

INDIAN MEDICINE PHARMACEUTICAL CORPORATION LIMITED

(A GOVERNMENT OF INDIA ENTERPRISE)

Tender No. HLL/IDN/IMPCL/2013-14/02

Request for Proposal (RFP)
for

**Modernization, Up-Gradation & Expansion of existing Plant Facilities at
Indian Medicine Pharmaceutical Corporation Limited (IMPCL) - Mohan,
District: Almora (Uttarakhand)
Package II- Electrical Substation, DG Sets and other electrical works etc.**

THE COMPLETE TENDER DOCUMENTS CONSIST OF THE FOLLOWING:

- **Volume-III (Tech. Specs)**



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(April, 2013)

General Instruction to Bidder

- a. The scope of the proposal shall be on the basis of a single Bidder's responsibility, completely covering all the equipment specified under the accompanying Technical Specification. It will include the following;
- 1-Detailed design of the equipment as applicable.
 - 2-Complete manufacture including shop testing and third party testing if any
 - 3-Providing engineering drawing, data, operation, manual, etc. for the owner's approval.
 - 4-Packing and transportation from the manufacturer's works to the site.
 - 5-Receipt, storage, preservation and conservation of equipment at the site including the insurance, if contractor feels, from dispatch from factory till commissioning.
 - 6-Pre-assembly, if any, erection, testing and commissioning of all the equipment.
 - 7-Reliability, tests and performance and guarantee tests on completion of commissioning.
 - 8-Furnishing of spares.
- b. The Bidder shall include in his proposal, the quality assurance programme containing the overall quality management and procedures which he proposes to follow in the performance of the works during various phases, as detailed in relevant clause of the erection and commissioning/technical conditions.
- c. At the time of award of contract, if required the detailed quality assurance programme to be followed for execution of the contract will be mutually discussed and agreed to and such agreed programme shall form a part of the contract.
- d. The specific reference in these specifications and documents to any material/equipment by brand name makes or catalogue number shall be construed as establishing standards of quality and performance and not as limiting competition. However, Bidders may offer other similar material/equipments. The bidder shall furnish adequate technical information about such alternative material/equipment to enable the owner to determine its acceptability. The owner shall be the sole judge on the acceptability or otherwise of such alternative material/equipment.
- e. The bidder shall note that standards for workmanship, material and equipment and reference to brand name or catalogue numbers designated by the owner in its technical specification are intended to be descriptive only and not restrictive. The bidder may substitute alternative standards, brand name and/ or catalogue numbers in its bid, provided that it demonstrates to the owner's satisfaction that the substitutions are substantially equivalent or superior to those mentioned in the technical specification (TSC).
- f. The proposal shall include all special tool & tackles required for the operation and maintenance of the equipment, in each equipment package. The bidder shall indicate all the above items in the proposal sheets given there in the description and quantity of each item.
- g. The bidder under separate sheets, in his proposal shall include a list of special tools & tackles etc., which he proposes to bring to site for the purpose of erection, handling, testing and commissioning including performance & guarantee test of the equipment. If any such equipment is listed anywhere else in the proposal and not specially mentioned in the above sheets, it shall be deemed to have been included in the bidder's proposed scope of work.
- h. **INSPECTION BY C.E.A. :-**

After completion of the work, the contractor will offer the same for inspection of Central Electricity authority. The contractor will extend all help including test facilities to the representative of Central Electricity Authority. In case of contractor fails to make desired facilities available during inspection, the department reserves the right to provide the same at the risk & cost of the contractor. The observation of the Central Electricity Authority which are a part of agreement will be attended by the contractor promptly. The installation will be commissioned only after receiving clearance from Central Electricity Authority. Inspection fees of Central Electricity Authority will be borne by the contractor.

PERFORMANCE WARRANTY PERIOD

All equipments, parts and components to be supplied and commissioned under the scope of work should be best of its kind and of proven national and inter-national quality and shall be guaranteed for successful and trouble free operation for a period of **12 months** from the day , these are handed over to the owner after installation erection and successful commissioning.

TECHNICAL SPECIFICATION FOR COMPLETE 11KV SF6 Circuit Breakers, Transformers, Generators and LT Panel

1.00.0 INTENT OF SPECIFICATION

This specification covers design, engineering, manufacture, shop testing, inspection, Painting, packing, supply, forwarding, delivery to site, erection, testing and commissioning of 11kV SF6 Circuit Breakers, 11/.433 KV out door type, Oil filled transformers, indoor type LT distribution panel ,Automatic power factor correction relay panel, DG Sets , laying of HT underground cables, laying of under ground LT cables, complete with all accessories including dismantling of existing panel boards, Shifting of DG Sets and depositing of the dismantled items to store for efficient and trouble-free operation of the distribution network for IMPCL campus. The Execution of entire works are to be done in a such way that it will not affects normal supply of IMPCL campus. The above scope of work also includes statutory clearances from the relevant authorities.

It is not the intent to specify completely herein all details of the equipment; nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.

Any thing, any part, any operational feature not specifically indicated but required for efficient and trouble- free operation and long life of the equipment and system shall be provided and shall be considered in the scope of supply ,erection and commissioning of work in quoted cost of the bid. Bidder should carefully go through the operational requirement of the system.

The design of the switchgear shall be based on safety to personnel and equipment during operation and maintenance, reliability of service, ease of maintenance, mechanical protection of equipment, interchange ability of equipment and ready addition of future loads.

2.00.00 CODES AND STANDARDS

In order to be accepted, the switchgear shall comply with the requirements stated in the latest editions of the following recommendations, standard and specifications:

■ IEC standards

IEC 298 MV metal-enclosed BS 5311 switchgear,	IS 13118/ BS 5311 HV AC circuit breakers
IEC 265 MV switches,	IS/BS 5463 High Voltage switches
IEC 129 AC disconnectors and	

earthing switches,
IEC 694 common clauses for MV
switchgear standards,
IEC 56 MV AC circuit breakers,
IEC 801 monitoring and control
IEC 529 degrees of protection
procured by enclosures (IP code).

IS/BS 5227 Metal
enclosed AC
switchgear

3.00.0 SCOPE OF WORK:

3.01.0 Scope of Supply

The scope of supply shall include design, manufacture, testing and supply of the 11kV 4way, 11kV , 3Phase, 50Hz, 3 wire , earthed neutral, Indoor type floor mounted ,non extensible/extensible ,having hinged arc proof cable doors ,Cable termination from the front, breaking capacity 21kA/3 Sec. SF6 Ring Main Unit enclosed in robotically laser welded stainless steel tank having IP67 degree of protection ,Leak rate of SF6 gas should be less than 0.1% and tested as per IEC 60056/60694/60298 consisting of individual stainless steel tank.

A1. 11kV SF6 circuit breakers:

A. TECHNICAL SPECIFICATIONS

11 kV 630A 21 kA SF6 Circuit Breaker Panel Board.

All Modules are modular in structure.

STANDARDS AND MECHANICAL DATA

Metal Enclosed switchgear: IEC 60298
General Purpose switches: IEC 60265
Disconnectors and Earthing switches: IEC 60129
Circuit Breakers: IEC 60056
Common clauses: IEC 60694
Pressure of SF6 gas: 1.2 bar at 20 qC
Cable bushings: DIN 47636
Temperature class: -25 qC to 40 qC
Degree of protection:
- SF6 tank: IP 67
- Front cover: IP 2X
- Cable cover: IP 3X
Busbars: 240 mm² Cu
Earth bar (external): 50*6 mm² GI - Bolt dimension: M10
Thickness of Stainless Steel Tank: 2.5 mm

Colours:

- Front cover: RAL 7035
- Side and cable cover: RAL 7035

ELECTRICAL DATA – 12 kV - 28kV-1min

- Rated current busbars: 630 A
- Short time withstand current (3 sec) SF6 circuit breaker: 21 kArms
- Rated current for transformer T-off : 630 A
- Impulse withstand voltage:
- To earth and between phases: 75 kV
- Insulation level:
- Power frequency 1 min: 28 kV

B. BILL OF MATERIAL**H.1 V – SF6 Circuit Breaker - Incomer Panel**

SafePlus V is a SF6 circuit breaker module with SF6 circuit breaker, three position isolator/earthing switch, busbars, interlocking, earthbar and stored spring energy mechanism (A-mech.).

