

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel



Maharashtra State Electricity Distribution Company Limited

Technical Specification
Of
1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T.
Shunt Capacitor Bank along with 11 kV Capacitor Control Panel
For Distribution System In MSEDCL

TECHNICAL SPECIFICATION NO.

CE/Testing & QC/MS-C-II/ Automatic Power Factor Controller/

DATE: 15.03.2019

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

INDEX

Clause No.	Contents
1.	Scope
2.	System Particulars
3.	Service Condition
4.	Applicable Standards
5.	Principle Parameters
6.	7.3 kV Capacitor Unit
7.	Automatic Power Factor Control Unit
8.	11 kV Vacuum Contactor Switches
9.	Residual Voltage Transformer
10.	11 kV Series Reactors
11.	Capacitor Cubicle
12.	11kV Vacuum Circuit Breaker
13.	11 kV Isolator
14.	9 kV Lightning Arrestor
15.	HRC Fuses
16.	11 kV Current Transformers
17.	Control & Protection Equipments
18.	Support structure, equipment frame
19.	Equipment terminal connectors(HV)
20.	11 kV Nominal Voltage HT XLPE Power Cables
21.	Earthing
22.	Lifting arrangement
23.	Painting
24.	Labels
25.	Tests
26.	Inspection
27.	Quality Assurance Plan
28.	Performance Guarantee
29.	Documentation
30.	Packing and Forwarding
31.	Training
32.	Schedules
	Schedules 'A' ... Guaranteed and technical particulars
	Schedules 'B' ... List of Unit Priced items.
	Schedules 'C' ... List of Type Test Reports to be enclosed with the offer
	Schedules 'D' ... Schedule of deviations from specification
	Schedules 'E' ... Schedule of bidder's experience
	Schedules 'F' ... Schedule of deviation from specified standards

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

	Schedules 'G' ... Deviation from specified test requirements
	Schedules 'H' ... Performa Of Undertaking
	Annexure
	Annexure -I -'A' ... Principal Technical Parameters of Capacitor Bank
	Annexure -I -'B' ... Principal Technical Parameters of Series Reactor
	Annexure -I -'C' ... Principal Technical Parameters of Residual Voltage Transformer.
	Annexure -I -'D' ... Principal Technical Parameters of Vacuum Contactor
	Annexure -I -'E' ... Principal Technical Parameters of Outdoor APFC CRCA Cubicle
	Annexure -I -'F' ... Principal Technical Parameters of Vacuum Circuit breaker
	Annexure -I -'G' ... Principal requirements of protective relays, metering equipment
33.	Annexure -I -'H' ... Principal Technical Parameters for Isolator
	Annexure -I -'I' ... Principal Technical Parameters of 11 kV CTs
	Annexure -I -'J' ... Principal Technical Parameters of 9 KV, 10 KA, Station class III
	Annexure -I -'K' ... Specification of 3 over current & 1 EF relay
	Annexure -I -'L' ... Specification of Under and over voltage relay
	Annexure -I -'M' ... Specification of NDR voltage Operated relay
	Annexure -II ... Type Test
34.	Information to be filled / furnished invariably by Bidder
35.	Guaranteed Technical Particulars
36.	Qualifying Requirement

Technical Specification of 1.2 MVAR/2.4 MVAR, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

MAHARASHTRA STATE ELECTRICITY DISTRIBUTION CO. LTD.

TECHNICAL SPECIFICATION OF

1.2 MVAR/2.4 MVAR, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank Along with 11 kV Capacitor Control Panel

1.0 Scope :-

- 1.1 This specification covers design, manufacture, assembly, testing before supply, inspection, packing and delivery and other basic technical requirements in respect of 1.2 MVAR/ 2.4 MVAR, 11kV, Automatically Switched HT shunt Capacitor Bank along with 11 kV Capacitor Control Panel, 11kV Isolator, 11kV Current Transformer and 11kV, 12.5 kA Vacuum Circuit Breaker (with highest system voltage of 12kV), to be installed on 5 MVA/10 MVA 33/11 kV Power Transformers at various 33/11 kV sub-stations in Maharashtra. The equipments to be supplied against this specification are required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble-free service over the years. 11kV Isolator, 11kV Current Transformer, 11kV, 12.5 kA Vacuum Circuit Breaker, Control & Relay panels are also covered in the scope of supply.
- 1.2 1.2 MVAR/ 2.4 MVAR, 11kV rated and designed for 12.65 kV, outdoor type, in CRCA Cubicle - shunt Capacitor Banks shall be automatically switched in steps.
- 1.3 Manufacturing of 'Capacitor, Automatic Power Factor Controller, Vacuum Contactor Switch, Series Reactor & APFC Cubicle' by one bidder can quote against this specification, in order to ascertain the highest reliability of system.
- 1.4 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.5 Tender scope also includes cable, conductor and terminal connectors/Hardware required to inter connect the equipment covered in this specification to above configuration and to the over head main bus.
- 1.6 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. The indicative drawings attached with this specification and the notes thereto are generally of illustrative nature. In actual practice, notwithstanding any anomalies, discrepancies, omissions, in-completeness, etc. in these specifications and attached drawings, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances and requirements for clearances etc. as are

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.

2.0 System Particulars:-

- | | | | |
|-----|---------------------------------------|---|--|
| 2.1 | Nominal System Voltage | : | 11kV |
| 2.2 | Voltage variation on supply side | : | ±10 % |
| 2.3 | Corresponding Highest System Voltage: | | 12kV |
| 2.4 | Frequency | : | 50 Hz with ± 3 % tolerance |
| 2.5 | Transient condition | : | -20 % or + 10 % combined variation of voltage and frequency. |
| 2.6 | Number of Phase | : | 3 Phases |
| 2.7 | Neutral earthing | : | Solidly earthed. |
| 2.8 | Fault level (minimum) | : | 12.5 kA for 3 sec. |

3.0 Service Conditions :-

A) The 11kV, Automatically Switched HT shunt Capacitor Bank and accessories to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- | | | |
|-----|--|----------|
| 3.1 | Maximum ambient temperature (Degree C) | 50 |
| 3.2 | Maximum temperature in shade (Degree C) | 45 |
| 3.3 | Minimum Temperature (Degree C) | 3.5 |
| 3.4 | Relative Humidity (percent) | 10 to 95 |
| 3.5 | Maximum Annual rain fall (mm) | 1450 |
| 3.6 | Maximum wind pressure (kg/sq.m) | 150 |
| 3.7 | Maximum altitude above mean sea level (Meter) | 1000 |
| 3.8 | Isoceraic level (days per year) | 50 |
| 3.9 | Seismic level (Horizontal Acceleration) | 0.3 g |

Moderately hot and humid tropical climate conducive to rust and fungus growth

B) The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

4.0 Applicable Standards :-

4.1 The design, manufacture and performance of the equipment shall comply with all currently applicable statutes, regulations and safety codes.

Nothing in this specification shall be construed to relieve the bidder off his responsibilities.

4.2 Unless otherwise specified , the equipment offered shall conform to the latest applicable Indian, IEC, British, U.S.A. or International Standards and in particular, to the following :-

Sr.	Standards	Particulars
1.	IS 13925:2012	Specification for H.T. shunt Capacitor
2.	IS 9920/IEC 62271-103	Vacuum Contactors/ Capacitor Switch
3.	IS 16227	Residual Voltage Transformer
4.	IS 5553	Series Reactor
5.	IEC 61000	Automatic Power Factor Controller
6.	IS 13118/1991	High Voltage Alternative current circuit breaker
7.	IEC 694	Common clauses for switchgear
8.	IS 16227	Current transformers.
9.	IS 5621:1980	Hollow Insulators for use in electrical equipment
10.	IS 9921/1981, 82,85	Alternating Current Disconnecter (Isolators)
11.	IS:2544/1973	Porcelain Post Insulators
12.	IS 3070-Part-III	Lighting Arrestor
13.	IS 12063/1987	Degree of protection provided for enclosures for electrical equipment.
14.	IS 5/2005	Colors for ready mixed paints and enamels.
15.	IS 5578/1984	Marking of insulated conductor.
16.	IS 1248/2003	Indicating instruments.
17.	IS :7098 (Part 2) - 1985	XLPE PVC sheathed cable for working voltages from 3.3 kV up to and including 33 kV
18.	IS 6875	Control switches.
19.	IS 3231/1986 & 87	Electrical Relays for Power System Protection.
20.	IS 8686/1977	Static protective relays.
21.	IS 4794/68 & 86	Push button.
22.	IS:9385/1979	High Voltage Fuses
23.	IS: 5831 - 1984	PVC insulation and sheath of electric cables.
24.	IS: 3975 - 1988	Mild steel wires , Formed wires and Tapes for armoring of cables.
25.	IS :10462 (Part I) - 1983	Fictitious calculation method for termination of dimensions of protective coverings of cables.
26.	IS: 8130 - 1984	Conductors for insulated electric cables and flexible cords.
27.	IEC 60255	Numerical protective relays.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

- 4.3** The components such as VCB, Isolator, Current Transformer, Vacuum contractors, HT fuses, Series Reactors, Residual Voltage Transformer & other auxiliary equipments shall comply with the latest version of latest Indian/International standards.
- 4.4** Equipment conforming to other internationally accepted standards which ensure equal or higher quality than the above mentioned standards would also be acceptable. In such case bidders, who wish to offer material conforming to standards other than listed above, shall clearly bring the salient points of difference between the standards forward/adopted and specified herein above. Four copies of such standards with authentic English Translation shall be furnished along with the offer. In case of conflict order of preference shall be (1) IS (2) IEC (3) other standards. In case of any difference between provisions of these standards and provision of this specification the provision contained in this specification shall prevail.

5.0 Principal Parameters :-

The equipment covered under this specification shall conform to specific parameters given below:

5.1 Capacitor Bank Rating :-

Sr. No.	Transformer Capacity (MVA)	Rating of Capacitor Bank (MVar)	Steps configuration kVAR X No. of Steps (Switched)
1	5	1.587	2X198.375 kVAR + 396.75 kVAR + 793.5 kVAR
2	10	3.174	2X198.375 kVAR + 2x396.75 kVAR + 793.5 kVAR + 1190.25 kVAR

5.2 Capacitor Banks :-

Sr.	Item	1.2 MVAR Bank	2.4 MVAR Bank
1.	Nominal system voltage	11 KV	
2.	Rated voltage of capacitor	12.65 KV	
3	Output of capacitor bank at 12.65 KV	1587 kVAR (2x198.375 kVAR + 396.75 kVAR + 793.5 kVAR)	3174 kVAR (2x198.375 kVAR + 2x396.75 kVAR + 793.5 kVAR + 1190.25 kVAR)
4.	Rated line current	72.43 Amp.	144.86 Amp.
5.	Connection of capacitor bank	Single star	
6.	No. of phases	3	
7.	Rated voltage of individual capacitor unit	7.3 KV	
8.	Capacity of individual capacitor unit	66.125 kVAR for 198.375 kVAR step & 132.25 kVAR for 396.75 kVAR Step & 264.5 kVAR for 793.5 kVAR Step	66.125 kVAR for 198.375 kVAR step & 132.25 kVAR for 396.75 kVAR Step & 396.75 kVAR for 1190.25 kVAR Step
9.	Insulation level	RMS-28 KV, Peak -75 KV	

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

10.	Maximum temp. rise over ambient temperature	10 Deg. C
11.	Type of discharge	Internally through within the Unit resistor provided
12.	Type of fuse	External fuse
13.	Type of installation	Outdoor
14.	Power loss	Not to exceed 0.2 watt/kVAR subject to tolerance as per standard. Offered capacitors should be built from best material which develop minimum losses.

6.0 7.3 kV Capacitor Unit:-

The capacitor shall be suitable for indoor installation having high dielectric strength. The capacitor should be able to withstand 10% overvoltage and 30% over current (r.m.s. value) arising due to over voltage.

6.1 Assembly:-

Capacitor units of 66.125 kVAR/132.25 kVAR/264.5 kVAR/ 396.75 kVAR, 7.3 kV single phase shall be connected in parallel in each phase to form a three phase star connected capacitor bank. The bank shall be panel mounted and shall be arranged that all equipments in panels can be removed easily without disturbing the complete assembly/ other units.

6.2 Construction of Capacitor Unit:-

The container shall be built from CRCA of minimum thickness of 1.6 mm to avoid damages to the tank in case of internal fault. It shall be of fabricated construction with all joints properly welded and designed to withstand rough handling. The lid of container shall be properly welded to the container. The capacitor unit shall be hermetically sealed after the entire assembly has been dried and impregnated with non polychlorinated biphenyls (PCBs) Dielectric liquid. The capacitor elements shall be thoroughly dried and impregnated with an impregnate which has been completely refined and degasified so as not to have any impurities or gas which may cause deterioration of the dielectric. The impregnate used shall have low viscosity and should be non-PCB. The container shall be adequately insulated from capacitor elements. The metallic surface of capacitor units shall be painted by using epoxy/ polyurethane paint. Before painting surface treatment like shot blasting required to remove rust & oily portion of the container sheet.

The capacitor unit shall have aluminum foil as conducting layer. The dielectric used shall be polypropylene film. Polypropylene film shall have the following compatibility criterion: -

- (i) Polypropylene film shall conform to standard specification with latest amendments, for plastic film for new generation.
- (ii) Compatibility between oil film (after thermal aging at 115 deg. C for 96 Hrs.)

The impregnate used shall be non polychlorinated biphenyls (PCBs) Dielectric liquid. Adequate number of such elements shall be assembled and enclosed in the enclosure to form a single phase unit with terminal bushings. The air in the enclosure and moisture absorbed by the paper shall be removed under high vacuum and temperature and replaced by suitable impregnating medium having high permeability, high dielectric strength and non-inflammable properties.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

1.	Physical and Electrical properties of polypropylene	
	a) Nominal thickness of polypropylene	9 to 15 μ
	b) Tensile strength of polypropylene	
	i) Length wise (M.D.)	≥ 120 Mpa
	ii) Cross wise (C.D.)/TD	≥ 200 Mpa
	c) Percentage Elongation (Break)	
	i) Length wise(M.D.)	$\geq 100\%$
	ii) Cross wise (C.D.)/TD	$\geq 30\%$
	d) Shrinkage at 120 Deg Celsius	
	i) Length wise (M.D.)	$\leq 5.0\%$
	ii) Cross wise (C.D.)/TD	$\leq 4.0\%$
	e) Dielectric breakdown voltage	≥ 210 Volts/ μ

(iii) Hazy Poly Propylene (APP), Double Layer Minimum

6.3 Oil Properties:-

1	Capacitor oil used in the container	Non PCB,
	a) Viscosity Kinetic- at 40 Deg. C	≤ 7.0 mm ² /s
	b) Specific gravity	1.01 g/Cm ³
	c) Tan delta Dielectric loss factor at 90 Deg Celsius	≤ 0.0010
	d) Breakdown voltage	≥ 60
	e) Flash point	≥ 140
	f) Acidity	≤ 0.015 mgKOH/g
	g) Volume resistivity at 90 Deg. Celcius	$\geq 1 \times 10^{12}$
	h) Gas content of oil	$\leq 174 \mu\text{L/Min}$

6.4 Discharge Device:-

Suitable discharge device shall be connected across the capacitor unit in accordance with IS:13925. The discharge device shall reduce the residual voltage from the crest value of the rated voltage to 75 V or less within 10 Minutes after the capacitor is disconnected from the source supply.

6.5 Earthing Connections:-

The container of each capacitor unit shall be provided with suitable earthing terminal clearly marked with Earth symbol.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

6.6 Marking:-

The capacitor unit shall be provided with a rating plate and terminal markings as stipulated in IS: 13925.

The bidder shall submit the similar or higher rating of type test report along with the bid.

6.7 Bushings:-

Bushing shall be of porcelain and shall be jointed to the case by soldering/welding method (solder-able/weld-able type bushing) to ensure adequate and permanent seal. Leads shall be brought out through one-piece bushing and soldered/ welded to the terminal stud to make a strong and positive electrical contact. Bushing terminal shall be of brass.

6.8 Routine Tests & Acceptance Tests:-

1. Sealing Test
2. Measurement of Capacitance
3. Voltage Test between Terminals
4. AC Voltage Test between Terminal & Container
5. Test of Internal Discharge Device
6. Measurement of the Tangent of the loss angle (Tan Delta) of the Capacitor
7. Discharge test on internal fuses

6.9 Type Tests:

1. Thermal Stability Test
2. Measurement of the Tangent of the loss angle (Tan Delta) of the Capacitor at elevated Temperature.
3. AC voltage test between terminals and container
4. Lightning impulse voltage test between terminals and container
5. Short circuit discharge test
6. Disconnecting test on internal fuses
7. Endurance Test
8. Test of an external fuse in combination with a capacitor

7.0 Automatic Power Factor Control Unit :-

(a) Switching Arrangement:

The Automatic control unit shall be mounted in the control & relay panel itself to continuously monitor total load KVAR on secondary side of the transformer and shall automatically switch ON or switch OFF the capacitor banks through the operation of 11 KV Vacuum Contactor Switch.

(b) Time Delay:

The switching ON operation will take place after period of 10 minutes. The switching OFF operation of relevant steps will be instantaneous.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

(c) Controls:

The Automatic control unit shall instantly switch OFF the capacitor bank in the following contingencies occurring in any of the phases.

- i) Voltage increased by 10% above the rated voltage of 11 KV.
- ii) Power transformer current impedance (due to single phasing and for any other reasons) between any of the two phases exceeding 20% of the lowest, iii) Current increases in any capacitor unit by 30% above the rated current (only the relevant capacitor switch will open). Current between any of the two phases of the capacitor bank differs more than 15% of the lowest current of the 3 phases (only the relevant capacitor switch will open).

