BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

NEW DELHI

DOCUMENT No.	TE-370-316-001A	Rev	00		Prepared	Checked	Approved
CUSTOMER Doc. No.				NAME	MVK	MVK	RS
TYPE OF DOC.	TECHNICAL SPECIFICATION			SIGN			
TITLE				DATE	06.08.15	06.08.15	06.08.15
CONTROLLED SWITHING DEVICES FOR EXISTING 420 kV CIRCUIT BREAKERS				GROUP	TBEM		
				W.O. No	84001		

CUSTOMER	**POWER GRID CORPORATION OF INDIA LIMITED**
PROJECT	**Substation Package-SS02 for Extension of I) 400kV Biharshariff S/s, II) 400kV Jamshedpur S/s, III) 400 kV Gazuwaka S/s, IV) 400 kV Rengali S/s, V) 400 kV Rourkela S/s, VI) 400 kV Durgapur S/s & VII) 400 kV Gorakhpur S/s associated with Eastern Region Strengthening Scheme-IX**

List of Contents — No. of Pages

Rev.	Date	Altered	Checked	Approved	REVISION DETAILS
00					First Issue

Distribution	CUSTOMER	TBMM	O/C	
	-	4	1	

SECTION - 1

1.1 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing & dispatch and supervision of erection, testing & commissioning of Controlled Switching Devices (CSD) for existing 420 kV Circuit Breakers complete with accessories as listed under this specification.

This section covers the scope, specific technical requirements and quantities of CSD's. This constitutes minimum technical parameters for the above item as specified by the customer (POWERGRID). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-2 of this specification.

In case of any discrepancies between the requirements mentioned under Section-1 and those specified in Section-2, the order of preference shall be Section-1 followed by Section-2 and shall be treated as binding requirement.

The equipment is required for the following project:

Name of the Customer	:	POWER GRID CORPORATION OF INDIA LIMITED (PGCIL)
Name of the Project	:	Extension of I) 400kV Biharshariff S/s, II) 400kV Jamshedpur S/s, III) 400 kV Gazuwaka S/s, IV) 400 kV Rengali S/s, V) 400 kV Rourkela S/s, VI) 400 kV Durgapur S/s & VII) 400 kV Gorakhpur S/s under ERSS-IX

The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

Existing Circuit Breaker shall be equipped with controlled switching with consequent optimization of switching behavior, when used in:

- Switching of shunt reactor.

The controller shall be provided in Circuit breaker of switchable line reactor and in Main & Tie circuit breakers of Transformers, line with non-switchable line reactors and Bus reactors.

The controlling relay shall also record and monitor the switching operations and make adjustments to the switching instants to optimize the switching behavior as necessary. It shall provide self diagnostic facilities, signaling of alarms and enable downloading of data captured from the switching events.

Technical Requirement for controlled switching device:

a) The controller shall be designed to operate at the correctly and satisfactorily with the excursion of auxiliary A/C & DC voltages and frequency as specified in

section - 2.

b) The controller shall meet the requirements of IEC-60255-4 Appendix 'E' class III regarding HF disturbance test, and fast transient test shall be as per IEC-61000 – 4 level III and insulation test as per 60255 – 5.
c) The controller shall have functions for switching ON & OFF the circuit breakers.
d) The controller shall get command to operate the breakers manually or through auto re-close relay at random. The controller shall be able to analyze the current and voltage waves available through the signals from secondaries of CTs & CVTs for the purpose of calculation of optimum moment of the switching the circuit breaker and issue command to circuit breaker to operate.
e) The controller shall also have an adaptive control feature to consider the next operating time of the breaker in calculation of optimum time of issuing the switching command. In calculation of next operating time of the breaker the controller must consider all factors that may affect the operating time of the breaker such as, but not limited to, ambient temperature, hydraulic/pneumatic pressure of the operating mechanism, control voltage variation, SF6 gas density variations etc. Schematic drawing for this purpose shall be provided by the contractor. The accuracy of the operating time estimation by the controller shall be better than +0.5 ms.
f) The controller should have display facility at the front for the settings and measured values.
g) The controller should be PC compatible for the setting of various parameters and down loading of the settings and measured values date time of switching etc. Window based software for this purpose shall be supplied by the contractor to be used on the owner's PC.
h) The controller shall have self-monitoring facility.
i) The controller shall be suitable for current input of 1 amp from the secondary of the CTs. and 110 V (Ph to Ph) from the CVTs. The controller shall also take care of transient and dynamic state values of the current from the secondary of the CTs and CVTs.
j) The controller shall have time setting resolution of 0.1 ms or better.
k) The controller shall have sufficient number of output/input potential free contacts for connecting the monitoring equipment and annunciation system available in the control room. Necessary details shall be worked out during engineering the scheme.
l) The provision for bypassing the Controlled switching device shall be provided through BCU and SCADA both. Further, in case of any non operation of the controlled switching device after receiving a close/trip command after a pre-determined time delay, the controlled switching device should automatically be bypassed so as to ensure that the trip and close commands are extended to the Trip/close coils.

1.3 BILL OF QUANTITIES

Sl. No	Description	Unit	Project Quantity					Total Qty
			Rourkela	Biharshariff	Rengali	Jamshedpur	Durgapur	
1.	Supply of Controlled Switching Device (CSD) for existing# 400kV CB [**ABB Make**] along with all accessories like transducers etc complete in all respect (except special cables)	Set	-	1	-	2	2	5
2.	Supply of Controlled Switching Device (CSD) for existing# 400kV CB [**BHEL Make**] along with all accessories like transducers etc complete in all respect (except special cables)	Set	1	-	-	-	-	1
3.	Supply of Controlled Switching Device (CSD) for existing# 400kV CB [**CGL Make**] along with all accessories like transducers etc complete in all respect (except special cables)	Set	-	-	1	-	-	1
4.	Supply of special cables$ for CSD [for **ABB Make** CB] Length = distance from CB to Relay panel	m	-	400	-	450	600	1450
5.	Supply of special cables$ for CSD [for **BHEL Make** CB] Length = distance from CB to Relay panel	m	300	-	-	-	-	300
6.	Supply of special cables$ for CSD [for **CGL Make** CB] Length = distance from CB to Relay panel	m	-	-	600	-	-	600
7.	Erection, Testing & Commissioning of all supplied CSD's at site. (including interface with existing CB) except special cable laying [for **ABB Make** CB]	Set	-	1	-	2	2	5
8.	Erection, Testing & Commissioning of all supplied CSD's at site. (including interface with existing CB) except special cable laying [for **BHEL Make** CB]	Set	1	-	-	-	-	1
9.	Erection, Testing & Commissioning of all supplied CSD's at site. (including interface with existing CB) except special cable laying [for **CGL Make** CB]	Set	-	-	1	-	-	1
10.	Training to Powergrid's personnel (two persons) on design, operation, maintenance and commissioning aspect of Circuit Breaker (Control switching Device) for two (2) days [CSD for **ABB Make** CB]	Lot	-	1	-	1	1	3

11.	Training to Powergrid's personnel (two persons) on design, operation, maintenance and commissioning aspect of Circuit Breaker (Control switching Device) for two (2) days [CSD for **BHEL Make** CB]	Lot	1	-	-	-	-	1
12.	Training to Powergrid's personnel (two persons) on design, operation, maintenance and commissioning aspect of Circuit Breaker (Control switching Device) for two (2) days [CSD for **CGL Make** CB]	Lot	-	-	1	-	-	1

[$] Special cables other than 1100V LT Power & Control Cables required for CSD shall be in bidders scope.

[#] Make/model of existing 420 kV Circuit Breakers at respective substations are as below:

Sl No	**Substation**	**SLD Drg No.**	**Dia.**	**Tie Bay CB**
1	Rourkela S/s	TB-3-370-316-001	422-423-424	BHEL make, Model-3AT2
2	Biharshariff S/s	TB-3-370-316-003	Sasaram#1-Tie-125MVAR B/R#1&3	ABB make, Model-ELF SL6-2
3	Rengali S/s	TB-3-370-316-004	Indrāvati-Tie 125MVAR B/R#1	CGL make, Model-400SFM
4	Jamshedpur S/s	TB-3-370-316-005	ICT#1-Tie-125MVAR B/R#3	ABB make, Model-ELF SL6-2
			ICT#2-Tie-125MVAR B/R#2	ABB make, Model-ELF SL6-2
5	Durgapur S/s	TB-3-370-316-006	Bidhannagar#2 -Tie- B/R#1&2	ABB make, Model-ELF SL6-2
			Jamshedpur#3-Tie-125MVAR B/R#3	ABB make, Model-400LTB420 E2

NOTE:

1) Total qty. in BOQ may vary by ± 30%. However, individual quantities may vary up to any extent.
2) For item no. 10, 11 & 12 of BOQ, training at manufacturer's/supplier's works/site is at the sole discretion of end Customer. However, travelling and living expenses of Powergrid's personal, if any, shall be borne by the Powergrid.
3) Cables, lugs, ties etc required for connection of CSD in existing relay panel is deemed to be included in bidders scope.
4) **Enclosures**:

Sl No	**Drg No.**	**Description**
1	TB-3-370-316-001 (R1)	SLD for 400 kV Rourkela S/s Extn.

2	TB-3-370-316-003 (R1)	SLD for 400 kV Biharshariff S/s Extn.
3	TB-3-370-316-004 (R1)	SLD for 400 kV Rengali S/s Extn.
4	TB-3-370-316-005 (R1)	SLD for 400 kV Jamshedpur S/s Extn.
5	TB-3-370-316-006 (R1)	SLD for 400 kV Durgapur S/s Extn.
6	TB-1-370-316-008 (R1)	Electrical layout Plan & Section for 400kV Rourkela s/s extension
7	TB-0-370-316-010 (R1)	Electrical layout Plan & Section for 400kV Biharshariff s/s extension
8	TB-0-370-316-011 (R2)	Electrical Plan & Section layout for 400kV Rengali s/s extension
9	TB-1-370-316-012 (R1)	Electrical Layout Plan and Section for 400kV Jamshedpur s/s extension
10	TB-0-370-316-013 (R2)	Electrical Layout Plan & section for 400kV Durgapur s/s extension

1.4 TYPE TESTING

Bidder shall submit valid type test reports (as per relevant IEC/IS Standard) for approval. The type test reports submitted shall be of tests conducted within last 10 years prior to the date of bid opening i.e. 27.01.2014. The bidder should have conducted type test on identical or similar equipment/ components to those offered. In case type test reports are found to be technically unacceptable to BHEL/PGCIL, the type test shall be conducted without cost and delivery implication to BHEL.

1.5 ERECTION, TESTING & COMMISSIONING

Bidder shall quote lump-sum price for installation and commissioning of CSD for each breaker at each site (including interface with existing CB) except special cable laying. The required instruments for testing & commissioning shall be brought by the bidder and shall be taken back by the bidder after successful completion of testing and commissioning.

1.6 TRAINING :

The successful bidder shall impart necessary training on design, operation, maintenance and commissioning aspect of Circuit Breaker (Control switching Device) to Powergrid's personnel at manufacturer's/supplier's works/site for two (2) days. Location for training is at the sole discretion of end Customer. However, the travelling and living expenses of Powergrid's personal, if any, shall be borne by the Powergrid.

1.7 QUALITY PLAN

Bidder to follow valid PGCIL approved Quality Plan as per PGCIL procedure. In case the bidder don't have PGCIL approved QP, it will be the bidder's responsibility to get its QP approved directly from the ultimate customer.

