

UNITED ARAB EMIRATES

FEDERAL ELECTRICITY AND WATER AUTHORITY

33 kV, 20 MVAR CAPACITOR BANK

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1.0 SERVICE CONDITIONS

The capacitors shall be suitable for the severe atmospheric conditions specified in Volume - II, section 2-1.1

The capacitors shall be designed for the system voltage level and short circuit levels specified in Volume - II, section 2- 1.2

The capacitors shall withstand at least the following over voltage conditions:

110% of normal system voltage for 12 hours in every 24 hours.

115% of the normal system voltage for 30 minutes in every 24 hours.

120% of the normal system voltage for 5 minutes

130% of the normal system voltage for 1 minute

Capacitor units shall be suitable for continuous operation at an r.m.s. current of 1.30 times the current that occurs at rated voltage and rated frequency.

2.0 TYPE AND RATING

The rating of the bank shall be fixed and standardized to 20 MVAR at 33 kV. The capacitor banks shall be of open terminal type and shall be suitable for outdoor installation.

3.0 CONSTRUCTION

The capacitors shall be generally in accordance with IEC 871. The capacitors shall be of PCB free type.

The capacitor units are to be built into galvanized steel racks/aluminium racks and supported wherever necessary by porcelain insulators.

The capacitors shall be free from ionization and corona discharges. The capacitors bank shall have provision for termination of 33 kV, single core, XLPE cables.

4.0 PROTECTION

Each capacitor unit shall be protected by an internally mounted fuse.

The double star connected capacitors will be protected by a relay, which detects unbalance/residual current in the capacitor banks, through a current transformer connected between the two star neutrals. The rating of the Neutral CT will be 10 -5 /1 Amps. The exact parameters for the same will be furnished during detailed design stage.

The number of switching operations of the capacitor bank shall be restricted to 10 switching operations per hour. Suitable timers and contacts shall be utilized in the opening and closing circuits to achieve the above.

5.0 DISCHARGE DEVICE

Adequate arrangement is to be provided for the discharge of capacitors. The discharge time from 130% of the nominal voltage to 75V shall be less than 10 minutes for capacitors and capacitor banks.

The discharge device shall be mounted internally, in the capacitor unit. There should be no switch fuse or any other isolating device between the capacitor unit and the discharge device. One three-phase bank shall have two discharge reactors connected between phases.

6.0 INRUSH CURRENT

To prevent the inrush current on energisation of capacitors, inrush current limiting reactors shall be provided on each phase.

7.0 MARKINGS

Markings on the capacitors and on the banks shall be as per IEC 871.

8.0 SAFETY FEATURES

Safety features shall be an important criterion for the evaluation of capacitor manufacturers.

Fault developed in a single capacitor unit shall not affect other equipment. Neither over pressure, nor fire damages outside the faulty unit shall occur.

Detailed design of the above shall be within the scope of manufacturer and shall be subject to approval of FEWA and will be implemented by installation contractor.

The access control door to the capacitor bank room shall be mechanically and electrically interlocked such that the gate can be opened only after the capacitor bank is switched off and the discharging of the capacitor has been successfully completed. The doors, fittings, accessories shall be from reputed manufactures and the building contractor shall incorporate the facilities as specified above.

In addition to the earthing facility in the 33kV capacitor feeder panel, a visible earth switch will be provided near the capacitor bank and the safe operation of the same will be ensured by suitable interlocks.

9.0 TESTS

9.1 TYPE TESTS

Type test reports for following tests performed on Capacitor unit as per IEC 871, where applicable, shall be submitted.

- (a) Thermal stability test
- (b) Capacitor loss tangent (tan delta) measurement at elevated temperature

- (c) A.C. voltage test between terminals and container
- (d) Lightning impulse voltage test between terminals and container
- (e) Short-circuit discharge test

The identical design of the same rated capacitors shall be type tested as per relevant IEC standards at an independent internationally reputed test laboratory and the test reports shall be enclosed along with offer. In case such test reports are not available, the type test shall be performed at an independent internationally reputed test laboratory in presence of FEWA Engineer with in the quoted price and tenderer shall bear all the cost for type testing including cost of witness inspection by Authority's Engineer.