(d) Monitoring Facility:

A suitable display should be provided to indicate the capacitor current in each phases of the complete capacitor bank on the ACU panel inside the control room. Indications shall also be provided to indicate ON & OFF status of each capacitor bank. Along with audio alarm indicating tripping of capacitor bank and ON /OFF, visual display window be provided on control panel.

(e) Control Power:

The AC control voltage for operation of the ACU shall be taken from substation. The required control voltage shall be 250 V \pm 10 AC supply.

(f) Temperature Variation:

The control equipment and associate circuitry shall be suitable for operation at an ambient temperature in the range of + 5 deg C to (+) 50 deg C.

(g) Protection of ACU:

Besides in-built protection against lines surges and transient over voltages, suitable fuses/MCB shall be provided for protection against over current. The ACU shall remain fully functional during and after line surges and transient over voltages.

Principal Technical Parameters of Automatic Power Factor Controller

Sr. No.	Description	Particulars
1	Feed-back Voltage:	3ph, 3wire, 110Volt (+10%/-20%)
2	Current input:	Selectable 1A or 5A for both load & capacitor
3	Auxiliary Supply:	3Ph 415V (+10% to -20%)/1Ph, 230V AC (+20%to-20%)
4	Output banks control for 8 banks.	(Isolated 'NO' contacts of rating 5Amp ac / 250Vac)
5	RS-232 baud rate selectable	up to 38.4kBPS
6	Dedicated RS232 port on front fascia	RS232 port
7	Facility for separate temperature probe (PT100) provided	Separate temperature probe

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

8	Operating temperature:	0 to 50°C.
9	Storage Temperature:	-10 to +75°C.
10	Humidity:	0 to 98%
11	Supply frequency:	45Hz to 55Hz
12	Automatic synchronization capable of giving correct results even for wrong connections at CT terminals (& also wrong polarity of CT connection)	YES
13	Load V, I and Cap. Current THD measurement with odd harmonic coeff. upto 15th harmonic	YES
14	Mode of switching	user defined
15	Standard 144 X 144 cabinet for panel door flush mounting	144 X 144
16	Serial communication through standard Dedicated protocols	YES
17	Selectable communication port	MODBUS RS485 or RS232
18	Logging of data in the form of Hourly Records, Fault Records & Daily Records	recording all electrical values
19	Protections provided	All these are user settable
20	Over/under Voltage	
21	Cap. Over/under current during switching ON	
22	Over / Under frequency	
23	Over / Under load	
24	Load unbalance	
25	Over temperature	
26	Out of steps (only for indication)	
27	NV-RAM battery down	

8.0 11 kV Vacuum Contactor Switches:

This specification covers 11 KV, 50 Hz, Indoor type Vacuum Contactor Switch suitable for switching capacitor in steps.

(a) Applicable Standards:

Unless otherwise stipulated in this specification the Vacuum Contactor Switch shall comply with the latest version of IS:9920/IEC 62271-103.

(b) Rated Voltage:

The rated voltage for the Vacuum Contactor Switch shall be 12 KV. This represents the highest system voltage corresponding to the nominal system voltage of 11 KV.

(c) Rated Current:

The standard rated normal current shall be 400A

(d) Rated Capacitive Switching Current:

The rated capacitive switching current shall not be less than 200 A.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

(e) Rated Short Time Current:

The rated short time symmetrical current for 1 second shall be 10KA (rms AC. component).

(f) Rated Short Circuit Making Current:

The rated making current shall be 25 KA Peak.

(g) Basic Impulse Level (BIL):

The rated basic impulse level of Vacuum Contactor Switch to earth as also across the open terminals shall be 75 KV.

(h) Control Supply:

The control power for closing the Vacuum Contactor Switch shall be 250 V single phase AC supply. The closing mechanism shall be Solenoid coil for a voltage variation of (+) 10% to (-) 20%.

(i) Design & Construction Requirement:

Type:

- a. The Capacitor Switch shall be of vacuum type.
- b. The Vacuum Contactor Switch shall be of three phase construction and shall be suitable for remote operation.
- c. The Vacuum Contactor Switch shall be suitable for indoor installation and shall have sealed weather proof type construction.

(j) Operating Mechanism:

The operating mechanism shall be Solenoid coil for which the control supply shall be as per clause No. (h).

(k) Mechanical and Electrical Endurance:

The Vacuum Contactor Switch shall be capable of performing not less than 10,000 mechanical operations and 10,000 electrical operations as per IEC : 62271-100.

(l) Marking:

The Vacuum Contactor Switch shall be provided with a legible and indelibly marked name plate with the following:

- a) Name of the manufacturer.
- b) Type, designation and serial number.
- c) Rated voltage and current.
- d) Rated frequency.
- e) Number of poles.
- f) Rated short time current (symmetrical).
- g) Rated making current.
- h) Rated capacitive switching current.
- i) Date of manufacturing.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

j) Property of MSEDCL.

(m) Tests: The Vacuum Contactor Switch shall be subjected to the following tests in accordance with the IS:9920 (Part-IV)/IEC 62271-103.

A. Type Tests :

- Tests to verify the insulation level, including withstand tests at power frequency voltages on auxiliary equipment.
- Tests to prove that the temperature rise of any part does not exceed the specified values.
- Making and breaking tests including tests for the rated capacitive current.
- Tests to prove the capability of the switch to carry the rated short time current.
- Tests to prove satisfactory operation and mechanical/electrical endurance.

B. Routine Tests:-

- Power frequency voltage dry tests.
- Voltage tests for auxiliary circuits.
- Measurement of the resistance of the main circuits.
- Tests to prove satisfactory operation.

Principal Technical Parameters of 11 kV Vacuum Contactor

Sr. No.	Description	Particulars
1	Applicable standard	IS 9920 (Part IV)/2002/ IEC 62271-103
2	Type & Make	
3	Number of poles, nos. of break/pole	3 Pole, 1break/Pole
4	Model	
5	Maximum capacity	12kV,400A
7	Rated Voltage	11Kv
8	Rated maximum voltage	12Kv
9	Rated normal current	400A
10	Rated single capacitor banks current	200A
11	Frequency	50Hz
12	Rated short time current for one sec	10Ka
13	Rated short circuit making current	25kAp
14	Impulse with stand voltage (1.2/50 micro sec. wave, crest)	75kVp
15	One minute power frequency withstand voltage	28Kv

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

16	One minute power frequency withstand voltage on auxiliary circuit	2Kv
19	Mechanical endurance	10,000 Operations
20	Electrical endurance	10,000 Operations
21	Max. current required for Closing of solenoid	<12 Amp
22	Closing time	<150ms
	Opening Time	< 80ms i.e. Less than the opening time of breaker
24	Operating Mechanism	
	Stored energy	Solenoid
	Rated voltage	250V AC
26	Inherent delay between two switching operations	10 Min
27	IP Protection	IP 55
28	Whether capacitor switch is type tested.	Yes.

9.0 Residual Voltage Transformer

The residual voltage transformers shall be indoor & dry type with primary in star and secondary in star & tertiary in open delta formation. The neutral of the primary winding shall kept fully insulated and would be isolated from ground. The tertiary winding in open delta shall be used to energies the neutral unbalanced voltage withstand relay. The RVT should be suitable to discharge the capacitor bank to voltage not exceeding as per standards with latest amendments thereof. The RVT should be designed to with stand the temperature rise due to energy discharge in to it capacitors in case of tripping. All the type test as per IS : 16227 including temperature rise test should be furnished. RVT shall be mounted inside the cubicle.

Type Tests :

- Temperature Rise Test.
- Impulse Voltage Test on primary Terminals
- Wet Test for outdoor Type Transformer
- Electromagnetic Compatibility Test
- Test for accuracy
- Short Circuit withstand capability test

Routine Tests :

- Power frequency withstand test on primary terminals
- Partial discharge measurement
- Power frequency Voltage withstand tests between sections
- Power frequency Voltage withstand tests on secondary terminals
- Test for accuracy
- Verification of marking

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

Principal Technical Parameters of Residual Voltage Transformer

Sr. No.	Description	Particular
1	Reference Standard	IS:16227
2	Type	Dry type resin cast, 5 Limb Construction
3	Rated primary voltage	11 kV
4	Frequency	50 Hz +/- 3%
5	No. of secondary windings	2
6	Ratio	11kV (Star) /110V(Star)-190V(Open Delta)
7	Rated burden per phase & Accuracy class	
	a) Metering Winding (Star)	Class: 1, Burden: 50 VA
	b) Protection Winding (Open Delta)	Class :3P; Burden : 50 VA
8	Method of connection	Star/Star-Open delta
9	Insulation Level	
	a) One minute power frequency withstand voltage b) Impulse withstand voltage (1.2/50 micro sec. wave, crest)	a) 28 kV b) 75kVp
10	Voltage Factor	1.2 times & 1.9 for 30 Sec.
11	Terminal arrangement	
	1) HV side 2) LV side	PRI. Terminals for R, Y, B, N SEC. Terminal R,Y,B,N & Open delta

10.0 11 kV Series Reactors :

- a) 0.2 % Series reactor per phase per step of capacitor rating for inrush current restriction to be connected on neutral end as per IS: 5553. The rated voltage of Series reactor shall be 11 KV. The reactor shall be dry type single phase reactors and designed to carry 130 % of rated current continuously. The Capacitor In-rush Limiting reactors are used in series with capacitor bank to control the in-rush current and to suppress the harmonics. Normally reactors with 0.2% rating are used for in-rush current limiting on neutral side and 6% for line side. Specific ratings 13% are used for harmonic suppression.
- b) Tests: The series reactor shall be type tested and shall be subjected to routine and acceptance test in accordance with IS: 5553.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

Type Test:

- i) Measurement of Winding Resistance
- ii) Measurement of Insulation Resistance
- iii) Measurement of Impedance of continuous current
- iv) Measurement of loss
- v) Separate source Voltage Withstand Test
- vi) Induced over Voltage Withstand Test
- vii) Temperature Rise Test at rated continuous current
- viii) Lightning impulse test

Routine Tests:

- i) Measurement of winding Resistance
- ii) Measurement of Insulation Resistance
- iii) Measurement of Impedance of continuous current
- iv) Measurement of loss
- v) Separate source Voltage Withstand Test
- vi) Induced over Voltage Withstand Test

Principal Technical Parameters of 11 kV Series Reactors

Sr. No	Description	Technical Particulars			
1.	Name of manufacturer				
2.	Reference Standard	IS 5553 Part – III			
3.	Capacitor Bank Rated kVar step	198.375	396.75	793.5	1190.25
4.	11 kV Series Reactor				
	a) Rated kVar (kVar)	0.132	0.265	0.529	0.794
	b) Impedance (Ohms)	1.613	0.807	0.403	0.269
	c) Rated current (Amps)	9.054	18.108	36.217	54.325
	d) Choke Voltage (Volts)	14.6	14.6	14.6	14.6
	e) Short time current rating for 2 Sec(Amps) 16.66 times of rated current	150.84	301.68	603.37	905.05
5.	a) Nominal system voltage	11 KV			
	b) Rated voltage of capacitor bank	12.65 KV			
6.	Rated frequency	50 Hz			
7.	No. of phases	1 Phase			
8.	Linear characteristic.	Yes			
9.	Type of Reactor	Aluminum wound, Air Core, Dry Type, Neutral side Series Reactor.			
10.	Power frequency withstands voltage.	28 KV (rms)			

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

11.	Lightning impulse withstand voltage.	75 KV (Peak)
12.	Creepage distance	300 mm

11.0 Capacitor Cubicle:

i) It shall be free standing outdoor type enclosure fabricated from 2 mm thick CRCA sheet for load bearing member & also for non-load bearing member. Capacitor cubicle shall be mounted on mild steel channel frame and base frame shall be provided with mounting holes for fixing on concrete foundation. Cubicle panel shall be bolted type design. All doors and covers shall be designed to avoid ingress of water, moisture, dust etc. and shall be provided with suitable gaskets to achieve IP-55 degree of protection.

Covers and doors shall be provided with electrical interlocks to avoid access to live parts. Viewing glasses shall be provided to view inside parts like fuses, contactors. CFL/LED type internal panel lighting shall also be provided to have proper view in the night. Capacitor enclosure shall be duly powder coated. FRP canopy shall be provided at the top and which projects about 200 mm beyond cubicle on all sides. All LT internal wiring shall be fire retardant cable of 2.5sq.mm. All cable entries shall be from bottom through cable glands of suitable size. HT XLPE cable entry shall be through a cable entry box mounted on cubicle or fixed separately on foundation and coupled to the cubicle. Necessary Danger plate & Name plate etc shall be provided at prominent places. All other necessary fittings and accessories should be provided by manufacturer to ensure safe and smooth operation of the equipment.

ii) Bus bars & Interconnection Materials:

Suitable bus bar arrangement shall be provided by the supplier and requisite quantity of bus bar material shall be provided for the Bank. All bus bars shall be aluminum flats with suitable cross section.

iii) Accessories :

Each capacitor bank cubicle panel shall be provided with the following accessories:

1. 2 Nos. earthing terminals
2. Cable entry box
3. Aluminum bus bar
4. RC Surge Suppressor one no per bank
5. RVT
6. Capacitors
7. Series reactor
8. Vacuum Contactor Switch
9. Rating plate

All other accessories required for erection, assembly and commissioning of the capacitor bank. ACU shall be mounted in C & R Panel and kept inside control room. LA and Isolator shall be mounted on same structure and to be installed in switchyard area.

iv) Rating Plate :

Each unit shall be fitted with a rating plate giving clearly the particulars specified of marking as per standards.

v) Operation of Capacitor Bank:-

- a. The capacitors are proposed to be connected in 3 phase, 11 KV, 50 Hz system.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

- b. It is to be specifically noted that 1.2 MVAR & 2.4 MVAR, 11 KV capacitor banks are intended for use at 33/11 KV substations within distribution network.
- c. Maximum permissible over voltage shall be as per standards and latest amendments thereof.

vi) **Tests:**

a) **Type test :**

- 1) IP-55 degree of protection
- 2) Temperature rise test

Type test should have been conducted on the similar capacity of equipments for 11 KV class from recognized test laboratory preferably CPRI or other Govt. test labs within 5 years prior to date of opening of bid.

b) **Acceptance Test:**

All acceptance tests stipulated in relevant standards shall be carried out by the Supplier in presence of Purchaser's representative.

- c) Valid type test reports of Capacitor Unit & Vacuum Contactor Switch to be submitted along with bid only.

12.0 11kV Vacuum Circuit Breaker :

- i. Circuit breakers shall be Vacuum type. Porcelain clad breakers will be accepted.
- ii. 11kV Vacuum Circuit Breaker used for switching on & off of the Capacitor bank shall be as follows. Circuit breaker shall be suitable for switching IN and OUT capacitor bank without restrike.
- iii. The circuit breakers offered shall be 3-pole gang operated Vacuum circuit breakers having rating 12.5KA for 3 seconds shall have 400 Amps continuous current. For similar rated circuit breakers, it shall be possible to interchange the CBs if required in future.
- iv. C.B. shall be suitable for rapid reclosing cycle 0-0.3 sec – CO – 3 min-CO. First pole to clear factor shall be 1.5,
- v. Breaker Contacts :

Main contacts shall have ample area and contact pressure for carrying continuous rated and short time current without excessive temperature rise, which may cause pitting or welding.

The inside operating rod or insulated fiber glass connecting rods wherever used shall be sturdy and shall not break during the entire life period of the breaker. The insulated rod shall have antitracking quality towards electrical stresses.

vi. **Operating mechanism :**

Operating mechanism and control circuitry shall be housed in suitable metallic enclosure. It shall be painted white on the interior and Dark Admiralty Grey to shade no 632 of IS-5 on exterior surface. The enclosures shall be dust, moisture and vermin proof, to provide a Degree of protection to IP 55 in accordance with IS: 13947. Control cubicle for local operation of the breaker shall be mounted at a convenient height to enable easy operation from ground level. It shall have backwards slanting hood of 2 mm thick (14 SWG) sheet for protection against rain water. It shall accommodate the following items:-

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

Sr. No.	Item	Quantity
1	Mechanical ON & OFF knobs.	1 No.
2	Electrical ON/OFF push buttons	1 no. each
3	Mechanical ON/OFF indicator.	1 No. each
4	Electrical ON/OFF indicator	1 No. each
5	Mechanical spring charged indicator.	1 No.
6	Electrical spring charge indicator	1 No.
7	Auxiliary A.C./D.C. supply indication	1 No. each
8	Conveniently located manual emergency trip	1 No.
9	Auxiliary switches as specified else where in this specification	1 set
10	Control cable termination connector blocks with stud type brass terminals of min 4 mm dia	1 set
11	One power plug along with control switch (250V,10A).	1 set
12	Space heater along with ON/OFF switch and thermostat	1 set
13	Cubical illumination lamp with switch.	1 set
14	Mechanical Operation counter to register the number of breaker operations.	1 No.
15	Local/Remote switch	1 No.

vii. Auxiliary Switches:

Each operating mechanism of the circuit breaker shall be provided with adequate number of Cam/Snap type auxiliary switches of normally open and normally closed contacts for the control and operation of the equipment with continuous current rating of 10 Amp. The Breaking capacity of the contacts shall be minimum 2 A with circuit time constant less than 20 milli seconds at the rated D.C. voltage. Normal position of auxiliary switches refers to contact position when circuit breaker is open.

All spare auxiliary contacts of the circuit breakers shall be wired up and brought to the terminal block. Minimum 8 N/O + 6 N/C contacts shall be available on each breaker for this purpose. Auxiliary contact multiplier, if any used, shall be connected to the DC supply only.

Insulation level of auxiliary contacts shall be 1100 volts, 2.5 kV for 1 min.

