

## **1. GENERAL**

### **1.1 SCOPE OF WORK:**

Tenderers are invited for the design, manufacture, testing and commissioning, of trailer mounted 33/11.5 KV 16 MVA mobile substations to be supplied complete with all necessary fittings accessories according to attached single line diagrams. spare parts and a valid ISO 9001 certificate for power transformer and (33KV, 11KV) switchgear i.e circuit breakers and their switchboard , to be submitted with tender documents, otherwise the offer will be rejected .

### **1.2 STANDARDS**

The applicable standard to design the equipments and accessories shall be the latest IEC recommendation .

### **1.3 SCHEDULES**

The tenderer shall duly fill in the schedules of guaranteed technical particulars , prices , delivery time schedules and deviations attached to this specification . Incomplete tenders will be rejected.

## **2. General Requirements:**

The materials shall be of first class quality and designed for continuous satisfactory operation as continuity of supply is of prime importance and to operate satisfactorily under variation of load, voltage and short circuit or other conditions which may occur on the system provided that these variations are within the assigned rating of the apparatus. The materials used shall be suitable for the following climatic conditions:

### **2-1 Ambient temperature:**

Highest maximum (in the shade) 55 °C for about 6 hours a day  
Lowest minimum (-10) °C  
Maximum yearly average (+30) °C  
Maximum daily average (+40) °C

### **2.2 Sun Shine temperature:**

Black objects under direct sunshine attain a temperature of 80 °C

### **2.3 Air humidity:**

Maximum	92% at 40 °C
Minimum	12%
Yearly average	44%

### **2.4 Altitudes:**

From sea level up to (1000m)

### **2.5 Sand storm:**

The equipments shall be suitable for outdoor installations and subjected to frequent sand storms and heavily polluted atmospher.

### 3. TECHNICAL REQUIREMENT

#### 3.1 System Data

##### a- 33 KV system

Nominal voltage	33000 volts
Highest system voltage	36000 volts
System	3- phase , 3 wire ,50Hz
Short circuit level	25 KA r.m.s at 33000 volts

##### b- 11 KV system

Nominal voltage	11000 volts
Highest system voltage	12000 volts
System	3-phase,3 wire with neutral earthed through an earthing resistance of 21.1 ohm to limit earth fault current to 300Amps.
Short circuit level	25 KA r.m.s at 11000 volts

##### c-L.T.System

Nominal voltage	416 volts + 6%, -10%
System	3- phase, 4 wire with neutral solidly earthed
Short circuit level	35 KA r.m.s at 400 volts

### 4. GENERAL SPECIFICATION OF THE SUBSTATION :

- 4.1 The substation is to include the 33 kV switchgear, 33/11 .5 KV transformer, 11 kV switchgear, 33 kV & 11 kV cables on drums , with all necessary accessories to complete in working condition .
- 4.2 The 33 kV & 11 kV switchgear is to be contained in an outdoor kiosk and the transformer to be of outdoor type. Mobile substation maximum height 4.5 meter.
- 4.3 The kiosk type is to be sheet steel with double layers, rock wool or any alternative of thermally insulating material in between roof and walls for thermal insulation to with stand the local ambient conditions. Kiosks to be air-conditioned.
- 4.4 The complete unit must be transportable as a single unit. The structure should be fixed to a rigid frame and base ensuring successful operation and transportation.
- 4.5 The trailer should be according to the relevant international standard and it is to be coupled to a truck. The trailer should be made steel framed, reinforced, complete with all necessary equipment (such as rear light, breaks, flashers, wheels. etc). The trailers have to be designed for heavy road conditions to prevent the damage of substation equipment during transportation. The trailer should be low-bed type with three axles for maximum permissible load. One axle in front to support the trailer It should be designed with suitable connection to 6x4 tractor (tractor is out of scope) Four number of heavy lifting jacks. Two spare tires.
- 4.6 Station fire extinguisher shall be of the portable type using suitable chemicals for the electrical fire extinguishers. The size shall be determined by the tenderer to suit the type of the equipment.
- 4.7 Normal indoor and outdoor lighting & sockets
- 4.8 In case of internal arc fault a safety diaphragm to relief the pressure caused by the arc outside the kiosk. Degree of protection between compartments should be IP40 in the switchgear.

### 5. INSTRUMENT AND PROTECTION TRANSFORMERS :

#### 5.1 CURRENT TRANSFORMER:

In general the instrument and protection current transformer must comply with the IEC 60185 and dry type. Three secondary winding of the CT's for 33 & 11 kV circuit one for over current and earth fault protection and the other for measurement shall be designed for rated



current of 5 AMP. The third shall be designed for differential protection with rated current of 1 AMP. Of special class with suitable accuracy class and a saturation factor protecting the instrument in case of short circuit in the main installation, and the protective CT shall ensure correct operation up to the maximum fault current which can be attained or any developed C.T to fulfill the above requirements.

## 5.2 VOLTAGE TRANSFORMER:

In general the voltage transformers must comply with the IEC 60186. And dry type. The secondary voltage shall be 110 Volts between phases.

