

01A	18.12.19	INTERNAL REVISION (EXCITER FIELD CURRENT AMMETER DELETED AS PER EDN MAIL DATED 18.12.19)			
01	16.05.19	REVISED AS PER CUSTOMER COMMENTS	MC	KK	MS
REV.	DATE	DESCRIPTION			

PROJECT

1 X 660 MW BHUSAWAL T.P.S. UNIT-6 TPP

OWNER

MAHAGENCO

MAHARASHTRA STATE POWER GENERATION
CO. LTD.

OWNER'S CONSULTANT



BHARAT HEAVY ELECTRICALS LTD
UNIT : PROJECT ENGINEERING MANAGEMENT, NOIDA

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	E	DRN	MC	—sd—	23.08.18
		DESN	MC	—sd—	23.08.18
		CHD	KK	—sd—	23.08.18
		APPD	MS	—sd—	27.08.18

TITLE

SLD FOR GENERATOR CIRCUIT METERING & PROTECTION [STG]

					ELEC	DEPT.	SCALE NTS	BHEL DRG NO.	
						SIGN		PE-DG-415-510-E001	
						DATE		TOTAL SHEETS = 11	REV. 01A

CUSTOMER'S DRAWING NO.

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DRAWING NO.
PE-DG-415-510-E001

LEGEND

A	AMMETER
AT	CURRENT TRANSDUCER
AVR	AUTOMATIC VOLTAGE REGULATOR
ARS	AUX. RELAY WITH SELF RESET CONTACTS AND HAND RESET OPERATION INDICATOR
CT	CURRENT TRANSFORMER
DDCMIS	DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM
ECP	ELECTRICAL CONTROL PANEL
F	FILTER
FBC	FIELD BREAKER CUBICLE
FFC	FIELD FLASHING CUBICLE
FS	FUSE
G20HZ	20 HZ GENERATOR
GEN	GENERATOR
GRP	GENERATOR RELAY PANEL
GT	GENERATOR TRANSFORMER
HZ	FREQUENCY METER
HZT	FREQUENCY TRANSDUCER
IVT	INTERPOSING VOLTAGE TRANSFORMER
LA	LIGHTNING ARRESTER
MCB	MINIATURE CIRCUIT BREAKER
MVARH	MEGA VAR HOUR METER
MWH	MEGA WATT HOUR METER
NGR	NEUTRAL GROUNDING RESISTOR
PF	POWER FACTOR METER
PFT	POWER FACTOR TRANSDUCER
R	RESISTOR
SC	SURGE CAPACITOR
T&AVTP	TRANSDUCER & AVT PANEL
UT	UNIT TRANSFORMER
V	VOLTMETER
VA	VA METER
VAR	VAR METER
VAT	VA TRANSDUCER
VART	VAR TRANSDUCER
VD	VOLTAGE DIVIDER
W	WATT METER
WT	WATT TRANSDUCER

	INDICATING METER
	INTEGRATING METER
	TRANSDUCER

REFERENCE DRAWINGS

- 1 ELECTRICAL SINGLE LINE DIAGRAM FOR AUXILIARY POWER DISTRIBUTION
BHEL DRAWING NO. PE-DG-415-565-E001
- 2 CT/VT SIZING CALCULATIONS FOR MV SWITCHBOARDS
BHEL DRAWING NO. PE-DG-415-505-E006
- 3 SINGLE LINE DIAGRAM: GENERATOR, GT, UT, ST METERING & PROTECTION
MAHAGENCO DRAWING NO. PE-189-EL-503, ISSUE P1

NOTES

- 1 ALL NUMERICAL RELAYS SHALL BE CONNECTED TO AN ETHERNET LAN OVER IEC 61850
PROTOCOL FOR COMMUNICATION WITH DDCMIS.
- 2 TIME SYNCHRONISATION OF NUMERICAL RELAYS SHALL BE DONE WITH DDCMIS OVER
IEC-61850 PROTOCOL.
- 3 LAPTOP PC FOR GENERATOR PROTECTION PANELS TO BE PROVIDED FOR COMMUNICATING
WITH FRONT RS-232 PORT FOR THE FOLLOWING PURPOSE :
A) RETRIEVING DATA FROM NUMERICAL RELAYS
B) UPLOADING SETTINGS & I/O CONFIGURATION
THE LAPTOP PC SHALL BE LOADED WITH RELAY SPECIFIC SOFTWARE FOR ABOVE PURPOSE.
- 4 EXACT MAKE, TYPE & COMBINATION OF PROTECTION FUNCTIONS IN NUMERICAL RELAYS SHALL
BE AS FINALLY DECIDED BY BHEL-BHOPAL.
- 5 ACCESSORIES FOR 100% STATOR EARTH FAULT AND ROTOR EARTH FAULT ARE INDICATED
BASED ON SIEMENS PROTECTION RELAYS. THE ARRANGEMENT AND DETAILS OF THE SAME SHALL
BE AS SHOWN IN BHEL-BHOPAL SCHEMATIC DRAWINGS BASED ON THE MAKE OF NUMERICAL RELAY
PROCURED BY THEM. FOR ABB MAKE RELAYS, THE ACCESSORIES SHALL BE MOUNTED IN A
SEPARATE STAND-ALONE PANEL.
- 6 METERING AND PROTECTION OF 11kV SWITCHBOARD ARE COVERED IN SEPARATE DRAWINGS OF BHEL-BHOPAL &
METERING AND PROTECTION OF 400kV SWITCHYARD IS IN MAHAGENCO SCOPE.
- 7 FACILITY SHALL BE PROVIDED TO ACCESS PROTECTION FUNCTION INCLUDING MODIFICATION IN RELAY SETTINGS
AND MONITORING OF RELAY FROM EWS/DISTURBANCE RECORDER STATION PERMANENTLY WIRED TO ALL GRP
NUMERICAL RELAYS.