- viii. In case the control cubicle mounting height is more, there shall be provision of suitable folding type ladder attached to the breaker support structure, by means of which it will be possible to reach the control cubicle/operating mechanism box conveniently. Further, electrical ON/OFF push buttons/switch shall be accessible from the ground.
- ix. The circuit breaker shall be provided with motor operated spring charged closing. Spring charging motor shall be suitable for 250V, 50 Hz, single phase AC. **Suitable rating starter shall be provided for Motor protection.** Spring release coil for closing shall be suitable for 30V DC. Provision shall be available for charging the springs manually as well, and to close CB mechanically.
- x. Tripping of the circuit breakers shall be through "Shunt trip" coils rated for 30V DC operation. It shall be possible to trip the breaker manually in case of necessity.
- xi. In each circuit breaker, one potential free contact of the limit switch of spring charging motor shall be provided for remote indication of spring charged. This contact shall be wired up and brought to the terminal block.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

xii. Electrical antipumping device shall be provided for breaker.

Principal Technical Parameters of 11 kV Vacuum Circuit breaker

Sr. No.	Particulars	Standard
1.	Reference Standard	IS : 13118
2.	System Voltage	
	Normal	11kV
	Highest	12kV
3.	System Frequency	50 Hz+ / - 3%
4.	System Neutral Earth	Effectively Earthed
5.	Installation	Outdoor
6.	Current	
	Normal	400 Amp
	Short Time Rating	12.5 kA rms for 3 sec.
7.	Insulation Level	
	Impulse	75 kVp
	One minute Power Frequency Voltage	28 kVrms
8.	Operating Duty Cycle	0-0.3sec-CO-3min-CO
9.	First pole to clear factor	1.5
10.	Clearances	
	a. Between Adjacent Pole	280 mm
	b. Between Live Part to Earth	370 mm
11.	Creepage Distance for Bushing	25 mm / kV
12.	Opening Time of breaker	80ms

Type Test :

- 1) Dielectric test
- 2) Radio interference voltage test
- 3) Temperature Rise Test
- 4) Measurement of resistance of main circuit
- 5) Short time withstand current and peak withstand current test
- 6) Mechanical and environmental test
- 7) Short Circuit Making and Breaking current Tests
- 8) Lightning Impulse Voltage withstand Test
- 9) Power Frequency Voltage Withstand Test Dry
- 10) Power Frequency Voltage Withstand Test Wet
- 11) Mechanical Operation Test
- 12) No load operation before and after test
- 13) Basic test duties no. 1 to 5
- 14) Single Phase Short circuit test

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

- 15) Condition of breaker after short circuit test
- 16) Capacitive current switching tests

Routine Test :

- 1) Power Frequency Voltage Withstand Dry Test on the main circuit
- 2) Voltage withstand test on control and auxiliary circuit
- 3) Measurement of resistance of main circuit
- 4) Mechanical Operation Test
- 5) Design and visual checks.

13.0 11 kV Isolator :

- i) For 11kV, Automatically Switched HT shunt Capacitor Bank, two nos. of isolators shall be offered. For incomer to capacitor bank, the isolators shall be of 400 Amps. Continuous current rating without earth blades and for outgoing to Capacitor cubicle, the isolators shall be of 400 Amps. Continuous current rating with earth blades.
- ii) All isolators shall be of center post rotation, double brake, horizontal isolation type and shall have a short time rating of 12.5KA for 3 seconds. The contacts and blades of the isolators shall be of electrolytic grade copper. The fasteners (nut-bolts) used for current carrying parts shall be of non magnetic stainless steel. Spacing between phases for all isolators shall be of 1000mm. Further the current density for copper current carrying parts shall not be more than 1.6 Amp./mm.sq in solid conductor and 2 Amp/sq.mm. in hollow tubes. The current density for Aluminum current carrying parts shall not be more than 1 Amp./ sq. mm.
- iii) Bidders shall quote separately for isolators with integral earthing facility. Such isolators shall have built-in mechanical inter lock between the main and earth blades so that the closing of the main blade is not possible without opening the earth blade and closing of the earth blade will not be possible without opening the main blade.
- iv) All the fixed contacts shall be provided with a sheet metal rain hood. This rain hood shall be fabricated out of at least 2 mm thick Galvanized iron sheet metal and shall be designed such that it will in no case shall obstruct or restrict the movement of moving contracts (blades) and arcing horns, if provided.
- v) Operating mechanism: Manual operating mechanism gang operated through Hand operated lever shall be provided for main switch and earth switch separately.
The operating mechanism shall provide quick, simple and effective operation. The design shall be such that one man shall be able to operate the isolator without undue effort. The operating mechanism shall be suitable to hold the main switch or earth switch in closed or opened position to prevent operation by gravity, wind, short circuit, seismic acceleration, vibration, shock, accidental touching etc.
- vi) Padlocking device: The isolator and earthing switch shall be provided with padlocking device to permit locking of the isolator and earthing switch in both fully open and fully closed positions
- vii) Earthing: Flexible branded copper connections shall be provided between rotating earth blades and the frame which shall have a cross section of at least 50 sq mm and shall be tinned or suitably treated against oxidation.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

- viii) The frame of each disconnect and earthing switch shall be provided with two reliable earthing terminals for connection to the purchaser's earthing conductor/flat so also clamping screw suitable for carrying specified short time current. Flexible ground connectors shall be provided for connecting operating handle to the earthing flat. The diameter of clamping screw shall be at least 12 mm. The connecting point shall be marked with earth symbol.
- ix) Moving blades: Contact surface of moving blades and associated connectors/contacts and terminal pads shall be heavily silver plated to at least 15 microns thick. The surface shall be wiped during closing and opening operations to remove any film, oxide coating etc. Wiping action shall not cause scouring or abrasion of surfaces.
Material of Earthing blades & contacts shall be the same as those of the main moving blades and contacts respectively. Cross-sectional area of the Earthing blades and contacts shall not be less than 50% of corresponding area of main moving blades and contacts.
- x) Bearings: All the friction locations and rotating parts shall be provided with two nos. of bearings of at least 25 mm ID. 50 mm clear spacing between the bearings shall be provided. The housing for bearings shall be made of gravity die cast metal with smooth surface and suitably machined for seating the bearings. The bearings bushes, joints, springs etc. shall be so designed that no lubrication shall be required during the service.
- xi) Tandem pipe: Tandem pipe shall be of at least 25 mm NB, at least 2200 mm long and class B Mild steel galvanized. One single tandem pipe shall be used for phase coupling of double break isolators. Base plate of rotating insulators for connection of tandem pipe shall be made out of one piece of at least 6 mm thick M.S. plate. Bolt and shackle device shall be used to connect tandem pipe to the base plate. Wherever unavoidable sliding clamps may be used. These clamps shall be made out of at least 6 mm thick M.S. flat with four nos. of nuts and bolts. A grub screw shall be provided for securing connection on tandem pipes.
- xii) Down pipe: 50 mm ID class B Mild steel galvanized single piece pipe shall be provided for operating disconnects. The pipe shall be terminated into a suitable swivel type joint between the tandem pipe driving mechanism and the operating mechanism if required to take care of marginal angular misalignment at site.
- xiii) Insulators: All outdoor type Porcelain insulators shall have a creepage distance of 25mm/kV (i.e. 300mm). The insulators shall be of outdoor post type conforming to IS 2544. All insulators shall have a rated voltage not less than 12 kV and rated current of 2000 Amps.
Post type insulators with 57 mm PCD shall only be provided. Pin type or PolyOne insulator shall not be acceptable.
The insulators shall be provided with a completely galvanized steel base designed for mounting on the support. The base and mounting arrangement shall be such that the insulator shall be rigid and self standing. Cap provided on top of the insulator shall be of high grade cast iron/malleable steel casting or aluminum alloy. It shall be machine faced and hot dip galvanized in case of first two options. The cap shall have four nos. of tapped holes with PCD same of that of insulator base. The holes shall be suitable for bolts with threads having anticorrosive protection. The effective depth of threads shall be adequate.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

The insulator shall be made of homogeneous and vitreous porcelain of high mechanical and dielectric strength. It shall have sufficient mechanical strength to sustain electrical and mechanical loading on account of wind load, short circuit stresses etc. Glazing of the porcelain shall be of uniform brown or dark brown color with a smooth surface arranged to shed away rain water. The porcelain shall be free from lamination and other flaws or imperfections that might affect the mechanical or dielectrical quality. It shall be thoroughly vitrified, tough and impervious to moisture.

The porcelain and metal parts shall be assembled in such a manner and with such material that any thermal differential expansion between the metal and porcelain through the range of temperature specified in this specification shall not loosen the parts or create undue internal stresses which may affect the mechanical or electrical strength or rigidity. The assembly shall not have excessive concentration of electrical stresses in any section or across leakage surfaces. The cement used shall not give rise to chemical reaction with metal fittings. The insulator shall be suitable for water washing by rain or artificial means in service condition.

The insulator unit shall be assembled in a suitable jig to ensure correct positioning of the top and bottom metal fittings relative to one another. The faces of the metal fittings shall be parallel and at right angle to the axis of the insulator and corresponding holes in the top and bottom metal fittings shall be in a vertical plane containing the axis of the insulator.

It shall be the sole responsibility of the supplier to carry out thorough inspection and quality checks on the insulators at the insulator supplier's works, before offering the insulators for purchaser's inspection.

Principal Technical Parameters for 11 kV Isolator

Sr. No.	Particulars	Standard
1.	Reference Standard	IS : 9921 (Part 1-4)
2.	System Voltage	
	Normal	11kV
	Highest	12kV
3.	System Frequency	50 Hz+ / - 3%
4.	System Neutral Earth	Effectively Earthed
5.	Installation	Outdoor
6.	Current	
	Normal	400 Amp
	Short Time Rating	12.5 kA rms for 3 sec.
7.	Insulation Level	
	Impulse	75 kVp
	One minute Power Frequency Voltage	28 kVrms
8.	Phase to Phase Centre Distance	1000 mm
9.	Current density at minimum cross section area at any place in current path	Maximum 1.6 A / Sq. mm
10.	Clearances	
	a. Between Adjacent Pole	850 mm
	b. Between Live Part to Earth	370 mm

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

11.	Creepage Distance for Bushing	25 mm / kV
12.	Interlock	Mechanical interlock between Main switch and earth switch.
13.	Operating mechanism	Manual
14.	Type of connection between earth blade (rotary contact) and earthing	Flexible copper contact

Type Tests :

- 1) Lightning Impulse Voltage withstand Test
- 2) Power Frequency Voltage Withstand Test Dry
- 3) Power Frequency Voltage Withstand Test Wet
- 4) Temperature Rise Test
- 5) Short Time Withstand Current and Peak Withstand Current Test
- 6) Mechanical Endurance Test

Routine Tests :

- 1) Power-frequency voltage dry tests of the main circuit
- 2) Voltage tests on control and auxiliary circuits
- 3) Measurement of the resistance of the main circuit
- 4) Mechanical operating tests.

14.0 A) 9 kV Lightning Arrestor :

The Lightning Arrestor shall be outdoor type 9 kV, 10 kA, Station class III heavy duty, gapless, metal (zinc) oxide surge arrestors complete along with clamps, complete fitting and accessories.

(i) Type Tests: The Lightning Arrestors shall be type tested and shall be subjected to routine and acceptance test in accordance with IS: 3070.

Type Tests:

1. Insulation withstand test:
 - a) Lightning Impulse Voltage Test
 - b) Power Freq. Voltage (Dry & Wet)
2. Residual Voltage Test
 - a) Step current impulse Residual Voltage Test
 - b) Lightning impulse Residual Voltage Test
 - c) Switching impulse Residual Voltage Test
3. Long duration Current Impulse withstand test
4. Operating Duty test
 - a) High Current impulse Operating Duty test
 - b) Switching surge operating duty test
5. Pressure relief test
6. Arrestor disconnect test
7. Artificial Pollution test
8. Porcelain housed arrestor
 - a) Temperature cycle test on hollow Porcelain bushing
 - b) Porosity test

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

9. Galvanizing test on exposed ferrous metal part
10. Power Frequency Voltage versus time cure
11. Power Frequency reference Voltage Test
12. Rated Voltage Test
13. Partial Discharge Test
14. Low Current Short Circuit Test
15. Seal Leak Test
16. Visual & Dimensional check

Acceptance Tests:

- 1.Measurement of Power frequency reference Voltage Test
- 2.Partial Discharge Test
- 3.Lightning impulse Residual Voltage Test
- 4.Visual and Dimensional check.

Routine Tests :

- 1.Measurement of reference Voltage Test
- 2.Partial Discharge Test
- 3.Residual Voltage Test
- 4.Visual and Dimensional check.
5. Seal Leak Test

Principal Technical Parameters of 9 kV Lightning Arrestor

Sr. No.	Description	Particulars
1.	Name of the Manufacturer and place Of manufacturing	
2.	Manufacturer's design type/model	
3.	Applicable Standard	
4.	Rated Voltage KV (rms)	9KV (rms)
5.	Rated Frequency (Hz)	50Hz +/-3%
6.	No. of Unit per arrester	one
7.	Nominal Discharge current (8/20 micro Second wave) (rms)	10kAp
8.	Maximum Continuous operating voltage KV (rms)	7.65 kV
9.	Insulation withstand voltage a) Dry power frequency b) Wet power frequency c) Impulse (1.2/50 micro second)	28 kV 28 kV 95 kVp
10.	Lightning Impulse residual voltage (8/20 micro second wave) a) 5000 A b) 10000 A c) 20000 A	27 kVp 30 kVp 35 kVp
11.	Steep current impulse Residual Voltage At 10kA of 1 micro second front time	36 kVp
12.	Switching Impulse Residual Voltage (50/100 microsecond)	24 kVp
13.	Current withstand capability a) Long duration discharge class	III

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

	b) Minimum energy discharge capability	As per IEC /IS
14.	Protective ratio	2.1
15.	High Current Impulse withstand value (4/10 microsecond)	100 kA
16.	Pressure relief class a) High Current b) Low current	40 kA rms 600 A \pm 200
17.	Maximum leakage current at MCOV (Maximum Continuous operating voltage) a) Resistive Current b) Capacitive Current	400 μ A 1500 μ A
18.	Reference Current	<5 mA
19.	Temporary over Voltage Capability a) 0.1 Second b) 1.0 Second c) 10.0 Second	15.9 kV rms 15.3 kV rms 14.7 kV rms
20.	Minimum Creepage distance	25 mm / kV
21.	Over all dimension a) Height b) Diameter	355 mm 262 mm Flange
22.	Cantilever strength	3200 N-m
23.	Mounting flange Dimensions	3 equi-spaced slots (14mm X 20mm) on 222 mm PCD
24.	Minimum Clearance a) Between Arresters b) Arresters and adjoining earthed objects	470 mm 310 mm
25.	Net weight of arrester	12 Kg. Approx.
26.	Lightning Impulse protection level	30 KVP
27.	Please confirm whether offered is type Tested as per IEC/IS	Yes
28.	Temperature Range	-5 to 50°C

B) RC surge suppressor : Suitable size one number RC surge suppressor shall be provided per bank which is suitable to mount inside the cubicle panel.

LA and Isolator shall be mounted on same structure and outgoing of Isolator shall be connected to CRCA capacitor panel incoming through suitable 11 KV HT XLPE power cable.

15.0 HRC Fuses :

Suitable indoor type 11 KV HRC fuses along with the mounting insulators etc. to provide at incoming supply of each step for protection.

16.0 11 kV Current Transformers :

- The Resin Cast assembly shall be of a single piece construction without any joint or coupling. The vertical clearance of Live part to Ground shall be at least 370 mm for 11 kV Current Transformer.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

- ii. Insulation Material used for Current Transformer should be Cycloaliphatic Epoxy Resin Cast having Insulation Class B. The insulation of the Current Transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The dielectric withstand values specified in this specification are meant for fully assembled Current Transformer. The temperature rise on any part of equipment shall not exceed the maximum temperature rise limits specified in relevant IS.
- iii. The Current Transformer shall be provided with Two separate Earthing Terminals for bolted connection to MS flat. The size of two numbers of Earthing Terminals shall be 16 mm dia. x 30 mm length, Hot Dip Galvanized with one plain washer and one nut.
- iv. The Current Transformer shall be provided with non-corrosive, legible Name plate, with the information specified in relevant standards, duly engraved / punched on it. The Current Transformer shall be provided with a rating plate with dimensions and marking as per IS – 16227. The markings shall be punched and not painted. The serial number and code of the supplier shall also be punched on the Current Transformer to identify the unit in case of loss or damage to the rating plate.
- v. Mounting details for fixing the Current Transformer on supporting structure shall be strictly in accordance with the specified details as follows: For 11kV Current Transformer requirement of Mounting Frame size is 350 mm×350 mm with mounting holes of $\varnothing 30$ mm. The Terminal connectors required for connection of the Current Transformer are in the scope of purchaser.
- vi. Primary winding shall be Wound Type. The primary winding conductor shall be high conductive (electrolytic grade) copper without any joint. Type of insulation used shall be described in the offer. For Primary Winding, current densities shall not exceed the limit 1.6 A/Sq.mm. for highest current ratio.
Enamel, if used for conductor insulation, shall be either polyvinyl acetate type or amide type and shall meet the requirements of IS – 4800. Polyester enamel shall not be used. The design density for short circuit current as well as conductivity of the metal used for primary winding shall meet the relevant requirement of IS:16227-2016.
The bidder shall, in his offer furnish detailed calculations for selection of winding cross sections. The cross section area of Primary Winding, cross section area of Secondary Winding, number of Primary Turns, number of Secondary Turns, Current Density etc. shall be mentioned by the bidder. The rating and the diagram plates should indicate the connection arrangement / diagram. The Primary Winding shall be designed for extended primary current at 120% of rated primary current.
- vii. Suitably insulated copper wire of electrolytic grade shall be used for Secondary Windings. Type of insulations used shall be described in the offer. For multi-ratio design, the multi-ratio shall be achieved by reconnection of the Secondary Windings. The cross section area of Secondary Winding, number of Secondary Turns, Current Density etc. shall be mentioned by the bidder.
The excitation current of the CT shall be as low as possible. The bidder shall furnish, along with his offer, the magnetizing curves for all the cores.
- viii. Each Primary Terminal shall be made out of 1 rod (stud) of 30 mm dia. x 80 mm length. The primary Terminal shall be of heavily tinned electrolytic copper of 99.9% conductivity. The minimum thickness of tinning shall be 15 microns. C.T.
- ix. Secondary Terminals shall be brought out in a weatherproof metallic Terminal box. The Terminal box shall be provided with removable gland and glands. The cable glands shall be

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

suitable for 1100 volts grade plate PVC insulated, PVC sheathed multi core stranded 6 Sq.mm copper conductor cable. This Terminal box shall be dust and vermin proof. The dimensions of the Terminal box and its opening shall be adequate to enable easy access and working space with the use of normal tools.