The PT should be of suitable accuracy class and protected by means of easily accessible fuses on H.T side and M.C.B on L.T side. The voltage transformers used for earth fault indication and metering shall be of three single phase double wound (star/ star) type with a tertiary winding connected in open delta the secondary star winding shall be used for visual indication of earth fault and for metering, the open delta winding for operating an audible alarm or trip of earth fault on the 11 kV side.

## 6. INSTRUMENTS AND RELAYS:

All indicating instruments must be water and dust proof designed for tropical climate and capable of continuous operation at full load current as well by fault current.

All relays shall be of ELECTRONIC type. Relays shall be of withdrawable type to carry out routine tests in service, and for early replacement. Additional protection relay without auxiliary supply or supplied through capacitor storage unit shall be added to operate the protection when there is no D.C supply in the substation.

## 7. PROTECTION RELAYS:

- 7.1 ALL panels shall be provided with over current and earth fault relay (2 O/C + 1E /F) of IDMTL type as follows:-

Time range 0 – 3 sec.

Current setting for O/C  $30-200 \% \times I_n$

Current setting for E/F  $5-40 \% \times I_n$

Instantaneous element 400-1600%(when required)

- 7.2 Under voltage relay on the 33kv side to trip the 33kv C. B. in case of supply voltage failure.

- Earth fault alarm relay self rest of two normally open contact for local and remote alarm should be connected to the open delta winding of V.T on the 11kv side.

- 7.3 Transformer Neutral point, this protection shall be definite time earth fault relay connected to the C. T. of the neutral earthing resistor to make trip of 33kv C.B, in case of earth fault

- 7.4 Differential protection for the transformer.

## 8. SWITCHGEAR:

- 8.1 The switchgear shall comply with IEC 60289, completely metal- clad type with suitable air insulated bus bar covered by proper insulation assigned for indoor installation equipped with vacuum type circuit breaker. The switchgear shall be provided with suitable interlocks and adequate safety devices to prevent access to the live compartment. 33 KV and 11Kvcircuit breakers to be withdrawable type. A set of metal shutters shall be provided to cover all live parts. Shutters shall open automatically by positive drive initiated by the movement of circuit breaker carriage. The circuit breaker should be fixed with suitable fixation facility in test position during transportation of mobile substation in order to protect the plug and socket isolating devices.

## 8.2 CIRCUIT BREAKER OPERATING MECHANISM:-

Circuit breaker operating mechanism shall be of the spring powered stored energy. Each equipment shall be provided with visual indicating device to show the circuit breaker "Open" or "closed" it shall operative when the circuit breaker is in the "service" "isolated" and "earthed" positions.



It shall be possible to complete the closing tripping indication and interlock circuits when the circuit breaker is isolated . Locking facilities shall be provided so that the circuit breaker can be locked in each position.

The closing mechanism shall be provided with electrical release coils and shall be of "trip free" type. It shall be possible to charge the mechanism spring with circuit breaker in either the "open" or the "closed" position . In normal operation the recharging of the operating spring shall be commenced immediately and automatically upon completion of the circuit breaker closure . A visual mechanical indicating device shall be provided to indicate the state of the spring " spring charged" when the spring is in condition to close the C.B and "spring free" when the spring not in a condition to close the C.B.

The mechanism shall be fitted with local manual spring release preferably by push button, shrouded to prevent inadvertent operation . The mechanism shall be suitable for motor and hand rewinding (motor should be for a system of 220 V A.C) and shall be suitable for remote control for both closing and opening operations .

## 9. TRANSFORMER:

### 9.1 TRANSFORMER SPECIFICATION

The transformer and its associated equipment shall comply with the latest issue of IEC6076. It should be as slim as possible to suit the requirement of the substation. The transformer shall have the following characteristics:

a)	Rated output power (ONAN)	16MVA
b)	Duty	Step – Down , Outdoor service
c)	Type	Core, double wound 3- phase, box type
d)	Rated voltage at no load	H.V –33 kV L.V 11.5 kV
e)	System frequency	50 Hz
f)	Interface connection	H.V- Delta L.V- star with neutral brought out Through 15 kV outdoor bushing and arrester of 7.3 KV
g)	Vector group	Dyn 11
h)	Type of cooling	ONAN
i)	Temperature rise	45°C in top oil by thermometer 50°C in winding by Resistance
j)	Impedance voltage	7-10% at 75°C and at principal tapping
k)	System highest voltage	H.V – 36 kV L.V - 12 kV
l)	Terminal arrangement	Suitable for switchgear connection
m)	Taps	On- load on H.V. side for variation in equal 13-17 steps from + 7.5% to –10%
n)	Oil characteristics	To be confirmed

### 9.2 ON LOAD TAP CHANGER:

The tap changer is to comply with IEC 60214 recommendation. Each transformer shall be equipped with on load tap changer suitable for the rated current of the transformer (+ 20 % over load) on-load tap changer of modern design and robust construction of MR type VACUTAB (machine - fabrick Reinhausen of West Germany). The current breaking contacts shall be contained in a separate oil tank. The tap changer shall be easily accessible so that it could be inspected and if necessary removed without having to remove the cover of main tank. The mechanism derive shall be (ED) type, designed to be controlled through push buttons. In addition to manual operation by means of a suitable operating handle, necessary interlock shall be provided to prevent simultaneous operation of manual and electric drive. The tap changer motor shall be designed for 3 - phase , 416 volt A.C. supply the tap changing process once initiated must be completed even in case of power failure to the driving mechanism .