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD



BHARAT HEAVY ELECTRICALS LTD.
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

MAHARASHTRA STATE POWER
GENERATION CO. LTD.
1 X 660MW BHUSAWAL TPP

TITLE
SINGLE LINE DIAGRAM FOR GENERATOR
CIRCUIT METERING & PROTECTION [STG]

DRAWING NO.
PE-DG-415-510-E001
SHEET 2 OF 10
REV. 1A

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CUSTOMER'S DRAWING NO.

PE-DG-415-510-E001
DRAWING NO.

RELAY DETAILS

DEVICE NO.	DESCRIPTION	RELAY TYPE	RATED CURRENT	RATED VOLTAGE	AUX VOLTAGE	TYPE	MAKE	QTY.	LOCATION
GR1	GENERATOR PROTECTION RELAY GEN BACKUP IMPEDANCE PROTECTION [21G1] GEN REVERSE POWER PROTECTION [32G1] GEN LOW FORWARD POWER PROTECTION [37G1] GEN FIELD FAILURE PROTECTION [40G1] GEN OVER CURRENT RELAY [51G1] GEN UNDER VOLTAGE PROTECTION [27G1] GEN NEGATIVE PHASE SEQUENCE PROTECTION [46G1] \$ GEN DEAD MACHINE PROTECTION [50GDM1]* GEN OVER VOLTAGE PROTECTION [59G1] GEN STANDBY EARTH FAULT PROTECTION [51NG1] GEN VT1 VOLTAGE SUPERVISION [60G(VT1)] GEN STATOR EARTH FAULT PROTECTION (95%) [64G1] GEN ROTOR EARTH FAULT PROTECTION [64R1] GEN UNDER FREQUENCY PROTECTION [81G1UF] GEN OVER FREQUENCY PROTECTION [81G1OF] GEN DIFFERENTIAL PROTECTION [87G1] GEN & GT OVERFLUXING PROTECTION [99G1] GEN POLE SLIPPING PROTECTION [98G1] GEN INTERTURN PROTECTION [64GIT] ⚠	NUMERICAL	5A	110V	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
GR2	GENERATOR PROTECTION RELAY GEN BACKUP IMPEDANCE PROTECTION [21G2] GEN REVERSE POWER PROTECTION [32G2] GEN LOW FORWARD POWER PROTECTION [37G2] GEN FIELD FAILURE PROTECTION [40G2] GEN OVER CURRENT RELAY [51G2] GEN UNDER VOLTAGE PROTECTION [27G2] GEN NEGATIVE PHASE SEQUENCE PROTECTION [46G2] \$ GEN DEAD MACHINE PROTECTION [50GDM2]** GEN OVER VOLTAGE PROTECTION [59G2] GEN STANDBY EARTH FAULT PROTECTION [51NG2] GEN VT2 VOLTAGE SUPERVISION [60G(VT2)] GEN ROTOR EARTH FAULT PROTECTION [64R2] GEN STATOR EARTH FAULT PROTECTION (95%) [64G2] GEN STATOR EARTH FAULT PROTECTION (100%) [64G3] GEN UNDER FREQUENCY PROTECTION [81G2UF] GEN OVER FREQUENCY PROTECTION [81G2OF] GEN DIFFERENTIAL PROTECTION [87G2] GEN POLE SLIPPING PROTECTION [98G2] GEN & GT OVERFLUXING PROTECTION [99G2]	NUMERICAL	5A	110V	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
60VT1	GEN VT1 VOLTAGE SUPPLY SUPERVISION RELAY	STATIC/ ELECTROMAGNETIC	—	110V	220V DC	MVAPM32/EQVT.	AREVA/EQVT. TO BE DECIDED BY BHOPAL	1	GRP
60VT2	GEN VT2 VOLTAGE SUPPLY SUPERVISION RELAY	STATIC/ ELECTROMAGNETIC	—	110V	220V DC	MVAPM32/EQVT.		1	GRP
60VT3	GEN VT3 VOLTAGE SUPPLY SUPERVISION RELAY	STATIC/ ELECTROMAGNETIC	—	110V	220V DC	MVAPM32/EQVT.		1	GRP