Secondary Terminal studs shall be provided with at least 3 nuts and adequate plain and spring washer for fixing the leads. The studs, nuts and washer shall be made of brass duly nickel-plated. The minimum outside diameter of stud shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. Horizontal spacing between centers of adjacent studs shall be at least 1.5 times the circum dia. of the nuts. The Current Transformer shall be provided with CT ratio changing facility on secondary side only.

Current Transformer characteristic shall be such as to provide satisfactory performance for burdens ranging from 25 % to 100% of rated burden over a range of 5 % to 120% of rated current in case of metering CTs and up to accuracy limit factor / knee point voltage in case of protection CTs.

Polarity shall be invariably marked in each Primary and Secondary terminal. Facility shall be provided for short circuiting and grounding of the CT secondary terminals inside the terminal box.

The Instrument Security Factor of metering core shall be less than 5. This shall be demonstrated on all the ratios of metering core in accordance with procedure specified in IEC-185 or IS: 16227-2016.

The C.T. shall be Outdoor Cycloaliphatic Epoxy Resin Cast and shall be so constructed that it can be easily transported to site within the allowable transport limitation. CT shall be provided with lifting lugs suitably located for easy mounting, dismantling & transportation purpose. Current Transformers shall be provided with suitable lifting arrangement, to lift the entire unit. The lifting arrangement shall be positioned in such a way as to avoid any damage.

Type Test :

- 1) Temperature Rise Test
- 2) Impulse Voltage Withstand Test on Primary Terminals
- 3) Wet Test for outdoor Type Transformers
- 4) Tests for accuracy
- 5) Short Time Current Test
- 6) Electromagnetic Compatibility Test

Routine test :

- 1) Power frequency voltage Withstand Test on Primary Terminals
- 2) Partial discharge measurement
- 3) Power frequency voltage Withstand Test between sections
- 4) Power frequency voltage Withstand Test on secondary Terminals
- 5) Tests for accuracy
- 6) Verification of marking
- 7) Determination of the secondary winding resistance
- 8) Determination of the secondary winding loop time constant
- 9) Test for rated knee point e.m.f. and exciting current at rated knee point e.m.f.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

10) Inter turn over voltage test

Principal Technical Parameters of 11kV Current Transformer

Sr. No.	Particulars	Specification
1.	11kV Current Transformer /Installation	Single Phase, Outdoor, Cycloaliphatic Epoxy Resin Cast Dry Type
2.	Highest System Voltage (kV rms)	12
	Rated Voltage (kV)	11
3.	Rated Primary Current (Amp)	200 or 400
	Rated Secondary Current (Amp)	5
4.	Lightning Impulse Withstand Voltage (kVp)	75
5.	One minute dry/wet power frequency withstand voltage primary (kV rms)	28
6.	Rated Short Time Withstand Current for 3 Second duration (kA rms)	25
7.	Rated Dynamic Withstand Current for 1 second duration (kAp)	62.5
8.	Rated Dynamic Withstand Current for 1 second duration (kAp)	62.5
9.	Minimum Creepage Distance	300
10.	Power Frequency Over Voltage Withstand requirement for Secondary winding (kVrms)	3 kV
11.	Instrument Security Factor	5 or less for Metering Core
12.	The die-electric withstand values of External & Internal Insulation	70 kV/170 kVp
13.	Type of mounting	Pedestal Type
14.	Suitable for Frequency	50 Hz plus or minus 1.5 %
15.	Method of Earthing the system to be connected	Solidly Effectively Earthed
16.	Rated Continuous Thermal Current (A)	120% of the rated Primary current
17.	Acceptable limit of temperature rise above the specified ambient temperatures for continuous operation at rated current	As per IS: 16227 (Part-I) 2016
18.	Acceptable Partial Discharge level at 1.1 times rated voltage	N.A.
19.	Max. Radio Interference Voltage at 1.1 times rated voltage	Less than 500 micro volts

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

20.	Core Details	
	i. Purpose of Core	Core I for Metering & Core II – for Protection
	ii. CT Ratio	400-200/5-5A
	iii.VA Burden	15/15
	iv.Class of Accuracy	0.5 /5P10
	v. Minimum Knee Point Voltage at lowest ratio	15x(Rct+19)for Protection Core only
	vi.Maximum magnetizing Current at guarantee knee point	100 mA for protection core only

17.0 Control & Protection Equipments:

A) Constructional details:

Capacitor bank should be provided with a separate indoor type Control & Relay panel with ACU. It shall be painted white on the interior and Dark Admiral Grey to shade No.632 of IS-5 on the exterior surface.

Control and relay panel detailed in this section is required for indoor installation for controlling switching ON & OFF operations of the 11 kV Capacitor bank.

Panel shall be made of rigid welded structural frames enclosed completely with smooth finished sheet steel of thickness not less than 2 mm. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transport and installation. Panel shall be completely metal enclosed and shall provide a minimum degree of protection to IP 34 in accordance with IS: 13947.

The doors shall be provided with 3-point locks operated by suitable handle. Bottom plates of the panels shall be fitted with removable brass cable glands to allow cable entries from the bottom.

Terminal Connectors and Test terminal blocks for cables shall be fixed at an elevated height of at least 100 mm above the bottom plate. Adequate quantity of cable glands of suitable size shall be provided.

Design, materials selection and workmanship shall be such as to result in a neat appearance both inside and outside, with no welds, rivets or bolt heads apparent from outside. Steel sheets shall be suitably treated to achieve neat appearance and long life.

Each panel shall be provided with cubicle illumination lamp in shrouded holder, controlled by door operated switch. Space heater of 80 W rating along with control switch shall be provided inside each panel. Cubicle lamp and space heater shall be suitable to work on 250 V AC supply. In each panel, one 3-pin 10 Amp industrial type power plug along with control switch shall be provided for extending 250 V AC supply.

Each panel shall be provided with one earth bus of size 25x3mm (minimum). The earth bus shall be of tinned/nickel plated copper. All metallic cases of relays, meters, instruments etc. shall be connected to this bus independently for their effective earthing.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

Other details of Control and relay panel shall be as per Annexure II 'H' of Guaranteed Technical Parameters attached.

B) Protective Relays:

For the capacitor bank, one non-directional IDMTL triple pole relay having O/C elements on R, Y and B poles and E/F element with IEC 60255 amended upto date with communication protocol as per IEC 61850 shall be provided. All these relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protection elements with standard inverse characteristics (1.3 and 3 Sec) IDMT, the O/C elements having current setting variable from 20% to 200% (in step of 1%) of CT rated secondary ratings, and the E/F elements having current setting variable from 5% to 80% of the CT rated secondary current.

Numerical type IDMTL O/C & E/F relays.

Numerical type over voltage and under voltage relays shall be provided with adjustable timer.

Numerical type Neutral Unbalance Voltage Relay with adjustable time setting shall also be provided.

Trip circuit supervision relay shall be provided for circuit breaker. Trip circuit supervision scheme shall be such that testing of trip circuit healthiness is possible irrespective of whether the C. B. is in the closed or open position. The Trip Circuit Healthy lamp should glow continuously in CB 'ON' Position and on demand in C.B. 'OFF' position. The rating of dropping resistance in series with Trip Circuit Healthy lamp shall be such that the Trip Coil should not get damaged because of continuous current flowing through it.

Separate auxiliary relay shall be provided for alarm & tripping circuits.

High speed Trip relay for tripping shall be provided.

Lead power factor relay which should be microprocessor based intelligent auto control unit and user friendly setting. Whenever LV loads are running at leading PF, the Meter (relay) shall give alarm and as well as trip command to breaker so that bank cannot be permitted to switch on. At lead PF the bank should be off / cut off through relay.

In case Static/Numerical/microprocessor based relays are offered these shall be suitable for the station auxiliary supply (30V D.C.) and shall have facility of a test push button to test the relay functioning.

All other relays shall be suitable for flush mounting, with only the flanges projecting on the front and connections at the back. Relays shall have dust-tight covers removable from the front. Protective relays shall have built-in test terminals.

The relays shall be mounted on the control and relay panel. The relay should be as per DIN Standard and suitable for panel mounting. The relay should be supplied ready to mount with the necessary terminal block provided on the relay. Connecting terminals should be suitable to take 2.5sq. mm cable. The entire electronic component used should have high reliability and should be of defense/industrial grade conforming to latest IS.

C) Wiring and control wiring terminals:-

All wiring shall be carried out with 1100 volts grade single core, multi strand, flexible tinned copper wires with PVC insulation. The conductor size shall 2.5 sq mm (minimum) for circuits. Wiring trough may be used for routing the cables. Wire numberings and color code for wiring shall be as per IS: 5578 & IS: 11353. The wiring diagram for various schematics shall be made on thick and durable white paper in permanent black ink and same should be encased in plastic cover, thermally sealed. It should be kept visibly in a pocket of size 350 x 400 mm of MS sheet of 1 mm thickness, on the interior surface of the door of C & R Panel.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

Terminal blocks shall be of clip-on design made out of non-crackable insulating material of 1100 V grade. All terminals shall be stud type, with all current carrying and live parts made of tinned/nickel plated brass. The studs shall be of min 4 mm dia. brass. The washers, nuts, etc. used for terminal connectors shall also be of tinned/nickel plated brass.

The terminal connector/blocks shall be similar to ELMEX type CAT-44. Non-disconnecting type terminal connectors with automatic shorting of C.T. secondary terminals shall be provided in CT secondary circuit. All other terminal connectors shall be disconnecting type. At least 20% spare terminals shall be provided. All terminals shall be provided with ferrules indelibly marked or numbered and identification shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity which shall not be less than 10 Amps.

All front mounted as well as internally mounted items shall be provided with individual identification labels. Labels shall be mounted directly below the respective equipment and shall clearly indicate the equipment designation. Labeling shall be on aluminum anodized plates of 1 mm thickness, letters are to be properly engraved.

All fuses used shall be of HRC type. The fuse base and carrier shall be plug-in type molded case kit Kat of Bakelite/DMC. All current carrying and live parts shall be of tinned/ nickel plated copper. No fuse shall be provided on DC negatives and AC neutrals. Tinned copper links shall, however, be provided on DC negatives and AC neutrals.

Test terminal blocks used in metering circuit shall be suitable for 3 phase 8 wire type connections (2 watt meter method) with 3 no LEDs glowing on face plate to indicate 3 phase potential available to the energy meter.

Control and relay panel shall be provided with Relays, ammeter, KV meter, MVar meter, Power factor meter, Annunciator & other accessories as mentioned bellow. Indoor type Control and relay panel shall have remote control of the shunt Capacitor bank. Following main components shall be provided on C & R panel.

Sr. No.	Particulars	Qty.
Protective Relays		
1.	3 O/C + 1 E/F IDMT protection relay	1no.
2.	Unbalanced protection relay	1no.
3.	Over Voltage protection relay	1no.
4.	Under Voltage protection relay	1no.
5.	Trip circuit supervision relay	1no.
6.	High speed trip relay	1no.
7.	Static type time delay relay	1no.
8.	Power factor meter(Relay) with lead alarm contact	1 no.
Measuring Instruments		
9.	96 X 96 mm Digital Ammeter with 4 position selector switch.	1no
10.	96 X 96 mm Digital KV meter with 7 position selector switch	1no
11.	Digital MVar meter	1no
12.	12 window static Annunciator	1no
Other accessories		
13.	LED type indicating lamps for CB ON, CB OFF, Spring Charge, Trip ckt. Healthy, Auto trip, D. C. Supply Healthy,	6nos
14.	Mimic Diagram	
15.	Push Buttons for Accept, Reset, Lamp test, & Sound cancel	4nos

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

16.	Semaphore indicator 1no.for circuit breaker & 2nos. for Isolators.	
17.	Breaker control switch spring return to neutral. Trip-neutral-close	1 no.
18.	Hooter	1no.
19.	Panel Heater	1no
20.	Panel illumination Lamp with door switch	1set
21.	Power Plug point	1no

Specification of 3 over current & 1 EF relay

Type	Numerical
Elements	3 over current + 1 Earth fault relay
CT sec input	5A
Operational characteristics selectable	IDMT 3 sec IDMT 1.3 sec Very inverse Extremely inverse Definite time
Aux Supply	30V DC
Setting for OC	20% to 200% in step of 1%
Setting for EF	5% to 80% in step of 5%
Time multiplier setting	0.05 to 1.5% in step of 0.01%
Memory storage for fault information	Storing of latest 5 fault with date and time stamping, fault amplitude & type of fault
Contacts	2 NO contacts for Alarm and Trip, Should carry 5A at 660VDC
Communication Port	RS 232 / RS485 Port.
IS Reference	IS 3231

Specification of Under and over voltage relay

Type	Numerical
Elements	1
PT sec input	110V AC
Operational characteristics selectable	Definite time
Aux Supply	30V DC
Setting for OV	105% to 135% in step of 5%
Setting for UV	45% to 90% in step of 5%
Contacts	Contact for alarm of UV,OV, and Trip
Contact rating	Should carry 5A at 660VDC
IS Reference	IS 3231

Specification of NDR voltage Operated relay

Type	Numerical
Element	1

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

RVT sec input	110V AC
Operational characteristics selectable	Definite time
No of Stage	2 Stage
Aux Supply	30V DC
Setting for Alarm	5% to 40%% in step of 5%
Setting for Tripping	5% to 40%% in step of 5%
Contacts	Contact for alarm stage and trip stage
Contact rating	Should carry 5A at 660VDC
IS Reference	IS 3231

18.0 Support structure, equipment frame etc.

Equipment frame, support structure, angles, channels etc. meant for the outdoor switch gear and other equipment viz. CTs, PTs, Isolators etc. shall all be hot dip galvanized. All the ferrous metal parts shall be hot dip galvanized smoothly as per IS 3638(as amended up to date), IS or any other equivalent authoritative standard. The material shall be galvanized only after shop operations upon it have been completed. The metal parts before galvanization should be thoroughly cleaned of any paint, grease, rust, scales or alkalis or any foreign deposits which are likely to come in the way of galvanization process. The metal parts coating shall withstand minimum four one minute dips in copper sulphate solution as per IEC-168. Fasteners (nut-bolts) shall be of non-magnetic stainless steel. No spring washer shall be used, instead one check nut of suitable size shall be provided with each bolt.

Support structure shall be supplied for each of the outdoor equipment and shall be suitable to maintain the clearances and spacing stipulated for various equipment. Current transformers and potential transformers may be mounted on the same structure as that of the circuit breaker, provided the requisite electrical and mechanical clearances are properly maintained. Typical bay arrangements indicating sectional clearances are shown in the enclosed drawings.

The main structure shall be fabricated out of hot dip galvanized angle of minimum 75x75x6 mm or equivalent strength.

Successful bidders shall clearly indicate on the relevant G.A. drawings the total dead weight coming on each support structure. Impact load, if any, shall also be stated on relevant drawing. These details are required for designing suitable foundations for the support structure for CBs, Isolators, etc.

19.0 Equipment terminal connectors(HV) :

Bidders shall include in their scope suitable connectors for each outdoor equipment. In the case of equipment with copper terminals, the terminal connectors shall be made of electrolytic grade copper, and shall be suitable for crimping type connection. Material required for inter connection between various bay equipment in between the two isolators of each bay shall be included in the bidder's scope of supply. Details of the inter connector and the material used for the terminals/jumpers shall be furnished in the offer. In order to fix the jumper length, size etc. standard layout drawing is enclosed. Successful bidder shall have to adopt Board's standard foundation plan.

Take-off terminals of both the isolators of each bay and for Cu-Al bimetallic connections shall be of electrolytic grade aluminum and suitable for crimping ACSR jumper along with suitable bimetallic plate of minimum 2 mm thickness. These connectors shall be suitable for 200 sq. mm. ACSR conductors for incomer and 50mm.sq / 80mm.sq. ACSR conductor for outgoing feeder. All nut-

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

bolts used in the connectors shall be of non-magnetic stainless steel. In place of spring washers, check nut of suitable size shall be provided.

20.0 11 kV Nominal Voltage HT XLPE Power Cables :

The specification covers design, manufacture, shop testing, packing and delivery of 11 kV, 3C x 70 Sq.mm. & 3C x 185 Sq.mm. multi core, cross linked polyethylene insulated power cables by road/rail to the designated Store Centers in the State of Maharashtra. These cables shall be suitable for the 3 phase AC-50 Hz system with the nominal voltage of 11kV which may reach maximum of 12kV. These cables shall primarily be designed for effectively earthed neutral system.