It shall not be possible for the tap changer to be left in an intermediate position. The tap changer control circuit should be provided with protective device against short circuit when the tap changer is in operation. (To prevent operation of tap changer during short circuit ).

The mechanism, fuses, relays and control equipment shall be housed in a suitable weather proof metallic cabinet mounted on the transformer .

### 9.3 FITTINGS AND ACCESSORIES:

The following fittings and accessories shall be provided:

- a. Conservator to be provided with filter cap and drain valve and a shut – off valve between the conservator and transformer tank .
- b. Oil level gauges marked to indicate normal level at 20 °C one at each side of the conservator one for transformer oil and the second for the tap changer oil.
- c. Explosion vent, double diaphragm type, with port – hole type oil level gauge. With one contact for tripping.
- d. Dial type thermometer to indicate top oil temperature with maximum reading pointer and 2 sets of contacts suitable for alarm and trip.
- e. Winding temperature indicator to indicate the hottest spot temperature of the winding with maximum reading indication and two sets of contacts for alarm and trip.
- f. Drain valve plug
- g. Dehydrating breather for each part of conservator
- h. Buchholz relay, double float type and flap with alarm and trip contacts and test terminal block.
- i. Gas relay for OLTC with trip contact
- j. Manhole of adequate size to permit internal inspection of the transformer.
- k. Air release plugs on the top of the necessary transformer parts
- l. Two nos. . filter valves with caps .
- m. Rating and terminal plate to be chromium plated
- n. Two nos. Grounding pads .
- o. Lifting and jacking lugs
- p. Water proof metallic junction box to house all terminals , controls , etc
- q. Alarm and signaling relays for all control and protection equipment of the transformer. All these devices shall be mounted on the 33 kv switchgear panel or on transformer control board.

### 9.4 PAINTING

A primary coat shall be applied immediately after cleaning all ungalvanized metallic parts thoroughly.

An oil and weather resistance type second coat shall then be applied and the transformer finished in aluminum metallic paint .

### 9.5 INSULATING OIL

The transformer shall be supplied with first filling of oil. The insulating oil shall be SHELL DIALA (B) or BP "Energol" JS-V/JS-A no other Oil will be acceptable

### 9.6 TESTING OF TRANSFORMER

In addition to the routine test which shall be carried out on the power Transformer. A type test of temperature rise, and impulse withstand voltage test must be carried out on one transformer test should be carried out by KEMA or CESI or EDF of France.

### 9.7 LOSS EVALUATION

The tolerance permitted is + 10% of the evaluated guaranteed total losses mentioned in the offer. Any transformer with losses more than + 10% will be rejected for transformers with total losses within + 5% of the evaluated guaranteed losses, no variation to the contract price shall be made . For transformers where the total evaluated losses between + 5% to + 10% of the total guaranteed losses , the contract price shall be reduced by the cost of the difference between the total evaluated costs of losses and the 105% of the total evaluated losses according to the following values:-

Iron losses 1800 USD per kw.  
copper losses 600 per kw.

for any transformer with total losses less than 100% of the guaranteed losses, no variation to the contract price shall be made

**9.8 COMPENSATION FOR EXCESSIVE TEMPERATURE RISE**

If the transformer C.M.R. output must be reduced by n% to maintain the rise of temperature of any part of the transformer within the guaranteed limits, the compensation shall represent twice times n % of the corresponding F.O.B. price of the transformer .

**10. DC SUPPLY:-**

Two kinds of DC supply are required: - The first is the main DC supply for control and protection is to use (110 V) DC system consist of nickel - cadmium alkaline type battery set of (55) ampere - hour, and battery charger of (20) Amp Current rating, of floating operating mode able to supply the control and protection circuit load and at the same time to charge the battery . the R.M.S ripple voltage on the DC side shall be less than 1% of the mean DC voltage.

On the front of the charger housing shall include the following: -

Operating on/off switch with red and green lamps respectively.

DC voltmeter indicating charger or battery voltage with selector switch.

DC Ampere meter to indicate the total output current. the second emergency DC supply is to use a capacitor storage units instead of the main DC in case of low or failure of DC voltage of battery and battery charger set. the charging of these capacitors shall be from the auxiliary transformer through rectifier , and this supply is to feed all protection and tripping circuit of 33kv and 11kv C.B including protection circuit of transformer tripping relay.

**10.1 DC DISTRIBUTION BOARD**

Consist of necessary MCCB and MCB's with suitable current ratings and sufficient number to fulfill all requirement of the DC distribution. DC under voltage and earth fault relay & indicators to be provided. voltage & current meters are required.