1.8 PROJECT TITLE BLOCK

CUSTOMER	POWERGRID CORPORATION OF INDIA LIMITED				
PROJECT	Substation Package-SS02 for Extension of I) 400kV Biharshariff S/s, II) 400kV Jamshedpur S/s, III) 400 kV Gazuwaka S/s, IV) 400 kV Rengali S/s, V) 400 kV Rourkela S/s, VI) 400 kV Durgapur S/s & VII) 400 kV Gorakhpur S/s associated with Eastern Region Strengthening Scheme-IX				
CONTRACT NO	CC-CS/393-ER2/SS-2266/3/G6/CA-I/4991, dtd. 14.07.14 (Supply) CC-CS/393-ER2/SS-2266/3/G6/CA-II/4992, dtd. 14.07.14 (Services)				
BHEL P.O. No.		**PROJ. DOC. No.**		**REV. No.**	
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED				
VENDOR'S STANDARD TITLE BLOCK					

- - x x - -

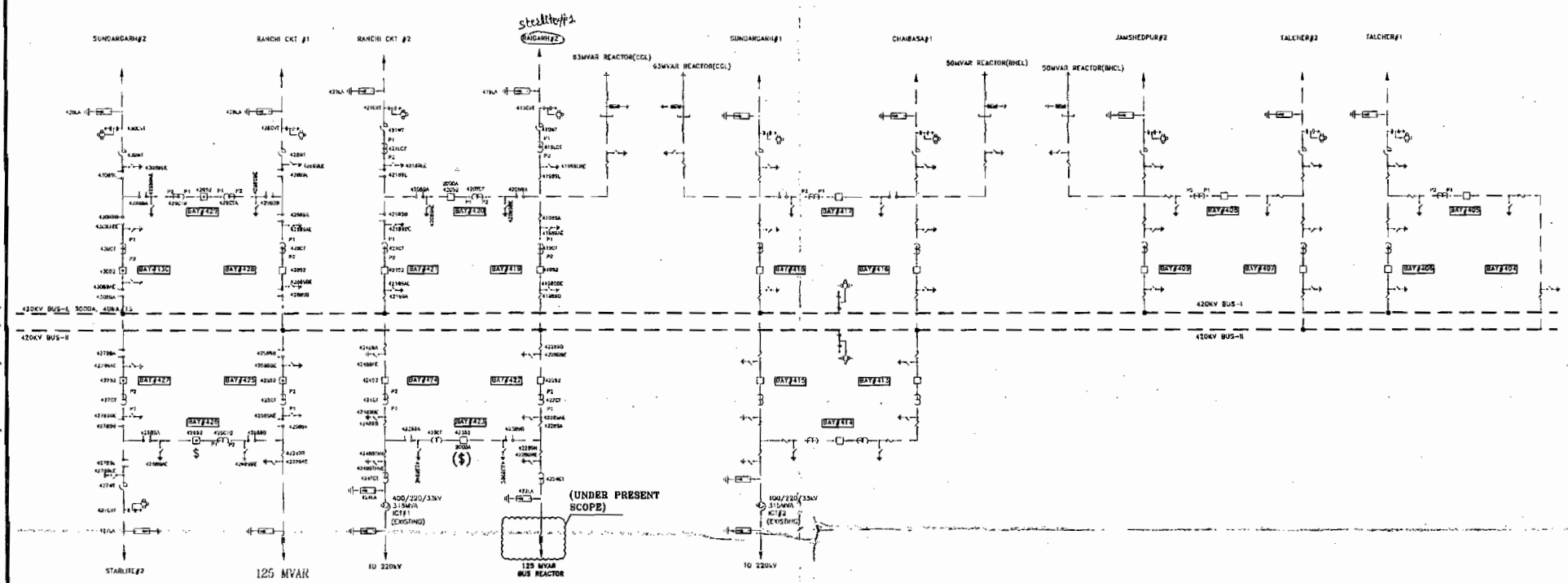
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-3-370-316-001

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.



GA-I

NOTES:-

1. SYSTEM 40kA/1S., 50 Hz, 3 PH., Effectively EARTHED.
2. EXISTING 420KV, 50MVAR (3-PH) BUS REACTOR SHALL BE REPLACED BY 125MVAR BUS REACTOR.
3. ($) CONTROL SWITCHING DEVICE FOR EXISTING 400KV TIE CIRCUIT BREAKER ASSOCIATED WITH 125MVAR BUS REACTOR UNDER PRESENT SCOPE.

LEGEND:-

——— BHEL SCOPE (PRESENT SCOPE)
- - - - FUTURE/EXISTING

REF. DWG.:-

DWG NO. C/ENGG/ER-II/ROK/ERSS-IX/SLD/01, R0 - TENDER SLD FOR 400kV ROURKELA S/STN. EXTN.
DWG NO. PGCIL-NTAMC-A/GEN-2-023, RB - ROURKELA S/S 400/220KV SLD.

SCHEDULE OF EQUIPMENT

S.NO.	DESCRIPTION	SYMBOL	QTY.	DESIG.	MAKE
1	125 MVAR BUS REACTOR 420kV (3-PH)	~~~	01		BHEL
2	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (BHEL MAKE) IN TIE BAY#423	($)	01		

CUSTOMER:	POWER GRID CORPORATION OF INDIA LTD.
PROJECT:	SUBSTATION PACKAGE-SSD2 FOR EXTN OF BIHARSHARIFF, JAMSHEDPUR, GAJUWAKA, RENGALI, ROURKELA, DURGAPUR AND GORAKHPUR SUBSTATIONS UNDER ERSS-IX
NOA REF NO.	CC-CS/393-ER2/SS-2266/3/G6/NOA-I/4991, DATED 23.06.2014
STATUS CONTRACT	
DISTRIBUTION	

REV.	DATE	ALTD.	CHD.	APPD.

REV.	DATE	ALTD.	CHD.	APPD.
01	20.01.15	MVK	MVK	SKS

1) REVISED AS PER POWERGRID COMMENTS DT. 19.09.14.

	NAME	SIGN.	DATE
DRAWN	M.SHARMA	SD/-	14.08.14
CHECKED	MVK/RK	SD/-	14.08.14
APPROVED	SKS/VK	SD/-	14.08.14

DISTRIBUTION OF PRINTS

DEPTT	CODE
TBEM	422

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS DIVISION

CARD CODE

SINGLE LINE DIAGRAM FOR 400kV ROURKELA S/S EXTN.

NEXT SHEET -
SHEET No. 01

SCALE | W.O. No. 84001 | DRG. No. TB-3-370-316-001 | REV. 01

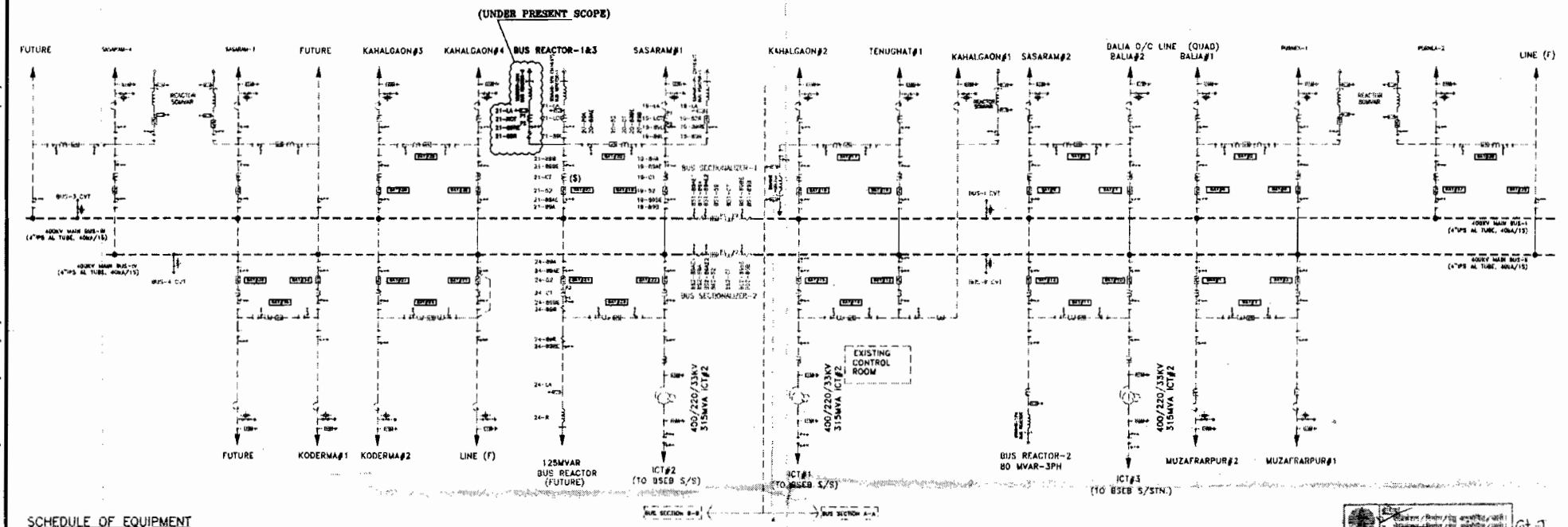
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-3-370-316-003

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.



SCHEDULE OF EQUIPMENT

S.NO.	DESCRIPTION	SYMBOL	QTY.	DESIG.	MAKE
1	125 MVAR BUS REACTOR 420kV (3-PH)		01		BHEL
2	420kV, 3150A, 40kA/1s CIRCUIT BREAKER WITHOUT CR (3-Ph)		-	52	SIEMENS
3	420kV, 3150A, 40kA/1s HDB ISOLATOR WITH 1 E/S (3-Ph)		01	89	
4	400kV, 3000A, 40kA/1s CT (1-PH)(WITH 120% EXTENDED CURRENT RATING)		03	CT	CGL
5	336kV SURGE ARRESTER (1-PH)		03	LA	CGL
6	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN MAIN BAY#21	($)	00		
7	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN TIE BAY#20	($)	01		

420 kV, 3000A, CT (6 CORE)

Core No.	Current Ratio	Accuracy Class	Output Burden VA	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	3000-2000-500/1	TPS	-	3000-2000-500	15/10/2.5	20-30-120	PROTECTION
2	3000-2000-500/1	TPS	-	3000-2000-500	15/10/2.5	20-30-120	PROTECTION
3	3000-2000-500/1	0.2S	20	-	-	-	METERING
4	3000-2000-500/1	0.2S	20	-	-	-	METERING
5	3000-2000-500/1	TPS	-	3000-2000-500	15/10/2.5	20-30-120	PROTECTION
6	3000-2000-500/1	TPS	-	3000-2000-500	15/10/2.5	20-30-120	PROTECTION

NOTES:-
1. SYSTEM 40kA/1S., 50 Hz, 3 PH., EFFECTIVELY EARTHED.
2. INDICATED CT PARAMETERS ARE AS PER POWERGRID SPECIFICATION.
3. ONE NO. 420KV, 125 MVAR BUS REACTOR SHALL BE PUT IN PARALLEL WITH EXISTING 50MVAR (3X16.67) BUS REACTOR-1.
4. ($) CONTROL SWITCHING DEVICE FOR EXISTING 400KV MAIN & TIE CIRCUIT BREAKER ASSOCIATED WITH 125MVAR BUS REACTOR UNDER PRESENT SCOPE.

LEGEND:-
—— BHEL SCOPE (PRESENT SCOPE)
- - - - FUTURE/EXISTING

REF. DWG.:-
DWG NO. C/ENGG/ER-I/ERSS-IX/SLD/01, R0 - TENDER SLD FOR 400kV BIHARSHARIFF S/STN. EXTN.
DWG NO. NIL - SLD FOR 400/220kV BIHARSHARIFF S/STN.