6.35/11 kV earthed, multi core power cables shall normally be with stranded compacted H2/H4 grade aluminum conductor as per IS: 8130 – 1984, provided with conductor screening (of extruded semi-conducting cross link material) and shall be insulated with XLPE of natural color. Identification of cores shall be by color, as per provision of clause 13.1 of IS: 7098 (Part 2) – 1985. The insulation (XLPE) screening shall be provided consisting of extruded semi-conducting cross link material in combination with a metallic layer of copper tapes. Three such screened cores shall be laid up together with fillers and/or binder tapes where necessary and provided with extruded inner sheathing of heat resistant PVC conforming to type ST-2 of IS: 5831 – 1984.

Maximum continuous operating temperature shall be 90 deg C under normal operation and 250 deg C under short circuit condition

Armoring shall be provided consisting of single galvanized round steel wires (In case of Single core cable armoring shall be of Non-magnetic material) conforming to IS: 3975 – 1988 (amended upto date) and over the armoring a tough outer sheath of PVC compound shall be extruded. The PVC compound for the outer sheath shall conform to type ST-2 of IS: 5831 – 1984 (amended up to date). The color of the outer sheath shall be black. The cable shall be manufactured strictly conforming to IS:7098 (Part 2) – 1985 amended upto date and shall bear ISI mark.

Non erasable Sequential Marking of length shall be provided by embossing on outer sheath of the cable for each meter length.

The quality of insulation should be good and insulation should not be deteriorated when exposed to the climatic conditions.

Inner conductor shielding, XLPE insulation and outer core shielding shall be extruded in one operation by special process (viz. Triple Extrusion Process) to ensure that the insulation is free from contamination and voids and perfect bonding of inner and outer shielding with insulation is achieved. The bidders are requested to elaborate the manufacturing technique adopted by their manufacturers to achieve this motive.

Continuous A.C. current capacity shall be as below :

Sr. No.	Conductor sizes in sq.mm.	Continuous A.C. current capacity in Amps. At maximum conductor temp. of 90 deg.c.	
		When laid direct in the ground 30 deg. C	When laid in air 40 deg. C.
1.	70 sq.mm	160	165
2.	185 sq mm	270	310

Short circuit current of 11 kV XLPE cable shall be as below :

Sr. No.	Conductor sizes in sq.mm.	Duration of Short Circuit in Sec.	Short circuit current in kA
1.	70 sq.mm	1	6.58
2.	185 sq mm	1	17.39

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

21.0 Earthing :

Metal tanks of the instrument transformers and all other equipment, C & R panels, mechanism boxes, structures etc. shall be provided with two separate earthing terminals of size 16 mm dia. X 30 mm length H.D.G., with one plane washer and one nut, for connection to station earth-mat.

22.0 Lifting arrangement :

Circuit Breaker, Current transformers, Capacitor Cubicle, RVT, Control and relay panel etc. equipment shall be provided with suitable lifting arrangement to lift the entire unit. Lifting arrangement (lifting eye) shall be positioned in such a way so as to avoid any damage to the porcelain housing, primary terminals or the tanks during the process of lifting for installation/transport. The general arrangement drawing shall show clearly the lifting arrangements provided such as lifting eye, guide etc.

23.0 Painting :

All sheet metal parts (panel, mechanism box, metal housing, etc.) for indoor installation shall be designed and fabricated with special care to avoid rust/fungus formation and corrosion. All metal parts shall preferably be hot dip galvanized. If this is not possible due to practical difficulties, cold galvanizing or epoxy coating shall be provided for all sheet metal parts, used for indoor installation. Sheet steel shall be treated as per the 7 tank process. In case tank process for treating the sheet metal is not possible, alternate process adopted shall be clearly explained in the technical offer which shall be got approved by the MSEDCL. Dark Admiralty Grey shade as per color shade no: 632 of IS-5 shall be used for epoxy coating.

The sheet metal works, after final painting shall present an esthetically pleasing appearance, free of any dent or uneven surface.

24.0 Labels :

All front mounted as well as externally mounted items including fuses shall be provided with individual identification labels. Labels shall be mounted directly below the respective equipment and shall clearly indicate the equipment designation. Labeling shall be on aluminum anodized plates of 1 mm thickness. The letters are to be properly engraved.

All front mounted as well as internally mounted items including fuses shall be provided with individual identification labels. Labels shall be mounted directly below the respective equipment and shall clearly indicate the equipment designation.

All the equipment and their parts shall be provided with suitable labels for identification and ease of operation and maintenance.

25.0 Tests :

Type tests:

The equipment offered in the Bid should have been successfully type tested at NABL laboratories for the tests indicated in the enclosed Annexure II in line with the relevant standard and technical specification, within the last 5 (five) years from the date of offer. The bidder shall be required to submit complete set of the type test reports along with the offer.

In case these type tests are conducted earlier than five years, all the type tests as per the relevant standard shall be carried out by the successful bidder at NABL in presence of purchaser's

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

representative free of cost before commencement of supply. The undertaking to this effect should be furnished along with the offer without which the offer shall be liable for rejection.

If above tests are carried out on higher capacity of offered equipment, then the offer is considered for placement of order. However, successful bidders have to carry out the said type tests on offered type equipment before commencement of supply at their own expense.

Acceptance & Routine Tests:

All acceptance and routine tests as stipulated in the respective applicable standards amended up-to-date for all the equipment shall be carried out by the supplier in the presence of purchaser's representative without any extra cost to the purchaser before dispatch.

The bidder shall have full facilities to carry out all the acceptance and routine test as per the applicable standards.

After finalization of the program of type/acceptance/routine testing, the supplier shall give three weeks advance intimation to the purchaser, to enable him to depute his representatives for witnessing the tests.

26.0 Inspection :

The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative/s at a reasonable notice when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

The supplier shall keep the purchaser informed, in advance, about the manufacturing programme so that arrangement can be made from stage inspection.

The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. The supplier shall keep the purchaser informed, in advance, about such testing program.

Final Inspection :

C.E. (MMC) will depute his representative at the time of final inspection along with Testing Engineer.

27.0 Quality Assurance Plan:

The bidder shall invariably furnish following information along with his offer, failing which, his offer shall be liable for rejection. Information shall be separately given for individual type and voltage rating of equipment:

Statement giving information about names of sub-suppliers, list of testing standards, list of tests normally carried out in presence of bidder's representative and copies of test certificates in respect of following items of raw materials.

- a) Copper
- b) Interrupter
- c) Porcelain Hollow support insulator

Information and copies of test certificate as in (i) above in respect of bought out accessories.

List of areas in manufacturing process, where stage inspection are normally carried out by the bidder for quality control and details of such tests and inspections.

Special features provided in the equipment to make it maintenance free.

List of testing equipment available with the bidder for final testing of breakers, Capacitor Cubicle, RVT, Capacitor Unit, Vacuum contractor switches, Automatic control unit, Isolator, Current transformer, series reactor etc I the type, special, acceptance and routine tests specified herein. The

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

limitations in testing facilities shall be very clearly brought out in Schedule-G i.e. schedule of deviation from specified test requirements.

The successful bidder shall, within 30 days of placement of Letter of Award, submit following information to the Chief Engineer (MMC) of the purchaser.

List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with the offer.

Type test certificates of the raw material and bought out accessories.

Quality assurance plan (QAP) with Customers hold points (CHP) for purchaser's inspection. The quality assurance plan and purchaser's hold points shall be discussed between the purchaser and supplier, before it is finalized.

The successful bidder shall submit the routine test certificates of bought out accessories at the time of routine testing of the fully assembled Automatic Power Factor Controller for the goods manufactured within purchaser's country. The supplier shall also submit the necessary documentary proof of source for the raw material used in manufacture of the offered goods, at the time of routine testing of the fully assembled breaker.

28.0 Performance Guarantee :

All equipment supplied against this specification shall be guaranteed for a period of 66 months from the date of receipt at the consignee's Stores Centre or 60 months from the date of commissioning, whichever is earlier. However, any engineering error, omission, wrong provision, etc. which do not have any effect on the time period, shall be attended to as and when observed/pointed out without any price implication.

29.0 Documentation :

After issue of letter of acceptance, the successful bidders shall submit 3 identical sets of complete drawings along with detailed bill of materials for approval, to the Chief Engineer, MMC, 1st floor, Prakashgad, MSEDCL, Bandra(E), Mumbai - 400 051. If any modifications are required on these, the same will be conveyed to the supplier who shall modify the drawings accordingly and furnish final drawings for approval. In no case delivery extension will be granted for any delay in drawing approved.

The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation will be permitted without the written approval of the MMC department. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the supplier's risk.

After approval of the drawings and bills of materials, the suppliers shall submit detailed packing lists for approval. After approval, copies of these packing lists shall be forwarded to the respective consignees. Copies of packing lists shall also be submitted to the Chief Accounts Officer (SB), MSEDCL, Prakashgad, Bandra(East) along with the bills for payment.

Before dispatch of equipment to various consignees, the suppliers shall furnish sets of final drawings, including bills of materials and wiring schedules and also sets of technical literature and commissioning manuals. These shall be in Five sets and shall be furnished to the MMC department, Bandra(E) positively before the dispatch of equipment. All drawings shall preferably be of A3 size. No drawing of width more than 35 cm will be acceptable. One set each of the final drawings; bill of materials, wiring schedules and commissioning manuals shall invariably be forwarded to the consignee along with the each Automatic Power Factor Controller consignment and shall be listed out in the packing list, when submitted for approval.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

In case the supplier fails to furnish contractual drawings and manuals even at the time of supply of equipment, the date of furnishing of drawings/manuals will be considered as the date of supply of equipment for the purpose of computing penalties for late delivery.

List of drawings to be submitted along with the offer are as under:

- (i) General arrangement drawing for bay.
- (ii) General arrangement drawing for circuit breaker.
- (iii) General arrangement drawing for Isolator (a) with and (b) without earth blade.
- (iv) General arrangement drawing of current transformer.
- (v) General arrangement drawing for control and relay panels
- (vi) Bill of material for complete Automatic Power Factor Controller and associated equipment, Vacuum Circuit Breaker, Capacitor Cubicle, Automatic Control Unit, Control and Relay Panel, RVT, CTs, Isolators, Terminal connectors etc. (Annexure II & III)
- (vii) Successful bidder shall furnish all above drawings and following additional drawings for approval.
- (viii) Support structure for Capacitor Cubicle, RVT, Vacuum circuit breaker, Isolator and CT .
- (ix) Common Foundation Plan and design details/data of foundations for incomer & outgoing section.
- (x) Detailed drawing for T-Connector, terminal connector and other connector.
- (xi) Schematic diagram of power control & protection circuit for incoming and outgoing feeder.
- (xii) Schematic diagram and sequence diagram of circuit breaker.
- (xiii) Schematic diagram of Capacitor Cubicle.
- (xiv) Detailed drawings for every equipment showing Assembly, important cross sections, drawings of relevant parts, joints, gaskets, name plates and other informative drawings etc.

The drawings, technical literature and manuals submitted by the bidder along with his offer shall be treated as purely and generally informative in nature and unless the details incorporated in them are clearly and specifically brought out in the various Schedules for Guaranteed Technical Particulars and Schedules of Deviations, the same shall not be binding upon the purchaser (a) for evaluation of the offer and (b) for the order, if placed.

30.0 Packing and Forwarding :

The equipment shall be packed in crates suitable for vertical/horizontal transport as the case may be and the packing shall be suitable to withstand handling during the transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following information:

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

- (a) Name of the consignee.
- (b) Details of consignment.
- (c) Destination.
- (d) Total weight of consignment.
- (e) Sign showing upper/lower side of the crate.
- (f) Handling and unpacking instructions.
- (g) Bill of material indicating contents of each package.

All the equipment covered in this specification shall be delivered to the various stores centers of the MSEDCL as will be intimated to the successful bidders. The equipment shall be delivered to these stores centers only by road transport and shall be suitably packed to avoid damages during transit in the case of indigenous supplies.

The bidders shall quote delivery periods for various equipment and shall stick to the committed delivery. The delivery period will be counted from the date of receipt of letter of award of the contract. It may clearly be noted that the delivery period will under no circumstances be linked up with other formalities like drawing approval, etc. It is therefore, the responsibility of the successful bidder to submit the drawings, bill of materials, packing lists, etc. in time and get these approved by the Distribution department of the MSEDCL.

31.0 Training:

All successful bidders for Automatic Power Factor Controller and associated equipment shall provide training facilities for the MSEDCL's engineers. The training shall be for not less than 8 man weeks. Syllabus and other details of the training shall be finalized in consultation with the MSEDCL. Boarding, lodging and traveling expenses for the deputed trainees will be borne by the MSEDCL. Charges for training shall be quoted in the offer separately. These will not be considered for evaluation of the offer.

32.0 Schedules:

The bidder shall fill-in the following schedules which is part and parcel of the tender specification and offer. If the schedules are not submitted duly filled-in with the offer, the offer shall be liable for rejection.

Schedule 'A' ... Guaranteed and technical particulars.

Schedule 'B' ... List of Unit Priced items.

Schedule 'C' ... List of Type Test Reports to be enclosed with the offer

Schedule 'D' ... Schedule of deviations from specification.

Schedule 'E' ... Schedule of bidder's experience.

Schedule 'F' ... Schedule of deviation from specified standards.

Schedule 'G' ... Deviation from specified test requirements.

Schedule 'H' ... Proforma for undertaking.

All the parameters to be filled in schedule 'A', 'B' and 'C' should be clearly mentioned. Leaving blanks or stating "As per IS", "As per drawing", "As per information elsewhere" etc. is not acceptable. Such offers are liable for rejection. All deviations from the specification shall be brought out in the schedules of deviation (Schedules 'D', 'F' & 'G'). Unless otherwise brought out specifically by the

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

bidder in the schedule of deviations (Schedules 'D', 'F' & 'G'), the items offered shall be deemed to conform to all clauses of the specification. The discrepancies, if any, between the specification and the catalogues or literature submitted as part of the offer by the bidder shall not be considered as valid deviations and no representations in this regard will be entertained unless these are specifically brought out in the schedule of deviations as stated above.

Any additional information other than those called for as per the above schedules may be furnished separately by the bidder, if felt necessary by him.

33.0 Annexure :

- Annexure –I –‘A’ ... Principal Technical Parameters of Capacitor Bank
- Annexure –I –‘B’ ... Principal Technical Parameters of Series Reactor
- Annexure –I –‘C’ ... Principal Technical Parameters of Residual Voltage Transformer
- Annexure –I –‘D’ ... Principal Technical Parameters of Vacuum Contactor
- Annexure –I –‘E’ ... Principal Technical Parameters of Outdoor APFC CRCA Cubicle
- Annexure –I –‘F’ ... Principal Technical Parameters of Vacuum Circuit breaker
- Annexure –I –‘G’ ... Principal requirements of protective relays, metering equipment, auxiliary relays, breaker control switches
- Annexure –I –‘H’ ... Principal Technical Parameters for Isolator
- Annexure –I –‘I’ ... Principal Technical Parameters of 11 kV CTs
- Annexure –I –‘J’ ... Principal Technical Parameters of 9 KV, 10 KA, Station class III Lightning Arrestor
- Annexure –I –‘K’ ... Specification of 3 over current & 1 EF relay.
- Annexure –I –‘L’ ... Specification of Under and over voltage relay.
- Annexure –I –‘M’ ... Specification of NDR voltage Operated relay.
- Annexure – II ... Type Test reports

34.0 Information to be filled / furnished invariably by Bidder:

The offer shall be complete in all respects, failing which the same are liable for rejection. In the bill of materials for each items, the bidder shall state the type designation and make of each item / equipment. Unit prices of all items and sub-components shall be quoted. The list of items for which unit prices are quoted shall be submitted along with the technical offer. Guaranteed technical particulars for various equipment shall be elaborate and complete in all respects. It may be noted that the technical evaluation of the tender is made mainly based on the guaranteed technical particulars and deviations from the specifications furnished along with the technical offer. Technical offer shall be submitted in triplicate, and each set shall include all the necessary particulars including the technical literature on various equipment. All sets of offer documents shall invariably be identical in all respects.

35.0 Guaranteed Technical Particulars :

The bidder should fill up the details in schedule A – ‘Guaranteed Technical Particulars’ and the statement such as “as per drawing enclosed”, “as per MSEDCL requirement”, “as per IS”, “as per specification” etc. shall be considered as details not furnished and such offers will be rejected.

36.0 Qualifying Requirement :

- i) The bidder should have proven experience of not less than 5 years in Design, Manufacture, supply and Testing at work for equipment / materials offered for equal or higher voltage class.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

The equipment/ material offered by bidder should be in the successful operation, at least for two years as on the date of submission of the tender.