## **11. CONNECTION**

The required arrangements regarding the connection between the substation with the network and transformer with the switchgear shall be as follows:

### **11.1 33KV CONNECTION**

The incoming connection to the 33 kV isolator shall be by a flexible single core cable with one end to be permanently connected to the incoming side of the isolator, or be connected after rewound the cable so the box to be of air insulated and easily worked. The other end to be of clamp for over head line connection operated from the ground by the telescopic insulating rod (the rod is to be part of the S/S).

### **11.2 11 KV CONECTIONS :**

The outgoing feeders of the 11 KV switchgear shall be connected to the line as for the 33KV side.

### **11.3 TRANSFOMER CONNECTION**

The connection between transformer with H.T & L.T switchgear shall be single core cables. All the connection & live parts to be protected against direct touch so that the connection to the transformer on 33KV and 11KV sides shall be through plug – in termination.

### **11.4 CABLES**

The 33&11kv cables are to be of flexible type EPR single core copper conductor and according to IEC recommendation:

The 33kv cable for incoming to be 3× 1× 150 sq mm cross section EPR type of 30 meter length with suitable clamps.

The 11 kV cable for outgoing to be 3× 1× 150 sq mm cross section EPR type of 50 meter length for each feeder.

For transformer connection the cables to be 3× 1× 150 sq mm XLPE TYPE ON 33KV SIDE AND 6× 1× 400 sq mm XLPE type on 11kv side for 16 MVA mobile substation and 3×1×400 Sq. mm. XLPE type for 10 MVA substation. Each cable has to be mounted on moving drum with arrangement for the connection on the side of the switchgear, the drum to be mounted on a stand fixed to the trailer with easy movable action for pulling & rewinding the cable.

## **12. EARTHING THE NEUTRAL POINT OF THE TRANSFORMER:-**

The neutral point of the 11 kV side of the transformer to be earthed through an earthing resistance of 21.1 OHM . 11KV 300 AMP rated current 30 sec-rated time. The housing of the resistance should include 11KV 400 AMPS on – load isolator and 7.3 KV arrester. Detailed design specification, descriptions, catalogues, methods of mounting to be submitted with the offer which include :

- Anticorrosion methods for resistor plates .
- Temp. rise curves
- The effect of the mechanical stresses on the resistor during faults.

The resistor shall be equipped with 300-150/5 A CT and E/F relay to be provided

## **13. AUXILIARY SUPPLY**

### **13.1 AUXILIARY TRANSFORMER:-**

An auxiliary transformer of (33/0.416) KV voltage and 50 KVA rating Oil immersed hermetically sealed to be supplied completed with all necessary fitting such as off load tap changer, pressure relief valve and mechanical oil level indicator. to be protected by 33kv switch fuse combination with suitable 33kv, 5Amp HRC fuses. The switch must be open automatically when each fuse has blown.

### **13.2 AC DISTRIBUTION BOARD**

Consist of necessary MCCB and MCB's with suitable current ratings of sufficient number to fulfill all requirements of the AC distribution. AC under voltage and earth fault relays and indicators to be provided. Voltage & current meters are required.

**SCHEDULE "A"**

**SCHEDULE OF GUARANTEED PERFORMANCE AND OTHER TECHNICAL PARTICULARS**

The schedule is to be fully completed by the tenderer to provide detailed characteristics of the equipment and materials offered, which shall be guaranteed. This is an important point which shall be taken into consideration during tender analysis.

**TRANSFORMERS:**

#	Description	Unit	Specification offered
1	Name of manufacturer		
2	Country of origin		
3	Standard on which performance data is based		
4	Continuous maximum rating for the specified temperature rise and ambient temperature ( vide class 5(1)-(KVA) a. ONAN rating		
5	Rated temperature rise		
	a- Oil by thermometer	°C	
	b- Winding by resistance	°C	
6	Hottest spot temperature		
7	No-load voltage ratio at normal tap		
8	Exciting current referred to H.V.50 HZ	Amp.	
	a- 90% rated voltage		
	b- 100% rated voltage		
	c- 110% rated voltage		
9	Power factor of exciting current at 100% rated voltage and 50 Hz		
10	Iron losses at 50 Hz and at	kw	
	a- 90% rated voltage		
	b- 100% rated voltage		
	c- 110 % rated voltage		
11	Copper losses at full load (ONAN) rating at 75 °C	Kw	
12	Total losses	Kw	
13	Resistance voltage at full load and at 75° C	%	
14	Reactance voltage of full load and at 75° C	%	
15	Impedance voltage at full load and at 75 °C	%	
	a- At normal tap		
	b- At highest tap		
	c- At lowest tap		
16	Resistance of H.V. winding per phases at 20°C	Ohm	
17	Resistance of L.V winding per phase at 20° C	Ohm	
18	Regulation at full load 75° C		
	a- 1.0 power factor		
	b- 0.8 P.F lagging		
19	Efficiency at 75° C	%	
	a- 100% load		
	b- 75%		
	c- 50%		
	d- 25%		
20	Calculated thermal time constant (ONAN)	Hrs	
21	Maximum flux density at normal voltage and frequency and at normal ratio	(KI/ eq.cm)	
	a- Core		
	b- Yoke		
22	Maximum flux density at 110% voltage and	(KI/ eq.cm)	