9.2 ROUTINE TESTS

Routine tests shall be carried out in accordance with IEC 871 on all capacitors and these shall include the following tests, but not necessarily be limited to them:

- (a) Capacitance measurement
- (b) Measurement of tangent of the loss angle ($\tan \delta$) of the capacitor
- (c) Voltage test between terminals
- (d) A.C. voltage test between terminals and container
- (e) Test of internal discharge device
- (f) Sealing test
- (g) Discharge test on internal fuses

Routine tests shall be performed in all units in presence of FEWA Engineer, however, the cost of airfare, accommodation, visa etc. will be borne by FEWA and the cost of same shall not be included in the quoted price.

10.0 STANDARDS

IEC-871 Shunt capacitors for A.C. power systems having rated voltages above 1000V.

APPENDIX 1

CORROSION PROTECTION

Cleaning, Painting and Finishing

It is to be borne in mind that the atmosphere at the site is highly corrosive. Therefore special attention should be given for the protection of all ironwork. The methods proposed and the means adopted for the rust proofing should be fully described in the tender.

The following would indicate in general the minimum requirement, which the tenderer should take into account while submitting his own proposal.

a. Cleaning

All surfaces shall be thoroughly cleaned and freed from rust, scale, grease, dirt and other foreign matter. Sharp points, weld spatters, flux or other imperfection shall be removed. The interior of all tanks and other oil filled chambers shall be cleaned of all scale and rust by sandblasting or other approved methods.

b. Painting

Immediately after cleaning, a primary coat of red lead or other approved primer shall be applied. After the application of the first primary coat all rough surfaces shall be rubbed down and filed and a second coat of red or other approved primer applied. This shall be followed for outdoor equipment by the application of two coats of approved epoxy paint of colour RAL-7032 (finish coat paint thickness shall be more than 80 microns).

For indoor equipment, after the application of the two primary coats, two coats of high-class paint shall be applied. The final coat shall a glossy finish of colour RAL-7032 (finish coat paint thickness shall be more than 80 microns).

The interior of all tanks and other oil filled chambers, after necessary preparation and cleaning as described in 'a' above, shall be painted with an oil resisting varnish or enamel.

All paint and/or enamel shall be applied by the brush or sprayer. Dipping shall be permitted. A first class blemish free pleasing finish shall be obtained. Sufficient paint shall be provided for all necessary touching up on site after erection.

Damage to paint work incurred during transport up to delivery to stores/site shall be made good by thoroughly cleaning the damaged portion and applying the full number that had been applied before the damage was caused. A matching finish shall be obtained satisfaction of the Authority.

c. Plating

Parts which are normally plated in hard chromium finish.

d. Galvanizing

Materials to be galvanized shall be of full dimensions shown or specified, and all punching, cutting, drilling, screw tapping and the removal of burrs is to be completed before the galvanizing process commences.

Galvanizing shall be done by the hot dip process with spelter not less than 98% of which must be pure zinc. No alternative process may be used without the approval of the Authority. No components may be galvanized which are likely to come into subsequent contact with oil. Bolts shall be completely galvanized including the threads. The zinc coating shall be uniform, clean, smooth and as free from spangle as possible.

In the case of component parts, galvanizing shall be in accordance with BS 729 and the minimum zinc coating shall be 915 g/m² (127 micron). Galvanized wire for general purpose shall comply with the requirement of BS 183, galvanized wire for cable armouring shall comply with BS 1442. the weight of zinc coating on wires shall be according to BS 443.

Nuts and bolts shall be galvanized to comply with requirements of BS 729. galvanized parts shall be protected from injury to the zinc coating due to differential aeration and abrasion during periods of transit, storage and erection. Damaged areas of the coating shall be brushed up with an approved metallic zinc rich priming paint complying with BS 4652.

APPENDIX 2

SMALL WIRING

All control panel wiring, secondary control wiring in circuit breakers, motor starters, control gear and the like shall be carried out in a neat and systematic manner with cable supports clear of the panels and other surfaces at all points to obtain free circulation of air.

In all cases, the sequence of the wiring terminals shall be such that the junction between multicore cables and the terminals is effected without crossover. Claw washers or crimped connectors of approved type shall be used to terminate all small wiring. Insulators bushes shall be provided where necessary to prevent the chafing of wiring.

All panel wiring shall conform to the requirements of IEC 228 and BS 6231. The conductors shall have a minimum cross section equivalent to 50/0.25mm (2.5 mm²) or 7/0.67mm (2.5mm).