- ii) The bidder should have adequate in house testing facilities for conducting acceptance tests in accordance with relevant IS.
- iii) Bidder should have a minimum turnover of 60% of the value of the material offered in any one financial year during the previous 3 years. However, being commercial aspect, MM Cell is requested to verify this point.
- iv) The bidder should furnish all the relevant documentary evidence to establish the fulfillment of the above requirement.
- v) The bidders not meeting the requirement at clause No. 36 (i) can also participate, provided they have valid ongoing collaboration with a manufacturer who has at least 10 years experience in the Design, manufacture and testing of the equipment of the type and class offered which have been in satisfactory service for a period of at least seven years. In such an event the bidder shall furnish along with the bid the documentary evidence for the same and undertaking from the bidder and collaboration accepting joint and several liability for all obligations under the contract.
- vi) The bidder who does not meet the above Qualifying requirement of experience (Clause No. 36 (i)) may be considered for a Trial Order subject to fulfilling the following requirements along with Clause Nos. 36 (ii) to 36 (iv).
 - i) The bidder should have type tested the equipment offered as per requirement of Clause No. 25.0
 - ii) The Bidder shall have the basic infrastructure for the design, manufacture and supply of the items offered, like machinery, technical know-how, capacity etc.
 - iii) The purchase is satisfied with the designing, manufacturing, supplying and financial capacity of the bidder after inspecting the supplier's works.
 - iv) Notwithstanding anything stated above, the purchaser's decision in this regard will be final.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

SCHEDULE 'A'
Guaranteed Technical Particulars

Sr. No.	Particulars	Offered
Capacitor Bank		
1.	Make of Capacitor Bank	
2.	Nominal System Voltage	
3.	Maximum Operational Voltage	
4.	Frequency	
5.	Rating of APFC Capacitor bank	
6.	Step Configuration	
7.	No. of Banks	
8.	Capacitor sub Bank Rating	
	Step	
	Unit	
9.	Rated Voltage, kV	
10.	Rated output, kVAr	
11.	Rated Current. Amps.	
12.	No. of Phases	
13.	Insulation Level (KV rms / KV peak)	
14.	No. of Banks/units	
	Banking Details	
15.	Type of Bank	
16.	Connection	
17.	Terminal Arrangement	
18.	Series group per phase	
19.	No. of unit in parallel per series group per phase	
20.	Bus Bar Material	
21.	Overall Dimensions	
	Unit Details	
22.	Dielectric and Impregnant	
23.	No. of Bushings	
24.	Discharge device to discharge to 75 Volts in less than 600 Sec after disconnection	
25.	Unit Protection	
26.	Allowable Overloads	
27.	Losses	
28.	Finish	
29.	Dimensions	
Series Reactor		
30.	Reference standard	
31.	Type of Reactor	
32.	Rated Voltage & Frequency	
33.	No. of phase	
34.	Capacitor Step-Bank rating	
35.	Per phase reactance, Ohms	
36.	Per phase voltage drop, volts	

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

37.	Rated output, KVAR	
38.	Rated current, Amp	
39.	Max. continuous current	
40.	Temperature rise	
41.	Basic insulation Level	
42.	Terminal arrangement	
43.	Accessories for Reactors	
44.	Testing	
45.	Class of insulation	
46.	Rated short time symmetrical RMS Current	
47.	Winding materials	
48.	Type of Installation	
Residual Voltage Transformer		
49.	Reference Standard	
50.	Type	
51.	Rated primary voltage	
52.	Frequency	
53.	No. of secondary windings	
54.	Ratio	
55.	Rated burden per phase & Accuracy class	
56.	Metering Winding (Star)	
57.	Protection Winding (Open Delta)	
58.	Method of connection	
59.	Insulation Level One minute power frequency withstand voltage Impulse withstand voltage (1.2/50 micro sec. wave, crest)	
60.	Voltage Factor	
61.	Terminal arrangement	
	HV side	
	LV side	
62.	Energy discharge Capability in kW	
11 kV Vacuum Contactor		
63.	Applicable standard	
64.	Type & Make	
65.	Number of poles, nos. of break/pole	
66.	Model	
67.	Maximum Capacity	
68.	Rated Voltage	
69.	Rated maximum voltage	
70.	Rated normal current	
71.	Rated single capacitor banks current	
72.	Frequency	
73.	Rated short time current for one sec	

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

74.	Rated short circuit making current	
75.	Impulse with stand voltage (1.2/50 micro sec. wave, crest)	
76.	One minute power frequency withstand voltage	
77.	One minute power frequency withstand voltage on auxiliary circuit earth	
78.	Mechanical endurance	
79.	Electrical endurance	
80.	Max. required current of solenoid	
	Closing solenoid	
81.	Closing time	
82.	Opening time	
83.	Operating Mechanism	
	Stored energy	
	Release	
	Rated voltage	
84.	Inherent delay between two switching operations	
85.	IP protection	
86.	Whether Internally Type tested	
Automatic Power Factor Control Unit		
87.	Size of APFC Unit L x B x H in mm	
88.	Application	
89.	Installation	
90.	Whether powder coated	
91.	Whether provision of Internal Arc prevention	
92.	Whether IP55 degree type tested at NABL Lab	
93.	STC Type tested for 26.2KA RMS for 1 sec	
94.	Switching steps	
95.	Thickness of CRCA	
96.	Whether Canopy provided	
97.	Whether Bolted type or Welded type	
11 kV Isolator		
98.	Make	
99.	Reference Standard	
100.	Rated Voltage	
101.	Continuous current carrying capacity	
102.	No. of Pole	
103.	Installation	
104.	Type	
105.	Type of Mounting Isolator	
106.	Rated short time current/sec	
107.	Insulation Level	
108.	Material contacts	
9 kV Lightning Arrestor		
109.	Name of the Manufacturer and place Of manufacturing	

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

110.	Manufacturer's design type/model	
111.	Applicable Standard	
112.	Rated Voltage KV (rms)	
113.	Rated Frequency (Hz)	
114.	No. of Unit per arrester	
115.	Nominal Discharge current (8/20 micro Second wave) (rms)	
116.	Maximum Continuous operating voltage KV (rms)	
117.	Insulation withstand voltage	
	Dry power frequency	
	Wet power frequency	
	Impulse (1.2/50 micro second)	
118.	Lightning Impulse residual voltage (8/20 micro second wave)	
	5000 A	
	10000 A	
	20000 A	
119.	Steep current impulse Residual Voltage At 10KA of 1 micro second front time	
120.	Switching Impulse Residual Voltage (50/100 microsecond)	
121.	Current withstand capability	
	Long duration discharge class	
	Minimum energy discharge capability	
122.	Protective ratio	
123.	High Current Impulse withstand value (4/10 microsecond)	
124.	Pressure relief class	
	High Current	
	Low current	
125.	Maximum leakage current at MCOV (Maximum Continuous operating voltage)	
	Resistive Current	
	Capacitive Current	
126.	Reference Current	
127.	Temporary over Voltage Capability	
	0.1 Second	
	1.0 Second	
	10.0 Second	
128.	Total Creep-age distance	
129.	Over all dimension	
	Height	
	Diameter	
130.	Cantilever strength	
131.	Mounting flange Dimensions	
	Minimum Clearance	

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

132.	Between Arresters	
	Arresters and adjoining earthed objects	
133.	Net weight of arrester	
134.	Lightning Impulse protection level	
135.	Please confirm whether offered is type Tested as per IEC/IS	
136.	Temperature Range	
11 kV Vacuum Circuit Breaker		
137.	Make	
138.	Type	
139.	Reference Standard	
140.	Nominal system voltage	
141.	Highest system voltage	
142.	Rated current	
143.	Single capacitor bank breaking current	
144.	Short time rating of circuit breaker	
145.	Short circuit breaking current	
146.	No. of poles	
147.	Frequency	
148.	Basic insulation level	
149.	Rated short circuit making current	
150.	Operation duty	
151.	First pole to clear factor	
152.	Control Circuit Voltage	
153.	Max. Total break time at 100% rated interrupting breaking capacity	
154.	Opening Time of breaker	
155.	Maximum Closing Time	
156.	1.2/50 micro second impulse withstand voltage	
157.	One minute power frequency withstand voltage	
158.	Creepage distance of support insulators	
159.	Details of operating mechanism along with the details of spring charging mechanism/motor etc	
160.	Clearances provided in air in mm between	
	Live part to live part	
	Live part to Earth	
	Live part to ground	
	Lowest part of support insulator to ground	
161.	Whether all other details of Circuit Breaker are as per the specifications & relevant IS	
11 kV Current Transformer		
162.	Make	
163.	Type	
164.	Reference Standard	

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

165.	Rated voltage	
166.	Rated Frequency	
167.	Rated primary current	
168.	Rated secondary current	
169.	Ratio	
170.	No. of cores	
171.	Rated output of each core	
172.	Class of accuracy	
173.	Over current factor	
174.	Power frequency withstand voltage	
175.	Impulse withstand test voltage	

MSEDCL

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

SCHEDULE 'B'
LIST OF UNIT PRICED ITEMS

(Note : Make and type designation of each item shall be furnished)

Make &Type	Unit price ex works with packing	Unit price with forwarding freight & ins.	Unit price F.O.R. destination.
------------	---	--	--------------------------------------

- 1.0 Outdoor switchgear 11 kV, 12.5 kA, 400 A VCB with operating mechanism box but without C&R panel
- 2.0 Capacitor Bank Rating : - 2X198.375 kVAR + 396.75 kVAR + 793.5 kVAR,
- 3.0 Capacitor Bank Rating : - 2X198.375 kVAR + 2x396.75 kVAR + 793.5 kVAR + 1190.25 kVAR
- 4.0 Vacuum Contactor Switches
- 5.0 Automatic Control Unit
- 6.0 Residual Voltage Transformer
- 7.0 Lightning Arrestor
- 8.0 Capacitor Cubicle
- 9.0 Series Reactors
- 10.0 Indoor Control and Relay panel
- 11.0 Outdoor 400amp. Isolator with earths witch
- 12.0 Outdoor 400amp. Isolator without earth switch
- 13.0 Current transformer:
 - i. 400/5 A
 - ii. 200/5 A

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

- 14.0 Non-discrepancy type or O.D.S. type T-N-C switch for CB
- 15.0 Local/remote selector switch
- 16.0 Indicating lamp
- 17.0 Push button
- 18.0 Triple pole, non-directional, combined 3 O/C + 1E/F IDMTL 3 sec relay
- 19.0 High speed trip relay (2 N/O+2 N/C)
- 20.0 Any other equipment (if felt necessary by the bidder)

Note: This price list will not be related in any way to the rates offered in the main price bid for the tendered items as advertised.

Name of the firm_____

Signature of the bidder_____

Designation_____

Date_____

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

SCHEDULE 'C'

List of Type Test Reports to be enclosed with the offer

Sr. No.	Description of Type Test	Type & Make of Circuit Breaker & its rating	IS/IEC Clause No.	Testing Lab. & Date of Testing	Type test report No.,dt & pages	Whether certificate of compliance with IS/IEC is enclosed with T.R.
Capacitor Unit						
1.	Thermal Stability Test					
2.	Measurement of the Tangent of the loss angle (Tan Delta) of the Capacitor at elevated Temperature.					
3.	AC voltage test between terminals and container.					
4.	Lightning impulse voltage test between terminals and container.					
5.	Short circuit discharge test.					
6.	Disconnecting test on internal fuses					
7.	Endurance Test.					
8.	Test of an external fuse in combination with a capacitor.					
Vacuum Contactor Switches						
9.	Tests to verify the insulation level, including withstand tests at power frequency voltages on auxiliary equipment.					
10.	Tests to prove that the temperature rise of any part does not exceed the specified values.					
11.	Making and breaking tests including tests for the rated capacitive current.					
12.	Tests to prove the capability of the switch to carry the rated short time current.					
13.	Tests to prove satisfactory operation					

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

	mechanical/electrical endurance.					
Residual Voltage Transformer						
14.	Temperature Rise Test					
15.	Impulse Voltage Test on primary Terminals					
16.	Wet Test for outdoor Type Transformer					
17.	Electromagnetic Compatibility Test					
18.	Test for accuracy					
19.	Short Circuit withstand capability Test					
Series Reactors						
20.	Measurement of Winding Resistance					
21.	Measurement of Insulation Resistance					
22.	Measurement of Impedance of continuous current					
23.	Measurement of loss					
24.	Separate source Voltage Withstand Test.					
25.	Induced over Voltage Withstand Test.					
26.	Temperature Rise Test at rated continuous current					
27.	Lightning impulse test					
Capacitor Cubicle						
28.	IP-55 degree of protection					
29.	Temperature rise test					
11kV Vacuum Circuit Breaker						
30.	Dielectric test					
31.	Radio interference voltage test					
32.	Temperature Rise Test					
33.	Measurement of resistance of main circuit					
34.	Short time withstand current and peak withstand current test					
35.	Mechanical and environmental test					
36.	Short Circuit Making and Breaking current Tests					

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

37.	Lightning Impulse Voltage withstand Test					
38.	Power Frequency Voltage Withstand Test Dry					
39.	Power Frequency Voltage Withstand Test Wet					
40.	Mechanical Operation Test					
41.	No load operation before and after test					
42.	Basic test duties no. 1 to 5					
43.	Single Phase Short circuit test					
44.	Condition of breaker after short circuit test					
45.	Capacitive current switching tests					
11 kV Isolator						
46.	Lightning Impulse Voltage withstand Test					
47.	Power Frequency Voltage Withstand Test Dry					
48.	Power Frequency Voltage Withstand Test Wet					
49.	Temperature Rise Test					
50.	Short Time Withstand Current and Peak Withstand Current Test					
51.	Mechanical Endurance Test					
9 kV Lightning Arrestor						
52.	Insulation withstand test					
	a) Lightning Impulse Voltage Test.					
	b) Power Freq. Voltage (Dry & Wet).					
53.	Residual Voltage Test :					
	a) Step current impulse Residual Voltage Test.					
	b) Lightning impulse Residual Voltage Test.					
	c) Switching impulse Residual Voltage Test.					
54.	Long duration Current Impulse withstand test.					

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

55.	Operating Duty test :					
	a)High Current Impulse Operating Duty test					
	b)Switching surge operating duty test.					
56.	Pressure relief test					
57.	Arrestor disconnecter test					
58.	Artificial Pollution test					
59.	Porcelain housed arrestor :					
	a) Temperature cycle test on hollow Porcelain bushing					
	b) Porosity test.					
60.	Galvanizing test on exposed ferrous metal part.					
61.	Power Frequency Voltage versus time curve					
62.	Power Frequency reference voltage Test					
63.	Rated Voltage Test					
64.	Partial Discharge Test					
65.	Low Current Short Circuit Test					
66.	Seal Leak Test					
67.	Visual & Dimensional check					
11 kV Current Transformers						
68.	Temperature Rise Test					
69.	Impulse Voltage Withstand Test on Primary Terminals					
70.	Wet Test for outdoor Type Transformers					
71.	Tests for accuracy					
72.	Short Time Current Test					
73.	Electromagnetic Compatibility Test					

Name of the firm_____

Signature of the bidder_____

Designation_____

Date_____

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

SCHEDULE 'D'

Schedule of Deviations from Specification

Sr.No.	Clause No.	Details of Deviations
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Name of the firm_____

Signature of the bidder_____

Designation_____

Date_____

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

SCHEDULE 'E'

Schedule of Bidder's Experience

Bidder shall furnish here a list of similar orders executed/under execution by him to whom a reference may be made by Purchaser in case he considers such a reference necessary.

Sr. No.	Name of Client & Description order	Value of order along with size & qty	Period of supply and commissioning	Name & Address to whom reference may be made
1.				
2.				
3.				
4.				
5.				
6.				
7.				

Name of the firm_____

Signature of the bidder_____

Designation_____

Date_____

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

SCHEDULE 'F'

Schedule of Deviations from Specified Standards

Sr. No.	Particulars	Stipulation of specified standard		Stipulation of standard adopted by bidder		Remarks
		Standard ref.	Stipulations	Standard ref.	Stipulations	
1.						
2.						
3.						
4.						
5.						
6.						
7.						

Name of the firm_____

Signature of the bidder_____

Designation_____

Date_____

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

SCHEDULE 'G'

**Deviations from Specified Test requirements Specified in Relevant Standards
and Present Specification.**

Sr. No.	Name of Test	Standard No. & Clause No.	Requirement of standards	Proposed deviation	Reasons for deviation.
1.	Type Test				
2	Additional Test				
3	Acceptance Test				
4	Routine Test				

Name of the firm_____

Signature of the bidder_____

Designation_____

Date_____

\

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

SCHEDULE 'H'

PROFORMA OF UNDERTAKING

We hereby confirm that 11 kV Automatically Switched HT Shunt Capacitor Bank along with 11 kV Capacitor Control Panel offered by us against this tender are of the same design and type as have been supplied to M.S.E.D.C.L. against earlier order No._____ dtd.

_____and all the Type Test Reports thereof were approved by C.E. (M.M. Cell) vide letter No. _____ dtd. _____ (copy enclosed.)

We further confirm that the said Type Test have been carried out at _____ within five years prior to the date of opening of present tender.

SEAL AND SIGNATURE OF BIDDER

Name of the firm_____

Signature of the Bidder_____

Designation_____

Date_____

Technical Specification of 1.2 MVAR/2.4 MVAR, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE- I- 'A'
Principal Technical Parameters of Capacitor Bank

Sr. No.	Item	1.2 MVAR Bank	2.4 MVAR Bank
1.	Nominal system voltage	11 KV	
2.	Rated voltage of capacitor	12.65 KV	
3.	Output of capacitor bank at 12.65 KV	1587 kVAR (2x198.375 kVAR + 396.75 kVAR + 793.5 kVAR)	3174 kVAR (2x198.375 kVAR + 2x396.75 kVAR + 793.5 kVAR + 1190.25 kVAR)
4.	Rated line current	72.43 Amp.	144.86 Amp.
5.	Connection of capacitor bank	Single star	
6.	No. of phases	3	
7.	Rated voltage of individual capacitor unit	7.3 KV	
8.	Capacity of individual capacitor unit	66.125 kVAR for 198.375 kVAR step & 132.25 kVAR for 396.75 kVAR Step & 264.5 kVAR for 793.5 kVAR Step	66.125 kVAR for 198.375 kVAR step & 132.25 kVAR for 396.75 kVAR Step & 396.75 kVAR for 1190.25 kVAR Step
9.	Insulation level	RMS-28 KV, Peak -75 KV	
10.	Maximum temp. rise over ambient temperature	10 Deg. C	
11.	Type of discharge	Internally through within the Unit resistor provided	
12.	Type of fuse	External fuse	
13.	Type of installation	Outdoor	
14.	Power loss	Not to exceed 0.2 watt/kVAR subject to tolerance as per standard. Offered capacitors should be built from best material which develop minimum losses.	

