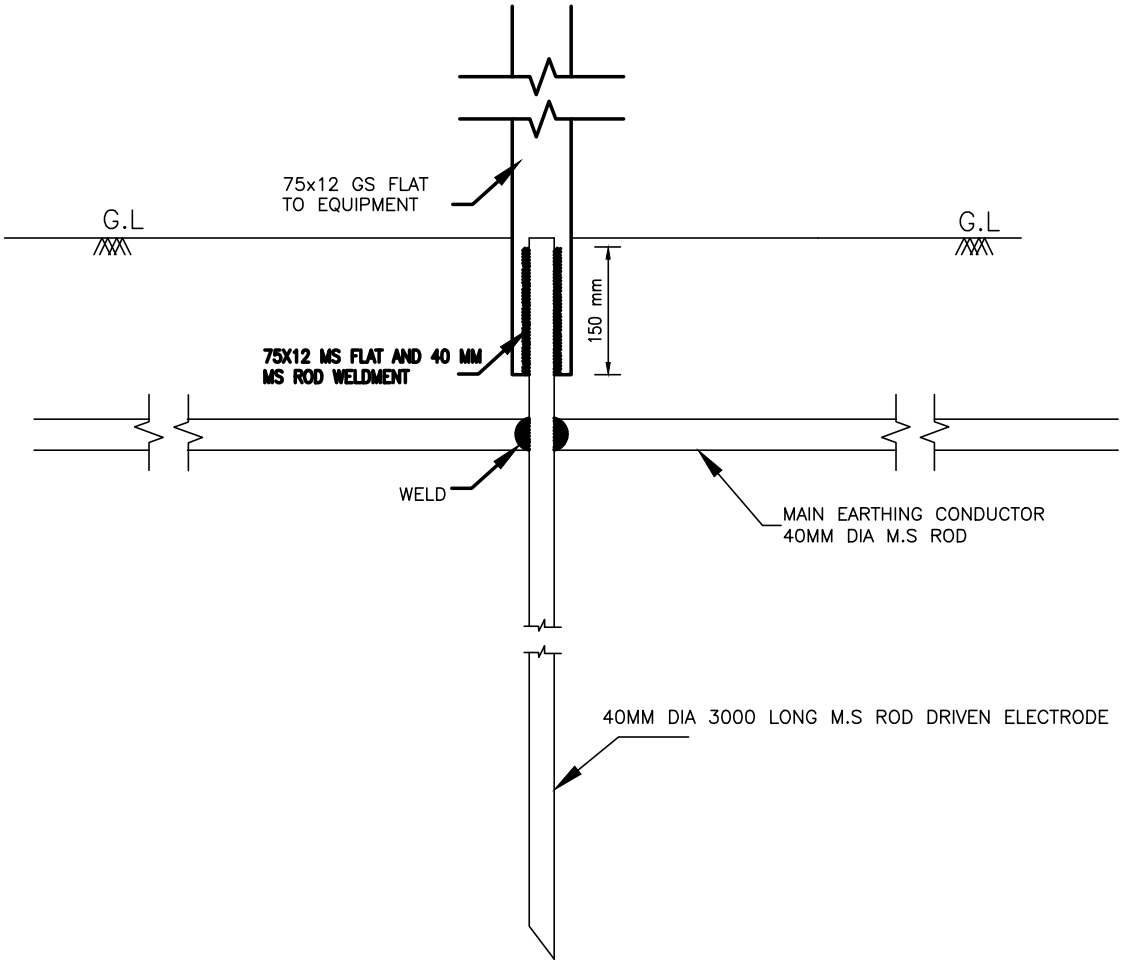


VIEW–'A'

NOTE:

1. SUPPLY OF FIXING BOLTS NUTS & WASHERS FOR GI FLAT EARTHING CONDUCTOR IS ALSO FORMS PART OF THE SCOPE.
2. TO BE USED FOR CONNECTING TRANSFORMER /REACTOR NEUTRAL

बीएचईएल BHEL	EQUIPMENT EARTHING DETAILS PIPE EARTH ELECTRODE WITH TREATED PIT	
COMPU. DRG. REF.	DRG. No. TB–4–369–316–009	SHEET No. 11

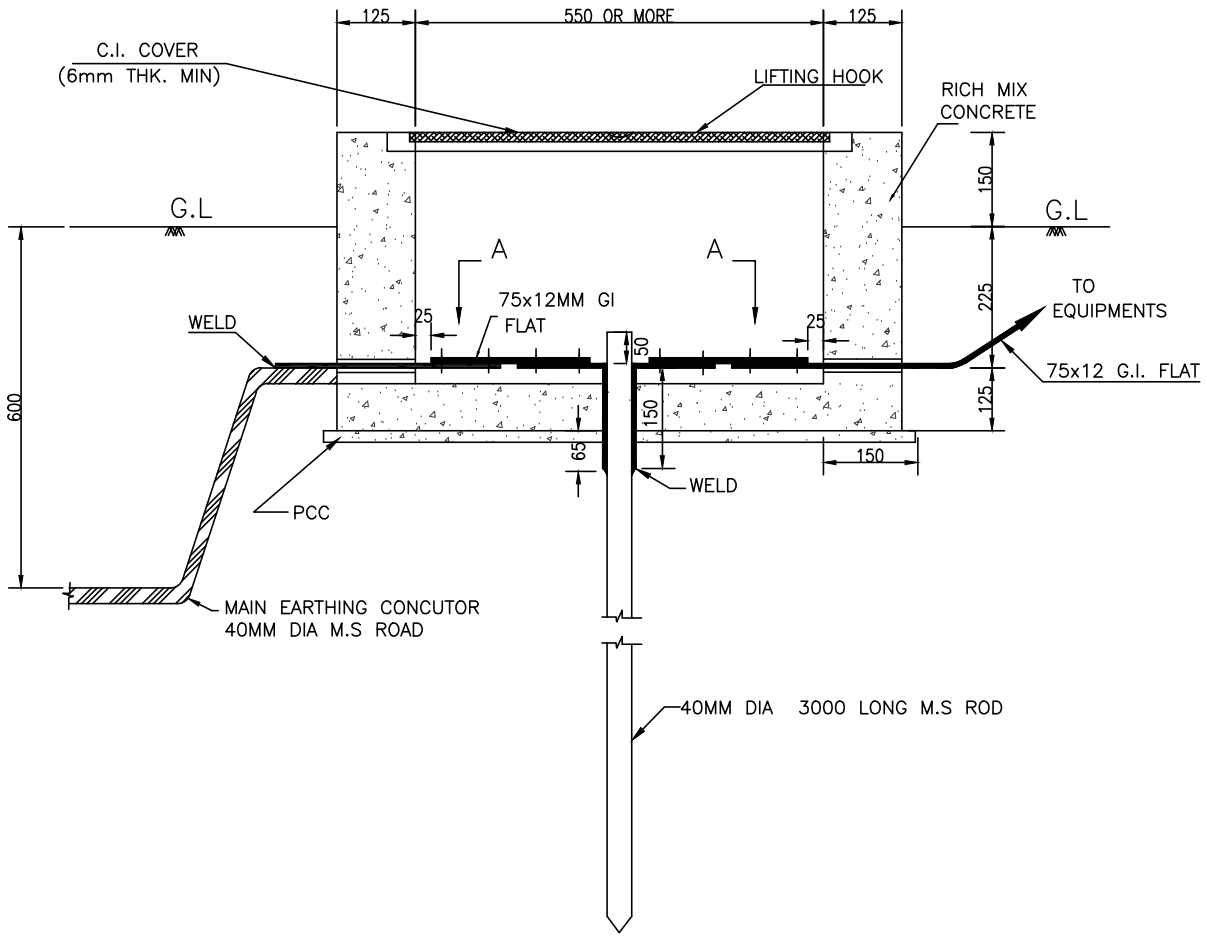


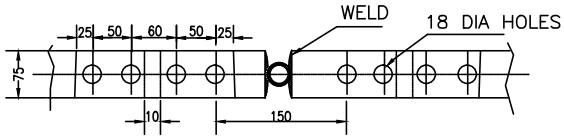
APPLICABLE FOR CVT & LA

NOTES:–

1. SUPPLY OF FIXING BOLTS NUTS & WASHERS FOR GI FLAT EARTHING CONDUCTOR IS ALSO FORMS PART OF THE SCOPE.
2. ALL NUTS, BOLTS & WASHERS SHALL BE GALVANISED.

बीएचईएल BHEL	EQUIPMENT EARTHING DETAILS ROD ELECTRODE WITHOUT PIT (FOR CVT & LA)	
COMPU. DRG. REF.	DRG.NO. TB–4–369–316–009	SHEET No. 12A



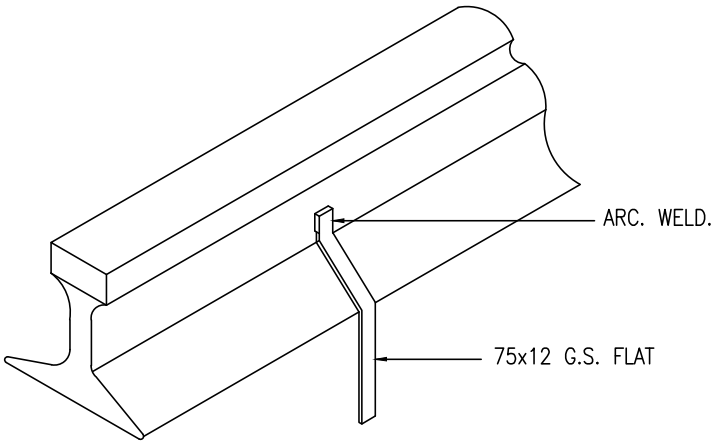


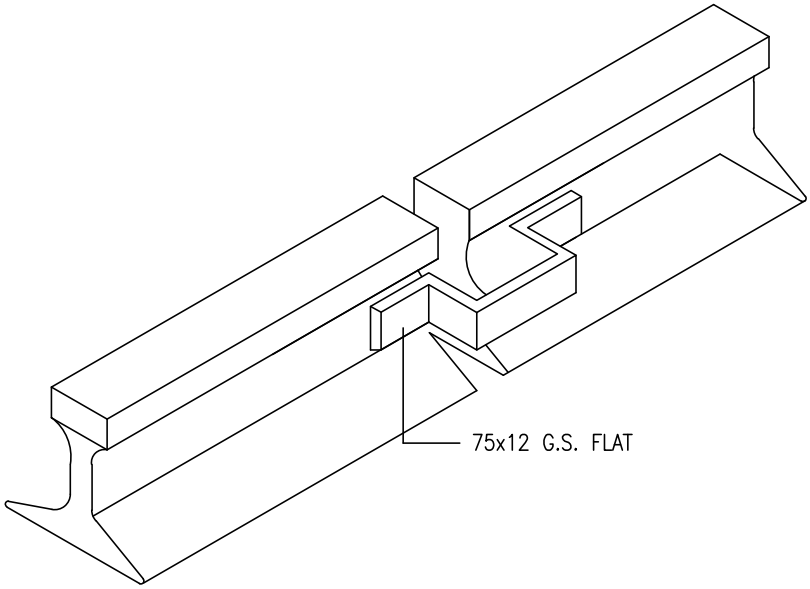
VIEW–'A'

NOTES:–

1. SUPPLY OF FIXING BOLTS NUTS & WASHERS FOR GI FLAT EARTHING CONDUCTOR IS ALSO FORMS PART OF THE SCOPE.
2. TO BE USED FOR CONNECTING DOWN CONDUCTOR OF LIGHTINING MASTS & TOWERS WITH PEAK.

बीएचईएल BHEL	EQUIPMENT EARTHING DETAILS ROD EARTH ELECTRODE WITH TEST PIT FOR TOWERS WITH PEAK & LM	
COMPU. DRG. REF.	DRG. No. TB–4–369–316–009	SHEET No. 12B

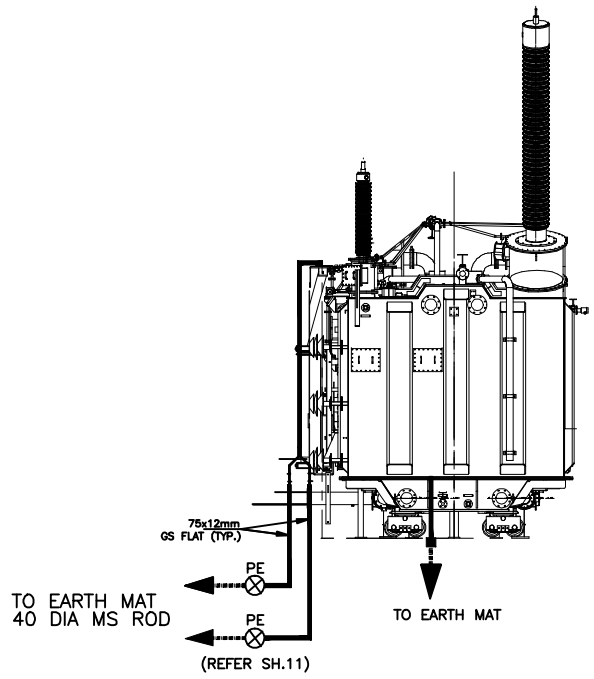


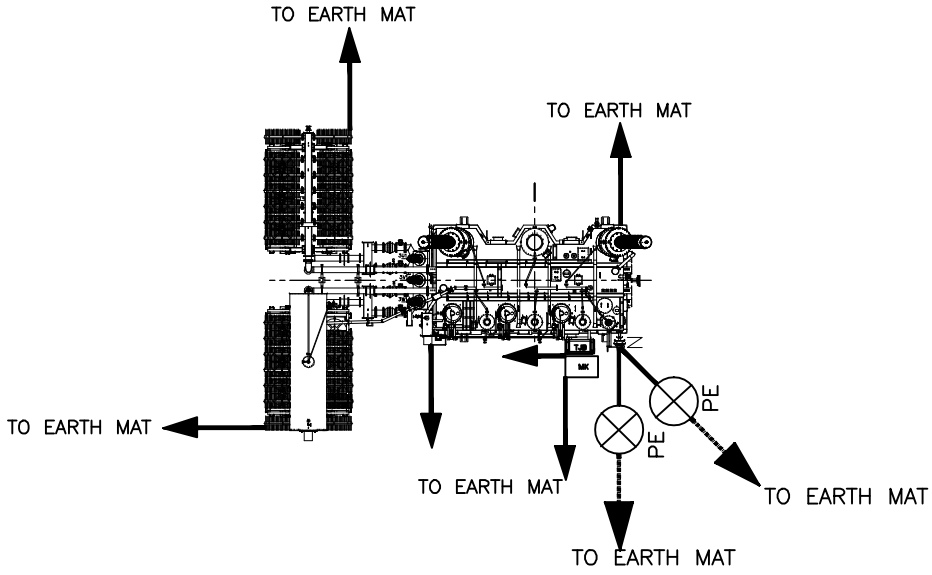


NOTE:–

1. RAILWAY TRACKS WITHIN SWITCHYARD AREA SHALL BE EARTHED AT A SPACING OF 30 m AND ALSO AT BOTH ENDS.

BHEL	EQUIPMENT EARTHING DETAILS RAIL BONDING	
COMPU. DRG. REF.	DRG. NO. TB–4–369–316–009	SHEET No. 13





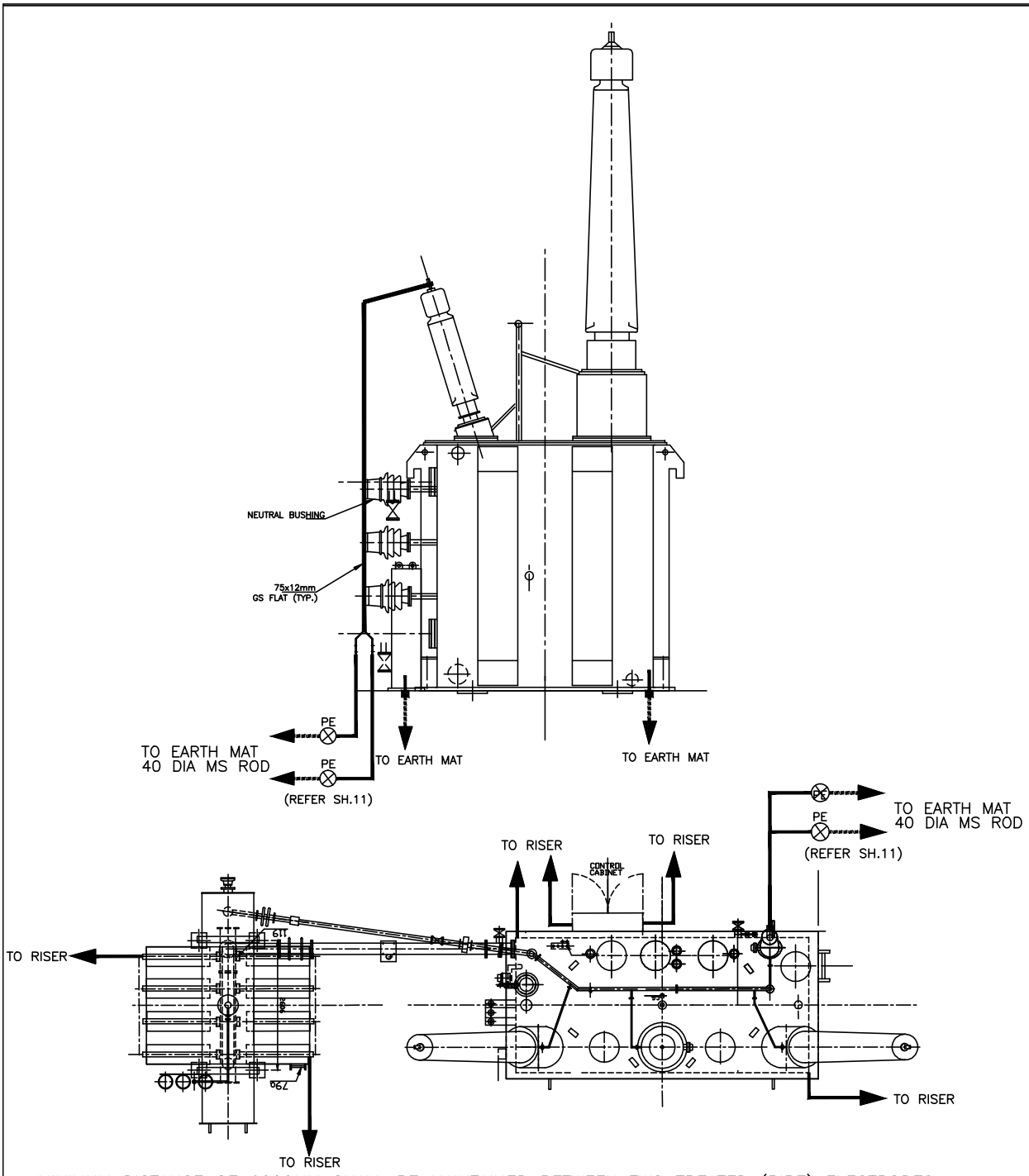
MINIMUM DISTANCE OF 6000MM SHALL BE MAINTAINED BETWEEN TWO TREATED (PIPE) ELECTRODES.
NO.OF PIPE EARTH ELECTRODE WITH TREATED PIT (REFER SHEET NO. 11) = 2 NOS.
NO.OF RISERS = 8 NOS. FOR EARTHING OF FOLLOWING PARTS OF AUTO TRANSFORMER
(TWO EARTHING STRIPS CAN BE CONNECTED TO ONE RISER)

MAIN TANK	2 Nos. (75x12 GS FLAT)
RADIATOR BANK	2 Nos. (75x12 GS FLAT)
MARSHALLING BOX	2 Nos./BOX (50x6 GS FLAT)
NEUTRAL EARTHING	2 Nos. (75x12 GS FLAT THROUGH PIPE ELECTRODE)

BHEL

EQUIPMENT EARTHING DETAILS
AUTO TRANSFORMER

COMPU. DRG. REF.	Report No. TB–4–369–316–009	SHEET No. 14A



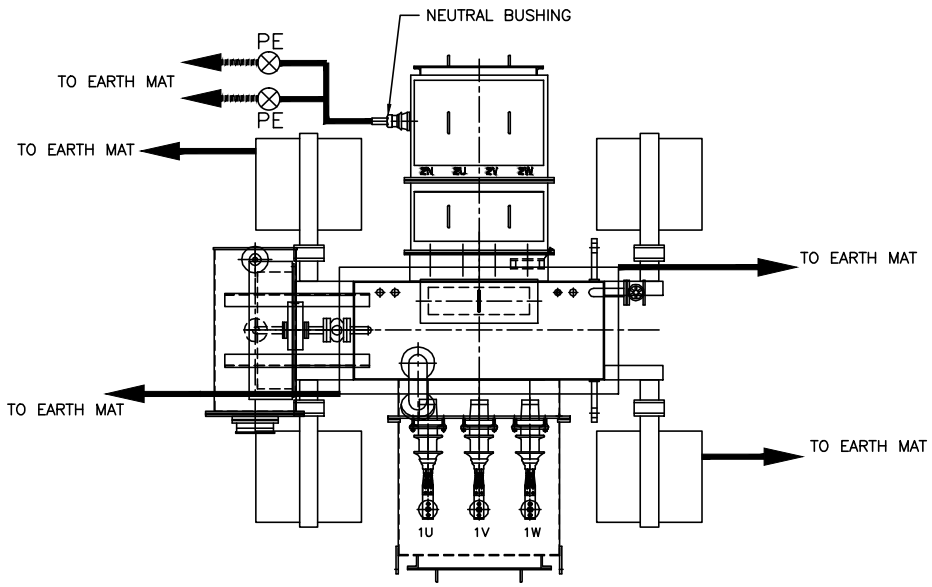
MINIMUM DISTANCE OF 6000MM SHALL BE MAINTAINED BETWEEN TWO TREATED (PIPE) ELECTRODES.
NO. OF PIPE EARTH ELECTRODE WITH TREATED PIT (REFER SHEET NO. 11) = 2 NOS.
NO.OF RISERS = 8 NOS. FOR EARTHING OF FOLLOWING PARTS OF 400KV BUS REACTOR
(TWO EARTHING STRIPS CAN BE CONNECTED TO ONE RISER)

MAIN TANK	– 2 Nos. (75x12 GS FLAT)
RADIATOR SUPPORT	– 2 Nos. (75x12 GS FLAT)
CONTROL CABINET/MB	– 2 Nos. (50x6 GS FLAT)
NEUTRAL EARTHING	– 2 Nos. (75x12 GS FLAT THROUGH PIPE ELECTRODE)

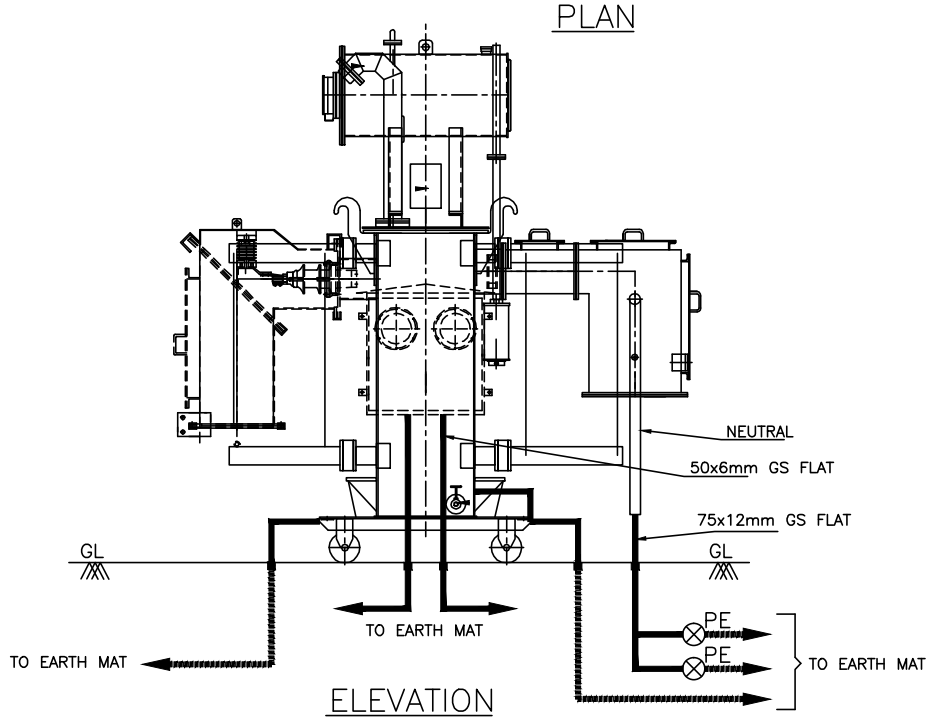
BHEL

EQUIPMENT EARTHING DETAILS
BUS REACTOR

COMPU. DRG. REF.	DRG. NO.	SHEET
	TB–4–369–316–009	14B



PLAN



ELEVATION

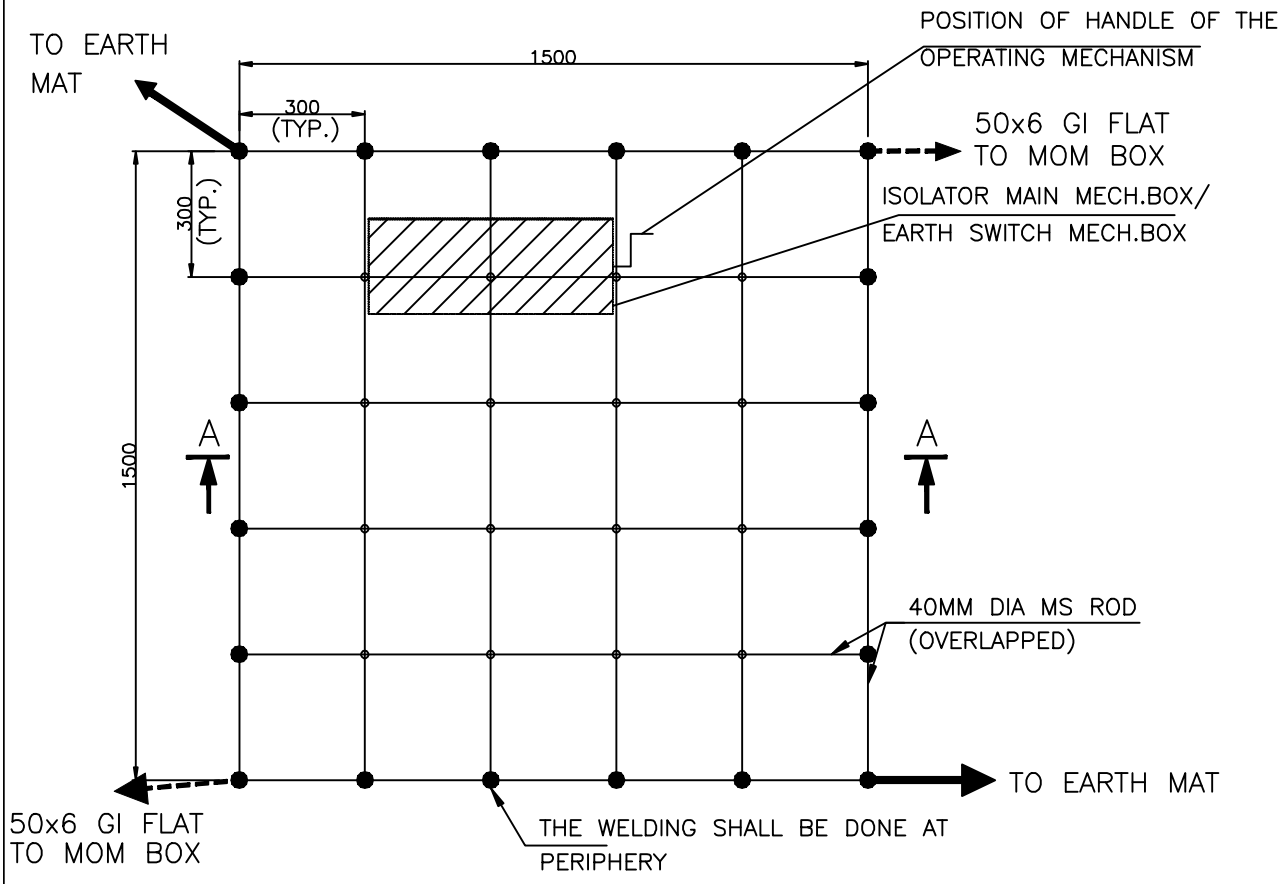
MINIMUM DISTANCE OF 6000MM SHALL BE MAINTAINED BETWEEN TWO TREATED (PIPE) ELECTRODES.
NO.OF PIPE EARTH ELECTRODE WITH TREATED PIT (REFER SHEET NO. 11) = 2 NOS.
NO.OF RISERS = 6 NOS. FOR EARTHING OF FOLLOWING PARTS OF TRANSFORMER
(TWO EARTHING STRIPS CAN BE CONNECTED TO ONE RISER):

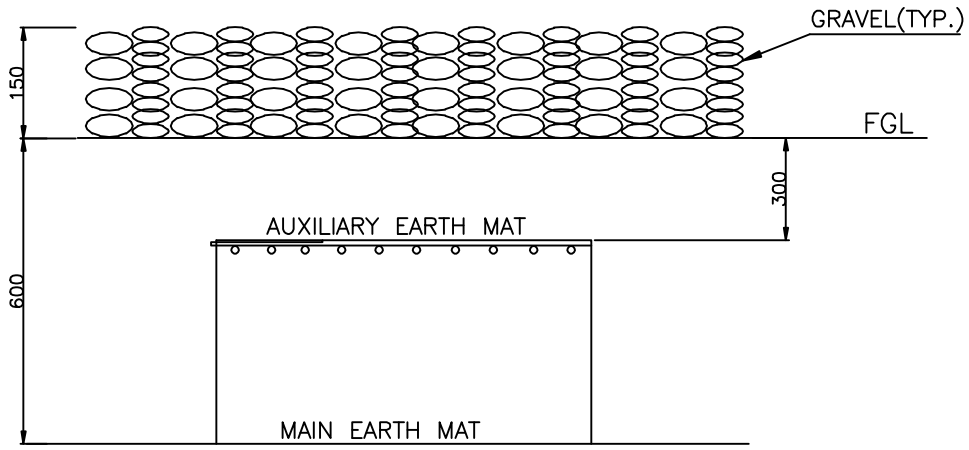
MAIN TANK	2 Nos. (75x12 GS FLAT)
RADIATOR BANK	2 Nos. (75x12 GS FLAT)
MARSHALLING BOX	2 Nos. (50x6 GS FLAT)
NEUTRAL EARTHING	2 Nos. (75x12 GS FLAT THROUGH PIPE ELECTRODE)

EQUIPMENT EARTHING DETAILS

SWITCHYARD SERVICE TRANSFORMER

	DRG. No.	SHEET No.
	TB-4-369-316-009	14C



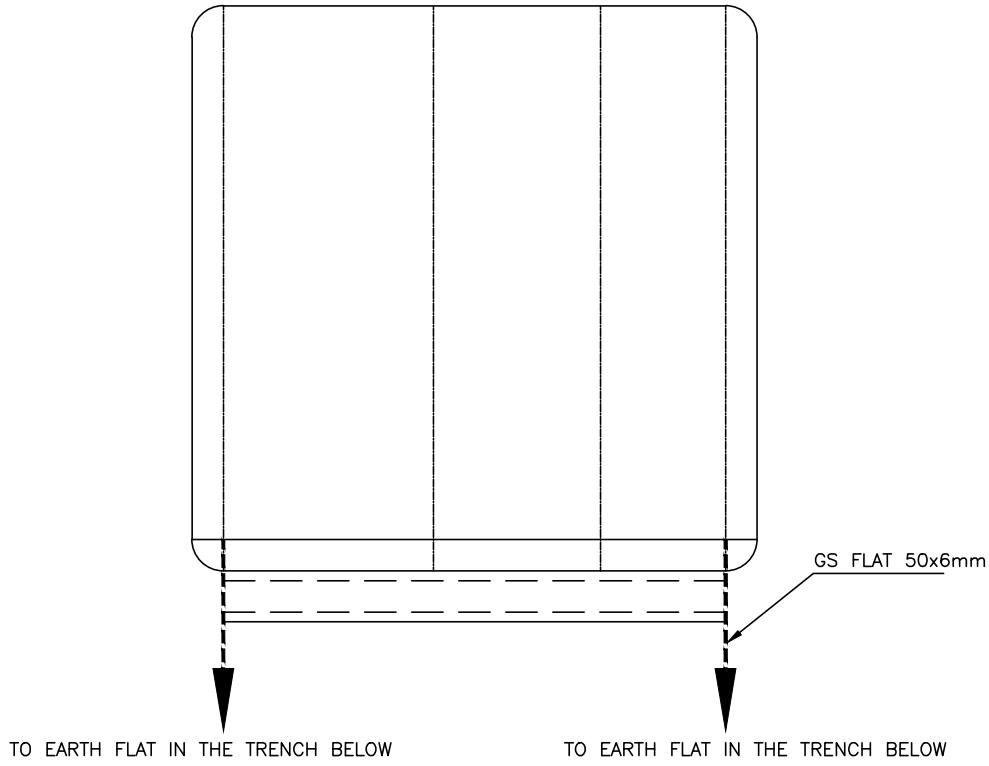


SECTION AA

NOTE:

AUX. EARTH MAT SHALL BE SO POSITIONED THAT THE FOOT OF THE OPERATOR ALWAYS LIE OVER THE AUX. EARTH MAT AREA WHILE ATTENDING / OPERATING THE MECH. BOX THE CABLE TRENCH ROUTING SHALL BE PLANNED ACCORDINGLY.