Wire colours shall be as follows:

Colour of wire	Circuit Particulars
Red	Red-phase connections in current and voltage transformer circuits only
Yellow	Yellow-phase connections in current and voltage transformer circuits only
Blue	Blue-phase connections in current and voltage transformer circuits only
Green-Yellow	Connections to earth
Black	A.C. neutral connections, earthed or unearthed, connected to the secondary circuits of current and voltage transformer. A.C. connections other than those above, and connections in a.c/d.c. circuits
Grey	Connections in d.c. circuits

Wiring diagrams shall indicate wire colours. All diagrams shall be drawn as viewed from the back of the panel and shall state the highest number in any group.

All wires shall be fitted with numbered ferrules of approved type at each termination. The same ferrule number should not be used on wires forming connections not directly in series or parallel in the same panel. At points of interconnection between wiring, where a change of numbering cannot be avoided, double ferrules shall be provided. Such points shall be clearly indicated on the wiring diagram.

The ferrules on all wiring directly connected to circuit breaker trip coils, tripping switches etc. shall be of a colour, preferably red, different from that of the remainder and marked "trip".

No wires may be teed or jointed between terminal points.

Electrical wiring and instruments shall be so located that leakage of oil or water cannot affect them.

Bus wiring between control panels, etc. shall be fully insulated and be completely segregated from the main panel wiring.

All metallic cases of instruments, switches, relays etc. mounted on control panels or in cubicles steel or otherwise, shall be connected by means of bare copper conductors of not less than 2.5 mm² section to the nearest earth bar.

All wiring when made up completely is to be capable of withstanding a minimum HV test of 2000 Volt RMS for one minute applied between each core and earth.

Sl.No.	Description	Unit	Value
1.	Manufacturer & Country of origin		
2.	Type		
3.	Voltage Rating		
4.	Rated frequency		
5.	Capacitance of single capacitor unit	MFD	
6.	Rated current per phase – unit/bank	A	
7.	Output of capacitor unit/bank at rated voltage	KVAr	
8.	Continuous over voltage withstand	%	
9.	Dielectric material		
10.	Impregnant material		
11.	Maximum permissible voltage	V	
12.	Maximum permissible current	A	
13.	Residual Voltage	V	
14.	Capacitor losses at 40 ⁰ C per unit	KW	
15.	Tangent of the loss angle of capacitor		
16.	Capacitance tolerance for capacitor units	%	
17.	Rated capacitance per phase per unit	μF+ 5%	
18.	Permanent raise/drop of system voltage by switching on / off	%	
19.	Fault level at 40 ⁰ C	MVA	
20.	Variation of capacitance with temperature	Curve	
21.	Risk of case bursting to be guaranteed	Yes/No.	

Sl.No.	Description	Unit	Value
22.	Fire proof design	Yes/No.	
23.	Maximum temperature rise at continuous full load	⁰ C	
24.	Overload	%	
25.	Weight of capacitor bank	Kg	
26.	Insulation level of capacitor unit :-		
a)	Units with full insulation to container		
b)	Units with containers insulated from earth		
c)	Insulation across phase of the capacitor bank		
d)	Insulation across phase to phase of the capacitor bank		
e)	Lightning impulse withstand voltage	kV	
f)	Power frequency withstand voltage	kV	
g)	Creepage distance (enclosed insulators)	mm/kV	
h)	Creepage distance (outdoor)	mm/kV	
27.	Container		
a)	Material		
b)	Thickness	mm	
28.	Painting		
a)	Painting system		
b)	Thickness	micron	

Sl.No.	Description	Unit	Value
29.	Discharge Device		
a)	Type of discharge device		
b)	Discharge time per bank	Sec	
c)	Nominal voltage	kV	
d)	Maximum voltage	kV	
e)	Lightning impulse withstand voltage	kV _{rms}	
f)	Power frequency withstand voltage	kV _{peak}	
g)	Manufacturer		
30.	Current Limiting Reactor		
a)	Damping reactance	Mh	
b)	Nominal voltage	kV	
c)	Maximum voltage	kV	
d)	Insulation level	kV	
e)	Nominal current rating	kA	
f)	Continuous over current	%	
g)	Thermal short circuit rating	kA	
h)	Dynamic short circuit rating	kA	
i)	Total phase losses	W/kVAr	
j)	Type		
k)	Manufacturer		

Sl.No.	Description	Unit	Value
31.	Neutral CT		
a)	Ratio		
b)	Class		
c)	Burden & V_k		
d)	R_{ct} at 75	Ohms	
e)	Magnetizing current I_{mag}	mA	
f)	Manufacturer		

Signature : _____

Designation : _____

Name of Tenderer ; _____

Date : _____