- 1 SafePlus type V: SF6 circuit breaker 12kV, 630A, 21kA for 3 sec
- 1 Stored energy mech. for manual operation
- 1 Bushings for connection of external Busbar
- 1 Busbar cover for module right side of M-module
- 1 Optical indication of latch function
- 1 Self Powered Numerical Protection relay with Over Current & Earth Fault Protection
- 3 Cast Resin Ring Core CTs 120/1A for protection.
- 3 Cast Resin Ring Core CTs 120/1A for metering.
- 1 Digital Multifunction Meter.
- 1 Cable bushings 400 series bolted
- 1 Arc proof cable cover complete incl. Interlocking
- 1 Capacitive voltage indication fixed type VPIS 9-15 kV

H.1 V – SF6 Circuit Breaker - Outgoing Panel (1, 2 & 3)

Safe Plus V is a SF6 circuit breaker module with SF6 circuit breaker, three position isolator/earthing switch, busbars, interlocking, earthbar and stored spring energy mechanism (A-mech.).

- 1 SafePlus type V: SF6 circuit breaker 12kV, 630A, 21kA for 3 sec
- 1 Stored energy mech. for manual operation
- 1 Bushings for connection of external Busbar

- 1 Busbar cover for module right side of M-module
- 1 Optical indication of latch function
- 1 Self Powered Numerical Protection relay with Over Current & Earth Fault Protection
- 3 Cast Resin Ring Core CTs 40/1A for protection.
- 3 Cast Resin Ring Core CTs 40/1A for metering.
- 1 Digital Multifunction Meter.
- 1 Master Trip Relay
- 1 Cable bushings 400 series bolted
- 1 Arc proof cable cover complete incl. Interlocking
- 1 Capacitive voltage indication fixed type VPIS 9-15 kV
- 6 Auxiliary relays for Transformer auxiliary protection
- 1 6-window annunciation for Trafo. auxiliary fault indication – WTI A/T, OTI A/T Etc.

H.2 M – Metering

SafePlus M is an air insulated metering module.

- 1 SafePlus type M: Air insulated metering module 12kV, 630A, 21kA for 3 sec
- 3 Bushings for connection of external Busbar
- 1 3 voltage transformers 11KV/ ¥3/110/ ¥3, 25 VA, Class 1.0 with HV fuse on primary side and MCB on secondary side.
- 1 Digital Voltmeter.
- 1 Busbar cover
- 1 Space heater with thermostat [230 Vac]

1 Illumination lamp

- 1 R Y B Phase Indication

Additional equipment delivered separately or mounted in respective panel.

- 1 Busbar with 6 pcs end adapters for right side of M-module
- 1 Cable support bars, standard for 1-way unit
- 1 Manometer
- 1 Operating handle

Note: 230V AC supply will be in customer scope.

4.00.0 Special Maintenance Tools & Tackles

The Bidder shall provide a list of recommended spare parts with their individual prices for equipment to be supplied against this specification. This list shall identify all essential spares items for any recommended maintenance for a period of five years after commissioning.

The Project Manager may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be supplied as part of the definite works. The Project Manager may order additional spares at any time during the contract period at the rates stated in the Contract Document.

A spare parts catalogue with price list shall be provided and this shall form part of the drawings and literature to be supplied.

The Bidder shall give an assurance that spare parts and consumable items will continue to be available through the life of the equipment, which shall be 25 years minimum. However, the Contractor shall give a minimum of 12 months notice in the event that the Contractor or any sub-contractors plan to discontinue manufacture of any component used in this equipment.

Spare parts shall be delivered suitably packed and treated for long periods in storage. Each pack shall be clearly and indelibly marked with its contents, including a designation number corresponding to the spare parts list in the operation and maintenance instructions,

Spanners and other maintenance equipment provided under this contract shall not be used for the purpose of erection.

Any special devices, slings or shackles necessary for the maintenance shall be handed over to the Purchaser in working order on completion of the installation and commissioning of the equipment.

5.00.00 General Technical Requirements:

5.01.00 SF6 Circuit Breaker

5.01.01 Service conditions:

- The SF6 Circuit Breaker shall be suitable for operations at a height of less than 1000 meters above sea level.
- The SF6 Circuit Breaker shall be capable of operating normally within the following temperature range :

Maximum air temperature: + 40 ° C

Minimum air temperature: - 25 ° C

Manufacturer shall declare whether the SF6 Circuit Breaker is able to operate in air temperature higher than + 40 ° C over the ambient of 50 deg centigrade and if current de-rating is necessary.

- The SF6 Circuit Breaker shall be capable of being operated in electrically exposed locations.

- The SF6 Circuit Breaker shall be capable of being exposed to high relative humidity and ambient air pollution.
- The SF6 Circuit Breaker shall be capable of being operated in Indoor switch room.

5.01.02 **System Parameters:**

General Technical Requirements	
Network	Three phases - Three wires
Rated Voltage	12kV
Service Voltage	11kV
System Frequency - Hz	50 Hz
Bus bar Rating- A	630
Min Gas pressure - BarG	0.05
Filling pressure- BarG	0.3
Min operating temperature – Deg c	- 25
IP Rating	IP 3X / 67
Internal Arc test	IEC60298
Lightning Impulse withstand Voltage	95 kV Peak
Power Frequency withstand voltage	28 kV RMS - 1 min
Rated Normal Current Incomer Load Break Switch Feeder Circuit-breaker	630 A 630A
Rated Short time current withstand (1 sec)	21 kA
Rated Short circuit making capacity of line switches and earthing switches	52.5 kA peak at Rated Voltage
Rated load interrupting current Incomer Load Break Switch	630 A rms
Rated load interrupting current Incomer Load Break Switch	630 A rms
Rated cable charging interrupting current Incomer Load Break Switch	30 A
Rated magnetizing interrupting current Incomer Load Break Switch	16 A

No.	General data, enclosure and dimensions		
1	Standard to which Switchgear complies		IEC
2	Type of Ring Main Unit		Metal Enclosed
3	Number of phases		3
4	Whether RMU is type tested		Yes

5	Whether facility is provided with pressure relief		Yes
6	Insulating gas		SF6
7	Nominal operating gas pressure		1.4 bar abs. 20° C
8	Gas leakage rate / annum	%	0.1
9	Expected operating lifetime		30 years
10	Whether facilities are provided for gas monitoring		Yes, temperature compensated manometer can be delivered
11	Material used in tank construction		Stainless steel sheet, 3 mm
No	Operations, degree of protection and colours		
1	Means of switch operation		separate handle
2	Means circuit breaker operation		separate handle and push buttons
3	Rated operating sequence of Circuit Breaker		O –3min-CO-3min-CO
4	Total opening time of Circuit Breaker		approx. 45ms
5	Closing time of Circuit Breaker		approx. 40ms
7	Principle switch / earth switch		3position combined switch / earth switch
	Degree of protection:		
8	High Voltage live parts, SF6 tank		IP 67
9	Front cover mechanism		IP 2X
10	Cable covers		IP 3X
	Colours:		
11	Front cover		RAL 7012
12	Side and cable cover		RAL 7035

5.03.00 General stipulations regarding the design and development of switchgear

5.03.01 Introduction

The SF6 Circuit Breaker shall meet the criteria for compact, metal-enclosed indoor switchgear in accordance with IEC 60298.

5.03.02 Switchboards

The RMU shall be of the fully arc proof metal enclosed, free standing, floor mounting, flush fronted type. Each unit is made of a cubicle sealed-for life with SF6 and contains all high voltage components sealed off from the environment.

The switchgear and busbar shall all be contained in a stainless steel enclosure filled with SF6 gas. The enclosure should meet the "sealed pressure system" criterion in accordance with the IEC 60298 standard (i.e a system for which no handling of gas is required throughout the 30 years of service life) , so that refilling is not required .In addition, manufacturer shall confirm that maximum leakage rate is lower than 0,1 % / year. It should Provide full insulation, making the switchgear insensitive to the environment (temporary flooding, high humidity...), IPX7 degrees of protection in accordance with recommendation IEC 529 . The active parts of the switchgear shall be maintenance-free and the switchboard shall be low-maintenance.

The overall design of the switchgear shall be such that front access only is required. It shall be possible to erect the switchboard against a substation wall, with HV and LV cables being terminated and accessible from the front.