**TECHNICAL SPECIFICATION FOR INDOOR CIRCUIT BREAKER**

#	Description	Unit	specification offered	
			11kV	33kV
1	Make			
2	Type			
3	Normal rated voltage	V		
4	Normal current rating	A		
5	Breaking capacity			
	a-Symmetrical	KA(r.m.s)		
	b- symmetrical	MVA		
	b-Asymmetrical	KA(r.m.s)		
6	Making capacity	KA peak		
7	Rated short time current	1 sec		
8	Capacitive breaking current	A		
9	Capacitive making current	A		
10	Certification for the above capacities			
	a- Name of certifying authority			
	b- Number of certificates issued by the Authority a copy of which is enclosed with the tender			
11	Impulse voltage withstand 1.2/50 wave	K.V crest		
12	Standard 1 min.50 Hz withstand voltage	K.V(r.m.s)		
13	temperature rise of main contacts continuous operation at rated current			
14	Opening time			
	a- Without current	msec		
	b- At 100% breaking current	msec		
15	Total break time	msec		
16	Making time	msec		
17	Type of closing mechanism			
18	Power at normal voltage for shunt trip coils	w		
19	Minimum clearance in air			
	a- between phases	mm		
	b- between live part & earth	mm		
20	weight of complete circuit breaker	kg		

**TECHNICAL SPECIFICATION OF CURRENT TRANSFORMERS**

#	Description	Unit	specification offered	
			11kV	33kV
1	make			
2	Impulse voltage withstand (1.2/50 wave)	KV(peak)		
3	1 min.power frequency withstand voltage	KV.(r.m.s)		
4	Rated short time current (3 sec)	K.A(r.m.s)		
5	Temperature rise of windings on continuous operation at rated current & output	°C		
6	For feeder circuit:			
	a- Type			
	b- Accuracy class			
	c- Transformation ratio			
	d- Current ratio error	%		
	e- Phase displacement	min		
7	For transformer circuit:			
	a. Over current & instrument			
	1- Type			
	2- Accuracy class			
	3- Transformation ratio			
	4-Current ratio error			
	5-Phase displacement			
	b. Differential			
	1- Type			
	2- Accuracy class			
	3- Transformation ratio			
	4- Correction C.T. ratio			
	5-Current ratio error			
	6-Phase displacement			
8	For metering transformer circuit			
	1- Type			
	2- Accuracy class			
	3- Transformation ratio			
	4-Current ratio error			
	5-Phase displacement			
9	For metering Auxiliary Transformer circuit			
	1- Type			
	2- Accuracy class			
	3- Transformation ratio			
	4-Current ratio error			
	5-Phase displacement			



**TECHNICAL SPECIFICATION OF THE VOLTAGE TRANSFORMER**

#	Description	Unit	specification offered	
			11kV	33kV
1	make			
2	type			
3	rated output	VA		
4	Rated frequency	Hz		
5	Number of phases (3 phase/single phase)			
6	Transformer ratio			
7	Accuracy class			
8	Ratio error	%		
9	Phase displacement	min		
10	Temperature rise limit at rated primary voltage	C		
11	Rated voltage factor (1,9 for 8 hrs )			
12	Fuse protection			
	a- Rated primary side	A		
	b- Rated secondary side	A		
13	Insulation level	A		
	a- Impulse withstand voltage	KV(peak)		
	b- 1 min. power frequency withstand voltage	KV(r.m.s)		
14	Dimensions			
	a- Length	mm		
	b- Width	mm		
	c- Heigh	mm		

**TECHNICAL SPECIFICATION FOR THE SWITCHGEAR**

#	Description	Unit	specification offered	
			11kV	33kV
1	make			
2	type			
3	Bus Bar			
	a- Normal current rating	A		
	b- Temperature rise on continuous operation at normal current	°C		
	c- Cross sectional area	mm <sup>2</sup>		
	d- Insulation of Bus Bar			
	e- Maximum working temperature of busbar insulation	°C		
	f- Bus bar joints insulation			
	g-- Minimum clearance between phases	mm		
	h- Minimum clearance between phases & earth	kV		
4	Service voltage	kV		
5	Highest voltage	kV		
6	Impulse withstand voltage	K.V(peak)		
7	1 Min. power frequency withstand voltage	K.V(r.m.s)		
8	Dimension			
	a- length	mm		
	b- width	mm		
	c- height	mm		

**SCHEDULE (B)**  
**OIL CHARACTERISTICS TABLE (TO BE COMPLETED BY THE TENDERER)**

Sl. No.	DESCRIPTION	UNIT	SPECIFICATION
1.	MAKERS NAME		
2.	REFERENCE NAME OF OIL		
3.	SLUDGE VALUE	%	
4.	FLASH POINT (CLOSED)	C°	
5.	POUR POINT	C°	
6.	VISCOSITY AT 21 C°	CST	
7.	ELECTRIC STRENGTH (BREAK DOWN VOLTAGE)	KV	
8.	ACIDITY (NEUTRALIZATION VALUE) - TOTAL - INORGANIC	MG/ KOH/G	
9.	SAPONIFICATION VALUE	MG/ KOH/G	
10.	COPPER DISCELERATION		
11.	CRACKLE		
12.	SPECIFIC GRAVITY		
13.	SULFER CONTENT		
14.	DIELECTRIC DISSIPATION FACTOR		