CUSTOMER:	POWER GRID CORPORATION OF INDIA LTD.
PROJECT:	SUBSTATION PACKAGE-SS02 FOR EXTN OF BIHARSHARIFF, JAMSHEDPUR, GAJUWAKA, RENGALI, ROURKELA, DURGAPUR AND GORAKHPUR SUBSTATIONS UNDER ERSS-IX
NOA REF NO.	CC-CS/393-ER2/SS-2266/3/G6/NOA-I/4991, DATED 23.06.2014
STATUS CONTRACT	
DISTRIBUTION	

REV.	DATE	ALTD.	CHD.	APPD.

REV.	DATE	ALTD.	CHD.	APPD.
01	29.12.14	MVK	MVK	SKS

1) REVISED AS PER POWERGRID COMMENTS DT. 19.09.14.

	NAME	SIGN.	DATE
DRAWN	M.SHARMA	SD/-	14.08.14
CHECKED	MVK/RK	SD/-	14.08.14
APPROVED	SKS/VK	SD/-	14.08.14

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS DIVISION

CARD CODE

SINGLE LINE DIAGRAM FOR 400kV BIHARSHARIFF S/S EXTN.

NEXT SHEET -

SHEET No. 01

SCALE | W.O. No. | DRG. No. TB-3-370-316-003 | REV. 01

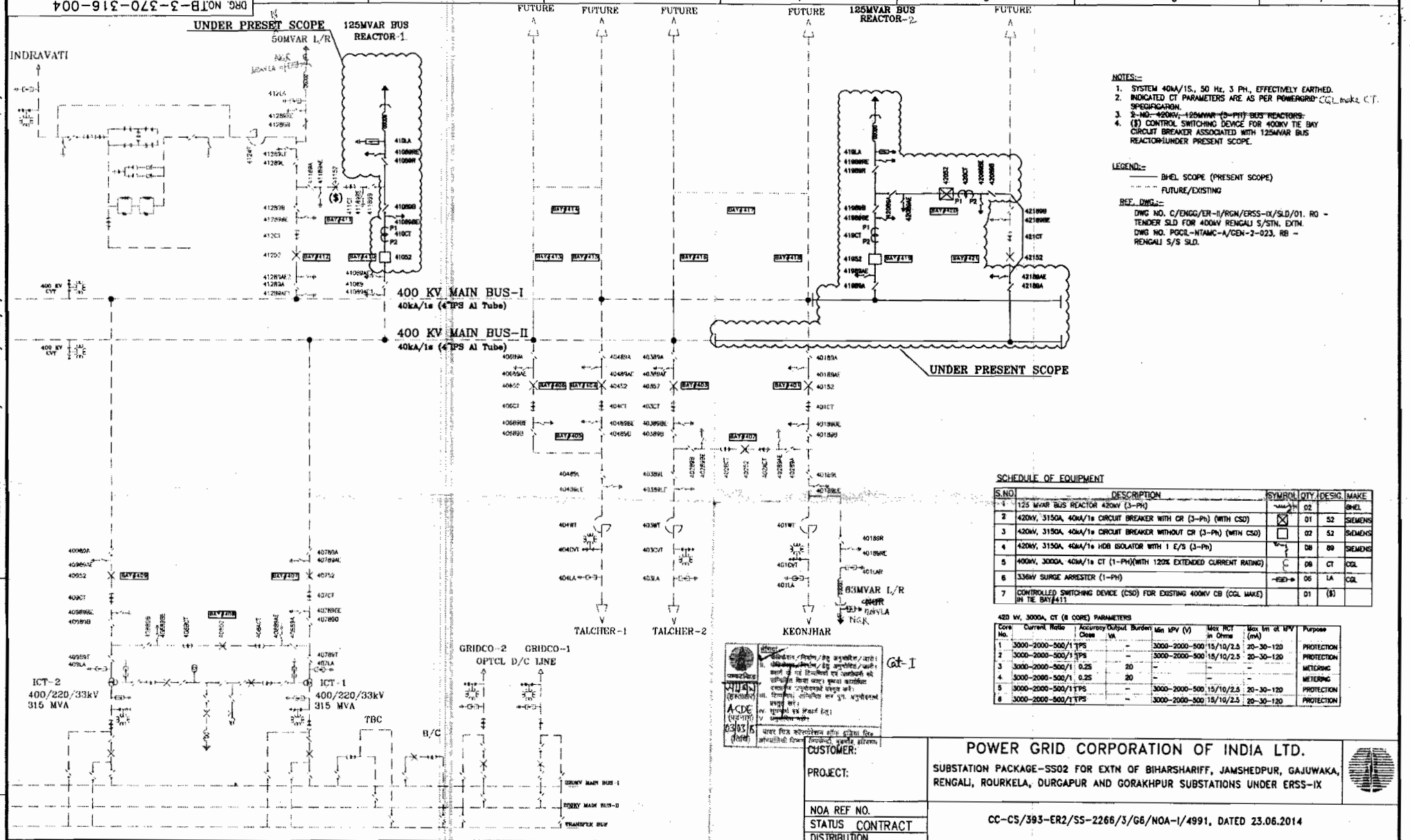
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-3-370-316-004

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.



NOTES:-

1. SYSTEM 400kA/1S., 50 Hz, 3 PH., EFFECTIVELY EARTHED.
2. INDICATED CT PARAMETERS ARE AS PER POWERGRID CGL make CT SPECIFICARION.
3. ~~2 NO. 420kV, 125MVAR (3-PH) BUS REACTORS.~~
4. ($) CONTROL SWITCHING DEVICE FOR 400KV TIE BAY CIRCUIT BREAKER ASSOCIATED WITH 125MVAR BUS REACTOR-I UNDER PRESENT SCOPE.

LEGEND:-

——— BHEL SCOPE (PRESENT SCOPE)
- - - - - FUTURE/EXISTING

REF. DWG.:-

DWG NO. C/ENGG/ER-II/RGN/ERSS-IX/SLD/01, R0 - TENDER SLD FOR 400kV RENGALI S/STN. EXTN.
DWG NO. PGCIL-NTAMC-A/CEN-2-023, R8 - RENGALI S/S SLD.

SCHEDULE OF EQUIPMENT

S.NO.	DESCRIPTION	SYMBOL	QTY	DESIG.	MAKE
1	125 MVAR BUS REACTOR 420kV (3-PH)		02		BHEL
2	420kV, 3150A, 40kA/1s CIRCUIT BREAKER WITH CR (3-Ph) (WITH CSD)		01	52	SIEMENS
3	420kV, 3150A, 40kA/1s CIRCUIT BREAKER WITHOUT CR (3-Ph) (WITH CSD)		02	52	SIEMENS
4	420kV, 3150A, 40kA/1s HDB ISOLATOR WITH 1 E/S (3-Ph)		09	89	SIEMENS
5	400kV, 3000A, 40kA/1s CT (1-PH)(WITH 120% EXTENDED CURRENT RATING)		09	CT	CGL
6	336kV SURGE ARRESTER (1-PH)		06	LA	CGL
7	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400kV CB (CGL MAKE) IN TIE BAY#411		01	($)	

420 kV, 3000A, CT (6 CORE) PARAMETERS

Core No.	Current Ratio	Accuracy Class	Output VA	Burden	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	3000-2000-500/1	TPS	-		3000-2000-500	15/10/2.5	20-30-120	PROTECTION
2	3000-2000-500/1	TPS	-		3000-2000-500	15/10/2.5	20-30-120	PROTECTION
3	3000-2000-500/1	0.25	20		-	-	-	METERING
4	3000-2000-500/1	0.25	20		-	-	-	METERING
5	3000-2000-500/1	TPS	-		3000-2000-500	15/10/2.5	20-30-120	PROTECTION
6	3000-2000-500/1	TPS	-		3000-2000-500	15/10/2.5	20-30-120	PROTECTION

Cat-I

CUSTOMER:

PROJECT: POWER GRID CORPORATION OF INDIA LTD.
SUBSTATION PACKAGE-SS02 FOR EXTN OF BIHARSHARIFF, JAMSHEDPUR, GAJUWAKA, RENGALI, ROURKELA, DURGAPUR AND GORAKHPUR SUBSTATIONS UNDER ERSS-IX

NOA REF NO. CC-CS/393-ER2/SS-2266/3/G6/NOA-I/4991, DATED 23.06.2014

STATUS CONTRACT

DISTRIBUTION

REV.	DATE	ALTD.	CHD.	APPD.

REV.	DATE	ALTD.	CHD.	APPD.
01	17.02.15	MVK	MVK	SKS

1) REVISED AS PER POWERGRID COMMENTS DT. 23.09.14 & 12.02.15.

	NAME	SIGN.	DATE
DRAWN	M.SHARMA	SD/-	14.08.14
CHECKED	MVK/RK	SD/-	14.08.14
APPROVED	SKS/VK	SD/-	14.08.14

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS DIVISION

CARD CODE

SINGLE LINE DIAGRAM FOR 400kV RENGALI S/S EXTN.

NEXT SHEET -

SHEET No. 01

SCALE | W.O. No. 84001 | DRG. No. TB-3-370-316-004 | REV. 01

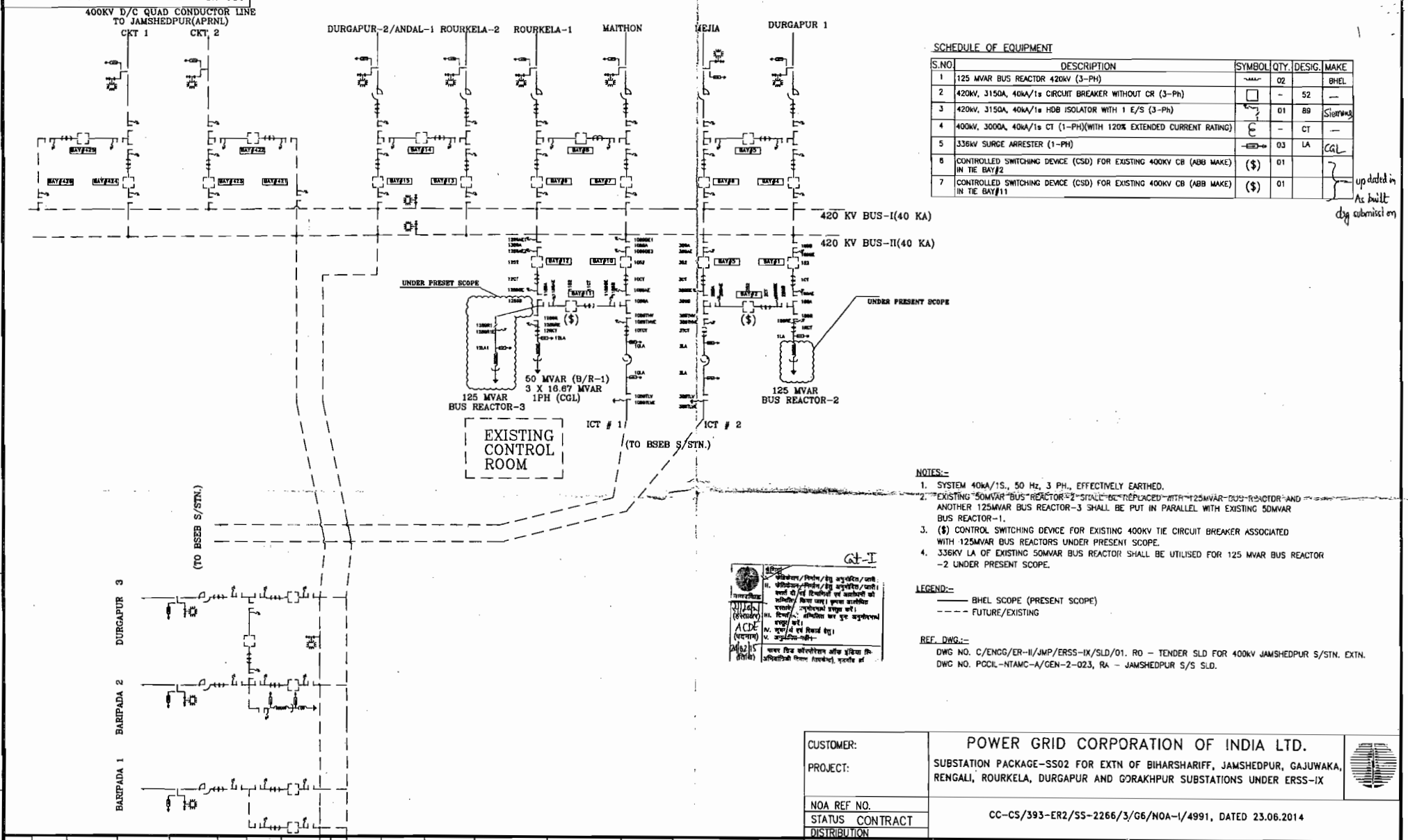
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-3-370-316-005

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.



