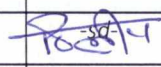
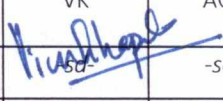


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	TYPE OF DOC.	TECHNICAL SPECIFICATION		NAME	DKS	VK	AG
	TITLE 33kV Fault Current Limiter Panel with its Accessories <i>(Suitable for highly corrosive environment of process/ petrochemical industry)</i>			SIGN	 		-sd-
				DATE	09.04.2020	09.04.2020	09.04.2020
				GROUP	TBEM		
				WO NO.	I19TB00003 REV00		
	CUSTOMER	Indian Oil Corporation Limited (IOCL)					
	CONSULTANT	TATA Consulting Engineers Limited (TCE)					
	PROJECT	LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery					
	LOA. NO.	RPRC182491/26286965 dtd. 24.01.2020					
WO. No.	26286965 dtd. 24.01.20120						
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Remarks: It is to be noted that data and details of Guaranteed Technical Particulars (GTP) shall not be reviewed during Technical Evaluation/ Review, hence compliance of Guaranteed Technical Particulars (GTP) in line with Technical Specification shall be deemed to under complete compliance of bidder.							
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SECTION 1:

SCOPE, PROJECT SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES

1. Scope

This technical specification covers the requirements of design, engineering, manufacturing, inspection including third party inspection and testing at manufacturer's works before supply, proper packing and delivery to project site, supervision of installation, testing at site & commissioning complete with all materials, support base structures at designated locations including hardware and anchoring bolts, accessories, commissioning spares & maintenance spares, consumables, special spanners, tools & tackles, any specific required supervision of ancillary services & mandatory spares etc. including training of BHEL/ Customer personnel, if required at site for Equipment (33kV Fault Current Limiter Panel with its Accessories) complete in all respects for efficient & trouble-free working mentioned under this specification.

Hence, the electrical scope of work under this requisition shall include but not be limited to basic and detailed engineering, as required, manufacturing, supply, transportation to site, inspection at manufacturer's work, supervision of installation, commissioning including site testing along with necessary equipment, training to Customer/ BHEL personnel, if required, supply of all mandatory spares, commissioning spares, special tools and tackles as required in drawings, standard specifications, standards etc. attached or referred with technical specification.

This section covers the specific technical requirements of Equipment (33kV Fault Current Limiter Panel with its Accessories). This constitutes minimum technical parameters for the above item as specified by the BHEL/ Customer. The offered Equipment (33kV Fault Current Limiter Panel with its Accessories) shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) and Section-2 (Equipment Specification Under Scope of Supplies) of this specification.

The specification comprises of following sections:

- | | | |
|-----------|---|--|
| Section-1 | : | Scope, Project Specific Technical Requirements & Bill of Quantities |
| Section-2 | : | Equipment Specification under scope of Supplies |
| Section-3 | : | Project Details & General Technical Requirements (For All Equipment under the Project) |
| Section-4 | : | Annexures |
| | | Annexure A- Compliance Certificate |
| | | Annexure B- Schedule of Technical Deviations |
| | | Annexure C- Guaranteed Technical Particulars |
| | | Annexure D- Technical Checklist |

The following order of priority shall be followed. In case of conflict between requirements specified in various documents, the more stringent one shall be followed. BHEL/Customer concurrence shall, however, be obtained before taking a final decision in such matters.

1. Statutory Regulations

- In particular, the latest version of the following statutory regulations, as applicable, shall be followed for system,
- o Indian Electricity Act

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- o CEA regulations
- o The Factory Act
- o The Petroleum Rules
- o OISD standards
- o Requirements of other statutory bodies as applicable, e.g. CEA, CCE, LPCB.

2. Section-1

3. Section-2

4. Section-3

5. Codes & Standards

Bidder shall furnish list of conflicts/ ambiguities/ deviations, if any, along with their technical offer and also furnish the basis that is considered for submitting technical offer. BHEL/ Customer will resolve listed conflicts prior to award. In case of ambiguity, bidder shall inform BHEL/ Customer of their interpretation. In case bidder fails to convey the same prior to award, BHEL/ Customer decision on interpretation shall be considered final if need arises during the execution. No additional cost or extra time on account of conflicts/ ambiguities/ deviations shall be admissible.

In general, no deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer (Annexure-A), however bidder shall furnish list of conflicts/ ambiguities/ deviations (Annexure-B), if any. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed.

The Equipment (33kV Fault Current Limiter Panel with its Accessories) is required for the following project:

Name of the Customer	:	Indian Oil Corporation Limited (IOCL)
Name of Consultant	:	Tata Consulting Engineers Limited
Name of Main Contractor	:	Bharat Heavy Electricals Limited
Name of the Project	:	LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery

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

2. Codes & Standards

The Equipment (33kV Fault Current Limiter Panel with its Accessories) shall comply with the latest edition of the following standards as applicable,

CIGRE WG A3.10: Fault current limiters in electrical medium and high voltage systems. CIGRE Technical Brochure 239 (2003)

CIGRE WG A3.16: Guideline on the impact of FCL devices on protection system. CIGRE Technical Brochure 339 (2008)

CIGRE WG A3.23: Applications and feasibility of fault current limiters in power systems. CIGRE Technical Brochure 497 (2012)

IEC 62271-200: HV Switchgear and Control gear

IEC 60282-1: High-voltage fuses – Part 1: Current-limiting fuses

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3. Specific Technical Requirements

Fault limiting device will be installed in parallel with the URT system of SS-63 at PR. The fault limiting device shall have copper bridge (main current path) inside the insert of the limiter carries the continuous current in normal operating condition. In case of a fault current the main current path is immediately opened, triggered by the control unit. The short-circuit current commutates to a parallel fuse with high breaking capacity, which limits the short-circuit current during the first rise within less than a quarter cycle.

The Specific technical requirements for the equipment (33kV Fault Current Limiter Panel with its Accessories) shall be as follows,

Sl. No.	Technical Parameters	Unit	Particulars
1	Equipment		33kV Fault Current Limiter Panel with its Accessories
2	Type		Metal enclosed
3	Installation		Indoor
A	Meteorological data		
1.1	Maximum ambient temperature	°C	50
1.2	Minimum ambient temperature	°C	-5
1.3	Average ambient temperature	°C	35
1.4	Design ambient temperature	°C	45
2	Average no. of thunder storm days	Days	45
3.1	Maximum Relative humidity	%	95
3.2	Maximum Relative humidity	%	26
4	Average Annual Rain Fall	mm	900
5	Maximum Wind Pressure	Kg/ sqm	195
6	Maximum Altitude above Mean Sea Level	m	1000
7	Isoceraunic Level	Days/ Year	45
8	Seismic Level (Horizontal Acceleration)	Zone	4
9	Average no. of rainy day per Year	Days/ Year	120
B	System Parameters		
1	Nominal system voltage	kV	33
2	Maximum operating voltage	kV	38
2	Continuous Current	A	2500
3	Limiting fault level of system	kArms	25 for 1sec
4	Basic Insulation Level	kV	150
5	Frequency	Hz	50±3%
6	Creepage	mm/kV	25
7	Earthing		Solidly Earthed
8	Ingress Protection	IP	IP41 or more
9	Cable entry		FCL Isolator panel shall be suitable for 3Rx1Cx630sqmm, 33kV XLPE Cu cable

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Notes:

1. Carrying out the electrical system studies required for generation of information which is essential for design of fault limiting systems. The proposed fault limiting system shall have suitable short time rating and system trigger settings to ensure proper actuation of system while maintaining the system fault level limits. Following check points shall be ensured while designing the fault limiting system to avoid spurious actuation and ensuring compliance of purpose of fault limiting system.
 - a. Due consideration of Initial symmetrical short-circuit current "Ik" of generators, transformers, the grid, motor Contribution
 - b. Permissible short-circuit current of the upstream & downstream switchboards
 - c. Rated power of big motors directly connected to Power system
 - d. Rated capacity of capacitor banks and the inductance in series connected to Power system
 - e. Rated power of the outgoing biggest transformer which is charged from 33kV system
2. Collection of all existing system data as required for fault limiting system design shall be in the scope of bidder.
3. The site installation, testing and commissioning of the system shall be done under the supervision of OEM.
4. The proposed fault limiting system shall be installed in SS-63 as an indoor installation. All required structural work specific to fault limiting system shall be in the scope of the bidder including design and supply of all materials.
5. All kinds of structural works required for cabling associated with the fault limiting system shall be in the scope of bidder contractor including supply of materials.
6. The alarm and actuation status of fault limiting device shall be provided in the existing ECS, new SAS and SCAP panels.

4. Other General Requirements

The other general requirements for the equipment (33kV Fault Current Limiter Panel with its Accessories) shall be as follows,

1. Schedule
 - a. Bidder shall submit detailed bar chart indicating all the milestones from engineering till manufacturing/ testing, dispatch to site, supervision for installation, testing and commissioning.
 - b. Bidder to submit list of consumables with shelf life of less than one year. It shall be supplied before erection after clearance from BHEL/ Customer/ Consultant.
2. Office and Staff
 - a. Bidder shall also provide their standard recommendations for precautions to be taken during unloading and storage etc. for approval of BHEL/ Customer/ Consultant. Requirement of closed store, if any shall be taken care by bidder.
 - b. Office facilities & accommodation for bidder's staff along with conveyance, transportation of all special tools & plants, testing kits etc. shall be in bidder's scope.
3. Supervision for Site Installation, Testing & Commissioning
 - a. Bidder shall depute its qualified supervisor for installation, testing & commissioning of the equipment (33kV Fault Current Limiter Panel with its Accessories).
 - b. Bidder shall submit complete methodology for installation, testing & commissioning of

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the equipment (33kV Fault Current Limiter Panel with its Accessories) for further approval of BHEL/ Customer/ Consultant.

4. Bidder to note that the equipment (33kV Fault Current Limiter Panel with its Accessories) may be commissioned at different point of time, and hence bidder shall be required to deploy the resources multiple times at site in line with site requirement.
5. Bidder shall dispatch the consumables just before the start of the work at site and only after specific clearance from BHEL/ Customer.
6. Any special tools and tackles required to complete the ~~cable~~ ^{equipment} installation, testing and commissioning etc. shall be included in the offer. However, general tools and tackles for installation of the equipment (33kV Fault Current Limiter Panel with its Accessories) shall be provided by BHEL.
7. The bidder must fill up all the details required for offered item/s. Instead of indicating "refer drawing, or as per IS/IEC", the exact value/s must be filled in.

5. Bill of Quantities

Quantities for supply and services for the equipment(33kV Fault Current Limiter Panel with its Accessories) shall be as per Annexure- 33kV Fault Current Limiter Panel with its Accessories.

1. Quantities for supply and services for 33kV Fault Current Limiter Panel with its Accessories shall be as per ANNEXURE- 33kV Fault Current Limiter Panel with its Accessories. However, any item/ service not appearing herein but required for completeness of the work is deemed to be included in bidder's scope.

6. Drawings / Documents required for Engineering Manufacturing Clearance

The drawings/ documents, as follows shall be used for providing engineering manufacturing clearance of 33kV Fault Current Limiter Panel with its Accessories and furthermore, it shall be used for delay analysis, if any from bidder. The schedule for submission and resubmission shall be in line with details provided in section-3.