LIST OF SPARE PAPTS PRICES

#	DESCRIPTION	UNIT PRICE
1	33KV C.T	
2	11KV C.T	
3	O /C & E/ F RELAY	
4	E/F RELAY FOR OPEN DELTA	
5	E/F RELAY FOR TRANSFORMER NEUTRAL POINT	
6	AUX . RELAY	
7	INDICATION LAMPS WITH HOLDERS	
8	PUSH PUTTON	
9	FLAG RELAY	
10	AMMETER	
11	BATTERY CELL	
12	VOLTMETER	
13	S . S FOR VOLT – MFTR	
14		
15	SET OF CASKET FOR 16MVA TR.	
16	33 KV TR BUSHING	
17	11 KV TR BUSHING	
18	OIL LEVEL GUAGE	
19	OIL TFMP. INDICATOR	
20	WIND. TFMP. INDICATOR	
21	DEHYDRATING BREATHER	
22	BUCHHOIZ RELAY	
23	GAS RELAY FOR O. L. T. C	
24	MOTOR FOR O.L.T.C	
25	PLUGIN TERMINATION 33KV	
26	PLUGIN TERMINATION 11KV	
27	33KV C.B COMPLETE	
28	33KV C.B. MECHANIZIM	
29	33KV C. B. POLE	
30	33KV C. B. CLOSING COIL	
31	33KV C. B. TRIPPING COIL	
32	33KV C. B. MOTOR	
33	33KV C. B. ANTI PUMPING RELAY	
34	11KV C.B COMPLETE	
35	11KV C. B. MECHANISIM	
36	11KV C. B. POLE	
37	11KV C. B. CLOSING COIL	

	DESCRIPTION	UNIT PRICE
38	11KV C.B TRIPPING COIL	
39	11KV C. B. MOTOR	
40	11KV C. B. ANTI PUMPING RELAY	
41	TRANSFORMER INSULATING OIL IN BAREL OF 200 LITERS	
42	DESCRIPANCY CONTROL SWITCH	
43	M .C.B	
44	ELECTRONIC CARD OF BATTERY CHARGER	
45	LAMPS	
46	SPARE TYRES FOR TRAILER	

## 21. SCHEDULE OF MATERIALS FOR 10MVA MOBILE S/S

### 21.1 33KV SWITCHGEAR :-

#### 21.1.1 33KV INCOMING SWITCHGEAR:

- One set of 33kv lightning arresters (30kv, 10kA)
  - On load 33kv 630 A line isolator interlocked with circuit breaker
  - 33kv cables 150 sq. mm. EPR 30 meter each phase.
  - 33KV fault making earthing switch interlocked with line isolator & C.B
  - Neon lamp indicator to indicate that the 33kv cable is under voltage.
- Three single phase V.T. rated  $\frac{33000}{\sqrt{3}} / \frac{110}{\sqrt{3}}$  V , 200 VA star connected windings to provide voltage measurement and capacitor unit charging.

#### 21.1.2 33KV TRANSFORMER SWITCHGEAR:

- One 33kv circuit breaker rated 630A withdrawable Type.
- One control lamp - pattern discrepancy switch .
- Corresponding section of mimic diagram.
- 3 current transformer ratio 200/5/5/1 for instrumentation and protection and third core for differential protection (200/1)
- Three ammeters scale (0 -200) .
- One set of over current and earth fault IDMTL electronic relay.
- One healthy - trip lamp with push - button.

#### 21.1.3 33KV auxiliary transformer switchgear

The 33kv auxiliary bay consist of the following:-

- switch fuse rated 5 AMP.
- blown fuse of any of the three phases cause 3 phase opening of the switch.
- Trans former within the cubicle 33/0.416 kv 50 KVA connection Dyn11, with L.T. neutral is solidly earthed and supplied with off – load tap changer.



**21.2 11kv switchgear :**

The 11 kv switchgear shall be comprising the following:-

**21.2.1 11KV INCOMING FEEDER:-**

The panel shall contain the following equipment:

- one set of insulated bus - bar in air insulated bus - bar chambers
- One 11 kv circuit breaker rated (1250) amp.
- One control lamp pattern discrepancy switch.
- 3 current Transformers 600/5/5/1 amp for instrument and protection
- Three ammeters scale (0-600) amp.
- One set of over current and earth fault relay type IDMTL electronic type.
- One set of 3 single phase voltage transformer protected by fuses rated  $\frac{11000/110/110}{\sqrt{3} \sqrt{3} 3}$  VOLT with open delta connection for protection.
- Differential relay with matching current Transformers star connected.
- One voltmeter scale (0-12) kV with selector switch
- Three lamps for E/F indication.
- E/F over voltage relay connected to open delta.
- E/F relay for transformer neutral earthing resistor.
- TAP position indicator for O.L.T.C
- One healthy trip lamp with push - button.