The cubicle shall have a pressure relief device. In the rare case of an internal arc, the high pressure caused by the arc will release it, and the hot gases is allowed to be exhausted out at the bottom of the cubicle. A controlled direction of flow of the hot gas should be achieved.

The tank shall be made of at least 2 mm AISI 304 unpainted stainless steel.
The switchboards shall be suitable for mounting on a trench, utilities space or base.

Each switchboard shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics.

The switchgear and switchboards shall be designed so that the position of the different devices is visible to the operator on the front of the switchboard and operations are visible as well.

In accordance with the standards in effect, the switchboards shall be designed so as to prevent access to all live parts during operation without the use of tools.

5.03.03 Dielectric medium

SF6 gas is the preferred dielectric medium for MV RMUs. SF6 gas used for the filling of the RMU shall be in accordance with IEC 376.

It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption.

5.03.04 Earthing of metallic parts

There shall be continuity between the metallic parts of the switchboard and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people.

The substation frames shall be connected to the main earth busbar without dismantling any busbars.

5.03.05 Earthing of the main circuit

The cables & feeders shall be earthed by an earthing switch with short-circuit making capacity, in compliance with IEC 129 standard. The earthing switch can only be operated when the main Load break switch / Circuit Breaker is open.

The earthing switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action.

Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earthing switch when the switch is closed.

5.03.06 Incomer Load Break Switches

It shall consist of an SF6 cubicle housing a switch disconnecter and an earthing switch. They shall be maintenance-free, with breaking in low pressure SF6 gas. Busbars and all electrical connections are located inside the tank. The operating shafts for the switches shall have rotary seals where they enter the SF6 cubicle. The operating mechanisms shall be located outside on the front of the SF6 tank.

The position of the power contacts and earthing contacts shall be clearly visible on the front of the switchboard. The position indicator shall provide positive contact indication in accordance with IEC 265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 129 .

The switches shall be of the "increased operating frequency" in accordance with IEC 265-1. They shall have at least 2 positions, open-disconnected & closed and will be constructed in such a way that natural interlocking prevents unauthorized operations. Earthing of the cable shall be either through a three position switch of a separate snap action type Earth Switch having fault making capacity. The Mechanism shall be constructed in such a way that natural interlocking prevents unauthorized operations.

The switches shall be fully mounted and inspected in the factory.

Manual opening and closing will be driven by a fast-acting mechanism, independent of operator action.

Each switch can be fitted with an electrical operating mechanism in a specially reserved location, without any modification of the operating mechanism and without de-energizing the switchboard.

5.03.07 "Feeder and Local Transformer Control circuit-breaker" feeders

The T-off circuit breaker module shall consist of an SF6 cubicle housing a SF6 circuit breaker unit and a disconnecter-earthing switch. The operation between circuit breaker and disconnecter-earthing is interlocked. An integrated relay and related CTs is used for tripping of the circuit breaker. Bus bars and all electrical connections are located inside the tank. The operating shafts for the switches shall have rotary seals where they enter the SF6 cubicle. The operating mechanisms are located outside on the front of the SF6 tank.

The circuit breakers shall be of the maintenance-free, SF6 type. The position indicator shall provide positive contact indication in accordance with IEC 265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 129.

The circuit breakers shall have 2 positions: open-disconnected & closed and shall be constructed in such a way that natural interlocks prevent all unauthorized operations. The earthing of the feeder shall be by a Fault Making Earth Switch. The earth switch shall be mechanically interlocked with the isolators / breaker to prevent any unauthorised operation.

They shall be fully mounted and inspected in the factory.

An operating mechanism can be used to manually close the circuit breaker and charge the mechanism in a single movement.

It shall be fitted with a local system for manual tripping by an integrated push button. There will be no automatic reclosing.

The circuit breaker shall be associated with an integrated protection unit that will operate without any auxiliary power supply and shall include:

- Three current transformers
- An electronic relay,
- A low energy release,
- A "fast-on" test receptacle for protection testing (with or without CB tripping)

The protection system will ensure circuit breaker tripping as of a minimum operating current (Is) which is the rated current of the underground network to be protected and may be set to following ratings from 12 to 600 A. Following settings shall be available :

Range 1 - 16 to 56 A :

Range 2 - 32 to 112 A :

Range 3 - 64 to 224 A

Range 4 – 128 to 448 A

The phase protection shall have two separately adjustable settings:

- The low setting may be chosen with definite time or IDMT. The IDMT curves shall be in compliance with the IEC 255-3 standard. They are of the standard inverse, very inverse and extremely inverse types.

The low setting may also be used with the RI curve.

- The high setting shall be of the definite time type earth protection
- The earth fault protection shall operate by residual current measurement: it uses the sum of the sensor secondary currents.
- Like phase protection, earth protection shall be fitted with two separately adjustable settings.

- There should be provision of flag Relay on each outgoing SF6 breaker module for indication of Trip on Fault.

- Provision for testing of cable by suitable arrangements with following to be confirmed and provided:
 - Doors can be opened only with the Earth Switch in Closed position.
 - A cable test rod has to be provided which can be fixed on the terminations to facilitate testing.
 - Termination boots should have a proper opening to facilitate the same. The opening should be covered by means of removable protection cap.
 - MECP / Raychem or boots used in terminations must have this facility.
 - In case of front door opened, it should not be possible to operate the load break switches / isolators or breaker.

- The cable cover door should be pad lockable and should be Tamper and Arc proof as per IEC 60298.

- Cable charge indication should be provided for Each RMU.

- One No Phase Comparator must be provided with each RMU (4 function or 3 function RMU)

- Provision for cable door interlocks such that the doors cannot be opened unless the Earth switch is closed

- There should be provision of hinged doors in the RMU.

5.03.08 RMU bushings and Cable terminations

5.03.08.01 Bushing

The bushing should be conveniently located for working with cables specified and allow for the termination of these cables in accordance with the instructions supplied.

The profiles of the cable connection bushings shall be in compliance with EN-50181 standard.

5.03.08.03 Cable clamps

A non ferro-magnetic cable clamp arrangement must be provided for all network cables terminated on the RMU

5.03.08.04 Padlocking facilities

The circuit breakers and earthing switches can be locked in the open or closed position by 1 to 3 padlocks 6 to 8mm in diameter.

5.03.09 Voltage indicator lamps and phase comparators

Each function shall be equipped with a voltage indicator box on the front of the device to indicate whether or not there is voltage in the cables. The capacitive dividers will supply low voltage power to the lamps.

Three inlets can be used to check the synchronization of phases.

This device shall be in compliance with IEC 61958 standard.

5.03.10 Safety of people

Any accidental overpressure inside the sealed chamber will be limited by the opening of a pressure limiting device in the rear part of the enclosure. Gas will be released to the rear of the switchboard away from the operator. Manufacturer shall provide type test report to prove compliance with IEC 298 appendix AA 'Internal fault'.

5.03.11 Operating lever

An anti-reflex mechanism on the operating lever shall prevent any attempts to reopen immediately after closing of the switch or earthing switch.

All manual operations will be carried out on the front of the switchboard.

The effort exerted on the lever by the operator should not be more than 250 N for the switch and 250 N for the circuit breaker.

5.03.12 Front plate

The front plate shall have an IP2XC degree of protection. The front shall include a clear mimic diagram which indicates the different functions.

The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator.

The lever operating direction shall be clearly indicated in the mimic diagram.

The manufacturer's plate shall include the switchboard's main electrical characteristics.

5.03.13 Fault Passage Indicators

Fault Passage Indicators shall be installed on the Ring Main Unit. The Bidder shall supply One FAULT INDICATOR per Load Break Disconnect Switch.

These devices shall be electronic devices with their own energy source and shall be provided with bright LEDs / flag Indicators, which shall be clearly visible in the daytime.

They shall have the following resetting facilities:

- Manual reset and
- Resetting after a set time duration and
- Resetting on restoring of LV

The unit shall have Short Circuit adjustable to different settings and Earth fault setting with separate Current transformer.

It should be possible to Test these indicators at site thru “Test” push button.
The Fault Passage Indicators should also be provided with a SCADA output contact.

They should conform to the following standards:

IEC 68-2-6, IEC 68-2-9 & IEC 529	: Mechanical Test
IEC 950	: Electrical Security
IEC 1000-4 and IEC 1000-6	: EMI / RFI
IEC 1000-4-2	: Air Discharges

They should have CE marking.