1	33kV FCL Panel- Single Line Diagram, GA Drawing & Schematics with Guaranteed Technical particulars
2	33kV FCL Panel- Type Test Reports
3	33kV FCL Panel- Quality Assurance Plan & Inspection Test Schedule

7. Type Testing

Bidder shall ensure that the equipment (33kV Fault Current Limiter Panel with its Accessories), being procured should have valid type test certificates as per specified in IS/ IEC standards (amended up to date) at any ISO/IEC accredited laboratories.

Type test certificates shall not be more than five (5) years old as on original scheduled date of technical bid opening. In those cases, where type test certificates are more than five (5) years old from original scheduled date of technical bid opening, OEM/ bidder shall carry out the type tests at any ISO/ IEC accredited laboratories prior to dispatch of equipment with no commercial implication to BHEL/Customer.

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In case any of Type tests have not been conducted on the offered design or there has been a change in the design after the type tests. The requisite tests shall be conducted by bidder on the offered design without any extra cost and delivery impact to BHEL/ Customer.

All type tests and any additional type tests shall be carried out as listed in IEC 60282/ IEC 62271-200 or any other applicable national / international standards,

- a. Power Frequency Voltage Withstand Test (Wet)
- b. Power Frequency Voltage Withstand Test (Dry)
- c. Impulse Voltage Withstand Test
- d. Temperature Rise Test
- e. Short time current test.

8. Quality Plan

The successful bidder shall submit Quality Assurance Plan in line with reference QAP attached in Section-2 for the equipment (33kV Fault Current Limiter Panel with its Accessories) etc. with in-process inspection methods, tests, records, etc. for BHEL/ Customer approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ Customer. In case bidder has reference Quality Assurance Plan agreed with BHEL/ Customer, same shall be submitted for specific project to BHEL/ Customer approval. There shall be no commercial implication to BHEL/ Customer on account of Quality Plan approval.

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of the equipment (33kV Fault Current Limiter Panel with its Accessories). All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all tests for the equipment (33kV Fault Current Limiter Panel with its Accessories) shall be deemed to be included in bidder's scope.

9. Inspection & Testing

1. The equipment (33kV Fault Current Limiter Panel with its Accessories) shall be subject to inspection by BHEL/ Customer or authorized representative at bidder/manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/ Customer.
2. The inspector shall have free access to the manufacturer's/ supplier's works for the purpose of inspecting the process of manufacture in all its stages and he will have the power to reject any material, which appears to him to be of unsuitable description or of unsatisfactory quality.
3. Bidder shall give at least 2 weeks' advance notice to BHEL/ Customer, regarding the date of testing to enable him or his representative to witness the tests. All the tests must be done as per the approved QAP.
1. Bidder shall ensure that the hazardous area equipment provided shall have the necessary test certificates and valid CCOE approval certificates.

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2. Bidder shall also furnish factory acceptance test (FAT) for BHEL/ customer approval in line with specific requirements mentioned in Section-2.

10. Supervision of Field Testing & Commissioning

1. Supervision for Field testing and commissioning of the equipment (33kV Fault Current Limiter Panel with its Accessories) shall be done by OEM only.
2. Bidder shall carry out the supervision of installation, field testing and commissioning of the equipment (33kV Fault Current Limiter Panel with its Accessories). Further appropriate test and commissioning reports and as-built documentation as necessary shall be submitted.
3. Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/ Customer before carrying out the site testing at site.
4. Bidder/OEM shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.

11. Makes of Equipment/ Components

Bidder while ordering shall ensure the availability of spare parts and maintenance support services for the equipment (33kV Fault Current Limiter Panel with its Accessories) at least for 15 years from the date of supply. Bidder/ OEM shall give a notice of at least one year to the BHEL/ Customer before phasing out the products/spares to enable the owner for placement of order for spares and services.

12. Packing and Dispatch

1. The equipment (33kV Fault Current Limiter Panel with its Accessories) shall be divided into several shipping sections for protection and ease of handling during transportation. All outgoing feeders shall be packed as separate shipping sections. The equipment shall be properly packed for selected mode of transportation i.e. sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage. The panels shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars\ 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.
2. The equipment may be stored outdoors for long periods before installation. The packing should also be suitable for outdoor storage areas with heavy rains/ high ambient temperature unless otherwise agreed and hence, Packing shall be suitable for long storage (minimum 1 year).

13. Definitions Used

The following expressions hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following meanings hereunder respectively assigned to them, namely:

1. Battery Limit: The demarcated area within which the Unit is to be located.
2. Bid/Bidding Documents: The totality of the documents comprising the Bidding Document for the notice inviting tender.

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3. Contract: The totality of agreement between Customer/ Purchaser/ Owner/IOCL and the Contractor/ LSTK Contractor/ BHEL as derived from the contract documents.
4. Contractor/ LSTK contractor: The bidder selected by the Customer/ Purchaser/ Owner/IOCL for the performance of the work and supply of materials. In this case, it is BHEL.
5. Customer/ Purchaser/ Owner: Indian Oil Corporation Limited.
6. Consultant: Any person(s)/ Firm nominated/ assigned by the Contractor/ LSTK Contractor/ BHEL for providing the engineering consultant services. In this case, it is TCE.
7. Bidder/ vendor: The bidder selected for this intended work shall be known as vendor.

14. Abbreviations Used

The following terminology/ acronym hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following full form hereunder respectively assigned to them, namely,

FCL:	Fault Current Limiter
URT:	Unit Ration Transformer
SLD:	Single Line Diagram
BIL:	Basic Insulation Level
SCAP:	Synchronization Control & Annunciation Panel
ECS:	Electrical Control System
SAS:	Substation Automation System
GIS:	Gas Insulated Switchgear
LCC:	Local Control Centre
CT:	Current Transformer
DC:	Direct Current
HV:	High Voltage
EHV:	Extra High Voltage
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
SAT:	Site Acceptance Testing
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
PE:	Poly Ethylene
ANSI:	American National Standards Institute
IEEE:	Institute of Electrical & Electronics Engineers
IS:	Indian Standards
IEC:	International Electro-Technical Commission
NEMA:	National Electrical Manufactures Association
CEA:	Central Electricity Authority
DIN:	Deutsches Institiut fur Normung
CCE:	Continuous and Comprehensive Evaluation
LPCB:	Loss Prevention Certification Board
CCOE:	Chief Controller of Explosives
OEM:	Original Equipment Manufacturer

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BHEL:	Bharat Heavy Electricals Limited
OISD:	Oil Industry Safety Directorate
IOCL:	Indian Oil Corporation Limited
HVPNL:	Haryana Vidyut Prasaran Nigam Limited
ISBL:	Inside Battery Limit
OSBL:	Outside Battery Limit
LSTK:	Lump sum Turnkey
PRPC:	Petroleum Refining and Petrochemical
PNC:	Panipat Naphtha Cracker Complex
PR:	Panipat Refinery Complex
GIS:	Gas Insulated Sub-station
QAP:	Quality Assurance Plan
BOQ:	Bill of Quantities
ASTM:	American Society for Testing and Materials
BIS:	Bureau of Indian Standards
BS:	British Standard
DGMS:	Director General of Mines and Safety
EPR:	Ethylene Propylene Rubber
FR:	Flame Retardant
HR PVC:	Heat Resistant Polyvinyl Chloride
ICEA:	Insulated Cable Engineers Association
PEM:	Project Engineering Management
PVC:	Polyvinyl Chloride
UV:	Ultra Violet
XLPE:	Cross-linked Polyethylene

15. List of Documents/ Drawings

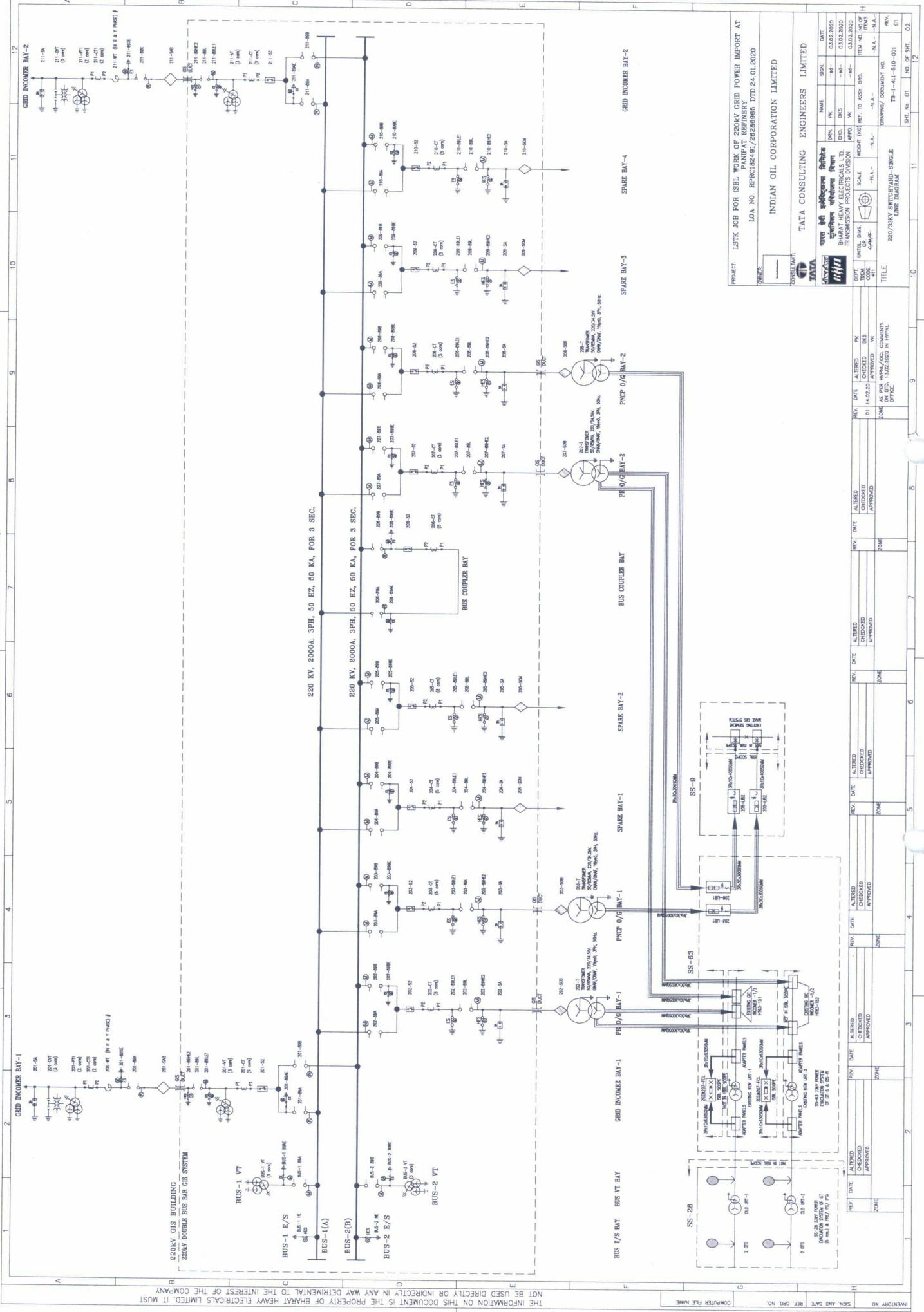
Following drawing/ documents are attached for information purpose,