Transformer protection indication relays (BUCHHOLZ, Oil. Temp., WINDING .Temp., GAS RECIEVER, PRESSURE RELIEF VALVE.)

**21.2.2 11 KV OUTGOING FEEDERS:-**

Consist of two cubicles each comprising the following:

- One set of insulated bus bar in air insulated bus bar chamber.
- One circuit breaker rated 630AMP
- C. B. indication ON/OFF.
- one control lamp - pattern discrepancy switch.
- 3 current transformers with the ratio 600- 300 /5/5A with suitable output and for instrument and protection.
- Three ammeter scale (0 - 300, 600A).
- One healthy - trip visual lamp with push - button.
- One set of over - current and earth - fault relay IDMTL electronic type.
- One earthing switch fully interlocked with C. B.
- Neon lamp to indicate that the 11kvcable is under voltage.

**21.3 CABLES AND CONNECTION :**

33kv cables 3x 1x 150 sq. mm. X LPE ( connection to transformer ).

33kv cable 3x 1x 150 sq. mm. EPR (flexible type) 30 meter with suitable clamps (for incoming feeder).

11kv cable 3x 1x 400 sq. mm. X LPE ( connection to transformer)

11kv cables 3x 1x 150 sq. mm EPR (flexible type) 50 m (outgoing feeders)

Transformer protection indication relays (BUCHHOLZ, Oil. Temp., WINDING Temp., GAS RECIEVER, PRESSURE RELIEFVALVE.)

#### 22.2.2 11 KV OUTGOING FEEDERS:-

Consist of three cubicles each comprising the following:

- One set of insulated bus bar in air insulated bus bar chamber.
- One circuit breaker rated 630AMP
- C. B. indication ON/OFF.
- One control lamp - pattern discrepancy switch.
- 3 current transformers with the ratio 600- 300 /5/5A with suitable output and for instrument and protection.
- Three ammeter scale (0 - 300, 600A).
- One healthy - trip visual lamp with push - button.
- One set of over - current and earth - fault relay IDMTL electronic type.
- One earthing switch fully interlocked with C. B.
- Neon lamp to indicate that the 11kvcable is under voltage.

#### 22.3 CABLES AND CONNECTION :

33kv cables 3x 1x 150 sq. mm. X LPE ( connection to transformer ).

33kv cable 3x 1x 150 sq. mm. EPR (flexible type) 30 meter with suitable clamps (for incoming feeder).

11kv cable 6x 1x 400 sq. mm. X LPE ( connection to transformer)

11kv cables 3x 1x 150 sq. mm EPR (flexible type) 50 m ( outgoing feeders)

#### 23. SCHEDULE OF COMMON MATERIAL FOR BOTH (10&16) MVA MOBILE S/S.

##### 23.1 NEUTRAL EARTHING RESISTOR AS MENTIONED IN ITEM (12)

##### 23.2 DC SUPPLY AS MENTIONED IN ITEM (10)

##### 23.3 CONTROL BOARD:-

The transformer control board contain auxiliary relays, horn for trip singal, bell for alarm signal with selector switch and lamp for each to stop the sound and to glow a lamp for permanent signal, signalling lamps, auxiliary relays, and flag relays to indicate all tripping and alarm signals with reset push - button as follows :-

1- Buchholz	trip
2- Winding temperature	trip
3- Oil temperature	trip
4- Gas receiver of O.L.T.C	trip
5- Pressure relief valve	trip
6- Buchholz	alarm
7- Winding temperature	alarm
8- Oil temperature	alarm
9- Low oil level	alarm
10- O.L.T.C AC failure	alarm

other flag relays are required:

11- O/C & E/F relays on 33kv	trip
12- O/C & E/F relay on 11kv	trip
13- E/F relay of N.E.R	trip
14- E/F relay of open - delta	trip



23.4 AC and DC distribution boards: contains AC and DC MCCB's and MCB's of sufficient number the following flag relays are required:-

- |                             |       |
|-----------------------------|-------|
| 1- MCB's OFF                | alarm |
| 2- D.C Fail and earth fault | alarm |
| 3- AC Fail and earth fault  | alarm |

24. SAFTY EQUIPMENT

- |                            |       |
|----------------------------|-------|
| portable fire extinguisher | 2.nos |
| H.V test hot stick         | 1.no  |
| H.V insulation gloves      | 2 nos |
| flat ladders               | 2nos  |
| Telescopic insulating rod  | 1no   |

EARTHING EQUIPMENT:-

- |                          |       |
|--------------------------|-------|
| Earthing rods            | 6nos  |
| Suitable connector clamp | 6 nos |