5.03.13 Busbars

Comprising the 3 single phases copper busbars and the connections to the switch or circuit breaker. The busbar shall be integrated in the cubicle Busbars shall be rated to withstand all dynamic and thermal stresses for the full length of the switchgear.

5.03.14 The cable switch

It shall be a switch-disconnector and earthing switch using SF6 gas as an arc-quenching medium. The switch positions are closed – open – earthed. In the open position the switch satisfies the disconnector requirements.

5.03.15 Earthing Switch

Earthing switches shall be rated equal to the switchgear rating.

Earthing switches shall be quick make type capable of making Rated Fault Current.

Earthing switch shall be operated from the front of the cubicle by means of a removable handle.

5.0316 The mechanisms

All mechanisms shall be situated in the mechanism compartment behind the front covers outside the SF6-tank.

The mechanism for the switch and the earthing switch is operating both switches via one common shaft. The mechanism provide independent manual operation for closing and opening of the switch, independent closing of the earthing switch and dependent opening of the earthing switch.

The mechanism for the T-off switch and earthing switch is operating both switches via one common shaft. The mechanism has stored spring energy and provide independent manual operation for closing and opening of the switch, independent closing of the earthing switch and dependent opening of the earthing switch. The mechanism has fuse tripping device.

The mechanism for the SF6 circuit breaker and disconnector-earthing switch is operating the SF6 circuit breaker and the disconnector-earthing switch via to separate shafts. The mechanism for the SF6 circuit breaker has stored spring energy and

provides independent manual operation for closing and opening of the SF6 circuit breaker. The mechanism has a relay with related CT's and/or remote tripping device. The mechanism for the disconnecter-earthing switch provide independent manual operation for closing and opening of the disconnecter, independent closing of the earthing switch and dependent opening of the earthing switch.

5.03.17 Cable compartment

It shall be possible to terminate up to a maximum of two single core HV cables per phase.

The access to the compartment will be possible by removing the cable cover, bolted to the main frame.

Removable steel covers close the cable compartments. Arc proof cable covers shall be available as option. Each module has a separate cable compartment that is segregated from each other by means of a partition wall. A partition wall shall be fitted to divide the cable compartment from the rear side of the switchgear. In case of an arc inside the tank, followed by the opening of the pressure relief, the partition wall prevents the hot gases flowing out from the pressure relief to enter the cable compartments. All covers are removable. The ground continuity is achieved when the covers are in place by means of bolted connections.

5.03.18 Power connection,

The cables are installed in the dedicated compartment below the mimic front cover. At the bottom of the cable compartment, an earthing bar system made of copper with a minimum cross section of 120 mm² shall be fitted. In each compartment the earthing bar shall be fitted with 4 screws M10. The earthing system is connected to the tank by a copper bar, which rises up to the connecting point of the tank behind the rear partition wall on the middle of the switchgear.

5.03.19 INTERLOCKING

The mechanism for the cable switch shall provide a built in interlocking system to prevent operation of the switch when the earthing switch is closed, and to prevent operation of the earthing switch when the switch is in the closed position.

The mechanism for the T-off switch shall provide a built in interlocking system to prevent operation of the switch when the earthing switch is closed, and to prevent operation of the earthing switch when the switch is in the closed position. In addition an interlocking device allows access to the fuses only when the earthing switch is in the earthed position and opening of the earthing switch is only possible when the fuse cover is closed and secured.

The mechanism for the SF6 circuit breaker and the disconnecter-earthing switch shall have a built in interlocking system to prevent operation of the disconnecter-earthing switch when the SF6 circuit breaker is in the closed position.

5.03.20 Current Transformers

All current transformers shall comply with IEC 60185.

Current transformers shall be of dry type, with ratings and ratios as required.

Cable current transformers used in circuit breaker modules shall be maximum 100mm wide.

Current transformers used in metering cubicles shall have dimensions according to DIN 42600, Narrow type.

6.00.0 TESTS

6.01.0 Routine Tests shall be conducted on the Ring Main Units in accordance with the latest versions of IEC. Type Test certificates for tests conducted earlier on similar equipment shall be furnished.

TYPE TESTS

Units shall be type tested in accordance with IEC standards 60056,60129,60265,60298,60420,60529 and 60694. The following type tests have been performed and available if required

- Short time and peak withstand current test
- Temperature rise tests
- Dielectric tests
- Test of apparatus i.e. circuit breaker and earthing switch
- Arc fault test

ROUTINE TESTS

Routine tests shall be carried out in accordance with IEC 60298 standards. These tests shall ensure the reliability of the unit.

Below listed test shall be performed as routine tests before the delivery of units;

- Withstand voltage at power frequency
- Measurement of the resistance of the main circuit
- Gas leakage test
- Withstand voltage on the auxiliary circuits
- Operation of functional locks, interlocks, signalling devices and auxiliary devices
- Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism
- Verification of wiring
- Visual inspection

Tests shall be performed in the presence of Purchaser's representatives. The Contractor shall give at least fifteen (15) days advance notice for witnessing the tests. Copies of certified reports of all tests carried out at works shall be furnished. The equipment shall be dispatched from works, only after receipt of Purchaser's written approval of the test reports.

Each completely wired Ring Main Unit shall be tested to ensure that all of its protective, control and interlock systems are satisfactorily functioning in the manner as required.

The Bidder shall indicate tests recommended to be carried out at site during installation and commissioning to ensure satisfactory performance of all the equipment supplied.

7.00.0 DRAWINGS, DATA AND MANUALS

7.01.0 To be submitted along with the bid:

- Completely filled-in technical schedules
- Typical general arrangement drawings
- Type Test Certificates
- Experience List
- Foundation fixing drawings

7.02.0 To be submitted after the award of the contract:

Sr. No.	Description	For Approval	For Review/Information	Final Submission
1	Completely filled in Technical Schedules	√		√
2	Dimensional General Arrangement drawings	√		√
3	Single Line Diagram	√		√
4	Installation Instructions		√	√
5	Instruction for Use		√	√
6	Transport/ Shipping dimension drawing		√	√
7	Foundation Plan & loading details		√	√
8	Quality Plan		√	√
9	Test Certificates	√	√	√

Distribution Transformer

4.0.0 Oil filled Transformer :

- 4.1.1 **Requirement:** 11000/433 Volt Oil immersed, 1000 kVA ONAN cooled suitable for installation at outdoor in Enclosure for ground mounting. The transformer should be hermitically sealed & should be with corrugated wall design
- 4.1.2 **Voltage Ratio:** No load voltage 11000/433 volts within tolerance as stipulated in IS:2026.
- 4.1.3 **Rating:** The transformer shall have a continuous rating as specified at any of the specified tapping position and with the maximum temperature rise specified.
- 4.1.4 **Temperature Rise:** The maximum temperature rise at the specified maximum continuous output shall not exceed 40°C by thermometer in the hottest portion of the oil or 50°C measured by resistance of winding above ambient temperature, not exceeding 40°C daily average or 50°C maximum.
- 4.1.5 **Type of Load:** The transformer shall be suitable for carrying load within temperature rise indicated in the Indian Standard specification IS:6600 'Guide for loading of oil immersed Transformer'.
- 4.1.6 **Overloads:** The transformers shall be suitable for carrying overload within temperature rise indicated in IS:6600 'Guide for Loading of oil immersed Transformer'.
- 4.1.7 **Connections:** H.V. Delta and L.V Star connected with neutral brought out on the secondary side for connection to earth; Vector group DYn11 of IS:2026.
- 4.1.8 **Tapping :**
- A) Each transformer shall be provided with **Rotary type tap switch** so as to provided for a voltage adjustment on H.V. from +5% to –15% of rated voltage of 11000 volts in 4 equal steps (5 position) to obtain rated voltage of 433 volts on LV side. Refer clause no:4.6.4 for details of rotary switch. The tapping shall be provided for following voltage ratios at no load.
 - B) Each transformer shall be provided with adjustable **tapping Links** such as to provided for a voltage adjustment on H.V. from +5% to – 15% of rated voltage of 11000 volts in steps +/-1.25 to obtain rated voltage of 433 volts on LV side. The tapping shall be suitable to change on H.V. side by links provided for this purpose.
- 4.2.1 **Cleaning & Painting :**
- a) All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents, as required to produce a smooth surface free of scales, grease and rust.
 - b) The internal surfaces in contact with insulating oil shall be painted with heat resistant insulation paint which shall not react & be soluble in the insulating liquid used.
 - c) The external Surfaces, after cleaning, shall be given two coats of high quality epoxy based rust resisting primer as per IS:2074 followed by filler coats.