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I- 'B'
Principal Technical Parameters of Series Reactor

Sr. No	Description	Technical Particulars			
1.	Name of manufacturer				
2.	Reference Standard	IS 5553 Part – III			
3.	Capacitor Bank Rated kVar step	198.375	396.75	793.5	1190.25
4.	11 kV Series Reactor				
	a) Rated kVar (kVar)	0.132	0.265	0.529	0.794
	b) Impedance (Ohms)	1.613	0.807	0.403	0.269
	c) Rated current (Amps)	9.054	18.108	36.217	54.325
	d) Choke Voltage (Volts)	14.6	14.6	14.6	14.6
	e) Short time current rating for 2 Sec(Amps) 16.66 times of rated current	150.84	301.68	603.37	905.05
5.	a) Nominal system voltage	11 KV			
	b) Rated voltage of capacitor bank	12.65 KV			
6.	Rated frequency	50 Hz			
7.	No. of phases	1 Phase			
8.	Linear characteristic.	Yes			
9.	Type of Reactor	Aluminum wound, Air Core, Dry Type, Neutral side Series Reactor.			
10.	Power frequency withstands voltage.	28 KV (rms)			
11.	Lightning impulse withstand voltage.	75 KV (Peak)			
12.	Creepage distance	300 mm			

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I- 'C'

Principal Technical Parameters of Residual Voltage Transformer

Sr. No.	Description	Particular
1	Reference Standard	IS: 16227
2	Type	Dry type resin cast, 5 Limb Construction
3	Rated primary voltage	11 kV
4	Frequency	50 Hz +/- 3%
5	No. of secondary windings	2
6	Ratio	11kV (Star) /110V(Star)-190V(Open Delta)
7	Rated burden per phase & Accuracy class	
	c) Metering Winding (Star)	Class: 1, Burden: 50 VA
	d) Protection Winding (Open Delta)	Class :3P; Burden : 50 VA
8	Method of connection	Star/Star-Open delta
9	Insulation Level	
	c) One minute power frequency withstand voltage	c) 28 kV
	d) Impulse withstand voltage (1.2*50 micro sec. wave, crest)	d) 75kVp
10	Voltage Factor	1.2 times & 1.9 for 30 Sec.
11	Terminal arrangement	
	1) HV side 2) LV side	PRI. Terminals for R, Y, B, N SEC. Terminal R,Y,B,N & Open delta

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I-'D'

Principal Technical Parameters of 11 kV Vacuum Contactor

Sr. No.	Description	Particulars
1	Applicable standard	IS 9920 (Part IV)/2002/ IEC 62271-103
2	Type & Make	
3	Number of poles, nos. of break/pole	3 Pole, 1break/Pole
4	Model	
5	Maximum capacity	12kV,400A
6	Rated Voltage	11Kv
7	Rated maximum voltage	12Kv
8	Rated normal current	400A
9	Rated single capacitor banks current	200A
10	Frequency	50Hz
11	Rated short time current for one sec	10Ka
12	Rated short circuit making current	25kAp
13	Impulse with stand voltage (1.2x50 micro sec.wave,crest)	75kVp
14	One minute power frequency withstand voltage	28Kv
15	One minute power frequency withstand voltage on auxiliary circuit	2Kv
16	Mechanical endurance	10,000 Operations
17	Electrical endurance	10,000 Operations
18	Max. current required for Closing of	<12 Amp
19	Closing time	<150ms
	Opening Time	< 80ms i.e. Less than the opening time of breaker
20	Operating Mechanism	
	Stored energy	Solenoid
	Rated voltage	250V AC
21	Inherent delay between two switching operations	10 Min
22	IP Protection	IP 55
23	Whether capacitor switch is type tested.	Yes.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE- I-‘E’

Principal Technical Parameters of Outdoor APFC Unit

No.	Particulars	Proposed
1	Feed-back Voltage:	3ph, 3wire, 110Volt (+10%/-20%)
2	Current input:	Selectable 1A or 5A for both load & capacitor.
3	Auxiliary Supply:	3Ph 415V (+10% to -20%)/1Ph, 230V AC (+20%to-20%)
4	Output banks control for 8 banks.	(Isolated ‘NO’ contacts of rating 5Amp ac / 250Vac)
5	RS-232 baud rate selectable	up to 38.4kBPS
6	Dedicated RS232 port on front fascia	RS232 port
7	Facility for separate temperature probe (PT100) provided	Separate temperature probe
8	Operating temperature:	0 to 50°C.
9	Storage Temperature:	-10 to +75°C.
10	Humidity:	0 to 98%
11	Supply frequency:	45Hz to 55Hz
12	Automatic synchronization capable of giving correct results even for wrong connections at CT terminals (& also wrong polarity of CT connection)	YES
13	Load V, I and Cap. Current THD measurement with odd harmonic coeff. Upto 15 th harmonic	YES
14	Mode of switching	User defined
15	Standard 144 X 144 cabinet for panel door flush mounting	144 X 144
16	Serial communication through standard Dedicated protocols	YES
17	Selectable communication port	MODBUS RS485 or RS232
18	Logging of data in the form of Hourly Records, Fault Records & Daily Records	recording all electrical values
19	Protections provided	All these are user settable
20	Over/under Voltage	
21	Cap. Over/under current during switching ON	
22	Over / Under frequency	
23	Over / Under load	
24	Load unbalance	
25	Over temperature	
26	Out of steps (only for indication)	
27	NV-RAM battery down	

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I-'F'

Principal Technical Parameters of 11 kV Vacuum Circuit breaker

1.	Reference Standard	IS 13118
2.	System voltage	Normal : 11 kV
		Highest : 12 kV
3.	Supply frequency	50 Hz
4.	System Neutral earth	Effectively earthed
5.	Installation	Outdoor
6.	Current	Normal : 400 Amp
		Short time rating : 12.5 kArms for 3 sec
7.	Insulation level	Impulse : 75 kVp
		1 min Power Frequency Voltage : 28 kVrms
8.	Operating duty cycle	0-0.3 sec-CO-3 min-CO
9.	First phase to clear factor	1.5
10.	Clearances	Between adjacent poles : 280 mm
		Between live part to earth : 370 mm
11.	Creepage distance for bushing	25 mm/kV (300 mm)
12.	Opening time of breaker	80ms

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I- 'G'

Principal requirements of protective relays, metering equipment, auxiliary relays, breaker control switches etc. to be mounted on control & Relay Panel are as follows:

SR. No.	Item	Description	Details
1.	Triple pole combined non directional 3 O/C + 1 E/F relay.	Setting for O/C	20% to 200% of Base Current in step of 1%
		Setting for E/F	5% to 80% of Base Current in step of 5%
		CT Secondary current	5 Amp.
		Characteristics	0-3 Sec.
		Contacts	2 set of Self Reset N/O Contacts
		Mounting	Flush.
		Type	APR31H OF ASHIDA or equivalent, as acceptable to the MSEDCL.
		Auxiliary voltage	30 V DC
		Size	Cutout 138x138, Bezel: 160x160 mm
		Operational indicator	Flags
		IS reference	3231
2.	High Speed Mater Trip Relay	Type	High speed of operation.
		Model/make	AVAJH 13 of Ashida or equivalent
		General Design	Electromechanical
		No of poles	3
		C.T. Sec. current	5 Amp
		Operation setting	50% to 120% of rated coil voltage

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

		Coil Rating	30 V DC
		Time setting	10-15 ms at nominal rated voltage
		Frequency	50 Hz
		Aux contacts	4 pair of Hand reset
		Case size	Cut Out 92x92 mm, Bezel 110 x 110 mm
		Aux voltage	30 V D.C.
		Operational indicator	Mechanical Flag in window : Hand Reset Type
		Mounting	Flush
		IS reference	3231
3.	Ammeter	Accuracy	0.5% of FSD + 5 Digits
		Mounting	Flush
		Size	48 x 96 sq. mm. case
		Response Time	1 second
		Operating Temperature	Up to 55°C
		Dielectric Strength	2 kV RMS for 1 minute
		Power Consumption	Less than 3 VA
		Frequency	50 Hz
		Operating Current	5 A from CT Secondary.
		Type	Panel Mounting with 3 1/2 Digital Display
		Make	AEL ARMS H 96 D or equivalent
4.	Ammeter selector switch	Four Position Rotary	3 way with off
	Ammeter Selector switch shall be a four-position rotary type with R, Y, B and 'OFF' positions marked clearly on 48x48 mm brushed aluminum plate with black	Type	CA 10 A048 621E of Kraus & Naimer make or equivalent

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

	handle. Switch should be single hole mounting and not screw mounting.		
		Rated Insulation Voltage	1100 V
		Rated Impulse withstand voltage	6 kV
		Rated Operational Current	12 A
5.	Volt Meter	Accuracy	0.5% of FSD + 5 Digits
		Mounting	Flush
		Size	48 x 96 sq. mm. case
		Response Time	1 second
		Operating Temperature	Up to 55°C
		Dielectric Strength	2 kV RMS for 1 minute
		Power Consumption	Less than 3 VA
		Auxiliary Supply	110 V
		Frequency	50 Hz
		Operating Current	110 V from PT Secondary.
		Type	Panel Mounting with 31/2 Digital Display
		Make	AEL VRMS H 96 D or equivalent
6.	Volt Meter selector switch	Seven Position	6 way & off
	Voltmeter Selector Switch shall be seven position type with 3 phase to phase and 3 phase to neutral and one OFF position marked clearly on 48x48 brushed aluminum plate with	Type	CA 10 A007 622E of Kraus & Naimer make or equivalent

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

	black handle. Switch should be single hole mounting and not screw mounting		
		Rated Insulation Voltage	1100 V
		Rated Impulse withstand voltage	6 kV
		Rated Operational Current	12 A
7.	Circuit Breakers control switch	Type	RBC 40 of recon or equivalent
			Non- discrepancy type
		3 Position	Trip-neutral-close, with pistol grip handle must be pushed in to spring return to either trip or close position from Neutral position for safety and not just turn to trip
			One contact to close in each position
8.	Auxiliary contactor	ARR	2 N/O+2 N/C
		Auxiliary voltage	30V DC
	Space Heater	Capacity	80 Watts
		Voltage	240 V AC
		Type	Strip type
	Thermostat	Voltage	240 V AC
		Range	30-90 Deg. C
	Contactor for antipumping duty	Contacts	2 N/O + 2 N/C
		Coil voltage	30V DC.

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I-'H'

Principal Technical Parameters for 11 kV Isolator

1.	Reference Standard	IS 9921 (Part 1-4)
2.	System voltage	Normal : 11 kV
		Highest : 12 kV
3.	Supply frequency	50 Hz
4.	System Neutral earth	Effectively earthed
5.	Current	Normal : 400 Amp
		Short time rating : 12.5 kArms for 3 sec
6.	Insulation level	Impulse : 75 kVp
		1 min Power Frequency Voltage(wet): 28 kVrms
7.	Phase to phase centre distance	1000 mm
8.	Current density at minimum cross section at any place in current path.	Not more than 1.6 A/sq mm
9.	Clearances	Between adjacent poles : 850 mm
		Between live phase to earth : 370 mm
10.	Interlock	Mechanical interlock between Main switch and earth switch.
11.	Operating mechanism	Manual
12.	Type of connection between earth blade (rotary contact) and earthing	Flexible copper contact

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I-'

Principal Technical Parameters of 11 kV CTs

1.	Reference Standard	IS 16227
2.	System voltage	Normal : 11 kV
		Highest : 12 kV
3.	Supply frequency	50 Hz
4.	System Neutral earth	Effectively earthed
5.	Insulation level	Impulse : 75 kVp
		1 min Power Frequency Voltage : 28 kVrms
6.	CT Installation	Outdoor, single phase unit
7.	Type	Oil insulated or dry type
8.	Current	Normal : 400 Amp
		Short time rating : 12.5 kArms for 3 sec
9.	Installation safety factor	Less than 5
10.	Clear height of bushing	370 mm (Bird clearance)
11.	Minimum creepage	25 mm/kV
12.	CT details	Ratio : 400-200/5-5 A
		Class of accuracy : 0.5, 5P10
		Burden : 15 VA/15 VA
13.	Mounting details	350 x 350 mm (±5mm)

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I-'J'

Principal Technical Parameters of 9 kV, 10 kA, Station class III Lightning Arrestor

Sr. No.	Description	Particulars
1.	Name of the Manufacturer and place Of manufacturing	
2.	Manufacturer's design type/model	
3.	Applicable Standard	
4.	Rated Voltage KV (rms)	9kV (rms)
5.	Rated Frequency (Hz)	50Hz +/-3%
6.	No. of Unit per arrester	one
7.	Nominal Discharge current (8X20 micro Second wave) (rms)	10kAp
8.	Maximum Continuous operating voltage kV (rms)	7.65 kV
9.	Insulation withstand voltage a) Dry power frequency b) Wet power frequency c) Impulse (1.2 X 50 micro second)	28 kV 28 kV 95 kVp
10.	Lightning Impulse residual voltage (8/20 micro second wave) a) 5000 A b) 10000 A c) 20000 A	27 kVp 30 kVp 35 kVp
11.	Steep current impulse Residual Voltage At 10kA of 1 micro second front time	36 kVp
12.	Switching Impulse Residual Voltage (50 X 100 microsecond)	24 kVp
13.	Current withstand capability a) Long duration discharge class b) Minimum energy discharge capability	III As per IEC /IS
14.	Protective ratio	2.1
15.	High Current Impulse withstand value (4 X 10 microsecond)	100 kA
16.	Pressure relief class a) High Current b) Low current	40 kA rms 600 A ±200
17.	Maximum leakage current at MCOV (Maximum Continuous operating voltage) a) Resistive Current b) Capacitive Current	400 µA 1500 µA
18.	Reference Current	<5 mA
19.	Temporary over Voltage Capability a) 0.1 Second b) 1.0 Second c) 10.0 Second	15.9 kV rms 15.3 kV rms 14.7 kV rms
20.	Minimum Creepage distance	25 mm / kV
21.	Over all dimension a) Height b) Diameter	355 mm 262 mm Flange
22.	Cantilever strength	3200 N-m

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

23.	Mounting flange Dimensions	3 equi-spaced slots (14mm X 20mm) on 222 mm PCD
24.	Minimum Clearance a) Between Arresters b) Arresters and adjoining earthed objects	470 mm 310 mm
25.	Net weight of arrester	12 Kg. Approx.
26.	Lightning Impulse protection level	30 KVP
27.	Please confirm whether offered is type Tested as per IEC/IS	Yes
28.	Temperature Range	-5 to 50°C

MSEDCL

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I-'K'

Specification of 3 over current & 1 EF relay

Type	Numerical
Elements	3 over current + 1 Earth fault relay
CT sec input	5A
Operational characteristics selectable	IDMT 3 sec IDMT 1.3 sec Very inverse Extremely inverse Definite time
Aux Supply	30V DC
Setting for OC	20% to 200% in step of 1%
Setting for EF	5% to 80% in step of 5%
Time multiplier setting	0.05 to 1.5% in step of 0.01%
Memory storage for fault information	Storing of latest 5 fault with date and time stamping, fault amplitude & type of fault
Contacts	2 NO contacts for Alarm and Trip, Should carry 5A at 660VDC
Communication Port	RS 232 / RS485 Port.
IS Reference	IS 3231

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I-'L'

Specification of Under and over voltage relay

Type	Numerical
Elements	1
PT sec input	110V AC
Operational characteristics selectable	Definite time
Aux Supply	30V DC
Setting for OV	105% to 135% in step of 5%
Setting for UV	45% to 90% in step of 5%
Contacts	Contact for alarm of UV,OV, and Trip
Contact rating	Should carry 5A at 660VDC
IS Reference	IS 3231

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -I-'M'
Specification of NDR voltage Operated relay

Type	Numerical
Element	1
RVT sec input	110V AC
Operational characteristics selectable	Definite time
No of Stage	2 Stage
Aux Supply	30V DC
Setting for Alarm	5% to 40%% in step of 5%
Setting for Tripping	5% to 40%% in step of 5%
Contacts	Contact for alarm stage and trip stage
Contact rating	Should carry 5A at 660VDC
IS Reference	IS 3231

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

ANNEXURE -II

Type Tests Report

Capacitor Unit	
Sr. No	Description of Type Test
1.	Thermal Stability Test
2.	Measurement of the Tangent of the loss angle (Tan Delta) of the Capacitor at elevated Temperature.
3.	AC voltage test between terminals and container
4.	Lightning impulse voltage test between terminals and container
5.	Short circuit discharge test
6.	Disconnecting test on internal fuses
7.	Endurance Test
8.	Test of an external fuse in combination with a capacitor
2.Vacuum Contactor Switches	
Sr. No	Description of Type Test
1.	Tests to verify the insulation level, including withstand tests at power frequency voltages on auxiliary equipment.
2.	Tests to prove that the temperature rise of any part does not exceed the specified values.
3.	Making and breaking tests including tests for the rated capacitive current.
4.	Tests to prove the capability of the switch to carry the rated short time current.
5.	Tests to prove satisfactory operation and mechanical/electrical endurance.
3.Residual Voltage Transformer	
Sr. No	Description of Type Test
1.	Temperature Rise Test
2.	Impulse Voltage Test on primary Terminals
3.	Wet Test for outdoor Type Transformer
4.	Electromagnetic Compatibility Test
5.	Test for accuracy
6.	Short Circuit withstand capability test

Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

4.Series Reactors	
Sr. No	Description of Type Test
1.	Measurement of Winding Resistance
2.	Measurement of Insulation Resistance
3.	Measurement of Impedance of continuous current
4.	Measurement of loss
5.	Separate source Voltage Withstand Test
6.	Induced over Voltage Withstand Test
7.	Temperature Rise Test at rated continuous current
8.	Lightning impulse test
5.Capacitor Cubicle	
Sr. No	Description of Type Test
1.	IP-55 degree of protection
2.	Temperature rise test
6.11kV Vacuum Circuit Breaker	
Sr. No	Description of Type Test
1.	Dielectric test
2.	Radio interference voltage test
3.	Temperature Rise Test
4.	Measurement of resistance of main circuit
5.	Short time withstand current and peak withstand current test
6.	Mechanical and environmental test
7.	Short Circuit Making and Breaking current Tests
8.	Lightning Impulse Voltage withstand Test
9.	Power Frequency Voltage Withstand Test Dry
10.	Power Frequency Voltage Withstand Test Wet
11.	Mechanical Operation Test
12.	No load operation before and after test
13.	Basic test duties no. 1 to 5
14.	Single Phase Short circuit test
15.	Condition of breaker after short circuit test