* : BASED ON U/V AND O/C PRINCIPLE

** : BASED ON CB STATUS AND O/C PRINCIPLE

\$: WITH SIGNAL FOR REMOTE METERING AT DDCMIS FOR GEN. NEGATIVE PHASE SEQUENCE CURRENT

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TITLE

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CIRCUIT METERING & PROTECTION [STG]

DRAWING NO.

PE-DG-415-510-E001

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DRAWING NO.

RELAY DETAILS

DEVICE NO.	DESCRIPTION	RELAY TYPE	RATED CURRENT	RATED VOLTAGE	AUX VOLTAGE	TYPE	MAKE	QTY.	LOCATION
GTR1	GT DIFFERENTIAL PROTECTION [87GT] GT HV REF PROTECTION [64RGT]	NUMERICAL	5A/1A	—	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
GTR2	OVERALL DIFFERENTIAL PROTECTION [870A] GT BACKUP E/F PROTECTION [51NGT] GT HV INST. & IDMT O/C PROTECTION [50GT/51GT] GT OVERFLUXING PROTECTION [99GT]	NUMERICAL	5A/1A	—	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
UT6A-R1	UT-6A DIFFERENTIAL PROTECTION [87UTA] UT-6A LV BACKUP EARTH FAULT PROTECTION [51NUTA]	NUMERICAL	1A	—	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
UT6A-R2	UT-6A HV INST. OVER CURRENT PROTECTION [50UTA] UT-6A HV DMT OVER CURRENT PROTECTION [51UTA] UT-6A RESTRICTED EARTH FAULT PROTECTION [64RUTA]	NUMERICAL	1A	—	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
UT6B-R1	UT-6B DIFFERENTIAL PROTECTION [87UTB] UT-6B LV BACKUP EARTH FAULT PROTECTION [51NUTB]	NUMERICAL	1A	—	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
UT6B-R2	UT-6B HV INST. OVER CURRENT PROTECTION [50UTB] UT-6B HV DMT OVER CURRENT PROTECTION [51UTB] UT-6B RESTRICTED EARTH FAULT PROTECTION [64RUTB]	NUMERICAL	1A	—	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
87HV	GT HV & OVERHEAD LINE DIFFERENTIAL PROTECTION	NUMERICAL	1A	—	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP
50Z1 50Z2	LOCAL BREAKER BACKUP PROTECTION	NUMERICAL	1A	—	220V DC	REFER NOTE 4	BHEL-BHOPAL TO DECIDE	1	GRP

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NOIDA

MAHARASHTRA STATE POWER
GENERATION CO. LTD.
1 X 660MW BHUSAWAL TPP

TITLE
SINGLE LINE DIAGRAM FOR GENERATOR
CIRCUIT METERING & PROTECTION [STG]

DRAWING NO. **PE-DG-415-510-E001**
SHEET 4 OF 10 REV. 1A

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AUXILIARY RELAYS DETAILS

DEVICE NO.	DESCRIPTION	RATED CURRENT	RATED VOLTAGE	AUXILIARY VOLTAGE	TYPE	MAKE	QTY.	LOCATION
GTX1/2	GT-A PRV-B/ GT-B PRV-B	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX3/4	GT-C PRV-B/ GT-A SPR	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX5/6	GT-B SPR/ GT-C SPR	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX7/8	GT-A BUCHHOLZ RELAY/ GT-B BUCHHOLZ RELAY	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX9/10	GT-C BUCHHOLZ RELAY/ GT CK SUPPLY C/O FAILURE	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX11/12	GT-A HV/LV WTI	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX13/14	GT-B HV/LV WTI	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX15/16	GT-C HV/LV WTI	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX17/18	GT-A FIRE PROTECTION/ GT-B FIRE PROTECTION	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX19/20	GT-C FIRE PROTECTION/ GT-A PRV-A	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX21/22	GT-B PRV-A/ GT-C PRV-A	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX23/24	GT-A OTI/ GT-B OTI	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX25/26	GT-C OTI/ GT-A OCTC	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
GTX27/28	GT-B OCTC/ GT-C OCTC	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
UTAX1/2	UT-A BUCHHOLZ/ UT-A OLTC OIL SURGE	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
UTAX3/4	UT-A HV WTI/UT-A LV WTI	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
UTAX5/6	UT-A FPR/ UT-A PRV	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
UTAX7	UT-A OTI	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
UTBX1/2	UT-B BUCHHOLZ/ UT-B OLTC OIL SURGE	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
UTBX3/4	UT-B HV WTI/UT-B LV WTI	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
UTBX5/6	UT-B FPR/ UT-B PRV	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP
UTBX7	UT-B OTI	-	-	220V DC	VAA21/EQ.	AREVA/EQUIVALENT	1	GRP