- d) The transformer shall be furnished with coats of weather resisting battleship gray epoxy based enamel paint as per IS:2932 specially recommended for transformer use.
 - e) The paints shall be carefully selected to withstand tropical heat rain, effect of proximity to the sea etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.
 - f) Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.
- 4.2.2 Both H.V. and L.V. bushings shall have creepage corresponding to **very heavily polluted atmosphere.**
- 4.2.3 **Oil:** New transformer oil used shall be according to IS:335.
- 4.2.4 **Phase Marking & Danger Plate:** Phase markings in fluorescent paint on small non-corrodible metallic tags shall be permanently fixed for H.V. and L.V sides. Phase markings tags shall be properly fixed with proper alignment. Danger plates shall be provided on the H.V & LV sides, mentioning the Corresponding Voltages.
- 4.3.0 **Core and Coil :**
- 4.3.1 **Core :** The core shall be constructed from high grade, cold rolled, non-ageing, low loss, high permeability, grain oriented, cold-rolled grain oriented silicon steel laminations. The transformer shall be so designed as to have minimum humming noise. The percentage harmonic potentials with the maximum flux density under any conditions shall be such that capacitors connected in the system shall not be overloaded.
- 4.3.2 The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer. The core and coil assembly shall be capable of withstanding without injury, the thermal and mechanical effects of short circuit at the terminals of any winding as per IS:2026.
- 4.3.3 **Impedance Volts:** The Percentage impedance value at 75 Deg. C at any tap shall be 5% subject to tolerance as specified in IS:2026. The value of the impedance volts at each tapping over the specified range shall be specified in the bid.
- 4.3.4 **Regulation:** The regulation at 75° C at full load at unity and 0.8 power factor subject to the usual tolerance as per IS:2026 shall be specified in the bid.
- 4.3.5 **Power Freq. High Voltage & Insulation Level (Impulse voltage):** The distribution transformer shall be designed so that they are capable of withstanding high voltage & impulse voltages as per IS:2026 and as given below:
- a) Impulse Voltage for 11kV winding: 75 kV (1.2/50 Microsecond wave shape).
 - b) High Voltage : 28kV rms.

4.4.0 **Miscellaneous:**4.5.0 **RATINGS (Summary) :**

	Application	1000 kVA Corrugated Tank
4.5.1	Service	Outdoor in an Enclosure, Step down
4.5.2	Type	Oil immersed corrugated tank
4.5.3	Cooling system	ONAN
4.5.4	No. of Phases	3
4.5.5	No. of winding per phase	2
4.5.6	Rated output (MVA) With ANAN cooling	1000KVA
4.5.7	Rated voltage in KV (Line to Line	HV-11 kV LV-0.433 kV
4.5.8	Rated frequency	50 Hz
4.5.9	Temperature rise above 40°C	
A	In winding by resistance	50°C or above
B	In Oil by thermometer	40°C or above
4.5.11	Insulation level	
A	H.V. Power Freq. KV rms	28 kV
B	H.V. (kVpeak) Impulse	75 kV
C	L.V. (kV)	-
4.5.12	Vector Group	Dyn11
4.5.13	Parallel operation	Yes
4.5.14	Type of taps provided	On Load full capacity
A	Taps provided on	H.V. winding
B	Range of taps	±5% in steps of 5% (4 steps, 5 position)
C	Method of Tap Change control	Rotary Switch
D	Manual load	Yes 'Off Circuit'
4.5.15	Percentage impedance at 75 Deg. C	5% with tolerance
4.5.16	System earthing	
A	H.V.	Solidly earthed
B	L.V.	Solidly earthed
4.5.17	Terminal arrangement	
A	H.V.	From H.V. Bushing on Top.
B	L.V.	From L.V. Bushing on Top.
C	L.V. Neutral	From L.V. Neutral Bushing on Top.
4.5.18	Transformer-bushing voltage class a) H.V. (kV) b) L.V. (kV)	12 kV class 1.1kV class
4.5.19	System fault level a) H.V. side b) L.V. side	500 kV A (11 kV) -

4.6.0 **Fittings & Accessories For Corrugated Tank Transformer :**

- 4.6.1 The following accessories conforming to IS:3639 shall be provided for 11 kV/0.433 kV, 1000 kVA distribution transformer.
- 4.6.2 Two earthing terminals with copper lugs. The lugs shall be provided in such a way that they shall not obstruct the movements of rollers. The earthing continuity for all the connected equipments shall be properly done.
- 4.6.3 Two lifting lugs for complete transformer as well as enclosure.
- 4.6.4 Off circuit tapping switch shall be rotary type, 3 pole gang operated, top mounting draw out type only. Tap switch shall be suitable for rated current considering 20% overloading & operating voltage. Switch shall be provided with externally operating hand wheel handle with indicator and locking device, with direction changing facility and locking arrangement.
- 4.6.5 **Rating plate and diagram plate** of durable non-corroding metal giving information as required under IS:2026. Rating plate shall also include Transformer **Actual %Z, No-Load Loss & Full-Load Loss at 75°C** along with details like Purchase Order Number, date. The name plate marking shall be done with fluorescent colour. Each equipment shall carry individual name-plate with proper instructions & affixed with screws.

Technical Specification for 500 KVA Silent DG Set

SCOPE : SUPPLY , INSTALLATION, TESTING & COMMISSIONING OF 2 NOS. 500 kVA DIESEL GENERATING SET, COMPLYING AS PER SPECIFICATION BELOW

SPECIFICATION CUM COMPLIANCE CERTIFICATE OF 1500 kVA DIESEL GENERATOR SET

S.NO.	DESCRIPTION FOR IIT ROORKEE REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY VENDER
1.0	PURPOSE & WORK PIECE MATERIAL:	
1.1	Two numbers 500 kVA diesel generating sets are required for generating power supply 433 V, 50 Hz, 3 phases 4 wire.	
2.0	EQUIPMENT CONFIGURATION :- Diesel generating set shall consist of Diesel engine (complete with air intake system, exhaust system, coolant system Lubrication system, fuel system, safety controls, instrument panel), an alternator, control panel with synchronizing panel etc. Complete equipment shall be of "State of art" latest design & technology. The equipment shall consists of various components / sub assemblies as listed below:	
2.1	DIESEL ENGINE	
2.1.1	Diesel engine shall be fuel efficient, robust in construction, water cooled four stroke engine and shall be confirming to BS : 5514 .	
2.1.2	Engine shall be electric start turbocharged and after cooled with capacity of 10% over load for one hour in 12 hours duration and to run continuously for a long duration up to 72 hours.	
2.1.3	Engine shall have sufficient BHP to meet 500 KVA requirement of alternator.	
2.1.4	Noise level of engine shall be as per environmental rule. (Noise level is < 75 dB (A) at 1 mtr distance under free field conditions.	
2.1.5	Engine shall be mounted on AVM pads and a common base frame for engine and Alternator.	
2.1.6	Following details of engine shall be furnished by the vender	
2.1.7	Make & model of the engine	
2.1.8	BHP of the engine	
2.1.9	RPM of the engine	
2.2	AIR INTAKE SYSTEM	
2.2.1	It shall consists of air intake manifold	
2.2.2	Dry type air cleaner	
2.2.3	Vacuum indicator	
2.2.4	air shut off valve	
2.3	EXHAUST SYSTEM	
2.3.1	It shall consists of turbocharger	
2.3.2	Flexible connection	
2.3.3	Exhaust manifold	
2.3.4	Residential silencer	
2.4	COOLENT SYSTEM	
2.4.1	It shall consists of Engine water pump	
2.4.2	Radiator	

2.4.3	Extended life Coolant (ELC)	
2.4.4	By pass thermostat	
2.5	LUBRICATING SYSTEM	
2.5.1	It shall consists of oil pan	
2.5.2	Engine mounted Lube oil pump	
2.5.3	Full flow Lube oil filter	
2.6	FUEL SYSTEM	
2.6.1	Direct fuel Injection system with fuel lift pump	
2.6.2	Combined unit Injector	
2.6.3	24 Volt D.C. solenoid coil	
2.6.4	Full -flow spin on fuel oil filters	
2.7	STARTING SYSTEM	
2.7.1	It shall consists of 24 Volt D.C. electric starter	
2.7.2	24 Volt D.C. battery charging alternator	
3.0	ALTERNATOR:- mention make & model	
3.1	Alternator shall be 500 KVA rating , 433 V at 0.8 pf (lag), 50Hz, 3 phase 4 wire self excited self regulated with brushless excitation. The alternator shall be confirming to IS : 4722/IEC-34 standard	
3.2	Voltage regulation of Alternator shall be : $\pm 1.0\%$ of rated voltage from No. load to Full load	
3.3	Voltage adjustment shall be : $\pm 5\%$ of rated voltage	
3.4	Alternator enclosure : IP 23	
3.5	Alternator insulation : Class 'F' with temperature rise limited to class 'F' insulation limit	
4.0	BASE FRAME	
4.1	Base frame shall be suitable to mount engine and alternator. These shall be coupled and aligned on a common channel iron fabricated base frame with pre drilled holes.	
5.0	FUEL TANK	
5.1	Daily service fuel tank shall be provided for each set. The size of tank shall be minimum 990 Lit. Capacity with fuel level indicator.	
5.2	The tank shall be made from 14 SWG sheet steel metal complete with drain valve, air vent, inlet and out let connections.	
5.3	The fuel tank shall be suitable for floor mounting installation outside the accoustic enclosure.	
6.0	BATTERIES	
6.1	Suitable battery bank shall be provided for starting the D.G.set. All batteries should be supplied in full charged and ready to use condition.	
6.2	Battery details to be submitted with offer i.e No. of batteries used in each set, battery voltage, battery capacity in AH, make of the battery etc.	

7.0	INTEGRATED DG SET CONTROLLER	
7.1	Controller shall be Microprocessor based DG set power command module compatible for remote, monitoring and data logging with operator interface to the Genset, digital voltage regulation through in-built AVR and digital governing.	
7.2	Data logger to store data (running hours, number of start attempt, kWh produced since last reset)	
7.3	Digital inbuilt AVR to provide voltage regulation of $\pm 1\%$ or below for any loads between no loads to full load	
7.4	Digital Engine speed Governing control to provide isochronous engine speed within $\pm 0.25\%$ for any steady state load from no load to full load	
7.5	Amp sentry protection for true alternator over current protection	
7.6	Sensor failure indication	
7.7	Compatibility for remote monitoring & data logging	
7.8	Smart starting. Integrated fuel ramping to limit black smoke & frequency overshoot in addition to optimize cold weather starting	
7.9	Generator set protective function shall be as below:.	
A	CONTROL	
	(i) OFF/Manual/Auto control switch	
	(ii) Emergency stop	
	(iii) Manual run/Stop control switch	
	(iv) Panel lamp / lamp test control switch	
	(v) Operator adjustment for time delay start/Stop & Alternator Voltage / Frequency	
B	METERING	
B-1	ENGINE	
	(i) Starting Battery Voltage	
	(ii) Lube oil Pressure	
	(iii) Engine control Temperature	
	(iv) Engine RPM	
B-2	ELECTRICAL	
	(i) Current	
	(ii) Voltage	
	(iii) Frequency	
	(iv) kW	
	(v) kWh	
	(vi) PF	

	(vii) kVA	
	(viii) kVAR	
	(ix) kVARh	
	(x) kVAh	
	(xi) Generator % load	
C	PROTECTION / WARNING	
C-1	ENGINE	
	(i) Over speed shutdown	
	(ii) Low Lube oil pressure warning / shutdown	
	(iii) High coolant Temperature warning / shutdown	
	(iv) Low coolant level warning / shutdown	
	(v) Low coolant temperature warning	
	(vi) Low & High battery voltage warning	
	(vii) Weak battery warning	
	(viii) Over Crank (Fail to start) shutdown	
	(ix) Fail to crank shutdown	
C-2	ALTERNATOR	
	(i) Over current warning/ shutdown	
	(ii) Short circuit shutdown	
	(iii) High / low voltage shutdown	
	(iv) Under / Over frequency shutdown/ warning	
	(v) Reverse power (kVA & kVA _r) shutdown	
	(vi) Excitation fault (Loss of voltage sensing input to control) shutdown	
8.0	CONTROL PANELS FOR D.G.SET	
8.1	L.T.SWITCHGEAR PANEL	
A	Generator panel - 3 Nos. (one each for three sets)	
i	Each generator incoming panel shall be comprised of 1 number 433 V, 800 Amp. 31.5 kA, 3 phase 50HZ, metal clad, fully draw out, vertical isolation, horizontal draw out type, motorized spring charging, 230 volt A.C. closing & tripping coil air circuit breaker complete with 100/5, 15 VA, Class -1 /5P CT's for metering/ protection.	

8.2	GENERATOR MONITORING AND PROTECTION PANEL- (2NOS.)	
8.2.1	Each monitoring panel shall be comprised of the following:	
8.2.1 (a)	Metering and control	
i	1 No. engine start push button	
ii	1 No. Engine stop push button	
iii	1 No. Engine priming pump start push button	
iv	1 No. Auto/Mains /Test master selector switch	
v	1 No. DOL starter for pre lube oil pump	
8.2.1(b)	Protection relays	
i	Over current warning/shutdown	
ii	Short circuit shutdown	
iii	High/Low voltage shutdown	
iv	Under /over frequency shutdown/warning	
v	Reverse power (kVA& kVAR) shutdown	
vi	Excitation fault (Loss of voltage sensing (Input to control) shutdown	
8.2.1 (c)	Battery charger	
i	Battery charger shall comprise of :	
ii	1 No. transformer	
iii	1 No. rectifier	
iv	1 No. DC ammeter	
v	1 No. DC voltmeter	
vi	1 No. DC ON indication lamp	
vii	1 No. Trickle / boost select switch	
8.3	AUTO/MANUAL SYNCHRONIZING CONTROL PANEL	
8.3.1	1 No. GCU/PLC based system for Auto start/ stop, Auto load shearing, Auto synchronizing and load management of 2 Nos. D.G.Sets 500 kVA & 1 No. 200 kVA.	
9.0	ACCOUSTIC ENCLOSER	
9.1	Suitable acoustic enclosure shall be provided in both D.G.Set. Details of encloser to be submitted with the offer.	

10.0	EXHAUST SYSTEM	
10.1	Vertical Exhaust piping system to be provided as per IS norms.	
10.2	Necessary support structure to be provided for supporting exhaust piping system	
10.3	Necessary SS belows with matching flanges and other accessories to be provided	
10.4	Aviation light & lighting arrestor system to be provided	
11.0	EARTHING SYSTEM	
11.1	Galvanized iron plate earthing of suitable number to be provided for the system earthing, grounding, and lightening arrestor	
12.0	CABLES	
12.1	3.5 Core 433 V grade of suitable rating LT cable along with termination to be provided to connect the Alternator to LT panels	
12.2	Suitable rating LT cable along with termination to be provided for D.G. auxiliaries and other equipments	
12.3	Suitable control cable along with termination to be provided for synchronizing panel	
13.0	DOCUMENTATION	
13.1	Following documentation shall be provided with each set:	
A	Operation and maintenance manual of diesel engine	
B	Test certificate of diesel engine	
C	Operation and maintenance of Alternator	
D	Test certificate of alternator	
E	Test certificate of D.G.Set	

CAPACITOR CONTROL PANEL

The capacitor control panel shall be floor mounting, freestanding type, totally enclosed, dust and vermin proof. The sheet steel used for the construction shall have a thickness of 2.0mm/1.6mm.

The capacitor control panel shall wired for automatic switching of capacitor units comprising of 6 steps with provision for manual control.

The respective MPP capacitor units shall be mounted behind their own switching modules. The capacitor bank and switching modules shall be housed in separate compartments. The connection between switching unit and step capacitor shall be done using stranded copper cable. The capacitors shall be at rear in two-tier formation in metal enclosure conforming to IP-23 degree of enclosure.

In the front capacitor control panel shall house switching components confirming to IP-54 protection.