SCHEDULE OF EQUIPMENT

S.NO.	DESCRIPTION	SYMBOL	QTY.	DESIG.	MAKE
1	125 MVAR BUS REACTOR 420kV (3-PH)		02		BHEL
2	420kV, 3150A, 40kA/1s CIRCUIT BREAKER WITHOUT CR (3-Ph)		-	52	—
3	420kV, 3150A, 40kA/1s HDB ISOLATOR WITH 1 E/S (3-Ph)		01	89	Siemens
4	400kV, 3000A, 40kA/1s CT (1-PH)(WITH 120% EXTENDED CURRENT RATING)		-	CT	—
5	336kV SURGE ARRESTER (1-PH)		03	LA	CGL
6	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN TIE BAY#2	($)	01		—
7	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN TIE BAY#11	($)	01		—

up dated in As built drg submission

NOTES:-
1. SYSTEM 40kA/1S., 50 Hz, 3 PH., EFFECTIVELY EARTHED.
2. EXISTING 50MVAR BUS REACTOR-2 SHALL BE REPLACED WITH 125MVAR BUS REACTOR AND ANOTHER 125MVAR BUS REACTOR-3 SHALL BE PUT IN PARALLEL WITH EXISTING 50MVAR BUS REACTOR-1.
3. ($) CONTROL SWITCHING DEVICE FOR EXISTING 400KV TIE CIRCUIT BREAKER ASSOCIATED WITH 125MVAR BUS REACTORS UNDER PRESENT SCOPE.
4. 336KV LA OF EXISTING 50MVAR BUS REACTOR SHALL BE UTILISED FOR 125 MVAR BUS REACTOR -2 UNDER PRESENT SCOPE.

LEGEND:-
——— BHEL SCOPE (PRESENT SCOPE)
- - - - FUTURE/EXISTING

REF. DWG.:-
DWG NO. C/ENCG/ER-II/JMP/ERSS-IX/SLD/01. R0 – TENDER SLD FOR 400kV JAMSHEDPUR S/STN. EXTN.
DWG NO. PGCIL-NTAMC-A/GEN-2-023, RA – JAMSHEDPUR S/S SLD.

Gt-I

REV.	DATE	ALTD.	CHD.	APPD.

REV.	DATE	ALTD.	CHD.	APPD.
01	17.02.15	MVK	MVK	SKS

1) REVISED AS PER POWERGRID COMMENTS DT. 19.09.14.

	NAME	SIGN.	DATE
DRAWN	M.SHARMA	SD/-	14.08.14
CHECKED	MVK/RK	SD/-	14.08.14
APPROVED	SKS/VK	SD/-	14.08.14

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

CUSTOMER: POWER GRID CORPORATION OF INDIA LTD.

PROJECT: SUBSTATION PACKAGE-SS02 FOR EXTN OF BIHARSHARIFF, JAMSHEDPUR, GAJUWAKA, RENGALI, ROURKELA, DURGAPUR AND GORAKHPUR SUBSTATIONS UNDER ERSS-IX

NOA REF NO. CC-CS/393-ER2/SS-2266/3/G6/NOA-I/4991, DATED 23.06.2014

STATUS CONTRACT

DISTRIBUTION

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS DIVISION

CARD CODE

SINGLE LINE DIAGRAM FOR 400kV JAMSHEDPUR S/S EXTN.

NEXT SHEET -

SHEET No. 01

SCALE | W.O. No. 84001 | DRG. No. TB-3-370-316-005 | REV. 01

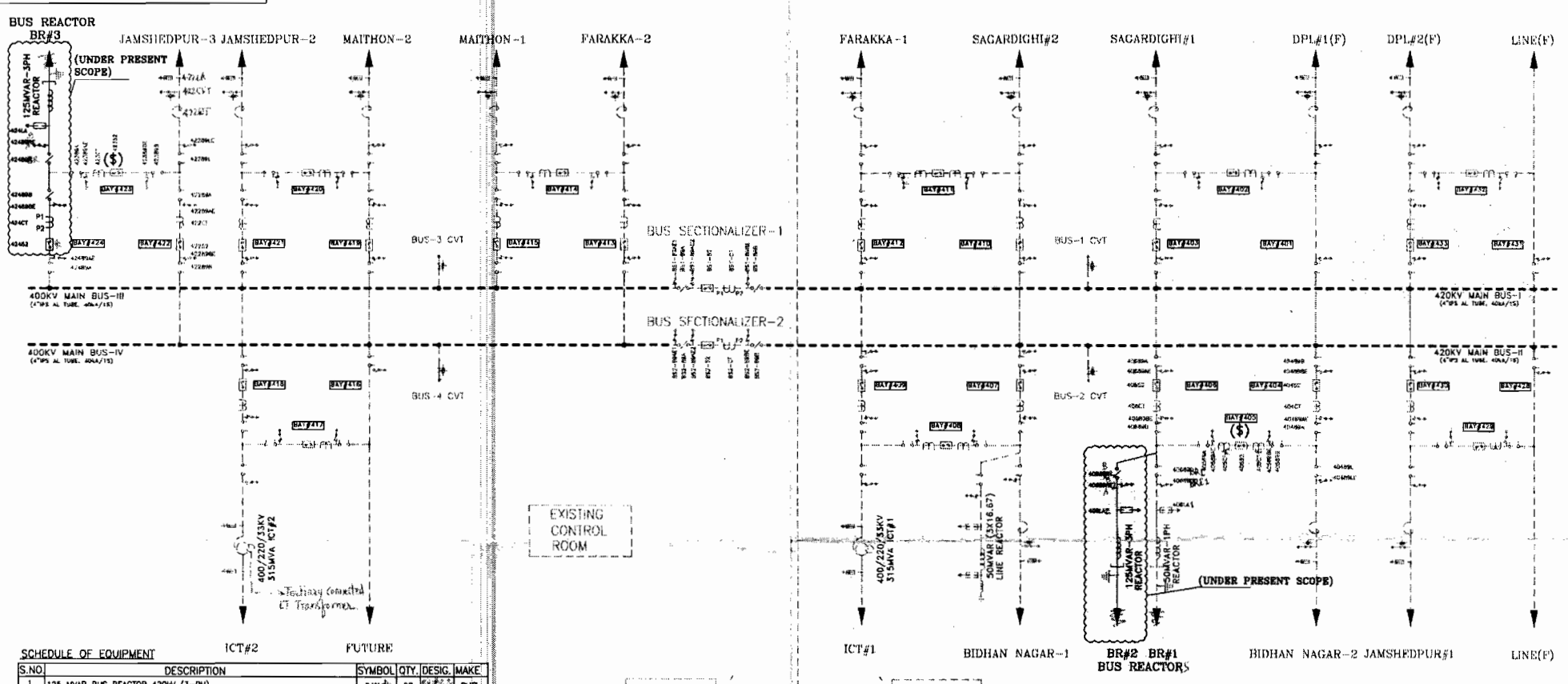
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-3-370-316-006

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.



SCHEDULE OF EQUIPMENT

S.NO.	DESCRIPTION	SYMBOL	QTY.	DESIG.	MAKE
1	125 MVAR BUS REACTOR 420kV (3-PH)		02	BR	BHEL
2	420kV, 3150A, 40kA/1s CIRCUIT BREAKER WITHOUT CR (3-Ph) (WITH CSD)		01	52	SIEMENS
3	420kV, 3150A, 40kA/1s HDB ISOLATOR WITH 1 E/S (3-Ph)		03	89	SIEMENS
4	400kV, 3000A, 40kA/1s CT (1-PH)(WITH 120% EXTENDED CURRENT RATING)		03	CT	C&L
5	336kV SURGE ARRESTER (1-PH)		06	LA	C&L
6	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN TIE BAY#423	($)	01		
7	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN TIE BAY#405	($)	01		
8	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN MAIN BAY#406	($)	00		

420 kV, 3000A, CT (6 CORE)

Core No.	Current Ratio	Accuracy Class	Output Burden VA	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	3000-2000-500/1	PS	-	3000-2000-500	15/10/2.5	20-30-120	PROTECTION
2	3000-2000-500/1	PS	-	3000-2000-500	15/10/2.5	20-30-120	PROTECTION
3	3000-2000-500/1	0.2S	20	-	-	-	METERING
4	3000-2000-500/1	0.2S	20	-	-	-	METERING
5	3000-2000-500/1	PS	-	3000-2000-500	15/10/2.5	20-30-120	PROTECTION
6	3000-2000-500/1	PS	-	3000-2000-500	15/10/2.5	20-30-120	PROTECTION

LEGEND:-
——— BHEL SCOPE (PRESENT SCOPE)
- - - - FUTURE/EXISTING

NOTES:-
1. SYSTEM 40kA/1S., 50 Hz, 3 PH., EFFECTIVELY EARTHED.
2. INDICATED CT PARAMETERS ARE AS PER POWERGRID SPECIFICATION.
3. ONE NO. 420KV, 125 MVAR BUS REACTOR SHALL BE PUT IN PARALLEL WITH EXISTING 50MVAR (3X16.67) BUS REACTOR.
4. ($) CONTROL SWITCHING DEVICE FOR EXISTING 400KV MAIN & TIE CIRCUIT BREAKER ASSOCIATED WITH 125MVAR BUS REACTOR-2 & EXISTING 400KV TIE CIRCUIT BREAKER ASSOCIATED WITH 125MVAR BUS REACTOR-3.

REF. DWG:-
DWG NO. C/ENGG/ER-II/DRP/ERSS-IX/SLD/01, R0 - TENDER SLD FOR 400kV DURGAPUR S/STN. EXTN.
DWG NO. NIL - SLD OF 400/220/33kV DURGAPUR S/S.

REV.	DATE	ALTD.	CHD.	APPD.
01	17.02.15	MVK	MVK	SKS

1) REVISED AS PER POWERGRID COMMENTS DT. 19.09.14.

	NAME	SIGN.	DATE
DRAWN	M.SHARMA	SD/-	14.08.14
CHECKED	MVK/RK	SD/-	14.08.14
APPROVED	SKS/VK	SD/-	14.08.14

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

CUSTOMER: POWER GRID CORPORATION OF INDIA LTD.