1. TB-411-510-001: 220/33kV Switchyard- Single Line Diagram
2. TB-411-510-002: 220/33kV Switchyard- Key Metering & Protection Single Line Diagram

Sl. No.	Item Description	Long Description	Unit	Qty.	Remarks
A.1 Supply Item- Main Items					
1	33 KV Fault Current Limiter Panel with its accessories	Three phase, metal enclosed, indoor type current limiting/ fault limiting devices of rating 38 kV, 2500 Amp Continuous Current, 150 kV BIL, suitable for limiting the fault level to 25 KA rms, symmetrical Interrupting in panel with its accessories shall be complete in all respects and comprising of following but not limited to, a. Three suitable bases for mounting replaceable interrupters, isolation Transformer, bus supports, Sensing Firing Logics, and tinned copper bus with suitable pad one for each phase b. Three redundant sensing and firing logic for each phase c. Feature of remote & local monitoring and remote actuation. Suitable numbers of contact's shall be available for monitoring of control supply, actuation state etc. d. One set of 3 phase unit to be installed in a proper metal enclosure suitable for installation in indoor sub-station. The metal enclosure shall be of IP41 class or more. The fault limiter housing shall ensure all safety aspects for installation in the indoor sub-station and shall comply all IS/IEC specifications relevant for metal enclosure installation. e. Provision of earthing connectivity etc. f. Structural material required for installation of system. g. Any other item/(s) required to complete the supply in all respects but not limited to above shall be in bidder's scope.	Set	2	Technical specification shall be in line with Section-2/ Customer Specification Section-3, Chapter-18.
2	Off-load Isolator Panel associated with 33 kV Fault Current Limiter Panel	Three phase, , metal enclosed, indoor type off-load Isolator panel on each end of the fault limiting device panel for providing the positive isolation for fault limiting device, of rating 33 kV, 2500 Amps, 25 KA for 1 Sec shall be complete in all respects and comprising of following but not limited to, a. Four number isolator panel shall be required (2 Nos. for each fault limiting device). b. The isolator panel shall be suitable for cable termination of size 3RX1CX630 sqmm, 33 KV, XLPE CU cables on both incoming and outgoing side. c. Structural material required for installation of system. d. Any other item/(s) required to complete the supply in all respects but not limited to above shall be in bidder's scope.	Set	4	Technical specification shall be in line with Section-2/ Customer Specification Section-3, Chapter-18.
3	Cable Adapter Extension Panel	Three phase, metal enclosed, indoor type cable adapter panel at URT panel for providing the connectivity with URT panel shall be complete in all respects and comprising of following but not limited to, a. Cable adapter extension panel complete with bus-bars, insulator for termination of fault limiter cables in SS-63 URT Outgoing feeders. b. Provision of earthing connectivity etc. c. Structural material required for installation of system. d. Any other item/(s) required to complete the supply in all respects but not limited to above shall be in bidder's scope.	Set	4	Technical specification shall be in line with Section-2/ Customer Specification Section-3, Chapter-18.
A.2 Supply Item- Mandatory Spare Items					
1	Single Phase interrupters	Single Phase interrupter shall be complete in all respects and comprising of following but not limited to, a. Single phase interrupter of similar rating as supplied with fault current limiter panel must be equipped with similar type of local and remote indication feature as supplied with fault current limiter panel. b. Any other item/(s) required to complete the supply in all respects but not limited to above shall be in bidder's scope.	No	3	Technical specification shall be in line with Section-2/ Customer Specification Section-3, Chapter-18.
A.3 Supply Item- Test Equipment					

Sl. No.	Item Description	Long Description	Unit	Qty.	Remarks
1	Field Tester Unit	Test Equipment Package shall be complete in all respects and comprising of following but not limited to, a. Field tester unit b. Interrupter simulators unit (1set=3no of interrupter simulators) Field Tester Unit shall be used for commissioning and periodic maintenance tests. It is also used to verify Sensing/Firing Logic readiness and capability.	Set	1	Technical specification shall be In line with Section-2/ Customer Specification Section-3, Chapter-18.
2	Interrupter Simulator Unit	Test Equipment Package shall be complete in all respects and comprising of following but not limited to, a. Field tester unit b. Interrupter simulators unit (1set=3no of interrupter simulators) Field Tester Unit shall be used for commissioning and periodic maintenance tests. It is also used to verify Sensing/Firing Logic readiness and capability.	Set	1	Technical specification shall be In line with Section-2/ Customer Specification Section-3, Chapter-18.
B	Main Services Items				
1	Supervision for Installation, Testing & Commissioning of 33 KV Fault Current Limiter Panel with its accessories	Supervision for installation, testing & commissioning of 33 KV Fault Current Limiter Panel with its accessories shall be complete in all respects. Any other supervisory service(s) required to complete the work in all respects shall be in bidder's scope.	Set	2	Technical specification shall be In line with Section-2/ Customer Specification Section-3, Chapter-18.
2	Supervision for Installation, Testing & Commissioning of off-load Isolator Panel associated with 33 kV Fault Current Limiter Panel	Supervision for installation, testing & commissioning of off-load Isolator Panel associated with 33 kV Fault Current Limiter Panel shall be complete in all respects. Any other supervisory service(s) required to complete the work in all respects shall be in bidder's scope.	Set	4	Technical specification shall be In line with Section-2/ Customer Specification Section-3, Chapter-18.
3	Supervision for Installation, Testing & Commissioning of Cable Adapter Extension Panel	Supervision for installation, testing & commissioning of Cable Adapter Extension Panel shall be complete in all respects. Any other supervisory service(s) required to complete the work in all respects shall be in bidder's scope.	Set	4	Technical specification shall be In line with Section-2/ Customer Specification Section-3, Chapter-18.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)



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PROJECT: 15TK JOB FOR BEL WORK OF 220KV GRID POWER IMPORT AT
LOA NO. RPHC18249/2426946, DTD 24.01.2020

DESIGNER:

CONSULTANT:

TATA CONSULTING ENGINEERS LIMITED

REV	DATE	REASON	BY	CHECKED	APPROVED
01	14.02.20	AS PER HAWA/ADD COMMENTS			

ZONE: AS PER HAWA/ADD COMMENTS
OFFICE: OFFICE

TITLE: 220/33KV SWITCHYARD-SINGLE LINE DIAGRAM

DWG NO: TB-1-411-600-001

REV: 01

SHEET NO: 01

NO. OF SHEETS: 02

SIZE-A1

Comments Resolution Sheet for

DRAWING / DOCUMENT TITLE: 220/33kV Switchyard- Single Line Diagram

DOCUMENT NUMBER: TB-411-510-001

REVISION NO: 00

Sl. No.	Comment (s)/ Observation(s)	Resolution(s)
A	CONSULTANT	
1	No comments	
B	CONSULTANT	
1	Surge arrestor shall also be provided in the incomer/line bays also in line with the observation point: (f) of mail ref. no.: PR/P&U/DGM(MN-EL)/26286965/2020/3 ; Dt.28.1.20.	It is to be noted that the requirements of surge arrestor, if required in line with sytem studies, shall taken care.
2	The no. of FCL is shown as 1 Set instead of the requirement of 2 Set in document no.: TB-1-411-510-001 9 Sheet 02 of 02. Please correct and submit.	Noted and complied.
3	The no. of runs of cable shown in the SLD is still incomplete. Please correct as detailed below, a. Cabling from existing URT to New Fault limiting devices both incoming and outgoing side- 3 Runs per phase per URT X 1 Core X 630 sqmm i.e. total of 18 runs per URT and 36 runs for two URT system b. From SS-9 LIB to SS-9 Generation Board (PNCP): 3 Runs per phase per feeder X 1 Core X400 sqmm i.e. total 9 Runs per feeder and 18 runs for 2 feeders	Noted and complied.

NOTE:

CONTRACTOR IS OBLIGED TO FURNISH THIS SHEET (DULY FILLED UP WITH RESOLUTION TO ALL CUSTOMER/CONSULTANT COMMENTS ALONGWITH REVISED DRAWINGS

NOTES (FOR IUCL PANIPAT END)

	CURRENT TRANSFORMER
	BUSING CURRENT TRANSFORMER
	CAPACITOR VOLTAGE TRANSFORMER
	EMT
	LIGHTNING ARRESTER
	CIRCUIT BREAKER
	DISCONNECTOR
	EARTHING SWITCH
	SF ₆ -TO-AIR BUSHING
	SF ₆ -TO-OIL BUSHING
	SF ₆ -TO-CABLE MODULE
	WAVE TRAP
	GIS BUS DUCT
	OPTICAL FIBRE
	O/D DISCONNECTER (HCB TYPE)
	GIS CT / AIR SWITCH BOARD CT