Power factor correction relay capable of automatic switching of the capacitor units shall be provide the relay shall have 6 steps. It shall be complete with all accessories for sensing of power factor or the system and initiating corrective action (for cutting in or cutting out of required number of capacitor banks) including step controller, reversing mechanism, time delay and NO Volt relay etc.

CAPACITOR PANEL

Capacitor rating of bank	As per BOQ
No. of steps	8
Capacity of each step	As per BOQ
System particulars	41.5 volt, 3 phase, 4 wire
System fault level	50 MVA
System voltage fluctuation	+/-10%
Frequency variation	+/-3%
Control voltage	110 volt AC
Type of dielectric	MPP
Type of unit connection	Delta
Ambient temp.	48 °C
Duty	continuous

: L.T. Panel :

5.1.0 System:-

- a) **Declared voltage** :- 3 Phase,400V ($\pm 6\%$) 50 Hz,
- b) **Neutral** :- Solidly earthed at substation.

5.2.0 **General finish**:- Tropical, totally enclosed, metal-clad, weather-proof, vermin and dust proof.

5.3.0 **Construction** :

Enclosure:- Type of enclosure shall be able to provide the degree of protection IP:54

5.4.0 **Circuit Ways**:

As per the requirement given in the specifications / schedule of requirement.

5.5.0 **Construction** :

5.5.1 The terminals shall be of sufficient mechanical strength and shall provide adequate electrical contact for the appropriate size of cable used. They shall be capable of receiving appropriate size of Aluminum conductors. They shall be provided with stainless steel nut bolts, plane washers and spring washers for cable connection.

5.5.2 The enclosure of LT Shall be constructed using 2mm CRCA sheet steel.

5.5.3 No contact pressure shall be transmitted through insulating material & the gripping of the conductor shall take place between metal faces.

5.6.0 **Earthing** :

5.6.1 Earthing arrangement shall be provided for earthing each cable, PVC cable gland, neutral busbar, chassis and frame work of the cubicle with separate earthing terminals at two ends. The main earthing terminals shall be suitably marked .The earthing terminals shall be of adequate size, protected against corrosion, and readily accessible. These shall be identified by means of sign marked in a legible manner on or adjacent to terminals.

5.6.2 Neutral bus bar strip shall be connected to Earthing terminal with help of copper strip of suitable capacity & nut-bolt arrangement.

5.7.0 **Accessories**: The following accessories shall be supplied duly mounted..

5.7.1 One incandescent lamp (with necessary fuse) to illuminate the fuse board internally.

: TYPE / ROUTINE TEST ON UNITIZED SUBSTATION :

6.0.0 **TYPE TESTS FOR THE UNITIZED SUBSTATION:**

The offered unitized substation should be fully type tested as per the IEC-1330

- 6.2.0 **Routine Tests:** The routine tests shall be made on each complete prefabricated substation.
- a) Voltage tests on auxiliary circuit.
 - b) Functional test.
 - c) Verification of complete wiring.
- 6.3.0 **Test Witness:** Routine test shall be performed in presence of Owner's representative if so desired by the Owner. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.
- 6.4.0 Test Certificates:**
- 6.6.1 Test report for the test mentioned under Type tests clause shall be submitted along with offer.
- 6.6.2 Certified reports of all the tests carried out at the works shall be furnished in three (3) copies for approval of the Owner.

General Erection Condition

- 1.1 The contractor upon signing of the contract shall, in addition to a project coordinator, nominate another responsible office as his representative at site suitably designed for the purpose of over all responsibility and Co-ordination of the works to be performed at site. such person shall function from the site office of the contractor during the tendency of contract.
- 2.0 **REGULATION OF LOCAL AUTHORITIES AND STATUTES**
- 2.1 The contractor shall comply with all the rules and regulations of local authorities during the performance of his field activities .he shall also comply with me minimum wages act,1948 and the payment of wages act (both of the government of India/and the state govt.)And the rules made there under in respect of any employee or workman employed or engaged by him or his Sub-Contractor.
- 2.2 All registration and statutory inspection fees lawfully payable under any statutory law, if any, in respect of his work pursuant to this contract shall be to account of the contractor. Should any such inspection or registration need to be re-arranged due to the fault of the contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the contractor.
- 3.0 **ACCESS TO SITE AND WORKS ON SITE**

- 3.1 Suitable access to the site shall be afforded to the contractor by the owner/Employer in reasonable time.
- 3.2 In the execution of the works on person other than the contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the site, except by the special permission, in writing of the engineer or his representative.
- 4.0 **CONTRACTOR'S FIELD OPERATION**
- 4.1 The contractor shall keep the engineer informed in advance regarding his field activity plans and schedules for carrying out each part of the works, any review of such plan or schedule or method of work by the engineer shall not relieve the contractor of any of his responsibilities towards the field activities .the contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.
- 5.0 **PROTECTION OF WORK**
- 5.1 The contractor shall have total responsibility for protecting his works till it is finally taken over by the engineer. no claim will be entertained by the owner or by the engineer for any damage or loss to the contractor's works and the contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings, should any such damage to the contractor's works occur because of any other party not being under his supervision or control. The contractor shall make his claim directly with the party concerned. The contractor shall not cause any delay in the repair of such damaged works because of any delay in the resolution of such dispute. The contractor shall proceed to repair the work immediately and no cause thereof will be assigned pending resolution of such disputes.
- 6.0 **FACILITIES TO BE PROVIDED BY THE CONTRACTOR**
- 6.1 The contractor shall provide all the construction, tools, tackles and scaffoldings required for pre-assembly, erection, testing and commissioning of the equipment covered under the contract. He shall submit a list of all such materials to the engineer before the commencement of pre-assembly at site. These tools and tackles shall not be removed from the site without the written permission of the engineer.
- 6.2 **FIRST-AID**
- The contractor shall provide necessary first-aid facilities for all his employees, representative and workmen working at the site .enough number of contractor's personnel shall be trained in administering first aid.
- 7.0 **SECURITY**
- 7.1 The contractor shall have total responsibility for all equipment and materials in his custody /stores, loose, semi-assembled and/or erected by him at site. The contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the contractor shall enter and leave the project site only with the written permission of the engineer in the prescribed manner.
- 8.0 **CONTRACTOR'S CO-OPERATION WITH THE OWNER**
- 8.1 In case where the performance of the erection work by the contractor affects the operation of the system facilities of the owner, such erection work of the contractor shall be scheduled to be performed only in the manner stipulated by the engineer and the same shall be acceptable at all times to the contractor. the engineer will provide free of cost to the contractor facilities such as electricity, water etc. as he may think fit in the interest of

the work .it will be the responsibility of the contractor to provide all necessary temporary instrumentation and other measuring devices required during startup and operation of the equipment systems, which are erected by him.

9.0 **MATERIALS HANDLING AND STORAGE**

9.1 All the equipment furnished under the contract and arriving at site shall be promptly received, unloaded, transported and stored in the storage spaces by the contractor.

9.2 Contractor shall be responsible for examining all the shipment and notify the engineer immediately of any damage, shortage, discrepancy etc. for the purpose of the engineer's information only. However the contractor shall be solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the any equipment at site. Any demurrage, shortage and other such charges claimed by the transporters railways etc. shall be to the account of the contractor.

9.3 The contractor shall be responsible for making suitable indoor storage. Normally, all the electrical equipment such as motors, control gear, and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Engineer, in addition, may direct the contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the contractor shall strictly comply with.

10. **PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY**

The Contractor shall be responsible for any damage resulting from his operation. He shall also be responsible for protection of all persons including members of public and employee of the owner and the employee s of other contractors and sub-contractors and all public and private property including structures, building, other plants and equipment and utilities either above or below the ground.

11. **INSURANCE**

In addition to the condition covered under the clause entitled "insurance" in commercial condition of contract, the following provisions will also apply to the portion of works to be done beyond the contractor's own or his sub-contractor's manufacturing works.

Workmen's Compensation Insurance and fatal accident insurance.

This insurance shall protect the Contractor against all claims applicable under the workman's Compensation Act, 1923 and Indian Fatal accident act 1855. The liabilities shall not be less than provided as per Act.

Comprehensive automobile Insurance

This insurance shall be in such a form as to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Owner's men and damage to the property of other arising from the use of motor vehicles during on or off the side operations, irrespective of the ownership of such vehicles.