PROJECT: SUBSTATION PACKAGE-SS02 FOR EXTN OF BIHARSHARIFF, JAMSHEDPUR, GAJUWAKA, RENGALI, ROURKELA, DURGAPUR AND GORAKHPUR SUBSTATIONS UNDER ERSS-IX

NOA REF NO. CC-CS/393-ER2/SS-2266/3/G6/NOA-I/4991, DATED 23.06.2014

STATUS CONTRACT

DISTRIBUTION

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS DIVISION

CARD CODE

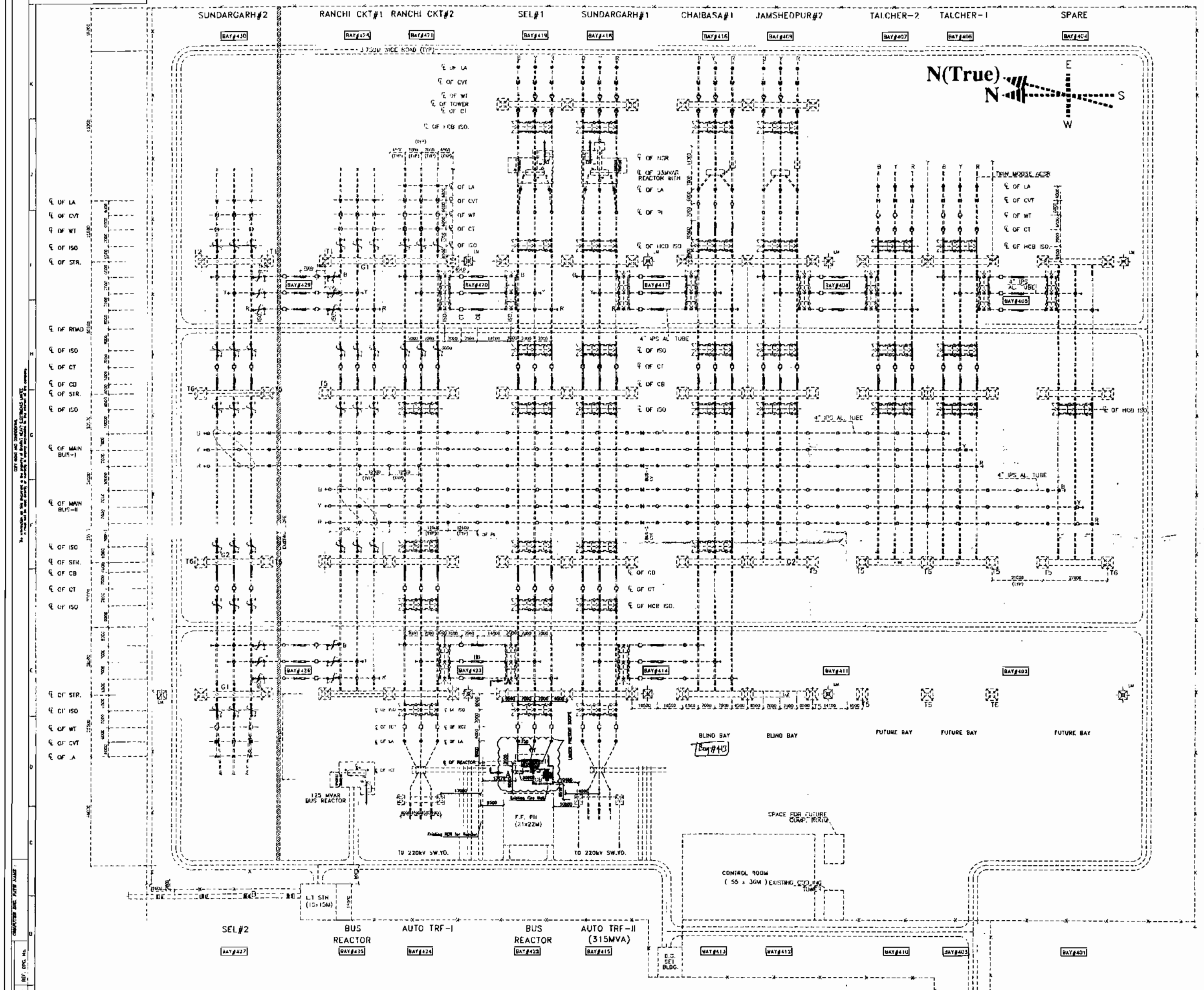
SINGLE LINE DIAGRAM FOR 400kV DURGAPUR S/S EXTN.

NEXT SHEET -

SHEET No. 01

SCALE | W.O. No. 84001 | DRG. No. TB-3-370-316-006 | REV. 01

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)



SYSTEM PARAMETERS :-

1.	NOMINAL SYSTEM VOLTAGE	400kV
2.	HIGHEST SYSTEM VOLTAGE	420kV
3.	RATED FREQUENCY	50Hz
4.	RATED SHORT TIME CURRENT FOR 1 SEC	40kA
5.	RATED FULL WAVE IMPULSE WITHSTAND VOLTAGE	1550kVp
6.	SWITCHING IMPULSE WITHSTAND VOLTAGE	1050kVp
7.	ONE MINUTE POWER FREQUENCY DRY WITHSTAND VOLTAGE	630kVrms
8.	MINIMUM CREEPAGE (25mm/kV)	10500mm
9.	SYSTEM NEUTRAL EARTHING	EFFECTIVELY EARTHED

CLEARANCE TABLE :-

MINIMUM CLEARANCE TABLE	400kV
PHASE TO PHASE (PP) (for Conductor-Conductor Config.) PHASE TO PHASE (PP) (for Rod-Conductor Config.)	4000mm 4200mm
PHASE TO EARTH (PE)	3500mm
SECTION CLEARANCE (SC)	6500mm
HT. OF EQUIP. BUS CENTRE LINE ABOVE PLINTH LVL (MIN.)	8000mm
VERTICAL DISTANCE BETWEEN LOWEST PART OF INSULATOR & PLINTH LEVEL	2550mm (min.)

STRINGING DETAILS :-

	CONDUCTOR	INS. STRING
JACK BUS & JUMPERING	-	-
ALL EQUIPMENT INTERCONNECTION	TWIN MOOSE	
SUB CONDUCTOR SPACING FOR TWIN MOOSE	450 mm	-
EARTHWIRE	-	

BILL OF QUANTITY

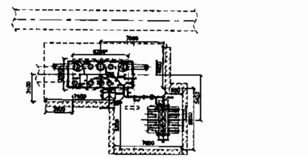
ITEM CODE	DESCRIPTION	SYMBOL	QTY.	MAKE
1	420KV, 125 MVAR BUS REACTOR (3-PH)		01	BHEL
2	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (BHEL MAKE) IN TIE BAY#423	(S)	01	

NOTES:-

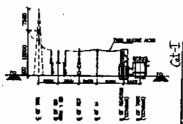
1. ALL DIMENSIONS ARE IN mm UNLESS SPECIFIED OTHERWISE.
2. PLINTH LEVEL 300mm ABOVE FGL.
3. ONE NO. EXISTING 420KV, 50MVAR(3-PH) BUS REACTOR SHALL BE REPLACED BY 125MVAR(3-PH) BUS REACTOR.
4. DISMANTLING OF EXISTING 50MVAR(3-PH) BUS REACTOR ALONG WITH ALL ACCESSORIES AND STORING AT A SUITABLE LOCATION AT ROURKELA S/S AS PER DIRECTIONS OF POWERGRID SITE IN-CHARGE.
5. MODIFICATION OF EXISTING 420KV, 50MVAR (3-PH) BUS REACTOR FOUNDATION TO SUIT 420KV 125MVAR BUS REACTOR ALONG WITH JACKING PADS, RAIL TRACK, PYLON SUPPORTS UNDER PRESENT SCOPE.
6. (S) CONTROL SWITCHING DEVICE SHALL BE PROVIDED FOR EXISTING 400KV RE BAY CIRCUIT BREAKER ASSOCIATED WITH 125MVAR BUS REACTOR UNDER PRESENT SCOPE.
7. EXISTING PIPING (FOR FIRE PROTECTION SYSTEM OF EXISTING 50MVAR REACTOR TO BE REPLACED) SHALL FURTHER BE EXTENDED FOR FPS (HVW SPRAY SYSTEM & HYDRANT SYSTEM) OF 125 MVAR BUS REACTOR. EXISTING HVW SPRAY SYSTEM INCLUDING DELUGE VALVE OF 420KV, 50MVAR BUS REACTOR SHALL BE DISMANTLED & STORED AT ROURKELA S/S AS PER INSTRUCTION OF SITE IN-CHARGE (SEPARATE DRG SHALL BE SUBMITTED).
8. MAIN EARTHMAT ALREADY EXISTS IN THE EXTENSION AREA UNDER PRESENT SCOPE. ALL THE EQUIPMENTS, BUS REACTOR ETC. SHALL BE EARTHED BY CONNECTING THEM TO THE MAIN EARTHMAT.
9. ILLUMINATION SYSTEM SWITCHYARD EXTENSION AREA UNDER PRESENT SCOPE (SEPARATE DRG SHALL BE SUBMITTED).
10. a. STONE HAS ALREADY BEEN LAID IN THE SWITCHYARD AREA UNDER PRESENT SCOPE. REMOVAL, CLEANING AND WASHING OF EXISTING STONE AND RE-SPREADING AFTER DOING ANTI-WEED TREATMENT & PCC AS PER SECTION-CIVIL WORKS IS IN THE SCOPE OF BHEL.
    b. IN THE AREA UNDER PRESENT SCOPE WHERE STONE SPREADING DOES NOT EXIST, THE SAME SHALL BE PROVIDED ALONG WITH ANTI-WEED TREATMENT & PCC AS PER SECTION-CIVIL WORKS.
11. THE REQUIRED CLEARANCES AS PER CLEARANCE TABLE ABOVE AND AS PER PROVISION OF I.E. RULE & OTHER STATUTORY REGULATION ETC SHALL BE MAINTAINED BY BHEL.
12. LIGHTNING PROTECTION IS ASSUMED TO BE EXISTING FOR 400KV SWITCHYARD AREA UNDER PRESENT SCOPE, CONSIDERING THE EXISTING REACTOR BEING REPLACED BY NEW REACTOR.

LEGEND TABLE :-

———	PRESENT SCOPE
— — —	FUTURE/EXISTING



BLOW UP VIEW OF REACTOR AREA (NTS)
(*) EXISTING REACTOR TANK FDN. TO BE MODIFIED TO SUIT NEW REACTOR.



SECTION A-A

REFERENCE DWG :-

DWG. NO.	TITLE
C/ENGG/ER-II/ROK/ERSS-IX/GA/01	GENERAL ARRANGEMENT DRAWING (TENDER DRG.)
C/ENGG/ER-II/ROK/ERSS-IX/PLAN&SECTION/01	ELECTRICAL PLAN & SECTION LAYOUT FOR 400 KV ROURKELA S/S EXTN. (TENDER DRG.)
TB-3-370-316-001	SINGLE LINE DIAGRAM FOR 400KV ROURKELA S/S EXTN.

ADDITIONAL INFORMATION
W.O.No. 04601

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

POWER GRID CORPORATION OF INDIA LTD.

NAME OF CUSTOMER/PROJECT

CC-CS/203-ER2/SS-2380/3/G6/NOA-1/4601, DATED 23.06.2014

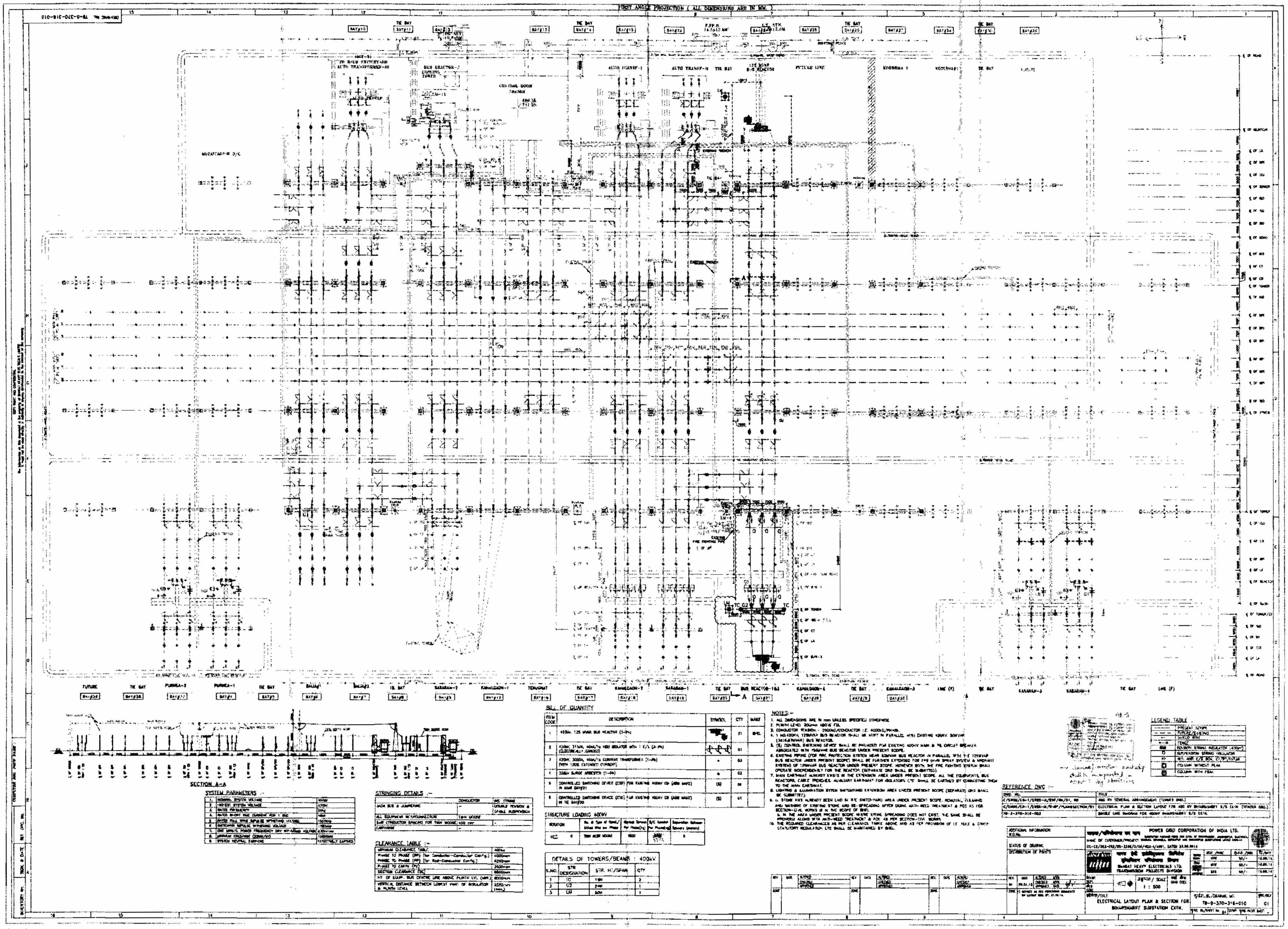
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION

SCALE 1 : 500

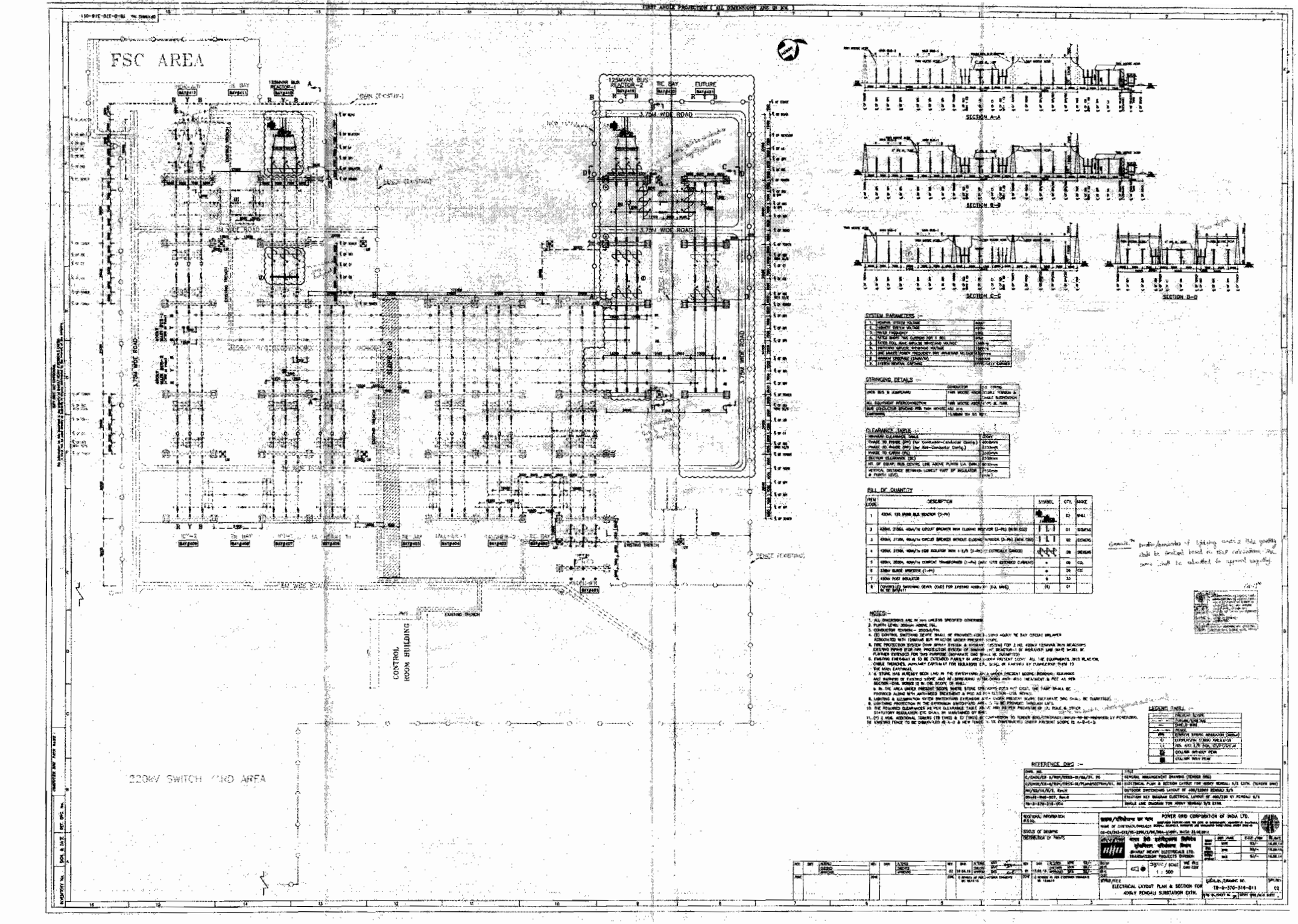
TITLE
ELECTRICAL LAYOUT PLAN & SECTION FOR 400KV ROURKELA SUBSTATION EXTN.

DRAWING NO. TB-3-370-316-008

REV. 00



FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)
MUZAFFARPUR D/C
AUTO TRANSF.-I
AUTO TRANSF.-II
TIE BAY
FUTURE LINE
KODERMA Y
FUTURE
FUTURE
PURNEA-2
PURNEA-1
BALIA-1
BALIA-2
SASARAM-1
KAHALGAON-1
TENUGHAT
KAHALGAON-2
BUS REACTOR-1&2
SECTION A-A
SYSTEM PARAMETERS :-
STRINGING DETAILS :-
CLEARANCE TABLE :-
BILL OF QUANTITY
STRUCTURE LOADING 400KV
DETAILS OF TOWERS/BEAMS : 400KV
NOTES:-
LEGEND TABLE
REFERENCE DWG :-
TB-3-370-316-003
ADDITIONAL INFORMATION
W.O.No.
STATUS OF DRAWING
DISTRIBUTION OF PRINTS
POWER GRID CORPORATION OF INDIA LTD.
NAME OF CUSTOMER/PROJECT
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION
SCALE
1 : 500
TITLE
ELECTRICAL LAYOUT PLAN & SECTION FOR
BIHARSHARIFF SUBSTATION EXTN.
DRAWING NO.
TB-0-370-316-010
01


FSC AREA
220kV SWITCH YARD AREA
CONTROL ROOM BUILDING
3.75M WIDE ROAD
SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
SYSTEM PARAMETERS :-
STRINGING DETAILS :-
CLEARANCE TABLE :-
BILL OF QUANTITY
NOTES:-
LEGEND TABLE :-
REFERENCE DWG :-
ELECTRICAL LAYOUT PLAN & SECTION FOR 400kV RENGALI SUBSTATION EXTN.
19-0-370-316-011

DRAWING No. TB-0-370-318-012

SYSTEM PARAMETERS :-

1.	NOMINAL SYSTEM VOLTAGE	400kV
2.	HIGHEST SYSTEM VOLTAGE	420kV
3.	RATED FREQUENCY	50Hz
4.	RATED SHORT TIME CURRENT FOR 1 SEC	40kA
5.	RATED FULL WAVE IMPULSE WITHSTAND VOLTAGE	1550kVp
6.	SWITCHING IMPULSE WITHSTAND VOLTAGE	1050kVp
7.	ONE MINUTE POWER FREQUENCY DRY WITHSTAND VOLTAGE	630kVrms
8.	MINIMUM CREEPAGE (25MM/kV)	10500MM
9.	SYSTEM NEUTRAL EARTHING	EFFECTIVELY EARTHED

STRINGING DETAILS :-

	CONDUCTOR	INS. STRING
JACK BUS & JUMPERING	TWIN MOOSE	–
ALL EQUIPMENT INTERCONNECTION	TWIN MOOSE	
BUS CONDUCTOR SPACING FOR TWIN MOOSE	450 mm	–
EARTHWIRE	–	

