E-TENDER SPECIFICATION

S. No.	E- TENDER SPECIFICATION NUMBER
01	BHE/PW/PUR/BWT6-ELE/2465

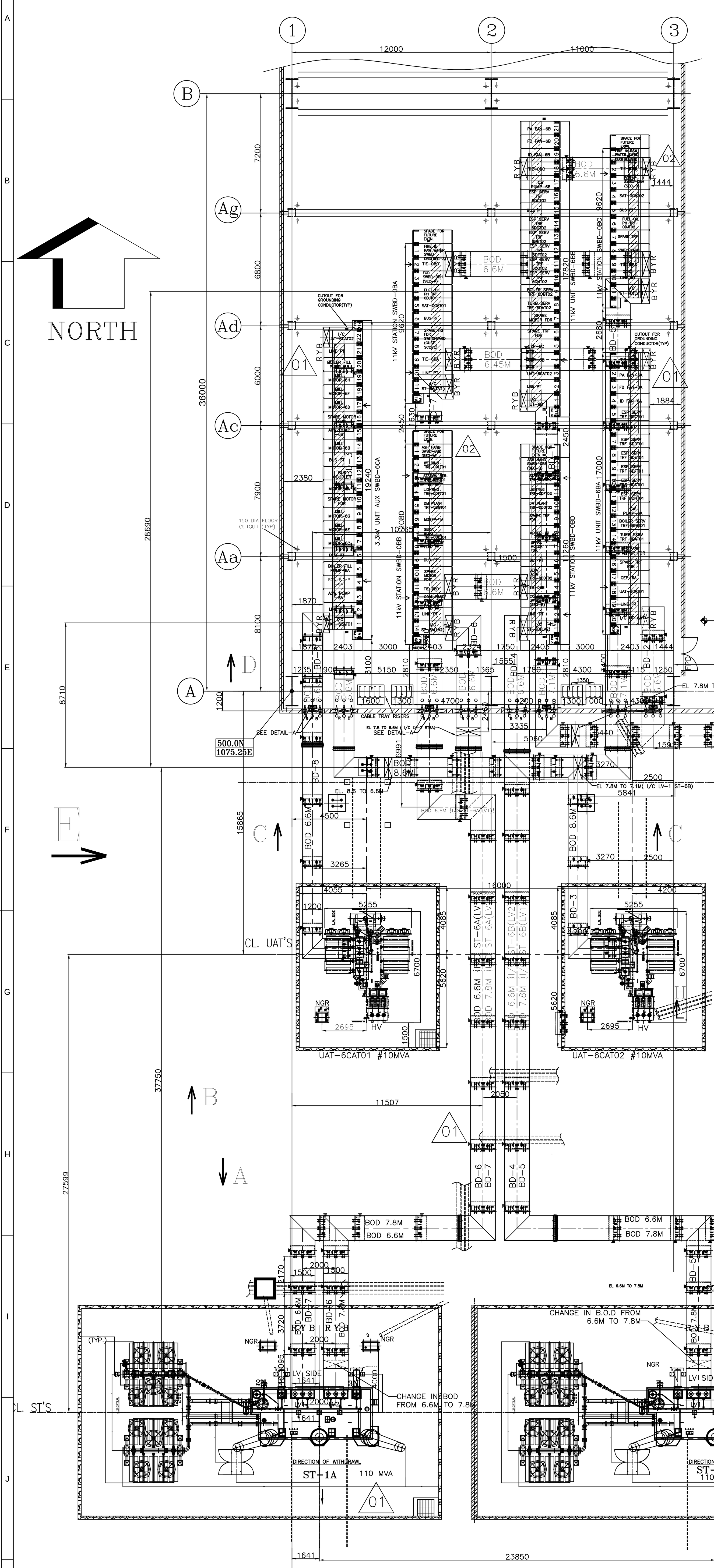
FOR

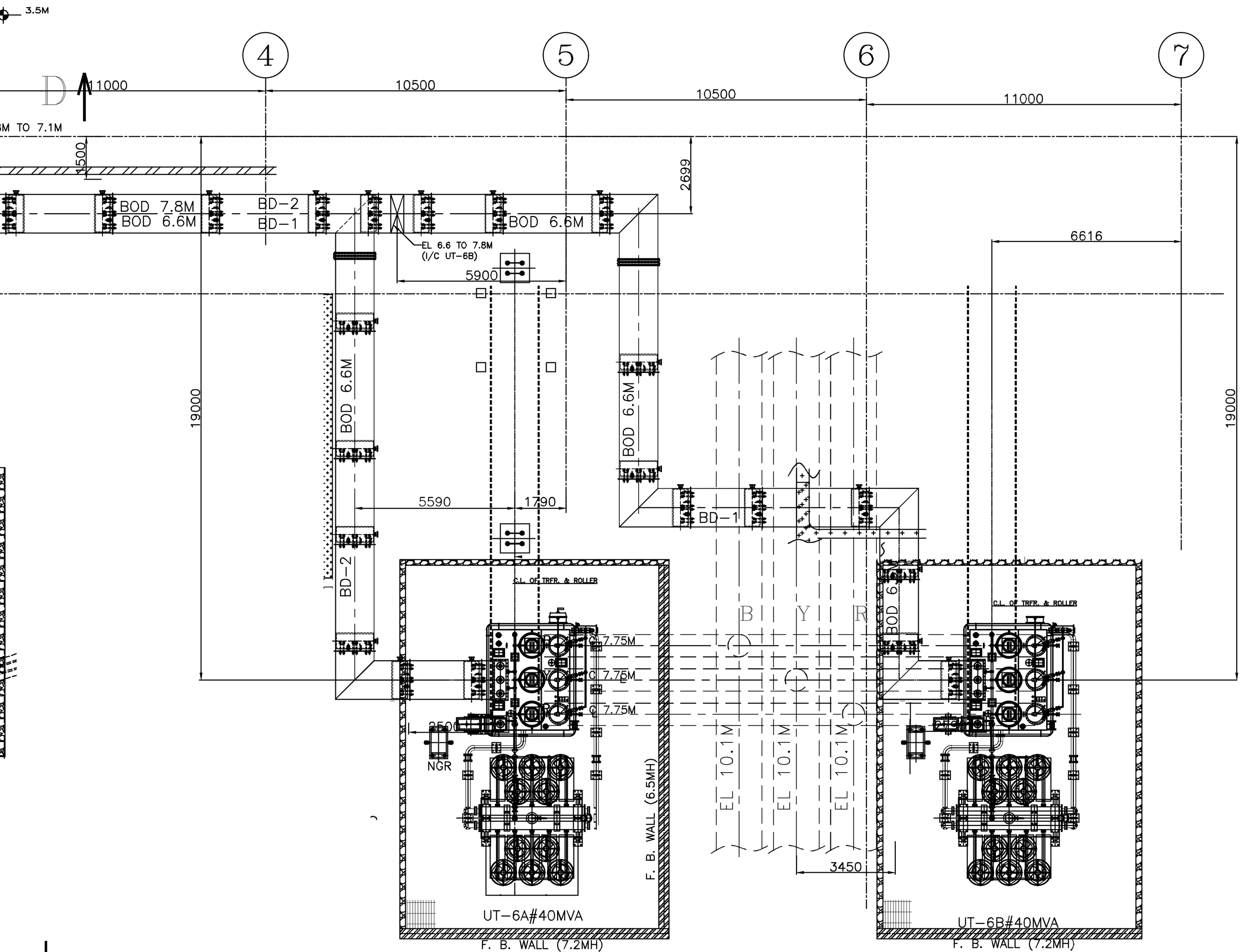
HANDLING AT SITE STORES/STORAGE YARD, TRANSPORTATION TO SITE OF WORK, COMPLETE ERECTION, CHECKING OF CALIBRATION, TESTING, ASSISTANCE FOR COMMISSIONING AND HANDING OVER OF HT/LT POWER TRANSFORMERS, ISOLATED PHASE BUS DUCT FOR GENERATOR TRANSFORMER, SEGREGATED PHASE BUS DUCT FOR STATION TRANSFORMER /UNIT AUX. TRANSFORMER, ELECTROSTATIC PRECIPITATOR, GENERATOR CONTROL & PROTECTION PANELS, 11KV/3.3KV/0.415KV SWITCHGEAR BOARDS /MCC, SOOT BLOWER SYSTEM, EXCITATION SYSTEM, 220 VOLT BATTERY SYSTEM AND ELECTRICAL HOIST AND ASSOCIATED EQUIPMENT'S & ASSOCIATED AUXILIARIES FOR **BHUSAWAL TPS, UNIT-6, 1x660 MW, MAHAGENCO PROJECT.**

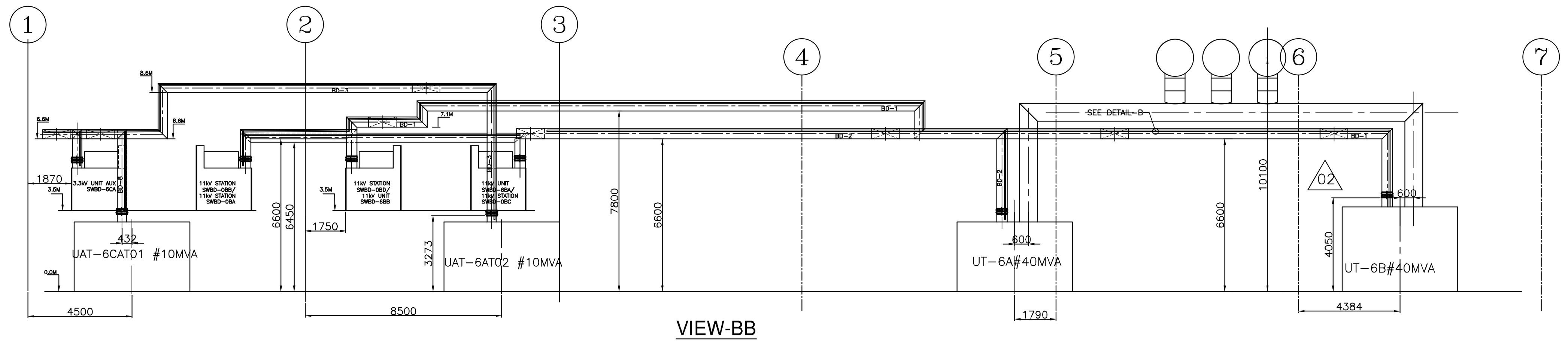
VOLUME I E– Technical Specifications (Part-2 of 2)

First Angle Projection

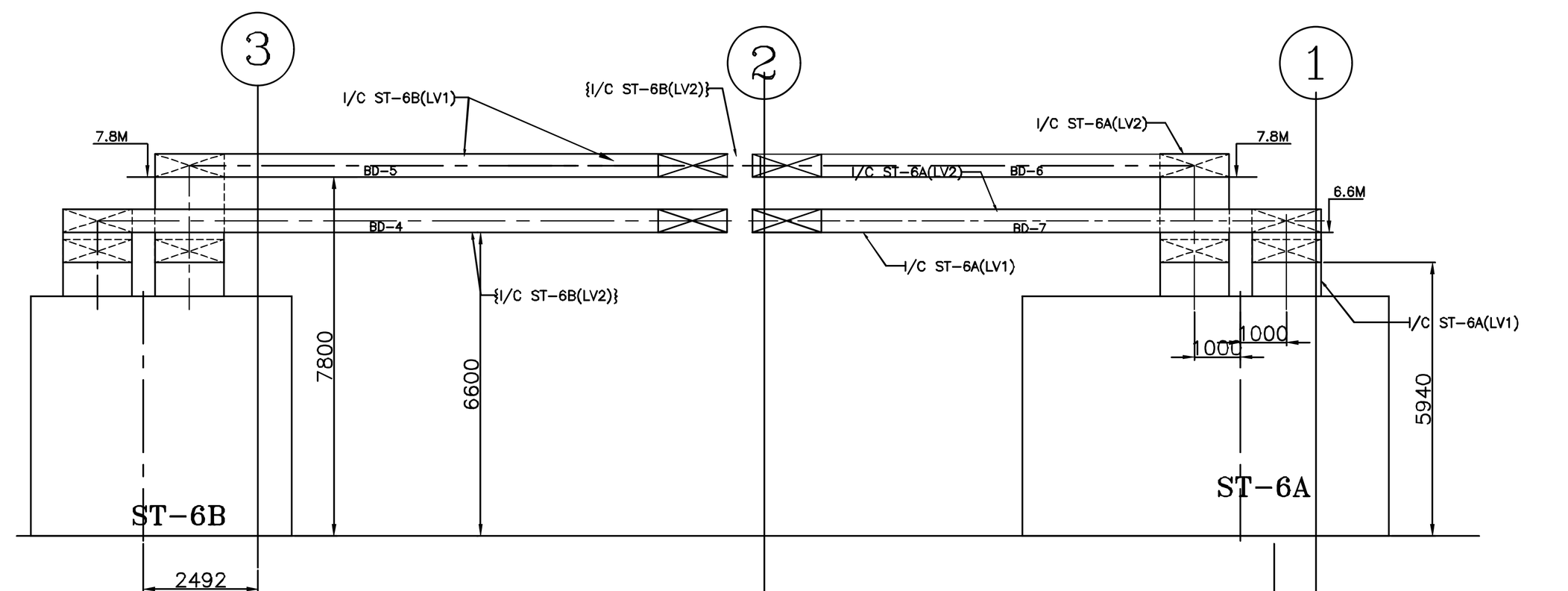
All Dimensions in 'mm'