11.4 Comprehensive general liability insurance

11.4.1 The insurance shall protect the contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the contractor, his agents his employees, his representatives and sub-contractor, his agents and his employees have to perform work pursuant to the contract.

11.4.2 The hazards to be covered will pertain to all the works and areas where the contractor, his agent and his employees have to perform work pursuant to the contract.

11.4.3 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the contractor to maintain all necessary insurance coverage to the

extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the contract.

12 WORK & SAFTY REGULATIONS

- 12.1 The contractor shall ensure proper safety of all the workmen, materials plant and equipment belonging to him or to owner or to others, working at the site. The contractor shall also be responsible for provision of all safety notices and safety equipment required both by the relevant legislations and the engineer, as he may deem necessary.
- 12.2 It is mandatory for the contractor to observe during the execution of the works requirements of safety rules which would generally include but not limited to following.

SAFETY RULES:

- i. Each employee shall be provided with initial indoctrination regarding safety by the contractor, so as to enable him to conduct his work in a safe manner.
- ii. No. employee shall be given a new assignment of work unfamiliar to him without proper introduction as to the hazards incident thereto, both to himself and his fellow employees.
- iii. Under no circumstances shall an employee hurry or take unnecessary chance when working under hazardous conditions.
- iv. Employees must not leave naked fire unattended. Smoking shall not be permitted around fire prone areas and adequate fire fighting equipment shall be provided at crucial locations.
- v. Employees under the influence of any intoxicating substance, even to the slightest degree shall not be permitted to remain at work.
- vi. There shall be suitable arrangement at every work site for rendering prompt and sufficient first aid to the injured.
- vii. The staircases and passageways shall be adequately lighted.
- viii. The employees when working around moving machinery must not be permitted to wear loose garments. Safety shoes are recommended when working in shops or places where materials or tools are likely to fall. Only experienced workers shall be permitted to go behind guardrails or to clean around energized or moving equipment.
- ix. The employees must use the standard protection equipment intended for each job .each piece of equipment shall be inspected before and after it is used.
- x. In cases of rock excavation blasting shall invariably be done through licensed blasters and other precautions during blasting and storage/transport of charged material shall be observed strictly.
- xi. The contractor shall follow and comply with all state safety rules, relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any demur, protest or contest or reservation. In case of any discrepancy between statutory. Requirement and state safety rules referred above, the later shall be binding on the contactor less the statutory provisions are more stringent.
- xii. If the contractor does not take all safety precautions and /or fails to comply with the safety rules as prescribed by consortium or under the applicable law for the safety rules as prescribed by consortium or under the applicable law for the safety of the equipment and plant and for the safety of personnel and the contractor does not prevent hazardous condition which cause injury to his own employees or employees of other contractor' s,

owner's employees or any other person who are at site or adjacent thereto, the contractor shall be responsible for payment of compensation as per the following schedule:

- | | | |
|-----|---|---|
| (a) | Fatal injury or accident causing
Death
who so ever | Rs. 1, 00,000/- applicable
per person for death /injury to any persons |
| (b) | Major injuries or accident causing 25% or more permanent disablement to workmen or employees. | |

- 12.3 Permanent disablement shall have same meaning as indicated in Workmen's Compensation Act. The compensation mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provision of the Workmen's Compensation Act and the rules framed hereunder or any other applicable laws as applicable from time to time. in case the owner is made to play such compensation indicated above.

13. **CODE REQUIREMENTS.**

- 13.1 The erection requirements and procedures to be followed during the installation of the equipment and procedures to be followed during the installation of the equipment shall be in accordance with the relevant codes and accepted good engineering practice, the engineer's drawings and other applicable Indian recognized codes and law and regulations of the government of India.

14. **FOUNDATION DRESSING & GROUTING**

- 14.1. The surface of foundation shall be dressed to bring the top surface of the foundation to the required level, prior to placement of equipment/equipment bases on the foundations.
- 14.2. All the equipment bases and structural steel base plates shall be grouted and finished as per these specifications unless otherwise recommended by the equipment manufacturer.
- 14.3. The concrete foundation surfaces shall be property prepared by chipping, grinding as required to bring the type of such foundations to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength all laitance and surface film shall be removed and cleaned.

15.0. **CHECKOUT OF CONTROL SYSTEMS**

After completion of wiring, furnished under separate specification and laid and terminated by the owner, the contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications all documents.

16.0. **COMMISSIONING SPARES**

- 16.1. It will be the responsibility of the contractor to provide all commissioning spares required for initial operation till the equipment is declared by the owner as ready for commissioning .the contractor shall furnish a list of all commissioning spares along with bid and such list shall be reviewed by the owner and mutually agreed to. However, such review and agreement will not absolve the contractor of his responsibilities to supply all commissioning spares so that initial operation does not suffer for want commissioning

spares. All commissioning spares shall be deemed to be included in the scope of the contract at no extra cost to the owner.

- 34.7 These spares shall be received and stored by the contractor along with the supply of main equipment prior to the schedule date of commencement of commissioning of the respective equipment and utilized as and when required. The unutilized spares and replaced parts. If any, at the end of successful completion of performance and guarantee test shall be the property of the contractor and he will be allowed to take these parts back at his own cost with the permission of engineer.

17.0 CABLING

- 17.1. All cables shall be supported by conduits or cable trays run in air or in cable channels. these shall be installed in exposed runs parallel or perpendicular to dominant surface with right angle turn made of symmetrical bands for fittings. When cables are run on cable trays, they shall be clamped at minimum intervals of 2000 mm or otherwise as directed by the engineer.
- 17.2. Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list(prepared by the contractor),at every 3 meter run or part thereof and at both ends of the cable adjacent to the termination. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.
- 17.3. Sharp bending and kinking of cable shall be avoided. The minimum radii for XPLPE insulated cables LT&HT grade shall be 15 D of the overall diameter of the cable. Installation of other cables high voltage coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Whenever cables cross roads and water, oil, sewage or gas lines, special care should be taken for the protection of the cables in designing the cable channels.
- 17.4. In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.
- 17.5. H.T. cable termination shall be through 11 KV cable termination kits control cable termination shall be made in accordance with wiring diagrams, using identifying codes subjects to engineer's approval. Multi core control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilizing plastic or nylon ties or specifically treated fungus protected cord made for this purpose .control cable conductor insulated shall be secure and even.
- 17.6. The connectors for control cables shall be covered with a transparent insulated sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably be terminated in elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductors insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

LIST OF Approved Make of Electric Goods

Sr.No.	Particulars	Manufacturer
1	Power Transformer/ Distribution Transformer	ABB / BHEL / Voltamp / Cromton / Kirloskar / Siemens
2	Current Transformers	Pragati/ ECS/ Gilbat maxwell/ Jyoti/ Precise
3	Potential Transformers	Pragati/ ECS/ Gilbat maxwell/ Jyoti/ Precise
4	11 kV HT XLPE Power Cables	Polycab, Universal, Cable Corporation of India/ Ford gloster
5	Cable Termination Kits	Mahindra, Raychem, Denson
6	11kV Switchgear	ABB/ Areva/Siemens/ BHEL/Schinder/CGL
7	Control/ LT Cables (1.1kV)	Polycab, Universal, Cable Corporation of India/ Ford gloster
8	Selector switch	Kaycee, Siemens, L&T
9	Cable Lug & Glands	Dowel / Comet
10	L T Switchgear	L&T, Siemens, ABB, Legrand
11	ACB/MCCB/MCB's	L&T, Siemens, ABB, Legrand
12	Bus Truncking / L.T. Panel / APFC Panel	ASPL, Advance Power Control, C&S System & Power Control, Zucchini(Legrand), Siemens
13	Meter	L&T/ Havell's/ HPL/ Conzerv
14	DG Set - Engine	Kirloskar / Cummins / Mitsubisi / Parkinson
15	Alternator	Kirloskar /Stemford / Crompton
16	Power Capacitors	Crompton / Siemens Apcos
17	Acoustic Encloser	DG supplier
18	Indicating Lamp	L&T, Siemens
19	Light Fitting	Philips,Bajaj,Crompton,C&S,Jabla or equilent
20	Fans	Bajaj,Crompton,Khaitan,Usha or equilent