1. ALL PROTECTION FEATURES SHOWN IN THIS DRAWING SHALL BE PROVIDED IN THE OFFERED SYSTEM.
2. REFERENCE DRAWING: SINGLE LINE DIAGRAM FOR 220/230V SWITCHING SINGLE LINE DIAGRAM DWG. NO. TB-1-411-501-001, REV. 01
3. FOR THE 220 V SYSTEM, IF RATING OF CRY SHALL BE 8800A/5 AND RHT RATING OF WAKE TRAPS SHALL BE 1250A, 1500A, 1600A, 1700A, 1800A, 1900A, 2000A, 2100A, 2200A, 2300A, 2400A, 2500A, 2600A, 2700A, 2800A, 2900A, 3000A, 3100A, 3200A, 3300A, 3400A, 3500A, 3600A, 3700A, 3800A, 3900A, 4000A, 4100A, 4200A, 4300A, 4400A, 4500A, 4600A, 4700A, 4800A, 4900A, 5000A, 5100A, 5200A, 5300A, 5400A, 5500A, 5600A, 5700A, 5800A, 5900A, 6000A, 6100A, 6200A, 6300A, 6400A, 6500A, 6600A, 6700A, 6800A, 6900A, 7000A, 7100A, 7200A, 7300A, 7400A, 7500A, 7600A, 7700A, 7800A, 7900A, 8000A, 8100A, 8200A, 8300A, 8400A, 8500A, 8600A, 8700A, 8800A, 8900A, 9000A, 9100A, 9200A, 9300A, 9400A, 9500A, 9600A, 9700A, 9800A, 9900A, 10000A, 10100A, 10200A, 10300A, 10400A, 10500A, 10600A, 10700A, 10800A, 10900A, 11000A, 11100A, 11200A, 11300A, 11400A, 11500A, 11600A, 11700A, 11800A, 11900A, 12000A, 12100A, 12200A, 12300A, 12400A, 12500A, 12600A, 12700A, 12800A, 12900A, 13000A, 13100A, 13200A, 13300A, 13400A, 13500A, 13600A, 13700A, 13800A, 13900A, 14000A, 14100A, 14200A, 14300A, 14400A, 14500A, 14600A, 14700A, 14800A, 14900A, 15000A, 15100A, 15200A, 15300A, 15400A, 15500A, 15600A, 15700A, 15800A, 15900A, 16000A, 16100A, 16200A, 16300A, 16400A, 16500A, 16600A, 16700A, 16800A, 16900A, 17000A, 17100A, 17200A, 17300A, 17400A, 17500A, 17600A, 17700A, 17800A, 17900A, 18000A, 18100A, 18200A, 18300A, 18400A, 18500A, 18600A, 18700A, 18800A, 18900A, 19000A, 19100A, 19200A, 19300A, 19400A, 19500A, 19600A, 19700A, 19800A, 19900A, 20000A, 20100A, 20200A, 20300A, 20400A, 20500A, 20600A, 20700A, 20800A, 20900A, 21000A, 21100A, 21200A, 21300A, 21400A, 21500A, 21600A, 21700A, 21800A, 21900A, 22000A, 22100A, 22200A, 22300A, 22400A, 22500A, 22600A, 22700A, 22800A, 22900A, 23000A, 23100A, 23200A, 23300A, 23400A, 23500A, 23600A, 23700A, 23800A, 23900A, 24000A, 24100A, 24200A, 24300A, 24400A, 24500A, 24600A, 24700A, 24800A, 24900A, 25000A, 25100A, 25200A, 25300A, 25400A, 25500A, 25600A, 25700A, 25800A, 25900A, 26000A, 26100A, 26200A, 26300A, 26400A, 26500A, 26600A, 26700A, 26800A, 26900A, 27000A, 27100A, 27200A, 27300A, 27400A, 27500A, 27600A, 27700A, 27800A, 27900A, 28000A, 28100A, 28200A, 28300A, 28400A, 28500A, 28600A, 28700A, 28800A, 28900A, 29000A, 29100A, 29200A, 29300A, 29400A, 29500A, 29600A, 29700A, 29800A, 29900A, 30000A, 30100A, 30200A, 30300A, 30400A, 30500A, 30600A, 30700A, 30800A, 30900A, 31000A, 31100A, 31200A, 31300A, 31400A, 31500A, 31600A, 31700A, 31800A, 31900A, 32000A, 32100A, 32200A, 32300A, 32400A, 32500A, 32600A, 32700A, 32800A, 32900A, 33000A, 33100A, 33200A, 33300A, 33400A, 33500A, 33600A, 33700A, 33800A, 33900A, 34000A, 34100A, 34200A, 34300A, 34400A, 34500A, 34600A, 34700A, 34800A, 34900A, 35000A, 35100A, 35200A, 35300A, 35400A, 35500A, 35600A, 35700A, 35800A, 35900A, 36000A, 36100A, 36200A, 36300A, 36400A, 36500A, 36600A, 36700A, 36800A, 36900A, 37000A, 37100A, 37200A, 37300A, 37400A, 37500A, 37600A, 37700A, 37800A, 37900A, 38000A, 38100A, 38200A, 38300A, 38400A, 38500A, 38600A, 38700A, 38800A, 38900A, 39000A, 39100A, 39200A, 39300A, 39400A, 39500A, 39600A, 39700A, 39800A, 39900A, 40000A, 40100A, 40200A, 40300A, 40400A, 40500A, 40600A, 40700A, 40800A, 40900A, 41000A, 41100A, 41200A, 41300A, 41400A, 41500A, 41600A, 41700A, 41800A, 41900A, 42000A, 42100A, 42200A, 42300A, 42400A, 42500A, 42600A, 42700A, 42800A, 42900A, 43000A, 43100A, 43200A, 43300A, 43400A, 43500A, 43600A, 43700A, 43800A, 43900A, 44000A, 44100A, 44200A, 44300A, 44400A, 44500A, 44600A, 44700A, 44800A, 44900A, 45000A, 45100A, 45200A, 45300A, 45400A, 45500A, 45600A, 45700A, 45800A, 45900A, 46000A, 46100A, 46200A, 46300A, 46400A, 46500A, 46600A, 46700A, 46800A, 46900A, 47000A, 47100A, 47200A, 47300A, 47400A, 47500A, 47600A, 47700A, 47800A, 47900A, 48000A, 48100A, 48200A, 48300A, 48400A, 48500A, 48600A, 48700A, 48800A, 48900A, 49000A, 49100A, 49200A, 49300A, 49400A, 49500A, 49600A, 49700A, 49800A, 49900A, 50000A, 50100A, 50200A, 50300A, 50400A, 50500A, 50600A, 50700A, 50800A, 50900A, 51000A, 51100A, 51200A, 51300A, 51400A, 51500A, 51600A, 51700A, 51800A, 51900A

NOTES (FOR REMOTE END - HVPNL MUNDEH S/S)

1. ALL PROTECTION FEATURES SHOWN IN THIS DRAWING SHALL BE PROVIDED IN THE OFFERED SYSTEM.
2. FOR THE 220 VLV SYSTEM, PF RATING OF COT SHALL BE 8800PF AND MH RATING OF NAME TRAPS SHALL BE 1250A, 10MVA/1MVA ICJL/ HAPNL TO CONFIRM THE SAME.
3. DIFFERENTIAL COM DISTANCE PROTECTION RELAY AT MUNDO S/S END SHALL MATCH WITH REMOTE END DIFFERENTIAL COM DISTANCE PROTECTION RELAY SHALL BE SUPPLIED LOOSESE BY REMOTE END DIFFERENTIAL COM DISTANCE PROTECTION RELAY IN THE SCOPE OF BHEL ASSOCIATED CO SYSTEMS) (NAME TRAPS, DIGITAL PLC TERMINALS, COUPLING DEVICES, REMOTE END DIFFERENTIAL COM DISTANCE PROTECTION RELAY SHALL BE SUPPLIED LOOSESE BY REMOTE END DIFFERENTIAL COM DISTANCE PROTECTION RELAY IN THE SCOPE OF BHEL ASSOCIATED CO SYSTEMS)
4. HAPNL TO ENSURE ADEQUACY OF SPACE & FACILITIES TO INSTALL PLC ITEMS AND DIFFERENTIAL COM DISTANCE PROTECTION RELAY AT REMOTE END (MUNDO S/S) WILL BE MAINTAINED IN RESPECTIVE PROTECTION PANEL OF HAPNL. SUPPLY OF PROTECTION PANELS IS NOT IN PRESENT SCOPE. HOWEVER, INSTALLATION, TESTING & COMMISSIONING AND INTEGRATION TO EXISTING SCADA IS IN BHEL SCOPE.
5. DIFFERENTIAL COM DISTANCE PROTECTION RELAY AT BOTH ENDS WILL BE CONNECTED THROUGH DIRECT CONNECTION (SINGLE MUX).
6. FOR THE 220V SYSTEM, PF RATING OF COT SHALL BE 8800PF AND MH RATING OF NAME TRAPS SHALL BE 1250A, 10MVA/1MVA ICJL/ HAPNL TO CONFIRM THE SAME.
7. DIFFERENTIAL COM DISTANCE PROTECTION RELAY AT MUNDO S/S END SHALL MATCH WITH REMOTE END DIFFERENTIAL COM DISTANCE PROTECTION RELAY SHALL BE SUPPLIED LOOSESE BY REMOTE END DIFFERENTIAL COM DISTANCE PROTECTION RELAY IN THE SCOPE OF BHEL ASSOCIATED CO SYSTEMS) (NAME TRAPS, DIGITAL PLC TERMINALS, COUPLING DEVICES, REMOTE END DIFFERENTIAL COM DISTANCE PROTECTION RELAY SHALL BE SUPPLIED LOOSESE BY REMOTE END DIFFERENTIAL COM DISTANCE PROTECTION RELAY IN THE SCOPE OF BHEL ASSOCIATED CO SYSTEMS)
8. HAPNL TO ENSURE ADEQUACY OF SPACE & FACILITIES TO INSTALL PLC ITEMS AND DIFFERENTIAL COM DISTANCE PROTECTION RELAY AT REMOTE END (MUNDO S/S) WILL BE MAINTAINED IN RESPECTIVE PROTECTION PANEL OF HAPNL. SUPPLY OF PROTECTION PANELS IS NOT IN PRESENT SCOPE. HOWEVER, INSTALLATION, TESTING & COMMISSIONING AND INTEGRATION TO EXISTING SCADA IS IN BHEL SCOPE.
9. DIFFERENTIAL COM DISTANCE PROTECTION RELAY AT BOTH ENDS WILL BE CONNECTED THROUGH DIRECT CONNECTION (SINGLE MUX).
10. FOR THE 220V SYSTEM, PF RATING OF COT SHALL BE 8800PF AND MH RATING OF NAME TRAPS SHALL BE 1250A, 10MVA/1MVA ICJL/ HAPNL TO CONFIRM THE SAME.
11. DETAILED DETAILS OF REMOTE END STATION TO BE INFORMED BY HAPNL (SLD, CT, VT, EXHAUST SCS SCHEMES).

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COMPUTER FILE NAME

REF. DRG. NO.

SIGN, AND DATE

INVENTORY NO.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	RD
		CHD/APPD			CHD/APPD	02	23/05/2020	CHD/APPD	WK
ZONE			ZONE			ZONE	REUSED AS PER TCE & IOCL COMMENTS DT 04/05/2020		
						01	28/04/2020	CHD/APPD	WK
						ZONE	REUSED AS PER TCE & IOCL COMMENTS DT 19/03/2020		

CUSTOMER: LSTK JOB FOR ISBL WORK OF 220kV GRID POWER IMPORT AT
PANIPAT REFINERY
LOA NO. RPRC192491/26286965 DTD.24.01.2020

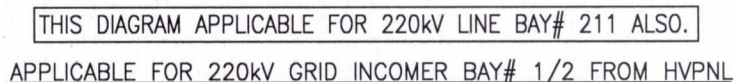
OWNER: INDIAN OIL CORPORATION LIMITED

CONSULTANT:
 TATA
TATA CONSULTING ENGINEERS LIMITED

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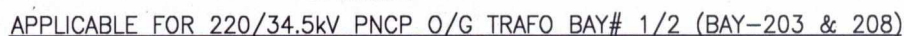
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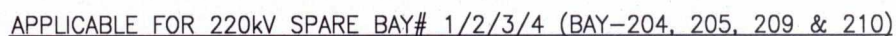
CUSTOMER: ISTK JOB FOR ISBL WORK OF 250KV GRID POWER IMPORT AT PANIPAT REFINERY					
LOA NO. RPRCIB8491/26286965 DTD 24.01.2020					
OWNER:					
INDIAN OIL CORPORATION LIMITED					
CONSULTANT: TATA CONSULTING ENGINEERS LIMITED					
					
					
BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP					
SERIAL NO.	UNITED DIMS. of m ³ /		SCALE	WEIGHT (KG)	
CODE		N.T.S	N.A.		
NAME	DRAWN	CHECKD.	APPROV.	DATE	SIGN.
RD	RD			12.03.2020	
				12.03.2020	
				12.03.2020	
				12.03.2020	
REF. TO ASST. DRWG.				ITEM NO.	NO. OF ITEMS
N.A.				N.A.	N.A.
DRAWING / DOCUMENT NO.					REV
TB-3-411-510-002					02
SHT. No	02	NO. OF SHIT.			08