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1 X 660MW BHUSAWAL TPP

TITLE

SINGLE LINE DIAGRAM FOR GENERATOR
CIRCUIT METERING & PROTECTION [STG]

DRAWING NO.

PE-DG-415-510-E001

SHEET 4A OF 10

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PE-DG-415-510-E001
DRAWING NO.

CT DETAILS

C.T. NO.	CORE NO.	RATIO	BURDEN	ACCURACY CLASS	ALF/ ISF	VK ≥	Ie ≤	RCT AT 75°C ≤	LOCATION
CT 1	—	25000/5A	—	PS	—	250Rct+400V	150mA AT VK/2	**	GEN BUSDUCT (NEUTRAL SIDE)
CT 2	—	25000/5A	—	PS	—	150Rct+250V	150mA AT VK/2	**	GEN BUSDUCT (NEUTRAL SIDE)
CT 3	—	25000/5A	75VA	0.2	≤ 5.0	—	—	—	GEN BUSDUCT (NEUTRAL SIDE)
CT 4	—	25000/5A	75VA	0.2	≤ 5.0	—	—	—	GEN BUSDUCT (NEUTRAL SIDE)
CT 5	—	25000/5A	—	PS	—	150Rct+250V	150mA AT VK/2	**	GEN BUSDUCT (NEUTRAL SIDE)
CT 6	—	25000/5A	—	PS	—	150Rct+250V	150mA AT VK/2	**	GEN BUSDUCT (PHASE SIDE)
CT 7	—	25000/5A	—	PS	—	150Rct+250V	150mA AT VK/2	**	GEN BUSDUCT (PHASE SIDE)
CT 8	—	25000/5A	75VA	0.2s	≤ 5.0	—	—	—	GEN BUSDUCT (PHASE SIDE)
CT 9	—	25000/5A	75VA	0.2	≤ 5.0	—	—	—	GEN BUSDUCT (PHASE SIDE)
CT 11	—	15000/5A	—	PS	—	250Rct+550V	150mA AT VK/2	**	GT LV PHASE BUSHING
CT 12	—	15000/5A	—	PS	—	250Rct+550V	150mA AT VK/2	**	GT LV PHASE BUSHING
CT 13	1	1250/1A	—	PS	—	20Rct+100V	30mA AT VK/2	**	GT HV NEUTRAL BUSHING
	2	1250/1A	15VA	5P	20	—	—	—	
CT 14	—	1250/1A	—	PS	—	50Rct+150V	30mA AT VK/2	**	GT HV PHASE BUSHING
CT 15	1	2000/1A	—	PS	—	≥ 2000 V	30mA @ Vk/2	**	GT HV PHASE BUSHING
	2	1250/1A	—	PS	—	20Rct+100V	30mA AT VK/2	**	
CT 16A	—	1600/1A	—	PS	—	50Rct+200V	30mA AT VK/2	**	GEN BUSDUCT TAP—OFF TO UT—6A
CT 16B	—	1600/1A	—	PS	—	50Rct+200V	30mA AT VK/2	**	GEN BUSDUCT TAP—OFF TO UT—6B
CT 17A	—	1600/1A	15VA	5P	20	—	—	—	GEN BUSDUCT TAP—OFF TO UT—6A
CT 17B	—	1600/1A	15VA	5P	20	—	—	—	GEN BUSDUCT TAP—OFF TO UT—6B
CT 18A	—	25000/5A	—	PS	—	250Rct+400V	150mA AT VK/2	**	GEN BUSDUCT TAP OFF TO UT—6A
CT 18B	—	25000/5A	—	PS	—	250Rct+400V	150mA AT VK/2	**	GEN BUSDUCT TAP OFF TO UT—6B
CT 19A	—	1600/1A	50VA	0.2S	≤ 5.0	—	—	—	GEN BUSDUCT TAP—OFF TO UT—6A
CT 19B	—	1600/1A	50VA	0.2S	≤ 5.0	—	—	—	GEN BUSDUCT TAP—OFF TO UT—6B
CT 10A	—	500/5A	100VA	5P	20	—	—	—	NG CUBICLE
CT 10B	—	500/5A	100VA	5P	20	—	—	—	NG CUBICLE
CT 10C	—	500/5A	100VA	1.0	≤ 5.0	—	—	—	NG CUBICLE

** : RCT VALUES TO BE DECIDED BY EQUIPMENT SUPPLIER.

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TITLE
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DRAWING NO. **PE-DG-415-510-E001**
SHEET 5 OF 10 REV. 1A

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DRAWING NO.

CT DETAILS

C.T. NO.	CORE NO.	RATIO	BURDEN	ACCURACY CLASS	ALF/ ISF	VK ≥	le ≤	RCT AT 75°C ≤	LOCATION
CT 20A	1	300/1A	15VA	5P	20	—	—	—	UT-6A LV NEUTRAL BUSHING
	2	2500/1A	—	PS	—	20Rct+100V ¹	30mA AT VK/2	**	
CT 20B	1	300/1A	15VA	5P	20	—	—	—	UT-6B LV NEUTRAL BUSHING
	2	2500/1A	—	PS	—	20Rct+100V ¹	30mA AT VK/2	**	
CT 1A'		REFER BHEL DOC TITLED 'CT/VT SIZING CALCULATION FOR MV SWITCHBOARDS'							11kV UNIT SWBD-6BA
CT 1B'		REFER BHEL DOC TITLED 'CT/VT SIZING CALCULATION FOR MV SWITCHBOARDS'							11kV UNIT SWBD-6BB
CT 2A'	1	2500/1A	—	PS	—	20Rct+100V ¹	30mA AT VK/2	**	11kV UNIT SWBD-6BA
	2	2500/1A	—	PS	—	50Rct+200V	30mA AT VK/2	**	
CT 2B'	1	2500/1A	—	PS	—	20Rct+100V ¹	30mA AT VK/2	**	11kV UNIT SWBD-6BB
	2	2500/1A	—	PS	—	50Rct+200V	30mA AT VK/2	**	

** : RCT VALUES TO BE DECIDED BY EQUIPMENT SUPPLIER.

VT DETAILS

VT NO.	RATIO	BURDEN	ACCURACY CLASS	LOCATION
VT 1	$\frac{21000}{\sqrt{3}} / \frac{110}{\sqrt{3}} \text{ V}$	100VA	0.2/3P	SP & VT CUBICLE
VT 2	$\frac{21000}{\sqrt{3}} / \frac{110}{\sqrt{3}} \text{ V}$	100VA	0.2/3P	SP & VT CUBICLE
VT 3	$\frac{21000}{\sqrt{3}} / \frac{110}{\sqrt{3}} \text{ V}$	100VA	0.2	SP & VT CUBICLE

IVT DETAILS

IVT NO.	RATIO	BURDEN	ACCURACY CLASS	LOCATION
IVT 1	$\frac{110}{\sqrt{3}} / 72 \text{ V}$	15VA	3P	GRP

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																TITLE	DRAWING NO.
										SINGLE LINE DIAGRAM FOR GENERATOR CIRCUIT METERING & PROTECTION [STG]						PE-DG-415-510-E001	
																SHEET 6 OF 10	

PE-DG-415-510-E001
DRAWING NO.

TRANSDUCER DETAILS

DEVICE NO.	RANGE	OUTPUT	NO. OF OUTPUT	ACCURACY	AUXILIARY VOLTAGE	LOCATION
AT1/2/3	0-25000 A	4-20mA	2	0.5	240V AC	INSIDE T&AVTP
HZT1/2/3	45-55 Hz	4-20mA	2	0.2	240V AC	INSIDE T&AVTP
PFT1	0.5 LAG-1.0-0.5 LEAD	4-20mA	2	0.5	240V AC	INSIDE T&AVTP
VT1/2/3	0-25 kV	4-20mA	2	0.5	240V AC	INSIDE T&AVTP
VART1	-350-0-600 MVAR	4-20mA	2	0.5	240V AC	INSIDE T&AVTP
WT1	0-720 MW	4-20mA	2	0.5	240V AC	INSIDE T&AVTP
VT5/6/7/8/9/10	0-500 kV	4-20mA	2	0.5	240V AC	INSIDE T&AVTP

INDICATING METER DETAILS

DEVICE NO.	RANGE	INPUT	SIZE (MM)	TYPE	LOCATION	DESCRIPTION
A1	0-25000 A	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR CURRENT
A2	0-10 kA DC	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR FIELD CURRENT
A3	0-200 A DC	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR EXCITER FIELD CURRENT
HZ1	45-55 Hz	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR FREQUENCY
HZ2/3	45-55 Hz	4-20mA	48 x 24	DIGITAL	ECP	400KV BUS-1/2 FREQUENCY
VAR1	-350-0-600 MVAR	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR REACTIVE POWER
W1	0-720 MW	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR ACTIVE POWER
PF1	0.5LAG-1-0.5LEAD	4-20mA	48 x 24	ANALOG	ECP	GENERATOR POWER FACTOR
V1	0-25 kV	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR VOLTAGE
V2	-15-0-15 V	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR BALANCE VOLTAGE
V3	0-1000 V DC	4-20mA	48 x 24	DIGITAL	ECP	GENERATOR FIELD VOLTAGE
V4/5	0-500 kV	4-20mA	48 x 24	DIGITAL	ECP	400KV BUS-1/2 VOLTAGE

INTEGRATING METER DETAILS

DEVICE NO.	TYPE	ACCURACY CLASS	LOCATION
MFM (GENERATOR TERMINAL)	DIGITAL (WITH RS485 PORT)	0.2S	ECP
MFM (GT HV SIDE)	DIGITAL (WITH RS485 PORT)	0.2S	ECP
MFM (UT-6A HV SIDE)	DIGITAL (WITH RS485 PORT)	0.2S	ECP
MFM (UT-6B HV SIDE)	DIGITAL (WITH RS485 PORT)	0.2S	ECP

MULTIFUNCTION METER SHALL BE USED FOR MEASUREMENT OF ENERGY AUDIT & ACCOUNTING

DISTURBANCE RECORDER (DR)

DEVICE NO.	PURPOSE	RANGE	INPUT	LOCATION
DR	GENERATOR CURRENT	0 - 25000A	CT I/P	GRP
	GENERATOR ACTIVE POWER	0 - 720MW	CT I/P, VT I/P	
	GENERATOR REACTIVE POWER	-600 -0- 600MVAR	CT I/P, VT I/P	
	GENERATOR VOLTAGE	0 - 25kV	VT I/P	
	GENERATOR FREQ.	45-55Hz	VT I/P	
	GEN. FIELD VOLTAGE	0-1000V DC	4-20mA	
	GEN. FIELD CURRENT	0-10kA DC	4-20mA	

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD
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BHARAT HEAVY ELECTRICALS LTD.
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**
1 X 660MW BHUSAWAL TPP

TITLE

**SINGLE LINE DIAGRAM FOR GENERATOR
CIRCUIT METERING & PROTECTION [STG]**

DRAWING NO. **PE-DG-415-510-E001**

SHEET 7 OF 10 REV. 1A

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CUSTOMER'S DRAWING NO.

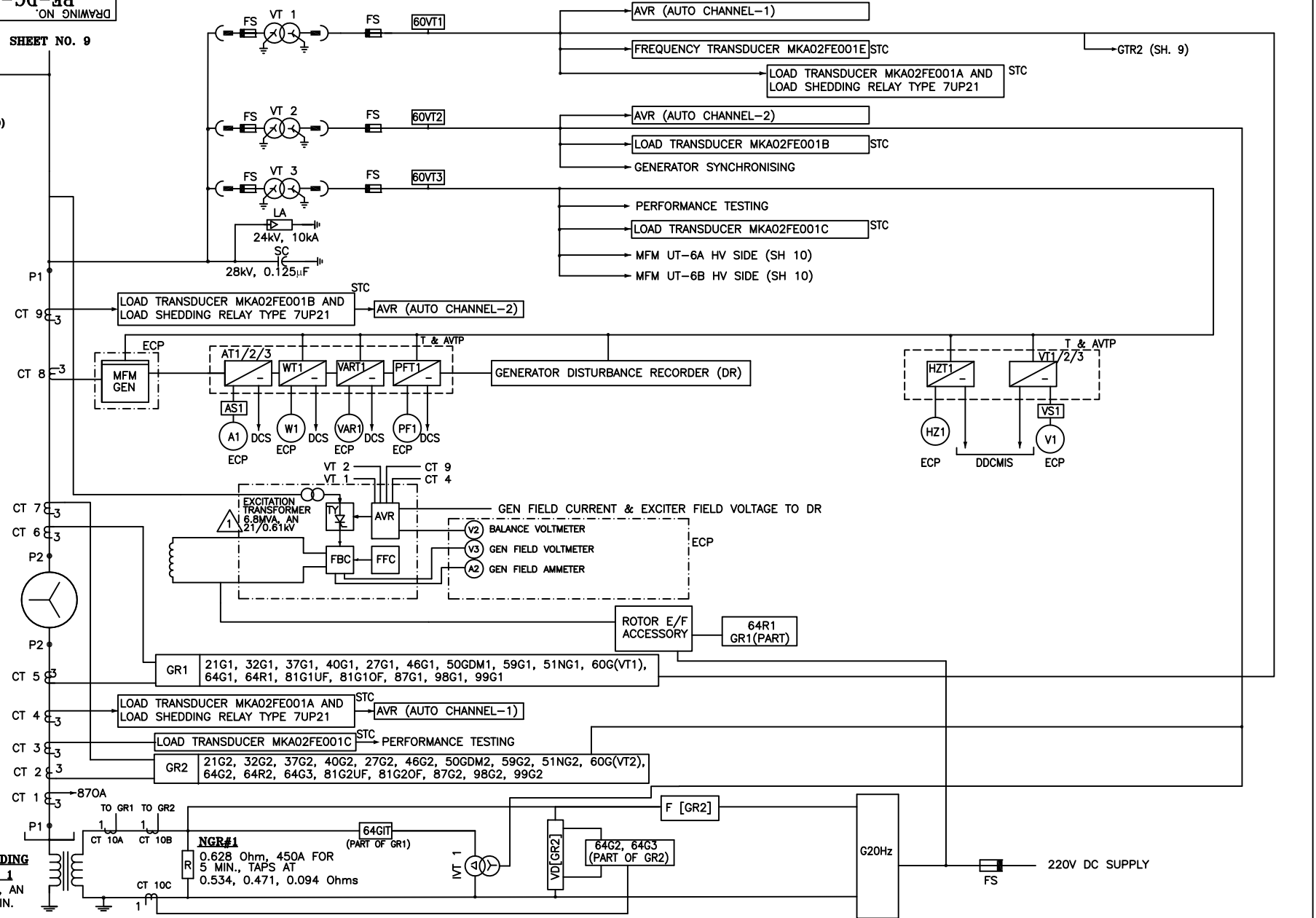
PE-DG-415-510-E001
DRAWING NO.

SHEET NO. 9

UT # 6A/6B
(SHEET NO. 10)

GENERATOR # 6
660MW, 21kV, 3Ph,
50Hz, PF=0.85,
Xd" = 20.2%
STATIC EXCITATION

**NEUTRAL GROUNDING
TRANSFORMER # 1**
13.5kV/240V, 1 PH, AN
175 kVA FOR 5 MIN.



REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD



BHARAT HEAVY ELECTRICALS LTD.
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

MAHARASHTRA STATE POWER
GENERATION CO. LTD.
1 X 660MW BHUSAWAL TPP

TITLE

SINGLE LINE DIAGRAM FOR GENERATOR
CIRCUIT METERING & PROTECTION [STG]

DRAWING NO.

PE-DG-415-510-E001

SHEET 8

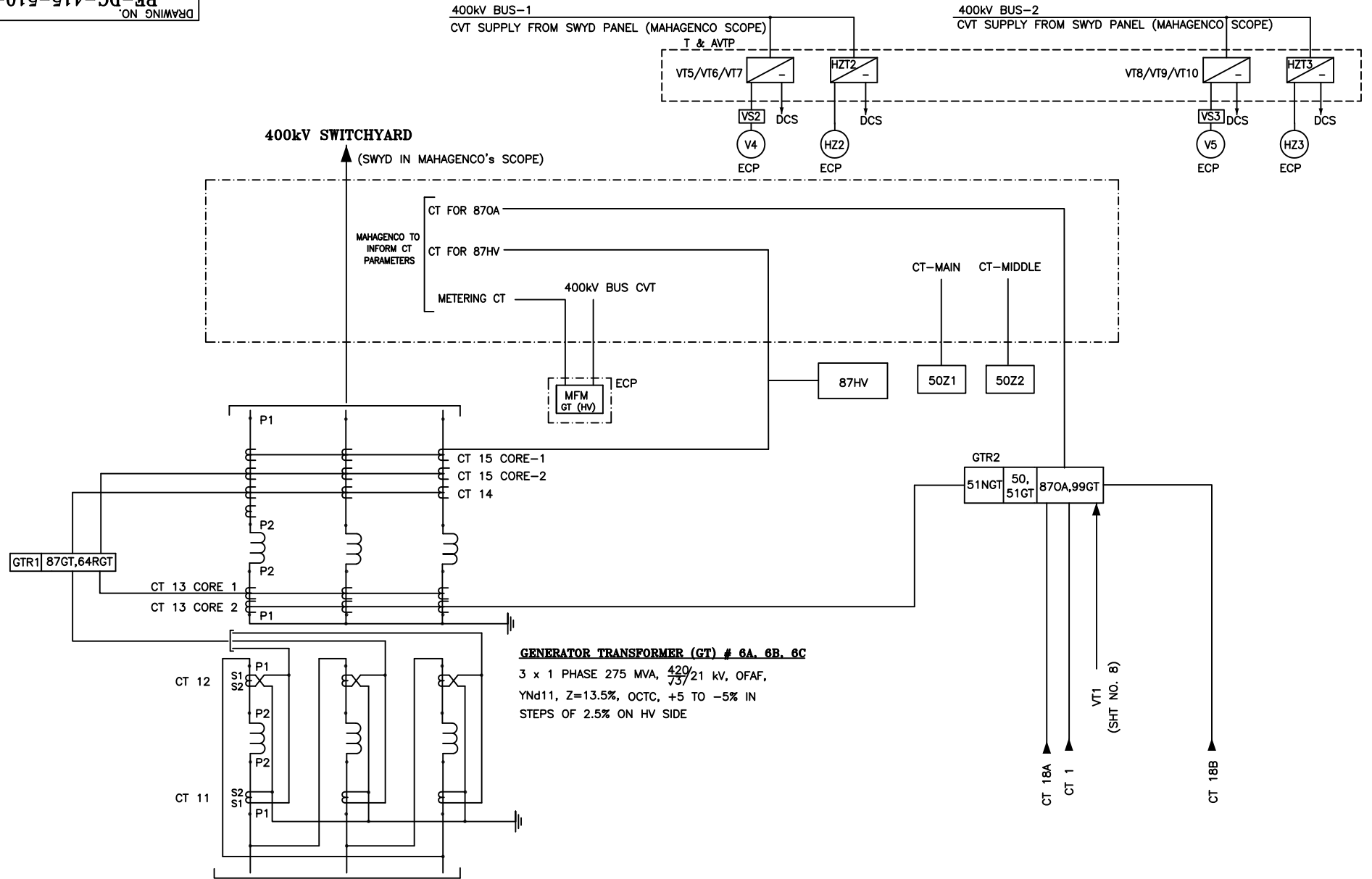
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SHEET NO. 8

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD
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NOIDA

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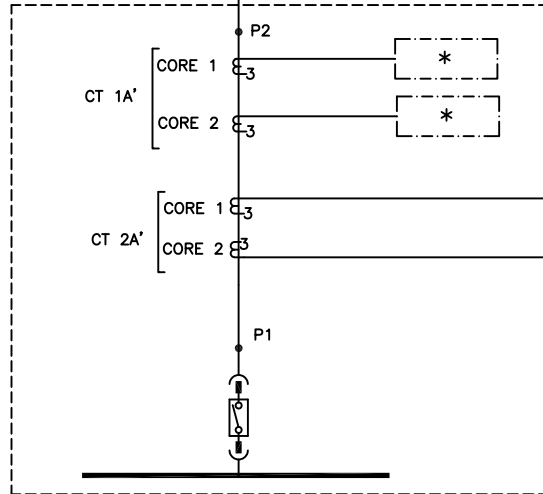
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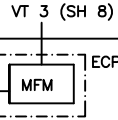
SHEET NO. 8

UNIT TRANSFORMER (UT) #6A

40 MVA, 21/11.5 kV,
ONAN/ONAF, Dyn1, Z=11.5%, AT
PRINCIPAL TAP, OLTC + 10%
TO -10% IN STEPS OF
1.25% ON HV SIDE



11kV UNIT SWBD. 6BA

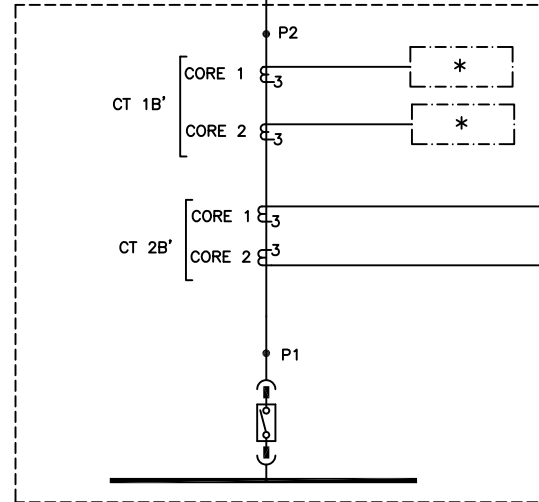


50/51UTA/64RUTA

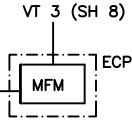
87UTA/51NUTA

UNIT TRANSFORMER (UT) #6B

40 MVA, 21/11.5 kV,
ONAN/ONAF, Dyn1, Z=11.5%, AT
PRINCIPAL TAP, OLTC + 10%
TO -10% IN STEPS OF
1.25% ON HV SIDE



11kV UNIT SWBD. 6BB



50/51UTB/64RUTB

87UTB/51NUTB

* CT/VT SIZING CALCULATIONS FOR MV SWITCHBOARDS BHEL DRAWING NO. PE-DG-415-505-E006

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD
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POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

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1 X 660MW BHUSAWAL TPP

TITLE

**SINGLE LINE DIAGRAM FOR GENERATOR
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DRAWING NO.

PE-DG-415-510-E001

SHEET 10 OF 10

REV. 1A