BHEL	EQUIPMENT EARTHING DETAILS AUXILIARY EARTH MAT FOR ISOLATOR MAIN MECH.,E/S MECH. BOX	
COMPU. DRG. REF.	Report No. TB-4-369-316-009	SHEET No. 15

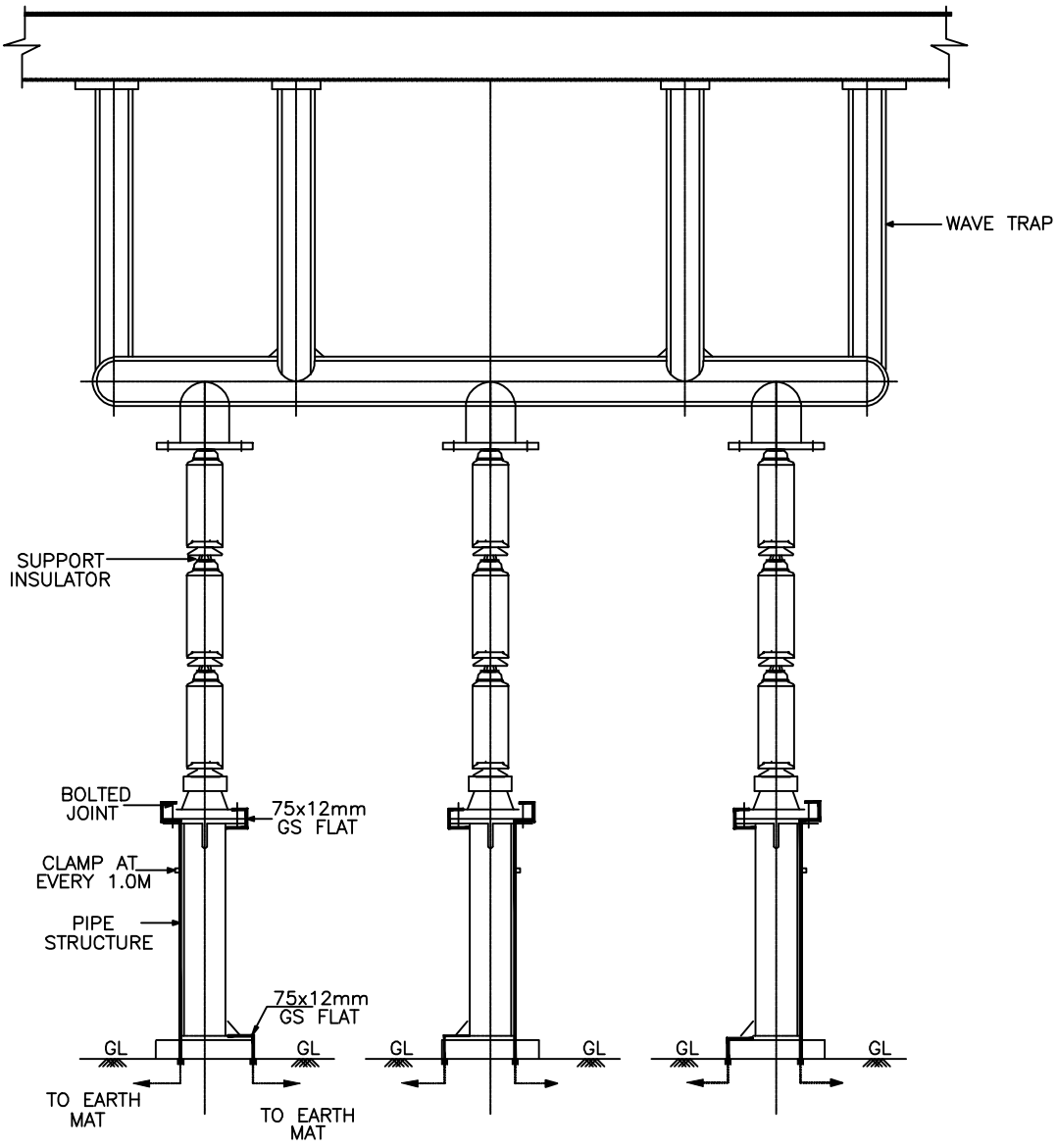


EQUIPMENT EARTHING DETAILS

ALL PANELS/KIOSKS/MBs/BATTERY CHARGER/AC DC BOARDS/MLDB

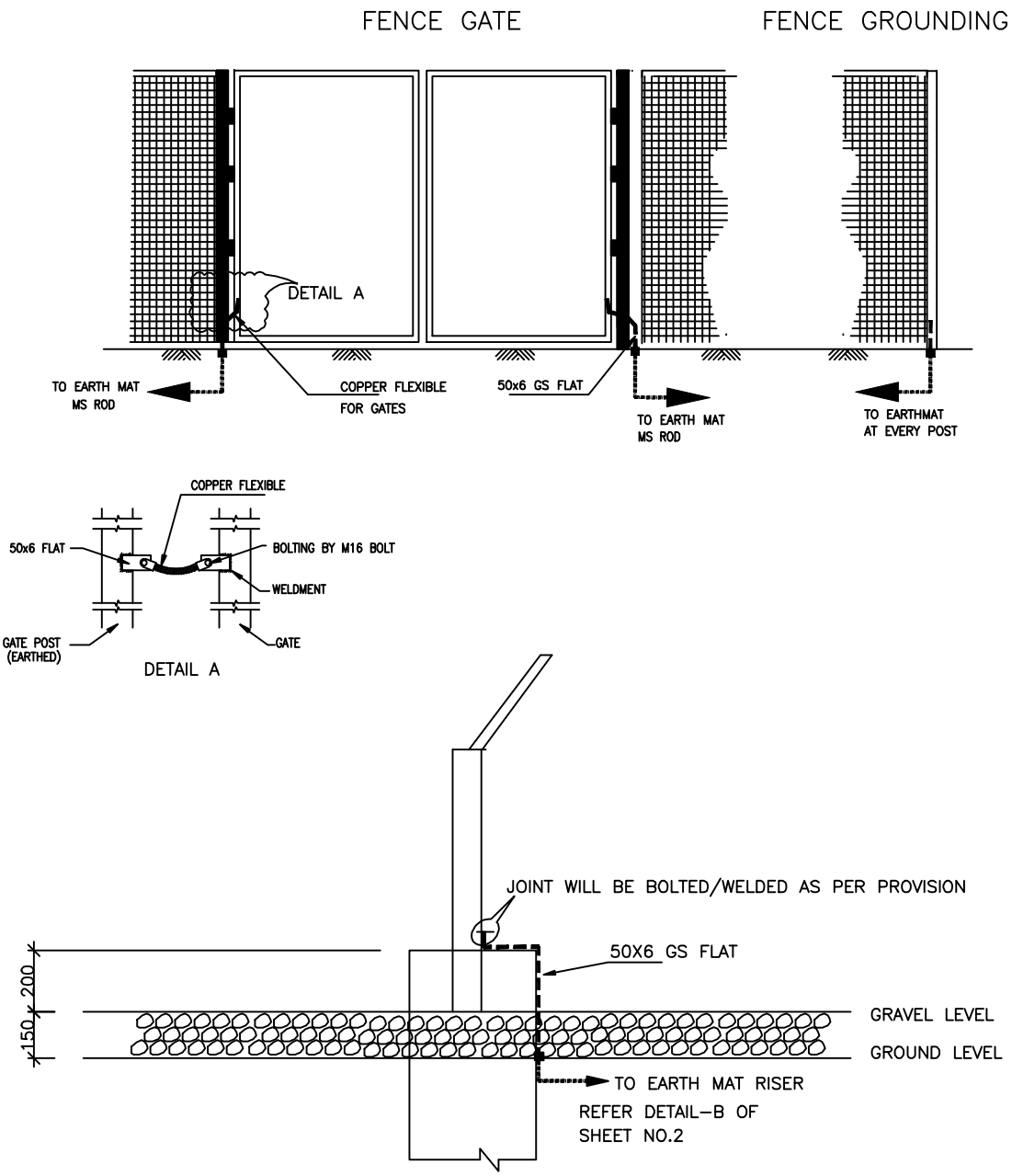
DRG. No. TB-4-369-316-009

SHEET No. 16



NOS.OF RISERS= 2 NOS./STRUCTURE

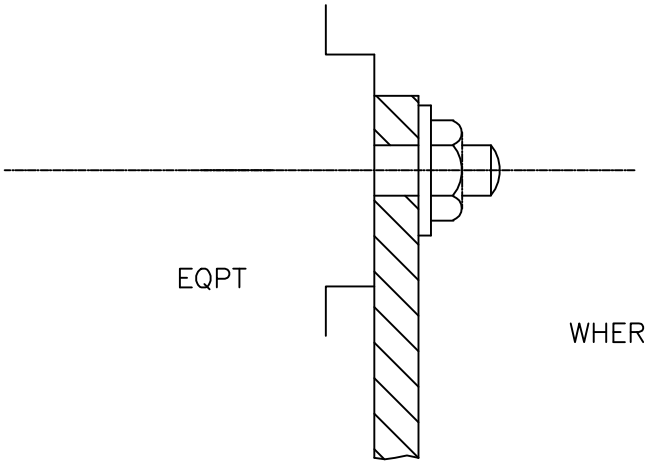
BHEL	EQUIPMENT EARTHING DETAILS 400kV WAVE TRAP	
COMPUTERREF.NO.	DRG. No. TB-4-369-316-009	SHEET No. 17



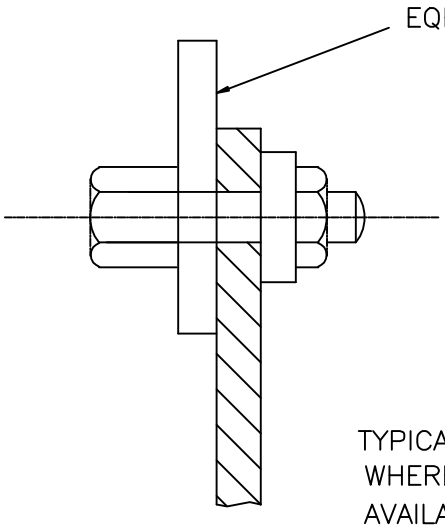
EVERY POST OF FENCE & GATES SHALL BE CONNECTED TO EARTHING LOOP BY 50X6 MM GS FLAT.
EARTHING CONDUCTOR SHALL BE BURRIED 2000mm OUTSIDE THE SWITCHYARD FENCE.

FENCE EARTHING

BHEL	EQUIPMENT EARTHING DETAILS GATE/FENCE POST	
	DRG. No. TB–4–369–316–009	SHEET No. 18



TYPICAL EARTHING TERMINAL JOINT



TYPICAL EARTHING TERMINAL JOINT WHERE ONLY THROUGH HOLE IS AVAILABLE

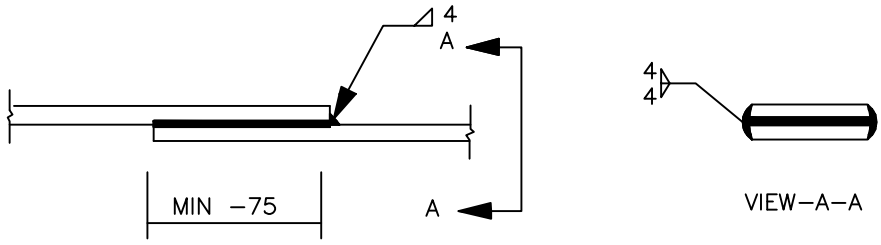
NOTE

1. THIS IS GENERAL TYPICAL BOLTING ARRANGEMENT APPLICABLE TO ALL PANELS, EQUIPMENT ETC. WHERE BOLTING ARRANGEMENT IS PROVIDED.
2. IN CASE EARTHING TERMINAL COMPRISES ONLY A TAPPED HOLE SUITABLE BOLT/ SCREW WITH WASHER MAY BE USED FOR EARTHING CONDUCTOR TERMINATION

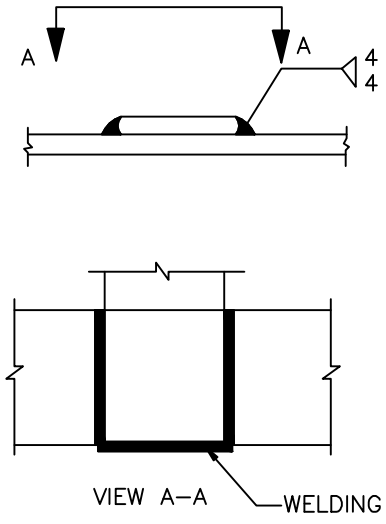
BHEL	EQUIPMENT EARTHING DETAILS TYPICAL ARRANGEMENT OF BOLTED JOINTS	
	DRG. No. TB–4–369–316–009	SHEET No. 19

STRIP TO STRIP (75x12/50X6 MS FLAT)

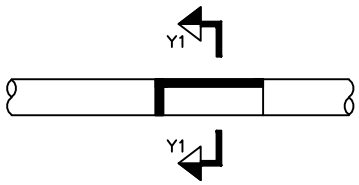
1. STRAIGHT LAP JOINT/RISER



2. CROSS LAP JOINT

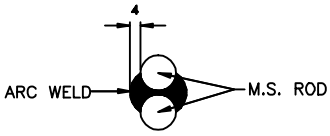


BHEL	EQUIPMENT EARTHING DETAILS WELDING DETAILS	
COMPUTERREF.NO.	DRG. No. TB–4–369–316–009	SHEET No. 20

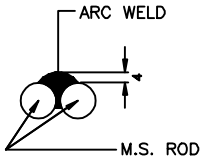


ELEVATION

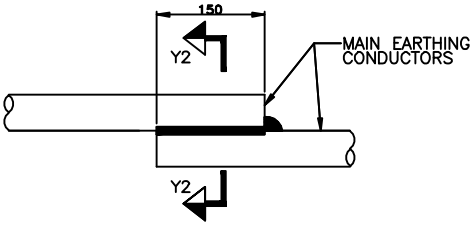
(CONDUCTOR IN HORIZONTAL PLANE)



SECTION Y2-Y2

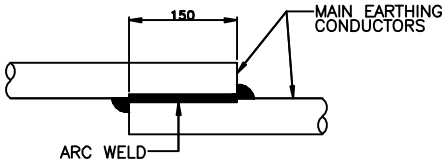


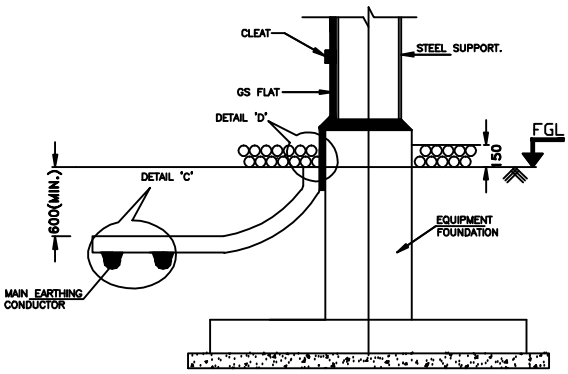
SECTION Y1-Y1



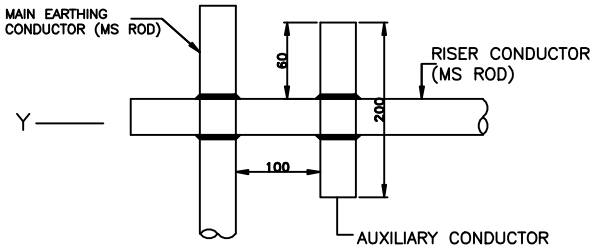
ELEVATION

(CONDUCTOR IN VERTICAL PLANE)

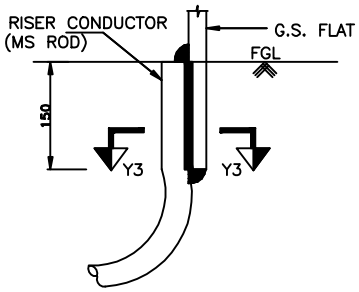




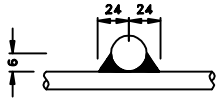
TYPICAL DETAILS OF RISER



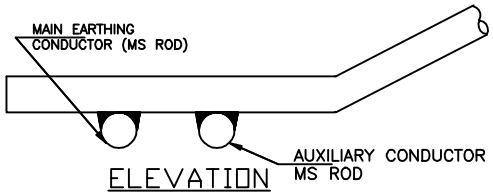
PLAN



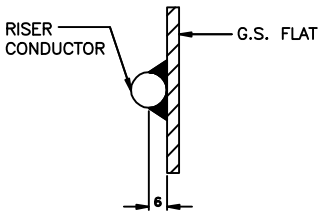
ELEVATION
DETAIL-D



VIEW-Y



ELEVATION
DETAIL-C



TYPICAL OVERLAPPING JOINT OF TWO CONDUCTORS

SECTION Y3-Y3

BHEL

EQUIPMENT EARTHING DETAILS

WELDING DETAILS

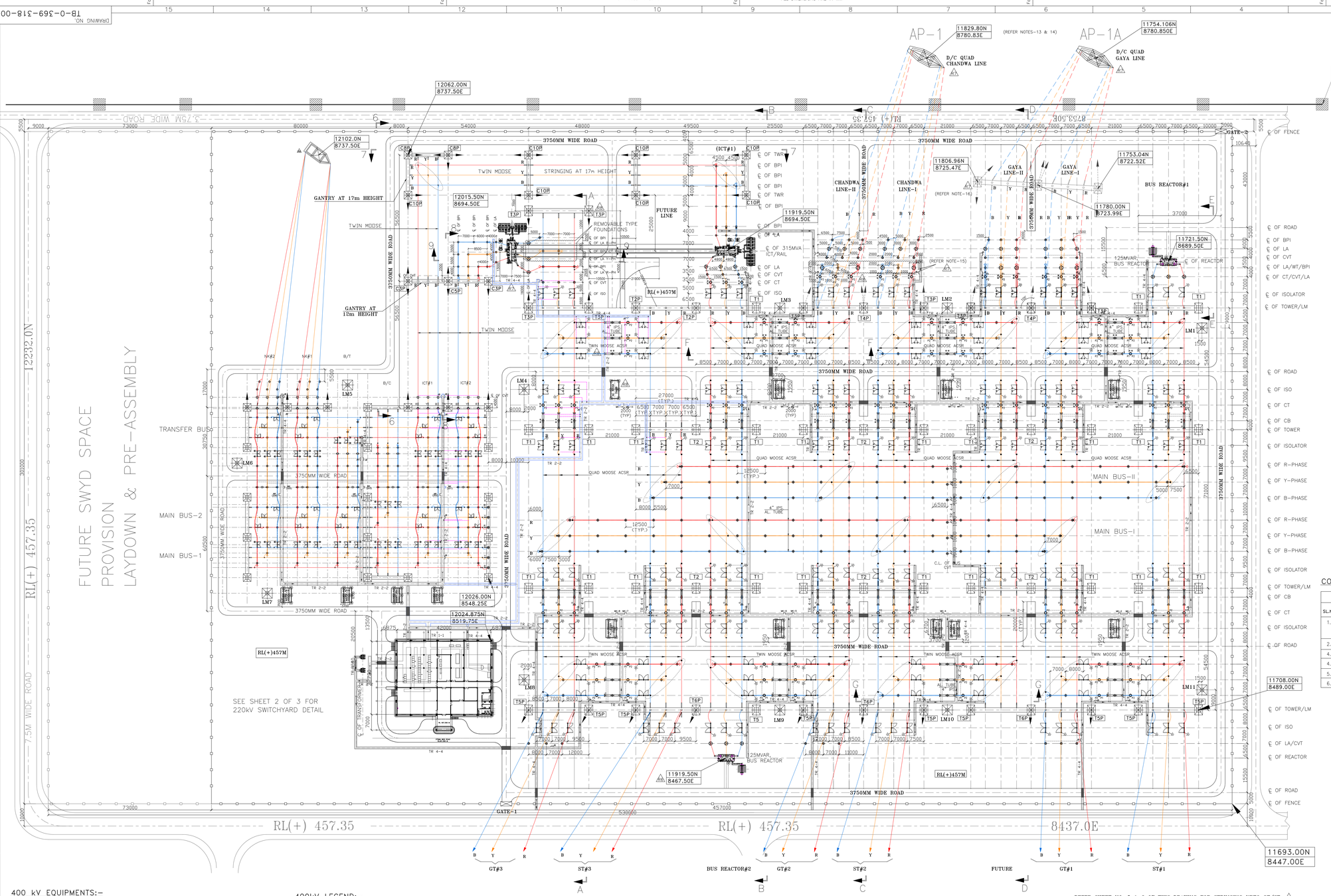
COMPUTERREF.NO.	DRG. No. TB-4-369-316-009	SHEET No. 21

DRAWING NO. TB-0-369-318-002

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

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



400kV SYSTEM PARAMETERS

Sl.No.	DESCRIPTION OF PARAMETER	
1	SYSTEM OPERATING VOLTAGE	400kV
2	MAX. OPERATING VOLTAGE OF THE SYSTEM (rms)	420kV
3	RATED FREQUENCY	50Hz
4	NO. OF PHASES	3
5	RATED INSULATION LEVELS i) FULL WAVE IMPULSE WITHSTAND VOLTAGE (1.2/50microsec.) ii) SWITCHING IMPULSE WITHSTAND VOLTAGE (250/2500microsec.) iii) ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE (rms)	 ±1425kVp ±1050kVp 630kV (rms)
6	CORONA EXTINCTION VOLTAGE (MIN)	320kV (rms)
7	MAX. RADIO INTERFERENCE VOLTAGE FOR FREQUENCY BETWEEN 0.5MHz & 2MHz AT 266KV rms	1000 microV
8	MIN. CREEPAGE DISTANCE	25MM/kV (10500 MM)
9	MIN. CLEARANCE i) PHASE TO PHASE ii) PHASE TO EARTH iii) SECTIONAL CLEARANCE	 4000MM 3500MM 6500MM
10	RATED SHORT CIRCUIT CURRENT FOR 1SEC DURATION	50kA
11	SYSTEM NEUTRAL EARTHING	EFFECTIVELY EARTHED
12	SUB CONDUCTOR SPACING	450MM
13	CONDUCTOR STATIC TENSION 400kV TWIN 400kV QUAD	 4T PER PHASE 6T PER PHASE

THIS DRG. SHALL BE READ IN CONJUNCTION WITH SLD.

CONDUCTOR & STRINGING DETAILS :-

		400kV	
SL.NO.	DESCRIPTION	CONDUCTOR DETAIL	CONNECTION HEIGHT (ABOVE PLINTH LEVEL)
1.	EQUIPMENT INTERCONNECTION	4.0" IPS (EH) AL. TUBE/ MOOSE CONDUCTOR	8 mtr.
2.	MAIN BUS	4.0" IPS (EH) AL. TUBE	8 mtr.
4.	JACK BUS ON GT/ST SIDE	TWIN ACSR MOOSE CONDUCTOR	16 mtr.
4.	JACK BUS ON LINE SIDE	QUAD ACSR MOOSE CONDUCTOR	16 mtr.
5.	EARTHWIRE	7/3.66mm SHIELD WIRE	24.5 mtr.
6.	DROPPER ON CVT, LA	TWIN ACSR MOOSE CONDUCTOR	–

400 kV EQUIPMENTS:-

SYMBOL	EQUIPMENT
	400kV, 2000A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR
	400kV, 2000A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR, WITH CONTROLLED SWITCHING DEVICE
	400kV, 3150A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR
	400kV, 3150A, 50kA FOR 1s, 3-PH CIRCUIT BREAKER WITHOUT PIR, WITH CONTROLLED SWITCHING DEVICE
	400kV, 3150A, 50kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 1 E/S
	400kV, 2000A, 50kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 1 E/S
	400kV, 2000A, 50kA FOR 1s, 3-PH HCB ISOLATORS, MOTOR OPERATED WITH 2 E/S
	400kV, 3000A, 50kA FOR 1s, 1-PH, 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RAITING
	400kV, 2000A, 50kA FOR 1s, 1-PH, 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RAITING
	400kV, 1-PH CAPACITOR VOLTAGE TRANSFORMER
	336 kV, 20kA, 50kA FOR 1 SEC, DISCHARGE CLASS-4, 1-PH SURGE ARRESTER
	400kV, 3150A, 1mH, 1-PH WAVE TRAP
	400 kV, 1 PHASE, SOLID CORE BUS POST INSULATOR

400kV LEGEND:-

	TOWER WITH PEAK
	TOWER WITHOUT PEAK
	LIGHTNING MAST
	SUSPENSION INSULATOR STRING (1X25 DISCS)
	DOUBLE TENSION INSULATOR STRING (2X25 DISCS)
	AL. TUBE
	R-PHASE ACSR MOOSE CONDUCTOR
	Y-PHASE ACSR MOOSE CONDUCTOR
	B-PHASE ACSR MOOSE CONDUCTOR
	END CAP/CORONA BELL FOR BUSBAR
	SHIELD WIRE (10.98MM)/ OPGW

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL STRUCTURE/CONDUCTOR HEIGHTS ARE ABOVE PLINTH LEVEL. PLINTH LEVEL IS 300 MM ABOVE F.G.L.
3. WAVE TRAP FOUNDATION SHALL BE PROVIDED FOR ALL THREE PHASE OF THE LINE AND SHALL BE SUITABLE FOR BPI ALSO. HOWEVER WAVE TRAP SHALL BE INSTALLED ON TWO PHASES ONLY. BPI SHALL BE PROVIDED FOR ONE PHASE WHEREVER WAVETRAP IS NOT INSTALLED.
4. TYPE OF GANTRY STRUCTURES SHALL BE AS PER APPROVED STRUCTURAL LAYOUT DRAWING.
5. LOCATION OF LM SHALL BE AS PER APPROVED DSLP LAYOUT
6. SA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE / ANY EQUIPMENT KEPT NEAR LIGHTING ARRESTER AND BHEL SHALL ENSURE THE SAME DURING ERECTION AT SITE.
7. FOR DETAILED PLAN LAYOUT OF 220kV BAYS REFER SHEET No. 02.
8. FOR SECTION DETAILS REFER SHEET No. 03.
9. STRINGING UPTO GT & ST BAYS SHOWN IN SHEET 5 & 6 OF THIS DRAWING.
10. LOCATION, SIZE & NUMBER OF AC KIOSKS IS TENTATIVE. REFER CIVIL FOUNDATION LAYOUT FOR FINAL LOCATIONS.
5. REFER CONTROL ROOM BUILDING CIVIL DRAWINGS FOR DETAILS OF CRB.
6. LOCATION OF DEAD END TOWERS (AP-1 & AP-1A) AND THE 400kV LINE SIDE PHASE SEQUENCE IS SHOWN AS PER THE INPUTS RECEIVED FROM NTPC.
7. SUPPLY AND STRINGING OF 400kV LINE CONDUCTOR, SHIELD WIRE, INSULATOR AND HARDWARE BETWEEN 400kV DEAD END TOWER AND SWITCHYARD TERMINAL GANTRY (INTERMEDIATE GANTRY FOR GAYA LINE) ARE NOT IN BHEL SCOPE. HOWEVER, JUMPERING FOR THE RESPECTIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
8. 400kV LINE NOMENCLATURE AND LOCATION OF DEAD END TOWERS CHANGED AS PER NTPC NKTL DRAWING NO. A12-OD-001.
9. AS PER NTPC MAIL DATED 06.08.2021, PHASES OF WAVE TRAPS CHANGED TO R & B PHASES IN CHANDWA LINE-1 & 2.
10. 400kV INTERMEDIATE TAKE-OFF GANTRY FOR GAYA D/C LINE IS SHOWN AS PER NKTL DRAWING NO. A12-OD-001 & IS NOT IN BHEL SCOPE. STRINGING WORK INCLUDING SUPPLY OF CONDUCTOR & HARDWARE FROM SWITCHYARD TAKE-OFF GANTRY TO THE PROPOSED NEW GANTRY & UPTO DEAD END TL TOWER IS ALSO NOT IN BHEL SCOPE. HOWEVER, JUMPERING FOR THE RESPECTIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
11. LOCATION OF CHANDWA LINE 1 WAVE TRAP HAS BEEN SHIFTED BY 2M TOWARDS SOUTH AS PER DISCUSSION WITH NTPC TO MEET THE NECESSARY ELECTRICAL CLEARANCE. CONNECTION OF LINE EQUIPMENT TO BE DONE ONLY AFTER GETTING CONFIRMATION FROM NTPC SITE & NTPC ENGINEERING.
12. LOCATION OF LA & BPI IN FRONT OF ICT#2 ARE TENTATIVE AND SHALL BE FINALIZED AFTER APPROVAL OF GA & FOUNDATION DRAWING OF ICT FROM BHEL BHOPAL. FOUNDATIONS OF THOSE LA & BPI SHALL BE THUS KEPT ON HOLD.

REFER SHEET NO. 5 & 6 OF THIS DRAWING FOR STRINGING UPTO GT/ST.

REV.	DATE	ALTD	CHD	APPD	DESCRIPTION
08	11.01.22	AK	AK	VK	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. LAYOUT ARRANGEMENT OF ICT#2 BAYS (BOTH 400kV & 220kV) REVISED TO CHANGE PHASE SEQUENCE OF ICT#2 SIMILAR TO THAT OF ICT#1. 2. CHANDWA LINE-2 R-PH WT SHIFTED BY 2M AS PER NTPC RECOMMENDATION.
07	18.08.21	PK	AK	VK	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. ICT#2 AND ASSOCIATED BAYS. 2. REVISED 400kV LINE TOWERS & CONNECTIONS TO SWYD. TAKE-OFF GANTRIES.
06	06.10.17	AK	DKM	RS	DRAWING REVISED TO INCORPORATE FOLLOWING: 1. STRINGING THROUGH ACC UPTO GT/ST INCLUDED. 2. LOCATION OF ISOLATOR & CVT IN SWYD. GT/ST BAYS TOWARDS ACC FINALIZED. 3. LOCATION OF 220kV DEAD END TOWER & LINE EQUIP. MARKED.
05	17.01.17	AK	AK	RS	DRAWING REVISED TO INCORPORATE FOLLOWING: 400kV OUTDOOR CT LOCATION CHANGED AS PER REVISED SLD. HOLD ON ICT AREA EQUIPMENT RELEASED. 400kV LINE SIDE EQUIPMENT LOCATION MARKED AS PER DEAD END TOWERS. LOCATION OF CRB MATCHED WITH CIVIL FOUNDATION LAYOUT.
04	12.12.16	AK	MM	AS	DRAWING REVISED TO INCORPORATE FOLLOWING: 400kV OUTDOOR CT ADDED IN LAYOUT ON HV SIDE OF ICT.
03	11.08.15	AK	MM	AS	DRAWING REVISED TO INCORPORATE NTPC COMMENTS DATED 08.04.15. REVISED CONTROL ROOM BUILDING DRAWING INCORPORATED. PHASE SEQUENCE OF GT & ST BAYS MATCHED.
02	01.11.14	AK	MM	AS	

REFERENCE DRGS.

SN	NTPC Drg. No.	DESCRIPTION
1	4410-001-999-POC-F-001 (Rev-02)	PLOT PLAN
2	4410-001-572-PVE-P-0002 (Rev-02)	400/220kV SWITCHYARD SINGLE LINE DIAGRAM

NTPC DRG. No. 4410-001-572-PVE-F-0013

PROJECT	NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)
OWNER	NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)
QBTGM	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR TRANSMISSION BUSINESS GROUP NOIDA

JOB NO. 83011
STATUS CONTRACT
DISTRIBUTION

TO	REV.	DATE	ALTD	CHD	APPD
NO. OF	02	11.08.15	AK	MM	AS

DEPT CODE		NAME	SIGN	DATE
M	DRN	DM	-sd-	27.01.15
	DESN	AK	-sd-	27.01.15
	CHD	MM	-sd-	27.01.15
	APPD	AS	-sd-	27.01.15

TITLE
LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END

DEPT. SCALE
SIGN
DATE

DRAWING NO. TB-0-369-318-002
SHEET 01 OF 06 REV. 08

ELECTRONIC FILE NAME:

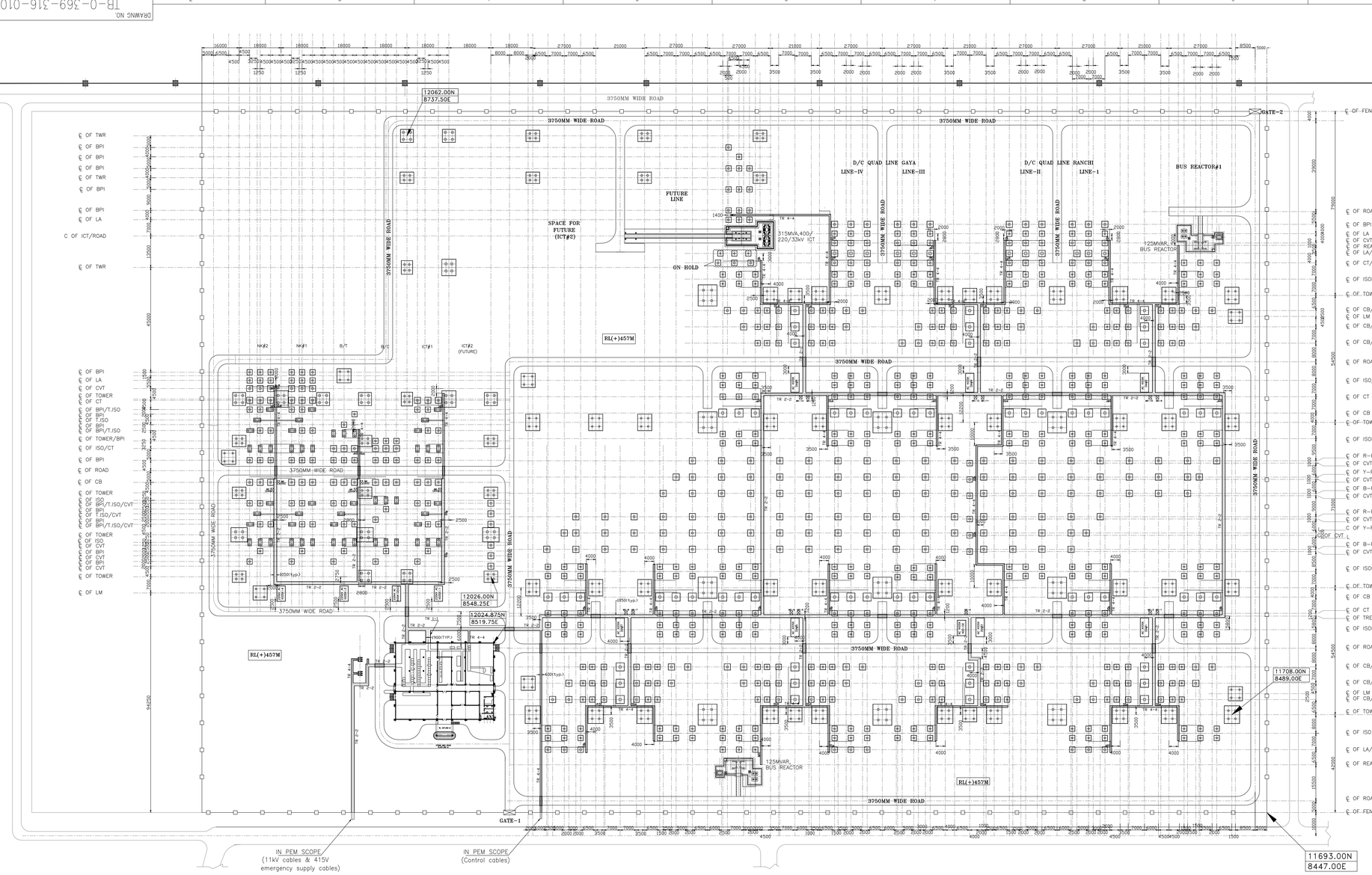
FORMAT SIZE A0

FIRST ANGLE PROJECTION

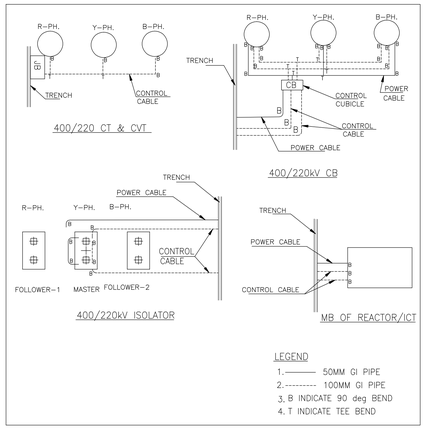
ALL DIMENSIONS ARE IN MM

DRAWING NO. TB-0-369-316-010

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIM
It must not be used in any way detrimental to the interest of the Company.



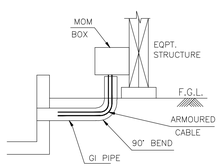
GI PIPE DETAILS OF 400/220 kV EQUIPMENTS



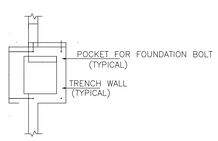
LEGEND
1. ——— 50MM GI PIPE
2. - - - - - - 100MM GI PIPE
3. B INDICATE 90 deg BEND
4. T INDICATE TEE BEND

NOTES :-

1. ALL DIMENSIONS ARE IN mm.
2. THE LOCATION OF CABLE TRENCHES MARKED IN THIS DWG MAY BE SLIGHTLY MODIFIED TO SUIT SITE CONDITIONS.
3. OPENINGS FOR TAKING OUT GI PIPES TO EQUIPMENTS SHALL BE PROVIDED IN CABLE TRENCHES. OPENING OF SIZE SUITABLE TO DIA. 50/100 PIPE SHALL BE PROVIDED BELOW TOP CABLE SUPPORT.
4. ☒ MK = INDICATES MARSHALLING KIOSK.
   ☒ JB = INDICATES JUNCTION KIOSK.
5. MK/JB SHALL BE PLACED IN THE LOCATION SHOWN. EXACT COORDINATES TO BE SUITABLY DECIDED AT SITE.
6. 1.1kV CONTROL CABLE SHALL BE PLACED IN MULTILAYER ON GI CABLE RACK SUPPORT (ANGLE).
7. CABLE SUPPORT FOR OUTDOOR TRENCHES SHALL BE PROVIDED AT EVERY 600mm INTERVAL.
8. AUXILIARY POWER CABLES SHALL BE LAID IN TOP TIERS AND CONTROL CABLES IN BOTTOM TIERS,
9. FIBER OPTIC CABLE BETWEEN AC KIOSK AND CONTROL ROOM SHALL BE LAID IN 50mm DIA GI PIPE AND SAME SHALL BE ROUTED THROUGH BOTTOM OF CABLE TRENCH.
10. CABLES FOR LIGHTING PURPOSE SHALL BE LAID IN GI PIPE/ TRENCH. SEPARATE DRAWING SHALL BE SUBMITTED FOR LIGHTING SYSTEM.
11. LOCATION OF CABLE TRENCHES INSIDE CONTROL ROOM SHALL BE SHOWN IN SEPARATE DRAWING.
12. EARTH CONDUCTOR 75X12 GI FLAT TO BE WELDED IN VERTICAL ON THE CABLE SUPPORT BEFORE INSTALLATION OF CABLES.
13. CABLES CROSSING ROAD SHALL BE LAID IN PIPE CULVERT.
14. FOR POWER & CONTROL CABLES, SEPARATE PIPES SHALL BE USED CONSIDERING 60% VOID FOR EACH PIPE I.E., 40% FILLING CRITERIA.
15. ALL OTHER DETAILS PERTAINING TO CIVIL WORKS SHALL BE REFLECTED IN THE RESPECTIVE CIVIL DRAWINGS.
16. GI PIPES SHALL BE SECURELY FIXED AT BOTH ENDS.
17. AFTER LAYING THE CABLES THE ENDS OF GI PIPES SHALL BE FULLY SEALED TO PREVENT INGRESS OF WATER INSIDE THE PIPE.
18. CONTROL CABLES & POWER CABLES MUST BE LAID IN SEPARATE GI PIPES.
19. THE PURPOSE OF TRENCH LAYOUT DRAWING IS FOR USE AS FOLLOWS:
    - TO BE USED AS CIVIL INPUT FOR CABLE TRENCHES.
    - FOR ERECTION OF CABLE RACKS AT SITE.
    - FOR CABLE LAYING AND ROUTING AT SITE.
20. THE CABLE OF CT /CVT BETWEEN SECONDARY TERMINAL BOX AND JUNCTION BOX SHALL BE LAID IN 100/50MM GI PIPE.
21. ▭ INDICATE CULVERT. CABLES CROSSING ROAD SHALL BE LAID IN BOX/PIPE CULVERT.
22. NO FOUNDATION SHALL REST ON FILLED UP SOIL,ANY EXTRA EXCAVATION/LOOSE EARTH BELOW FOUNDATION SHALL BE FIELD UP WITH PCC M 7.5.
23. PROPER PLANNING SHALL BE MADE AT SITE SUCH THAT THE LA, PI & CSE FOUNDATION IN TRANSFORMER YARD AREA SHALL BE CAST BEFORE CONSTRUCTION OF OIL PIT OF GT & ST.
24. ORIENTATION OF FOUNDATION SHALL BE VERIFIED WITH RESPECT TO LAYOUT BEFORE CONSTRUCTION.
25. ——— GI PIPE FOR CABLING.



ROUTING OF CABLE INSIDE
GI PIPE/ CABLE TRENCH TO EQUIPMENT



MK/JB FIXING DETAIL ON TRENCH
A & B DIMENSIONS ARE AS PER MK DRAWING.
X-TRENCH WALL THICKNESS.

REFERENCE DRG. :-

4410-001-572-PVE-F-0013- LAYOUT PLAN & SECTION OF 400/220kV SWITCHYARD AT NKSTPP END

NTPC DRAWING NO. 4410-001-572-PVC-F-0045A

PROJECT: NORTH KARANPURA
SUPER THERMAL POWER PROJECT (3X660MW)
(400/220kV SWITCHYARD AREA)

CUSTOMER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION PROJECTS DIVISION

	NAME	SIGN	DATE	NO.OF VAR
DRN.	AK		28-09-15	
CHD.	MM		29-09-15	
APPD.	AS			

DEPTT: TBEM | CODE : 316 | SCALE: 1:700 | WEIGHT(Kgs.) | REF.TO ASSY.DRG. | ITEM NO. | NO.OF ITEMS

TITLE : 400/220 kV – CABLE TRENCH LAYOUT AT NKSTPP END

DRAWING NO. TB-0-369-316-010 REV. 01

SHEET NO. 1 NO.OF SHTS.: 2

REV.		NAME	SIGN	DATE
01	ALTERED	AK		19.02.16
	CHECKED	MM		
	APPROVED	AS		

REVISED AS PER NTPC COMMENTS 15.10.15

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

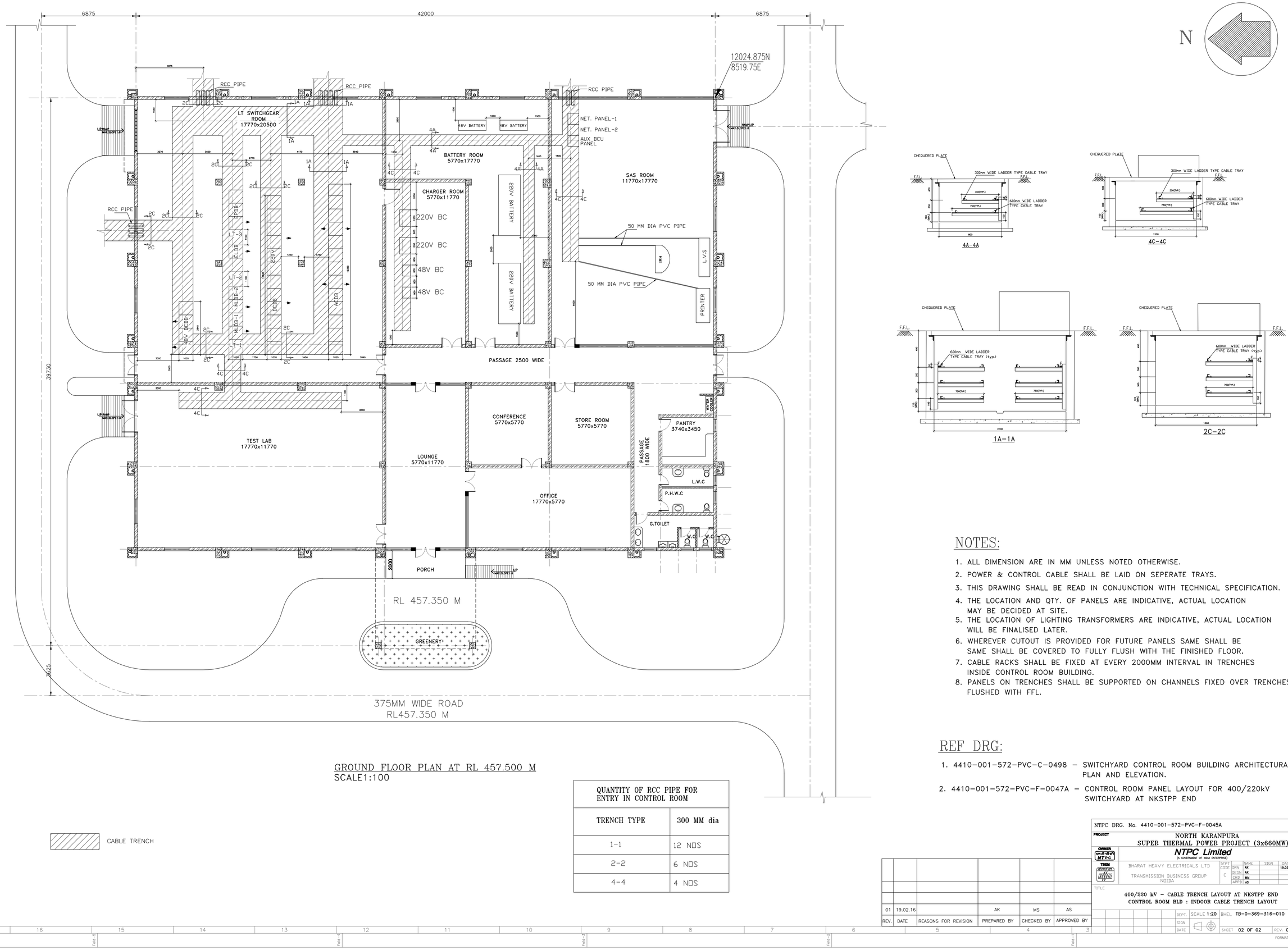
SIZE-A0

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

DRAWING NO. TB-0-369-316-010

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



GROUND FLOOR PLAN AT RL 457.500 M
SCALE1:100

CABLE TRENCH

QUANTITY OF RCC PIPE FOR ENTRY IN CONTROL ROOM	
TRENCH TYPE	300 MM dia
1-1	12 NOS
2-2	6 NOS
4-4	4 NOS

NOTES:

1. ALL DIMENSION ARE IN MM UNLESS NOTED OTHERWISE.
2. POWER & CONTROL CABLE SHALL BE LAID ON SEPERATE TRAYS.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.
4. THE LOCATION AND QTY. OF PANELS ARE INDICATIVE, ACTUAL LOCATION MAY BE DECIDED AT SITE.
5. THE LOCATION OF LIGHTING TRANSFORMERS ARE INDICATIVE, ACTUAL LOCATION WILL BE FINALISED LATER.
6. WHEREVER CUTOUT IS PROVIDED FOR FUTURE PANELS SAME SHALL BE SAME SHALL BE COVERED TO FULLY FLUSH WITH THE FINISHED FLOOR.
7. CABLE RACKS SHALL BE FIXED AT EVERY 2000MM INTERVAL IN TRENCHES INSIDE CONTROL ROOM BUILDING.
8. PANELS ON TRENCHES SHALL BE SUPPORTED ON CHANNELS FIXED OVER TRENCHES FLUSHED WITH FFL.

REF DRG:

1. 4410-001-572-PVC-C-0498 – SWITCHYARD CONTROL ROOM BUILDING ARCHITECTURAL PLAN AND ELEVATION.
2. 4410-001-572-PVC-F-0047A – CONTROL ROOM PANEL LAYOUT FOR 400/220kV SWITCHYARD AT NKSTPP END

REV.	DATE	REASONS FOR REVISION	PREPARED BY	CHECKED BY	APPROVED BY
01	19.02.16		AK	MS	AS

NTPC DRG. No. 4410-001-572-PVC-F-0045A

PROJECT: NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP NOIDA

DEPT CODE	NAME	SIGN	DATE
DRN	AK		19.02.16
DESN	AK		
CHD	MS		
APPD	AS		

TITLE: 400/220 kV – CABLE TRENCH LAYOUT AT NKSTPP END CONTROL ROOM BLD : INDOOR CABLE TRENCH LAYOUT

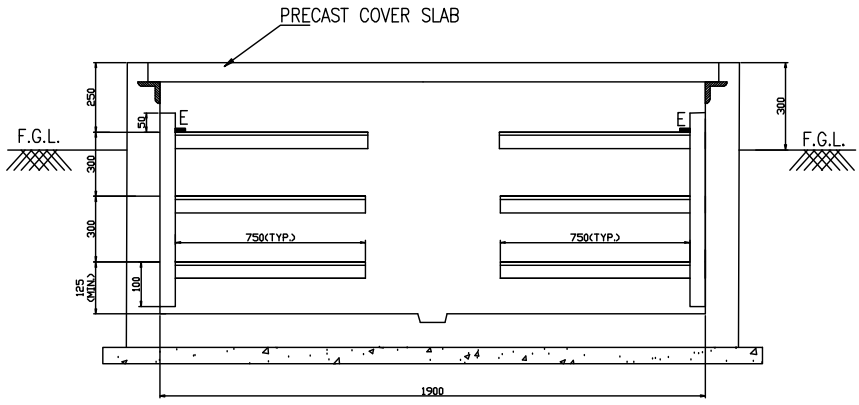
DEPT. SCALE 1:20 BHEL TB-0-369-316-010
SIGN
DATE
SHEET 02 OF 02 REV. 01

FORMAT SIZE A1

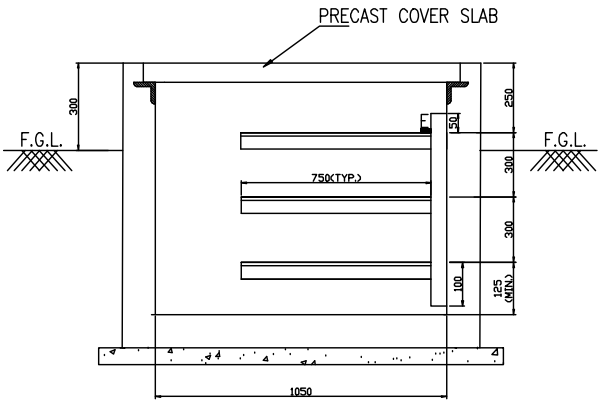
ELECTRONIC FILE NAME:

ANNEXURE–A

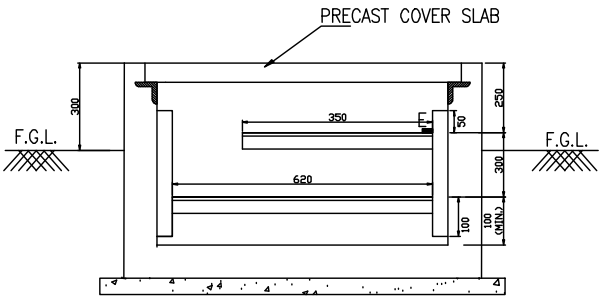
OUTDOOR CABLE TRENCH SECTIONS: NKSTPP YARD & MINE END YARD



TR 1–1



TR 2–2



TR 4–4

ANNEXURE-B

and rain protection to check out any leakage and air tightness. The following main tests shall be carried out:

(a) Illumination inside the kiosk shall be switched off and it shall be checked that no light enters through panel joints, holes and other joints in the kiosk.

(b) Water Leakage Test (with a water pipe with suitable pressure from all sides for one hour.)

(c) Working and functional tests of all accessories like air-conditioning system,fire and smoke detector, lighting arrangements as per technical specification

(d) Start up test for air conditioner

(e) Satisfactory operation of air conditioner installed on Kiosk.

(f) The total heat load for panels and devices to be placed inside the kiosk including PLCC, all IEDs etc. shall be calculated and equivalent calculated heating load (maximum value from among the calculated values for various kiosk) shall be placed inside the kiosk and the kiosk shall be made operational for four hours with all accessories and inside & outside temperature of kiosk shall be recorded.

On successful completion of proto testing, all other system shall be manufactured after incorporation of all alteration/modifications observed/suggested during/after proto testing.

The detail test procedure shall be submitted by the contractor and get it approved from the owner before commencement of proto testing.

SWITCHYARD INSTALLATION & COMMISSIONING NOTES

9.00.00 **INSTALLATION**

9.01.00 **EARTHING**

The earthing shall be done in accordance with requirements given in Annexure-I of this section and drawing enclosed with the specifications. Earthing of panels shall be done in line with the requirements given in respective equipment section of this specification. The cost of welding laying etc of earth flats and rods is deemed to be included in the cost of respective item.

9.02.00 **CIVIL WORKS**

The civil works shall be done in accordance with requirements stipulated elsewhere in this specification.

9.03.00 **STRUCTURAL STEEL WORKS**

The structural steel works shall be done in accordance with requirements stipulated elsewhere in this specification.

9.04.00 **BAY EQUIPMENT**

9.04.01 The disposition of equipment to be supplied are shown in enclosed single line diagrams and layout drawings.

CLAUSE NO.	TECHNICAL REQUIREMENTS
9.04.02	The Contractor shall prepare layout drawings and submit the same for approval of the Employer. The approval of drg. shall not absolve Contractor from his responsibility regarding designing & engineering of switchyard and Contractor shall be fully responsible for all works covered in the scope of this specification.
9.05.00	**LIGHTNING PROTECTION**
9.05.01	Direct stroke lightning protection (DSLP) shall be provided in the switchyard by lightning masts (at least 50 m high) and shield wires.
9.05.02	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.
9.05.03	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.
9.05.04	The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.
9.06.00	**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.
g)	The rigid busbars for equipment interconnections shall have rigid connections at one end and expansion / flexible at the other end. The tubular aluminium connections shall have not more than one joint per span. Since no wastages are permissible, the bidder shall work out the cut lengths of aluminum tube based on finalized layout and dispatch the same to site

CLAUSE NO.	TECHNICAL REQUIREMENTS
	without requiring owners's approval. Corona bells shall be provided at the end of the rigid busbars.
9.07.00	**CABLING**
9.07.01	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.
9.07.02	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. Prefabricated GI angles welded / bolted to galvanized insert plates before embedment in RCC shall be preferred.
9.07.03	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.
9.07.04	Cabling in the control room shall be done on ladder type cable trays.
9.07.05	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 burried in the ground at a depth of 300mm.

CLAUSE NO.	TECHNICAL REQUIREMENTS

ANNEXURE-I

a) **EARTHING NOTES FOR SWITHCYARD**

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 systems 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) **DETAILS OF EARTHING SYSTEM**

Item	Size	Material
Main Earthing conductor	40mm dia rod	Mild steel
Conductor above ground & earthing leads (for equipment)	75 x 12/ G.S. Flat 50 x 6 mm	Galvanized steel
Rod Electrode	40mm dia, 3000mm	Mild steel
G.I. Earthwire	7/8 SWG	GI

c) For Step and Touch potential the following parameters shall be considered
i) Current distribution factor – 1(One)
ii) Duration of fault current - 0.5 sec
iii) Human body weight - 50kg

d) Grid resistance shall be less than 1(one) ohm.

e) **EARTHING CONDUCTOR LAYOUT**

i) Earthing conductors in outdoor areas shall be burried atleast 600mm below finished grade level unless stated otherwise.

ii) Minimum 6000mm or higher spacing between rod electrodes shall be provided based on the earthmat design calculations.

iii) Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid atleast 300mm below them and shall be re-routed in case it fouls with equipment/structure foundations.

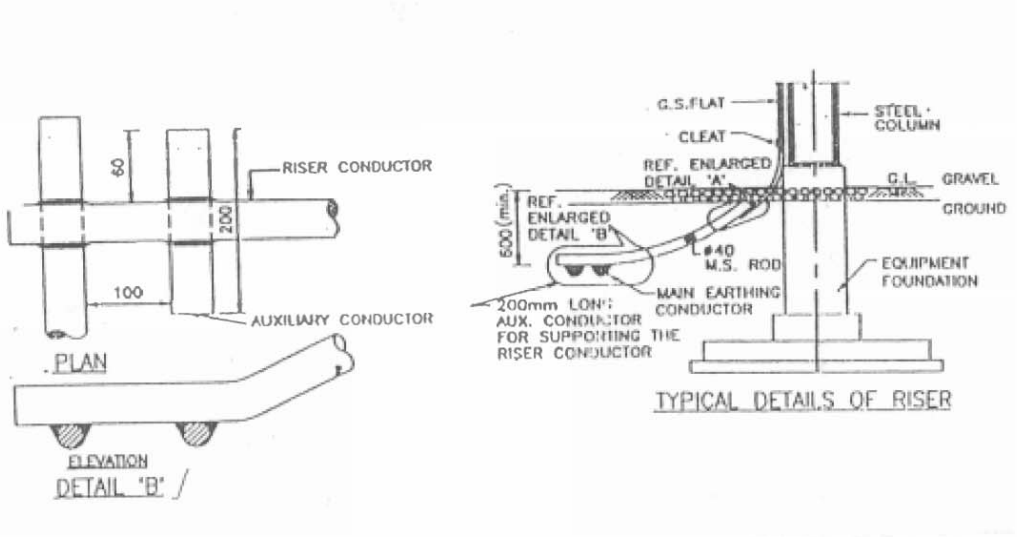
iv) Tap connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid. Otherwise, “earth insert” with temporary wooden cover or “earth riser” shall be provided near the equipment foundation/pedestal for future connections to the equipment earthing terminals.

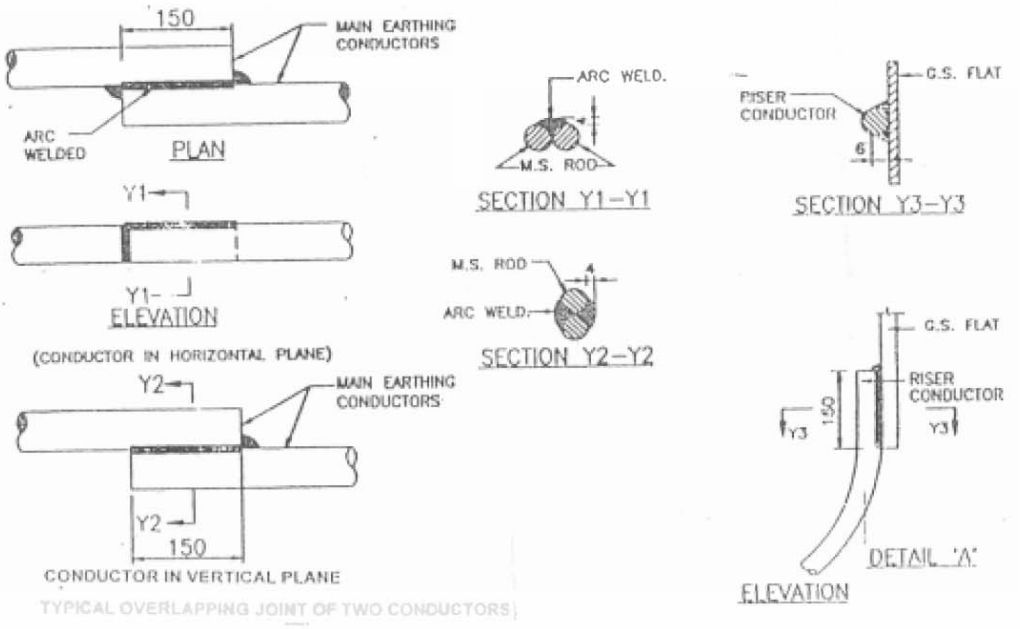
CLAUSE NO.	TECHNICAL REQUIREMENTS
v)	Earthing conductor along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable welding/cleating at intervals of 750mm. Earthing conductors along cable trenches shall be on the wall nearer to the equipment. Wherever it passes through walls, floors etc. galvanized iron sleeves shall be provided for the passage of the conductor. Both ends of the sleeves shall be sealed to prevent the passage of water through the sleeves.
vi)	Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.
vii)	In outdoor areas, tap connections shall be brought 300mm above ground level for making connections in future, in case equipment is not available at the time of grid installations.
viii)	Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.
ix)	Earthing conductors embedded in the concrete fibre shall have approximately 50mm concrete cover.
f)	**EQUIPMENT AND STRUCTURE EARTHING**
i)	The connection between earthing pads and the earthing grid shall be made by short and direct earthing leads free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with engineer.
ii)	Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.
iii)	Metallic conduits shall not be used as earth continuity conductor.
iv)	A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.
v)	Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.
vi)	Cable and cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running alongwith the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points, whether specifically shown or not.
vii)	Railway tracks within switchyard area shall be bonded across fish plates and connected to earthing grid at several locations.
viii)	Earthing conductor shall be burried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop.
ix)	Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.

CLAUSE NO.	TECHNICAL REQUIREMENTS
x)	Equipment earthing (Riser & welding of two conductors) shall be done as per enclosed sketch.
g)	**JOINTING**
i)	Earthing connections with equipment earthing pads shall be of bolted type. Contact surfaces shall be free from scales, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint/compound.
ii)	Connection between equipment earthing lead and between main earthing conductors shall be welded/brazed type. For rust protections, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.
iii)	Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingression.
iv)	Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
v)	All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.
vi	Bending of large diameter rod/thick conductor shall be done preferably by gas heating.
vii	All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.
h)	**POWER CABLE EARTHING**
	Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
i)	**SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS**
i)	Earthing terminal of each surge arrester, capacitor voltage transformer and lightning down conductors shall be directly connected to rod electrode which in turn, shall be connected to station earthing grid.
ii)	Auxilliary earthing mat of 1500mmX1500mm size comprising of closely spaced conductors at 300mm x 300mm spacing and at 300mm below ground shall be provided below the operating handles of the isolators. Operating handle shall be directly connected to earthing mat.
j)	**SPECIFIC REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEM**
i)	Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
ii)	Down conductors shall be cleated on the structures at 2000mm interval.
iii)	Connection between each down conductor and rod electrodes shall be made via test joint located approximately 150mm above ground level.

CLAUSE NO.	TECHNICAL REQUIREMENTS

iv) Lightning conductors shall not pass through or run inside G.I. conduits.





NOTE : WELDING OF EARTHING CONDUCTOR SHALL BE CONDUCTED IN VERTICAL PLANE WHEREVER POSSIBLE

EQUIPMENT EARTHING DETAILS

STANDARD DRAWING

CLAUSE NO.	TECHNICAL REQUIREMENTS

10.00.00 **SITE TESTING AND COMMISSIONING**

10.01.00 **INTRODUCTION**

An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field QP/ instructions of the equipment supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Employer for approval.

10.02.00 **GENERAL CHECKS**

a) Check for physical damage.
b) Visual examination of zinc coating/ plating
c) Check from name plate that all items are as per older/ specification.
d) Check tightness of all bolts, clamps and connecting terminals using toque wrenches.
e) For oil filled equipment check for oil leakage, if any. Also check oil level and top up.
f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces.
g) Check cleanliness of insulator and bushings.
h) All checks and tests specified by the manufactures in their drawings and manuals as well as all tests specified in the relevant code of erection.
i) Check for surface finish of grading rings (corona control ring.)
j) Pressure test on all pneumatic lines at 1.5 times the rated pressure shall be conducted.

10.03.00 **CIRCUIT BREAKERS**

a) Insulation resistance of each pole.
b) Check adjustments, if any, suggested by manufacturer.
c) Breaker closing and tripping time.
d) Slow and power closing operation and opening
e) Trip free and anti pumping operation.
f) Minimum pick up volts of coils
g) Contact resistance
h) Functional checking of compressed air plant and all accessories
i) Functional checking of control circuits, interlocks, tripping through protective relays and auto-reclose operation.
j) Insulation resistance of control circuits, motor etc.
k) Resistance of closing and tripping coils.

10.04.00 **ISOLATORS**

a) Insulation resistance of each pole
b) Manual and electrical operation on interlocks
c) Insulation resistance of control circuits and motors.
d) Ground connections
e) Contact resistance
f) Proper alignment to minimise the vibration to the extreme possible during operation.
g) Measurement of operating torque for isolator and Earth switch
h) Resistance of operating and interlocking coils.

10.05.00 **CURRENT TRANSFORMERS**

a) Insulation Resistance Test

CLAUSE NO.	TECHNICAL REQUIREMENTS

b) Polarity test.
c) Ratio identification test-checking of all ratios on all cores by primary injection of current.
d) Dielectric test of oil (wherever applicable)
e) Magnetizing characteristics test.

10.06.00 **VOLTAGE TRANSFORMERS/CAPACITOR VOLTAGE TRANSFOMERS**

a) Insulation resistance test
b) Polarity test
c) Ratio test
d) Dielectric test of oil (if applicable)

10.07.00 **SURGE ARRESTER**

a) Grading leakage current
b) Resistance of ground connection.

10.08.00 **PHASING OUT**

The phasing out of all supplies in the station system shall be carried out.

10.09.00 **STATION EARTHING**

a) Check soil resistivity
b) Check continuity of grid wires
c) Check earth resistance of the entire grid as well as various sections of the same.
d) Check for weld joint and application of zinc rich paint on galvanised surface.
e) Dip test on earth conductor prior to use.

10.10.00 **CONDUCTOR STRINGING AND POWER CONNECTORS**

a) Physical check for finish
b) Electrical clearance check
c) Testing of torque by torque by torque wrenches on all bus power connectors and other accessories.
d) Milli volt drop test on all power connectors.
e) Sag and tension check on conductors.

10.11.00 **INSULATORS**

Visual examination for finish damage, creepage distance, etc.

10.12.00 **WAVE TRAP**

a) Insulation resistance Test
b) Visual check

SUB–SECTION – B-09

CABLING, EARTHING AND LIGHTNING PROTECTION

CLAUSE NO.	TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable .

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fIttings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables.
BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems

	DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
	DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
	BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
		Indian Electricity Act.
		Indian Electricity Rules.

1.02.00 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

2.00.00 DESIGN AND CONSTRUCTIONAL FEATURE

2.01.00 **Inter Plant Cabling**

2.01.01 Interplant cabling for main routes shall be laid along overhead trestles/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly burried cables, if essential, shall not have concentration of more than 4 cables in one route. All buried cables & cables for switchyard and CHP shall be armoured.

2.01.02 **Transformer yard**

In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing.

2.01.03 **Trenches**

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

2.01.04 No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.

2.01.05 **Cable Vault**

Cable vault of not less than 2.5 mts clear height shall be provided.

Clear access passage of at least 750mm wide & 2.0 mt clear heights shall be provided at entrances and along cable ways. Wherever the passage is through cable routes 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

CLAUSE NO.	TECHNICAL REQUIREMENTS

2.01.06 **Boiler Area**

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

Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor.

Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.

Contractor shall provide two (2) independent routes for the cables between ESP control room and ESP. Contractor shall provide the cable trays along with its supporting structure arrangement on the trestles.

2.01.07 **Turbine Hall Area**

Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.

2.01.08 **OffSite Area**

In offsite pumphouses, overhead cable tray arrangement shall be preferably followed. However cable trenches may be considered below switchgear/MCC.
Trestle In fuel oil pump house, overhead cable tray arrangement shall be provided. RCC trenches provided in MCC room shall be separated from fuel oil area to avoid oil accumulation.

2.01.09 The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.

2.01.10 Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.

2.01.11 Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to.

- Meet all safety requirements
- Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc

3.00.00 EQUIPMENT DESCRIPTION

3.01.00 **Cable trays, Fittings & Accessories**

3.01.01 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

3.01.02 Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.
3.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanised as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm
3.02.00	**Support System for Cable Trays**
3.02.01	Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".
3.02.02	Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised. c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied d. All steel components, accessories,fittings and hardware shall be hot dip galvanised after completing welding, cutting, drill ing and other machining operation. e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below: The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS. f. Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position. g. Support system shall be able to withstand • weight of the cable trays • weight of the cables (75 Kg/Metre run of each cable tray) • Concentrated load of 75 Kg between every support span. • Factor of safety of minimum 1.5 shall be considered.

CLAUSE NO.	TECHNICAL REQUIREMENTS

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

3.03.04 FOR COAL HANDLING PLANT THE FOLLOWING SHALL ALSO BE APPLICABLE **:**

a) All overhead cable routes shall be along the route of the conveyor gallery on a separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route.

b) Cable trenches shall be provided only in Switchgear/MCC rooms.

c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.

d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.

3.04.00 **Pipes, Fittings & Accessories**

3.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

3.03.02 GI Pipes shall be of medium duty as per IS:1239

3.03.03 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

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

3.04.00 **Junction Boxes**

3.04.01 Junction Boxes with IP:55 degree of protection, shall comprise of a case with hinged door constructed from cold rolled sheet steel of thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

3.04.02 Terminal blocks shall be 1100V grade, 10Amps rated, 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 two (2) nos. stranded copper conductors of size upto 2.5 sq mm each. All internal wiring shall be of minimum 1.5 sq. mm cu. Conductor PVC wire.

3.05.00 **Terminations & Straight Through Joints**

3.05.01 Termination and jointing kits for 33kV,11kV,6.6 kV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 33kV, 11kV, 6.6 kV & 3.3kV grade joints and terminations shall be type tested as per IS:13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule as per DIN standard suitable for aluminium compacted conductor cables.

3.05.02 Straight through joint and termination shall be capable of withstanding the fault level for the system.

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

3.06.00 **Cable glands**

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

3.07.00 **Cable lugs/ferrules**

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

3.08.00 **Trefoil clamps**

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

3.09.00 **Cable Clamps & Ties**

3.09.01 The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.

CLAUSE NO.	TECHNICAL REQUIREMENTS

3.10.00	**Receptacles**
3.10.01	Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity.
3.12.00	**Cable Drum Lifting Jack**
	The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.
3.13.00	**Galvanising**
3.13.01	Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.
3.13.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified
3.14.00	**Welding**
3.14.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595
4.00.00	**INSTALLATION**
4.01.00	**Cable tray and Support System Installation**
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general . For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general . Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/

	drawings. Vendor shall design the support system along with tray, spacing etc in line with relevant standard .
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.
4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.
4.02.00	**Conduits/Pipes/Ducts Installation**
4.02.01	The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.
4.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.
4.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material
4.02.04	Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	**Spacing**
Upto 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm and above	3.0 M

4.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

CLAUSE NO.	TECHNICAL REQUIREMENTS

4.03.00	**Junction Boxes Installation**
4.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.
4.04.00	**Cable Installation**
4.04.01	Cable installation shall be carried out as per IS:1255 and other applicable standards.
4.04.02	For Cable unloading, pulling etc following guidelines shall be followed in general : a) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture. b) While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.
4.04.03	Cables shall be laid on cable trays strictly in line with cable schedule
4.04.04	Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend. Fibre Optical cable shall be laid in trenches/trays or as decided by Employer.
4.04.05	Bending radii for cables shall be as per manufacturer's recommendations and IS:1255.
4.04.06	Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.

4.04.07	No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.
4.04.08	In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
4.04.09	Wherever few cables are branching out from main trunk route troughs shall be used.
4.04.10	Wind loading shall be considered for designing support as well Cable trays wherever required.
4.04.11	Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.
4.04.12	The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
4.04.13	**Separation** At least 300mm clearance shall be provided between : - HT power & LT power cables, - LT power & LT control/instrumentation cables,
4.04.14	**Segregation** 1) Segregation means physical isolation to prevent fire jumping. 2) All cables associated with the unit shall be segregated from cables of other units. 3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set. 4) In switchyard, control cables of each bay shall be laid on separate racks/trays.
4.04.15	Minimum number of spare cores required to be left for interconnection in control cables shall be as follows: Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

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

	14C and above 3
4.04.16	**Directly Buried Cables**
	a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details.
	b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.
4.04.17	Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags
4.04.18	While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.
4.05.00	**Cable Terminations & Connections**
4.05.01	The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.
4.05.02	Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.
4.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting . The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.
4.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.

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

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

5.00.00 EARTHING SYSTEM

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

Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All off-site areas shall be interconnected together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system.

5.02.00 The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects

5.03.00 The material of the earthing conductors shall be as follows :

1)	Conductors above ground level and in built up trenches.	-	Galvanized steel
2)	Conductors buried in earth	-	Mild steel
3)	Earth electrodes	-	Mild steel rod

5.04.00 The sizes of earthing conductors for various electrical equipments shall be as below:

	Equipment	Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches
a)	Main earth grid	40 mm dia. MS rod	65 x 8mm GS flat
b)	33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	---	65 x 8mm GS flat
c)	415 V MCC/ Distribution boards / Transformers	---	50 x 6mm GS flat
d)	LT Motors above 125 KW	---	50 x 6mm GS flat
	25 KW to 125 KW	---	25 x 6mm GS flat
	1KW to 25 KW	---	25 x 3mm GS flat
	Fractional House power motor	---	8 SWG GS wire
e)	Control panel & control desk	---	25 x 3 mm GS flat

	f)	Push button station / Junction Box	---	8 SWG GI wire
	g)	Columns, structures, cable trays and bus ducts enclosures	---	50 x 6mm GS flat
	h)	Crane, rails, rail tracks & other non-current carrying metal parts		25 x 6mm GS flat

5.05.00 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.

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

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

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

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

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

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

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

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

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

CLAUSE NO.	TECHNICAL REQUIREMENTS

5.15.00	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.		
5.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.		
5.17.00	Earth pit shall be of treated type & shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal as per IS:3043. Test links shall be provided with bolted arrangement alongwith each earth pit, in order to facilitate measurement of earth resistance as & when required.		
5.18.00	On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.		
5.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.		
5.20.00	Other Requirements of Earthing System:		
	Standard/Code		IEEE 80, IS 3043
	Earthing System		
	Life expectancy		40 Years
	System Fault Level		As per system requirement (B0)
	Soil resistivity		Actual as per site conditions.
	Min. Steel corrosion		0.12mm/year
	Depth of burial of main earth conductor		600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.
	Conductor joints		By electric arc welding, with resistance of joint not more than that of the conductor.
	Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.		
	Surface resistivity	- Gravel	3000 ohm-meter
		- Concrete	500 ohm-meter
6.00.00	**LIGHTNING PROTECTION SYSTEM**		
6.01.01	Lightning protection system shall be in strict accordance with 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 specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
7.01.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.
7.01.03	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
7.01.04	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.

d) Proof load tests on cable tray support system

i) Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test.

ii) Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done.

iii) Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test.
The procedure for carrying out tests at "d" above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity.

e) The above acceptance tests shall be done only on one sample from each offered lot.

8.00.00 COMMISSIONING

8.01.01 The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers or else required for satisfactory performance..

8.01.02 **Cables**

a) Check for physical damage

b) Check for insulation resistance before and after termination/jointing.

c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning.

d) Check of continuity of all cores of the cables.

e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor.

f) Check for correct polarity and phasing of cable connections.

g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc.

h) Check for provision of correct cable tags, core ferrules, tightness of connections.

8.02.00 **Cable trays / supports and accessories**

1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.

2) Check for continuity of cable trays over the entire route.

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

CLAUSE NO.	TECHNICAL REQUIREMENTS

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

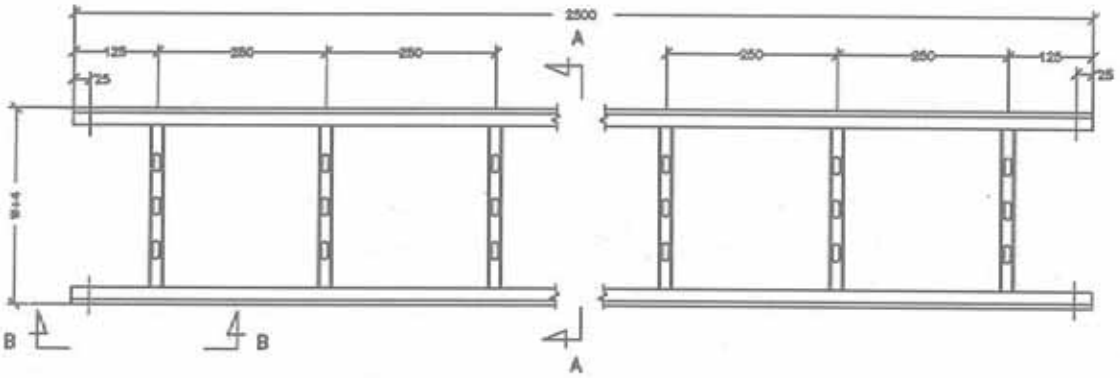
8.03.00 **Earthing and Lightning protection system**

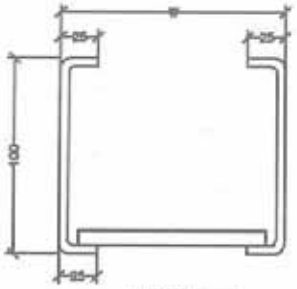
1) Earth continuity checks.

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

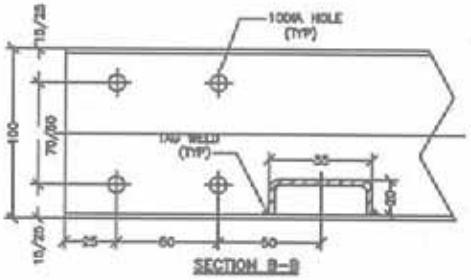
891199/2022/TBG-TBG_ENGG

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

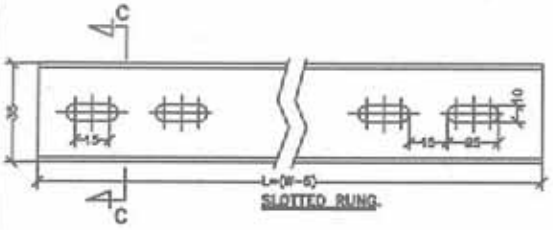




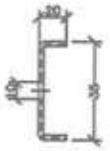
SECTION A-A



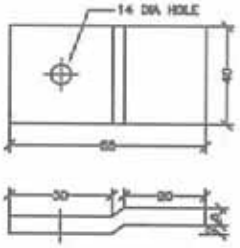
SECTION B-B



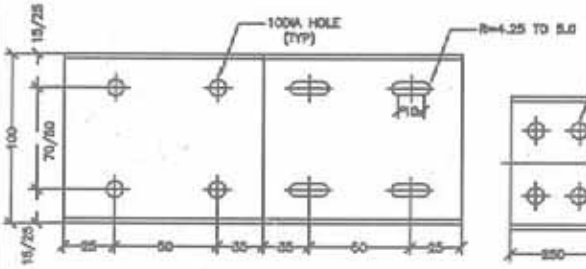
SLOTTED RUNG



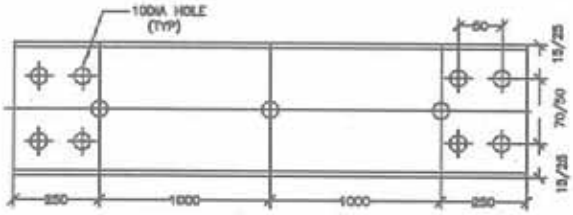
SECTION C-C



FIXING CLAMP.



COUPLER PLATE



SIDE RUNNER

NOTES.

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE				–		–	–	–		05.02.18
RC	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RB	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

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

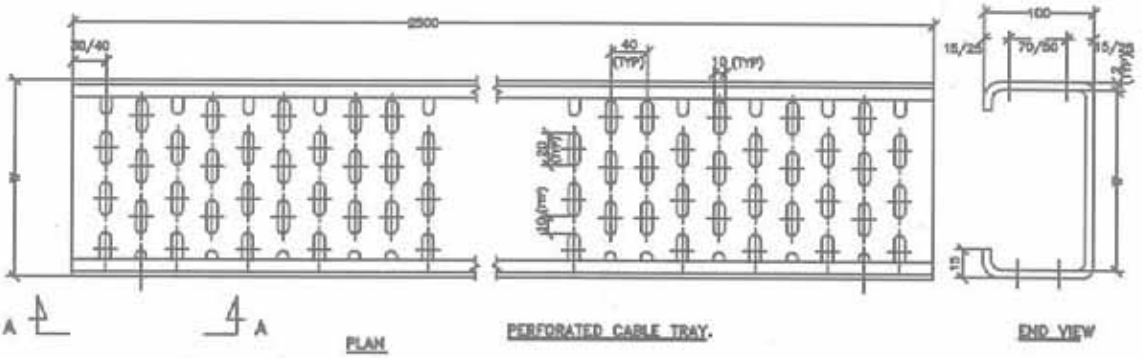
PROJECT: STANDARD

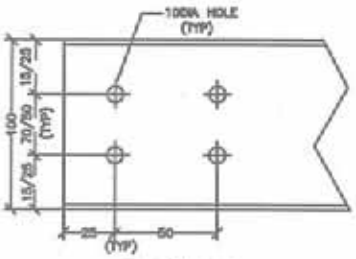
TITLE: LADDER TYPE CABLE TRAY.

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

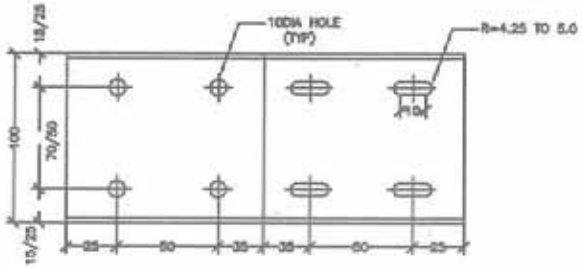
891199/2022/TBG-TBG_ENGG

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





SECTION A-A



COUPLER PLATE

NOTES.

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	KB	KB	RVP	–	VV	–	–	–		05.12.22
RC	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RB	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

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

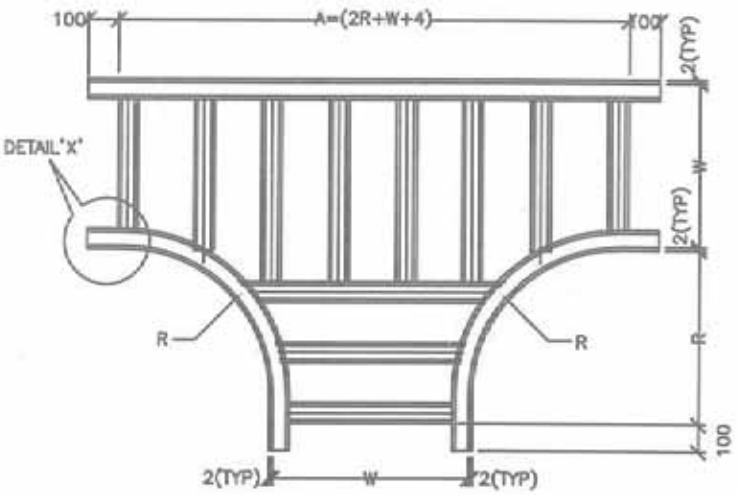
PROJECT: STANDARD

TITLE: PERFORATED TYPE CABLE TRAY.

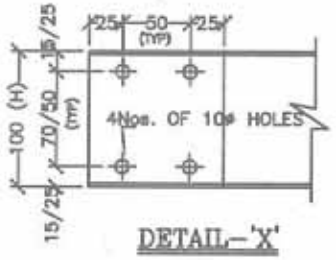
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-002	RD

891199/2022/TBG-TBG_ENGG

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



HORIZONTAL TEE



DETAIL–'X'

INNER WIDTH OF TRAY(W)	DEPTH OF TRAY (H)	BENDING RADIUS (R)	A		
			150	300	600
150, 300 & 600	100	600	1354	1504	1804
		900	1954	2104	2404
		1200	2554	2704	3004

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	01-07-10
RC	FOR TENDER PURPOSE	RT	AG	VKM	–	SS	–	–	–	DT	[illegible]
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

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

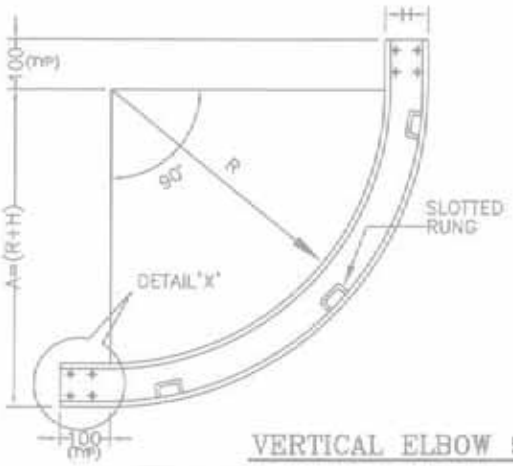
PROJECT: STANDARD

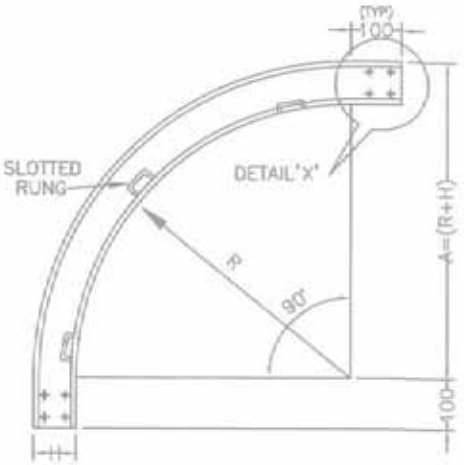
TITLE: CABLE TRAY DETAILS
HORIZONTAL TEE

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

891199/2022/TBG-TBG_ENGG

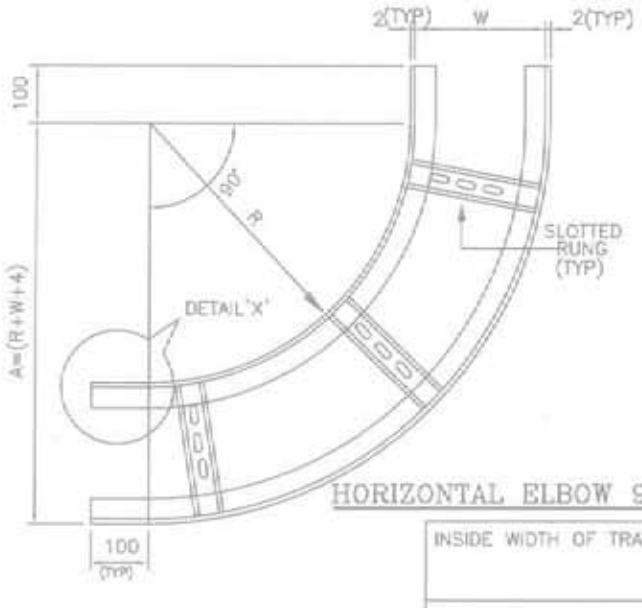
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

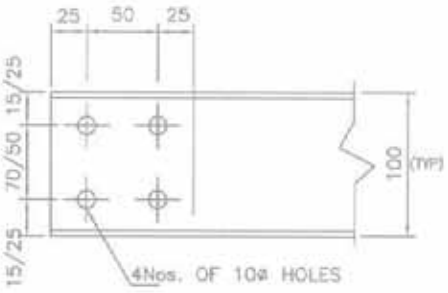




VERTICAL ELBOW 90° UP/DOWN

IN SIDE WIDTH OF TRAY (W)	DEPTH OF TRAY(H)	BENDING RADIUS (R)	A
150, 300, & 600	100	600	700
		900	1000
		1200	1300





DETAIL-X

HORIZONTAL ELBOW 90°

INSIDE WIDTH OF TRAY(W)	DEPTH OF TRAY (H)	BENDING RADIUS(R)	A		
			150	300	600
150, 300 & 600	100	600	754	904	1204
		900	1054	1204	1504
		1200	1354	1504	1804

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	MS	MS	RMP	–	VV	–	–	–	[illegible]	05/07/22
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

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

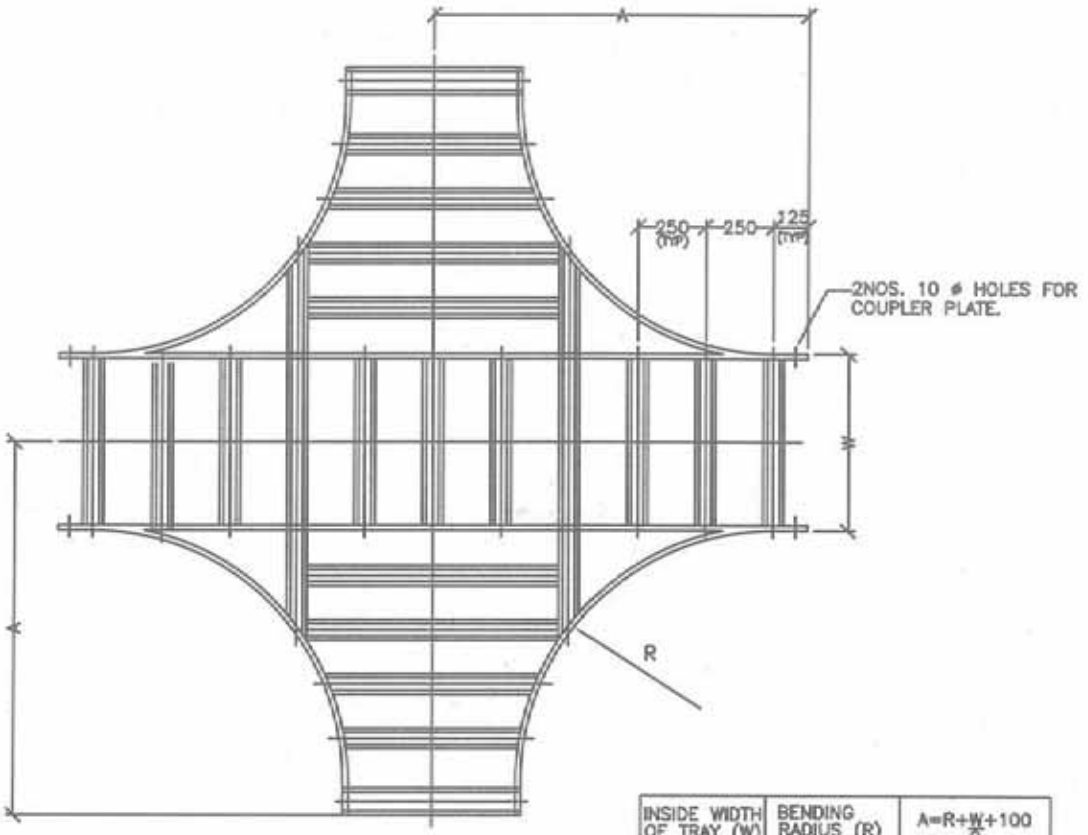
PROJECT: STANDARD

TITLE: CABLE TRAY 90ø BENDS (CTB 90ø)

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

891199/2022/TBG-TBG_ENGG

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



PLAN

INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	$A=R+\frac{W}{2}+100$
600	1050	1450
	600	1000
	450	850
	300	700
300	1050	1300
	600	850
	450	700
	300	550

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.12.19
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

एन टी पी सी NTPC

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

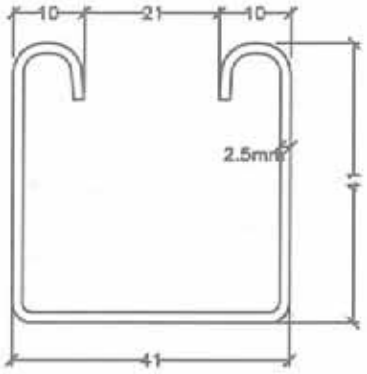
PROJECT: STANDARD

TITLE: CABLE TRAY DETAILS CROSS

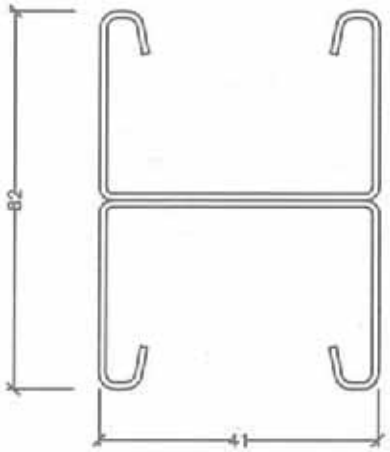
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-008	RC

891199/2022/TBG-TBG_ENGG

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



SINGLE CHANNEL–TYPE C1



DOUBLE CHANNEL–TYPE C2

TWO LENGTHS OF C1 WELDED BACK TO BACK

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

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

एन टी पी सी NTPC

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

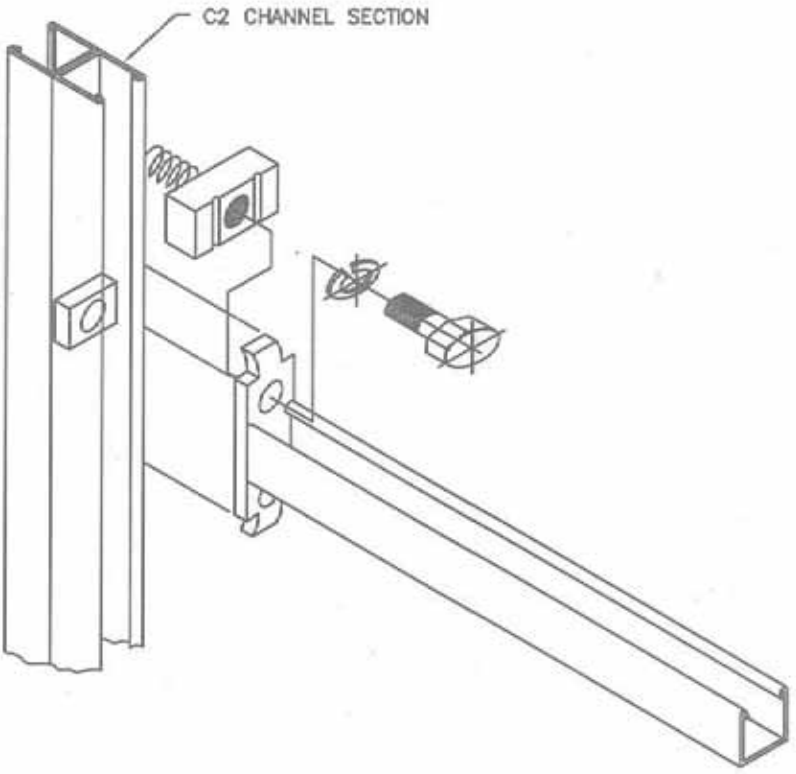
PROJECT: STANDARD

TITLE: C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-013	RC

891199/2022/TBG-TBG_ENGG

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



NOTE.

1. FINISH :–HOT DIP GALVANISED

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

एन टी पी सी NTPC

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

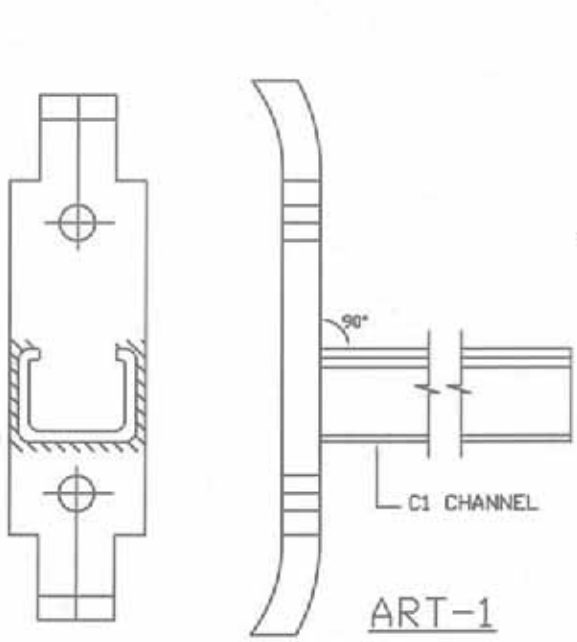
PROJECT: STANDARD

TITLE: TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM

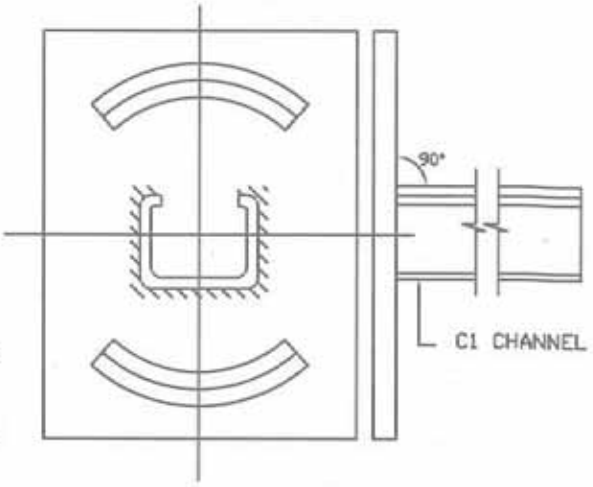
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-015	RC

891199/2022/TBG-TBG_ENGG

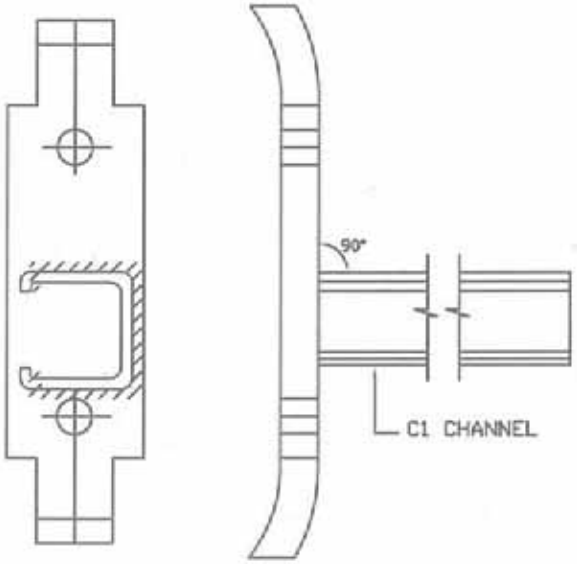
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.



ART-1



ART-3



ART-2

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.12.22
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

एन टी पी सी NTPC

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

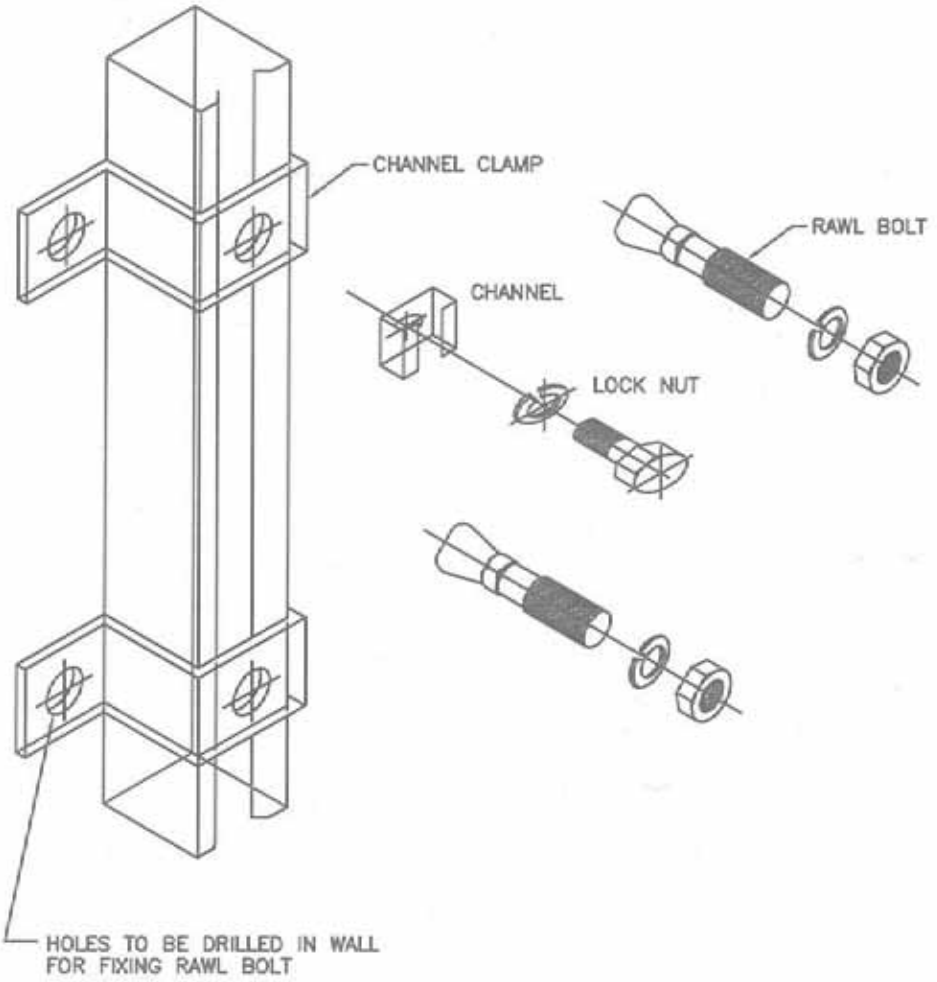
PROJECT: STANDARD

TITLE: CANTILEVER ARMS

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

891199/2022/TBG-TBG_ENGG

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



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

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

एन टी पी सी NTPC

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

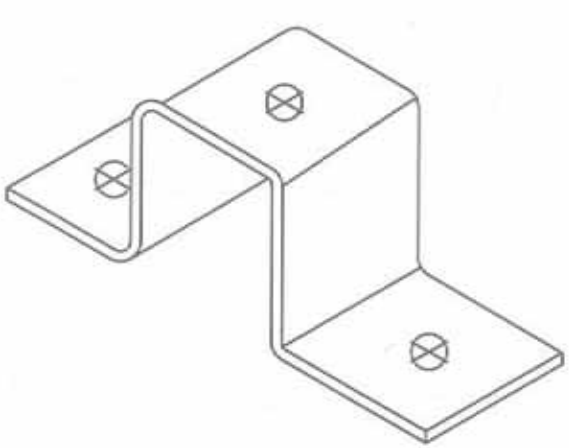
PROJECT: STANDARD

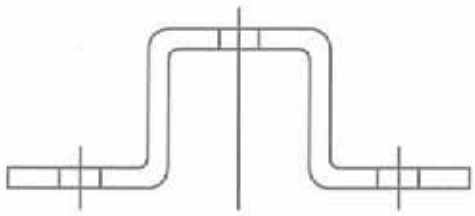
TITLE: FIXING OF CHANNEL IN TRENCH WALL

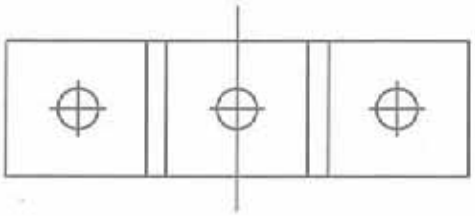
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-019	RC

891199/2022/TBG-TBG_ENGG

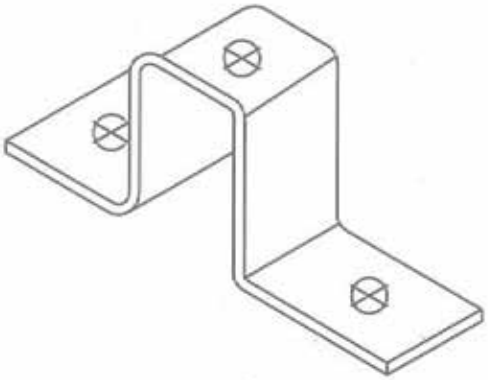
This drawing and the design it covers are the property of NTPC LTD. and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

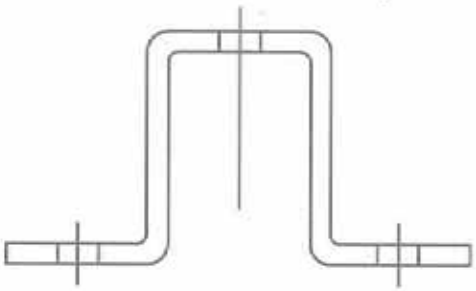


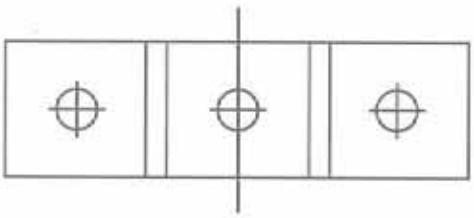




BRACKET–C1 CHANNEL CLAMP HEAVY DUTY.







BRACKET–C2 CHANNEL CLAMP.

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

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

एन टी पी सी NTPC

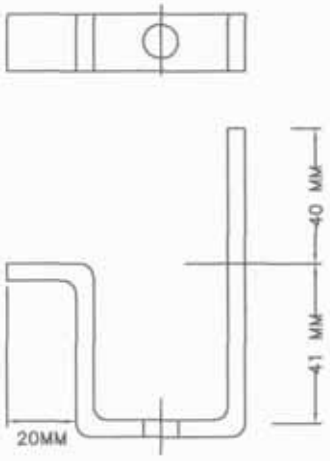
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

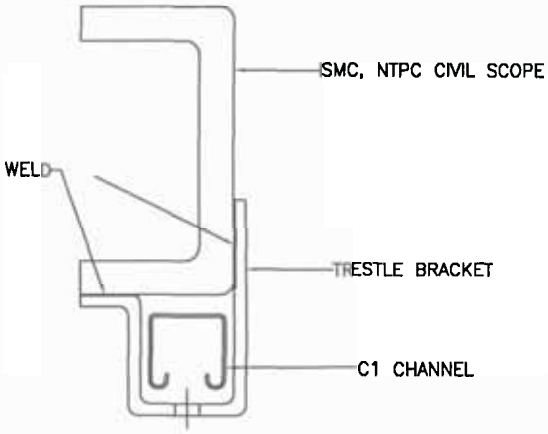
TITLE: BRACKET C1 CHANNEL CLAMP HEAVY DUTY. AND BRACKET C2 CHANNEL.

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

891199/2022/TBG-TBG_ENGG



TRESTLE BRACKET.



FIXING ARRANGEMENT OF TRESTLE BRACKET.

NOTES

1) MATERIAL : MILD STEEL.
2) FINISH : HOT DIP GALVANISED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RA	FOR TENDER PURPOSE	MV	RKP	VKM	–	SS	–	–	–	DT	09.10.2008
					CLEARED BY						

एन टी पी सी NTPC

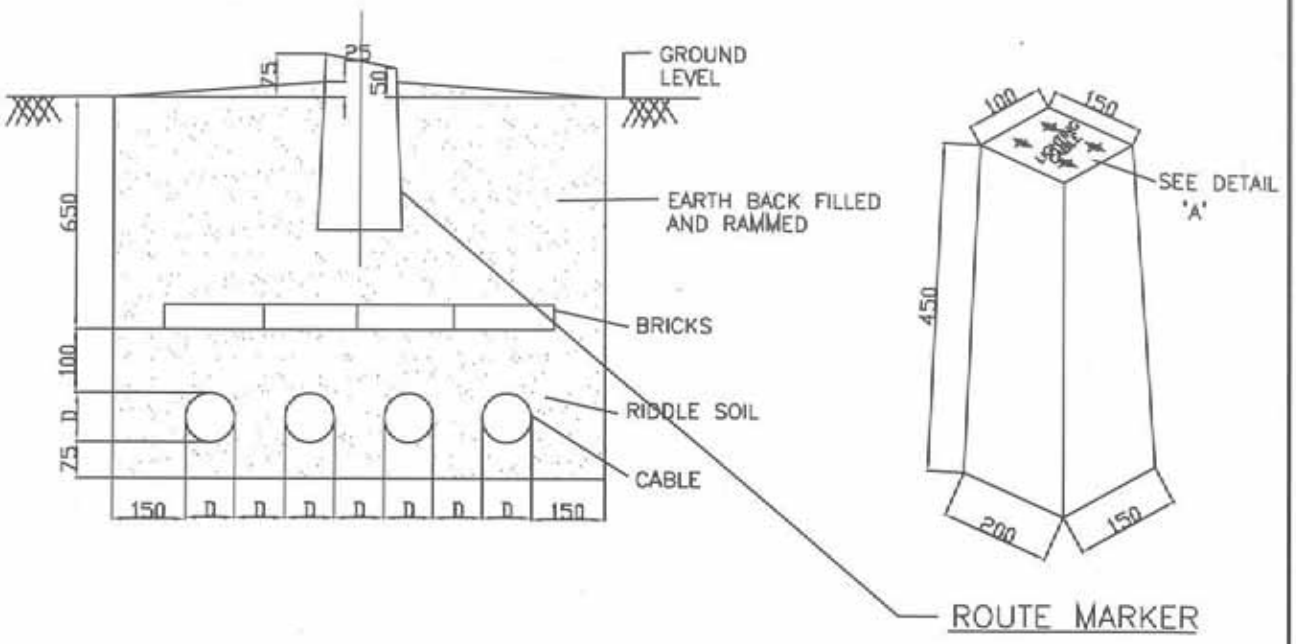
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
(FORMERLY NATIONAL THERMAL POWER CORPORATION LTD.)
ENGINEERING DIVISION

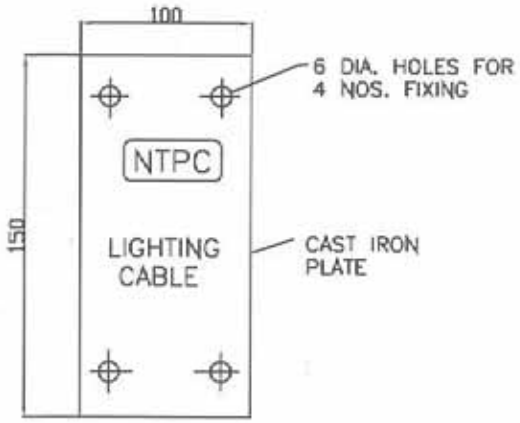
PROJECT	STANDARD		
TITLE	FIXING OF CHANNEL FOR TRESTLE AND TRESTLE BRACKET.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-022A	REV. NO. RA

RA

TRAY1A-211-022A

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





DETAIL – 'A'

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ROUTE MARKERS SHALL BE CONSTRUCTED OF CONCRETE WITH CAST IRON PLATE, WITH THE ROUTE INFORMATION ENGRAVED ON IT, BOLTED ON TOP OF THE CONCRETE BLOCK AS SHOWN.
3. CAST IRON PLATE SHALL BE OF Min. 6.0mm THICKNESS.

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

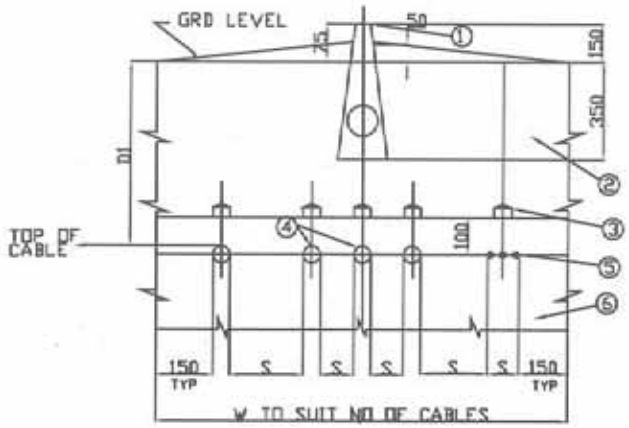
एन टी पी सी NTPC

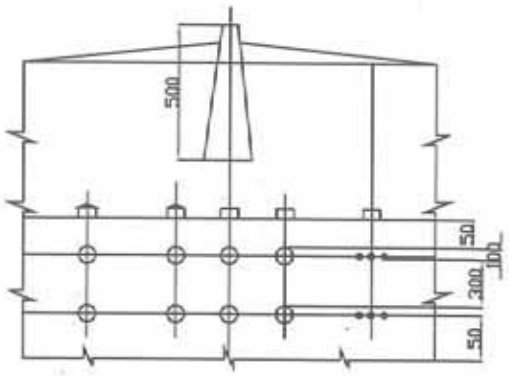
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	BURIED CABLE TRENCH DETAILS FOR LIGHTING		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-049	REV. NO. RC

891199/2022/TBG-TBG_ENGG

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





DIRECTLY BURIED CABLES IN SINGLE LAYER

DIRECTLY BURIED CABLES IN TWO LAYER

LEGEND

① CABLE ROUTE MARKER
② EARTH BACK FILLED & RAMMED
③ PROTECTIVE COVERS
   a) BRICKS FOR LOW VOLTAGE CABLES
   b) RCC FOR HIGH VOLTAGE CABLES WITH HOLE AT EACH END TO TIE EACH OTHER WITH G.S. WIRE
④ ARMOURED POWER CABLE
⑤ ARMOURED CONTROL CABLE
⑥ FINE SAND/RIDDLED SOIL COMPACTED

DIMENSION MIN.	1100V GRADE CABLES	FOR 3.3 KV TO 11KV	ABOVE 11KV & UPTO 33KV
D1	750	900	1050
S	= d BETWEEN CABLES OF SAME CLASS = 300MM BETWEEN CABLES OF DEFT CLASS = 400MM BETWEEN 1/C POWER CABLE AND COMMUNICATION CABLE. = 300MM BETWEEN MULTICORE POWER CABLE & COMMUNICATION CABLE.		

d - OVERALL DIAMETER OF THE BIGGER OF THE TWO CABLES.
D1 - MINIMUM DEPTH OF LAYING FROM GROUND SURFACE TO TOP OF CABLES.

NOTE

1. SINGLE CORE CABLES SHALL BE RUN IN TREFOIL FORMATION AND SHALL BE BOUND BY SELFLOCKING CABLE TIES AT EVERY 750 MM.
2. CABLE IDENTIFICATION TAG SHALL BE TIED AT BOTH ENDS OF THE CABLE.
3. IF THE MINIMUM CLEARENCE AS INDICATED THE ABOVE TABLE FOR CABLES OF DIFFERENT CLASSES ARE NOT FEASIBLE BRICK BARRIERS SHALL BE USED BETWEEN ADJACENT CABLES.
4. G.I/HUME/HDPE. PIPES SHALL BE PROVIDED FOR ROAD CROSSING AT A MINIMUM DEPTH OF 600 FROM THE GRADE LEVEL AS DECIDED BY NTPC.
5. ALL DIMENSIONS ARE IN mm

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

एन टी पी सी NTPC

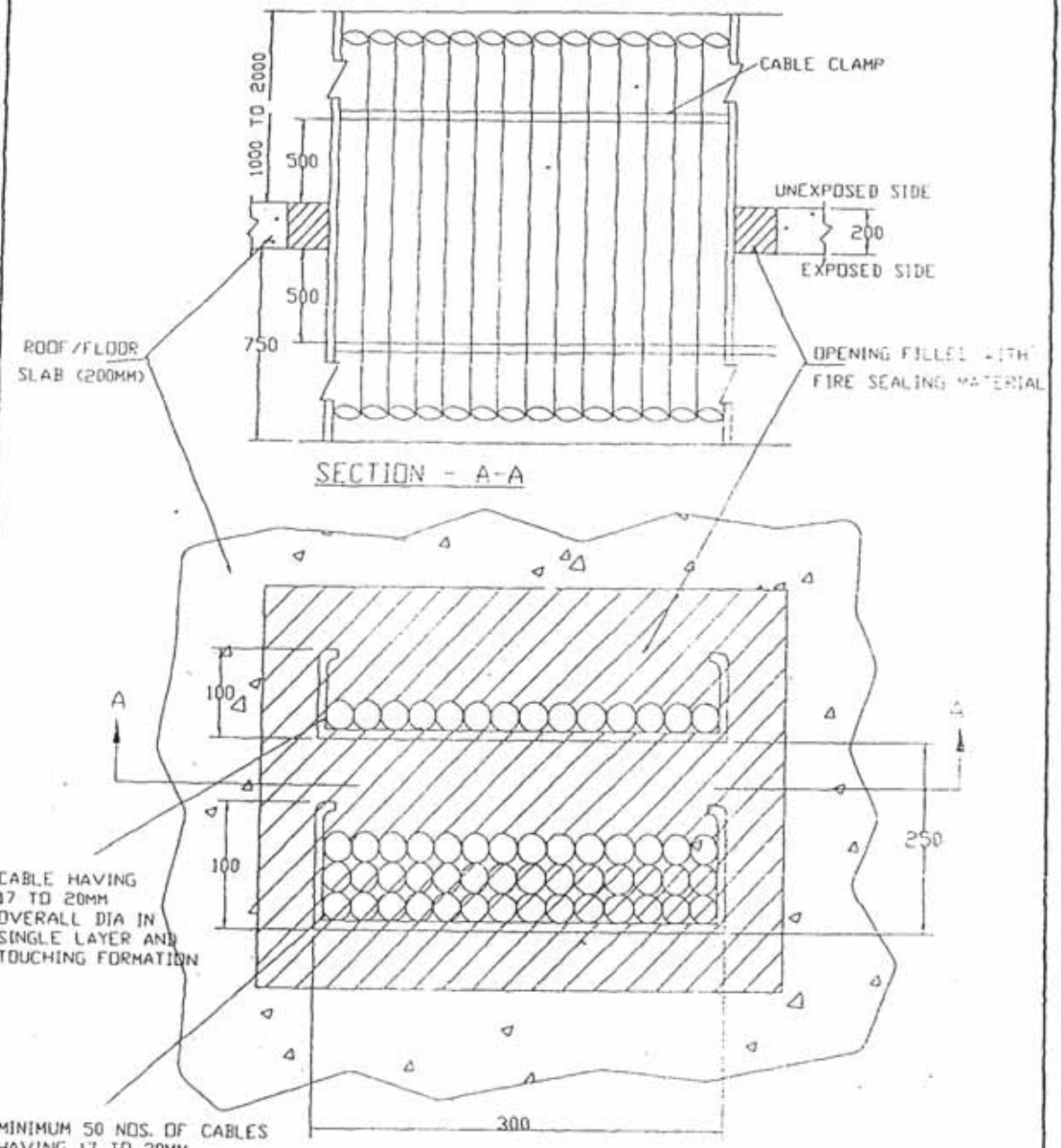
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BURIED CABLES TRENCH FOR HT & LT CABLES

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-060	RC

891199/2022/TBG-TBG_ENGG



NOTES:

1. IN CASE OF BLOCK TYPE SYSTEM ARRANGEMENT SHALL BE WITH FRAME & BLOCKS HOWEVER NUMBER OF CABLES SHALL REMAIN SAME.
2. ALL DIMENSIONS ARE IN MM ONLY.
3. CABLES TO BE USED SHALL BE OF DIFFERENT DIA. ALL THE CABLES SHALL NOT BE OF SAME DIA.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RB	FOR TENDER PURPOSE				-		-	-	-		5/7/22
RA	FOR TENDER PURPOSE				-		-	-	-		

एन टी पी सी NTPC

NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: FIRE PROOF CABLE PENETRATION SYSTEM TEST SETUP

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

211-051.dwg

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

PART - D

ERECTION CONDITIONS OF CONTRACT

ERECTION CONDITIONS OF CONTRACT

PART - D

CONTENTS

Clause No.	Description	Page No.
1.00.00	General	1
2.00.00	Regulation of Local Authorities and Statutes	1
3.00.00	Welding of Pressure Parts and High Pressure Piping	1
4.00.00	Heat Treatment	2
5.00.00	Weld Edge Preparation	3
6.00.00	Cleaning and Servicing	3
7.00.00	Field Welding Schedule	3
8.00.00	Site Run Miscellaneous Piping	4
9.00.00	Thermal Expansions	4
10.00.00	Piping Supports	4
11.00.00	Pressure Testing	5
12.00.00	Thermowells and Flow Nozzles	5
13.00.00	Insulation, Lagging and Cladding	6
14.00.00	Code Requirements	7
15.00.00	Electrical safety regulations	7
16.00.00	Removal of Material	8
17.00.00	Inspection, Testing and Inspection Certificates	8
18.00.00	Access to site and Works on Site	8

Clause No.	Description	Page No.
19.00.00	Contractor's Site Office Establishment	8
20.00.00	Co-operation with other contractors	9
21.00.00	Discipline of Workmen	9
22.00.00	Contractor's Field Operation	9
23.00.00	Photographs and Progress Report	10
24.00.00	Man-Power Report	10
25.00.00	Protection of Work	10
26.00.00	Employment of Labour	11
27.00.00	Facilities to be provided by the Employer	11
28.00.00	Facilities to be provided by the Contractor	12
29.00.00	Lines and Grades	13
30.00.00	Fire Protection	13
31.00.00	Security	13
32.00.00	Contractor's Area Limits	14
33.00.00	Contractor's Co-operation with the Employer	14
34.00.00	Pre-commissioning and Commissioning Activities	14
35.00.00	Materials Handling and Storage	17
36.00.00	Construction Management	18
37.00.00	Field Office Records	18
38.00.00	Contractor's Materials Brought on to Site	18
39.00.00	Protection of Property and Contractor's Liability	19
40.00.00	Painting	19

Clause No.	Description	Page No.
41.00.00	Insurance	20
42.00.00	Unfavourable Working Conditions	21
43.00.00	Protection of Monuments and Reference Points	21
44.00.00	Work & Safety Regulations	21
45.00.00	Foreign Personnel	30
46.00.00	Foundation Dressing & Grouting for Equipment/Equipment Bases	31
47.00.00	Shaft Alignments	32
48.00.00	Dowelling	32
49.00.00	Check Out of Control Systems	32
50.00.00	Commissioning Spares	33
51.00.00	Cabling	33
52.00.00	Equipment Delivery and Erection	34
53.00.00	Welding-Special Requirements	40
54.00.00	Deviations Dispositioning	40
55.00.00	Non-Destructive Testing (NDT)	41
56.00.00	Testing Equipment & Facilities	41
Annexure-I	Standard Check List	42
Annexure-II	Brief Writeup on the contents of testing schedule/commissioning schedule	49
Annexure-III	Safety Plan	50

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
1.00.00	**GENERAL**
1.01.00	The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall respon-sibility and co-ordination of the Works to be performed at Site. Such a person shall function from the Site office of the Contractor during the pendency of Contract.
2.00.00	**REGULATION OF LOCAL AUTHORITIES AND STATUTES**
2.01.00	In addition to the local laws and regulations, the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.
2.02.00	All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully pay-able under the provisions of the Indian Boiler Regula-tions and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.
3.00.00	**WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING** The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements :
3.01.00	**Qualification of Weld Procedures** Only qualified welding procedures as per ASME Section IX shall be used by contractor at site. Procedure qualification records along with WPS shall be submitted to NTPC for review. Welding procedure shall indicate all essential and non-essential parameters as per ASME Section IX. Makes of welding consumables shall be subject to employer's approval.
3.02.00	**Welder's Qualification** Only welders who are qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts and its attachment welding. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory pre-production qualification

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	test to be conducted by the Contractor at site as per ASME Sec IX in presence of employer's representative(s), prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders. All the welders carrying out welding at site shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested and authorised to carry out welding.
3.03.00	**Records** Welders performance shall be monitored regularly and record of their performance shall be maintained by contractor in a manner acceptable to the employer. Contractor shall maintain such records including record of procedure qualification & welder qualification and hand-over to the employer at the end of work.
3.04.00	**MARKING** On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.
4.00.00	**HEAT TREATMENT**
4.01.00	Pre-heating, post-heating and post-weld stress relief operations of all welds, shall be performed in accordance with the requirements of applicable code. Local post weld stress relieving heat treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils. Oxy-acetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of a potentiometric recorder. Recorders other than those of potentiometric type shall not be used for such temperature recording during stress relieving operations. The contractor & employer's representative, at start and at the end of HT Cycle shall sign the time and temperature charts for heat-treatment.
4.03.00	After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (as specified at clause no 7.00.00- of this chapter) etc.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
5.00.00	**WELD EDGE PREPARATION** Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.
6.00.00	**CLEANING AND SERVICING**
6.01.00	The inside of all tubes, pipes, valves and fittings shall be free from dirt, and loose scales before being erected. All the pipelines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.
6.02.00	All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and serviced prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.
6.03.00	All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.
7.00.00	**FIELD WELDING SCHEDULE** The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field-welding schedule to be issued by the Contractor shall contain the following: (a.) Drawing No (s) (b.) Location of the weld (c.) Size of the weld (outside diameter and thickness) (d.) Type of joints (e.) Material specifications (f.) Size of fillet on backing ring, when the type of joint is with backing ring

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	(g.) Electrode/ filler metal specifications (h.) Number of welds per unit (i.) Quantity of filler metal per weld (j.) Indication of required Non-destructive Examination (NDE) for each weld (k.) Pre-heat temperatures for welding (l.) Process of welding (m.) Post-welding heat treatment temperature ranges, duration, under as specified at clause no 4.00.00 of this chapter entitled "Heat Treatment". (n.) Qualification details of weld procedures to be adopted as specified at clause no 3.01.00 of this chapter entitled 'Qualification of Weld Procedures'.
8.00.00	**SITE RUN MISCELLANEOUS PIPING** Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of such site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipes between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.
9.00.00	**THERMAL EXPANSIONS** All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.
10.00.00	**PIPING SUPPORTS**
10.01.00	Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly levelled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
10.02.00	The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.
11.00.00	**PRESSURE TESTING**
11.01.00	On completion of erection of pressure parts, a hydraulic test in accordance with the requirements of the Indian Boiler Regulations shall be performed by the Contractor.
11.02.00	All the valves, high pressure pipes and inter-connected pipes connecting the pressure parts shall be tested along with pressure parts. All blank flanges or any removable plugs required for openings not closed by the valves, and piping provided, shall be furnished by the Contractor. The pressurization equipment including water piping from the supply, needed for the above test shall also be furnished by the Contractor. Any defects noticed during the testing are to be rectified and the unit re-tested. If any welding is done on the pressure parts after the Hydraulic test, the Hydraulic test for that portion of pressure parts shall be repeated.
11.03.00	Thy hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting Authority as per the provisions of the Indian Boiler Regulations and the Employer.
12.00.00	**THERMOWELLS AND FLOW NOZZLES**
12.01.00	All the thermowells and flow nozzles in the equipment furnished under the technical specifications shall be installed as a part of this work.
12.02.00	All thermowell connections incorporated in the steam service shall be plugged during the pressure testing and the blow out of steam piping systems. Upon completion of the blow out operation, all thermowells shall be installed and seam welded. Similarly, all flow nozzles in the steam lines shall also be installed only on completion of steam blowing operations unless otherwise agreed to by the Employer, depending upon the sequence of cleaning and purging operations to be adopted by the Contractor at the field.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
13.00.00	**INSULATION, LAGGING AND CLADDING** The provision of insulation, lagging and cladding of the various equipments and portion of the equipment covered under the Contract, shall be furnished by the Contractor as specified elsewhere or agree to separately in writing. Welds required for holding insulation on pressure parts shall be carried out by IBR qualified welder.
13.01.00	**Piping, Pipe Fittings & Valves** All piping insulation and metal cladding furnished with the equipment to be erected shall be applied as specified herein.
13.01.01	**Piping** The insulation on piping shall be applied using wire loops on 150mm centres. These wire loops shall be thoroughly embedded into the outer insulation surface and all cracks, voids and depressions shall be filled with insulating cement suitable for the piping temperature so as to form a smooth base for application of cladding. The wires used for piping insulation shall be of 16 SWG. The surface shall be smooth and uniform before applying the outer covering . All piping insulation ends shall be terminated at a sufficient distance from flanges to facilitate removal of bolts.
13.01.02	**Flanges** Insulation on flanges shall be by means of blocks of insulating material securely bound to the flange by wire loops. Such blocks of insulation shall be long enough to overlap the adjacent pipe insulation by an amount equal to the thickness of adjacent pipe insulation. Smooth finish shall be obtained by the application of insulating cement. Alternatively, sectional pipe insulation of proper diameter may be used. Insulation on flanges shall not be done until the pipe and equipment have been in service during the initial operation and till all the flange bolts have been retightened.
13.01.03	**Bends and Elbows** Insulation on bends and elbows shall be cut into sections sufficiently short to form a reasonable smooth external surface. After the application of insulation material in place, it shall be smoothly coated with insulating cement. Elbows may be insulated as above or alternatively by means of specially moulded insulation enclosures.
13.01.04	**Cladding** Cladding shall be of aluminium sheet of thickness as per details given in detail Technical Specification or will be provided during detail engineering shall be machine rolled and formed to accurately fit insulation curvatures. Cladding shall be secured using self-tapping screws. Screws shall be adequate number and so located as to produce tight joints. The spacing of screws shall be as far as possible uniform and on centres not exceeding 150 mm. For outside diameters less than 230 mm, spacing of screws shall be on centres not exceeding 100 mm. adequate number of screws shall be provided for fixing the cladding and be so placed in such locations, as to produce a smooth cladding finish without bellying'. Insulated elbows having insulated diameters less

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	than 330 mm shall be provided with preformed smooth aluminium elbow jackets. Wherever possible, all joints should be lapped a minimum of 50 mm with joints facing downwards and so placed that they are obscured from normal points of vision. All the joints in the cladding shall be made with suitable provisions for expansions. All butt joints such as those at piping tees shall be made using rolled seams. In addition, to prevent galvanic corrosion, suitable action, as specified at clause no 13.02.00 of this chapter, shall be taken.
13.01.05	**Valves and Fittings** All valves and fittings (above valve size of 2 inches) installed in the pipelines shall also be applied with insulation and furnished with suitably shaped boxes so as to facilitate easy dismantling of the fittings. The insulation thickness for valves, valve fittings etc., shall be same as that used on the line on which they are installed. All voids shall be properly filled up with insulating material and as per the directions of the Employer.
13.02.00	**Protection of Equipment during Insulation Applications** All equipment and structures shall be suitably protected from damage while applying insulation after completion of insulation. All equipment and structures shall be thoroughly cleaned and remove insulating materials which might have fallen on them.
14.00.00	**CODE REQUIREMENTS** The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules & Codes, Indian Boiler Regulations, ASME codes and accepted good practices, the Employer's Drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.
15.00.00	**ELECTRICAL SAFETY REGULATIONS**
15.01.00	In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the other Contractor or Employer.
15.02.00	Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall: (a) Satisfy the Employer that the appliance is in good working condition. (b) Inform the Employer of the maximum current rating,voltage and phase of the appliances. (c) Obtain permission of the Employer detailing the socket to which the appliances may be connected. The Employer will not grant permission to connect unitl he is satisfied that (d) The appliance is in good condition and is fitted with suitable plug.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	(e) The appliance is fitted with a suitable cable having two earth conductors,one of which shall be an earthened metal sheath surrounding the cores.
15.03.00	No electric cable in use by the other Contractor/Employer will be disturbed without permission.No weight of any description willl be imposed on any such cable and ladder or similar equipment will rest against or to be attached with it.
15.04.00	No reapir work shall be carried out on any live equipment.The equipment must be declared safe by the Employer and a permit to work issued before any work is carried out.
15.05.00	The Contractor shall employ the necessary number of qualified,full time electricians to maintain his temporary electrical installation..
16.00.00	**REMOVAL OF MATERIAL**
	No material brought to the Site shall be removed from the Site by the Contractor and/ or his Sub-Contractors without the prior written approval of the Employer.
17.00.00	**INSPECTION, TESTING AND INSPECTION CERTIFICATES**
	The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.
18.00.00	**ACCESS TO SITE AND WORKS ON SITE**
18.01.00	Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the Employer in reasonable time.
18.02.00	In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the Employer or his representative.
19.00.00	**CONTRACTOR'S SITE OFFICE ESTABLISHMENT**
	The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
20.00.00	**CO-OPERATION WITH OTHER CONTRACTORS**
20.01.00	Employer, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the works under the Contract. The Contractor shall also arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the Contractor shall have no claim against the Employer on that account other than an extension of time for completing his works. Employer shall have full access to visit the contractor's site at any time for inspection and surveillance checks.
20.02.00	The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, re-quired to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.
21.00.00	**DISCIPLINE OF WORKMEN**
	The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Employer such employee has mis-conducted himself or is incompetent, negligent or otherwise unde-sirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.
22.00.00	**CONTRACTOR'S FIELD OPERATION**
22.01.00	The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.
22.02.00	The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.
23.00.00	**PHOTOGRAPHS AND PROGRESS REPORT**
23.01.00	The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.
23.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.
23.03.00	The Contractor shall submit the progress of work in video cassettes (2 copies) quarterly highlighting the progress and constraints at site.
24.00.00	**MAN-POWER REPORT**
24.01.00	The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.
24.02.00	The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill- wise and the areas of employment of such labour.
25.00.00	**PROTECTION OF WORK**
	The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagree-ment or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the as specified at clause no 20.00.00- of this chapter entitled "Co-opera-tion with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such dis-putes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
26.00.00	**EMPLOYMENT OF LABOUR**
26.01.00	In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work only his regular skilled employees with experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.
26.02.00	All travelling expenses including provisions of all necessary transport to and from Site, lodging allow-ances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.
26.03.00	The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.
26.04.00	Contractor's employees shall wear identification badges while on work at Site.
26.05.00	In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contact Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Employer may make such payments and shall recover the same from the Contractor's Bills.
27.00.00	**FACILITIES TO BE PROVIDED BY THE EMPLOYER**
27.01.00	**Electricity** Refer to construction power, as envisaged at Clause 1.14.00 of Sub Section-II-B, Part A, Sec VI of Technical specification. Further, complete construction power requirement (including power for bidder's labour camp & staff colony) will be available on chargable basis based on prevailing commercial rates of DISCOM.
27.02.00	**Water** Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite/colony.
27.03.00	**Communication** The Employer will extend the telephone facilities, if available at Site, for purposes of Contract. The Contractor shall be charged at actuals for such facili-ties.
27.04.00	**Railway Siding** Railway siding shall be provided by owner for coal transportation to site.However the same may not be available to the bidder for material/supplies transport etc.Bidder has to plan on its own for movement of ODC consignment to plant site. Further,irrespective of readiness of railway siding,owner reserves the option of coal supply in stackyard before the synchronization of first unit for which bidder has to ensure readiness of coal supply system upto mill bunker.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

28.00.00 FACILITIES TO BE PROVIDED BY THE CONTRACTOR

28.01.00 **Contractor's site office Establishment**

The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC.

28.02.00 **Tools, tackles and scaffoldings**

The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, etc. for the purpose of fabrication, erection and commissioning.

28.03.00 **Testing Equipment and Facilities:**

The contractor shall provide the necessary testing, equipment and facilities.

28.04.00 **Site laboratory for civil works:**

Contractor shall provide and maintain a site laboratory for the testing of construction material under the direction and general supervision of employer.

28.05.00 **First-aid**

28.05.01 The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.

28.05.02 The Employer will provide the Contractor, in case of any emergency, the services of an ambulance for transportation to the nearest hospital.

28.06.00 **Cleanliness**

28.06.01 The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
28.06.02	Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.
29.00.00	**LINES AND GRADES**
	All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense.
30.00.00	**FIRE PROTECTION**
30.01.00	The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.
30.02.00	Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.
30.03.00	All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.
30.04.00	The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time.
31.00.00	**SECURITY**
	The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.
32.00.00	**CONTRACTOR'S AREA LIMITS** The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contactor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.
33.00.00	**CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER** In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and installed by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.
34.00.00	**PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES**
34.01.00	**GENERAL**
34.01.01	The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. All pre-commissioning/ commissioning activities considered essential for such readiness of the equipment/ systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the contractor.
34.01.02	The pre-commissioning and commissioning activities including Guarantee/demonstration/ acceptability tests, checks and trial operations of the equipment/systems furnished and

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

installed by the contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at site during such operations.

34.01.03 The following activities shall be carried out by the contractor, 18 month prior to schedule date of commissioning of the equipment/systems installed by him.

(a.) The contractor shall furnish the organization chart of his operation and commissioning engineers for the acceptance of employer. Adequate number of operation and commissioning engineers shall be deployed by the contractor to effectively meet the requirement of round the clock operation in shifts also, till the plant is taken over by the employer.

(b.) The contractor shall submit the bio-data containing the details of experience of his operation and commissioning engineers for the acceptance of employer.

(c.) The contractor shall furnish the deployment schedule of his operation and commissioning engineers for the acceptance of the employer.

(d.) Apart from above, contractor shall ensure deployment of sufficient skilled/semi-skilled/unskilled manpower during pre-commissioning and commissioning activities.

34.01.04 It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment/systems which are installed by him.

34.01.05 The Contractor shall also be responsible for flushing and initial filling of all oils and lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications and documents.

34.02.00 **COMMISSIONING DOCUMENTATION**

34.02.01 The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various equipment/systems covered under the contract, for the approval of employer.

34.02.02 Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking. An indicative list of such equipment is enclosed as Annexure I.

34.02.03 The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system (for example Boiler Feed Pump, condensate pump,

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	compressor etc) Commissioning schedule is a document envisaged for commissioning of a system (for example feed system, Condensate system, Compressed Air system, Fire water system, Unit commissioning etc). The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is enclosed as Annexure-II.
34.02.04	The contractor shall submit the list of commissioning documentation to be submitted by him, alongwith their submission schedule for various equipment/systems covered under the contract, with in 6(six) month from the date of award of contract, for the acceptance of employer.
34.02.05	The Contractor shall submit the commissioning documentation, for various equipment/ covered under the contract, for the approval of employer, at least 18 months before the scheduled date of commissioning of the equipment/systems.
34.03.00	**COMMISSIONING ACTIVITIES**
34.03.01	Upon completion of pre-commissioning activities/tests, the contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities.
34.03.02	Contractor shall carry out the checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.
34.03.03	Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.
34.03.04	The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment of prior to that as the case may be.
34.03.05	Other tests shall be conducted, if required by the Employer, to establish that the plant equipment are in accordance with requirements of the specifications.
34.03.06	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all electrical and C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.
34.05.00	**Initial Operation** Upon completion of system checking/Tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation as stipulated in General Technical Requirements.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
35.00.00	**MATERIALS HANDLING AND STORAGE**
35.01.00	All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.
35.02.00	Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
35.03.00	The Contractor shall maintain an accurate and exhaus-tive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.
35.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equip-ment at Site.
35.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
35.06.00	All the electrical equipment such as motors, genera-tors, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Employer.
35.07.00	The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.
35.08.00	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or dete-rioration in quality by storage.
35.09.00	All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable.
35.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
35.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space . The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.
36.00.00	**CONSTRUCTION MANAGEMENT**
36.01.00	The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.
36.02.00	The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.
36.03.00	Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.
36.04.00	The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.
37.00.00	**FIELD OFFICE RECORDS**
	The Contractor shall maintain at his Site Office up-to- date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.
38.00.00	**CONTRACTOR'S MATERIALS BROUGHT ON TO SITE**
38.01.00	The Contractor shall bring to Site all equipment, components, parts, materials, including

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruc-tion thereof and damage thereto.
38.02.00	The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.
38.03.00	After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under as specified at clause no 38.02.00- of this chapter and credit the proceeds thereto to the account of the Contractor.
39.00.00	**PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY**
39.01.00	The Contractor shall be responsible for any damage resulting from his operations. He shall also be re-sponsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub-Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.
39.02.00	The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utili-ties when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.
40.00.00	**PAINTING**
	For painting refer Part-A, sub section-III, Section VI of Technical specification.
	Painting for structures shall conform to the painting specification specified in Part-B under Civil.
	Painting for piping shall conform to the painting specification given in Part-B of the respective chapter.
	Painting for Electrical equipments/systems shall conform to the painting specification given in Electrical portion of Part-A and Part-B of technical specifications.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
41.00.00	**INSURANCE**
41.01.00	In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.
41.02.00	**Workmen's Compensation Insurance** This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disa-bility disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabili-ties shall not be less than the following: Workmen's Compensation - As per Statutory Provisions Employee's Liability - As per Statutory Provisions
41.03.00	**Comprehensive Automobile Insurance** This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated : Fatal Injury : Rs.100,000 each person : Rs.200,000 each occurrence Property Damage : Rs.100,000 each occurrence
41.04.00	**Comprehensive General Liability Insurance**
41.04.01	The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC).
41.04.02	The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.
41.05.00	The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

42.00.00 UNFAVOURABLE WORKING CONDITIONS

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

43.00.00 PROTECTION OF MONUMENTS AND REFERENCE POINTS

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be preformed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

44.00.00 WORK & SAFETY REGULATIONS

44.01.00 **General**

i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.

ii) The Contractor shall follow NTPC Safety Rules as issued from time to time with respect to safety in construction & erection.

iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge.

iv) The contractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents to Engineer I/c for approval as per the format of Safety plan as annexed at Annexure - III.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.

vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard.

vii) The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.

viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.

ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NTPC safety documents as stated above.

x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured.

The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 0f The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health records shall be maintained accordingly and to be submitted to Engineer I/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c).

xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
44.01.01	**Emergency Action Plan** The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.
44.01.02	**Scaffolding** The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.
44.01.03	**Opening** The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. When ever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.
44.01.04	**Explosives** The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.
44.02.00	**Fencing of Machinery** The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery. The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.
44.03.00	**Carrying of Excessive Weight by a Worker** The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.
44.04.00	**Dangerous and Harmful Gases / Equipment**

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc. The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.
44.05.00	**Overhead Protection** The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.
44.06.00	**Working at Heights** All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping. Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work. Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls. Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards. The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

44.07.00 **Handling of Hazardous Chemicals**

The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.

Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule.

Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.

The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.

The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.

44.08.00 **Eye Protection**

The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
44.09.00	**Excavation** The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.
44.10.00	**Electrical Hazards** The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules. The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks. The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools. The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.
44.11.00	**Vehicular Traffic** The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.
44.12.00	**Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc.** The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.
44.13.00	**Excessive Noise, Vibration** The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000.

44.14.00 **Electrical Installations**

44.14.01 The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment.
Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall

i) Satisfy the Engineer I/C that the appliance is in good working condition;

ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances;

iii) Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected.

The Engineer I/C will not grant permission to connect until he is satisfied that:

The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

iv) No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.

v) The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation.

The installations are provided with suitable ELCBs and RCCBs wherever required.

44.15.00 **Safety Organisation**

44.15.01 The contractor employing more than 250 workmen whether temporary, casual, probationary, regular or permanent shall employ at least one full time safety officer exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub contractor

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	shall also be considered as the contractor's employees/workmen for the above purpose. In case of contractor deploying less than 250 workmen he should designate one of his Engr / supervisor or the contractor himself (if he is directly supervising the work) as safety officer in addition to his existing responsibilities. The Engr./ supervisor should get atleast 2days safety training from any reputed organization or from NTPC before resuming the work. If already trained in past the declaration along with trg. certificate to be furnished to NTPC safety officer.
44.15.02	The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.
44.16.00	**Reporting of Accident and Investigation** In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.
44.17.00	**Right to stop Work**
44.17.01	The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.
44.17.02	The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.
44.18.00	**Fire Protection** The contractor shall provide sufficient fire extinguishers at place /s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment.
44.19.00	**Penalties** I If the Contractor fails in providing safe working environment as per the Safety Rules of NTPC or continues the work even after being instructed to stop the

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

work by the Engineer I/C as provided in Clause XVIII (1) above, the Contractor shall be penalized at the rate of Rs. 25,000/- per day or part thereof till the instructions are complied with and so certified by the Engineer I/C. However, in case of accident, the provisions contained in Sub-Clause XX (II) below shall also apply in addition to the penalties mentioned in this sub-clause.

II If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or employees of other contractors, or NTPC's employees or any other person who are at the Site or adjacent thereto, the Contractor shall be responsible for payment of penalty to NTPC as per the following schedule:-

a) Fatal injury or accident causing death:

Penalty @10% of contract value or Rs. 5,00,000/- per person, which ever is less.

b) Major injuries or accident causing 25% or more permanent disablement to workmen or employees:

Penalty @2.5% of contract value or Rs. 1,00,000/- per person which ever is less

Permanent disablement shall have the same meaning as indicated in The Workmen's Compensation Act' 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen / employees under the relevant provisions of the Workmen's Compensation Act' 1923 and rules framed there under or any other applicable laws as applicable from time to time.

III If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c / Safety Officer of NTPC shall have the right to penalize the contractor for Rs. 200/- per person per day and such worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.

IV If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has

(1) not complied with keeping adequate PPEs in stock or

(2) defaulted in providing PPEs to his workmen

(3) not followed statutory requirements / NTPC safety rules

(4) been issued warning notice/s by NTPC head of the project on non

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	observance of safety norms (5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident. The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by NTPC. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evolution of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.
44.20.00	**Award** If the Contractor's performance on safety front is found satisfactory i.e. without any fatal/reportable accident in the year of consideration; he may be considered for suitable award "ACCIDENT FREE SAFETY MERITORIOUS AWARD" as per scheme of the employer.
45.00.00	**FOREIGN PERSONNEL**
45.01.00	The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.
45.02.00	Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.
45.03.00	No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satis-fied that the progress of work will not suffer due to such repatriation.
45.04.00	The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.
45.05.00	The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time or full-time nor shall they take part in any local politics.
45.06.00	The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.
46.00.00	**FOUNDATION DRESSING & GROUTING FOR EQUIPMENT/ EQUIPMENT BASES**
46.01.00	The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.
46.02.00	All the equipment/ equipment bases, shall be grouted and finished by bidder as per these specifications unless otherwise recommended by the equipment manufacturer.
46.03.00	The concrete foundation surfaces shall be properly prepared by bidder by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength.
46.04.00	**Grout** The grout for equipment foundation shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm2 at 28 days. The grout shall be ready mix non-shrink, chloride - free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer. The ready mix grout shall be of reputed make as approved by the Employer. The Grout shall have good flowability even at very low water/ grout powder ratio. The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use. The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout.
46.05.00	**Placing of Grout**
46.05.01	After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipu-lation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back & forth to push the grout into every part of the space under the base.
46.05.02	The grout shall be poured either through grout holes if provided or shall be poured at

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.

46.05.03 In addition to the above, recommendations of Grout manufacturer shall also be followed.

46.06.00 **Finishing of the Edges of the Grout**

The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothened with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.

46.07.00 **Checking of Equipment After Grouting**

After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check- up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Employer.

47.00.00 SHAFT ALIGNMENTS

All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall conform to Zone A of ISO 10816. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

48.00.00 DOWELLING

All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the Employer.

49.00.00 CHECK OUT OF CONTROL SYSTEMS

After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	systems for the equipment furnished and installed under these specifications and documents.
50.00.00	**COMMISSIONING SPARES**
50.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However. such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.
50.02.00	These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.
51.00.00	**CABLING**
51.01.00	All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer.
51.02.00	Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.
51.03.00	Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulted cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.
51.04.00	In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.
51.05.00	Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.

51.06.00 The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

52.00.00 **EQUIPMENT DELIVERY AND ERECTION**

52.01.00 **General Requirements**

(a.) This part covers Contractor's responsibilities for packing, shipping, ware-housing and the installation of all equipment and materials furnished and installed under this specification.

(b.) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following :

(1.) Instructions for packing, shipping, receiving handling, ware-housing and storage.

(2.) Instructions for location and installation of equipment furnished by this specification.

(3.) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.

(4.) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.

(5.) Check lists and quality assurance hold points.

(6.) Format for all related documentation.

(c.) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

(d.) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg.

52.02.00 **Crating**

(a.) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.

(b.) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.

(c.) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping.

(d.) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.

(e.) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.

(f.) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.

(g.) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number :

a) Export case markings

b) Case number

c) Gross weight and net weight in Kilograms

d) Dimensions in centimeters

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	e) Complete description of material (h.) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site. (i.) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. (j.) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. (k.) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired. (l.) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit. (m.) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site. (n.) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense. (o.) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.
52.03.00	**Factory Assembly** (a.) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels. (b.) All separately packaged accessories items and parts shall be shipped with the

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.

A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.

52.04.00 **Equipment Installation**

(a.) **General Requirements**

(1.) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification.

(2.) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.

(3.) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.

(4.) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications.

(b.) **Installation Materials**

All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.

(c.) **Regulatory Requirements**

All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.

(d.) **Cleaning**

All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.

(e.) **Equipment Assembly**

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

to perform the installation and commi ssioning work described in these specifications.

(f.) **Equipment Setting**

Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.

Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level.

(g.) **Free-Standing Equipment**

Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.

(h.) **Non-free Standing Equipment**

(1.) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner.

(2.) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part.

(i.) **Equipment Location**

(1.) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.

(2.) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the

components with which they are associated.

(3.) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.

(4.) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.

(5.) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion.

(6.) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.

For location of C&I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred.

(j.) **Installation of Field Mounted Instruments and Devices**

The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/ devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.

In addition to above relevant Portion as specified elsewhere in technical specification may be referred.

(k.) **Piping Connections**

(1.) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.

(2.) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.

(l.) **Equipment Checkout**

(1.) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.

(2.) After erection, all equipment having moving parts, having electrical

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

apparatus, or subject to pressure differentials shall be trial-operated.

(m.) **Defects**

(1.) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.

(2.) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.

(n.) **Equipment Protection**

(1.) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.

(2.) The equipment shall be protected during storage as described herein.

(3.) Equipment shall be protected from weld spatter during construction.

(4.) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.

(5.) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.

(6.) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.

53.00.00 **WELDING - SPECIAL REQUIREMENTS**

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.

54.00.00 **DEVIATIONS DISPOSITIONING:**

Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NTPC. All the deviations shall be bought to the knowledge of employer's representative for suitable dispositioning.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

55.00.00 **NON-DESTRUCTIVE TESTING (NDT):**

The contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job & acceptance norms agreed.

56.00.00 **TESTING EQUIPMENT & FACILITIES:**

Contractor shall provide the testing equipment and facilities necessary to carry out tests & inspections.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

ANNEXURE-I

STANDARD CHECKLIST

COMMISSIONING/TESTING ESSENTIAL PRE-REQUISITE

1. MECHANICAL

(A.) **VALVES**

(1.) MANUALLY OPERATED VALVE

(2.) ELECTRICALLY OPERATED VALVE

(3.) PNEUMATICALLY ACTUATED VALVE

(4.) HYDRAULICALLY ACTUATED VALVE

(5.) SAFETY VALVE

(6.) ELECTROMATIC RELIEF VALVE

(7.) STEAM TRAP

(8.) BUTTERFLY VALVE(ELECTRICALLY OPERATED)

(9.) BUTTERFLY VALVE (MANUALLY OPERATED)

(10.) BUTTERFLY VALVE(FOUR WAY-ELECTRICAL)

(11.) NON-RETURN VALVE(INCLUDING HYDRAULIC/PNEUMATIC FCNRVS)

(12.) THREE WAY CONTROL VALVE

(13.) RELIEF VALVE

(14.) DIFFERENTIAL PRESSURE REGULATING VALVE

(15.) FLOAT OPERATED VALVES

(B.) TANKS AND PRESSURRE VESSELS

(1.) TANKS (METAL)UPTO 20 M2

(2.) TANKS (LARGE STORAGE)

(3.) PRESSURE VESSEL (BELOW 17 BARS)

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

(4.) AIR RECEIVER

(5.) PRESSURE VESSEL-ACCESS DOOR

(6.) TURBINE MAIN OIL TANK

(C.) PUMPS

(1.) PUMP LOW PRESSURE CENTRIFUGAL (MOTOR DRIVEN)

(2.) PUMP UP TO 350 HP (260 KW)

(3.) PUMP SUMP INSTALLATION

(4.) GEAR PUMP/SCREW PUMP

(D.) PIPE WORK SYSTEM

(1.) STEAM SERVICES

(2.) WATER SERVICES

(3.) OIL/FIRE RESISTANT FLUID SYSTEM

(4.) AIR SERVICES (COMPRESSOR)

(5.) HIGH PRESSURE SERVICES

(6.) CONSTANT LOAD SUPPORT

(7.) SPRING SUPPORTS

(8.) HANGERS AND OTHER SUPPORTS

(E.) STRAINER AND FILTER

(1.) STRAINER/FILTER BASKET TYPE

(2.) STRAINER ROTARY(LOW PRESSURE)

(3.) FILTER & STRAINERS CENTRIFUGAL SEPARATORS

(4.) FILTER & STRAINER Y-TYPE

(5.) FILTER & STRAINER (PLATE TYPE)

(6.) PURIFIER

(7.) FILTER-COMPRESSED AIR LINE

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
	(F.) HEAT EXCHANGER (1.) HEAT EXCHANGER (GENERAL) (2.) HEAT EXCHANGER-OIL/WATER (3.) ROTARY AIR HEATER (G.) FANS AND COMPRESSORS (1.) FANS-NON-PRESSURE LUBRICATED (2.) FANS-AXIAL FLOW PRESSURE LUBRICATED (3.) COMPRESSORS-GENERAL (4,) DAMPERS & GATES (H.) CRANES AND ELEVATORS (1.) AUXILIARY OVERHEAD CRANE (2.) TRAVEL SUPPORT STRUCTURE FOR CRANE (3.) LONG TRAVEL & CROSS TRAVERSE MOTION OF CRANE (4.) MAIN AUX. HOIST MOTION (CRANE) (5.) ELECTRIC HOIST (I.) POWER TRANMISSION (1.) POWER TRANSMISSION GEAR BOX (2.) BEARING (3.) FLUID COUPLINGS **2. ELECTRICAL** (1.) D.C. MOTOR (2.) HV SQUIRREL CAGE INDUCTION MOTOR (3.) 415 V SQUIRREL CAGE INDUCTION MOTOR (4.) MOTOR OPERATED ACTUATORS

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

(5.) LT SWITCHGEARS/MCC

(I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM

(II.) PT CARRIAGE AND CUBICLES

(III.) CABLE/BUS DUCT/BUS BARS

(IV.) CONTRACTOR MODULE

(V.) SWITCH FUSE MODULE

(VI.) MASTER PANEL OF LUBE OIL PANEL

(VII.) FEEDER PANEL OF LUBE OIL PANEL

(VIII.) SPACE HEATER AND CABLE MODULE

(IX.) CONTROL TRANSFORMER MODULE

(X.) HT CIRCUIT BREAKER

(XI.) 415 V CIRCUIT BREAKER

(6.) POWER CABLE

(7.) CONTROL CABLE

(8.) AUXILIARY CABLE

(9.) D.C. CABLE

(10.) EXPLOSION PROOF ELECTRICAL EQUIPMENT

(11.) JUNCTION BOX

(12.) CONTROL TRANSFORMER MODULE

(13.) BRUSH GEAR ASSEMBLY

(14.) AUX. CONTROL AND RELAY PANEL DESK

(15.) INDICATING INSTRUMENT

(16.) RECORDING INSTRUMENT

(17.) INTEGRATING INSTRUMENT

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
3.	**CONTROL & INSTRUMENTATION** (A.) CONDUCTIVITY ANALYSING EQUIPMENT INCLUDING TEST PROCEDURES (B.) PH ANALYSER INCLUDING TEST PROCEDURE (C.) SILICA ANALYSER (D.) LEVEL SWITCH (FLOAT ACTUATED) (E.) LEVEL SWITCH (ELECTRODE TYPE) (F.) LEVEL SWITCH (DISPLACER ACTUATED) (G.) TRANSMITTER (FLOAT OPERATED PNEUMATIC OUTPUT) INCLUDING TESTING PROCEDURE (H.) LEVEL INDICATOR (FLOAT/PULLEY TYPE) (I.) LOCAL TEMPERATURE INDICATORS INCLUDING TEST PROCEDURE (J.) RESISTANCE THERMOMETER ELEMENT INCLUDING TEST PROCEDURE (K.) THERMOCOUPLE ELEMENT AND CONNECTING CABLE (L.) THERMOCOUPLE AND RESISTANCE THERMOMETER CONVERTOR/ TRANSMITTER INCLUDING TEST PROCEDURES. (M.) TEMPERATURE SWITCH/THERMOSTAT INCLUDING TEST PROCEDURES (N.) COLD JUNCTION BOXES (O.) ZENER BARRIER (P.) O2 ANALYSER (Q.) O2 IN HYDROGEN INCLUDING TEST PROCEDURES (R.) PRESSURE AND VACUUM GAUGE (S.) PRESSURE AND VACUUM SWITCH INCLUDING TEST PROCEDURE (T.) DIFFERENTIAL PRESSURE TRANSMITTER INCLUDING TEST PROCEDURE (U.) DIFFERENTIAL PRESSURE SWITCH INCLUDING TEST PROCEDURE.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

(V.) FLOW INDICATOR (VARIABLE AREA)

(W.) ORIFICE PLATE

(X.) TURBINE FLOW TRANSMITTER

(I.) FLOW SWITCH

(II.) WEIR

(III.) NOZZLE

(IV.) FLOW INDICATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE

(V.) FLOW INTEGRATOR (PNEUMATIC INPUT)INCLUDING TESTPROCEDURE

(VI.) FLOW INDICATOR (FLOAT OPERATED) INCLUDING TEST PROCEDURE

(VII.) VENTURI (FLUID)

(VIII.) FLOW SWITCH (MAGNETIC TYPE)

(IX.) AVERAGING INLET

(X.) LIMIT SWITCHES

(Y.) TURBINE SUPERVISORY MEASURING SYSTEM

(Z.) POSITION MEASUREMENT AND INDICATION INCLUDING TEST PROCEDURES

(AA.) TACHOMETER

(BB.) VIBRATION MEASUREMENT

(CC.) DIGITAL INDICATOR

(DD.) MOVING COIL INDICATOR INCLUDING TEST PROCEDURE

(EE.) RECORDER INCLUDING TEST PROCEDURE

(FF.) FLAME SCANNER

(GG.) ELECTRICAL AUTO MANUAL CONTROL STATION

(HH.) PUSH BUTTON MODULE

(II.) ALARM ANNUNCIATOR EQUIPMENT INCLUDING TEST PRO

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT

(JJ.) TEST PROCEDURE FOR ELECTRONIC MODULES OF DDCMIS

(KK.) THERMO CONTROL VALVE

(LL.) TEST PROCEDURE FOR ADJUSTMENT OF MODULATING CONTROLLER - PID TERMS

(MM.) TEST PROCEDURE INDICATING CONTROLLER-ELECTRICAL INPUT AND PNEUMATIC OUTPUT

Note: The items which are not part of this specification may be considered as not applicable.

ANNEXURE-II

BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULE / COMMISSIONING SCHEDULE

Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices.

Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting.

Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self contained one:

1. Plant Details/Design data
2. Testing Objective/Proposals
3. State of the Plant
   - a) Erection Status with respect to Mech. Elect and C&I
   - b) Availability of the services required
   - c) Safety requirements as per Manufacturer's
4. Test method including completion/acceptance criteria
5. Results
6. Appendix
   - a) Testing Programme
   - b) Mech/Elect/C&I -Plant item completing list
   - c) List of Drawing/documents required for carrying out the testing.

ANNEXURE - III

SAFETY PLAN

01. Safety Policy of the Contractor to be enclosed:

02. When was the Safety Policy last reviewed:

03. Details of implementation procedure / methods to implement Safety Policy / Safety Rules :

04. Name, Qualification, experience of Safety Officer

05. Review of Accidents Analysis Method, Methods to ensure Safety and Health:

06. Unit executive responsible to ensure Safety at various levels in work area:

07. List of employees trained in safety employed before execution of the job. Give the details of training:

08. Safety Training Targets, Schedules, methods Adopting to providing safety training to all employees:

09. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed):

10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed:

11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity:

12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up:

13. Provision for treatment of injured persons at work site:

14. Review of overall safety by top Management and Periodicity:

15. System for Implementation of Statutory legislations:

16. Issue of PPEs to employees, Periodicity / stock on hand etc:

Signature
Head of the Organisation
with date & stamp

Annexure-C

Name of Customer :	**NTPC LTD.**
Name of Projects :	**North Karanpura Super TPP (3x660MW)** **ADDITIONAL SCOPE OF ICT-2 AT 400/220kV Switchyard at NKSTPP**

PROCEDURE FOR WELDING OF ALUMINIUM BUSES

A. Recommended welding procedures to insure a sound weld are as follows:

Pure aluminum melts at 660 Deg. C while aluminum alloy melts in the range of 519 Deg. C depending on the alloy content of the particular metal involved. When aluminum alloy are heated there is no change in color. This makes it difficult, if not impossible; to tell metal is near the welding temperature.

The ever present surface oxide films on aluminum have a melting point of 1982 Deg. C. The parent aluminum or aluminum alloy can therefore be melted without fusing the surface oxides. Unless this film is removed, cleanliness of the molten filler metal and the parent metal cannot be completed and both strength and conductivity may be sacrificed. Therefore, it is of prime importance that aluminum oxides be removed from the aluminum alloys before welding is started. In the shielded arc welding method the shielding gas has a tendency to clean the material as welding progresses.

B. CLEANING OF BUSES & FITTINGS:

It is very important to remove all greases and oxides from the surfaces to be welded. This can be accomplished by using a mild alkaline solution or standard degreasing solution. The preferred method is to use a stainless steel wire brush and vigorously scrub the surfaces to be welded. The stainless steel brushes are specified because the stainless steel has fewer tendencies to pick up particles of aluminum.

C. WELDING METHODS

The following types of welding methods for welding aluminum fittings and buses are recommended.

1. TUNGESTEN-ARC WELDING (TIG)

The inert-gas shielded tungsten arc process is widely used for welding aluminum bus fittings. In this process the arc is established between a non-consumable tungsten electrode and the section to be welded. Inert gas envelopes the arc to prevent oxidation during welding.

Hence no flux is required. A bare filler rod supplies filler metal to the weld area. To initiate the arc the tungsten electrode is placed in contact with the component and then withdrawn to establish an arc length of approximately 3/16". The arc is given a circular motion until the base metal liquefies and the weld puddle is established. Filler metal is added by hand as required. In this process, if more than one pass is required for a sufficient weld, the weld should be wire brushed between passes, to remove any surface dirt or oxides which have accumulated from the previous pass. Since no flux is used the finished weld does not require cleaning. In this process the heat of the tungsten arc is concentrated in a smaller area and is much faster than the conventional type of welding and distortion of the weld is negligible since the heat is concentrated in a small area. In this process, if thickness is greater than 0.5" arc to be welded, pre-heating of parts will increase the arc speed.

2. METALLIC ARC INERT GAS SHIELDED WELDING

MIG welding process combines the advantages of tungsten arc welding with the increased welding speed. Welding can be done from any position and the process can be either manual or automatic, Manual welding techniques are somewhat different from other methods. However, a welder can be trained to use the MIG process with only a few days concentrated training. In the MIG process the bare filler rod is supplied as a coil of bare wire. In the commercially available equipment this wire is added to the weld at predetermined

Annexure-C

rate by a motor driven feed that can be adjusted to the magnitude of the welding current. In this process as well as the tungsten arc process, gas forms a shield around the arc to prevent oxidation during welding.

Either helium, argon or a mixture of helium and argon are suitable shielding gases. Pure argon is most widely used on the gas arc usually mixed to combine the hotter arc argon. If exceptionally hot arc characteristics are required pure helium can be substituted for the gas mixture. Precaution should be exercised if this substitution is made in that it is very easy to burn through the items that are to be welded with a pure helium atmosphere.

As it is readily apparent, the basic difference between the two types of welding apparatus is the automatic feeding mechanism for the filler wire. In both types of apparatuses the electrode holder and the welding gun can or cannot be cooled by water. If welding currents of more than 125 Amps are required, both methods will have to have water cooling apparatuses to the electrode holder and the welding gun.

D.WELDERS QUALIFICATIONS

No welding should be done until the operator has had experience with welding aluminum alloys by the methods described above.

Contractor shall present Welder's Qualification to BHEL/ NTPC and only qualified/ certified welders will be allowed to complete the work. For Welder Qualification, a welding Test Sample practice on actual fittings or buses has to be passed from government accredited National Test Lab.

The following is the recommended specification for the current fittings wire feeds, gas flows etc. These specifications are of a general nature to the extent that many factors have to be considered such as:

1. Type of equipment used, whether water cooled or not.
2. The size and mass of the piece to be welded.
3. The position of the weld.
4. And most important of all, the operator's skill
5. All persons in the welding area would wear the proper shields. The arc is approximately twice as strong as the standard AC welding arc. Extreme caution should be exercised for the protection of eyes.

ACCEPTANCE STANDARDS FOR NON-DESTRUCTIVE TESTING
LIQUID PENETRANT EXAMINATION OF WELDED JOINTS

a) Evaluation of indications:
- Relevant indications are those which result from mechanical discontinuities.
- Linear indications are those indications in which the length is more than three times with width.
- Rounded indications or indication, which are circular or elliptical with the length less than three times, the width.
- Any questionable or doubtful indications shall be re-tested to verify whether or not actual defects are present.
- Localised surface imperfections, such as may occur from machining marks, surface conditions, may produce similar indications, which are not relevant to detection of unacceptable discontinuities.

b) **Acceptance standards**:
- Linear indications
- Four or more rounded defects with any dimensions more than 1.6 mm in a line separated by 1/16 inch (1.6 mm) or less (edge to edge)

c) Defect removal and repair:

Unacceptable imperfections shall be removed and reexamination made to assure the complete removal. Whenever a defect is removed and subsequent repair by welding is not required, the excavated area shall be blended into the surrounding surface so as to avoid

Annexure-C

sharp notches, crevices or corners. Where welding is required after removal of a defect, the area shall be cleaned and welding performed in accordance with a qualified welding procedure, Completed repairs shall be re-examined by the method originally used for detection of the defection.

d) Treatment of imperfections believed non-relevant.

Any indication of an imperfection, which is believed to be non-relevant, shall be regarded as defect unless, on re-evaluation, it is shown by re-examination by the same method or by the use of other non-destructive methods and/ or by surface conditioning that no unacceptable defect is present.

e) Examination of areas form which defects have been removed:

After a defect is thought to have been removed and prior to making weld repairs, the area shall be examined by suitable methods to ensure the defect has been eliminated.

f) Re-examination of repaired areas:

After repairs are made, the repaired areas shall be blended.

ACCEPTANCE STANDARDS FOR NON-DESTRUCTIVE TESTING RADIOGRAPHIC EXAMINATION OF WELDED JOINTS

A minimum of 10% sample joints shall be subjected to Radiographic examination. Tests shall be done with X-rays under strict adherence of Statutory Safety norms.

Radiographic Test results shall be certified only by ASNT NDT Level – II Qualified individual or BARC Level – II qualified Technician.

Radiographic examination shall cover minimum 10% of weld seam and acceptance standard for visual examination and Radiography shall be as follows:

Any of the following imperfections shall not be acceptable.

1. Cracks

2. Zone of incomplete fusion or penetration, which exceed 10% of the weld length of the joint in longitudinal or transverse butt weld, where full penetration is intended by the weld procedure, some lack of penetration acceptable. The total length of weld with lack of penetration shall not exceed 10% of the overall weld length. At no place, shall weld penetration be less than 90% of the thickness of the material. Continuous occurrence of lack of penetration is permitted, but shall not exceed 50 mm in any 500 mm length of weld.

3. Inadequate weld dimensions, root cavity (shrinkage) and incompletely filled groove greater than 10% effective throat thickness.

4. Excess penetration shall be permitted provided it does not exceed 25% of the wall thickness or 4 mm whichever is smaller.

5. Weld reinforcement: Build up in excess of 25% of the effective throat thickness shall be dressed. Any reinforcement shall be substantially symmetrical about the center line of the weld and shall be of smooth contour blending smoothly at the toes with the parent material.

6. Undercutting and overlapping, greater than 10% effective throat thickness.

7. Elongated cavities and/or worm holes exceeding 3 mm dia or equivalent area in length provided the limitations on porosity are met with.

8. Copper, tungsten or oxide inclusions greater than t/1 or 3 mm whichever is smaller.

Annexure-C

9. Crater pipes exceeding 2597o effective throat thickness or 3 mm whichever is smaller.

10. Porosity: Scattered porosity not exceeding 0.5% by volume is acceptable. In general, the size of the pores shall not exceed 0.8 mm dia, but occasional 1.6 mm dia pores may be acceptable, provided the following limits are not exceeded.
    a) Where pore size is 0.4 mm or less, up to 150 t pores may be permitted in 1000 mm sq. area of radiograph.
    b) Where pore size is 0.8 mm or less, up to 19 t pores may be permitted in 1000 mm. sq. area of radiograph.
    c) Where pore sizes are generally 0.8 mm dia or less, but occasional 1.6 mm dia/pores are present, up to 9t pores of 0.8 mm dia may be permitted in 1000 sq. mm area of radiograph, provided the number of pores up to 1.6 mm in dia does not exceed it.
    d) However, visible surface porosity> 1mm dia is not acceptable.

Note:

i. In all cases, t+ thickness of the thinnest section of the weld under examination.

ii. Unacceptable weld defects shall be repaired in accordance with the original welding procedure. All repairs shall be 100% inspected in accordance with original testing procedure.

SUB–SECTION – B-11

FIRE PROOF CABLE PENETRATION SEALING SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**CODES AND STANDARDS**
1.01.00	The fire proof cable penetration (FPCP) sealing system shall conform to the requirement of latest edition including amendments of BS:476 Part-20 Fire tests on Building materials and structures.
1.02.00	Fire penetration seal complying with any other international standards will also be considered if it ensures performance equivalent or superior to standard listed above.
1.03.00	The Bidder shall clearly indicate the standards adopted and furnish a copy of the English version of the latest editions of standards along with the bid, and shall clearly bring out the salient features for comparison.
2.00.00	**SYSTEM DESCRIPTION**
2.01.00	The fire proof cable penetration sealing system shall be of the following types; i) Type - A Type A fire sealing system is either Silicone foam or equivalent foam system or using individual blocks for each cable along with suitable frame work rated for one hour. Type A is to be implemented at floor openings below C&I panels, control panels/Boards etc. in CER & CCR. ii) Type-B Type B fire sealing system is any proven fire sealing system rated for one hour. This will comprise of rest of wall and floor crossings of cables/cable trays, opening below HT/LT Switchgears/board other than those covered under Type A.
2.02.00	The penetration system, shall be installed immediately after the completion of cable termination in a particular switchboard/control panel/area after clearance from the Project Manager.
3.00.00	**GENERAL INFORMATION**
3.01.00	The cables shall generally be laid in cable trays/racks, conduits, ducts. The fire proof cable penetration system shall be designed in such a way that the existing supporting structure/cable is not disturbed.
3.02.00	The penetration system shall be suitable for site condition at 50^0C ambient temperature and relative humidity of 100%.
3.03.00	The penetration system of each wall/floor crossing shall be adequately designed/sized such that 20% addition of cables is possible at any later date without disturbance/wastage of material in the penetration system.
3.04.00	Contractor shall plan the schedule of supply of the materials in consultation with Project Manager and use the material within stipulated shelf life of material. After award of work, drawings for each penetration seal shall be prepared by the contractor after verifying the

	actual installation of cables at site and approval shall be taken from the Project Manager's representative before proceeding with the actual work. The requirement of fire sealing material shall be quantified accordingly. Fire sealing material to be supplied shall be based on the net area to be sealed, wastage, thickness, density and other parameters as per the type test report approved under this contract.
4.00.00	**TECHNICAL REQUIREMENTS**
4.01.00	The fire proof cable penetration system shall fully comply with the requirements of BS:476 Part-20 and also to the requirements specified in this specification.
4.02.00	The penetration system shall prevent spreading of fire in cable beyond the seal system in case of fire and shall have minimum 1 hour fire resistance rating.
4.03.00	The penetration system shall be physically, chemically, thermally stable and shall be mechanically secure to the masonry/concrete/structural members. The system shall be mechanically robust and capable of giving satisfactory performance under vibrations encountered in power stations.
4.04.00	The penetration system shall be capable of withstanding mechanical loads, foot traffic drop loads, vibrations, wind pressure, etc.
4.05.00	The penetration system shall be completely gas and smoke tight.
4.06.00	The penetration system shall retain integrity and perform satisfactorily even after remaining in water for long period.
4.07.00	The materials used in FPCP sealing system shall be non-toxic and harmless to the working personnel.
4.08.00	The penetration materials shall have no reaction with cable sheath/galvanising/painting of structural steel.
4.09.00	The penetration materials shall have anti-rodent and anti-termite properties.
4.10.00	The penetration materials shall have no shrinkage or cracking after the setting for the complete life of the power Plant.
4.11.00	Under normal load, short circuit and fire conditions, cables may be subjected to movement and vibration. The FPCP sealing system shall be designed to withstand and perform satisfactorily under these conditions.
4.12.00	The penetration system shall not affect the current carrying capacity of cables passing through it.
4.13.00	Asbestos shall not be used in the construction of fire penetration seal system.
4.14.00	The penetration system shall have life expectancy of 40 years.

CLAUSE NO.	TECHNICAL REQUIREMENTS
4.15.00	The penetration system shall not emit any corrosive or toxic fumes or smoke on the unexposed face of the barrier.
4.16.00	Any wastage of the compound during the process of mixing for preparing the FPCP sealing compound shall be to Contractor's account.
4.17.00	For foam type of systems, only the foam shall form the penetration seal of specified rating, having the damming board removed after curing of the foam.
5.00.00	**PACKING AND STORAGE**
5.01.00	All materials and components of penetration system shall be supplied in packing to avoid contamination of materials due to dust/moisture and temperature during transit and storage. All packing shall be of durable quality and the date of expiry and the date of manufacture shall be printed on it.
6.00.00	**INSTALLATION**
6.01.00	The contractor shall take adequate care to ensure that cables are not damaged in any manner during penetration system installation.
6.02.00	Wherever the floor/wall opening provided in the vicinity of penetration seals larger or smaller than that required for the cable fire penetration, these opening size can be reduced or increased in an approved manner by the contractor using the same materials as provided around the opening and of the same thickness. Generally the walls in the power station comprises of brickwork and the floors are made of RCC/steel work.
6.03.00	The work to be carried out under this specification shall be done under the supervision of Project Manager’s representative.
6.04.00	All work shall be carried out in accordance with the agreed “field quality plan” and approved drawings. The “field quality plan” shall additionally specify the fire sealing material thickness, minimum cured density and other related parameters achieved in the approved type tests for the contract. The work shall be done to the satisfaction of the Project Manager and the same shall be subject to Project Manager’s approval for acceptance.
6.05.00	The installation shall be carried out in a neat workmen like manner by the skilled, experienced and competent workmen.
6.06.00	Installation work at site shall be properly coordinated with other services.
6.07.00	All materials being supplied or consumed during installation by the Contractor in the process of installation shall be of the best quality and according to relevant standards. All materials shall be inspected and approved by the Project Manager before the same is used for installation work. Also regarding inspection of work, the engineer shall have the right to inspect at any stage during installation, testing and commissioning.
6.08.00	The drilling and welding of building-steel or fixing supports etc. shall be carried out by contractor after taking prior approval of Project Manager.

CLAUSE NO.	TECHNICAL REQUIREMENTS
7.00.00	**TYPE TESTS, ROUTINE & ACCEPTANCE TESTS**
7.01.00	All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
7.02.00	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.
7.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
7.04.00	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design change”. Minor changes if any shall be highlighted on the endorsement sheet.
7.05.00	Following Type test reports as per the setup and procedures given in subsequent clauses for the Fire proof cable penetration sealing system shall be submitted: a) The accelerated ageing test b) Water absorption test c) Fire rating test d) Hose stream test e) Vibration test followed by fire rating test
7.05.01	Tests a, b, c and d should have been carried out on same test sample subsequently one after the other without any touching up/repair/modifications in the same sequence and in accordance with the clause 9.00.00. The test sample shall be assembled as per clause 8.00.00.
7.05.02	Test indicated in clause 7.05.00 (e) above should have been carried out on a separate sample and as per the procedure indicated under clause 9.05.00.
7.05.03	Physical, chemical and mechanical properties of various components/ingredients used should have been also be tested as a part of type tests.
7.05.04	Test reports shall contain the following information: 1. Type of penetration material tested

CLAUSE NO.	TECHNICAL REQUIREMENTS
	2. Details of various components/ingredients used alongwith their catalogue. 3. Physical, chemical and mechanical properties of various components/ ingredients used. 4. Description of the various test assemblies tested. 5. Details of method of conditioning. 6. The observations as called for in BS:476 Part-20 and technical specification.
7.06.00	**ROUTINE & ACCEPTANCE TESTS** Routine and acceptance tests to be carried out on Type-A and Type-B cable fire sealing system shall be mutually agreed based on the type of fire sealing material offered before placement of award.
8.00.00	**TEST SPECIMEN ASSEMBLY**
8.01.00	The test specimen shall be assembled as per enclosed drawing and shall resemble typical floor crossing cable penetration system.
8.02.00	The test specimen shall be designed to seal an opening of adequate size in a concrete slab of 200 mm thickness. Two lengths of 300/600 mm wide ladder type cable tray shall be assembled with required layer of XLPE/PVC insulated, PVC sheathed unarmoured cables in touching formation. Type and number of cables in the cable tray shall be as per enclosed drawing. Cables shall be adequately clamped with tray at both the sides of the penetration as shown in the drawings. However, for penetration system with blocks which require staggered arrangement, cables can be clamped at an adequate distance from the penetration and the tray need not pass through the penetration seal.
8.03.00	The opening in the test specimen then shall be sealed with fire proof cable penetration sealing materials.
9.00.00	**TEST PROCEDURES**
9.01.00	**ACCELERATED AGEING TEST** The test specimen assembled as per clause 8.01.00 with damming board removed shall be subjected to accelerated ageing test by storing in air furnace where the temperature of the inside air shall be maintained at 85 degree centigrade for 168 hours. The temperature controlled furnace should have 7 air changes per hour approx.
9.02.00	**WATER ABSORPTION TEST**
9.02.01	The test specimen shall be immersed in fresh clean water at a temperature of 20 deg. C $\pm$ 2 deg C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hour soak period the specimen shall be removed from water and mopped up with a damp cloth.

CLAUSE NO.	TECHNICAL REQUIREMENTS
9.03.00	**FIRE RATING TEST**
9.03.01	The test specimen after withstanding water absorption test shall be subjected to fire rating test as per BS: 476 part-20.
9.03.02	Oil/Gas fired furnace shall be used for heating. The furnace shall have achieved standard time/temperature characteristics for fire tests as per BS:476 part-20.
9.03.03	The pressure inside the furnace at the time of test shall be within 1.5 $\pm$ 0.5 mm water gauge.
9.03.04	Cables in the test specimen shall be anchored on the hot side to a structure independent of the barrier and its penetrations. This is to ensure that any differential movement between the penetration and the cable that could occur during a fire, is produced in the type tests and the reliability of the integrity of the penetration is checked.
9.03.05	Cables shall be protruding between 1 to 2 metre, from the penetration face on the unexposed side and protruding into the furnace as far as it is practicable with a minimum length 750 mm. The ends of the cables shall be capped on the unexposed face to prevent gases and fumes to escape from the furnace during the fire.
9.03.06	The test specimen shall be subjected to fire test with surface exposed to controlled fire in the furnace confirming to time/temperature characteristics specified in BS:476(20).
9.03.07	During the test the temperature of both the faces of the fire stop i.e. one which is exposed to fire and other unexposed shall be measured by calibrated thermo couples after regular interval of 5 minutes.
9.03.08	Atleast 3 thermo couples shall be provided for temperature measurement of each face. The results at the end of the test shall be interpreted for failure criteria as under. 1. The system is deemed to have failed to maintain stability if there is a total collapse of the fire proof seal. 2. In case cracks are seen on the face of the fire stop or cracks through which the flame/ hot gas can pass the systems deemed to have failed to maintain integrity. The development of crack is characterised by appearance of black soot on cotton wool held near the penetration on the unexposed surface at a distance of about 100mm. 3. Failure shall be deemed to have occurred when the mean temperature of the unexposed surface of the specimen assembly increases by more than 140^0C above the initial temperature or if the temperature of the unexposed surface is increased at any point by more than 180^0C above the initial temperature. During the test the specimen shall meet all the three criteria simultaneously.
9.03.09	Temperature measurement on the unexposed side of penetration seal shall be measured by thermocouples at a distance of 25 mm from unexposed side of fire stop.

CLAUSE NO.	TECHNICAL REQUIREMENTS
9.04.00	**HOSE STREAM TEST**
9.04.01	A hose stream test shall be conducted on the test specimen immediately following a fire resistance test on that assembly. The specimen must first be removed from the furnace since the hose stream is to be applied to the exposed face. This must be done quickly since it is the intention of the test that the stream be applied to the specimen whilst it is hot.
9.04.02	The hose stream shall be long range narrow angle, (20^0 - 90^0 set at 30^0 included angle). High velocity water spray provided from a 28 mm hose discharging through an appropriate nozzle. The water pressure shall be 5 bar calculated at the base of the nozzle and the minimum flow rate shall be 4.7 litres/second. The stream shall be supplied perpendicularly to the exposed face of the test specimen with nozzle 3 m away from the exposed face.
9.04.03	Application shall be for minimum of two and a half minutes per 9 sq.m. of the test specimen including the barrier.
9.05.00	**VIBRATION TEST**
9.05.01	The test assembly is to comprise a single ladder rack penetration in 1 m x 1m high normal section of fire barrier which is securely supported. The penetration seal shall be formed in the middle of the barrier around 1 m length of 600 mm ladder rack. The tray shall be fully loaded with cables in touching formation. The penetration assembly shall be formed symmetrically through the fire barrier as in service. The penetration sealant material shall then be allowed to cure for atleast as long as the time required for conditioning to constant mass. A vibration test shall then be conducted on the sample as set out below.
9.05.02	The vibration shall be of 100 Hz frequency and of 0.5 mm amplitude (1.0 mm peak to peak) and this shall be applied to one rail of the ladder rack or the centre of a cross member secured to the two rails at 250 mm from the centre line of the penetration. This vibration shall be applied to the sample for the minimum period of 3 hrs. Immediately following this vibration test the barrier/ penetration assembly shall be successfully subjected to a fire test in accordance with clause no. 9.03.00.

ANNEXURE-E1

2.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Cable Glands. No deviation from the requirements specified in various clauses of this specification shall be allowed.

The actual cable data as guaranteed by the cable supplier will be furnished separately. However, for exact measurements, supplier should contact site for cable samples. The final supply shall be made based on actual cables supplied at site.

2.1 SPECIFIC TECHNICAL REQUIREMENT

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.

Required number of packing glands to close unused openings in gland plates shall also be provided.

The glands shall be dust proof, screw on type, shrouded complete with necessary armour clamp and tapered washers etc.

The glands shall have provision for securing armour of the cable separately and shall be provided with earthing tag.

2.2 TEST

All valid test reports as per relevant standard shall be furnished including Proof Torque Test, Tensile Test, Seal Test and Electrical Continuity Test as per BS 6121. Cable glands shall also be tested for dust proof and weather-proof termination. Bidders shall submit valid reports of type tests carried out within five years of bid opening. These reports should have been conducted on identical / similar equipment to those offered. In case less than five years old type test reports OR valid type tests are not furnished, the tests shall be conducted free of charge. No separate type test charges shall be paid.

ANNEXURE-E2

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES FOR ERECTION HARDWARE

1.0 SCOPE

The scope of this specification is to specify all details required by a supplier for supply of galvanized hardware for projects being executed by BHEL on turnkey basis.

2.0 SPECIFIC TECHNICAL REQUIREMENTS

2.1 BOLTS:

Bolts as per BOQ shall be used in equipment mounting and earthing connection.

All bolts for member connections in towers, beams & equipment support structures shall conform to IS: 12427 - 2001 and for step bolts shall conform to IS: 10238 – 1982.

The mechanical properties shall conform to property class 5.6 of IS:1367 (part 3) - 1991.

All bolt heads shall have hexagonal shape, the heads being forged out of the solid material truly concentric and square with the shank, which must be perfectly straight.

All bolts shall be threaded with metric standard thread to take the full depth of the nut and permit firm grip of the member.

All bolts shall be hot dip galvanized as per IS: 1367 (Part 13) – 1983.

2.2 NUTS:

All nuts shall conform to IS: 1363 (Part 3) –1992.

The mechanical properties shall conform to property class 5 of IS:1367 (part 6) – 1980.

The nuts shall be capable of being worked with fingers along the entire threaded portion of the bolt with a neat fit capable of developing the full strength of the bolt.

All nuts shall be hot dip galvanized as per IS: 1367 (Part 13) – 1983.

2.3 PLAIN WASHERS:

All plain washers shall be punched washers, A type conforming to IS: 2016-1967.

These shall be hot dip galvanized as per IS: 4759 – 1984.

2.4 SPRING WASHER:

All spring washers shall be of spring steel, positive lock type and conforming to type B of IS: 3063-1972. The thickness of spring washer shall be as per IS: 3063 – 1994 (Table 1A & 1B)

These shall be electro-galvanized as per IS: 1573 – 1986 and shall have service grade number – 4 as per IS:1573 – 1986 (Appendix A).

3.0 QUANTITIES:

Each nut bolt set will generally have two plain washers and one spring washer

Sl. No.	Bolt Size	Length (mm)	Threading	Spring Washer	Plain Washer
01	M12 – M33	40 - 140	Fully Threaded	Service grade number – 4 as per IS: 1573 – 1986 (Appendix A).	As per table 2 of IS: 2016-1967

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

NEW DELHI

DOCUMENT No.	TB-XXX-316-040	Rev. No.	02		Prepared	Checked	App.
TYPE OF DOC.	STANDARD TECHNICAL SPECIFICATION			NAME	NK	DS	SN
TITLE	GI PIPE & BENDS			SIGN	Sd/-	Sd/-	Sd/-
				DATE			
				GROUP	TBEM	W.O. No	
CUSTOMER							
CONSULTANT							
PROJECT	RATE CONTRACT (ONE YEAR)						

COPYRIGHT AND CONFIDENTIALITY
The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD.
It must not be used directly or indirectly in anyway detrimental to the interest of the company

SCOPE AND SPECIFIC TECHNICAL REQUIREMENT

1.0 SCOPE

This technical specification covers design, manufacture, testing at works, packing and dispatch of 'GI pipe, its fittings and bends'. The material supplied shall fully comply with relevant Indian Standard given below and the product shall be BIS certified. The sizes and types of Pipes shall be as specified below. No Technical Deviations shall be acceptable in this regard.

1.1 SPECIFIC TECHNICAL REQUIREMENT

1.1.1 Galvanized Iron (GI) Pipe

The GI pipes shall be of nominal diameter 50 mm and/ or 100 mm, as per the indent. The pipe shall be of medium Grade as per IS 1239 and shall be of standard length of 6 meters. The pipe shall fully comply with specified standard and carry the BIS certification marking. The pipe shall have a socket at one end and threaded at both ends.

1.1.2 Sockets

The sockets shall fully comply with the requirements of IS 1239 (Part-2).

1.1.3 For Bends

The bends shall be of 90°, 112.5° and/ or Tee, as specified, for above mentioned pipes. The bends shall, in general, comply with the requirement of IS 1239 (part-2). The specific requirements and BIS certification marking of these bends shall be as per IS 1239 (Part-2). 90°, 112.5° and Tee bends shall have a socket at one end and threaded at all ends.

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS	
02	25.04.13				90° bends has been included.	
01	30.11.10	Sd/-	Sd/-	Sd/-	Document revised.	
Distribution				To	TBMM	OFFICE COPY
				Copies		

PROCEDURE OF DRY OUT BY N2 / Associated Heating Method

For effective and faster removal of moisture from Transformer/Reactor, method of dry out by N2 filling / vacuuming and if required heating is adopted. The detail procedure is as mentioned under.

First Cycle

- Blank all the openings on Transformer/Reactor tank. Transformer /Reactor tank is than subjected to vacuum upto 1.00 torr (1mm Hg) to be pulled and maintained for 48 -72 hrs duration during first dry out cycle. Leakages if any observed to be attended and rectified in this cycle.
- After vacuum cycle Dry Nitrogen of Dew point more than -50ºC Dew point or Nitrogen of UHP grade (purity 99.9999%) to be pushed under vacuum till pressure of 2.0 Psi is achieved in Transformer tank and to be maintained for 24 Hrs.
- At the end of Nitrogen pressure cycle for 24 hrs, measure dew point values and record these values as dry out values of First Dry out cycle. Moistened Nitrogen inside Transformer tank will be removed during second dry out vacuuming cycle.

Second Cycle:

- Again start vacuuming of transformer tank upto 1.00 Torr i.e. (1mm Hg) and vacuum is to be maintained for 48 hrs in second dry out cycle.
- Dry Nitrogen of Dew point more than -50ºC Dew point or Nitrogen of UHP grade (purity 99.9999%) is again to be pushed under vacuum till pressure of 2.0 Psi is achieved in Transformer tank and to be maintained for 24 Hrs.
- Measure dew point after 24 hrs in second Nitrogen cycle and record these dew point values as dew point values of second dry out cycle and compare these second cycle dry out dew point values as per BHEL standard values in consideration with quality of Nitrogen gas used for dry out.
- If the dew point values of second cycle is in line with the BHEL Standard values of Dew point considering the dew point of the gas used for dry out, the transformer is cleared for further vacuuming followed by oil filling and subsequently for HOC.
- In case desired dew point is not achieved than Transformer tank is to be again subjected for vacuum pulling for 24 hrs, followed by N2 filling for duration of 24 hrs in each dry out cycle and subsequent measurement of Nitrogen gas dew point.

NOTE

If the dew point values were not achieved in 5 dry out cycle and values of dew point as measured is higher on positive dew point side then the N2 pressurized tank to be heated externally to raise the temperature of transformer upto 55-65°C, followed by dew point measurement. This process is repeated till the proper dew point were achieved.

HOT OIL CIRCULATION

If the dew point is achieved then transformer is to be further cleared for vacuuming, oil filling and subsequently HOC to meet oil parameters.

Effective dry out process in most case will give the best results in 3 cycles, as per BHEL standard norm's minimum 2 dry out cycle has to carried out at site before oil filling .

- Once dew point is achieved, new processed/filtered oil in separate oil storage tank having BDV more than 70 KV and moisture content less than 5 ppm shall be filled in from bottom of Transformer tank under vacuum. Hot oil circulation shall be carried out under vacuum and at a temperature of 50- 55 deg. C. to achieve BDV > 70kV and water content < 5 PPM.

IR values of different windings and combinations will be tested and thus the improved value will reveal effective dryness of the transformer and complete insulation system inside the transformer.

Aniruddh Vyas
Manager –TXX
Transformer Services Deptt.
BHEL Bhopal

Annexure-G

Testing of Transformer:-

1. IR values of windings & bushings at 5 kV for 60sec/600 sec.
2. Tan delta measurement of windings and HV bushing, neutral bushing at 10kV
3. Ratio test by turn ratio meter & vector group verification.
4. Resistance measurement on all taps of HV winding & LV winding.
5. Measurement of magnetization current of HV& LV windings.
6. Measurement of dew point of N2 used for dry out & that of transformer.
7. BDV test of oil before filling in the tank.
8. BDV, PPM, resistivity & tan delta tests on oil after completion of oil filtration.
9. SFRA measurement of transformer.
10. Functional checks of all TRANSFORMER / REACTOR protections like PRV, buchholz relay etc.
11. Pre-commissioning checks for charging of the TRANSFORMER / REACTOR
12. Fine Filtration & Particle count test.

ANNEXURE - H

एनटीपीसी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)
(Formerly National Thermal Power Corporation Ltd.)
केन्द्रीय कार्यालय नोएडा
Corporate Centre NOIDA

Reference: CC:PE:572:33051

Date:21-08-17

From:	N.A.RAMAKRISHNAN CTF (NABINAGAR)	To:	BHEL New Delhi BHEL. Transmission Business Group, Integrated office complex, Lodhi Road New Delhi
		CC:	- dipak@bhel.in ranjan@bhel.in

SUBJECT : NABIJV, SWITCHYARD PACKAGE

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

VENDOR DRG NO:	null
NTPC DRG NO:	0370-572-PVE-B-650
REVISION NO:	04
DRG TITLE:	Lighting Mast for Illumination System
APP CATEGORY:	I
RELEASE DATE:	21-08-17
COMMENTS:	No comments.

CONTENTS

Annexure-A					
Sl. No.	Description	NTPC DOC No.	Doc. No.	Page No.	Remarks
1	GA DRAWING-30 M HIGH MAST	0370-572-PVE-B-650	Approved Doc. No- SL/HMP/SIE/30M/HM/2350, REV 02	3	APPROVED DRAWING OF NABINAGAR SUPER THERMAL POWER PLANT(2X660 MW) TO BE EXTENDED FOR 400/132 KV SWITCHYARD PACKEAGE OF NABINAGAR
2	TECHNICAL DATASHEET OF 30 M HIGH MAST & ACCESSORIES			6	
3	GA DRAWING-FEEDER PILLAR		Approved Doc. No- SL/HMP/FEEDER/135, REV 01	9	
4	AVIATION LIGHT			12	
5	30M HIGH MAST FOUNDATION GA DRAWING		SL-NTPC-HM-FDN-3084-GA DRAWING REV 0	14	Fresh GA Drawingenclosed for approval
6	30M HIGH MAST FOUNDATION DESIGN		MH-SL-055-30M-NTPC/RO-16-FG-R1	5	Fresh Design for approval

Note: Foundation design document of lighting mast enclosed

DOC. TITLE	LIGHTING MAST FOR ILLUMINATION	
NTPC DOC NO.	0370-572-PVE-B-650	Rev-04

NABINAGAR POWER GENERATION CO. PVT. LTD.
(A JV OF NTPC LTD. & BIHAR STATE POWER (HOLDING) CO. LTD.)

400/132 kV SWITCHYARD AT NABINAGAR STPP
& 400 KV SWITCHYARD EXTENSION AT NABIN
NOA Number :CS-0370-572-2-FC-N(

Signature Not Verified
Digitally signed by Vikram Jaiwal (PPD/PPDC)
Date: 2017.06.24 14:23:02 +05'30'
Reason: CAT I
Location: NTPCEOC

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION
NEW DELHI

PO No. 354P121 dt. 29.09.2014

ENDORSEMENT SHEET FOR
DATA SHEET AND DRAWINGS

TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION		To be filled in by NTPC
PROJECT NAME	400/132KV SWITCHYARD PACKAGE AT NABINAGAR SUPER THERMAL POWER PROJECT (3X660)	*REVIEW & ENDORSEMENT BY NTPC* PROJEC
CONTRACT NO.	354P121, DATED:- 24.09.2014	SPECIFIC DRG NUMBER ALLOTTED
CONTRACT NAME	400/132kV SWITCHYARD PACKAGE AT NABINAGAR	DRG NO.:
MAIN SUPPLIER	BHEL TBG	REV. NO.: 00 DATE:
MANUFACTURER WORKS & ADDRESS	M/s. SKIPPER LIMITED, NH-6, VILL. MADHABPUR, PO MAHISHREKHA, PS ULUBERIA, HOWRAH- 711303	
ITEM /EQUIPMENT / SYSTEM/ SUB-SYSTEM DETAILS i.e. MODEL TYPE / SIZE /RATING etc.	30 MTR HIGH MAST, FEEDER PILLAR, AVIATION LIGHT	
APPROVED DRG NO.:	SL/HMP/SIE/30M/HM/2350, SL/HMP/FEEDER/135 R01	

Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)	*(TICK APPLICABLE)*
I. That the item/ component is identical to that considered for GA and Data sheet approval. √	The Drawing is endorsed for this project without change √
II. That there are minor changes in the item/ component with respect to that considered for GA and Data sheet approval.	
III. That there are minor changes in the item/ component with respect to that considered for GA and Data sheet approval as per the attached reference drawing, however the same affect slightly, as indicated below / in attached sheet.	The Drawing is endorsed for this project with char as indicated.
	DISTRIBUTION OF ENDORSEMENT OF
	1. MAIN SUPPLIER (WITH A COPY OF QP)
	2. MANUFACTURER
	3. RIO/CQA as applicable

SKIPPER LIMITED ★ Mumbai-93 ★ 652 Solitaire Park

SIGN.: (Main Supplier) *DATE*	*SIGN.: (Manufacturer)* *DATE:13.01.2017*	NTPC (Reviewed /Approved by/ Date & Seal)

Signature
Not Verified

Digitally signed by R S SALUJA
Date: 2016.03.29 16:26:40 IST
Reason: CAT I
Location: NTPCEDC

CAT-I BASED ON ENDORSEMENT

LIGHTING MASTS - OUTLINE DIMENSIONS DRAWING/GA DRAWINGS & DATA SHEET

NO.	DATE	REVISION	DRAWN	CHKD	APPD.
03	15.03.2016	COMMENTS INCORPORATED	GYP	SRG	ANM
02	15.02.2016	COMMENTS INCORPORATED	GYP	SRG	ANM
01	12.01.2016	Material Re-ordered to Skipper Ltd	GYP	SRG	ANM
00	24.07.2014	FIRST RELEASE	GYP	SRG	RRP

CLIENT :

NABINAGAR POWER GENERATING COMPANY PRIVATE LTD.

(A JOINT VENTURE COMPANY BETWEEN NTPC LTD. & BIHAR STATE ELECTRICITY BOARD)

PROJECT :

NABINAGAR SUPER THERMAL POWER PLANT (3X660 MW)

PACKAGE : ELECTRICAL EQUIPMENT SUPPLY & ERECTION PACKAGE

CONTRACTOR :

SIEMENS

M/S SIEMENS LTD., EPIE, PLOT NO. 6A, SECTOR-18, GURGAON, HARYANA-122015

DRAWN BY	GYP	24.07.14	NTPC DRG NO:	REV.	SHEET
CHECKED BY	SRG	24.07.14			
APPROVED BY	RRP	24.07.14	0 3 7 0 - 2 1 5 - P V E - B - 0 6 9	03	1 OF 11
SCALE	NTS				

Unrestricted

SKIPPER
Limited

STRUCTURE STABILITY CERTIFICATE

Date: 02.01.2017

Subject: Regarding stability of High Mast offered for NTPC at Nabhinagar.

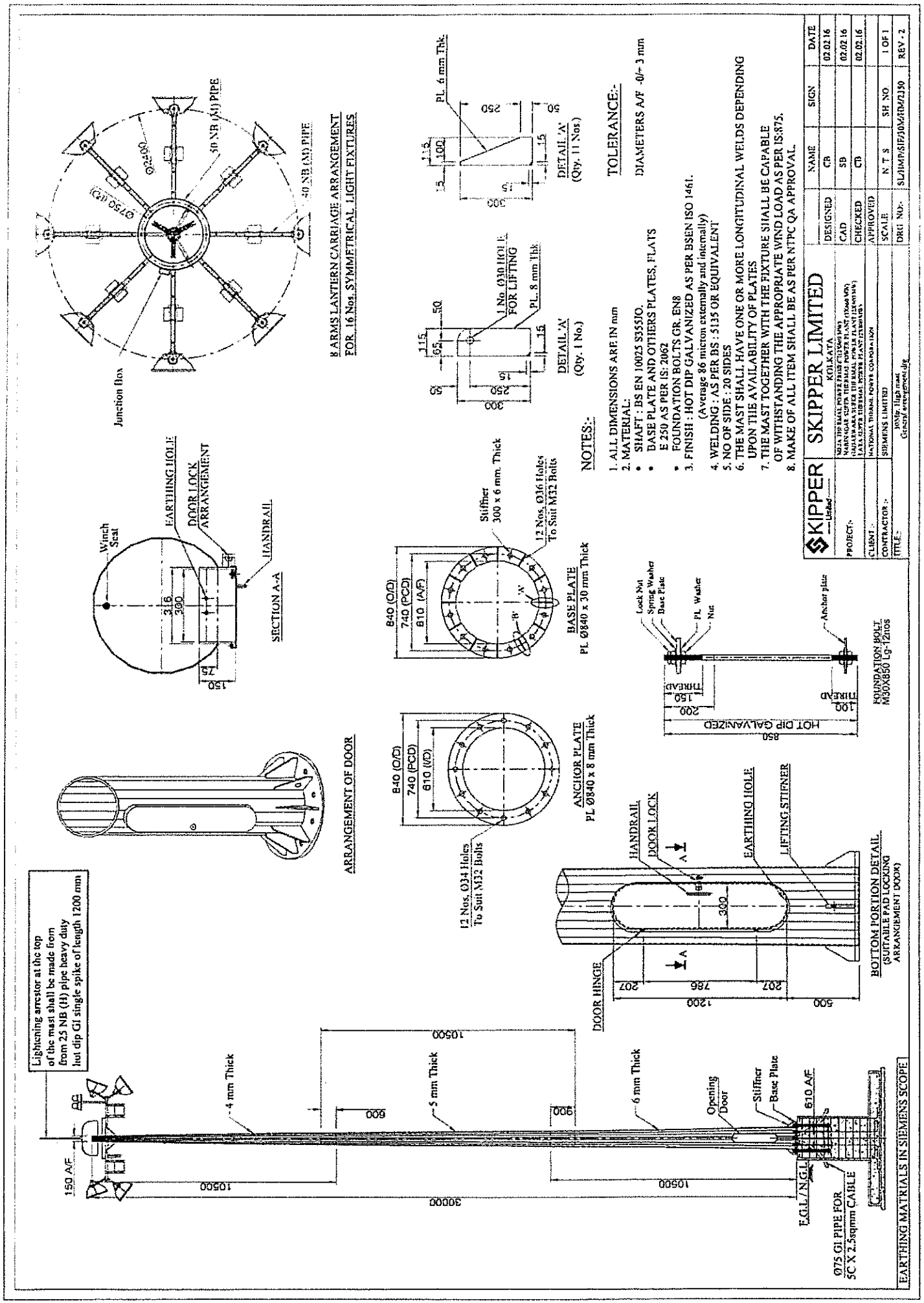
Respected Sir/ Madam,

With reference to above mentioned subject, we hereby confirm that the 30M Lighting High Mast offered by us are structurally suitable to carry 16 No's of Luminaries with Symmetrical arrangement and shall sustain the wind speed prevailing at site i.e. (47 m/sec) as per IS- 875 Part-III.

Thanking you,

Yours faithfully
For Skipper Limited

Chandrakant Avhad
Senior Manager (Design & Engineering)


8 ARMS LANTERN CARRIAGE ARRANGEMENT
FOR 16 Nos. SYMMETRICAL LIGHT FIXTURES
Junction Box
50 NB (A) PIPE
40 NB (A) PIPE
Ø2500
Ø750 (GI)
DETAIL 'A'
(Qty. 11 Nos.)
PL. 6 mm Thk.
DETAIL 'A'
(Qty. 1 No.)
1 No. Ø30 HOLE FOR LIFTING
PL. 8 mm Thk.
NOTES:-
1. ALL DIMENSIONS ARE IN mm
2. MATERIAL:
• SHAFT : BS EN 10025 S355JO.
• BASE PLATE AND OTHERS PLATES, FLATS E 250 AS PER IS: 2062
• FOUNDATION BOLTS GR. EN8
3. FINISH : HOT DIP GALVANIZED AS PER BSEN ISO 1461. (Average 86 micron externally and internally)
4. WELDING : AS PER BS : 5135 OR EQUIVALENT
5. NO OF SIDE : 20 SIDES
6. THE MAST SHALL HAVE ONE OR MORE LONGITUDINAL WELDS DEPENDING UPON THE AVAILABILITY OF PLATES
7. THE MAST TOGETHER WITH THE FIXTURE SHALL BE CAPABLE OF WITHSTANDING THE APPROPRIATE WIND LOAD AS PER IS:875.
8. MAKE OF ALL ITEM SHALL BE AS PER NTPC QA APPROVAL.
TOLERANCE:-
DIAMETERS A/F -0/+ 3 mm
SKIPPER LIMITED
KOLKATA
PROJECT:-
CLIENT :-
CONTRACTOR :- SIEMENS LIMITED
TITLE :-
DESIGNED CB 02.02.16
CAD SB 02.02.16
CHECKED CB 02.02.16
APPROVED
SCALE N T S SH NO 1 OF 1
DRG NO:- SLIMP/SIE/10MTM/2139 REV - 2
Stiffner 300 x 6 mm. Thick
12 Nos. Ø36 Holes To Suit M32 Bolts
BASE PLATE
PL Ø840 x 30 mm Thick
840 (O/D)
740 (PCD)
810 (A/F)
ANCHOR PLATE
PL Ø840 x 8 mm Thick
12 Nos. Ø34 Holes To Suit M32 Bolts
Lock Nut
Spring Washer
Base Plate
PL Washer
Nut
Anchor plate
FOUNDATION BOLT
M30X850 Lg-12nos
HOT DIP GALVANIZED
THREAD
ARRANGEMENT OF DOOR
EARTHING HOLE
DOOR LOCK ARRANGEMENT
HANDRAIL
SECTION A-A
Winch Seat
DOOR HINGE
HANDRAIL
DOOR LOCK
EARTHING HOLE
LIFTING STIFFNER
BOTTOM PORTION DETAIL
(SUITABLE PAD LOCKING ARRANGEMENT DOOR)
Lightning arrestor at the top of the mast shall be made from from 25 NB (1) pipe heavy duty hot dip GI single spike of length 1200 mm
150 A/F
10500
30000
4 mm Thick
5 mm Thick
6 mm Thick
Opening Door
Stiffner
Base Plate
610 A/F
Ø75 GI PIPE FOR 5C X 2.5sqmm CABLE
E.G.L./N.G.L.
EARTHING MATRIALS IN SIEMENS SCOPE

SKIPPER

Technical Data Sheet of 30 Meter High Mast & Accessories

PROJECT:- MEJA THERMAL POWER PROJECT(2X660 MW)
NABINAGAR SUPER THERMAL POWER PLANT (3X660 MW)
GADARWARA SUPER THERMAL POWER PLANT (2X800 MW)
LARA SUPER THERMAL POWER PLANT (2X800 MW)

Client : - NATIONAL THERML POWER CORPORATION
CONTRACTOR :- SIEMENS LIMITED
Ref. G.A. Drg. No. SL/HMP/SIE/30M/HM/2350 R-2 Date 01.02.16 R-2

1	**Highmast Structure**	
a.	Nominal height of mast (mtrs.)	: 30 MTR
b.	i) Material construction of Shaft ii) Material construction of Base Plate	: BSEN 10025 : IS 2062 E250
c.	Nominal Thickness.	: Base Section - 6 mm : Middle Section - 5 mm : Top Section - 4 mm
d.	Cross section of mast	: 20 sided polygon
e.	Length of individual sections (approx)	: Base Section - 10500 mm : Middle Section - 10500 mm : Top Section- 10500 mm
f.	Base and top A/F (Approx.)	: Base A/F - 610 mm : Top A/F - 150 mm
g.	Type of joints	: By slip stressed fit at site
h.	Nominal length of overlap	: Bottom - 900 mm : Top - 600 mm
i.	Size of base flange diameter and thickness (approx.)	: Outer Diameter - 840 mm, Thickness - 30 mm thk.
j.	Metal protection treatment of mast sections.	: Hot Dip Galvanizing as per BSEN ISO 1461 (86 Micron Average)
k.	Type of door construction and locking arrangement.	: Close fitting door with Allen key locking and suitable reinforcement to avoid buckling.
k.	Door size	: 300 X 1200 mm Long
2	**Details of bolts**	
a.	Size of anchor plate, tem plate and its thickness.	: 840 (O/D) x 610 (I/D) x 8 mm Thickness : 840 (O/D) x 610 (I/D) x 4 mm Thickness
b.	Details of template	: P.C.D.- 740 mm
c.	Size of foundation bolts	: M30 x 850 lg. x 12

SKIPPER **Technical Data Sheet of 30 Meter High Mast & Accessories**

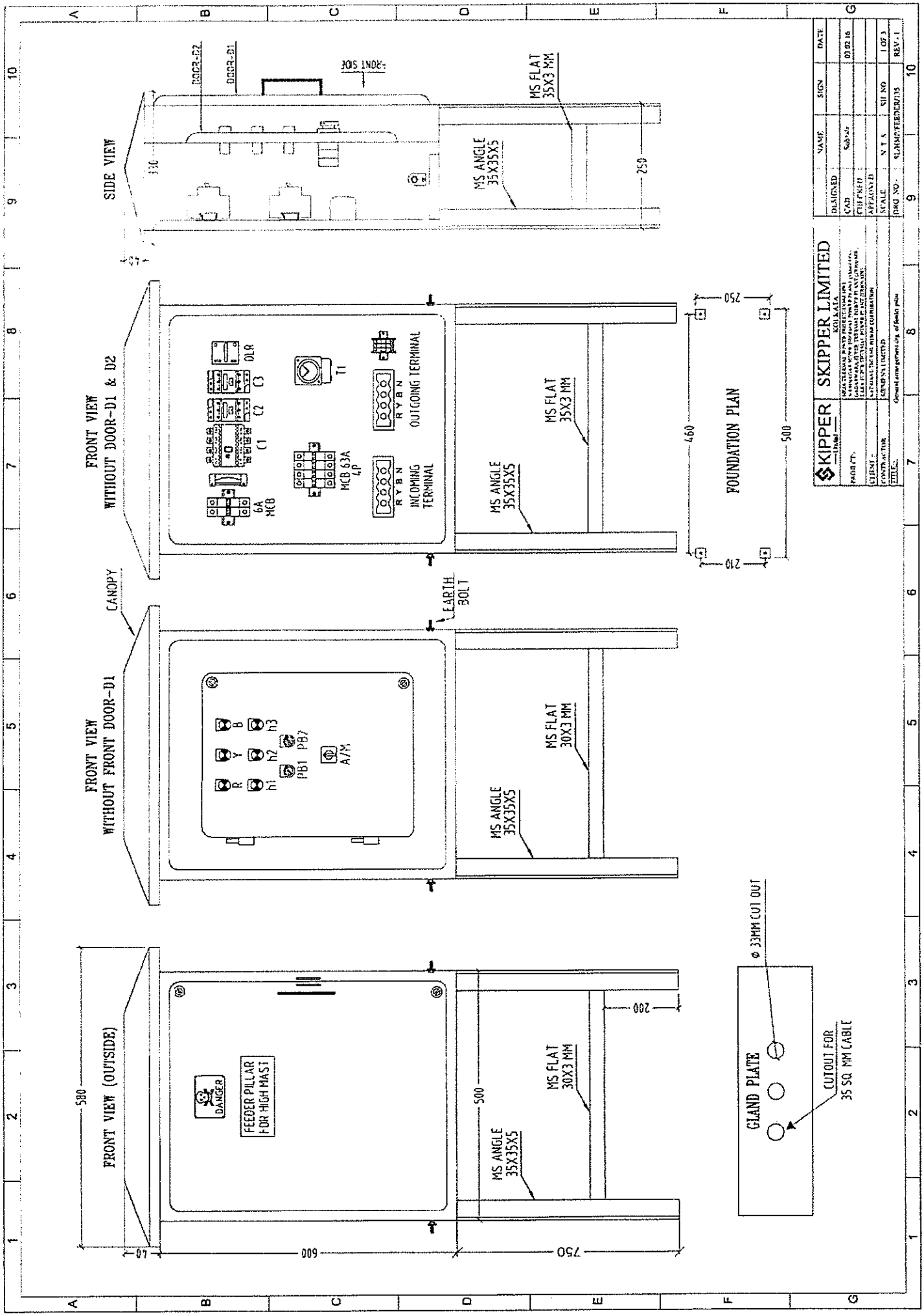
d.	Grade of Foundation Bolt	: EN8
3	**Lantern Carriage**	
a.	Material of construction	: 50 NB (M) Pipe hot dip galvanized
b.	Diameter of carriage ring (O/D)	: 750 mm (I/D) Approx
c.	Nos. of ring arm attachable	: 8 Arm Welded
d.	Number of sections	: 2 Segments / 3 Segments
e.	Load carrying capacity	: 16 Luminaire, Symmetrical twin 400W HPSV
4	**Winch**	
a.	Number of Drums Per Winch	: Double Drum
b.	Gear Ratio	: 53 : 1 / 50 : 1
c.	Capacity	: 750 kgs
d.	Method of Operation	: Manual / Electrical (Both)
e.	Lubrication Arrangement	: Self Lubricating in Permanent Oil Bath
f.	Gear material	: Alloy steel
5	**Stainless Steel Wire Ropes**	
a.	Grade	: AISI 316/304
b.	Diameter of SS Rope (mm)	: 6 mm
c.	Construction	: 7/19
d.	Number of ropes	: 3 Rope System
e.	Factor of safety	: 5 or More
g.	Breaking load	: 2450 Kg. X 2
6	**Trailing Cable**	
a.	Type	: Flexible Copper 5 Core 4 Sq. mm
b.	Material	: PVC Cable
c.	Make	: Centurion
d.	No. of Circuits per mast	: Two
7	**Integral Power Tool**	

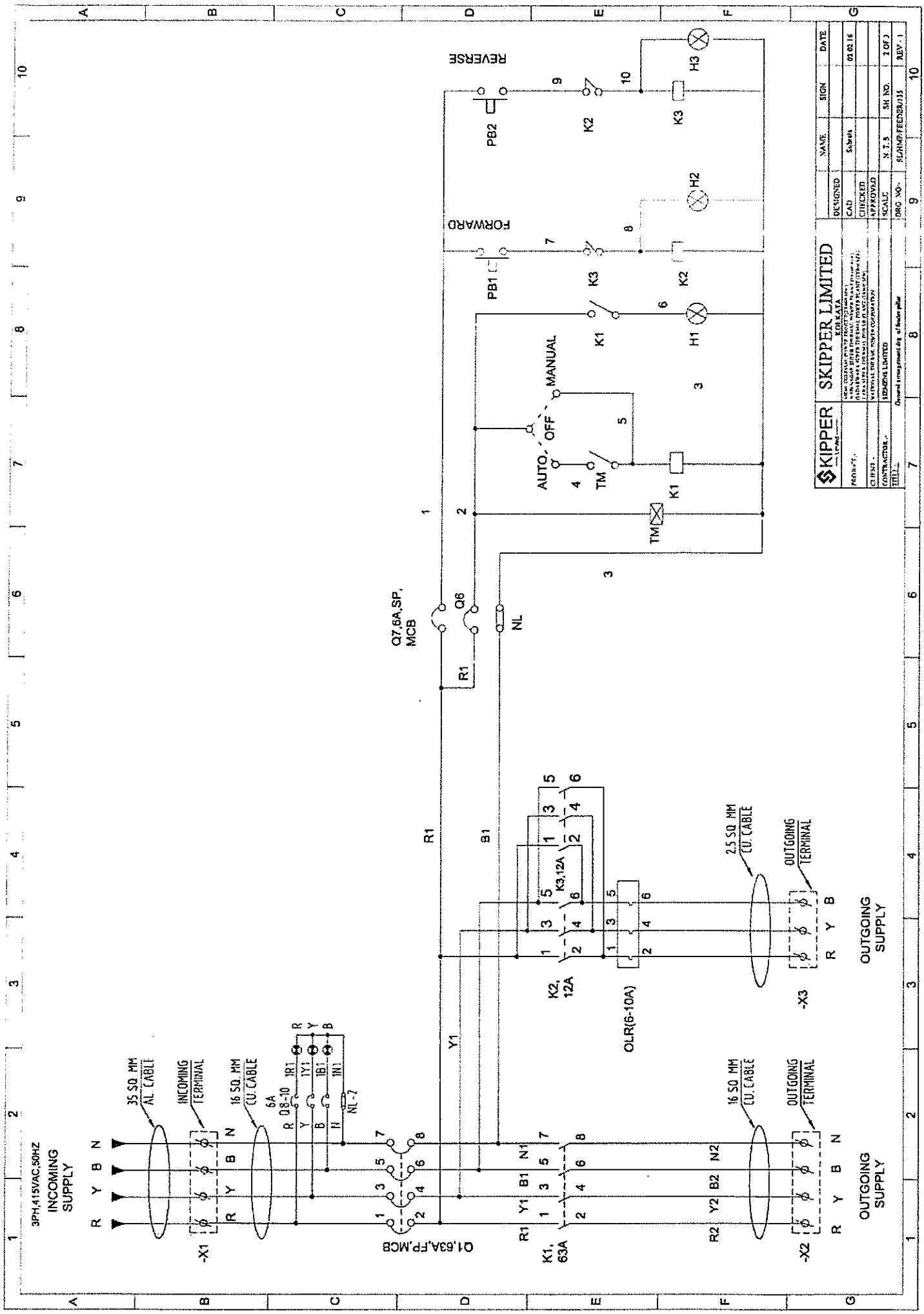
SKIPPER **Technical Data Sheet of 30 Meter High Mast & Accessories**

a.	Wattage/HP	: 2.0 HP with handle
b.	Number of Speeds	: Single Speed
c.	Reversible	. Yes
d.	Input supply	: 415 Volts
8	The technical details of :-	

i) Twin dome LED type Aviation warning light

ii) Lightening arrestor at the top of the mast shall be made from 25 NB (H) pipe heavy duty hot dip GI single spike of length 1200 mm


SIDE VIEW
FRONT SIDE
DOOR-D2
DOOR-D1
MS FLAT 35X3 MM
MS ANGLE 35X35X5
FRONT VIEW WITHOUT DOOR-D1 & D2
OUTGOING TERMINAL
INCOMING TERMINAL
MCB 63A 4P
6A MCB
OLR
C3
C2
C1
T1
R Y B N
MS ANGLE 35X35X5
MS FLAT 35X3 MM
FOUNDATION PLAN
460
500
250
210
CANOPY
FRONT VIEW WITHOUT FRONT DOOR-D1
EARTH BOLT
R
Y
B
h1
h2
h3
PB1
PB2
A/M
MS ANGLE 35X35X5
MS FLAT 30X3 MM
FRONT VIEW (OUTSIDE)
DANGER
FEEDER PILLAR FOR HIGH MAST
580
600
750
200
40
GLAND PLATE
ø 33MM CUT OUT
CUTOUT FOR 35 SQ MM CABLE
SKIPPER LIMITED
KOLKATA
NAME
SIGN
DATE
DESIGNED
CAD
CHECKED
APPROVED
SCALE
N.T.S
SH. NO
1 OF 3
DRG. NO:
SL/HMP/FEEDER/35
REV.: 1
CONTRACTOR:
CLIENT:
PROJECT:
TITLE:


3PH,415VAC,50HZ
INCOMING SUPPLY
R Y B N
35 SQ. MM AL. CABLE
INCOMING TERMINAL
-X1
16 SQ. MM CU. CABLE
6A
Q8-10
IR1
IY1
IB1
IN1
NL-2
Q1,63A,FP,MCB
Q7,6A,SP, MCB
Q6
R1
NL
Y1
B1
K1, 63A
K2, 12A
K3,12A
OLR(6-10A)
REVERSE
FORWARD
PB1
PB2
K1
K2
K3
H1
H2
H3
AUTO
OFF
MANUAL
TM
2.5 SQ. MM CU. CABLE
OUTGOING TERMINAL
-X3
OUTGOING SUPPLY
N1
N2
B2
Y2
R2
-X2
SKIPPER LIMITED
DESIGNED
CAD
CHECKED
APPROVED
SCALE
DRG NO-
DATE
SIGN
NAME
REV - 1
2 OF 2

BILL OF MATERIALS

SL	DESCRIPTION	RATING	Q T Y	MAKE
1	4P,MINIATURE CIRCUIT BREAKER(10kA)	63A	1	L&T/C&S
2	4P POWER CONTACTOR, AC-1 (K1)	63A	1	L&T/C&S
3	TP POWEWR CONTACTOR (K2, K3)	17A	2	L&T/C&S
4	OVER LOAD RELAY WITH BUILT-IN SINGLE PHASING PROTECTION	(6-10)A	1	L&T/C&S
5	4 WAY POWER TERMINAL(-X1,-X2) (FOR 35 SQ MM CABLE	---	2	REPUTED
6	3 WAY POWER TERMINAL (-X3) (FOR 2.5 SQ MM CABLE)	---	1	REPUTED
7	SP,MINIACURE CIRCUIT BREAKER(Q6-Q10) 10 kA	6A	5	L&T/C&S
8	NEUTRAL LINK	---	2	REPUTED
9	AUTO MANUAL SELECTED SWITCH 1 POLE, 2 WAY	6A	1	KAYCEE/SALZER
10	LED INDICATION LAMP(H1,H2,H3)	240V AC	3	ESBEE (L&T)/ C&S
11	24 HOURS TIME SWITCH	240V AC	1	L&T/HAVELLS
12	NORMAL PUSH BUTTON WITH ELEMENT	6A	2	ESBEE (L&T)/ C&S
13	PHASE INDICATION LAMP (R,Y,B)	240V AC	3	ESBEE (L&T)/ C&S

NOTES

1 ENCLOSURE CRCA 1.6 MM THICK, DOOR & COVERS - 1.6mm THICK CRCA

2 ENCLOSURE - DUST TIGHT, VERMIN PROOF WITH GASKETED
DOORS/COVERS : IP-55.

3 PAINTING - EPOXY BASED POWDER COATED PAINT SHADE 9002 OF IS-5, AND STAND SHALL BE BLACK.

4 DOOR - CONCEALED HINGE WITH LOCK ARRANGEMENT AND RUBBER GASKETED.

5. WIRING-1.5 SQMM PVC INSULATED CABLE FOR CONTROL (GRAY & BLACK) POWER-16SQ.MM, STARTER-2.5SQ.MM.

6. CABLE ENTRY WILL BE FROM BOTTOM THROUGH GLAND PLATE.

7. NAME PLATE WILL BE WHITE LETTERING ENGRAVED ON BLACK ANODIZED PLATE.

8 ALL DIMENSION ARE IN MM

9 ALL CABLE ENTRY FROM BOTTOM THROUGH 1.6mm THICK DETACHABLE
GLAND PLATE (KNOCK OUT TYPE PUNCH)

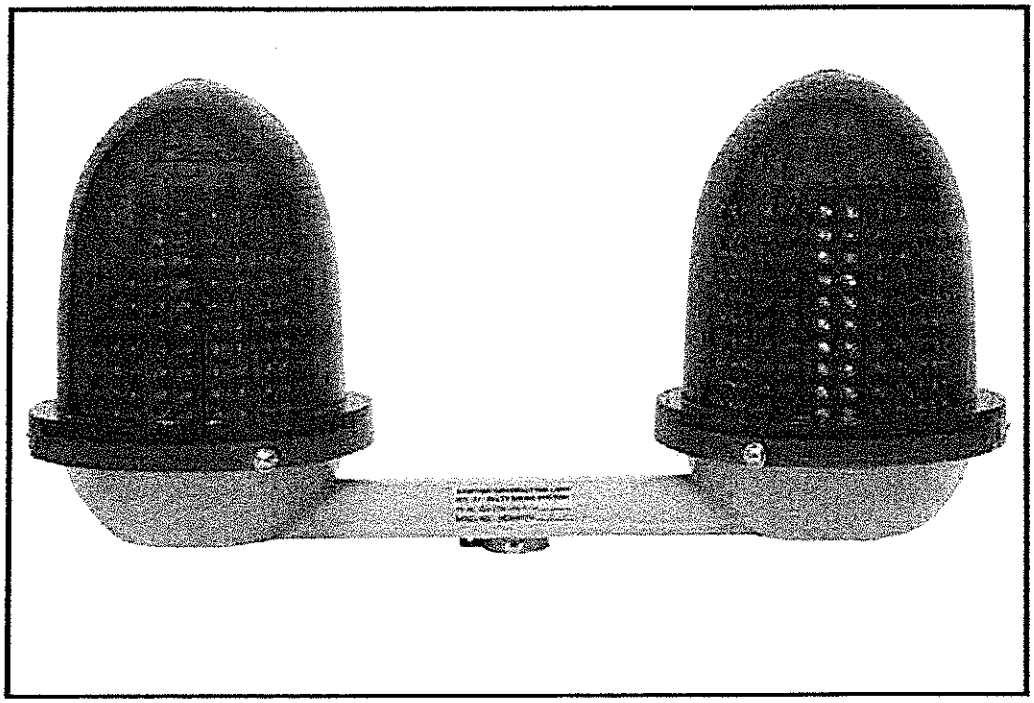
10 2NOS M8 EARTH BOLT SHALL BE PROVIDED BOTH SIDE OF THE FEEDER PILLAR

11 PANEL WILL BE OUT DOOR INSTALLATION TYPE

12 LAMINATED CIRCUIT DIAGRAM SHALL BE PASTED INSIDE THE DOOR.
POWER CIRCUIT SHALL HAVE COLOUR SLEEVES AND FERRULES ON COPPER LUGS
LABELS ALUMINIUM ANODIZED.

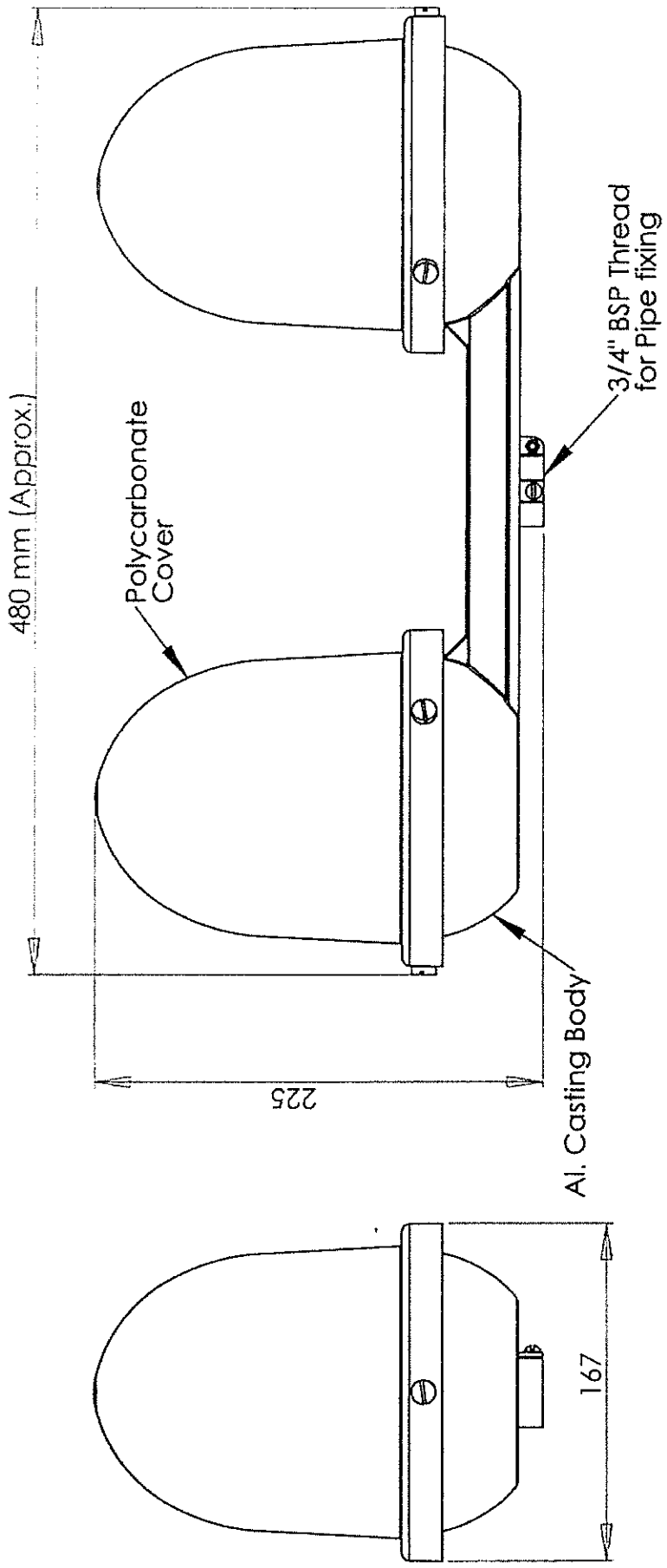
SKIPPER	SKIPPER LIMITED KOLKATA		NAME	SIGN	DATE
		DESIGNED			
PROJECT :-	MEJIA THERMAL POWER PROJECT (UNIT NOS. 5 & 6) MAHADEV PRASAD STPP PHASE-I (UNIT NOS. 1 & 2) DAMODAR S.A. (2 NOS. THERMAL POWER PLANT (UNDER LAND & WATER THERMAL POWER PLANT (UNDER LAND)	CAD	Subrata		02.02.16
		CHECKED			
CLIENT :-	NATIONAL THERMAL POWER CORPORATION	APPROVED			
CONTRACTOR :-	SIEMENS LIMITED	SCALE	N T S	SH NO	3 OF 3
TITLE :-	General arrangement drg. of feeder pillar	DRG NO:-	SL/HMP/FEEDER/335		REV - 1

195/203
891

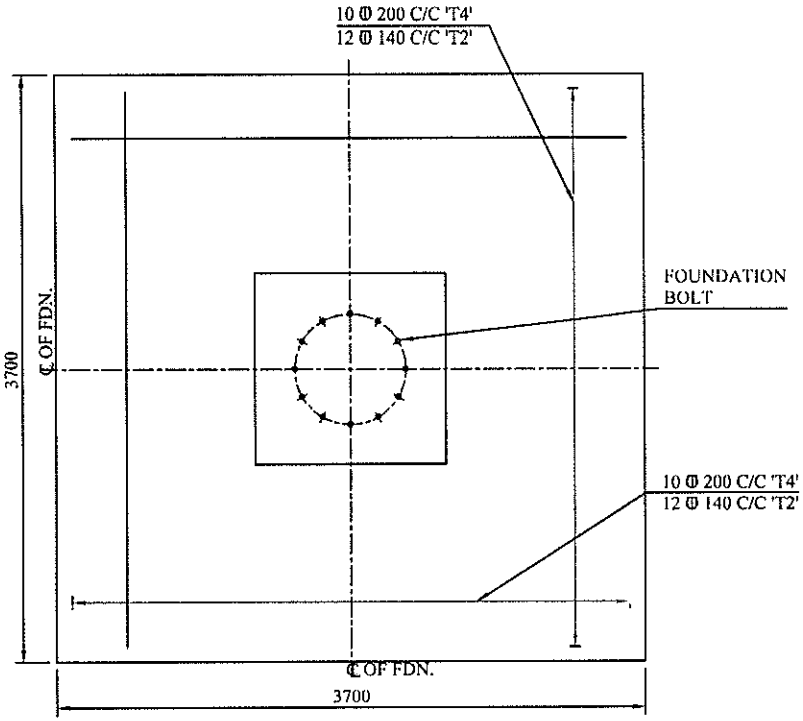


TWIN TYPE LOW INTENSITY AVIATION OBSTRUCTION LAMP

a	Name of Manufacturer	DELTA SOLAR SYSTEMS, THANE
b	Type	LED 360 - TWIN
c	Model no.	LEDWATCH - 230V T,
d	Make	'DELTA'
e	Specifications conforming to	ICAO' ANNEX-14, TYPE - B
f	Body Material	PRESSURE CAST ALUMINIUM
g	Enclosure Material	U.V. STABILISED, RED POLYCARBONATE
h	Size and construction details	DRG. ATTACHED HEREWITH
i	Weight of Laminar	1.9 K.G.
j	Effective Intensity	MORE THAN 32 Cd OF SINGLE LAMP
k	Colour shade	RAL 7032 (SIEMENS GRAY) OR GOLDEN YELLOW
l	Consumption	09 WATTS @ 230 VOLTS PER LAMP
m	Powder Paint Thickness	60 MICRON
n	Average Burning Life	100000 Hrs
o	Termination Arrangement	CONNECTING LEADS WITH CONNECTOR UPTO 01 MTR. LENGTH
p	IP Rating	IP- 65
q	Mounting detail	3/4" X 4" G.I. BARREL NIPPLE & CHUCKNUTS



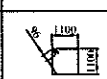
Twin Aviation Light Fitting

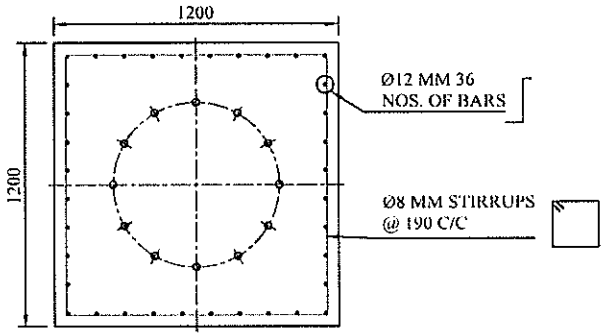


FOUNDATION PLAN

FOUNDATION LOADING AT THE BASE OF MAST		
WIND SPEED	M/SEC	47
BENDING MOMENT	KN-M	25.969
HORIZONTAL SHEAR	KN	1.547
VERTICAL LOAD	KN	2.249
S.B.C OF SOIL	T/SQM	5.0

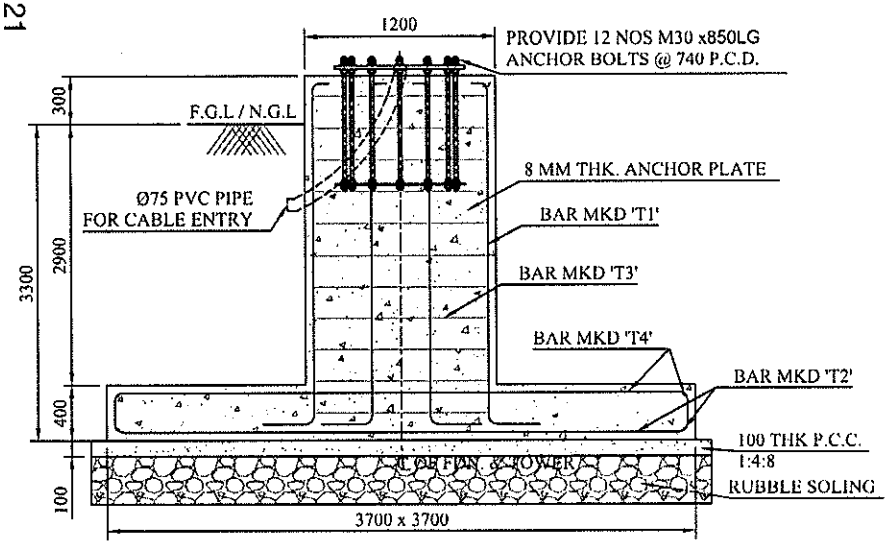
SCHEDULE OF REINFORCEMENT

MK	DIA	SHAPE	NOS	LENGTH
T1	Φ 12		36	3895
T2	Φ 12		54	3840
T3	Φ 8		19	4592
T4	Φ 10		38	3800



DETAIL OF PEDESTAL

SCHEDULE OF QUANTITIES		
P.C.C	CU.M	1.52
R.C.C	CU.M	10.08
STEEL Fe 415	Kg	449



SECTIONAL ELEVATION

GENERAL NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL OF CONSTRUCTION : CONCRETE - M25
   REINFORCEMENT - Fe 415.
   P.C.C. - 1:4:8
3. COVER TO ALL REINFORCEMENT - 50MM
4. MINIMUM LAP LENGTH OF BARS SHALL BE 50 x DIA, UNLESS OTHERWISE STATED.
5. FOUNDATION SHOULD REST ON VIRGIN SOIL, IF SAID S.B.C IS NOT AVAILABLE AT SPECIFIED FOUNDATION LEVEL, IT SHOULD BE TAKEN DEEPER.
6. MAST FLANGE SHOULD REMAIN UNGROUTED FOR DRAINAGE & VENTILATION.
7. IF MAST FLANGE IS GROUTED MIN- 4 NOS OF 25MM DIA DUCTS SHALL BE PLACED AROUND IT TO ALLOW DRAINAGE & VENTILATION.
8. FOUNDATION IS DESIGNED CONSIDERING NET S.B.C- 5T/SQM AT 3.3M DEPTH.
9. PLEASE VERIFY THE BOLT DETAILS BEFORE CASTING THE FOUNDATION.
10. 500MM THK. RUBBLE SOLING SHALL BE PROVIDED BELOW FOUNDATION.

BEFORE CASTING THE FOUNDATION VERIFY THE DIMENSIONS OF FOUNDATION BOLT(DIA. & QTY.) & ANCHOR PLATE (P.C.D.) WITH RESPECT TO THE DIMENSIONS MENTIONED IN THIS DRAWING.

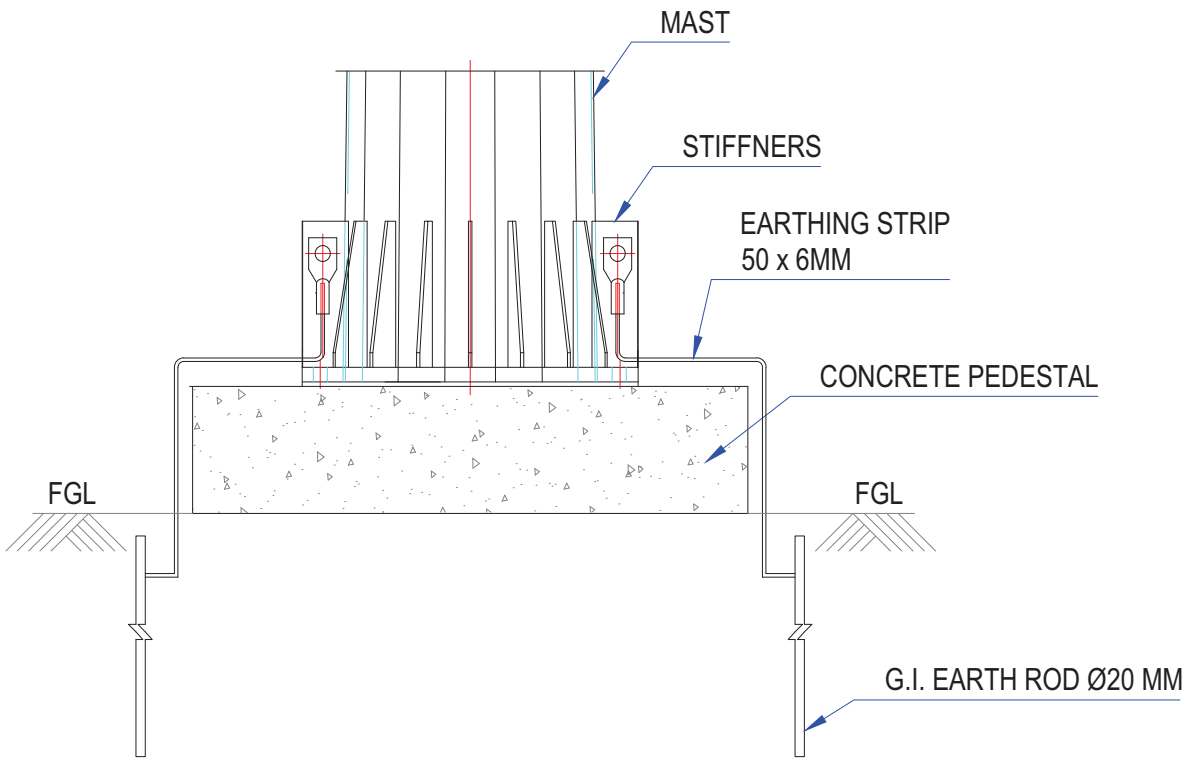
SKIPPER Limited — SKIPPER LIMITED

CLIENT:- NTPC

TITLE:- 30M HIGH MAST FOUNDATION GA DRAWING

	NAME	SIGN	DATE
DESIGN BY	C.A.		04-08-2017
DRAWN BY	SARVESH		04-08-2017
CHECKED BY	C.A.		04-08-2017
ALL DIMENSIONS ARE IN MM	SHEET NO. 1 OF 1		SCALE N.T.S.
DRG. NO:-	SL-NTPC-HM-FDN-30M-GA DRAWING-R1		REV. NO. R1

891199/2022/TBG-TBG_ENGG



NOTES :-

1. ALL DIMENSION ARE IN MM.

SKIPPER Limited	SKIPPER LIMITED		NAME	SIGN	DATE
		DESIGN BY			24-08-2016
		DRAWN BY	SARVESH		24-08-2016
CLIENT:-	AVAIDS TECHNOVATORS PVT. LTD	CHECKED BY	C.A.		24-08-2016
		ALL DIMENSIONS ARE IN MM		SHEET NO. 1 OF 1	SCALE AS SHOWN
TITLE:-	EARTHING DETAIL	DRG. NO.-	SL-EARTHING-GA DRAWING		REV. NO. 0

SKIPPER
Limited

STRUCTURE STABILITY CERTIFICATE

Date: 04.11.2016

Subject: Regarding stability of High Mast offered for NTPC at Karanpura.

Respected Sir/ Madam,

With reference to above mentioned subject, we hereby confirm that the 30M Lighting High Mast offered by us are structurally suitable to carry 16 No's of Luminaries with Symmetrical arrangement and shall sustain the wind speed prevailing at site i.e. (39 m/sec) as per IS- 875 Part-III.

Thanking you,

Yours faithfully

SKIPPER LIMITED Mumbai-400 613 652 Solitaire Park

H.K Jain
President- Pole Business
For Skipper Limited.

891199/2022/TBG-TBG_ENGG

PROJECT: 400/220kV Switchyard for North Karanpura Super TPP (3x660MW)
Additional Scope of ICT-2 and associated 400kV & 220kV Bays
CUSTOMER: NTPC LTD.

PROJECT DETAILS

3.1 PROJECT DETAILS

	Particular	Details
a)	Customer	NTPC Ltd.
b)	Engineer/Consultant/ Inspector	NTPC Ltd.
c)	Project Title	North Karanpura Super Thermal Power Project (3x660 MW) : 400/220kV Switchyard at NKSTPP end & 220kV Sub-station at Mine end
d)	Project Location	Place: Near Tandwa town District: Hazaribagh & Chatra State: Jharkhand
e)	Latitude & Longitude	**400/220kV S/s at NKSTPP:** North: 23°50' to 23°52' and East: 84°59' to 85°2'
f)	Nearest Railway Station	Khalari Railway Station Ranchi-Garhwa section of Eastern Railways
g)	Distance of project location from the Railway station	40 Km (approx.)
h)	Nearest Major Town	Hazaribagh city
i)	Distance of the town from the project site	50 Km.
j)	Nearest commercial airport	Ranchi
k)	Distance of airport from the project site	150 Km
	SITE CONDITIONS (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 (With Coal dust & Fly ash) and Highly Corrosive environment.
e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3) 1987
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	220 kV
1	Highest system voltage	420 kV rms	245 kVrms
2	Lightning Impulse voltage	±1425kVp	± 1050kVp
3	Switching impulse voltage	±1050kVp	-
4	Power frequency withstand for 1 min (rms)	630 kV(rms)	460 kV(rms)
5	Max. fault level (1 sec.)	50 kA	40kA
6	Minimum creepage distance	10500 mm	6125mm

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 switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	2nd Level	3rd Level	Peak
220kV	6000mm	12000mm	17000mm	8500mm
400kV	8000mm	16000mm	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.

3.1.4 The minimum clearances for 400kV & 220 kV switchyards shall be as given below:

	400kV	**220kV**
Phase to earth clearance	3500 mm	2100mm
Phase to phase clearance	4000 mm	2100mm
Section clearance	6500 mm	5000mm

PROJECT: 400/220kV Switchyard for North Karanpura Super TPP (3x660MW)
CUSTOMER: NTPC LTD.

ANNEXURE-4: LIST OF NTPC APPROVED VENDORS

1.1 Sub-Suppliers

Bidder should consider NTPC approved make of items. Few of the approved make of equipments shall be as follows:

Item Description	Proposed sub-supplier	Place	Sub-supplier approval status code/category
Cable Lugs	DOWELS	MUMBAI	A
	3D	UMBERGAON	A
	CHETNA	NASIK	A
Cable Glands	COMET	MUMBAI	A
	SUNIL & CO	KOLKATA	A
	STANDARD METAL INDUSTRIES	MUMBAI	A
	ARUP ENGG	KOLKATA	A
	QUALITY PERCISION	KOLKATA	A
	BRACO	MUMBAI	A
Fire Sealing System i) Type-A material supplier	3M INDIA	BANGALORE	A
	GE SILICON	USA	A
	DOW CORNING	USA	A
Fire Sealing System ii) Type-B material supplier	LLOYDS	DELHI	A
	SIGNUM	NAGPUR	A
	VIJAY SYSTEMS ENGEERS Pvt. Ltd.	MUMBAI	A
Execution Agency for Fire Sealing System	3M INDIA	BANGALORE	A
	LLOYDS	DELHI	A
	SIGNUM	NAGPUR	A
	VIJAY SYSTEMS ENGEERS Pvt. Ltd.	MUMBAI	A
Equipment Erection Hardware and GI pipe	BHEL approved sources		

A – For this item proposed sub-vendor is acceptable to NTPC.
DR – For these items Details required for NTPC review.
Above vendor list is final and no additional vendor approval will be given.