SIZE-A3

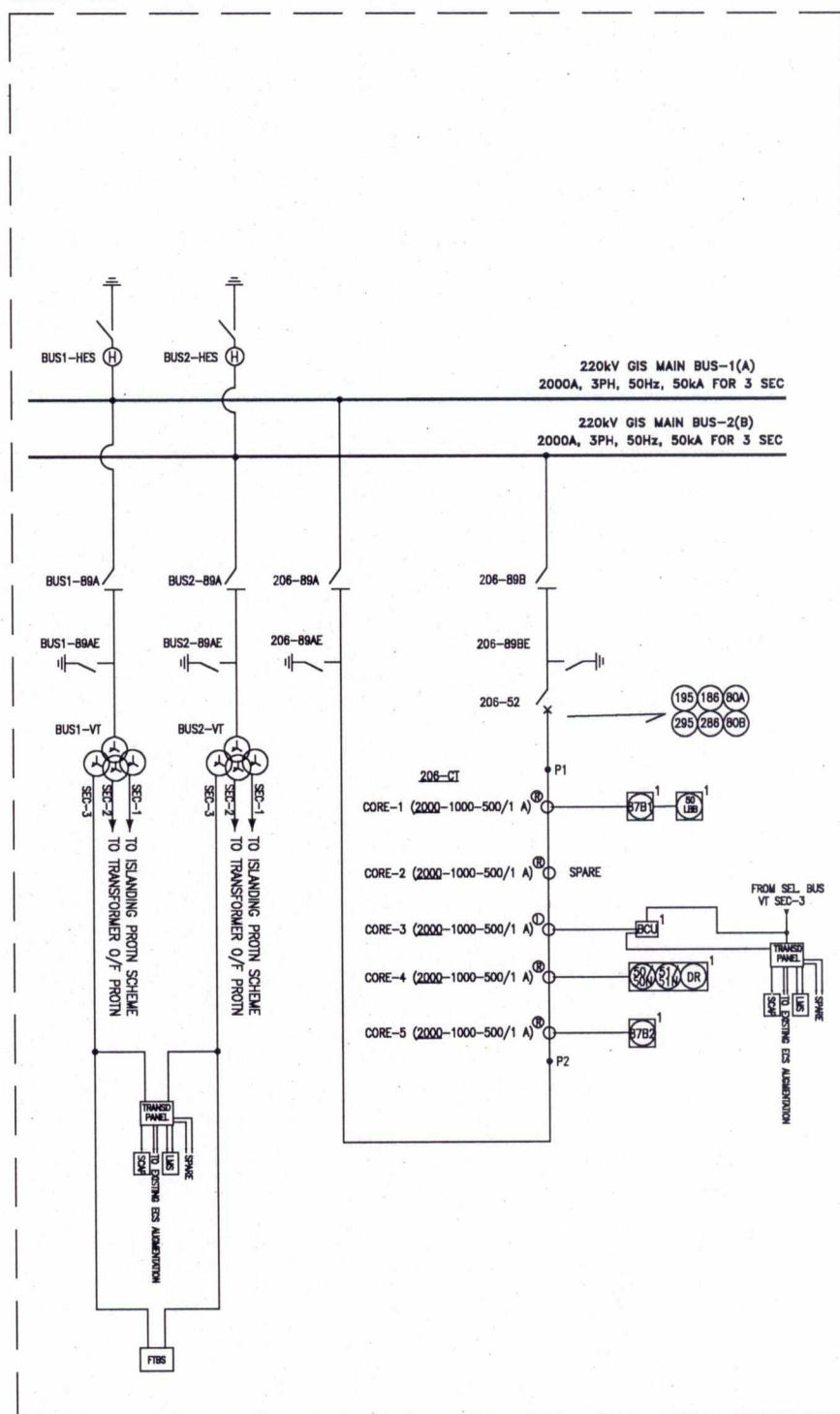
CUSTOMER: ISTK JOB FOR ISBL WORK OF 220KV AIR POWER IMPORT AT PANPAT REFINERY		LOA NO. RPRC182491/26286965 DTD.24.01.2020		OWNER:	
INDIAN OIL CORPORATION LIMITED					
CONSULTANT: TATA CONSULTING ENGINEERS LIMITED					
 					
BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP					
DEPTH CODE UNIT	UNITED DIMS. of m	SCALES N.T.S	WEIGHT (KGS) N.A.	NAME RD CHD. APPRO. UK	SIGN.
11					
TITLE	220/33KV SWITCHYARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM				
DRAWING DOCUMENT NO.	TB-3-411-510-002				REV
SHT. NO	04				NO. OF SHT.
					08



[illegible]SIZE-A3

INVENTORY NO	SIGN. AND DATE	REF. DRG. NO.	COMPUTER FILE NAME	THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY
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220kV GIS

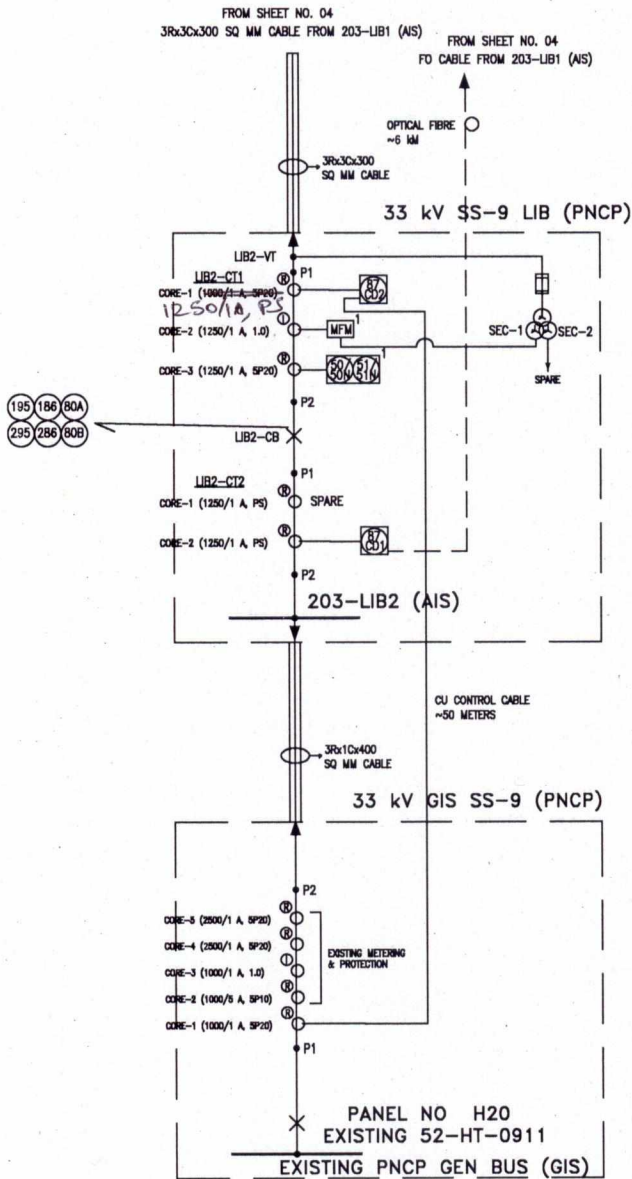


APPLICABLE FOR 220kV BUS COUPLER (BAY-206) & BUS VT-1/2

CUSTOMER: ISTK JOB FOR ISBL WORK OF 220kV GRID POWER IMPORT AT PANIPAT REFINERY			
LOA NO. RPRC182491/26286965 DTD.24.01.2020			
OWNER: INDIAN OIL CORPORATION LIMITED			
CONSULTANT: TATA CONSULTING ENGINEERS LIMITED			
PROJECT: 220/33kV SWITCHBOARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM			
DEPT. CODE	UNIT/DWG. NO.	SCALE	WEIGHT (KG) REF. TO ASST. DRG.
411	220/33kV	N.T.S	N.A.
TITLE	DATE	DATE	DATE
220/33kV SWITCHBOARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM	12.03.2020	12.03.2020	12.03.2020
DRWING/DOCUMENT NO.	NO. OF SHEET	NO. OF SHEET	NO. OF SHEET
TB-3-411-510-002	02	02	02

INVENTORY NO	SIGN. AND DATE	REF. DRG. NO.	COMPUTER FILE NAME	THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY
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REV.	DATE	ALTERED	CHD/APPD	REV.	DATE	ALTERED	CHD/APPD
ZONE				ZONE			
02	23/05/2020		CHD/APPD WK	01	29/04/2020		CHD/APPD WK
DT 04/05/2020				DT 19/03/2020			



APPLICABLE FOR 33kV FEEDERS TO PNCP SS-9 (203-LIB1/2 & 208-LIB1/2)

CUSTOMER: ISTK JOB FOR ISBL WORK OF 220KV GRID POWER IMPORT AT PANDIPAT REFINERY			
LOA NO. RPRCIB2491/2628985 DTD.24.01.2020			
OWNER: INDIAN OIL CORPORATION LIMITED			
CONSULTANT: TATA CONSULTING ENGINEERS LIMITED			
TATA			
BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP			
DESIGN	CHKD.	DATE	12.03.2020
CODE	RD	DATE	12.03.2020
411	WK	DATE	12.03.2020
UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASST. DRG.
9/11/1	N.T.S	N.A.	N.A.
220/33KV SWITCHBOARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM	DRWING/ DOCUMENT NO.	DATE	02
TB-3-411-510-002	NO. OF SHEET	08	

220 kV CURRENT TRANSFORMER
(GIS CT)

CORE NO.	CURRENT RATIO	OUTPUT BURDEN AT LOWEST TAP	MIN KPV	MAX Ie AT KPV	MAX RCT	ACCURACY CLASS	PURPOSE
1	2000-1000-500/1A	-	2000-1000-500V	30-60-120mA	10-5-2.5 Ohms	PS	PROTECTION
2	2000-1000-500/1A	-	2000-1000-500V	30-60-120mA	10-5-2.5 Ohms	PS	PROTECTION
3	2000-1000-500/1A	30VA	-	-	-	0.2% _M 0.5S	METERING
4	2000-1000-500/1A	-	2000-1000-500V	30-60-120mA	10-5-2.5 Ohms	PS	PROTECTION
5	2000-1000-500/1A	-	2000-1000-500V	30-60-120mA	10-5-2.5 Ohms	PS	PROTECTION

220 kV CURRENT TRANSFORMER - TARIFF
METERING (OUTDOOR CT)

CORE NO.	CURRENT RATIO	OUTPUT BURDEN AT LOWEST TAP	MIN KPV	MAX Ie AT KPV	MAX RCT	ACCURACY CLASS	PURPOSE
1	250/1A	10VA	-	-	-	0.2% _M 0.5S	TARIFF METERING
2	250/1A	10VA	-	-	-	0.2% _M 0.5S	TARIFF METERING

BUSHING CURRENT TRANSFORMER
(HV SIDE)

CORE NO.	CURRENT RATIO	OUTPUT BURDEN AT LOWEST TAP	MIN KPV	MAX Ie AT KPV/2	MAX RCT	ACCURACY CLASS	PURPOSE
1	250/1A	-	(208cct + 100) V	30 mA	1.25 Ohms	PS	REF PROTECTION

BUSHING CURRENT TRANSFORMER
(HV NEUTRAL SIDE)

CORE NO.	CURRENT RATIO	OUTPUT BURDEN AT LOWEST TAP	MIN KPV	MAX Ie AT KPV/2	MAX RCT	ACCURACY CLASS	PURPOSE
1	250/1A	-	(208cct + 100) V	30 mA	1.25 Ohms	PS	REF PROTECTION
2	250/1A	20VA	-	-	-	SP20	SEEF PROTECTION

BUSHING CURRENT TRANSFORMER
(LV SIDE)

CORE NO.	CURRENT RATIO	OUTPUT BURDEN AT LOWEST TAP	MIN KPV	MAX Ie AT KPV/2	MAX RCT	ACCURACY CLASS	PURPOSE
1	1500/1A	-	(1508cct + 300) V	30 mA	7.5 Ohms	PS	REF PROTECTION