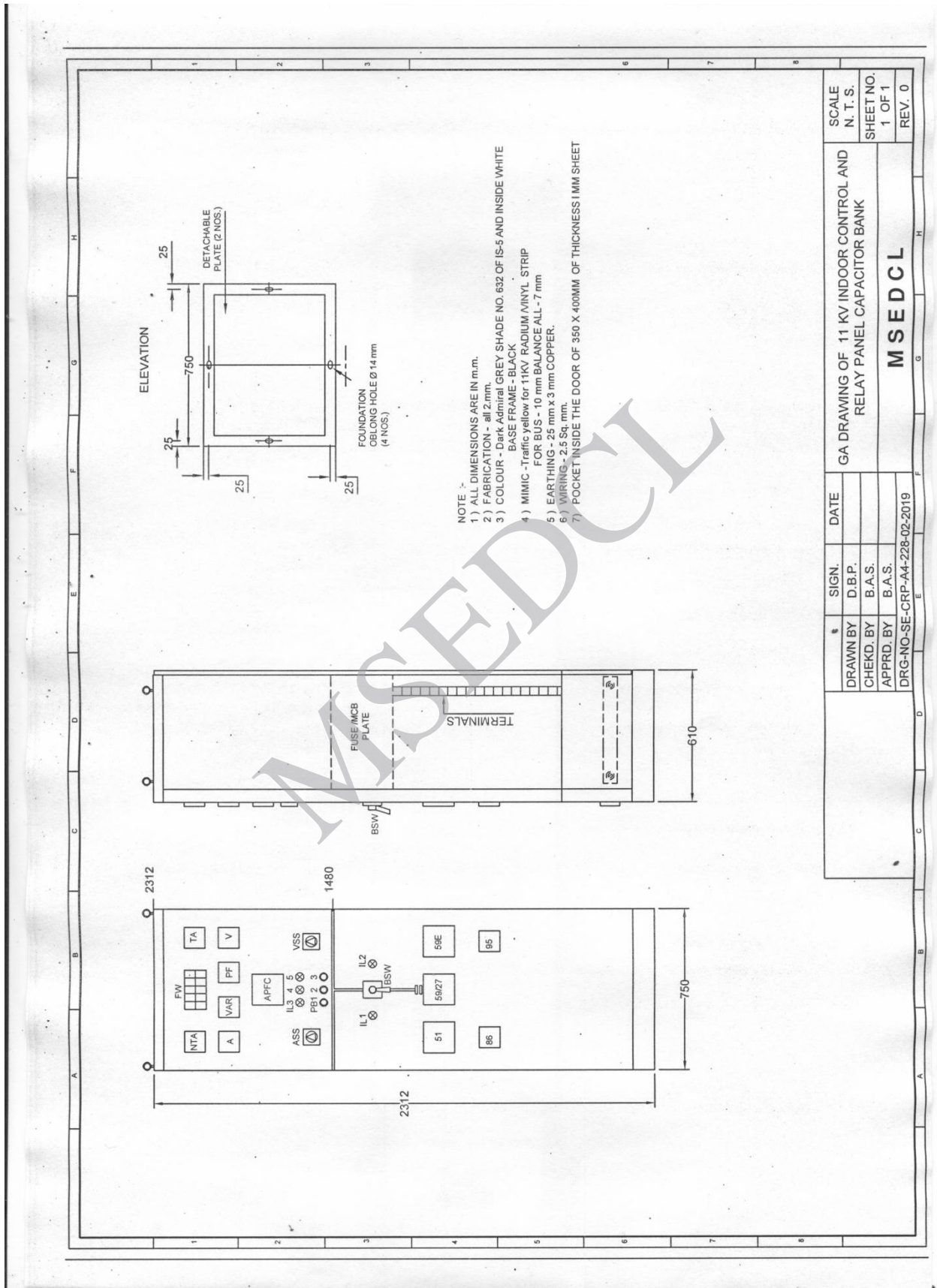
Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

16.	Capacitive current switching tests
7.11 kV Isolator	
Sr. No	Description of Type Test
1.	Lightning Impulse Voltage withstand Test
2.	Power Frequency Voltage Withstand Test Dry
3.	Power Frequency Voltage Withstand Test Wet
4.	Temperature Rise Test
5.	Short Time Withstand Current and Peak Withstand Current Test
6.	Mechanical Endurance Test
8.Lightning Arrestor	
Sr. No	Description of Type Test
1.	Insulation withstand test:
	Lightning Impulse Voltage Test
	Power Freq. Voltage (Dry & Wet).
2.	Residual Voltage Test :
	Step current impulse Residual Voltage Test.
	Lightning impulse Residual Voltage Test.
	Switching impulse Residual Voltage Test.
3.	Long duration Current Impulse withstand test.
4.	Operating Duty test :
	High Current impulse Operating Duty test.
	Switching surge operating duty test.
5.	Pressure relief test.
6.	Arrestor disconnecter test.
7.	Artificial Pollution test.
8.	Porcelain housed arrestor :
	Temperature cycle test on hollow Porcelain bushing.
	Porosity test
9.	Galvanizing test on exposed ferrous metal part
10.	Power Frequency Voltage versus time cure
11.	Power Frequency reference Voltage Test

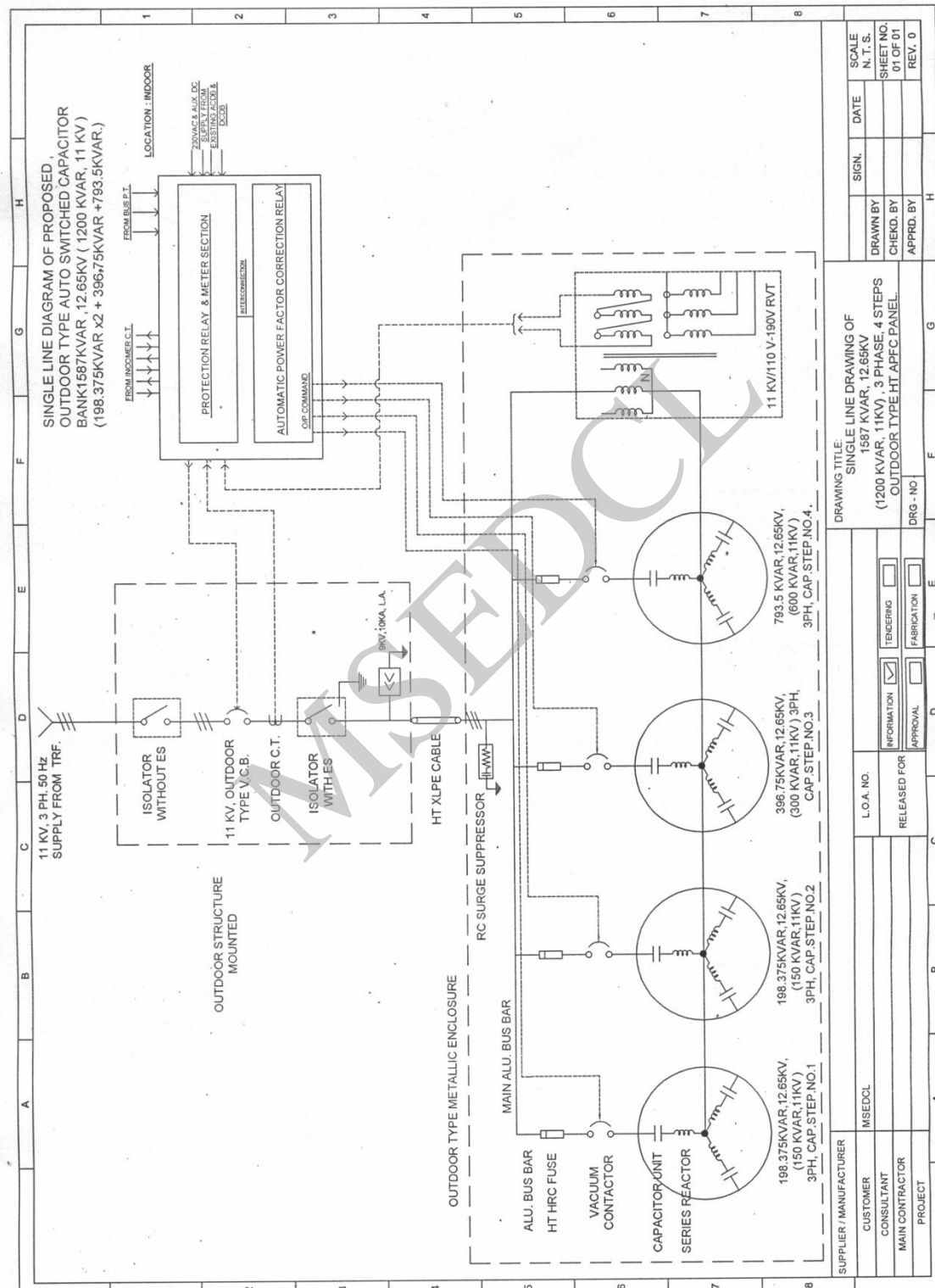
Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

12.	Rated Voltage Test
13.	Partial Discharge Test
14.	Low Current Short Circuit Test
15.	Seal Leak Test
16.	Visual & Dimensional check
9. 11 kV Current Transformers	
Sr. No	Description of Type Test
1.	Temperature Rise Test.
2.	Impulse Voltage Withstand Test on Primary Terminals.
3.	Wet Test for outdoor Type Transformers.
4.	Tests for accuracy.
5.	Short Time Current Test.
6.	Electromagnetic Compatibility Test

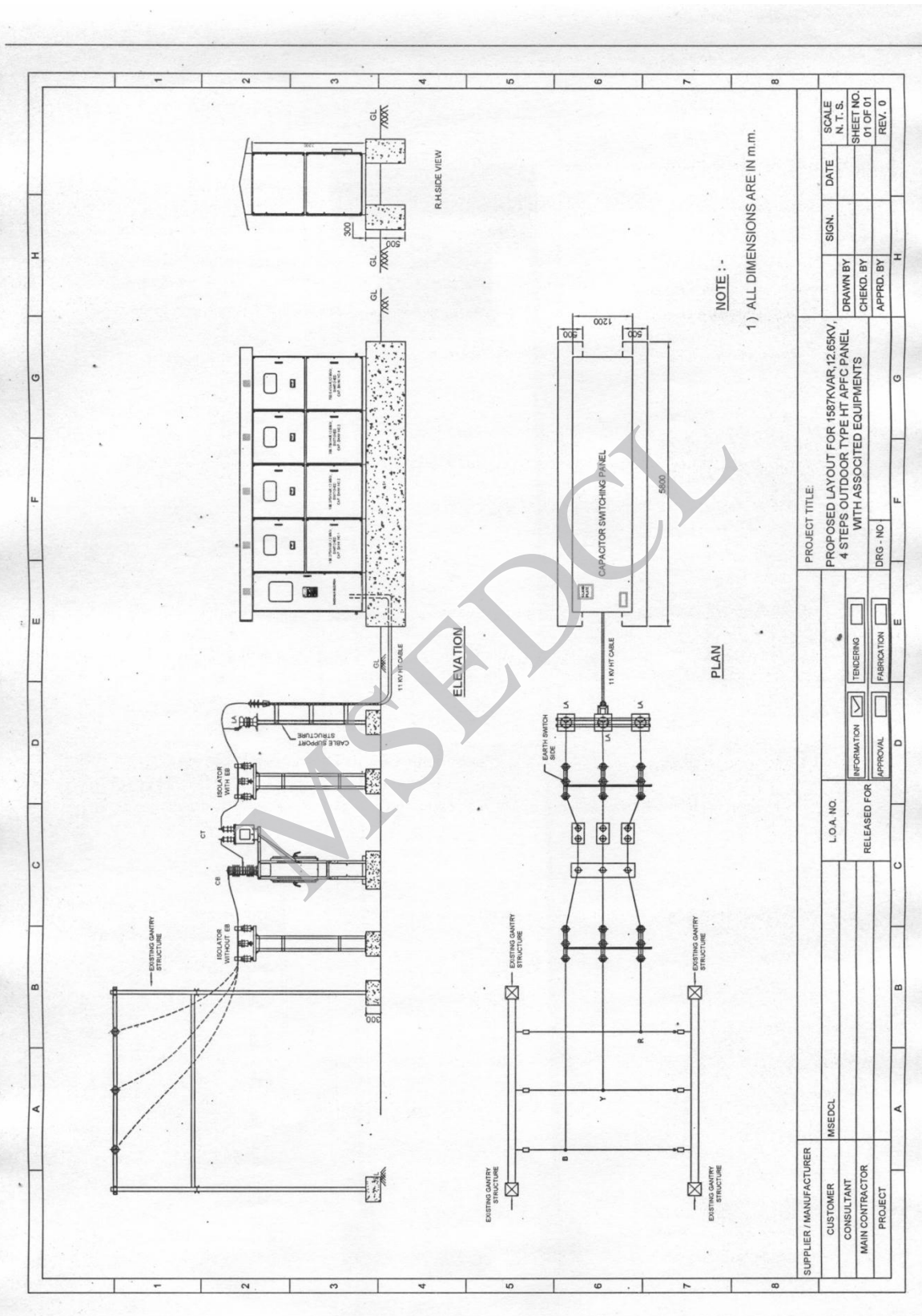
Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel



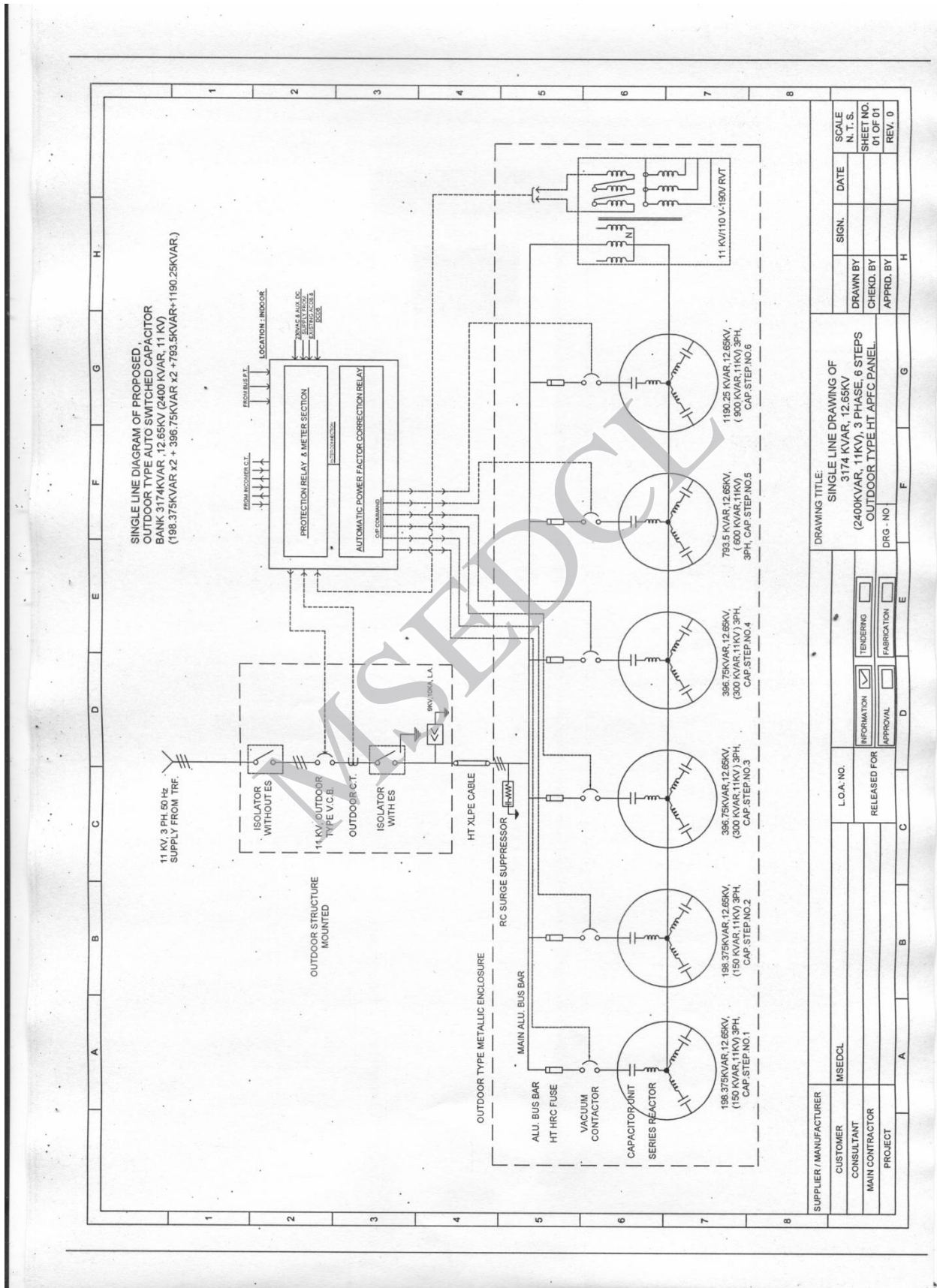
Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel



Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel



Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel



Technical Specification of 1.2 MVar/2.4 MVar, 11kV, Outdoor Type in CRCA Cubicle, Automatically Switched H.T. Shunt Capacitor Bank along with 11 kV Capacitor Control Panel