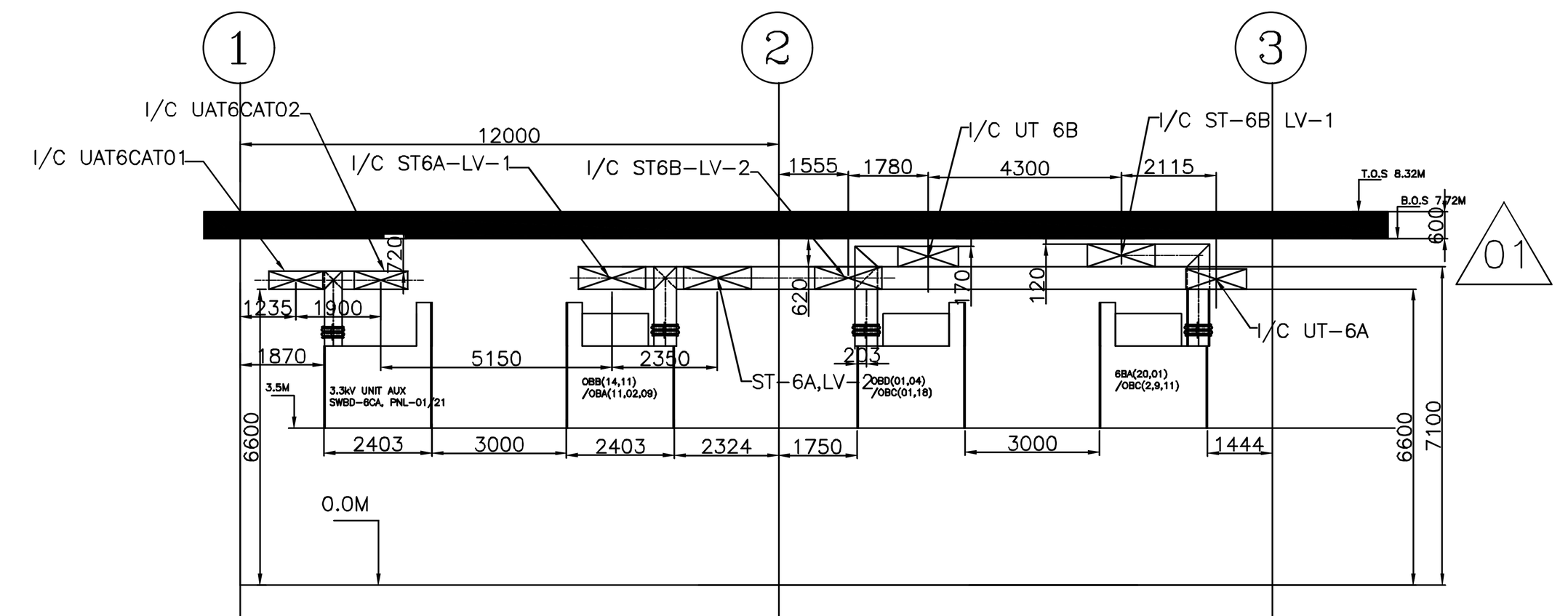




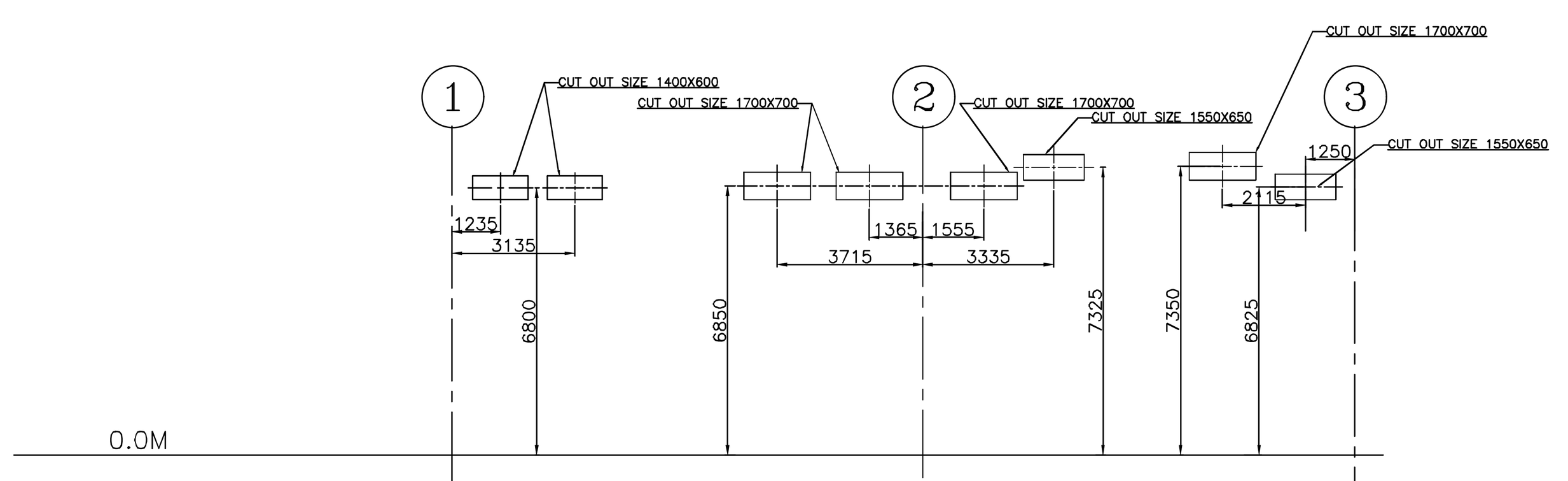
VIEW-BB



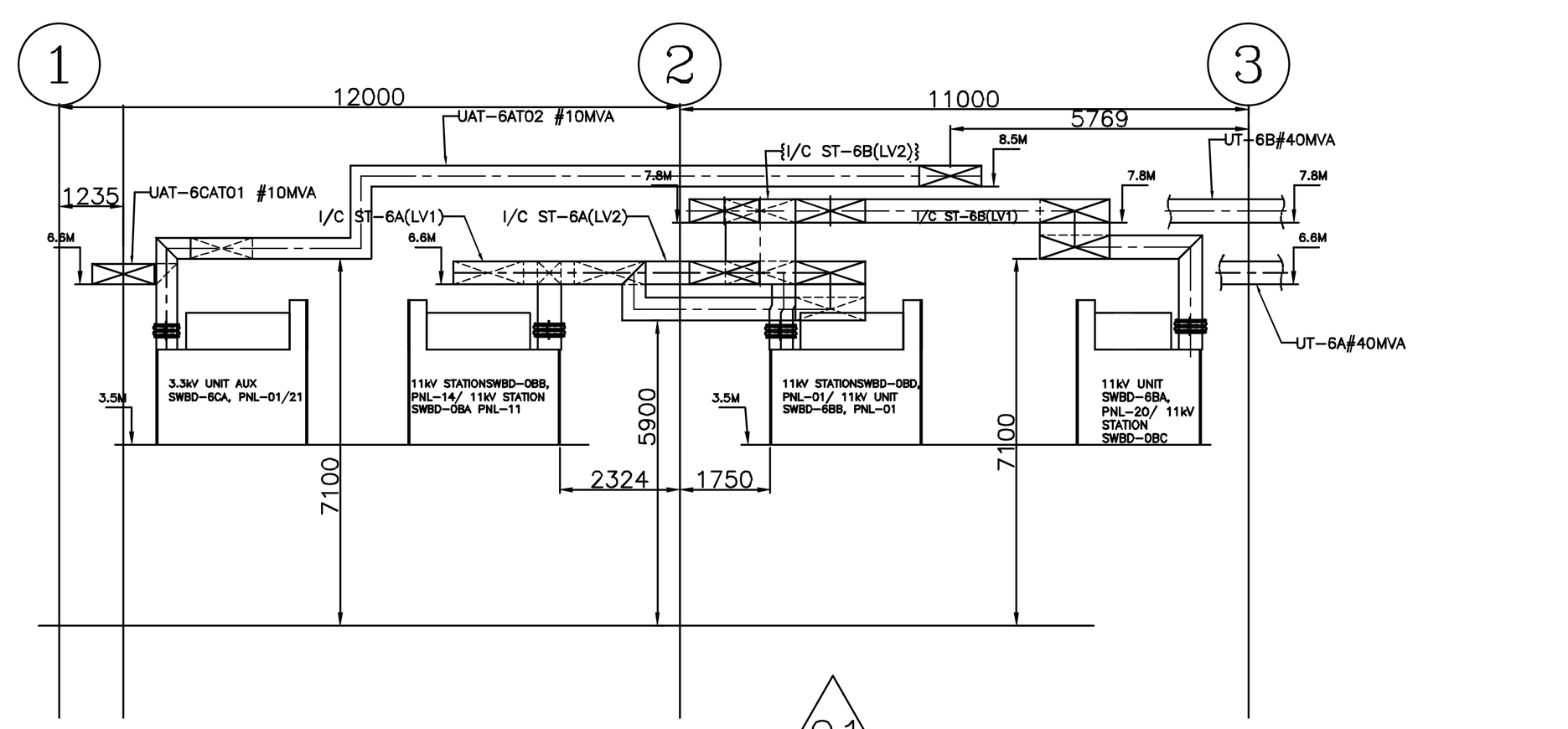
VIEW-AA



VIEW-DD



WALL CUT-OUT DETAILS



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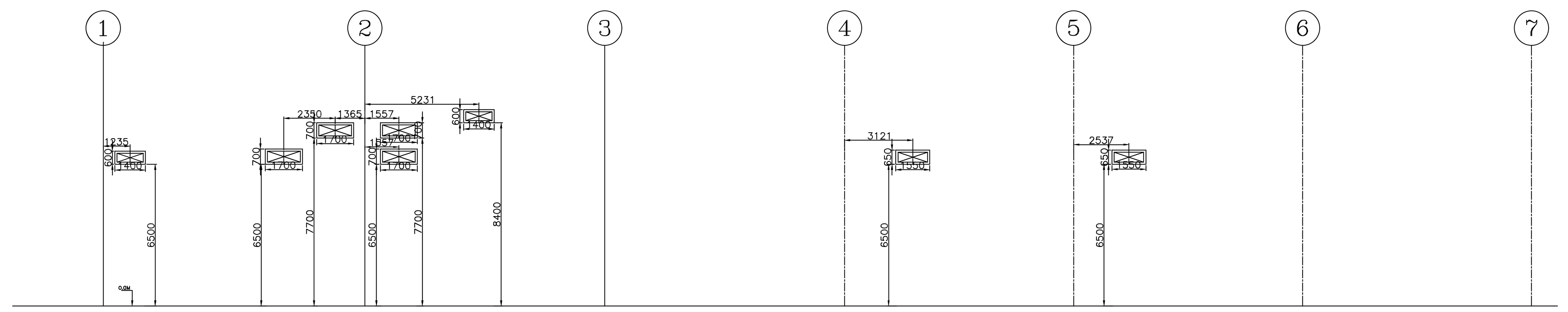
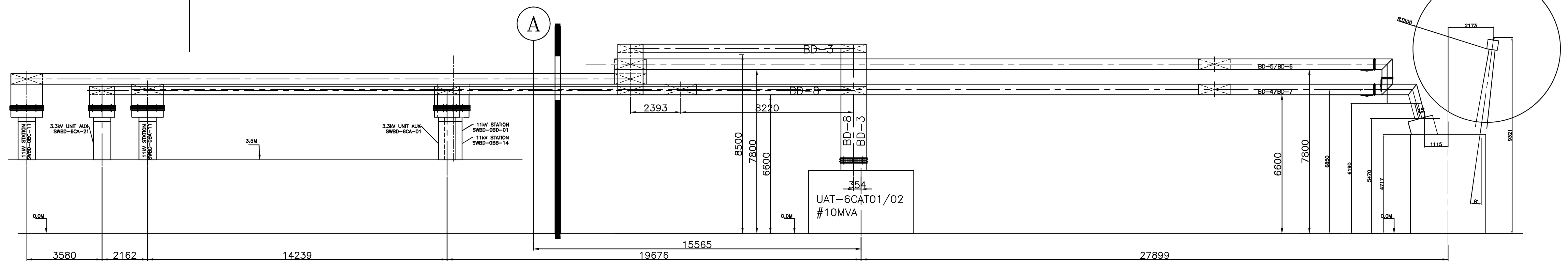


FRAMING CUTOUT DETAILS



VIEW-E

REFERENCE DRAWINGS/DOCS:-

1.	TRANSFORMER YARD LAYOUT	PE-DG-415-100-E001 REV-R01
2.	LAYOUT OF MV SWGR ROOM EL. 3.5M	PE-DG-415-100-E002 REV-R04
3.	ELECTRICAL SLD FOR AUXILIARY POWER DISTRIBUTION	PE-DG-415-565-E001 REV-01
4.	OGA OF ST-	141600050013 REV-02
5.	OGA OF UT-	14560050997 REV-02
6.	LAYOUT OF SAT -	01531800007 REV-01

NOTE-

1) INSULATOR SPAN SHALL BE AS PER STC TEST CONDUCTED ON BUSDUCT

01

REV.	DATE	ALTERED / CHECKED
01	22.08.19	SURAJ / A.NARAYAN

DRAWING REVISED AS PER CUSTOMER COMMENTS

DISTRIBUTION OF PRINTS

	NAME	SIGN	DATE
DRN	SUSHIL		13.05.19
CKD	SURAJ		13.05.19
APPD	A. NARAYAN		13.05.19

DEPT.	CODE
BDE	–

NAME OF CUSTOMER: M/S MAHAGENCO
NAME OF CONSULTANT: DCPL
NAME OF PROJECT: 1x660MW BHUSAWAL PROJECT

BHARAT HEAVY ELECTRICALS LTD.
RUDRAPUR

CARD CODE: –

TITLE: LAYOUT OF SEGREGATED PHASE BUSDUCT

NO. OF SHTS: 02
SHT NO.: 01

SCALE	ORDER / ENQUIRY NO.	DRAWING NO.	REV.
–	17-153-C-1	01531800004	02A

SIZE -A0

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.

FIRST ANGLE PRO

(ALL DIMENSIONS ARE IN mm)

00 02077

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN any WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

REF.WO.NO. 63003-P-517-01
REF.DRG.NO. 3 469 00 01468

SIGN.DATE

INVENTORY NO.

DEVELOPMENT CONSULTANT PVT. LTD.

Reviewed only for general conformance with contract drawings and specifications;
Contractor to be responsible for any error and for fulfilment of details requirements of contract documents.

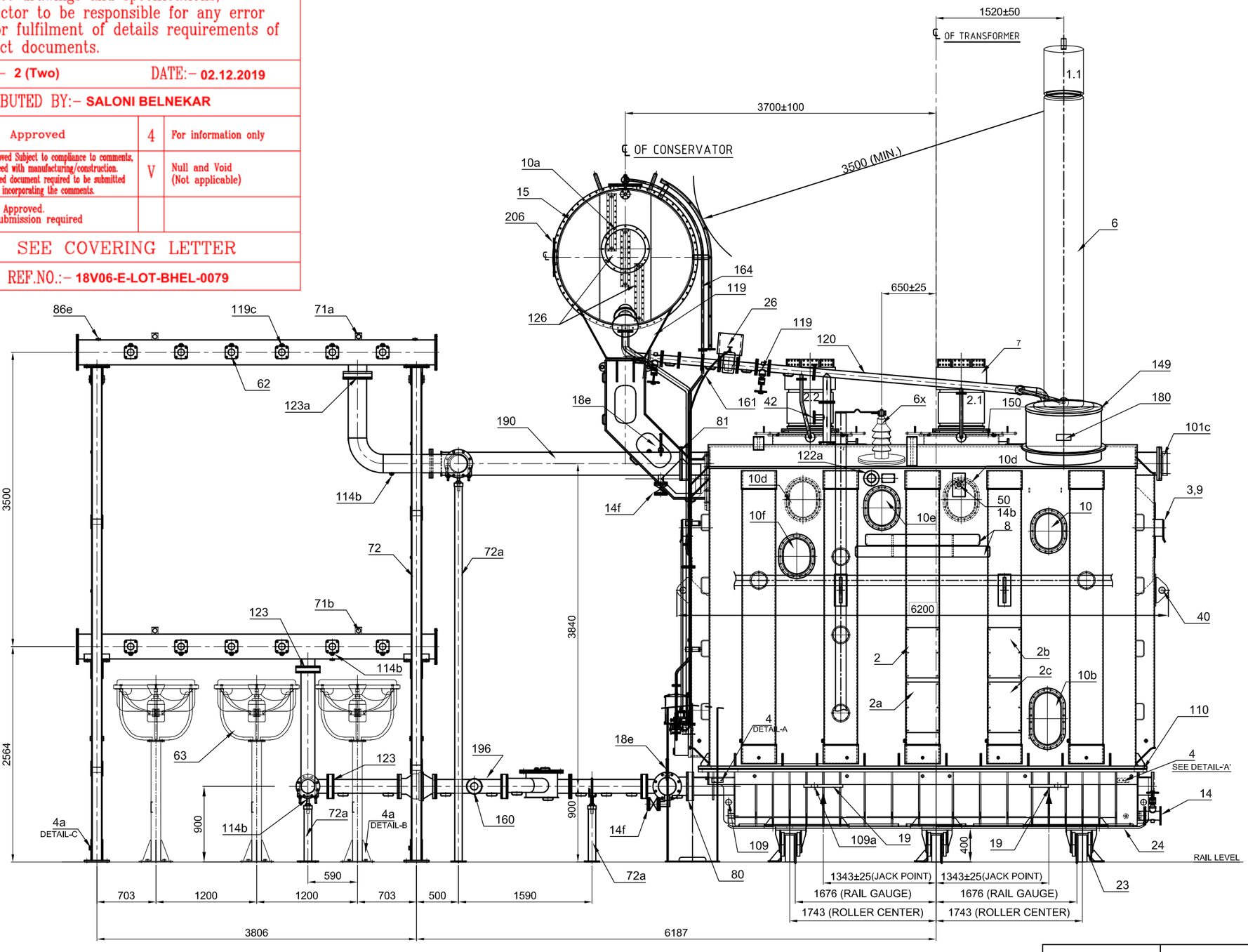
CODE:– **2 (Two)** DATE:– **02.12.2019**

DISTRIBUTED BY:– **SALONI BELNEKAR**

1	Approved	4	For information only
2 ✓	Approved Subject to compliance to comments, Proceed with manufacturing/construction. Revised document required to be submitted after incorporating the comments.	V	Null and Void (Not applicable)
3	Not Approved. Resubmission required		

SEE COVERING LETTER

LETTER REF.NO.:– **18V06-E-LOT-BHEL-0079**



REV	DATE	ALT.				REV	DATE	ALT.				REV	DATE	ALT.				REV	DATE	ALT.	RAKESH
		CKD.						CKD.						CKD.				01	14.11.19	CKD.	LK
		APPD.						APPD.						APPD.						APPD.	LK/SS
ZONE						ZONE						ZONE						ZONE	DRAWING REVISED INLINE WITH CUSTOMER COMMENTS.		