220kV BUS VT (GIS EMVT)

WINDING NO.	VOLTAGE RATIO	RATED BURDEN	ACCURACY CLASS	PURPOSE
1	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	3P	PROTECTION
2	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	3P	PROTECTION
3	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	150 VA	0.2	METERING

220kV CTV (8800 pF, +10%, -5%) - OUTDOOR CTV

WINDING NO.	VOLTAGE RATIO	RATED BURDEN	ACCURACY CLASS	PURPOSE
1	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	3P	PROTECTION
2	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	3P	PROTECTION
3	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	0.2	METERING

220kV VT - TARIFF METERING (OUTDOOR EMVT)

WINDING NO.	VOLTAGE RATIO	RATED BURDEN	ACCURACY CLASS	PURPOSE
1	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	20 VA	0.2	TARIFF METERING
2	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	20 VA	0.2	TARIFF METERING

BUSHING CURRENT TRANSFORMER
(LV NEUTRAL SIDE)

CORE NO.	CURRENT RATIO	OUTPUT BURDEN AT LOWEST TAP	MIN KPV	MAX Ie AT KPV/2	MAX RCT	ACCURACY CLASS	PURPOSE
1	1500/1A	-	(1508cct + 300) V	30 mA	7.5 Ohms	PS	REF PROTECTION
2	1500/1A	20VA	-	-	-	SP20	SEEF PROTECTION

33 kV IIB CURRENT TRANSFORMER (IIB-CT1)

CORE NO.	CURRENT RATIO	OUTPUT BURDEN AT LOWEST TAP	MIN KPV	MAX Ie AT KPV/2	MAX RCT	ACCURACY CLASS	PURPOSE
1	1250/1A	-	625V	30mA	6.25 Ohms	PS	PROTECTION
2	1250/1A	30VA	-	-	-	1.0% _M 0.5S	METERING
3	1250/1A	10VA	-	-	-	SP20	PROTECTION

33 kV IIB CURRENT TRANSFORMER (IIB-CT2)

CORE NO.	CURRENT RATIO	OUTPUT BURDEN AT LOWEST TAP	MIN KPV	MAX Ie AT KPV/2	MAX RCT	ACCURACY CLASS	PURPOSE
1	1250/1A	-	625V	30mA	6.25 Ohms	PS	PROTECTION
2	1250/1A	-	625V	30mA	6.25 Ohms	PS	PROTECTION

4 CORE SWG RE-1950/1A CLASS-PS 30P-
IIB-1-1000/1A CLASS-SP20-10VA 30P-
IIB-2

220kV LINE VT (GIS EMVT)

WINDING NO.	VOLTAGE RATIO	RATED BURDEN	ACCURACY CLASS	PURPOSE
1	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	3P	PROTECTION
2	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	3P	PROTECTION
3	$\frac{220}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	0.2	METERING

33kV IIB VT

WINDING NO.	VOLTAGE RATIO	RATED BURDEN	ACCURACY CLASS	PURPOSE
1	$\frac{33}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	1.0	METERING
2	$\frac{33}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} \text{ kV}$	50 VA	3P	PROTECTION

CUSTOMER: LSTK JOB FOR ISBL WORK OF 220kV GRD POWER IMPORT AT
PANIPAT REFINERY
LOA NO. RPRCIB2491/26286965 DTD.24.01.2020

OWNER:

INDIAN OIL CORPORATION LIMITED

CONSULTANT:

TATA CONSULTING ENGINEERS LIMITED

TATA

Bharat Heavy Electricals Ltd.

TRANSMISSION BUSINESS GROUP

Bharat Heavy Electricals Ltd.

TRANSMISSION BUSINESS GROUP

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REV. DATE ALTERED RD

01 29/04/2020 CHD/APPD VK

ZONE REUSED AS PER TDE & IOCL COMMENTS

DT 19/03/2020

ZONE REUSED AS PER TDE & IOCL COMMENTS

DT 04/05/2020

ZONE REUSED AS PER TDE & IOCL COMMENTS

DT 04/05/2020

ZONE REUSED AS PER TDE & IOCL COMMENTS

REV. DATE ALTERED RD

02 23/05/2020 CHD/APPD VK

ZONE REUSED AS PER TDE & IOCL COMMENTS

DT 04/05/2020

ZONE REUSED AS PER TDE & IOCL COMMENTS

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Bharat Heavy Electricals Limited

Project: LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery

Technical Specification: 33kV Fault Current Limiter Panel with its Accessories

Doc No. TB-411-316-003 Rev 00

SECTION 2:

EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES

1. Technical Specification for 33kV Fault Current Limiting Protector Device (FCL)
2. 33kV Fault Current Limiting Protector Device (FCL)- Technical Corrigendum 1
3. 33kV Fault Current Limiting Protector Device (FCL)- Technical Corrigendum 2

SECTION-3

CHAPTER-18

**TECHNICAL SPECIFICATION FOR
FAULT CURRENT LIMITING
PROTECTOR DEVICE**

Rashid Raza

1.0: SCOPE OF WORK: The scope of work includes the design, engineering, manufacturing, supply, installation, cabling, site testing and commissioning of fault limiting system as specified in this specifications. The fault limiting devices will be used in parallel with existing unit ratio transformers (URT) for system fault levels are within the designed limits. As there are two URTs for providing connectivity between grid generation bus and internal generation system, so two complete sets of fault limiting will be required each in parallel with the one URT. This fault limiting device will be installed in SS-63 in Panipat Refinery. The SLD of proposed system for fault limiting devices is indicated in Clause-4.0 of this document.

2.0 Functionality – The proposed Fault limiting device will be installed in parallel with the URT system of SS-63 at PR. The fault limiting device shall have The copper bridge (main current path) inside the insert of the limiter carries the continuous current in normal operating condition. In case of a fault current the main current path is immediately opened, triggered by the control unit. The short-circuit current commutates to a parallel fuse with high breaking capacity, which limits the short-circuit current during the first rise within less than a quarter cycle.

3.0 SCOPE OF SUPPLY:

3.1 Two set of Three (3) phase, metal enclosed, indoor type Current Limiting/ Fault limiting devices of rating:

38 kV, 2500 Amp Continuous Current,

150 kV BIL, suitable for limiting the fault level to 25 kA rms, sym. Interrupt.

Complete 3-Phase unit includes:

a. Three suitable bases for mounting replaceable interrupters, isolation Transformer, bus supports, Sensing Firing Logics, and tinned copper bus with suitable pad one for each phase

b. Three (3) redundant sensing and firing logic. One per each phase

c. Feature of remote & local monitoring and remote actuation . Suitable numbers of contact's shall be available for monitoring of control supply, actuation state.

d. One set of 3 phase unit to be installed in a proper metal enclosure suitable for installation in indoor sub-station. The metal enclosure shall be of IP41 class or more. The fault limiter housing shall ensure all safety aspects for installation in the indoor sub-station and shall comply all IS/IEC specifications relevant for metal enclosure installation

3.2 33 KV, 3-phase, 2500 Amps, 25 KA for 1 Sec, Metal enclosed Off-load Isolators on each end of the fault limiting device for providing the positive isolation for fault limiting device. Total 4 (Four) numbers of isolators required (2 Nos. for each fault limiting device). The isolator panel shall be suitable for cable termination of size 3R X 1C X 630 sqmm, 33 KV, XLPE CU cables on both incoming and outgoing side.

3.3 Supply, laying, termination of Single core, 630 sqmm (minimum), 33 KV (E) cables including end termination systems suitable for developing connectivity between following points:

3.3.1 Existing URT panel (in SS-63) to new isolator panels (in SS-63) for both incoming and outgoing side.

3.3.2 Between new isolator panel to fault limiting devices at both incoming and outgoing side.

The minimum number of runs shall be 3 (three) per phase in all the circuits.

3.4 Supply, laying and termination of all control cables required for control supply, remote indications and controls as per system requirements.

3.5 Design, manufacturing, installation and hook-up of cable adaptor box in existing URT panels (4 Nos.) for developing cable connectivity as mentioned above.

3.6 Supply and provision of earthing for new fault limiting system.

3.7 Supply, fabrication and installation of structural material required for installation of system, cable laying infrastructures including cable trays.

3.8 Three single phase interrupter of similar rating to be supplied as mandatory spares and must be equipped with similar type of local and remote indication feature.

3.9 Supply of Test Equipment Package (1 Set)

Test Equipment Package includes:

- One Field Tester Unit
- One set of Three (3) Interrupter Simulators

Field Tester Unit shall be used for commissioning and periodic maintenance tests. It is also used to verify Sensing/Firing Logic readiness and capability.

4.0 SCOPE OF SERVICES:

4.1 Carrying out the electrical system studies required for generation of information which is essential for design of fault limiting systems. The proposed fault limiting system shall have suitable short time rating and system trigger settings to ensure proper actuation of system while maintaining the system fault level limits. Following check points shall be ensured while designing the fault limiting system to avoid spurious actuation and ensuring compliance of purpose of fault limiting system.

4.1.1 Due consideration of Initial symmetrical short-circuit current I_k'' of generators, transformers, the grid, motor Contribution

4.1.2 Permissible short-circuit current of the upstream & downstream switchboards

4.1.3 Rated power of big motors directly connected to Power system

4.1.4 Rated capacity of capacitor banks and the inductance in series connected to Power system

4.1.5 Rated power of the outgoing biggest transformer which is charged from 33kV system

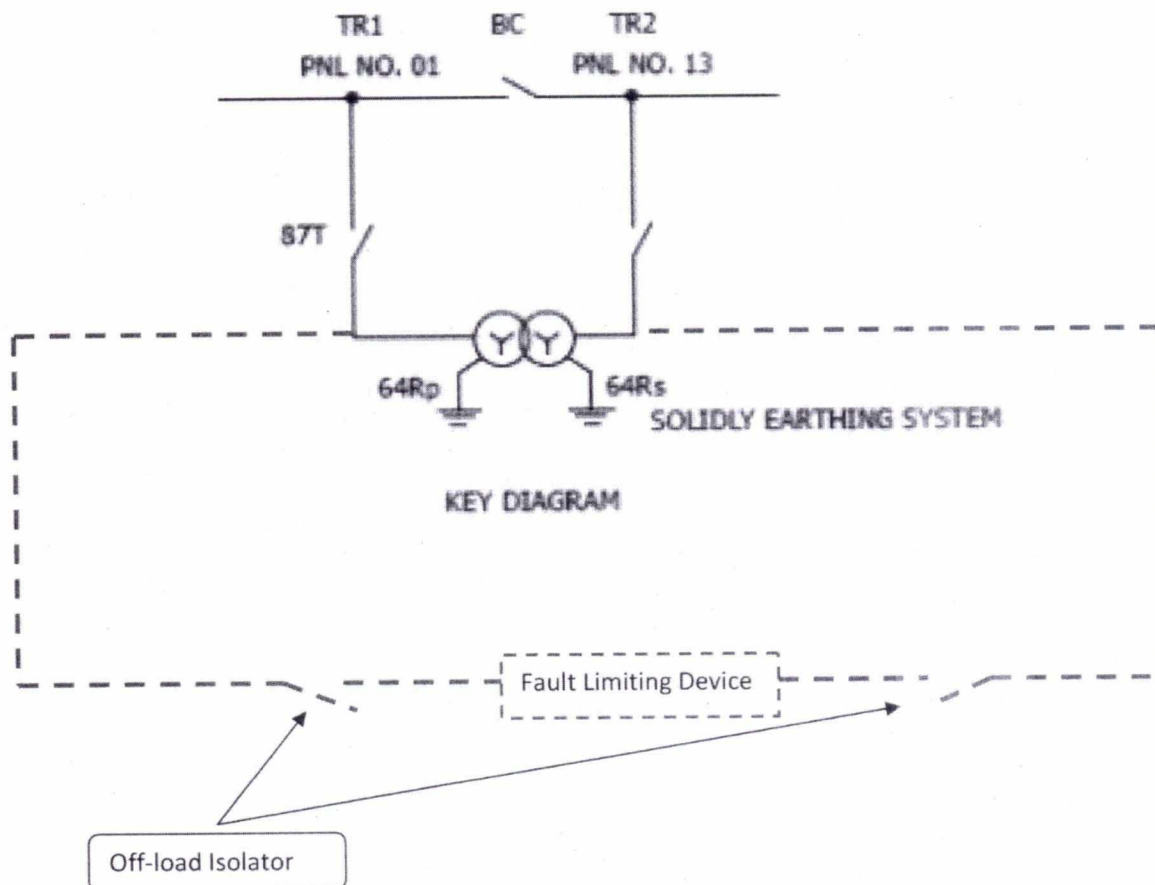
4.2 Collection of all existing system data as required for fault limiting system design shall be in the scope of LSTK contractor.