LEGEND TABLE :-

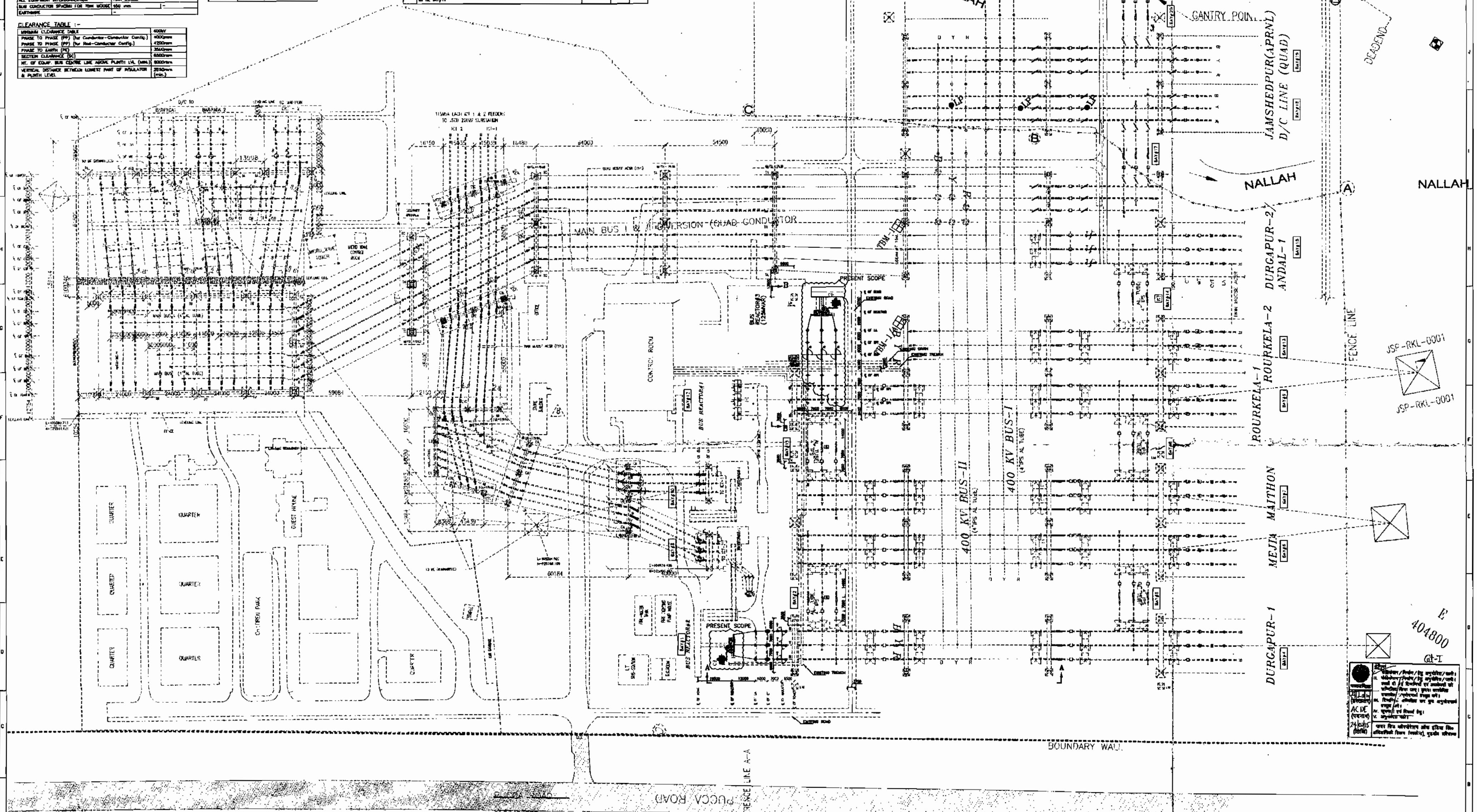
———	PRESENT SCOPE
– – –	FUTURE/EXISTING
▭	ISO. AND E/S BOX

CLEARANCE TABLE :-

MINIMUM CLEARANCE TABLE	400kV
PHASE TO PHASE (PP) (for Conductor-Conductor Config.)	4000mm
PHASE TO PHASE (PP) (for Rod-Conductor Config.)	4200mm
PHASE TO EARTH (PE)	3500mm
SECTION CLEARANCE (SC)	6500mm
HT. OF EQUIP. BUS CENTRE LINE ABOVE PLINTH LVL (MIN.)	8000mm
VERTICAL DISTANCE BETWEEN LOWEST PART OF INSULATOR & PLINTH LEVEL	2550mm (min.)

BILL OF QUANTITY

ITEM CODE	DESCRIPTION	SYMBOL	QTY.	MAKE
1	420kV, 175 MVAR BUS REACTOR (3-Ph)	[illegible]	02	BHEL
2	420kV, 3150A, 40kA/1s HCB ISOLATOR WITH 1 E/S (3-Ph) (ELECTRICALLY GANGED)	[illegible]	01	SIEMENS
3	336kV SURGE ARRESTER (1-Ph)	●	03	CGL
4	420kV POST INSULATOR	◆	09	
5	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN THE BAY#2	(S)	01	
6	CONTROLLED SWITCHING DEVICE (CSD) FOR EXISTING 400KV CB (ABB MAKE) IN THE BAY#11	(S)	01	



SECTION A-A

SECTION B-B

NOTES :-

ADDITIONAL INFORMATION
W.O.No.

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

POWER GRID CORPORATION OF INDIA LTD.

CC-CS/383-ER2/SS-2206/3/G6/NOA-I/4081, DATED 23.08.2014

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION

REV.	DATE		
01	17.02.15	ALTERED MVK, CHECKED MVK, APPROVED SKS	1) REVISED AS PER POWERGRID COMMENTS ON LAYOUT DRG. DT. 14.11.14.

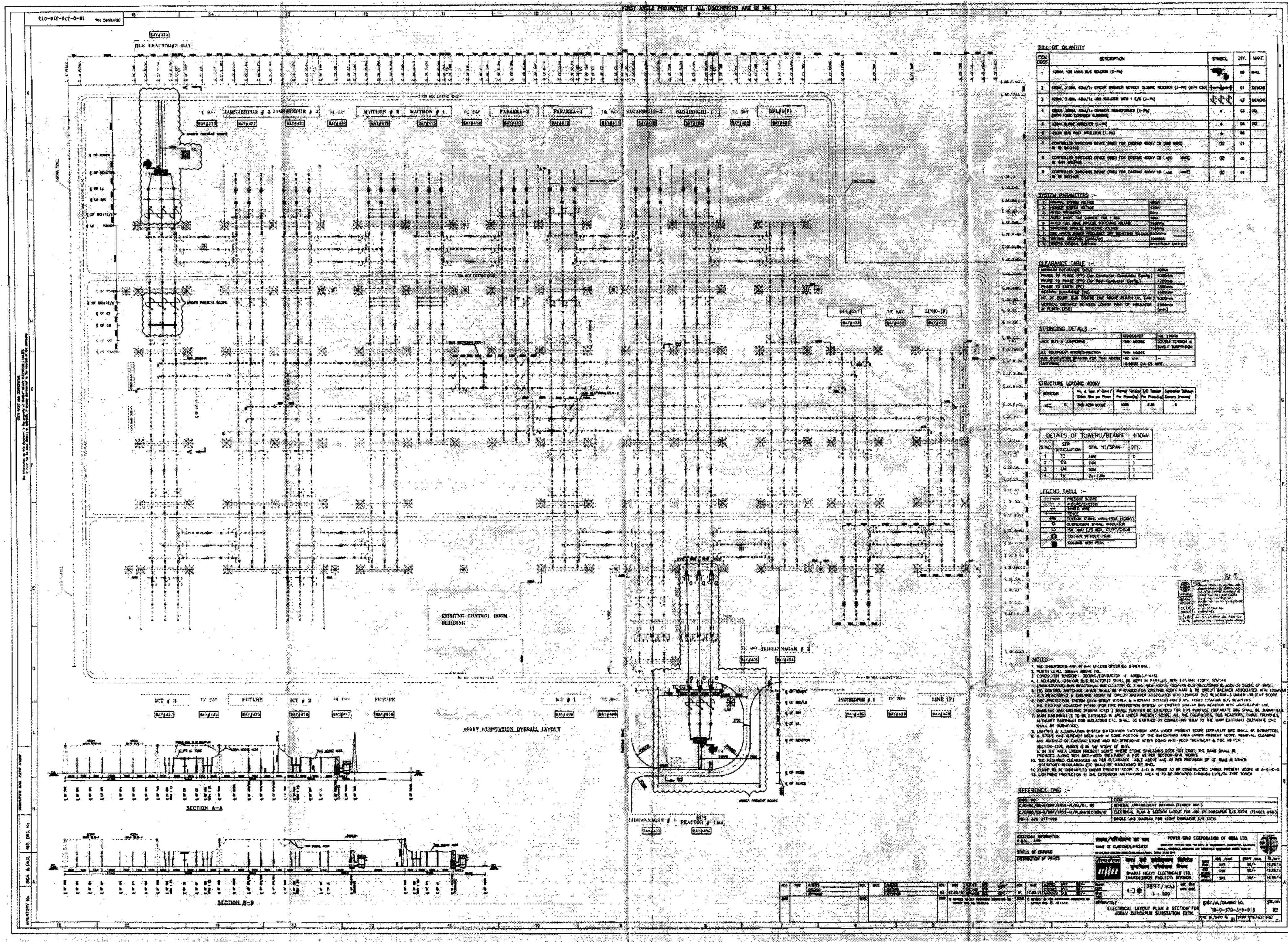
	NAME	SIGN.	DATE
DRAWN	MVK	-SD-	16.08.14
CHECKED	MVK	-SD-	16.08.14
APPROVED	SKS	-SD-	16.08.14

SCALE 1 : 500

TITLE
ELECTRICAL LAYOUT PLAN & SECTION FOR JAMSHEDPUR SUBSTATION EXTN.

DRAWING NO. TB-1-370-318-012 REV. 01

SHEET No. 01



FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)
DRAWING No. TB-0-370-316-013
BUS REACTOR#2 BAY
JAMSHEDPUR # 3
JAMSHEDPUR # 2
MAITHON # 2
MAITHON # 1
FARAKKA-2
FARAKKA-1
SAGARDIGHI-2
SAGARDIGHI-1
DPL#1(F)
DPL#2(F)
LINE-(F)
EXISTING CONTROL ROOM BUILDING
BIDHANNAGAR # 2
BIDHANNAGAR # 1
BUS REACTOR # 1&2
ICT # 3
FUTURE
ICT # 2
ICT # 1
JAMSHEDPUR # 1
LINE (F)
400KV SUBSTATION OVERALL LAYOUT
SECTION A-A
SECTION B-B
BILL OF QUANTITY
SYSTEM PARAMETERS :-
CLEARANCE TABLE :-
STRINGING DETAILS :-
STRUCTURE LOADING 400KV
DETAILS OF TOWERS/BEAMS 400kV
LEGEND TABLE :-
NOTES :-
REFERENCE DWG :-
GENERAL ARRANGEMENT DRAWING (TENDER DWG.)
ELECTRICAL PLAN & SECTION LAYOUT FOR 400 KV DURGAPUR S/S EXTN. (TENDER DWG)
SINGLE LINE DIAGRAM FOR 400KV DURGAPUR S/S EXTN.
POWER GRID CORPORATION OF INDIA LTD.
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION
SCALE 1 : 500
ELECTRICAL LAYOUT PLAN & SECTION FOR 400KV DURGAPUR SUBSTATION EXTN.
TB-0-370-316-013
02

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Customer	**Power Grid Corporation of India Limited**
b)	Project Title	Extension of I) 400kV Biharshariff S/s, II) 400kV Jamshedpur S/s, III) 400 kV Gazuwaka S/s, IV) 400 kV Rengali S/s, V) 400 kV Rourkela S/s, VI) 400 kV Durgapur S/s & VII) 400 kV Gorakhpur S/s Extension package under ERSS-IX
c)	Location	Biharshariff (Bihar) Jamshedpur (Jharkhand) Gazuwaka (Andhra Pradesh) Rengali/ Rourkela (Orissa) Durgapur (West Bengal) Gorakhpur (Uttar Pradesh)
d)	Transport Facilities	Nearest Rail Head Biharshariff (Biharshariff), Jamshedpur (Jamshedpur), Gazuwaka (Vizag), Rengali (Talcher Road), Rourkela (Rourkela), Durgapur (Durgapur) & Gorakhpur (Gorakhpur)
SITE CONDITIONS		
a)	Altitude above sea level	Less than 1000m
b)	Ambient air temp. (Max)	50°C
c)	Average Humidity	Shall be informed during detailed engg.
d)	Special corrosion conditions	-do-
e)	Solar Radiation	-do-
f)	Atmospheric UV radiation	-do-
g)	Seismic Acceleration	0.3g horizontal
h)	Pollution Severity	High Pollution level (25mm/kV)
WIND DATA		
a)	Wind velocity	Gazuwaka - 50m/s; All others - 47 m/s
b)	Average No. of thunderstorm days per annum	As per IS

1.0 GENERAL

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other sections of technical specification and is not exclusive.

a) Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions.

b) Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the equipment and accessories unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost.

c) All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

d) Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

e) In case any Deviation Schedule, Bid Proposal Sheet, Schedule of Data Requirements (DRS), test reports or any other document/information are not furnished along-with the bid, the bid is liable to be rejected. Unless brought out clearly, the Bid will be deemed to conform to the specification scrupulously. All deviations from the specification shall be clearly brought out in the respective deviation schedule.

f) Auxiliary supplies as described below would be available at site.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
110V	95V to 120V	DC	-	Isolated 2 wire System
48V	_	DC	_	2 wire system (+) earthed

NOTE: Combined variation of frequency and voltage shall be limited to ±10 %.