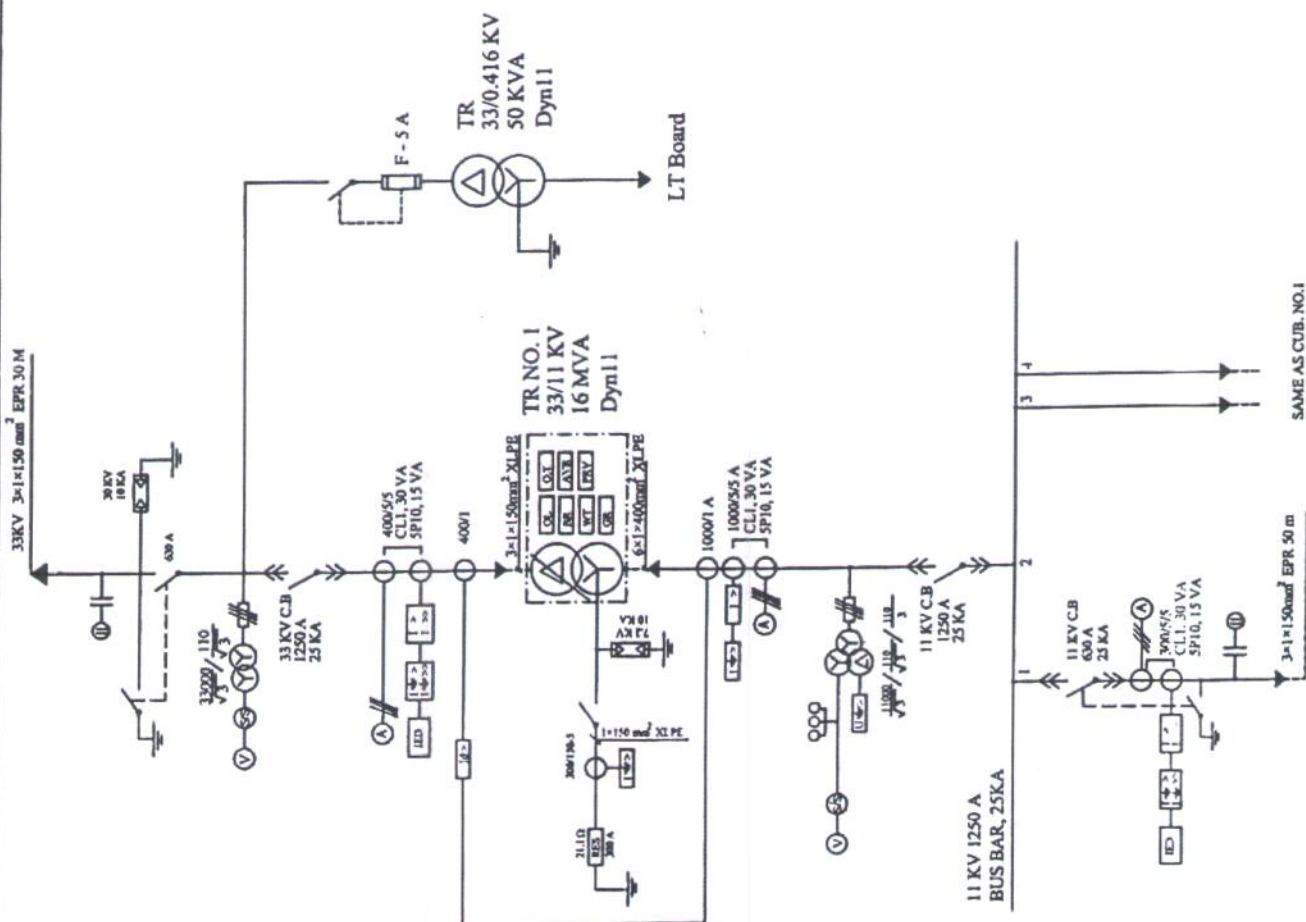
NOTES

- Ordinary and emergency lighting should be provided
- Single line diagrams for mobile 10MVA and 16 MVA substations are enclosed.

25. SCHEDULE OF PRICE ( WITHOUT SPARE PARTS)

- 33KV Switchgear
- 11KV Switchgear
- Power transformer
- 33KV cables
- - 11kV cables
- Auxiliary transformer, dc supply and control boards for signaling and AC. D.C distribution .
- Safety and earthing equipment.
- Trailer & kiosk.

LEGEND	
Ⓐ	AMMETER
BR	BUCHOLZ RELAY
GR	GAZ RECEIVER
OL	OIL LEVEL
OLT	OIL TEMP
WT	WINDING TEMP
PRV	PRESURE RELIEF VALVE
SS	SELECTOR SWITCH
1-2	OVER CURRENT WITH INSTANTENUS RELAY
1-2	EARTH FAULT RELAY WITH INSTANTENOUS
1-2	OVER CURRENT RELAY
1-2	EARTH FAULT RELAY
UBR	UNBALANCE RELAY
U	OVER VOLTAGE RELAY
LD	LIGHTNING ARRESTOR
LO	LAMP VOLTAGE INDICATION
1-10	NEON LAMP VOLTAGE INDICATION
100	for SCADA in each panel



MINISTRY OF ELECTRICITY

33/11 KV Mobile S/S 1x16 MVA

### Single line diagram

**APPROVED BY:**  
**COMMITTEE OF M.**

**CHECKED BY:**  
**COMMUNITY OF M**

YEAR 2009