4.3 The installation, site testing and commissioning of the system. The site installation and commissioning shall be done under the supervision of OEM.

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- 4.4 The proposed fault limiting system shall be installed in SS-63 as an indoor installation. All required civil work and structural work specific to fault limiting system shall be in the scope of the LSTK contractor including design and supply of all materials.
- 4.5 All kinds of structural and trays works required for cabling associated with the fault limiting system shall be in the scope of LSTK contractor including supply of materials.
- 4.6 The alarm and actuation status of fault limiting device shall be provided in the existing ECS, new SAS and SCAP panels as specified in the ISBL scope of work. All required control cabling, its interconnection, laying, termination shall be in the scope of LSTK contractor including required supply of materials.

5.0 Single Line Diagram



Note : Section indicated in dashed red line is in the scope of LSTK contractor.

6.0 Testing : The LSTK contractor shall have to submit the type tests reports & carry out the routine/ acceptance test for subject item as per IEC 60282/ IEC 62271-200 or any other applicable national / international standards

- a- Power Frequency Voltage Withstand Test (Wet)
- b- Power Frequency Voltage Withstand Test (Dry)
- c- Impulse Voltage Withstand Test
- d- Temperature Rise Test
- e- Short time current test..

TECHNICAL CORRIGENDUM POINT (TENDER NO.: RPRC182491)

Sl. No.	Tender Reference	DID READ	SHOULD READ
1	Section-1/Cl. no. 2 a/Pg. no.1	Construction of 11 bays, 220KV GIS Switchyard with allied switchgear and protective equipments. (Inclusive of four numbers 220 KV bays for P-25 project costing 27.01Cr.)	Construction of 11 bays 220KV GIS Switchyard with allied switchgear and protective equipments inclusive of 4 Nos. of spare 220 KV transformer bays.
2.	Section-1/Cl. no. 2 b/Pg. no.1	Provision of 04 nos. of 220/33 KV 50 MVA grid transformers	Provision of 04 nos. of 220/34.5 KV 50/65 MVA (ONAN/ONAF) grid transformers
3	Section-1/Cl. no. 2 f/Pg. no.1	Fault current limiters for installation in parallel of URT.	Fault current limiter shall be provided in parallel with existing URTs in SS-63. The detailed scope and specification is attached as Section-3 Chapter-18.

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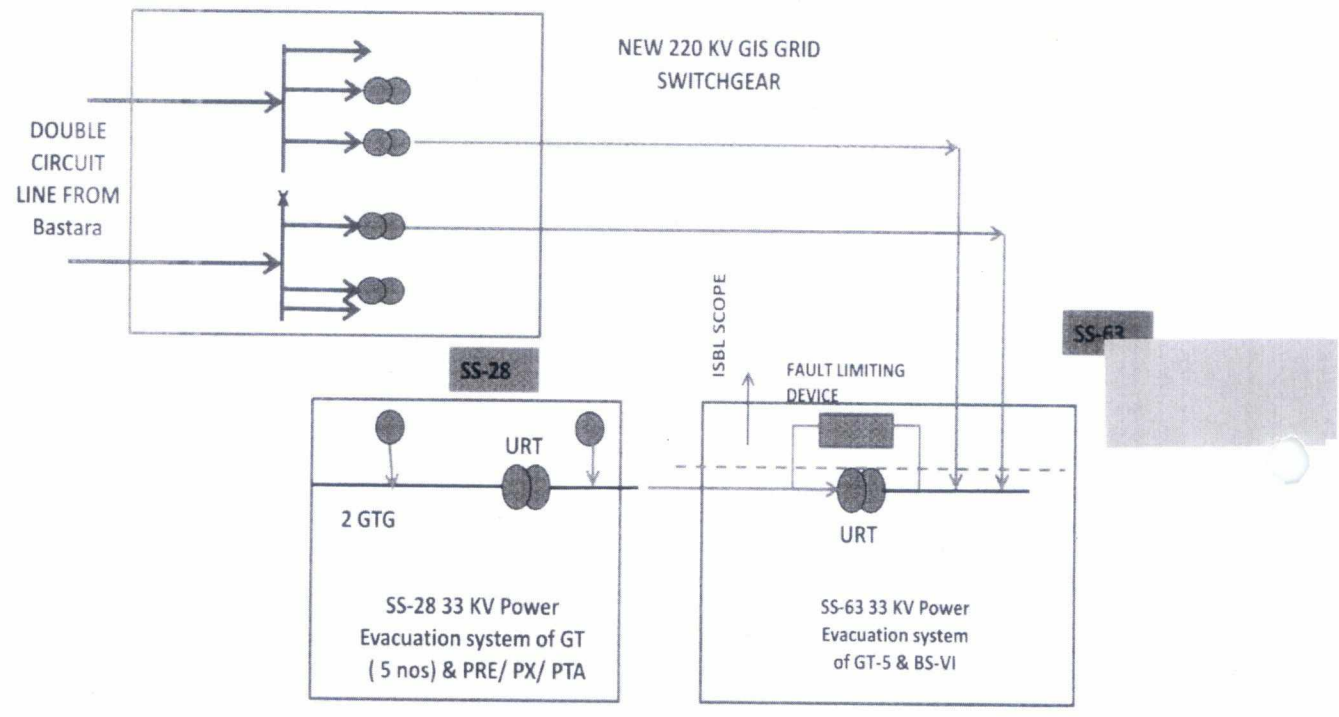
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		accessories shall be supplied without any extra cost. Also all similar components shall be interchangeable and shall be of same type and rating for easy maintenance and low spare inventory.	
159	Section-3 Chapter-11 Clause 4.7	The Internal Arc withstand shall be in the category IAC AFLR as per IEC62271-200 for 31.5 KA for 0.3 Sec or better. The bidder to offer the design of the panel in line with the Internal Arc compliance requirements only.	The Internal Arc withstand shall be in the category IAC AFLR as per IEC62271-200 for 31.5 KA for 0.3 Sec or better. The bidder to offer the design of the panel in line with the Internal Arc compliance requirements only.
160	Section-3 Chapter-11 Clause 4.8.3	The Switchboards shall be metal enclosed cubicle type, suitable for indoor installation, floor - mounting and free - standing. The design shall be totally enclosed, dust-tight, damp-proof and vermin proof offering degree of protection not less than IP4X.	The Switchboards shall be metal enclosed cubicle type, suitable for indoor installation, floor - mounting and free - standing. The design for the total enclosure shall be dust-tight, damp-proof, vermin proof and totally enclosed offering degree of protection not less than IP4X.
161	Section-3 Chapter-11 Clause 4.8.7	The switchgear cubicles shall be rigid and robust in design & construction. Sheet steel used for fabrication shall be cold rolled. Cubicles shall be made from rigid welded structural frames made of structural steel sections or of pressed / formed sheet steel of not less than 3 mm thickness. The frames shall be enclosed by sheet steel of at least 2 mm thickness, smoothly finished, leveled and free from	The switchgear cubicles shall be rigid and robust in design & construction. Panel Sheet used for fabrication shall be cold rolled steel or suitable metallurgy material. Cubicles shall be made from rigid welded structural frames made of structural steel or suitable material sections or of pressed / formed sheet of not less than 2 mm thickness. The design shall have to be type tested for full short circuit rating, internal arc resistance and ingress protection..

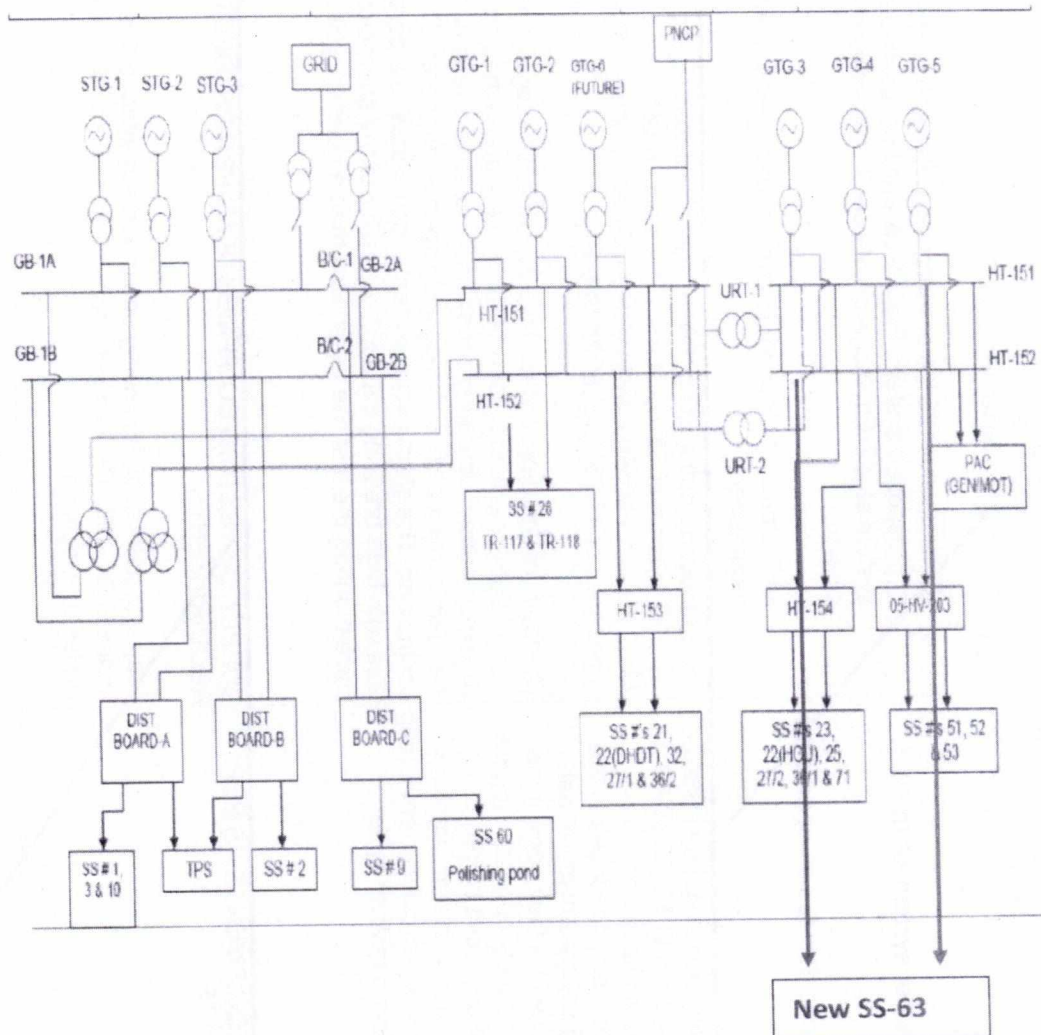
		flaws. Stiffeners shall be provided wherever necessary.	
162	Section-3 Chapter-11 Clause 4.10.9	The hot spot temperature for bus bars including joints at design ambient temperature shall not exceed 85°C for normal operating conditions.	The hot spot temperature for bus bars including joints at design ambient temperature shall not exceed the limits defined in IEC-62271 for normal operating conditions.
163	Section-3 Chapter-11 Clause 5.12.a.6	One minute power frequency withstand voltage - For type tests: 48 KVRms - For routine tests: 48 KVRms	One minute power frequency withstand voltage - For type tests: 70 KVRms - For routine tests: 70 KVRms
164	Section-3 Chapter-11 Clause 5.12.a.10;	Dynamic withstand rating : 80 KA	Dynamic withstand rating : 78.75 KA or better
165	Section-3 Chapter-11 Clause 5.12.d.3;	Short ckt. Making current: 80 kA (peak)	Short ckt. Making current: 78.75 kA (peak) or better
166	Section-3 Chapter-11 Clause 5.13.A.4	System making capacity: 80 kA (peak)	System making capacity: 78.75 kA (peak) or better
167	Section-3 Chapter-11 Clause 5.12.g.2	Rated output of each core: Adequate for the relays and devices connected, but not less than fifteen (15) VA	Rated output of each core: Adequate for the relays and devices connected, but not less than fifteen (15) VA. Minimum VA requirement shall be mandatory.