2.0 STANDARDS

a) The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

b) The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the originally scheduled date of bid opening) of standard specified under respective sections of the specification.

c) The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

d) Bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

e) When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

f) Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified in individual sections shall also, be accepted, however the salient points of difference shall be clearly brought out in the bid along with English language version of such standard. The equipment conforming to standards other than specified in technical specification shall be subject to Purchaser's approval.

3.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

a) The 420kV system is being designed to limit the switching surge over voltage of 2.5 p.u. and the power frequency over voltage of 1.5 p.u. The initial value of the temporary overvoltages could be 2.0 p.u. for 1 - 2 cycles. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.

b) Equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

c) All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

d) The equipment shall also comply to the following:
   i) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
   ii) All piping, if any between equipment control cabinet/ operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

e) Equipments and system shall be designed to meet the following major technical parameters as brought out in Section-1 of the specification.

4.0 ENGINEERING DATA AND DRAWINGS

4.1 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalised by the Purchaser at the time of award. The Contractor shall necessarily submit all the drawings/ documents unless anything is waived.

4.2 The Contractor shall submit 4 (four) sets of drawings/ design documents/ data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Purchaser. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.

4.3 Drawings

4.3.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

4.3.2 Drawings submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

4.3.3 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser may not indicate a thorough review of all dimensions, quantities

and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

4.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

4.5 All engineering data submitted by the Contractor after final process including review and approval by the Purchaser shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Purchaser in Writing.

4.6 **Approval Procedure**

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/ by Purchaser on initial submission	As per agreed schedule
ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution copies (5 hard copies per substation and one scanned copy (pdf format) for Corporate Centre)	2 weeks from the date of approval
v)	Furnishing of distribution copies of test reports	
	(a) Type test reports (one scanned softcopy in pdf format per substation plus one for corporate centre & one hardcopy per substation)	2 weeks from the date of final approval

	(b) Routine Test Reports (one copy for each substation)	-do-
vi)	Furnishing of instruction/ operation manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	As per agreed schedule
(vii)	As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre& per substation)	On completion of entire works

NOTE :

(1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Purchaser or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.

(3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

(4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Purchaser.

(5) The Contractor shall furnish to the Purchaser catalogues of spare parts.

(6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

5.0 MATERIAL/ WORKMANSHIP

5.1 General Requirement

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

5.1.2 Incase where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Purchaser shall decide upon the question of similarity. When required by the specification or when

required by the Purchaser the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the bidder.

5.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

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

5.1.5 All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

5.2 **Provisions For Exposure to Hot and Humid climate**

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

5.2.1 **Space Heaters**

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

5.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be

installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

5.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

5.2.2 **FUNGI STATIC VARNISH**

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

5.2.3 **Ventilation opening**

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

5.2.4 **Degree of Protection**

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:
a) Installed out door: IP- 55
b) Installed indoor in air conditioned area: IP-31
c) Installed in covered area: IP-52
d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.
e) For LT Switchgear (AC & DC distribution Boards) : IP-52
The degree of protection shall be in accordance with IS:13947 (Part-I) / IEC-60947(Part-I)/IS 12063/IEC-60529. Type test report for degree of protection test, shall be subrnitted for approval.

5.3 **RATING PLATES, NAME PLATES AND LABELS**

5.3.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture,

equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

5.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

5.4 **FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS**

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

6.0 DESIGN IMPROVEMENTS/ COORDINATION

6.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Purchaser or the bidder may propose changes in the specification of the equipment or quality thereof and if the Purchaser & bidder agree upon any such changes, the specification shall be modified accordingly.

6.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

6.3 The bidder shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

6.4 The bidder has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Purchaser/Customer. The names of agencies shall be intimated to the successful bidders.

6.5 The bidder will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Purchaser/Customer (if any) during the period of Contract.

7.0 QUALITY ASSURANCE PROGRAMME

7.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub-contractor's premises or at the Employer's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following :

a) The organisation structure for the management and implementation of the proposed quality assurance programme.

b) System for Document and Data Control.

c) Qualification and Experience data of Bidder's key personnel.

d) The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.

f) System for Control of non-conforming products including Deviation Dispositioning, if any and system for corrective and preventive actions based on the feed back received from the Customers and also internally documented system for Customer complaints.

g) Inspection and test procedure both for manufacture and field activities.

h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.

i) System for indication and appraisal of inspection status.

j) System of Internal Quality Audits and Management review and initiation of corrective and Preventive actions based on the above.

k) System for authorising release of manufactured product to the Employer.

l) System for maintenance of records.

m) System for handling storage and delivery.

n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.

o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records". In this regard, the Employer has already prepared Standard Field Quality Plan for transmission line/substation equipments as applicable, Civil/erection works which is required to be followed for associated works.

The Employer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the bidder/his vendor's quality management and control activities.

7.2 Quality Assurance Documents

The Contractor shall be required to submit the following Quality Assurance Documents.

i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.

ii) Welder and welding operator qualification certificates.

iii) Welder's identification list, welding operator's qualification procedure and welding identification symbols.

iv) Raw Material test reports on components as specified by the specification and in the quality plan.

v) The manufacturing Quality Plan indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.

vi) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc as applicable.

viii) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

8.0 INSPECTION, TESTING & INSPECTION CERTIFICATE

8.1 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Contractor's premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Employer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. The equipment if found unsatisfactory as to workmanship or material is liable to be rejected.

8.2 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which at least 30 days notice in advance shall be given by the Contractor. Contractor shall ensure before giving notice for type test that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer.

8.3 The Contractor shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing far each stage of testing as identified in the approved quality plan as customer inspection point. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Employer/inspector, unless witnessing of the tests is waived, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector six copies of tests, duly certified.

8.4 The Employer or Inspector shall, within Twenty (21) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

8.5 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Employer/Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Employer/Inspector. Failure of the Employer/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the

Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.

8.6 In all cases where the Contract provides for tests whether at the premises or works of the Contractor or of any Sub- Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer/Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/Inspector or to his authorised representative to accomplish testing.

8.7 The inspection and acceptance by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract, or if such equipment is found to be defective at a later stage.

8.8 Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. MICC will be issued only after review and approval of the test reports.

8.9 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

8.10 The Employer reserves the right for getting any field tests conducted on the completely assernbled equipment at site.

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

9.2 The reports for all type tests as per technical specification shall be furnished by the Contractor alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all project with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO /IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the originally scheduled date of bid opening. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the originally scheduled date of bid opening, the contractor shall repeat these test(s) at no extra cost to the purchaser.
Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.
The Contractor shall intimate the Purchaser the detailed program about the tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.
Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the contractor.

10.0 TESTS

10.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective sections and shall be included in the bidder's quality assurance programme.

10.2 Commissioning Tests

a) The available instrumentation and control equipment will be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.

b) Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

c) The specific tests to be conducted on equipment have been brought out in the respective sections of the technical specification.

11.0 PACKAGING & PROTECTION

11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage

at Site till the time of erection. On request of the Purchaser, the Contractor shall also submit packing details/associated drawing for any equipment/ material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises.

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

12.3 PAINTING

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning.

12.3.2 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

12.3.3 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting.

13.0 HANDLING, STORING AND INSTALLATION

a) In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Employer or his representative,

the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

b) Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

c) In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Employer. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

d) 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.

e) The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Employer in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Employer, as well as protection of the same against theft, element of nature, corrosion, damages etc.

f) Where material/equipment is unloaded by Employer before the Contractor arrives at site or even when he is at site, Employer by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

g) Contractor shall be responsible for the proper storage and maintenance of all materials/equipment entrusted to him. He shall take all required steps to carry out frequent inspection of material/equipment stored as well as erected until the same is taken over by the Employer.

h) The words 'erection' and 'installation' used in the specification are synonymous.

i) Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

j) Clearances and spacings shall be provided as per relevant IS.

Bidder shall confirm in their technical offer that all clearances and spacing as stated above will invariably be provided. Even though phase to earth clearance under normal conditions will be as above at certain points where there can be bird faults (i.e. a bird sitting on the earthed metal part coming in contact with the HT terminal) adequate clearance as required shall be provided between the HT terminal and nearest grounded metal part.

k) Equipment Bases
A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with protecting device. All ends of equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

PRESERVATIVE SHOP COATING

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall beforehand be treated and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scale, oxide and other coatings and prepared in the shop. The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Transformers and other electrical equipment, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colours shall be selected and specified by the Employer at a later date.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 deg.C. shall be selected by the Contractor, after

obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperatures higher than 95 deg.C. and such primers shall also be subject to the approval of the Employer.

All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

PROTECTIVE GUARDS

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

14.0 SUPPORT STRUCTURES

a) The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter and 5.9 meter from plinth level for 765 kV, 420 kV and 245 kV substations respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.
b) Support structure shall meet the following mandatory requirements:
The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

15 CONTROL PANELS, RELAY PANELS, CABINETS, JUNCTION BOXES, TERMINAL BOXES, MARSHALING BOXES AND MARSHALING KIOSKS:

a) All types of boxes, cabinet/panels shall generally conform to IS : 5039, IS : 8623, IEC : 439, as applicable and the clauses given below:

b) Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel can also be used. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

c) A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

d) Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment. The quality of the hinges, locking system and handles shall be such that it does not get damaged/cracked/rusted during the operation of the equipment.

e) All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.
Further, the gasketing arrangement shall be such that gaskets are pasted in slots (in door fabrication/gasket itself) in order to prevent ingression of dust and moisture inside the panels so that no internal rusting occurs in panels during the operation of the equipment.

f) All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

g) A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

h) For illumination, a fluorescent tube or CFL of approximately 9 to 15 watts shall be provided. The switching of the fittings shall be controlled by the door switch. For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

i) All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.

j) Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be

done by using a separate earth wire.

k) The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

l) a) The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:
i) Check for wiring
ii) Visual and dimension check
b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

16 TERMINAL BLOCKS AND WIRING

16.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

16.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But the terminal blocks shall be non-disconnecting stud type except for the secondary junction boxes of Current Transformer and Voltage Transformer.

16.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

16.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

16.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.

16.6 The terminal blocks shall be of extensible design.

16.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

16.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

16.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
a) All circuits except Minimum of two of 2.5 sq mm CT/PT circuits copper flexible.
b) All CT/PT circuits Minimum of 4 nos. of 2.5 sq mm copper flexible.

16.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

16.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

16.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

16.13 The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the equipment or due to transients induced from the EHV circuits.

16.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

17.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

a) Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.

The bidder may also offer composite hollow insulators, conforming to IEC-61462.

b) Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

c) Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

d) Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

e) When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

f) Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

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

h) **TESTS :**

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS : 2099 & IS : 2544 & IS : 5621.

18 **MOTORS:**

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall conform to type tests and shall be subjected

to routine tests as per applicable standards. The motors shall be of approved make.

19 TERMINAL CONNECTORS AND CLAMP CONNECTORS:

The Terminal Connectors of all types shall meet the following requirements:

a) Terminal connectors shall be manufactured and tested as per IS: 5561.

b) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

c) No part of a clamp shall be less than 10 mm thick.

d) All ferrous parts shall be hot dip galvanised conforming to IS: 2633.

e) For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be provided.

f) Flexible connectors shall be made from tinned copper/ aluminium sheets or cables.

g) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

h) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS: 5561.

i) All test/checks on terminal connectors shall be as per IS: 5561.

ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

S.No.	Page No.	Clause No.	Deviation	Reason / Justification

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Tenderer's Stamp & Signature