101	102	103	104	105	106	107	108		

BHEL DRAWING/DOCUMENT NO	**BP-DG-415-301-0001**		
ADDITIONAL INFORMATION	W.O.- 68001-A-512-01		
	STATUS OF DRAWING "PR"		
	DISTRIBUTION OF PRINTS		
	TRE-1, TRM-3		
PO. NO.	**DG/BSL U-6/2011/T-1/BTG+BOP EPC CONTRACT/SUPPLY/0054 DATED: 07/01/2018**		

TYPE OF PRODUCT	4 X 275 MVA, 21/420/√3 KV, 1-PH, ONAN/ONAF/OFAF, GENERATOR TRANSFORMER
PROJECT	1 X 660 MW BHUSAWAL UNIT-6
OWNER	MSPGCL
OWNER'S CONSULTANT	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS VASHI, NAVI MUMBAI

भारत हेवी इलेक्टिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

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

TITLE/- OUTLINE GENERAL ARRANGEMENT (ELEVATION VIEW)

	NAME	SIGN	DATE
DRN.	RAKESH		28.03.19
CHD.	LK		01.04.19
APPD.	LK/SS		01.04.19

DRG. NO 3 469 00 02077 REV. 01

SHEET 01 OF 03

Rakesh

FIRST ANGLE PROJECTION

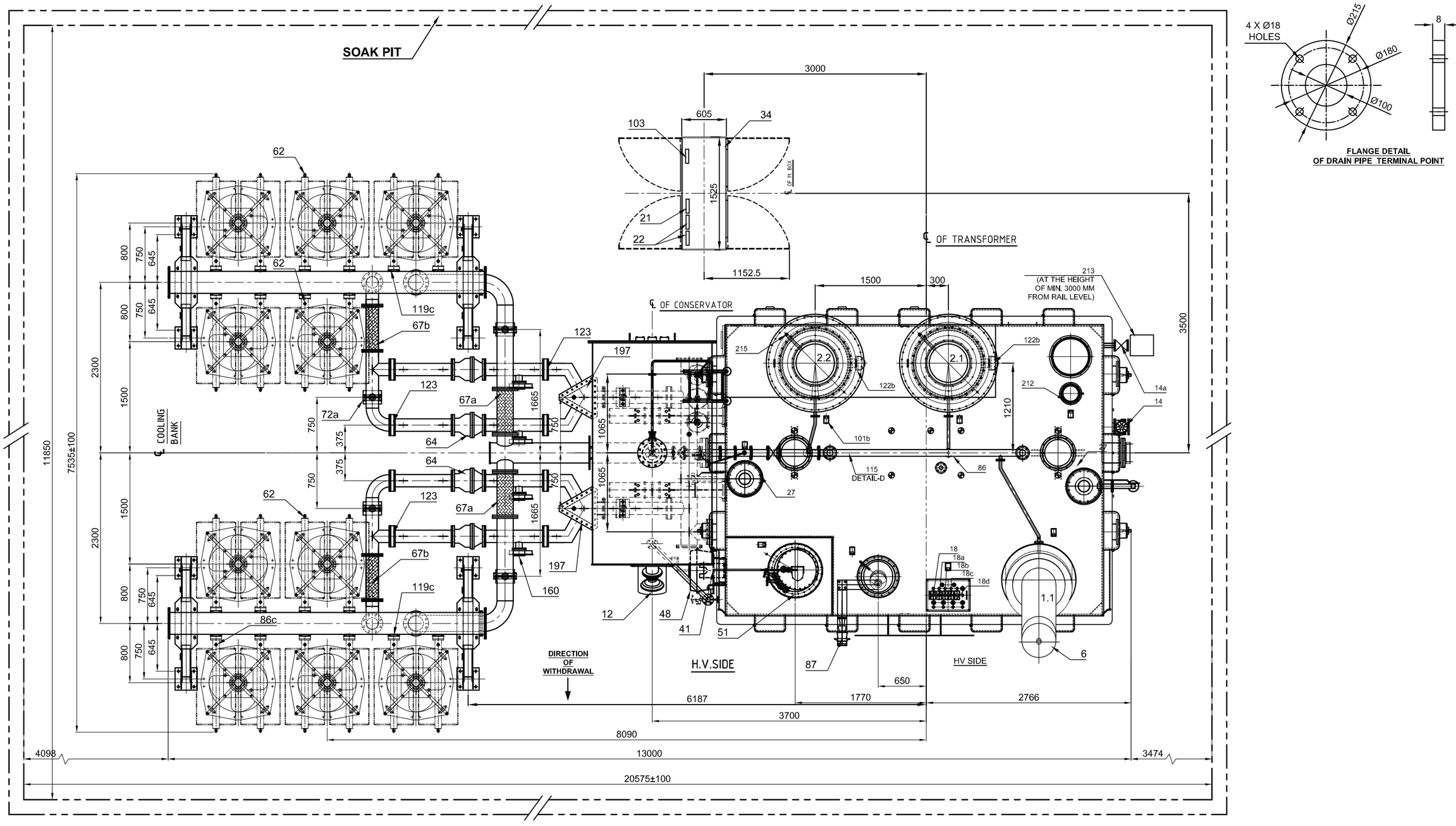
(ALL DIMENSIONS ARE IN mm)

REF.WO.NO. 63003-P-517-01
REF.DRG.NO. 3 469 00 01468

SIGN.DATE

INVENTORY NO.

DRG. NO. 3 469 00 02077



FLANGE DETAIL OF DRAIN PIPE TERMINAL POINT

NOTE: 1. COMPLETE PIPING TILL BURNT OIL PIT SHALL BE SUPPLIED BY BHEL, BHOPAL.
2. THE ONLINE DGA SHALL BE MOUNTED ON THE VALVE (ITEM NO.-14a) AND ALSO SUPPORTED BY THE SUPPORT STRUCTURE PROVIDED ON THE TANK WALL.
3. ORIENTATION OF COOLER CONTROL CABINET (CCC) TO SUIT THE SITE.

REV	DATE	ALT.				REV	DATE	ALT.				REV	DATE	ALT.				REV	DATE	ALT.			
		CKD.						CKD.						CKD.				01	14.11.19	CKD.	LK	RAKESH	
		APPD.						APPD.						APPD.						APPD.	LK/SS	LK	
ZONE						ZONE						ZONE						ZONE	DRAWING REVISED INLINE WITH CUSTOMER COMMENTS.				

TYPE OF PRODUCT	4 X 275 MVA, 21/420/√3 KV, 1-PH, ONAN/ONAF/OFAF, GENERATOR TRANSFORMER		
PROJECT	1 X 660 MW BHUSAWAL UNIT-6		
OWNER	MSPGCL		
OWNER'S CONSULTANT	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS VASHI, NAVI MUMBAI		
BHEL DRAWING/DOCUMENT NO	BP-DG-415-301-0001		
ADDITIONAL INFORMATION	W.O.- 68001-A-512-01	भारत हेवी इलेक्टिकल्स लिमिटेड भोपाल BHARAT HEAVY ELECTRICALS LTD. BHOPAL	
	STATUS OF DRAWING "PR"		
	DISTRIBUTION OF PRINTS	DEPT / CODE / WEIGHT(kg) / SCALE	
	TRE-1, TRM-3	TRE / 406 / ----- / COMP.SCALE-1:1	
PO. NO.	DG/BSL U-6/2011/T-1/BTG+BOP EPC CONTRACT/SUPPLY/0054 DATED: 07/01/2018	TITLE/- OUTLINE GENERAL ARRANGEMENT (PLAN VIEW)	

	NAME	SIGN	DATE
DRN.	RAKESH		28.03.19
CHD.	LK		01.04.19
APPD.	LK/SS		01.04.19

DRG. NO. 3 469 00 02077 REV. 01

SHEET 02 OF 03

Rakesh

FIRST ANGLE PROJECTION

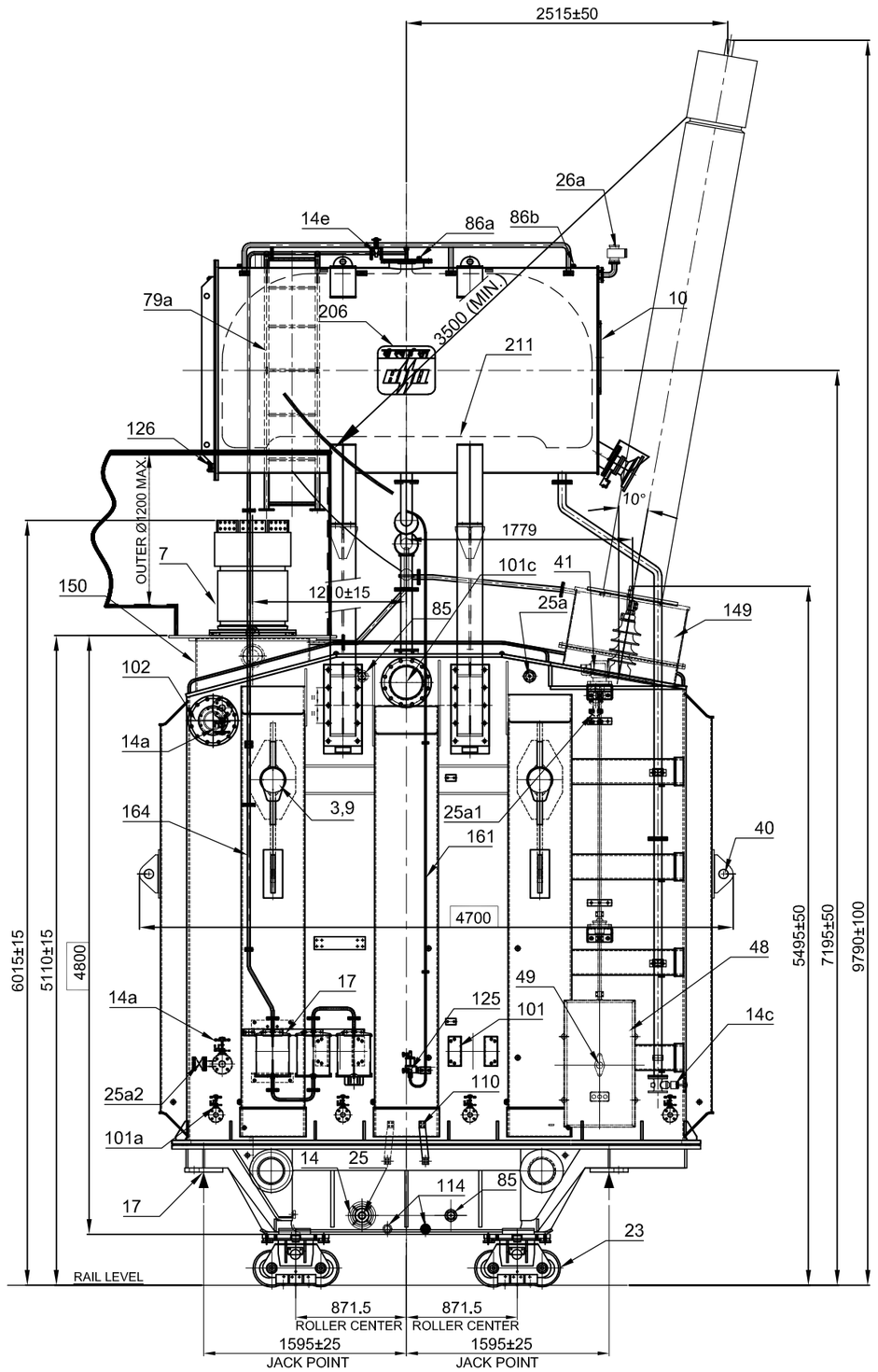
(ALL DIMENSIONS ARE IN mm)

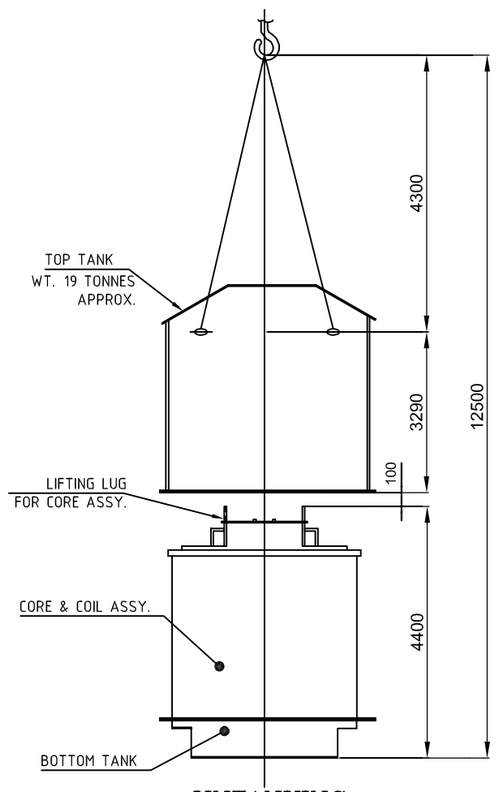
DRG. NO. 3 469 00 02077

REF.WO.NO. 63003-P-517-01
REF.DRG.NO. 3 469 00 01468

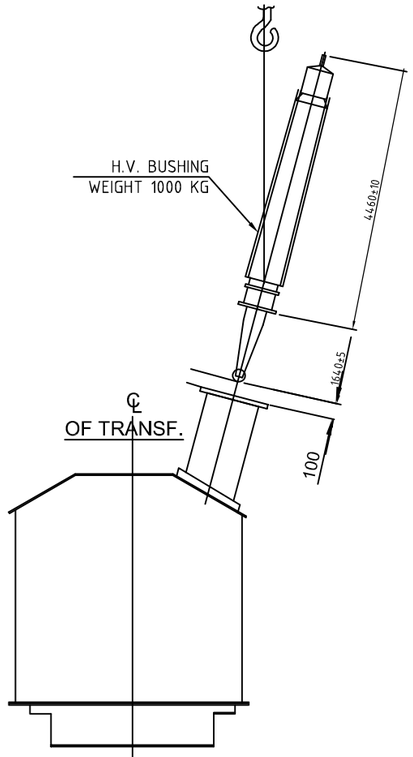
SIGN.DATE

INVENTORY NO.

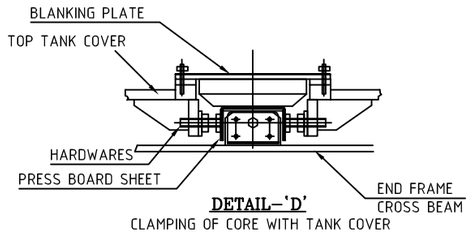




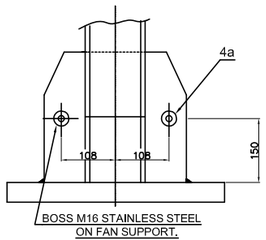
UNTANKING



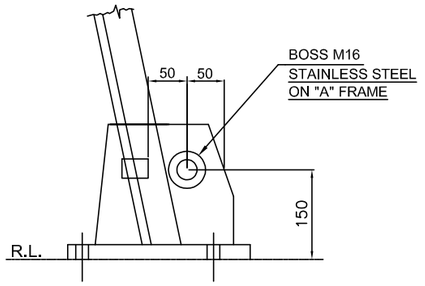
DISCONNECTION–HV BUSHING



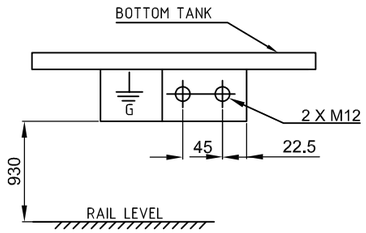
DETAIL–'D'
CLAMPING OF CORE WITH TANK COVER



DETAIL – B



DETAIL – "C"



DETAIL–A
EARTHING TERMINAL PLATE

NOTE:-

1. FOR NOTES, REFERENCE DRAWINGS, DETAILS OF WEIGHT & OIL QUANTITES ANDPART LIST, REFER DRG. NO. 34520001016.

REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.	RAKESH	
		CKD.					CKD.					CKD.			01	14.11.19	CKD.	LK	
		APPD.					APPD.					APPD.					APPD.	LK/SS	
ZONE					ZONE					ZONE					ZONE	DRAWING REVISED INLINE WITH CUSTOMER COMMENTS.			

TYPE OF PRODUCT	4 X 275 MVA, 21/420/√3 KV, 1-PH, ONAN/ONAF/OFAF, GENERATOR TRANSFORMER		
PROJECT	1 X 660 MW BHUSAWAL UNIT-6		
OWNER	MSPGCL		
OWNER'S CONSULTANT	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS VASHI, NAVI MUMBAI		
BHEL DRAWING/DOCUMENT NO	BP-DG-415-301-0001		
ADDITIONAL INFORMATION	W.O.- 68001-A-512-01	भारत हेवी इलेक्टिकल्स लिमिटेड भोपाल BHARAT HEAVY ELECTRICALS LTD. BHOPAL	
	STATUS OF DRAWING "PR"		
	DISTRIBUTION OF PRINTS	DEPT / CODE / WEIGHT(kg) / SCALE	
	TRE-1, TRM-3	TRE / 406 / ----- / COMP.SCALE-1:1	
PO. NO.	DG/BSL U-6/2011/T-1/BTG+BOP EPC CONTRACT/SUPPLY/0054 DATED: 07/01/2018	TITLE/- OUTLINE GENERAL ARRANGEMENT (END VIEW)	

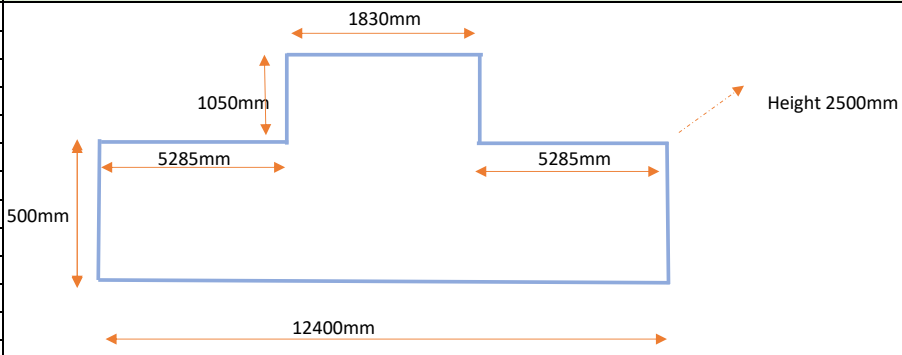
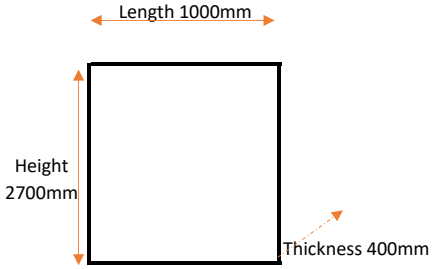
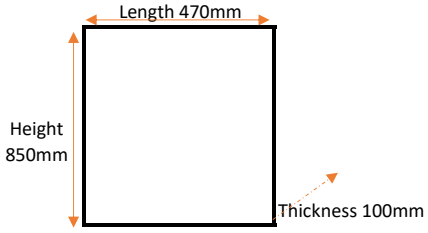
	NAME	SIGN	DATE
DRN.	RAKESH		28.03.19
CHD.	LK		01.04.19
APPD.	LK/SS		01.04.19

DRG. NO 3 469 00 02077 REV. 01

SHEET 03 OF 03

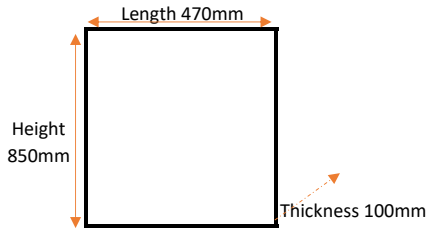
Rakesh

Removal of Materials in Old Raw Water Pump House

Sl. No.	Equipment	Quantity	Dimentions
			
1	MCC PANEL	1 SET	
2	CONTROL PANEL	1 No.	
3	LDB WALL MOUNTED	1 No.	

DRG No. : BHEL-WR-REM-01

4	**JB FOR LIGHTING WALL MOUNTED**	1 No.			
5	**PERFORATED CABLE TRAYS**				
	600W	Lumpsum			
	150W	Lumpsum			
	350W	Lumpsum			
6	**LADDER TYPE CABLE TRAYS**				
	600W	Lumpsum			
7	**POWER CABLES**				
	1Cx230sqmm	Lumpsum			
	3Cx120sqmm	Lumpsum			
	3Cx6sqmm	Lumpsum			
	4Cx1.5/2.5sqmm	Lumpsum			
	4Cx16sqmm	Lumpsum			
8	**CONTROL CABLES**				
	VARIOUS SIZES	Lumpsum			
9	**STRUCTURAL STEEL**	Lumpsum			
10	**GI CONDUTE 3/4"**	Lumpsum			
11	**TUBE LIGHT FITTING**	Lumpsum			



DRG No. : BHEL-WR-REM-01

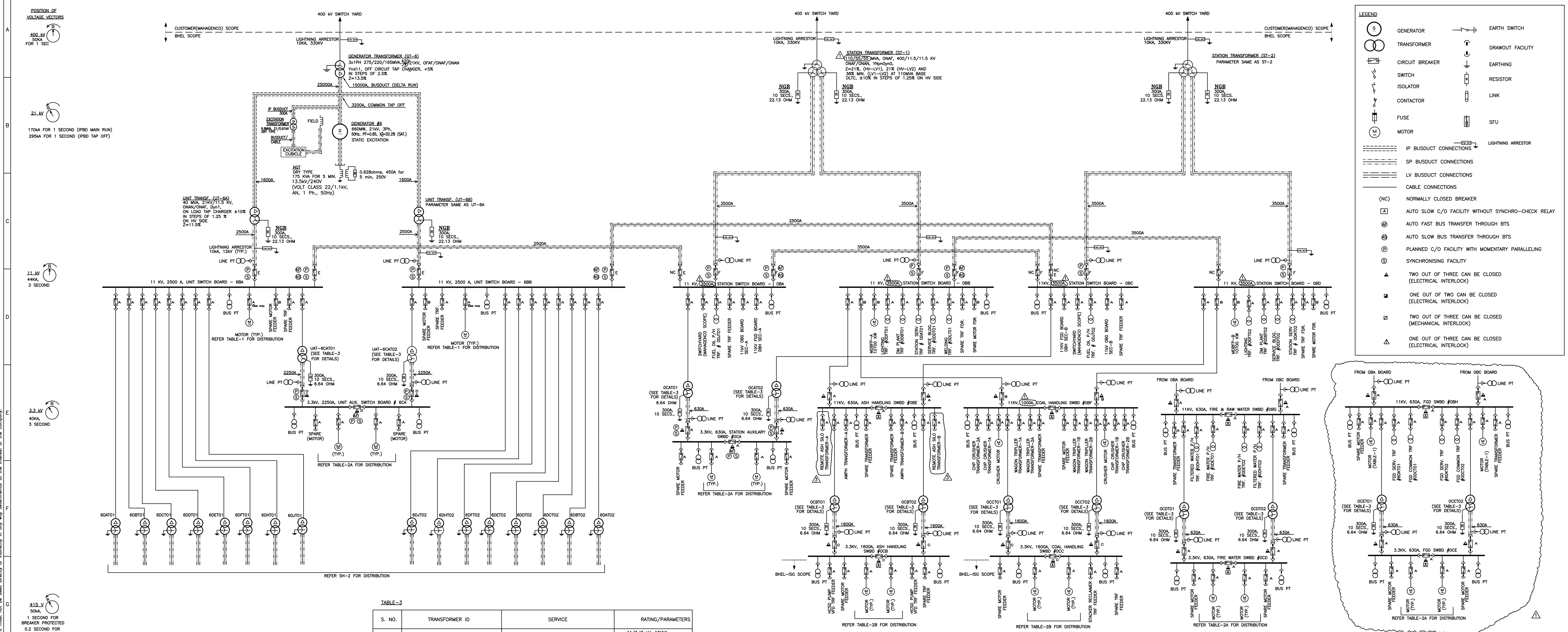


TABLE-1
11KV MOTORS (1000KW & ABOVE)

S.NO.	DRIVE	QUANTITY 6BA	6BB	0BB	0BD	0BH-A	0BH-B	0BF	RATING
1.	MDBFP	–	–	1	1				10000 △2
2.	ID FAN	1	1						10400 △1
3.	PA FAN	1	1						3600
4.	CW PUMP	1	1						3200 △2
5.	FD FAN	1	1						1650
6.	CEP	1	2						1200 △2
7.	RECIRCULATION PUMPS					2	2		1180 △2
△1 8.	CRUSHER MTR							2	1250

△1 TABLE-2A
3.3KV UNIT/STN/FGD/FIRE WATER SWITCHGEAR (3.3KV MOTORS) (BELOW 1000KW)

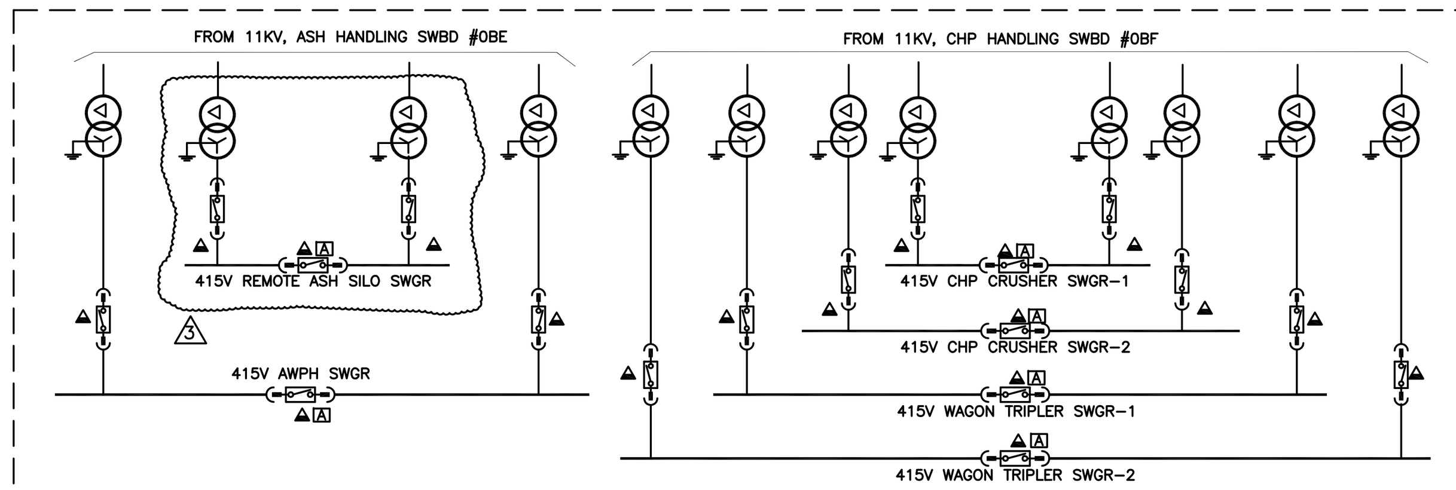
S.NO.	DRIVE	QUANTITY 6CA-A	6CA-B	0CA-A	0CA-B	0CD-A	0CD-B	0CE-A	0CE-B	RATINGS (KW)
1.	ACW PUMP	1	1							620
2.	BCW PUMP	1	–							830 △2
3.	BOILER FILL PUMP	1	1							180
4.	MILL MOTOR	4	4							807
5.	IA COMPRESSOR			2	1					390
6.	SA COMPRESSOR			1	2					390
7.	HYDRANT PUMP					1	1			230
8.	SPRAY PUMP					1	–			230
9.	OXIDATION BLOWER							1	1	710 △2
10.	WET BALL MILL							1	1	425 △2
11.	VACCUUM PUMP							1	1	160 △2

△1 TABLE-2B
3.3KV AHP/CHP SWITCHGEAR (3.3KV MOTORS) (BELOW 1000KW)

S.NO.	DRIVE	QUANTITY 0CB-A	0CB-B	0CC-A	0CC-B	RATINGS (KW)
1.	CONVEYING AIR COMP.	2	1			500
2.	TRANSPORT AIR COMP.	1	2			600
3.	HP WATER PUMP BA	1	1			350
4.	HP WATER PUMP FA	1	1			450
5.	SLURRY DISPOSAL PUMP	5	5			250
6.	BCN-2			1	1	360
7.	BCN-3			1	1	225 △3
8.	BCN-4			1	1	360
9.	BCN-5			1	1	360
10.	BCN-6			1	1	160
11.	BCN-7			1	1	160
12.	BCN-8			1	–	225

TABLE-3

S. NO.	TRANSFORMER ID	SERVICE	RATING/PARAMETERS
1	6CAT01, 6CAT02	UNIT AUX. TRANSFORMER	11/3.45 kV, 10MVA ONAN, Dyn11, Z=9%, △3 OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
2	0CAT01, 0CAT02 0CET01, 0CET02	STN. AUX. TRANSFORMER FGD AUX. TRANSFORMER △2	11/3.45 kV, 2.0MVA ONAN, Dyn11, Z=6% OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
3	0CBT01, 0CBT02	AHP TRANSFORMER	11/3.45 kV, 7.5MVA △2 ONAN, Dyn11, Z=8% OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
4	0CCT01, 0CCT02	CHP TRANSFORMER	11/3.45 kV, 6.3MVA ONAN, Dyn11, Z=8% OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
5	0CDT01, 0CDT02	FIRE WATER TRANSFORMER	11/3.45 kV, 1.0MVA ONAN, Dyn11, Z=6% OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
6	0DAT01, 0DAT02 6DKT01, 6DKT02	STN. SERVICE TRANSFORMER △1 FGD SERVICE TRANSFORMER	11kV/433 V, 2500kVA AN, Dyn11, Z=10 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
7	6DAT01, 6DAT02	TURBINE SERVICE TRANSFORMER	11kV/433 V, 2000kVA AN, Dyn11, Z=10 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
8	6DBT01, 6DBT02	BOILER SERVICE TRANSFORMER	11kV/433 V, 2500kVA AN, Dyn11, Z=10 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
9	6DCT01, 6DDT01, 6DET01, 6DFT01, 6DHT01, 6DJT01 6DCT02, 6DDT02, 6DET02, 6DFT02, 6DHT02, 6DJT02	ESP SERVICE TRANSFORMER	11kV/433 V, 2000kVA AN, Dyn11, Z=10 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
10	0DDT01, 0DDT02	SERVICE BUILDING TRANSFORMER	11kV/433 V, 1000kVA AN, Dyn11, Z=6 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
11	0DET01, 0DET02 0DCT01, 0DCT02	FIRE WATER P/H TRANSFORMER △1 FGD COMMON TRANSFORMER	11kV/433 V, 1600kVA AN, Dyn11, Z=8 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
12	0DFT01, 0DFT02	LIGHTING TRANSFORMER	11kV/433 V, 1000kVA AN, Dyn11, Z=6 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
13	0DBT01, 0DBT02	DM PLANT TRANSFORMER	11kV/433 V, 2000kVA AN, Dyn11, Z=10 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
14	0DHT01, 0DHT02	FILTERED WATER P/H TRANSFORMER	11kV/433 V, 2000kVA AN, Dyn11, Z=10 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
15	0DJT01, 0DJT02	FUEL OIL UNLOADING P/H TRANSFORMER	11kV/433 V, 630kVA AN, Dyn11, Z=6 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
16	0DKT01, 0DKT02	RAW WATER INTAKE P/H TRANSFORMER	6.6kV/433 V, 630kVA ONAN, Dyn11, Z=6%, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%
17	0DLT01	WELDING TRANSFORMER	11kV/433 V, 630kVA AN, Dyn11, Z=6 %, OFF CKT. TAP CHANGER ±5% IN STEPS OF 2.5%



LIST OF AHP & CHP LT SERVICE TRANSFORMERS (ISG SCOPE) △2

S NO.	TRANSFORMER ID	TENTATIVE RATING
1.	AWPH TRANSFORMER	2500KVA
2.	REMOTE ASH SILO TRANSFORMER	750KVA △3
3.	HCSD PUMP VFD TRANSFORMER	950kVA
4.	CHP CRUSHER TRANSFORMER -1/2	2500KVA/2000KVA △3
5.	WAGON TRIPPLER TRANSFORMER- 1/2	2000KVA
6.	STACKER RECLAIMER TRANSFORMER	800kVA

BHEL-ISG SCOPE

TABLE-4A

S. NO.	BOARD DESCRIPTION	LOCATION
1.	11kV UNIT SWITCHBOARD # 6BA/6BB	MV SWITCHGEAR ROOM 3.5MTR
2.	11kV STATION SWITCHBOARD # 0BA/0BB/0BC/0BD	MV SWITCHGEAR ROOM 3.5MTR
3.	3.3kV UNIT AUX. SWITCHBOARD # 6CA	MV SWITCHGEAR ROOM 3.5MTR
4.	3.3kV STATION AUX. SWITCHBOARD # 0CA	COMPRESSOR HOUSE BUILDING
5.	11kV ASH HANDLING SWITCHBOARD # 0BE 3.3kV ASH HANDLING SWITCHBOARD # 0CB	AWPH MCC BUILDING (AHP AREA)
6.	11kV COAL HANDLING SWITCHBOARD # 0BF 3.3kV COAL HANDLING SWITCHBOARD # 0CC	NEAR CRUSHER HOUSE (CHP AREA)
7.	11kV FIRE & RAW WATER SWITCHBOARD # 0BG 3.3kV FIRE WATER SWITCHBOARD # 0CD	FIRE CUM RAW WATER PUMP HOUSE
8.	△1 11kV FGD SWITCHBOARD # 0BH 3.3kV FGD SWITCHBOARD # 0CE	FGD CONTROL ROOM BUILDING

TABLE-5

S.NO.	DESIGNATION	RATING (A)
1.	A	630
2.	B	1000 △1
3.	C	1600
4.	D	2250
5.	E	2500
6.	F	3500

NOTES

1 BUS DUCTS ARE OF FOLLOWING TYPE :

GENERATOR SYSTEM	(21 kV)	ISOLATED PHASE BUSDUCT
MEDIUM VOLTAGE SYSTEM	(11 kV & 3.3 kV)	SEGREGATED PHASE BUSDUCT
LOW VOLTAGE SYSTEM	(415 V)	NON-SEGREGATED PHASE BUSDUCT

2 11KV AND 3.3KV SYSTEM ARE 3Ph, 3W, 50 Hz.; 415V SYSTEM IS 3Ph, 4W, 50 Hz EXCEPT EMERGENCY BOARD WHICH IS 3Ph, 3W, 50 Hz.

3 2 X 30% , MOTOR DRIVEN BFP IS PROVIDED FOR STARTING AND STANDBY OPERATION.

4 CHANGEOVER FACILITY

(A) 11kV SYSTEM UNIT & STATION BUSES EMPLOY FAST BUS TRANSFER SCHEME FOR RESTORATION OF SUPPLY FROM THE STATION BUS IN CASE OF SUPPLY FAILURE FROM RESPECTIVE UNIT/STATION TRANSFORMER. MANUAL LIVE CHANGEOVER WITH CHECK SYNCHRONISATION AND SLOW AUTO CHANGEOVER FACILITY AS A BACK-UP TO FAST AUTO CHANGEOVER IS ALSO PROVIDED FOR THESE BUSES.

△1 (B) 3.3kV BUS(6CA & 0CA) EMPLOY FAST BUS TRANSFER SCHEME IN B/C. MANUAL LIVE CHANGEOVER WITH CHECK SYNC. BETWEEN I/C & B/C, AS WELL AS AUTOMATIC SLOW CHANGEOVER IS ALSO PROVIDED. ALL OTHER 3.3kV SYSTEM BUSES ARE PROVIDED WITH MANUAL LIVE CHANGEOVER WITH CHECK SYNCHRONISATION BETWEEN I/C & B/C, AS WELL AS AUTOMATIC SLOW CHANGEOVER IN B/C THROUGH DCS.

(C) ALL 415V SYSTEM BUS INCOMERS FED FROM TRANSFORMERS ARE PROVIDED WITH MANUAL DEAD BUS CLOSING AND MANUAL LIVE CHANGEOVER (BETWEEN I/C-1, B/C & I/C-2) FACILITY THROUGH DCS. BUS-COUPLERS ARE PROVIDED WITH AUTO-CLOSING FACILITY.

5 INTERLOCKING

THE 11kV, 3.3KV & 415V SWITCHBOARDS/MCC ARE PROVIDED WITH POSITIVE ELECTRICAL INTERLOCKING TO ENSURE THAT DIFFERENT POWER SUPPLY SOURCES ARE NOT OPERATED IN PARALLEL FOR PROLONGED DURATION TO AVOID FAULT LEVEL EXCEEDING THE DESIGNATED SWITCHBOARD CAPABILITY, EXCEPT DURING MOMENTARY PARALLELING IN CASE OF ON LOAD LIVE CHANGEOVER, WHERE PROVIDED.

6 MOTORS RATED 1000kW & ABOVE ARE CONNECTED TO 11 kV SYSTEM, MOTORS RATED ABOVE 160kW AND BELOW 1000kW ARE CONNECTED TO 3.3kV SYSTEM AND MOTORS RATED UPTO 160kW ARE CONNECTED TO 415 V SYSTEM. MOTORS RATINGS ARE TENTATIVE AND SHALL BE AS PER ACTUAL REQUIREMENTS.

7 LT SUPPLY FEEDERS RATED 630A & ABOVE ARE ACB CONTROLLED AND BELOW 630A SHALL BE SFU CONTROLLED. LT MOTORS RATED 90KW & ABOVE SHALL BE ACB CONTROLLED.

8 THE RATINGS OF MV CIRCUIT BREAKERS ARE DENOTED BY AN ALPHABET ON THE RIGHT HAND SIDE OF THE BREAKERS AND THE CORRESPONDING AMPERE RATING IS INDICATED IN TABLE-5.

9 LT DISTRIBUTION SHOWN IS PRELIMINARY. THE FINAL RATING AND QUANTITY OF LV SERVICE TRANSFORMERS/SWITCHBOARDS/MCCs/DBs SHALL BE AS PER ACTUAL REQUIREMENTS.

10 EQUIPMENT RATINGS INDICATED ARE AT 50°C AMBIENT TEMPERATURE.

11 FOR SIZING CALCULATIONS OF EQUIPMENTS, REFER DOCUMENT:- DESIGN CALCULATIONS FOR GENERATOR & MV SYSTEM (PE-DC-415-565-E002)

12 DETAILED LT DISTRIBUTION ARRANGEMENT FOR ESP (DOWNSTREAM OF LTMSBs) SHALL BE AS PER BHEL-RANIPET DRGS.

△1 13 CONNECTION FROM EXCITATION TRF TO EXCITATION CUBICLE & FIELD BKR CAN BE THROUGH BUSDUCT/CABLE BASED ON LAYOUT FEASIBILITY.

△2 14 DETAILED LT DISTRIBUTION ARRANGEMENT FOR AHP AND CHP SYSTEM SHALL BE AS PER BHEL-ISG DRGS.

15 BHEL-EDN DOCUMENTATION SHALL BE REFERRED FOR 24V DC AND UPS SYSTEM DISTRIBUTION ARRANGEMENT.

REV.	DATE	ALTD	CHD	APPD	DESCRIPTION
03	24.10.19	MC	KK/MS	DR	220V MAIN PLANT DCDB- ACB FOR B/C IN LINE WITH CUSTOMER TENDER SLD; 415V REMOTE ASH SILO SWGR ADDED
02	07.06.19	MC	KK/MS	DR	REVISED AS PER CUSTOMER COMMENTS
01	16.02.19	MC	KK/MS	DR	REVISED AS PER CUSTOMER COMMENTS

JOB NO. 415
STATUS CONTRACT
DISTRIBUTION

MAHARASHTRA STATE POWER GENERATION CO. LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS. VASHI, NAVI MUMBAI

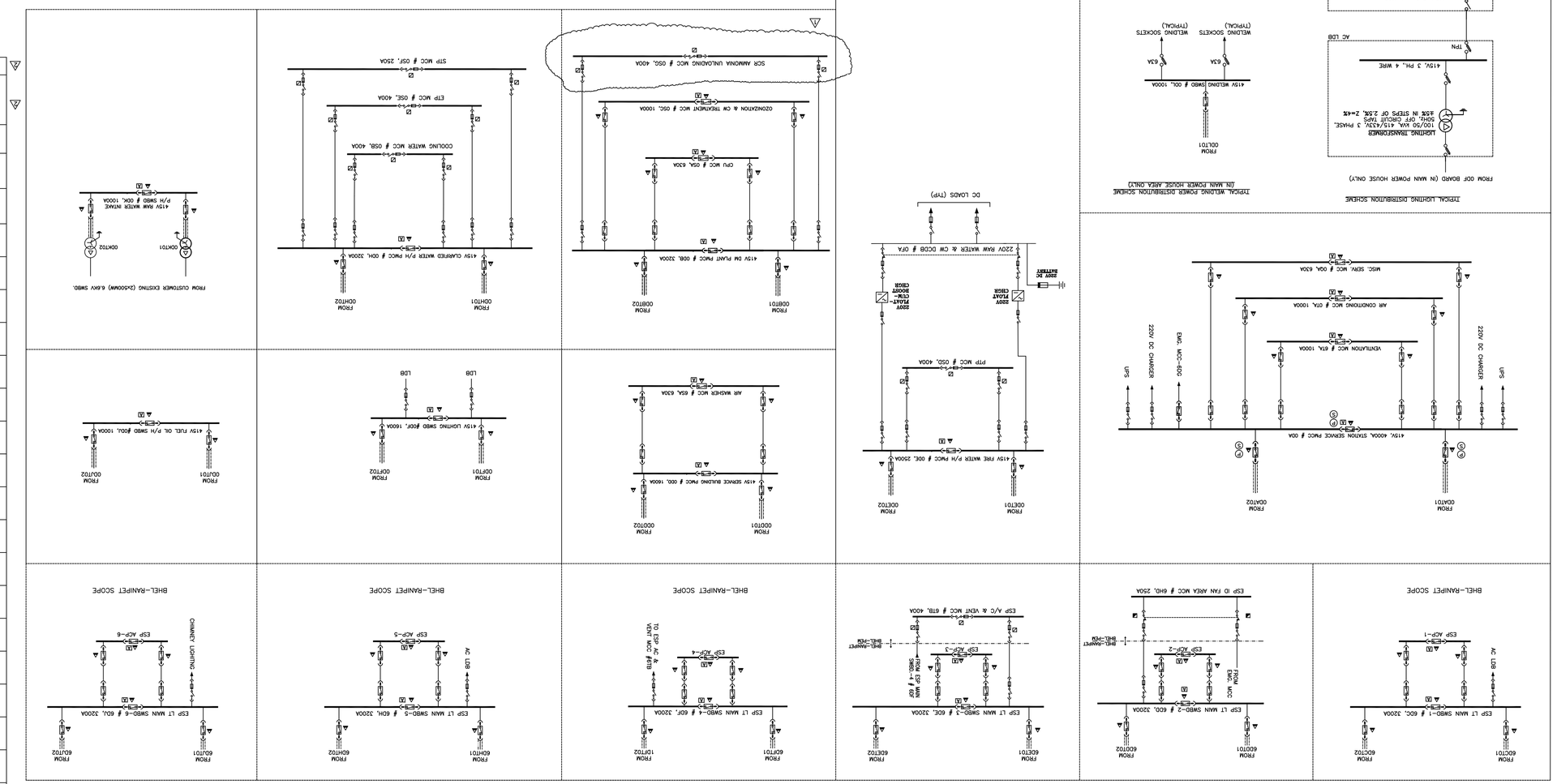
BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE E

	NAME	SIGN	DATE
DRN	MC		26.04.18
DESN	MC		26.04.18
CHD	KK/MS		26.04.18
APPD	RG		26.04.18

TITLE
ELECTRICAL SINGLE LINE DIAGRAM FOR AUXILIARY POWER DISTRIBUTION

DEPT. SIGN SCALE SCALE
DRAWING NO. PE-DG-415-565-E001
SHEET 1 OF 2 REV. 03
SIZE-A1



FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING No. PE-DG-415-565-E001

CUSTOMER'S DRAWING No.

TABLE-4B

S. NO.	BOARD DESCRIPTION	LOCATION
1.	415V TURBINE SERVICE PMCC # 6DA	LV SWITCHGEAR ROOM 12.0MTR
2.	415V STATION SERVICE PMCC # 0DA	LV SWITCHGEAR ROOM 12.0MTR
3.	415V TURBINE VALVE MCC # 6KB	LV SWITCHGEAR ROOM 12.0MTR
4.	415V UNIT SERVICE ACDB # 6QA	SWITCHGEAR ROOM 3.5MTR
5.	415V EMERGENCY MCC # 6DG	LV SWITCHGEAR ROOM 12.0MTR
6.	220V MAIN DCDB # 6FA	LV SWITCHGEAR ROOM 12.0MTR
7.	415V MISC. SERVICE MCC # 0QA	SWITCHGEAR ROOM 3.5MTR
8.	415V LIGHTING SWBD # 0DF	LV SWITCHGEAR ROOM 12.0MTR
9.	415V BOILER SERVICE PMCC # 6DB	BOILER MCC ROOM 27.5MTR
10.	415V BOILER VALVE & DAMPER MCC # 6HB	BOILER MCC ROOM 27.5MTR
11.	415V BOILER SERVICE ACDB # 6HC	BOILER MCC ROOM 27.5MTR
12.	415V SOOT BLOWER MCC	BOILER MCC ROOM 27.5MTR
13.	415V VENTILATION MCC # 6TA	BOILER MCC ROOM 27.5MTR
14.	415V WELDING SWBD # 0DL	BOILER MCC ROOM 27.5MTR
15.	415V DG MAIN SWBD # 0DG	DG BUILDING
16.	415V AIR CONDITIONING MCC # 0TA	SWITCHGEAR ROOM 3.5MTR
17.	415V AIR WASHER MCC # 6SA	SWITCHGEAR ROOM 3.5MTR
18.	415V SERVICE BLDG PMCC # 0DD	LV SWITCHGEAR ROOM 12.0MTR
19.	415V ESP LT MAIN SWBD # 6DC/6DD/6DE/6DF/6DH/6DJ	ESP CONTROL ROOM
20.	415V ESP ACP-1/2/3/4/5/6	ESP CONTROL ROOM
21.	415V ESP AC & VENT MCC # 6TB 415V ESP ID FAN AREA MCC # 6HD	ESP CONTROL ROOM
22.	415V FIRE WATER P/H PMCC # 0DE 220V RAW WATER & CW DCDB # 0FA	RAW WATER P/H
23.	415V DM PLANT PMCC # 0DB	DM PLANT
24.	415V CLARIFIED WATER P/H PMCC # 0DH	CLARIFIED WATER P/H
25.	415V FUEL OIL SWBD # 0DJ	NEAR FUEL OIL PRESSURIZING P/H
26.	415V RAW WATER INTAKE P/H SWBD # 0DK	RAW WATER INTAKE P/H
27.	415V CPU MCC # 0SA	△3 DM PLANT
28.	415V COOLING WATER MCC # 0SB	CW PUMP HOUSE
29.	415V OZONIZATION & CW TREATMENT MCC #0SC	OZONIZATION & CW TREATMENT AREA
30.	415V PTP MCC # 0SD	PT PLANT
31.	415V ETP MCC # 0SE	ETP BUILDING
32.	415V STP MCC # 0SF	△3 ETP BUILDING
33.	415V SCR AMMONIA UNLOADING MCC # 0SG	NEAR AMMONIA UNLOADING & STORAGE AREA (FOR SCR)
△2 34.	415V FGD PCC # 6DK 415V FGD MCC # 6QB 415V GYPSUM MCC # 6QC 415V LIMESTONE MCC # 6QD 415V, FGD EMERGENCY MCC # 6DL 415V WATER SYSTEM/AC VENTILATION MCC # 0TB	FGD CONTROL ROOM BUILDING
△2 35.	415V LHP/GHP PMCC # 0DC	LHP/GHP AREA

MAHARASHTRA STATE POWER GENERATION CO. LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS. VASHI, NAVI MUMBAI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

REV.	DATE	ALTD	CHD	APPD	DESCRIPTION
03	24.10.19	MC	KK/MS	DR	220V MAIN PLANT DCDB- ACB FOR B/C IN LINE WITH CUSTOMER TENDER SLD 415V REMOTE ASH SILO SWGR ADDED
02	07.06.19	MC	KK/MS	DR	REVISED AS PER CUSTOMER COMMENTS
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JOB NO. 415
STATUS CONTRACT
DISTRIBUTION

DEPT CODE E

	NAME	SIGN	DATE
DRN	MC		26.04.18
DESN	MC		26.04.18
CHD	KK/MS		26.04.18
APPD	RG		26.04.18

TITLE
ELECTRICAL SINGLE LINE DIAGRAM
FOR AUXILIARY POWER DISTRIBUTION

DEPT. SCALE SCALE
SIGN

DRAWING NO. PE-DG-415-565-E001
SHEET 2 OF 2 REV. 03

SIZE-A1

COMPUTER FILE NAME:

DEVELOPMENT CONSULTANT PVT. LTD.

Reviewed only for general conformance with contract drawings and specifications;
Contractor to be responsible for any error and for fulfilment of details requirements of contract documents.

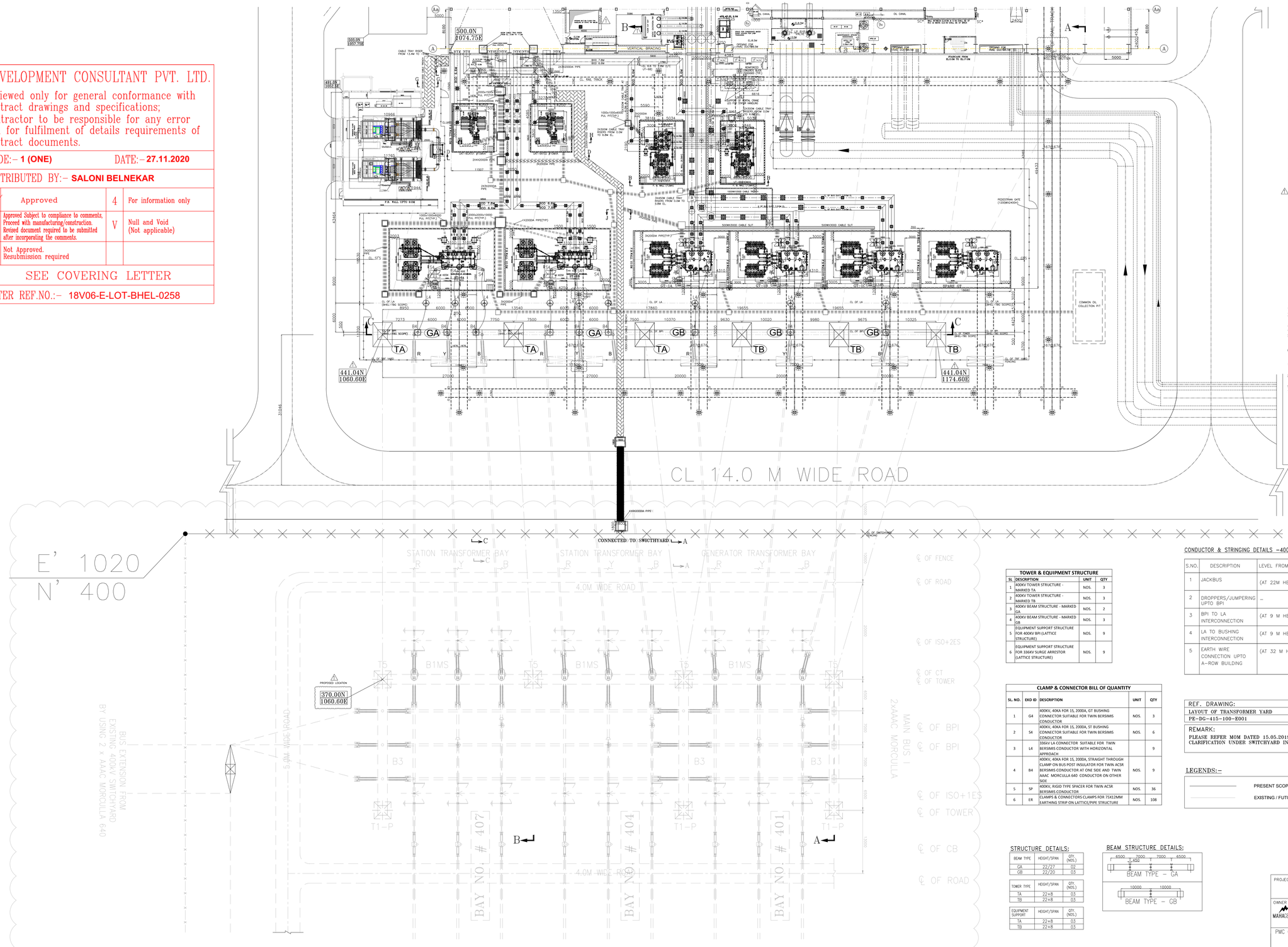
CODE:– **1 (ONE)** DATE:– **27.11.2020**

DISTRIBUTED BY:– **SALONI BELNEKAR**

1	Approved	4	For information only
2	Approved Subject to compliance to comments, Proceed with manufacturing/construction. Revised document required to be submitted after incorporating the comments.	V	Null and Void (Not applicable)
3	Not Approved. Resubmission required		

SEE COVERING LETTER

LETTER REF.NO.:– **18V06-E-LOT-BHEL-0258**



SYSTEM PARAMETERS:

S.NO.	DESCRIPTION	400KV
01	SYSTEM OPERATING VOLTAGE	400kV
02	MAXIMUM OPERATING VOLTAGE OF THE SYSTEM (rms)	420kV
03	RATED FREQUENCY	50Hz
04	FULL WAVE IMPULSE WITHSTAND VOLTAGE (1.2/50 MICROSES.)	1550kVp
05	SWITCHING IMPULSE WITHSTAND VOLTAGE (250/2500 MICRO SEC.) DRY AND WRT	1050kVp
06	ONE MINUTE POWER FREQUENCY DRY WITHSTAND VOLTAGE (rms)	630kV
07	BASIC INSULATION LEVELS	1425KV
08	ONE MINUTE POWER FREQUENCY DRY AND WET WITHSTAND VOLTAGE (rms)	--
09	CORONA EXTINCTION VOLTAGE	320kV
10	MAX. RADIO INTERFERENCE VOLTAGE FOR FREQUENCY BETWEEN 0.5 MHz AND 2 MHz	1000µV AT 266kV rms
11	MINIMUM CREEPAGE DISTANCE–FOR LA & BPI	31 mm / kV
12	SYSTEM FAULT LEVEL	50kA FOR 3 SEC
13	MINIMUM CLEARANCE PHASE TO PHASE	4200mm
14	MINIMUM CLEARANCE PHASE TO EARTH	3500mm
15	SECTIONAL CLEARANCES OTHER THAN INSULATOR STRING	6500mm
16	GROUND CLEARANCES OTHER THAN INSULATOR STRING	8000mm

BILL OF QUANTITIES–400KV (50kA / 3 Sec):

S.NO.	DESCRIPTION	SYMBOL	QTY.
01	336kV, 1–PH, SURGE ARRESTER		9
02	400kV, 1–PH, 8KN, BUS POST INSULATOR		9

NOTES : –

1. THIS DRAWING IS MEANT FOR SWITCHYARD INTERCONNECTION.
2. THIS DRAWING IS TO BE READ FOR INTERCONNECTING GANTRY, LA, BPI, CONDUCTOR & SHIELD WIRE CONNECTION.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
4. DESIGN SHORT CIRCUIT FORCE FOR TOWER & BEAM STRUCTURE = 5444.2 KG
5. TOP OF FOUNDATION FOR LA's & BPI SHALL BE AT 0.0M AND THEIR SUPPORTING STRUCTURE SHALL BE REMOVABLE TYPE TO FACILITATE WITHDRAWAL OF TRANSFORMERS WHEREVER REQUIRED.
6. THIS DRAWING IS TO BE READ FOR SWITCHYARD INTERCONNECTION WORKS AND LA, BPI & GANTRY TOWER POSITIONS. THEIR RELATIVE POSITION IS SHOWN HERE W.R.T. CENTER LINES OF GT & ST.
7. PLEASE REFER PE–DG–415–100–E001 (LAYOUT OF TRANSFORMER YARD) FOR OTHER DETAILS
8. PLEASE REFER "400 kV SWITCHYARD PLAN & SECTIONAL ELEVATION LAYOUT" FOR 400KV SWITCHYARD DETAILS.
9. SWITCHYARD PLOT PLAN DRAWING NUMBER D&E–S2/252.769
10. PLEASE REFER PE–DG–415–100–E001 FOR CONCRETE ENCASED DUCT BANK FOR ELECTRICAL ROAD CROSSING OF CABLE FROM SWITCHYARD.

CONDUCTOR & STRINGING DETAILS –400kV

S.NO.	DESCRIPTION	LEVEL FROM PLINTH	SUB–CONDUCTOR	REMARK / SCOPE
1	JACKBUS	(AT 22M HEIGHT)	TWIN AAAC MORCULLA 640 CONDUCTOR WITH 450MM SUB–CONDUCTOR SPACING	MAHAGENCO / MAHATRANSCO SCOPE ##
2	DROPPERS/JUMPERING UPTO BPI	– –	TWIN AAAC MORCULLA 640 CONDUCTOR 450MM SUB–CONDUCTOR SPACING	MAHAGENCO / MAHATRANSCO SCOPE ##
3	BPI TO LA INTERCONNECTION	(AT 9 M HEIGHT)	TWIN ACSR BERSIMIS CONDUCTOR WITH 450MM SPACING	BHEL SCOPE
4	LA TO BUSHING INTERCONNECTION	(AT 9 M HEIGHT)	TWIN ACSR BERSIMIS CONDUCTOR WITH 450MM SPACING	BHEL SCOPE
5	EARTH WIRE CONNECTION UPTO A–ROW BUILDING	(AT 32 M HEIGHT)	SINGLE SHIELD WIRE	MAHAGENCO / MAHATRANSCO SCOPE ## HOOKING ARRANGEMENT TO BE PROVIDED BY BHEL.

TOWER & EQUIPMENT STRUCTURE

SL	DESCRIPTION	UNIT	QTY
1	400KV TOWER STRUCTURE - MARKED TA	NOS.	3
2	400KV TOWER STRUCTURE - MARKED TB	NOS.	3
3	400KV BEAM STRUCTURE - MARKED GA	NOS.	2
4	400KV BEAM STRUCTURE - MARKED GB	NOS.	3
5	EQUIPMENT SUPPORT STRUCTURE FOR 400KV BPI (LATTICE STRUCTURE)	NOS.	9
6	EQUIPMENT SUPPORT STRUCTURE FOR 336KV SURGE ARRESTOR (LATTICE STRUCTURE)	NOS.	9

CLAMP & CONNECTOR BILL OF QUANTITY

SL. NO.	EKD ID	DESCRIPTION	UNIT	QTY
1	G4	400KV, 40KA FOR 1S, 2000A, GT BUSHING CONNECTOR SUITABLE FOR TWIN BERSIMIS CONDUCTOR	NOS.	3
2	S4	400KV, 40KA FOR 1S, 2000A, ST BUSHING CONNECTOR SUITABLE FOR TWIN BERSIMIS CONDUCTOR	NOS.	6
3	L4	336KV LA CONNECTOR SUITABLE FOR TWIN BERSIMIS CONDUCTOR WITH HORIZONTAL APPROACH		9
4	B4	400KV, 40KA FOR 1S, 2000A, STRAIGHT THROUGH CLAMP ON BUS POST INSULATOR FOR TWIN ACSR BERSIMIS CONDUCTOR AT ONE SIDE AND TWIN AAAC MORCULLA 640 CONDUCTOR ON OTHER SIDE	NOS.	9
5	SP	400KV, RIGID TYPE SPACER FOR TWIN ACSR BERSIMIS CONDUCTOR	NOS.	36
6	ER	CLAMPS & CONNECTORS-CLAMPS FOR 75X12MM EARTHING STRIP ON LATTICE/PIPE STRUCTURE	NOS.	108

REF. DRAWING:
LAYOUT OF TRANSFORMER YARD
PE–DG–415–100–E001

REMARK:
PLEASE REFER MOM DATED 15.05.2019 FOR SCOPE CLARIFICATION UNDER SWITCHYARD INTERCONNECTION.

LEGENDS:–

PRESENT SCOPE

EXISTING / FUTURE

STRUCTURE DETAILS:

BEAM TYPE	HEIGHT/SPAN	QTY. (NOS.)
GA	22/27	02
GB	22/20	03

TOWER TYPE	HEIGHT/SPAN	QTY. (NOS.)
TA	22+8	03
TB	22+8	03

EQUIPMENT SUPPORT	HEIGHT/SPAN	QTY. (NOS.)
TA	22+8	03
TB	22+8	03

BEAM STRUCTURE DETAILS:

REV.	DATE	ALTD	CHD	APPD
01	17.11.2020	DS –SD–	JK –SD–	SKS –SD–
1)	DRAWING REVISED AS PER CUSTOMER COMMENTS			
2)	DRAWING REVISED MARKED AS ⚠			

JOB NO. 415
STATUS CONTRACT
DISTRIBUTION

PROJECT: 1 X 660MW BHUSAWAL TPS UNIT–6

OWNER: MAHAGENCO — MAHARASHTRA STATE POWER GENERATION CO.LTD.

PMC CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS VASHI, NAVI MUMBAI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
E	DRN		–SD–	09.09.2020
	DESN	DS	–SD–	09.09.2020
	CHD	JK	–SD–	09.09.2020
	APPD	SK	–SD–	09.09.2020

TITLE: LAYOUT OF SWITCHYARD INTERCONNECTION

DEPT. SCALE
SIGN

DRAWING NO. PE–DG–415–100–ETBG

SHEET 01 OF 02 REV. 01

SIZE–A0

COMPUTER FILE NAME:

Bharat Heavy Electricals Limited, Jhansi

Transformer Engineering Department

BHEL Ref : TRE / 72057N / TDS
REV 04

Technical Data sheet

Customer	:	**M/S MAHAGENCO**
Project	:	**1x660 MW BHUSAWAL U-6**
Object	:	**2 NO 110MVA, 400/11.5-11.5 KV, 3-PHASE, STATION TRANSFORMER**
BHEL Work Order	:	**72057N19800**
BHEL JHS DOC NO.	:	**TRE**

DEVELOPMENT CONSULTANT PVT. LTD.

Reviewed only for general conformance with contract drawings and specifications;
Contractor to be responsible for any error and for fulfilment of details requirements of contract documents.

CODE:– **1 (ONE)** DATE:– **03.09.2020**

DISTRIBUTED BY:– **SALONI BELNEKAR**

1	Approved	4	For information only
2	Approved Subject to compliance to comments, Proceed with manufacturing/construction. Revised document required to be submitted after incorporating the comments.	V	Null and Void (Not applicable)
3	Not Approved. Resubmission required		

SEE COVERING LETTER

LETTER REF.NO.:– 18V06-E-LOT-BHEL-0218

MAHAGENCO

Maharashtra State Power Generation Co. Ltd.

2.0	STATION TRANSFORMER	`	STATION TRANSFORMER
2.1	GENERAL		Outdoor Installation
2.1.1	Make		BHEL Jhansi
2.1.2	Type		STATION TRANSFORMER
2.1.3	Number of Winding per Phase		Three
	Number of Phase		Three
2.1.5	Number of Unit per set		02
2.1.6	Reference Standard		IS-2026, IEC-60076 &CBIP Manual
2.2	RATING		
2.2.1	Type of Cooling		ONAN/ONAF
2.2.2	Rated Output		HV / LV1 –LV2
(a)	With ONAN Cooling	MVA	88 / 44 - 44
(b)	With ONAF Cooling	MVA	110 / 55- 55
(c)	With OFAN Cooling	MVA	NA
(d)	With OFAF Cooling	MVA	NA
2.2.3	Rated Voltage		
(a)	HV	kV	400
(b)	LV1 - LV2	kV	11.5-11.5
2.2.4	Rated Current	Amps.	
(a)	HV		158.77
(b)	LV1 & LV2		2761.24
2.2.5	Rated Frequency	Hz	50
2.2.6	Connection		
(a)	HV		STAR
(b)	LV1 - LV2		STAR - STAR
2.2.7	Vector Group Reference		YNyn0yn0

2.2.8	Voltage Withstand Time		
(a)	110% of rated voltage	sec.	Continuous
(b)	125% of rated voltage	sec	60
(c)	140% of rated voltage	sec	5
(d)	150% of rated voltage	sec	2
2.2.9	Overfluxing Capability		
(a)	For Overfluxing Factor 1.1	Sec	Continuous
(b)	For Overfluxing Factor 1.25	sec	60
(c)	For Overfluxing Factor 1.4	sec	5
2.3	TEMPERATURE		
2.3.1	Reference Ambient Temperature	Deg. C	50
2.3.2	Temperature rise over reference ambient		
(a)	Of Top oil by thermometer	Deg. C	40
(b)	Of winding by resistance	Deg. C	45
2.3.3	Maximum continuous over loading capacity of the transformer without exceeding the specified winding temperature		As per IS 6600
2.4	TAPPINGS		
2.4.1	Type		ON-LOAD TAP CHANGER
2.4.2	Capacity		FULL
2.4.3	Range		+10% to –10%
2.4.4	Steps x % Variation		16 x 1.25%
2.4.5	Taps provided on HV / LV Winding		HV
2.5	INSULATION LEVEL		
2.5.1	HV	kVp /kV rms	LI-1425 SI-1050 AC-630
2.5.2	LV1& LV2	kVp / kVrms	LI-75 AC-28

2.5.3	HV Neutral	kVp / kVrms	LI-95 AC-38
2.5.4	LV1&LV2 Neutral	kVp/k Vrms	75/28
2.6	Impedances at Principal Tap at Rated Frequency and 75 Deg.C winding temperature		
2.6.1	Base MVA	MVA	110
2.6.2	Impedance HV-LV1 or LV2 i. at principal tap ii. At Max tap iii. At min. tap LV1-LV2		 24.00%±10 % TOL. 25.00%±10 % TOL 24.00% ±10% TOL. 48% ±15% Tol.
2.6.3	Reactance		11.5% between HV-(LV1+LV2)
2.6.4	Resistance at 75 Deg.C (Principal Tap) HV (Nor Tap) LV1 or LV2	In Ohms	 2.2000 approx. 0.0028 approx.
2.6.5	Zero Sequence Impedance at 75 Deg.C		20.40% Approx.
2.6.6	Capacitance of Windings		
(a)	H.V. — Earth	micro farad /ph	Shall be furnished at the time of testing
(b)	L.V. — Earth	micro farad / ph	Shall be furnished at the time of testing
(c)	H.V. - L.V.	micro farad /ph	Shall be furnished at the time of testing
2.7	Guaranteed Losses at Principal Tap, Full Load and 75De .C	kW	
2.7.1	No load losses	kW	88 KW (Max)
2.7.2	Load losses	kW	345 KW (Max)
2.7.3	Cooler losses	kW	10
2.7.4	Total Losses	kW	443

2.7.4	Tolerance on losses		NIL
2.8	Efficiency at 75 Deg.C and 0.8 Power Factor Lag		
2.8.1	At full load		99.51
2.8.2	At 3/4 load		99.57
2.8.3	At 1/2 full load		99.60
(a)	Load and Power Factor at which it occurs		99.68 at 50.5 % load at unity pf 99.60 at 50.50 % load at unity 0.8 pf
2.9	REGULATION AT FULL LOAD AT 75 Deg.c		
2.9.1	At unity power factor		3.80%
2.9.2	At 0.8 power factor lagging		18.36%
2.10	No Load Current Referred to HV/L1 or LV2 (Approx.)		
2.10.1	At 90% rated voltage	Amps.	~1.5/10
2.10.2	At 100% rated voltage	Amps.	~2.5/15
2.10.3	At 110% rated voltage	Amps.	~5/25
2.10.4	At 125% rated voltage	Amps.	~10/40
2.10.5	At 140% rated voltage	Amps.	~20/60
2.11	Approx. Maximum Flux Density		
2.11.1	At 90% rated voltage	Web / Sq.m	1 .548 T
2.112	At 100% rated voltage	Web / Sq.m	1.72 T
2.11.3	At 110% rated voltage	web/ Sq.m	1.892 T
2.11.4	At 125% rated voltage	Web / Sq.m	2.15 T
2.11.5	At 140% rated voltage	Web / Sq. m	2.408 T
2.12	MAXIMUM CURRENT DENSITY		At rated voltage and current

2.12.1	H.V. Winding	Amps/ Sq.cm	300
2.12.2	L.V. Winding	Amps/Sq. cm	300
2.13	WITHSTAND TIME WITHOUT INJURY FOR		
213.1	Three phase dead short-circuit at terminal with rated voltage maintained on the other side	Sec.	2 sec
2.13.2	Single phase short-circuit at terminal with rated voltage maintained on other side		2 sec
	COOLING SYSTEM		
2.14.1			
(a)	No. x Capacity of cooling unit furnished		2X50%
(b)	No. of cooling units required for full load operation		2
2.14.2	Each Cooling Unit is provided with		
(a)	No. x kW of oil pump motor		NA
(b)	No. x kW of fan motor		4 Nos 0.77 kW, 36” Fans; Total- 8Nos
(c)	No. of standby fan		01 per Bank; Total-02
(d)	No. of standby oil pumps		NA
2.14.3	Motors rated for voltage phase-frequency		415V±10%, 3 Ph, 50Hz±5%
2.14.4	Automatic Operation of cooler pumps and fans provided?		Yes
2.14.5	Transformer is capable of delivering rated output under following conditions		
(a)	Failure of all fans of one cooling unit		
	(i)Continuous in % rated, MVA		110
	(ii) Rated output for... min.		20 min.
(b)	Failure of one complete cooling unit including radiator, fans etc.		

	(i) Continuous in % rated, MVA		110
	(ii) Rated output for ... min.		20 min
(c)	Failure of fans of all the cooler units		
	(i) Continuous in % rated, MVA		110
	(ii) Rated output for... min.		10 min
(d)	Failure of complete cooling system including radiators, fans etc.		
	(i) Continuous in % rated, MVA		110
	(ii) Rated output for... min.		10 min.
2.14.6	Schematic Flow Diagram of the Cooling System Furnished?		AS PER OGA Drg
2.14.7	Oil Pumps		
(a)	Make		NOT APPLICABLE
(b)	Type		NA
(c)	Catalogue Furnished		NA
2.15	DETAILS OF TANK		
2.15.0	Type of tank		Bell type
2.15.1	Material		Low carbon steel
2.15.2	Thickness of sides		8mm
2.15.3	Thickness of bottom		16mm
2.15.4	Thickness of cover		16mm
2.15.5	Tank Designed for		
(a)	Vacuum	mm of	Full
(b)	Pressure		Continuous internal pressure of 35kN/m^2 over

			normal hydrostatic pressure of oil
2.16	CORE		
2.16.1	Type - Core or shell		Core type
2.16.2	Core material		High grade CRGO Silicon Steel
2.16.3	Thickness of lamination		0.27mm
2.16.4	Insulation of lamination		Carlite
2.16.5	Equivalent cross-sectional area		4900 Sqr.cm (Approx)
2.17	COILS		
2.17.1	Type of Coil		
(a)	H.V.		DISC
(b)	L.V.		Helical
2.17.2	Conductor Material		Electrolytic Copper
2.17.3	Insulating Material		
(a)	H.V. — Turn		Pressboard + paper +oil
(b)	L.V. — Turn		Pressboard + paper +oil
(c)	L.V. — Earth		Pressboard + paper +oil
(d)	H.V. – L.V.		Pressboard + paper +oil
(e)	H.V. Earth		Pressboard + paper +oil
2.17.4	Class of Insulation of Coil		Class “A”
2.18	TAP CHANGER		
2.18.1	Make		BHEL/ BHEL Approved vendors

2.18.2	Type		Transition resistance type
2.18.3	Rated Voltage	kV	110
2.18.4	Rated Current	Amps.	350
2.18.5	Auxiliary Power	kW	1.1
2.18.6	Time required for one step change	Secs.	5-6 secs
2.18.7	Rated Voltage		
(a)	Tap-change motor	Volts	415V±10%, 3 Ph, 50Hz±5%
(b)	Control circuit	Volts	110 VAC
2.18.8	Control		
(a)	Manual/ Local Electrical/ Remote Electrical / Auto		Yes
(b)	Group / Solo		Solo
2.18.9	Voltage Control Automatic/ Non-automatic	Both	Automatic / non-automatic
2.18.10	Provision for parallel operation	Yes/No	Yes
2.18.11	Maximum Short Circuit Current withstand capability		
(a)	Current		6 KA
(b)	Time		3 sec
2.18.12	Loose equipment and provisions for remote control furnished as per specification?		Yes
2.18.13	Local manual operation feasible from standing height from ground?		Yes
2.18.14	Local indicator furnished for		
(a)	Tap position		Yes
(b)	Operation counter		Yes
2.18.15	In case of off-circuit tap changer		NA

(a)	Padlocking provided		NA
(b)	Auxiliary switch for interlock provided		NA
(c)	Safety limit switch provided		NA
(d)	Discrepancy detector provided		NA
2.18.16	In case of On-load tap changer		
	Interlocks as per specification provided		Yes
(a)	Voltage Regulating relay provided		
	(i) Make		MSPGCL approved vendor
	(ii) Type		AVR
	(iii) Sensitivity (Dead band) and nominal value range		REFER OLTC SCHEMATIC DRG.
	(iv) Timer range		REFER OLTC SCHEMATIC DRG.
	(v) Literature furnished?		REFER OLTC SCHEMATIC DRG.
(b)	Under voltage Relay		
	(i) Voltage range		REFER OLTC SCHEMATIC DRG.
	(ii) Timer range		REFER OLTC SCHEMATIC DRG.
2.19	INSULATING OIL		
2.19.1	Approximate volume Litre	Litres	68500
2.19.2	10% excess oil furnished?		Yes
2.19.3			
(a)	Oil conforms to		IS-335, inhibited oil As per MAHAGENCO Approved Venders

(b)	Details of oil furnished		As per IS-335 (2018)
2.19.4			
(a)	Oil preservation system provided?		Yes,
(b)	Type		Air bag inside the conservator provided
2.20	BUSHINGS		
2.20.1	Make		HV--BHEL/ALSTOM/ CGL/Approved vendors Rest---BHEL make
2.20.2	Type		HV-OIP, all other—Oil communicating type
2.20.3	Reference Standard		IS-2099 /IEC-60137
2.20.4	Voltage class Current rating Height of bushing	kV Amps mm	HV-420kV LV1,LV2& N-36kV HV-1250A, LV1,LV2-3150A N-630A HV-4550mm LV1,LV2&N-1200mm
2.20.5	Type Of atmosphere		Heavily polluted
2.20.6	Creepage Distance	mm	HV-13020mm LV1,LV2,N-1116mm
	Protected Creepage	mm	As per IS-2099
2.20.7	Weight	kg	HV-800, LV1,LV2,N-35
2.20.8	Free space required for bushing removal		HV-4000mm LV1,LV2,N-1500mm
2.20.9	Test terminals for H.V. bushing provided?		Yes
2.20.10	One minute power frequency withstand voltage	kV rms	HV-630 LV1,LV2,N—70
2.20.11	Impulse withstand voltage	kVp	HV-1425 LV1,LV2,N----170
2.21	MINIMUM CLEARANCE		

2.21.1	Between Phases		
(a)	In air		
	(i) HV	mm	4000
	(ii) LV	mm	280 (in SPB)
(b)	In oil		
	(i) HV		Proprietary data/ as per design requirement
	(ii) LV		Proprietary data/ as per design requirement
2.21.2	Between Phase & Earth		
(a)	In air		
	(i) HV	mm	3500
	(ii) LV	mm	140(in SPB)
(b)	In oil		
	(i) HV		Proprietary data/ as per design requirement
	(ii) LV		Proprietary data/ as per design requirement
2.22	Terminal Connection & Arrangement		
2.22.1	H.V.		Outdoor Bushing with ACSR Conductor
2.22.2	L.V.		Bushing for Connection to SP Bus duct
2.22.3	H.V. Neutral		Outdoor Bushing with 2Nos.75x10 GS Flat
2.22.4	L.V. Neutral		Cable Box for Connection to NGR thru 2x1/C 630 Sqr.mm Al XLPE Cable

2.23	MARSHALLING BOX		
2.23.1	Weatherproof, suitable for outdoor duty		Yes
2.23.2	Degree of protection		IPW55
2.24	TERMINAL BLOCKS		
2.24.1	Make		MSPGCL Approved vendor
2.24.2	Type		Connecting/ disconnecting type
2.24.3	20% spare terminals furnished?		Yes
2.25	WIRING		
2.25.1	Cable type		PVC
2.25.2	Voltage grade	Volt	1100 V
2.25.3	Conductor Size	Sq.mm	2.5 /4.0 as applicable
(a)	Material		Copper stranded cable
(b)	Stranded		Yes
2.26	Trip and Alarm Contacts Ratings		
(a)	220V D.C		0.5 Amp
(b)	240V A.C.		5 Amp
2.26.1	Voltage	Volt	220V DC 0.5A, 240V AC 5A
2.26.2	Rated	Amps.	
(a)	Making Current		0.5A (220V DC) 5A(240V AC)
(b)	Breaking Current (Inductive Breaking)		5 Amp
2.27	Accessories		Yes

	Each transformer furnished with fittings and accessories as per specification		
2.28	DETAILS OF CONSERVATOR		
2.28.1	Volume of conservator	Ltr	5000
2.28.2	Volume of oil between the highest and lowest levels	Ltr	4500
2.29	PRESSURE RELEASE DEVICE		
(a)	Minimum pressure the device is set to operation/ rupture	KN/Sq. m	0.49 ± 0.07 kg/cm^2
(b)	Alarm and trip contacts provided		Yes
2.30	SPARE PARTS Each transformer furnished with spare parts as per specification		Yes as per contract
2.31	APPROXIMATE OVERALL DIMENSION		
2.31.1	Length	mm	17000
2.31.2	Breadth	mm	8500
2.31.3	height	mm	10100
(a)	Crane lift (a) for untanking core and coil assembly (including sling) (b) tank cover in case of Bell type tank	mm	12000
2.32	APPROXIMATE WEIGHTS		
2.32.1	Core and Coil	kg	90000
2.32.2	Tank cover for Bell type tank	kg	15500
2.32.3	Tank and fittings	kg	50000
2.32.4	Oil	kg	60000
2.32.5	Total Weight	kg	210000
2.33	SHIPPING DATA		
2.33.1	Weight of the heaviest package	kg	115000

2.33.2	Dimension of the largest package (L x B x H)	mm	7700 x 3580 x 4500
2.34	Tests to be conducted on each Transformer		
2.34.1	Routine tests, Type tests, special tests as per specification / relevant standard		Yes as per approved QAP. A separate Test schedule shall be submitted for approval
2.34.2	Tank pressure test on each transformer		
(a)	Test Pressure	KN/Sq. m	As per CBIP & approved QAP
(b)	Duration	Hour	01
(c)	Permenant deflaction	mm	As per CBIP & approved QAP
2.34.3	Tank Vacuum test on each transformer		
(a)	Vacuum	Hg	760-barometric reading
(b)	Duration	Hour	01
(c)	Permenant deflaction	mm	As per CBIP
2.34.4	Oil leak test on each transformer		
(a)	Test pressure	kN/sqm	94.5
(b)	Duration		12 hours
2.34.5	Core bolt withstand voltage for 1 minute on each transformer		10kVrms
2.34.6	Maximum Noise Level as per NEMA TR-1	dB	86
2.35	CURRENT TRANSFORMER		
2.35.1	General		
2.352	Make		BHEL
2.35.3	Type		Ring type turret mounted
2.35.4	Reference Standard		IS-2705

2.35.5	Use Core-I Core-II		HVΦ HVN LVNs REF SEF SEF --- REF REF
2.35.6	Rating		
(a)	C.T. Ratio Core-I Core-II		CT-4 CT-3 CT-2A/CT-2B 250/1 250/1 300/1 ---- 250/1 3500/1
(b)	Class Core-I Core-II		PS 5P20 5P20 ---- PS PS
(c)	Insulation level		NA
(d)	Burden Core-I Core-II		NA 10VA 10VA ---- NA NA
2.35.7	Insulation Class		CLASS A
(a)	Temperature rise at rated burden over top oil temperature		------max 50degC------
2.35.8	Characteristics		
(a)	Secondary resistance Rct Ohm at 75 Deg.c Core-I Core-II		3.0 NA NA ---- 3.0 20
(b)	Knee point voltage Vk Core-I Core-II		20Rct+50 NA NA ------ 20rct+50 20rct+75
(c)	Excitation current at Vk/2 Core-I Core-II		30mA NA NA --- 30mA 30mA
2.35.9	Dimensions and Weights		NA
(a)	Dimension (L x B x H)		As
(b)	Weight		Inside turret
(c)	Tests		Yes
(d)	As per Standard?		AS PER IS-2705

NOTE:- Following online monitoring systems are provided on transformer:-

1. Temperature measurement of oil and windings shall be done using Fiber optic sensors.

2. Online Dissolved Gas analysis (DGA) system for measuring minimum eight gases (H2, CO, CO2, O2, CH4, C2H2, C2H4, and C2H6) along with moisture in oil.

3. Provision for NIFPES System is provided on transformer.

Bharat Heavy Electricals Limited, Jhansi

Transformer Engineering Department

BHEL Ref : TRE/72058N/GTP

REV 04 dtd 28-12-19

Technical Data sheet

Customer	:	**M/S MAHAGENCO** **1x660 MW BHUSAWAL U-6**
Object	:	**2 NO 40 MVA, 21/11.5 KV, 3-PHASE, UNIT TRANSFORMER**
BHEL Work Order	:	**72058N17700**
BHEL JHS DOC NO.	:	**TRE/72058N/GTP**

DEVELOPMENT CONSULTANT PVT. LTD.

Reviewed only for general conformance with contract drawings and specifications;
Contractor to be responsible for any error and for fulfilment of details requirements of contract documents.

CODE:– **1 (ONE)*** DATE:– **08.01.2020**

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1	Approved	4	For information only
2	Approved Subject to compliance to comments, Proceed with manufacturing/construction. Revised document required to be submitted after incorporating the comments.	V	Null and Void (Not applicable)
3	Not Approved. Resubmission required		

SEE COVERING LETTER

LETTER REF.NO.:– **18V06-E-LOT-BHEL-0090**

SR. NO.	ITEM	UNIT	
(a)	Temperature rise at rated burden over top oil temperature	Deg.c	
1.34.8	Characteristics		
(a)	Secondary resistance Rct Ohm at 75	Deg.c	
(b)	Knee point voltage Vk	Volt	
(c)	Excitation current at Vk/ 2	Amps.	
1.34.9	Dimensions and Weights		
(a)	Dimension (L x B x H)		
(b)	Weight	kg.	
(c)	Tests		
	As per Standard?		
2.0	UNIT TRANSFORMER		UNIT TRANSFORMER
2.1	GENERAL		
2.1.1	Make		BHEL Jhansi
2.1.2	Type		UNIT TRANSFORMER, OIL IMMERSED REANSFORMER
2.1.3	Number of Winding per Phase		Two
2.1.4	Number of Phase		Three
2.1.5	Number of Unit per set		2

SR. NO.	ITEM	UNIT	
2.1.6	Reference Standard		IS2062/IEC-76/CBIP GUIDE LINES
2.2	RATING		
2.2.1	Type of Cooling		ONAN/ONAF
2.2.2	Rated Output		
(a)	With ONAN Cooling	MVA	32
(b)	With ONAF Cooling	MVA	40
(c)	With OFAN Cooling	MVA	NA
(d)	With OFAF Cooling	MVA	NA
2.2.3	Rated Voltage	kV	
(a)	H.V.		21
(b)	L.V.		11.5
2.2.4	Rated Current	Amps.	
(a)	H.V.		1099.714
(b)	L.V.		2008.174
2.2.5	Rated Frequency		50
2.2.6	Connection		
(a)	H.V.		Delta
(b)	L.V.		Star
2.2.7	Vector Group Reference		Dyn1
2.2.8	Voltage Withstand Time		
(a)	110% of rated voltage	Sec.	Continuous

SR. NO.	ITEM	UNIT	
(b)	125% of rated voltage		60 sec
(c)	140% of rated voltage		5 sec
(d)	150% of rated voltage		2 sec
2.2.9	Overfluxing Capability		
(a)	For Overfluxing Factor 1.1	Sec•	Continuous
(b)	For Overfluxing Factor 1.25		60 sec
(c)	For Overfluxing Factor 1.4		5 sec
2.3	TEMPERATURE		
2.3.1	Reference Ambient Temperature	Deg. c	50
2.3.2	Temperature rise over reference ambient		
(a)	Of Top oil by thermometer	Deg. c	40
(b)	Of winding by resistance	Deg. c	45
2.3.3	Maximum continuous over loading capacity of the transformer without exceeding the specified winding temperature		As per IEC-60076-7
2.4	TAPPINGS		
24.1	Type		OLTC(SEPARATE TAP WINDING) OLTC AS PER APPROVED VENDOR LIST
2.4.2	Capacity		FULL POWER
24.3	Range - Steps x % Variation		+10% to –10% IN 16 x 1.25%

SR. NO.	ITEM	UNIT	
	Taps provided on HV / LV Winding		HV WINDING
2.5	INSULATION LEVEL		
2.5.1	H.V.	kVp /kV rms	125/50
2.5.2	L.V.	kVp / kVrms	75/28
2.5.3	H.V. Neutral	kVp / kVrms	NA
2.5.4	L.V. Neutral	kVp/kVrms	75/28
2.6	Impedances at Principal Tap at Rated Frequency and 75 Deg.C winding temperature		
2.6.1	Base MVA		40
2.6.2	Impedance		11.5±10 % TOL. ON 40 MVA BASE
2.6.3	Reactance		11.5%
2.6.4	Resistance at 75 Deg.C	HV LV	0.06470 ohms, APPROX. 0.00570 ohms APPROX
2.6.5	Zero Sequence Impedance at 75 Deg.c		9.77%± 10 ^{0}/0 TOL.
2.6.6	Capacitance of Windings		
(a)	H.V. — Earth	micro farad /ph	2.8 nf approx. .data based on previous projects, It may change during testing
(b)	L.V. — Earth	micro farad / ph	8.7 nf approx. data based on previous projects, It may change during testing
(c)	H.V. - L.V.	micro farad /ph	7.8 nf approx.. data based on previous projects, It may change during testing
2.7	Guaranteed Losses at Principal Tap, Full Load and 75De .C		

SR. NO.	ITEM	UNIT	
2.7.1	No load losses	kW	19 KW firm @ 40 MVA
2.7.2	Load losses	kW	200 KW firm @ 40 MVA
2.7.3	Cooler losses		3 KW
2.7.4	Tolerance on losses	kW	NO POSITIVE TOLERANCE
2.8	Efficiency at 75 Deg.C and 0.8 Power Factor Lag		
2.8.1	At full load		99.319
28.2	At 3/4 load		99.453
2.8.3	At 1/2 full load		99.568
	Maximum Efficiency		
(a)	Load and Power Factor at which it occurs		99.319 at 31.225 %
2.9	REGULATION AT FULL LOAD AT 75 Deg.c		
2.9.1	At unity power factor		1.161
2.9.2	At 0.8 power factor lagging		7.751
2.10	NO LOAD CURRENT REFERRED TO HV		
2.10.1	At 90% rated voltage	Amps.	<0.5 % of rated current
2.10.2	At 100% rated voltage	Amps.	<1.0 % of rated current
2.10.3	At 110% rated voltage	Amps.	APPROX. 1.2 % of rated current
2.10.4	At 125% rated voltage	Amps.	APPROX 1.5 % of rated current
2.10.5	At 140% rated voltage	Amps.	APPROX. 2.5% of rated current

SR. NO.	ITEM	UNIT	
2.11	APPROXIMATE MAXIMUM FLUX DENSITY		
2.11.1	At 90% rated voltage	Web / Sq.m	1 .548 T
2.11.2	At 100% rated voltage	Web / Sq.m	1.72 T
2.11.3	At 110% rated voltage	web/ Sq.m	1.892 T
2.11.4	At 125% rated voltage	Web / Sq.m	2.15 T
2.11.5	At 140% rated voltage	Web / Sq. m	---
2.12	MAXIMUM CURRENT DENSITY AT RATED VOLTAGE AND RATED MVA		
2.12.1	H.V. Winding	Amps/ Sq.cm	300
2.12.2	L.V. Winding	Amps/Sq. cm	300
2.13	WITHSTAND TIME WITHOUT INJURY FOR		
213.1	Three phase dead shortcircuit at terminal with rated voltage maintained on the other side	Sec.	2 sec
2.13.2	Single phase short-circuit at terminal with rated voltage maintained on other side		2 sec

SR. NO.	ITEM	UNIT	
2.14	COOLING SYSTEM		
2.14.1			
(a)	No. x Capacity of cooling unit furnished		2X50%
(b)	No. of cooling units required for full load operation		2
2.14.2	Each Cooling Unit is provided with		
(a)	No. x kW of fan motor		10x 0.264 kw
(b)	No. x kW of fan motor		4 X 0.264 KW TOTAL 8 FAN RUNNING
(c)	No. of standby fan		2
(d)	No. of standby oil pumps		NA
2.14.3	Motors rated for voltage phase-frequency		415 V, 3 Ph, 50 Hz
2.14.4	Automatic Operation of cooler pumps and fans provided?		Yes
2.14.5	Transformer is capable of delivering rated output under following conditions		
(a)	Failure of all pumps and fans of one cooling unit		
	(i)Continuous in % rated, MVA		100% 40 MVA
	(ii) Rated output for... min.		20 MIN APPROX.

SR. NO.	ITEM	UNIT	
(b)	Failure of one complete cooling unit including radiator, fans, pumps etc.		
	(i) Continuous in % rated, MVA		50% 20 MVA
	(ii) Rated output for ... min.		10 MIN
(c)	Failure of fans of all the cooler units		
	(i) Continuous in % rated, MVA		As per IS 6600 , 80% 32 MVA
	(ii) Rated output for... min.		As per IS 6600 , 10 min APPROX.
(d)	Failure of complete cooling system including radiators, fans, pumps, etc.		
	(i) Continuous in % rated, MVA		As per IS 6600
	(ii) Rated output for... min.		As per IS 6600 , 10 min APPROX.
2.14.6	Schematic Flow Diagram of the Cooling System Furnished ?		AS PER OUTLINE GENERAL ARRANGEMENT
2.14.7	Oil Pumps		
(a)	Make		NOT APPLICABLE
(b)	Type		NA
(c)	Catalogue Furnished		NA

SR. NO.	ITEM	UNIT	
2.15	DETAILS OF TANK		
2.15.1	Material		LOW CARBON STEEL
2.15.2	Thickness of sides		8
2.15.3	Thickness of bottom		16
2.15.4	Thickness of cover		16
2.15.5	Tank Designed for		
(a)	Vacuum	mm of	FULL VACUUM
(b)	Pressure		TWICE THE NORMAL HEAD OF OIL OR NORMAL PRESSURE + 35 KN/M2 WHICHEVER IS LOWER
2.16	CORE		
2.16.1	Type - Core or shell		Core
2.16.2	Core material		CRGO SILICON STEEL
2.16.3	Thickness of lamination		0.27
216.4	Insulation of lamination		Carlite
2.16.5	Equivalent cross-sectional area		1796 SQ CM APPROX
2.17	COILS		
217.1	Type of Coil		
(a)	H.V.		Disc
(b)	L.V.		Helical/DISC
2.17.2	Conductor Material		Electrolytic Copper
2.17.3	Insulating Material		

SR. NO.	ITEM	UNIT	
(a)	H.V. — Turn		Pressboard paper +0il
(b)	L.V. — Turn		Pressboard paper +0il
(c)	L.V. — Earth		Pressboard paper +0il
(d)	H.V. - L.V.		Pressboard paper +0il
(e)	H.V. Earth		Pressboard + paper +0il
2.18	TAP CHANGER		
2.18.1	Make		MAHAGENCO approved Vendor
218.2	Type		Transition resistance type high speed
2.18.3	Rated Voltage	kV	33
218.4	Rated Current	Amps.	800
2.18.5	Auxiliary Power	kW	1.1
218.6	Time required for one step change	Secs.	5-6 sec
2.18.7	Rated Voltage		
(a)	Tap-change motor	Volts	415 V AC 3 PH , 50 HZ
(b)	Control circuit	Volts	110 VAC
2.18.8	Control		
(a)	Manual/ Local Electrical/ Remote Electrical		Yes
(b)	Group / Solo		Group+Solo
2.189	Voltage Control Automatic/ Non-automatic		Automatic

SR. NO.	ITEM	UNIT	
2.18.10	Provision for parallel operation	Yes/No	Yes
2.18.11	Maximum Short Circuit Current withstand capability		
(a)	Current		16 KA
(b)	Time		3 sec
(c)	Insulation level of the connecting lead between tap changer and transformer winding		170 KV
(d)	Insulation to ground		72.5 KV (350 KVp / 140 KV rms
2.18.12	Loose equipment and provisions for remote control furnished as per specification?		Yes
2.18.13	Local manual operation feasible from standing height from ground?		Yes
2.18.14	Local indicator furnished for		
(a)	Tap position		Yes
(b)	Operation counter		Yes
2.18.15	In case of off-circuit tap changer		NA
(a)	Padlocking provided		NA
(b)	Auxiliary switch for interlock provided		NA
(c)	Safety limit switch provided		NA
(d)	Discrepancy detector provided		NA
2.18.16	In case of On-load tap changer		

SR. NO.	ITEM	UNIT	
	Interlocks as per specification provided		Yes
(B)			
(a)	Voltage Regulating relay provided		In Technical data sheet 2.18.16. (B) (a) (i)-Make for voltage regulating relay shall be per only MSPGCL approved vendor list.
	(i) Make		MSPGCL /~~BHEL~~ approved Vendor
	(ii) Type		AUTOMATI VOLTAGE REGULATION
	(iii) Sensitivity (Dead band) and nominal value range		AS PER VENDORS PRODUCT SPEC
	(iv) Timer range		AS PER VENDORS PRODUCT SPECIFICATION
	(v) Literature furnished?		SUBMITTED WITH MANNUAL
(b)	Under voltage Relay		
	(i) Voltage range		AS PER VENDORS PRODUCT SPEC
	(ii) Timer range		AS PER VENDORS PRODUCT SPEC
2.19	INSULATING OIL		
2.19.1	Approximate volume Litre		21350
219.2	10% excess oil furnished?		Yes
2.19.3			
(a)	Oil conforms to		IS335
(b)	Details of oil furnished		As per IS335
2.19.4			
(a)	Oil preservation system provided?		Yes

SR. NO.	ITEM	UNIT	
(b)	Type		Air cell
2.20	BUSHINGS H V/LV HVN /LVN		
2.20.1	Make		As per MSPGCL approved vendor
2.20.2	Type		
2.20.3	Reference Standard		IS2099/ IS3347
2.20.4	Voltage class	kV	HV =36 KV,LV& LVN 17.5 KV
2.20.5	Type Of atmosphere		
2.20.6	Creepage Distance		31 mm/KV
2.20.7	Weight	kg	HV= 40 KG LV = 44 KG
220.8	Free space required for bushing removal		1000 mm APPROX.
2.20.9	Test terminals for H.V. bushing provided?		As per IS 2099
2.20.10	One minute power frequency withstand voltage	kV rms	HV=70,LV & LVN 38
2.20.11	Impulse withstand voltage	KVp	HV =175,LV &LVN = 95
2.21	MINIMUM CLEARANCE		
2.21.1	Between Phases		
(a)	In air		
	(i) HV		330
	(ii) LV		280
(b)	In oil		

SR. NO.	ITEM	UNIT	
	(i) HV		25
	(ii) LV		18
2.21.2	Between Phase & Earth		
(a)	In air		
	(i) HV		230
	(ii) LV		140
(b)	In oil		
	(i) HV		---------
	(ii) LV		---------
2.22	TERMINAL CONNECTIONS		
2.22.1	H.V.		Porcelain Bushing
222.2	L.V.		Porcelain Bushing
222.3	H.V. Neutral		NA
2.22.4	L.V. Neutral		Porcelain Bushing
2.23	MARSHALLING BOX		
223.1	Weatherproof, suitable for outdoor duty		Yes
223.2	Degree of protection		IPW55
2.24	TERMINAL BLOCKS		
2.24.1	Make		MSPGCL Approved vendor
2.24.2	Type		STUD TYPE

SR. NO.	ITEM	UNIT	
2.24.3	20% spare terminals furnished?		Yes
2.25	WIRING		
2.25.1	Cable type		PVC
2.25.2	Voltage grade	Volt	1100 V
2.25.3	Conductor Size	Sq.mm	2.5/4.0 Sq.mm for CT
(a)	Material		Copper stranded cable
(b)	Stranded		Yes
2.26	Trip and Alarm Contacts Ratings		
(a)	nov D.C		5 Amp
(b)	240V A.C.		5 Amp
2.26.1	Voltage	Volt	220 V DC,
2.26.2	Rated	Amps.	
(a)	Making Current		5 Amp
(b)	Breaking Current (Inductive Breaking)		5 Amp
2.27	ACCESSORIES Each transformer furnished with fittings and accessories as per specification?		Yes
2.28	DETAIL OF CONSERVATOR		
228.1	Volume of Conservator		1600 L

SR. NO.	ITEM	UNIT	
2.28.2	Volume of oil between the highest and lowest levels		1200 L
2.29	PRESSURE RELEASE DEVICE		
(a)	Minimum pressure the device is set to operation/ rupture	KN/Sq.m	0.49±0.07 Kg/sq cm
(b)	Alarm and trip contacts provided		TRIP
2.30	SPARE PARTS Each transformer furnished with spare parts as per specification		Yes
2.31	APPROXIMATE OVERALL DIMENSION		
2.31.1	Length	mm	10000
2.31.2	Breadth	mm	8000
2.31.3	Height	mm	6700
(a)	Crane lift (a) for untanking core and coil assembly (including sling) (b) tank cover in case of Bell type tank		9000
2.32	APPROXIMATE WEIGHTS		
2.32.1	Core and Coil	kg	25000 a rox. .
2.32.2	Tank cover for Bell type tank	kg	CONVENTIONAL TANK
2.32.3	Tank and fittings	kg	19000 (approx.)

SR. NO.	ITEM	UNIT	
2.32.4	Oil	kg	18000 (approx.)
2.32.5	Total Weight	kg	62000 a rox.
2.33	SHIPPING DATA		
2.33.1	Weight of the heaviest package	kg.	40000 kg approx. (gas-filled)
2.33.2	Dimension of the largest package (L x B x H)	mm	4700 x 3000 x 3700 mm (approx.)
2.34	Tests to be conducted on each Transformer		
2.34.1	Routine tests as per specification / relevant standard		Yes
2.34.2	Tank pressure test on each transformer		
(a)	Test Pressure	KN/Sq.m	Twice the normal head of oil or to normal pressure + 35 KN/M2 WHICHEVER IS LOWER
(b)	Duration	Hours	8 HRS
(c)	Permanent deflection		As per CBIP
2.34.3	Tank vacuum test on each transformer		
(a)	Vacuum	KN/Sq.m	Internal pressure of 3.33 KN/M2
(b)	Duration	Hours	1 Hrs
(c)	Permanent deflection		As per CBIP
2.34.4	Oil leak test on each transformer		
(a)	Test pressure		Twice the normal head of oil or to normal pressure + 35 KN/M2 whichever is lower

SR. NO.	ITEM	UNIT		
(b)	Duration		1 hr	
2.34.5	Core bolt withstand voltage for 1 minute on each transformer		2 KVrms	
2.35	NEUTRAL CURRENT TRANSFORMER			
2.35.1	General			
2.35.2	Make		BHEL make	
2.35.3	Type		CORE 1	CORE II
2.35.4	Reference Standard		IS 2705	IS 2705
2.35.5	Use		PROTECTION	PROTECTION
2.35.6	Rating			
(a)	C.T. Ratio		300/1	2500/1
(b)	Class		5P20	PS
(c)	Insulation level		--------	----------
(d)	Burden		15 VA	
2.35.7	Insulation Class		CLASS A	CLASS A
(a)	Temperature rise at rated burden over top oil temperature	Deg.c	AS PER IS 2705	
235.8	Characteristics			
(a)	Secondary resistance Rct Ohm at 75 Deg.c	Ohms	---	≤ 10 OHM
(b)	Knee point voltage Vk	Volt	--	Vk≥20Rct+100V

SR. NO.	ITEM	UNIT	
(c)	Excitation current at Vk/2	Amps.	-- Ie≤30mA at Vk/2
2.35.9	Dimensions and Weights		
(a)	Dimension (L x B x H)	mm	To be fitted in turret
(b)	Weight	kg.	50 Kg Approx.
(c)	Tests		As per Is 2705
(d)	As per Standard?		Is 2705