INTERCONNECTION SLD OF PR

Annex- S-2/C-1/5



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Fault Current Limiting Protector Device- Technical Corrigendum 2

37	Clause 9.0 on Page 610 pof 1047 of Section-C	Single line to ground fault current: For HV cables to be supplied as per the design requirements for the project: a. Current value: (as per system kA (min) requirement) b. kA/Duration: a. to be decided as per project requirements.	Single line to ground fault current: For HV cables to be supplied as per the design requirements for the project: a. Current value: 25 KA or matching with earth fault current of proposed system. Fault level shall be justified by system study with inclusion of contribution of existing system. b. kA/Duration: 1 Second (Minimum) or as per project requirement
38	Clause 2.0 of Section-3 Chapter-18	The proposed Fault limiting device will be installed in parallel with the URT system of SS-63 at PR. The fault limiting device shall have The copper bridge (main current path) inside the insert of the limiter carries the continuous current in normal operating condition. In case of a fault current the main current path is immediately opened, triggered by the control unit. The short-circuit current commutates to a parallel fuse with high breaking capacity, which limits the short-circuit current during the first rise within less than a quarter cycle.	The proposed Fault limiting device will be installed in parallel with the URT system of SS-63 at PR. The existing URT rating is 33/33 KV; 37.5 MVA/50 MVA (ONAN/ONAF) and percentage impedance of 17.78 % @ 50 MVA base. The fault limiting device shall have The copper bridge (main current path) inside the insert of the limiter carries the continuous current in normal operating condition. In case of a fault current the main current path is immediately opened, triggered by the control unit. The short-circuit current commutates to a parallel fuse with high breaking capacity, which limits the short-circuit current during the first rise within less than a quarter cycle.
39	Clause 2.0 on Page 509 of 1047 of Section-C	SUPPLY OF TESTING EQUIPMENTS AS PER PROJECT REQUIREMENTS:	SUPPLY OF TESTING EQUIPMENTS AS PER PROJECT REQUIREMENTS: The corrected list of the testing equipments is attached as Annex-S-3/C-5/6. The scope of supply remains same in line with tender specification.

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40	Clause 10.1.1.9 on Page 98 of 1047 of Section-C	Complete 220 kV & 33 kV C & R Panels with remote monitoring HMI system. All required relay panels, ECS/ SCADA panels shall be installed in same 220 KV GIS switchgearbuilding while remote HMI to be installed in existing control room of both PR and PNCP.	Complete 220 kV & 33 kV C & R Panels with remote monitoring HMI system. All required relay panels, ECS/ SCADA panels shall be installed in same 220 KV GIS switchgearbuilding while remote HMI to be installed in existing control room of both PR and PNCP.
41	Clause 5.2 of Section-3 Chapter-12 on Page no.; 892 of 1047 of Section-C	All motor feeders rated 75 KW and above shall be ACB fed.	The relay panel shall be of relay OEM or equivalent manufacturer with due approval of E-I-C.
42	Clause 7.11 of Section-3 Chapter-12 on Page no.; 892 of 1047 of Section-C	The maximum height of the operating handle and switches shall not exceed 1900 mm and the minimum height not below 300 mm.	In line with tender clause 1.2 on Page 887 of 1047 of Section-C. The motor of capacity more than 55 KW shall be breaker fed motor.
43	Clause 4.2 of Section-3 Chapter-18	Collection of all existing system data as required for fault limiting LSTK contractor.	The maximum height of the operating handle and switches shall not exceed 1900 mm and the minimum height not below 300 mm or as per type tested design of approved OEMs as specified in Section-3 Chapter-17.
		Collection of all existing system data as required for fault limiting system design shall be in the scope of LSTK contractor.	Basic information related with the existing system is attached as Annexure-S-3/C-18/1.

Annex-S-3/C-18/1

PART-A:**EXISTING SYSTEM DATA OF PANIPAT REFINERY:**

- i. Presently in PR CPP there are 3 STG units (3 X 25 MW) and 5 GTG (1 X 30.77 MW + 4 X 30.5 MW) units are installed.
- ii. STG-1 to 3 generation voltage level is 11 KV which is connected with Generation bus through Generator transformer of 11/ 11.7 KV transformer (Delta / star). STG generator grounding is High resistance grounding by use of NGT and NGR and generator transformer is also high resistance grounded by use of NGR. STG side Generation bus and distribution bus voltage is 11 KV.
- iii. GTG-1 to 5 generation voltage level is 11 KV which is connected with Generation bus through Generator transformer of 11/ 34.5 KV transformer Delta / star). GTG generator grounding is High resistance grounding by use of NGT and NGR while 33 KV side of generator transformer is solidly grounded. GTG side Generation bus and distribution bus voltage is 33 KV.
- iv. 2 nos. of Unit ratio transformers (URT-1 & 2) are provided for fault current limit in 33 KV side. The ration of URT is 33/33 KV.
- v. Tie transformer (Tr-111 & Tr-112) provide the required interconnection between 11 KV and 33 KV system. The details of Generator and generation system transformer is given below.

BASE DATA SHEET					
Equipment	MVA	MW	Impedance (%)		Voltage
			Xd''	Xd'	
GTG-1/2/3/5/5	38.4625	30.77	14.61	21.915	11
GT Transformer	50		11.74		11/34.5
Existing URT (old)	37.5		17.7		33/33
New URT at SS-63 related to BS-VI project	50		17.78		33/33
STG	31.25	25	16.57	24.855	11
STG Transformer	31.5		15		11/11.7
Tie transformer(Tr-111/ Tr-112)	37.5		11.18		
PNCP Tie	50		22		33/33
STG side 11 KV generation bus design fault level	750 MVA (40 KA for 3 sec)				
GTG side Generation bus design fault level	1500 MVA (25 KA for 1 sec)				



PART-B:**EXISTING SYSTEM DATA OF PANIPAT NAPHTHA CRACKER:**

- i. Presently in PNCP CPP there are 3 STG units (3 X 36.8 MW) and 5 GTG (5 X 25 MW) units are installed.
- ii. All STG & GTGs, generation voltage level is 11 KV which is connected with Generation bus through Generator transformer of 11/ 34.5 KV transformer Delta / star). GTG generator grounding is High resistance grounding by use of NGT and NGR while 33 KV side of generator transformer is solidly grounded. Generation bus and distribution bus voltage is 33 KV.
- iii. 2 nos of Unit ratio transformers (BTR-1 & 2) is provided for fault current limit in 33 KV side. The ratio of BTR is 33/33 KV.
- iv. Basic data of Generator and generation system transformer is given below.

BASE DATA SHEET				
Equipment	MVA	MW	Impedance (%)	Voltage
GTG-1/2/3/5/5	32.46		14 (Xd'')	11
STG 1/2/3	46		14.72 (Xd'')	11
GT Transformer	40		12.5	11/34.5
BST	37.5		12.5	33/33
STG Transformer	50		12.5	11/34.5
STG & GTG 33 KV generation (Bus design fault level)	40 KA for 3 sec- GIS			



Bharat Heavy Electricals Limited

Project: LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery

Technical Specification: 33kV AIS Local Isolation Breaker Panel with its Accessories

Doc No. TB-411-316-004 Rev 00

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Bharat Heavy Electricals Limited

Project: LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery

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SECTION 3:

PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS (FOR ALL EQUIPMENT UNDER PROJECT)

1. General

1. This section stipulates the general technical requirements under the contract and will form integral part of the technical specification.
2. The provisions under this specification are intended to supplement requirement for the materials, equipment and services covered under this specification and is not exclusive. However, in case of conflict between requirements specified in this section and requirements specified in other sections the requirements specified under respective sections shall hold good.

2. Project Details

Panipat Refinery is a PSU Refinery and is having capacity of 15 MMTPA, catering the customers of northern India and is strategically important as per national interest. The refinery is located at Panipat, Haryana and was commissioned in the year 1998.

Presently 132KV supply to Panipat Refinery is provided from 2 sections of grid (one from PTPS and one from Munak) and point of supply is at Panipat Refinery 132KV switchyard. Panipat Refinery complex is consisting of Refinery (will be marked as PR here onwards) and Naphtha cracker complex (will be marked as PNCP here onwards). As a strategic initiative, Panipat Refinery is planning for Bulk power import from HVPNL (Haryana Vidyut Prasaran Nigam Limited) at 220 KV level of 70 MW.

In view of this, Indian Oil Corporation Ltd. (IOCL) - Panipat Refinery is in the process of developing infrastructure to import 70 MW power from grid at 220 KV. Infrastructure development for grid power import at 220KV jobs consists of Inside Battery Limit (ISBL) jobs, Outside Battery Limit (OSBL) jobs.

Sl. No.	Description	Particulars
1	Customer	Indian Oil Corporation Ltd.
2	Consultant	TATA Consulting Ltd.
3	Project	LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery
4	Project location	Panipat (City): 16 Km (approx.) Chandigarh Highway: 11 Km (approx.) Noida (Advant)/ Delhi: 150 Km/ 80 Km (approx.)
5	Transport facilities	Well connected by road, rail & air with other parts of the country.

3. Meteorological Data

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions,