

Saudi Electricity Company



الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION

43-SDMS-01

DATE: 29-03-2005G

43-SDMS-01

SPECIFICATIONS

FOR

**MV SHUNT POWER CAPACITOR BANK
UP TO 36 KV**

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subject to change or modification without any notice**



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1.0 SCOPE

This SEC Distribution Materials Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, inspection, testing and performance requirements of outdoor fixed/switched shunt capacitor bank, three-phase, intended to be used for the MV overhead distribution system of Saudi Electricity Company (SEC) in Saudi Arabia.

2.0 CROSS REFERENCES

This material standard specification shall be read in conjunction with SEC Specification No.01-SDMS-01 latest revision for 'General Requirement for all Equipments/Materials', which shall be considered as an integral part of this SDMS. This SDMS shall also be read in conjunction with SEC Purchase order requirements.

3.0 APPLICABLE CODES & STANDARDS

The latest revision/amendment of the following codes and standards shall be applicable for the equipment/material covered in this SDMS. In case of conflict, the vendor/manufacturer may propose equipment/material conforming to one group of industry codes and standards quoted hereunder without jeopardizing the requirements of this SDMS.

- | | | |
|-----|-------------|---|
| 3.1 | IEC 60137 | Bushings for Alternating Voltage above 1000V |
| 3.2 | IEC 60273 | Characteristics of Indoor and Outdoor Post Insulators for Systems with Nominal Voltage greater than 1000V |
| 3.3 | IEC 60549 | High-Voltage Fuses for the External Protection of Shunt Power Capacitors |
| 3.4 | IEC 60867 | Insulating Liquids-Specification for Unused Liquids Based on Synthetic Aromatic Hydrocarbons |
| 3.5 | IEC 60871-1 | Shunt Capacitors for a.c. Power systems Having a Rated Voltage above 1000V |
| 3.6 | IEC 60871-4 | Shunt Capacitors for a.c. Power systems Having a Rated Voltage above 1000V-Internal fuses |
| 3.7 | IEEE 18 | Standard for Shunt Power Capacitor |



- | | | |
|------|------------------|---|
| 3.8 | IEEE 21 | General Requirements & Test Procedure for Outdoor Apparatus Bushings |
| 3.9 | IEEE 1036 | Guide for Application of Shunt Power Capacitors |
| 3.10 | ANSI C29.9 | Wet Process Porcelain Insulators (Apparatus, Post Type) |
| 3.11 | ANSI 37.66 | Requirements for oil-filled capacitor switches for alternating-current systems |
| 3.12 | ANSI/IEEE C37.99 | Guide for Protection of Shunt Capacitor Bank. |
| 3.13 | ASTM D-2296 | Standard Specification for Continuity of Quality of Electrical Insulating Polybutene Oil for Capacitors |
| 3.14 | NEMA 107-1993 | Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus. |
| 3.15 | SES-W-1 | General Welding Criteria |

4.0 DESIGN & CONSTRUCTION REQUIREMENTS

4.1 Design Criteria

- 4.1.1 Capacitor units shall be connected in star configuration.
- 4.1.2 Switched capacitor bank shall be automatic switching type.
- 4.1.3 Capacitor bank shall consist of individual capacitors, externally fused separately, racked and grouped to make a three phase complete system, as required. The equipment shall include a common support structure for pole mounting and all necessary accessories to complete the capacitor bank installation.
- 4.1.4 Fixed/switched Shunt Capacitor bank shall be designed per IEC 60871-1 or IEEE 18, but subject to requirements of this specification. Unless otherwise specified in the data schedule, in each phase, the number of parallel groups in series and number of individual capacitor per parallel group shall be per IEEE 1036.



4.2 Ratings

Ref	Description	Unit	Specification Value		
4.2.1	Maximum Operating Voltage	kV	15.2	36	
4.2.2	BIL	kV	As per 01-SDMS-01		
4.2.3	Minimum Creepage Distance	mm	Dry	345	825
		mm	Wet	552	1320
4.2.4	Frequency	Hz	60		
4.2.5	Maximum Ambient Temperature	°C	As per 01-SDMS-01		
4.2.6	Minimum Ambient Temperature	°C	As per 01-SDMS-01		
4.2.7	Maximum Discharge Time	Minute	5		
4.2.8	Maximum Continuous Operating kvar	kVAR	172.5, 230, 345, 460		
4.2.9	Reactive Power Ratings	kVAR	150, 200, 300, 400		

4.2.10 Capacitors shall be capable of continuous operation at:

- a. rms current of 1.35 times the current that occurs at rated kVAR and rated frequency and at ambient temperature specified in 01-SDMS-01, excluding transients.
- b. 110% of rated voltage, including harmonics but excluding transients.

4.3 Capacitor Unit

- 4.3.1 Individual capacitor unit shall be made of all film type (poly-propylene) and aluminum foil.
- 4.3.2 Capacitor unit shall consist of a stainless steel or corrosion resistant aluminum. Capacitor tank shall be painted as per 01-SDMS-01 if unit is other than stainless steel.
- 4.3.3 Capacitor unit mounting bracket and provision for lifting shall be provided with the capacitor tank.
- 4.3.4 Discharge resistor shall be connected across the capacitor leads and located inside the capacitor tank and shall be capable to discharge capacitors within the specified time.



The discharge resistor shall reduce residual voltage of the capacitor unit to the limiting value as specified in applicable IEC or IEEE standard after the capacitor has been disconnected from the source of supply.

- 4.3.5 Capacitors shall be of a sealed construction to prevent breathing and the absorption of moisture.
- 4.3.6 Capacitor dielectric fluid shall be oil as per ASTM D-2296 or IEC 60867 Sheet-1 Class-III and shall not contain Polychlorinated Biphenyl (PCB) substance. Oil other than the type mentioned above having superior electrical and chemical characteristics and at least 5 years of proven field experience can also be offered for review and final acceptance by SEC.
- 4.3.7 Capacitor leads shall be brought out and terminated at porcelain/polymer bushings, which shall be hermetically sealed with the tank cover.

4.4 Capacitor Bushing

Bushings shall be electrical grade II bushing type, porcelain/polymer as per listed standards and shall be sealed such that to avoid water ingress in to the capacitor unit.

4.5 Switched Capacitor

The switch covered by this specification shall be manufactured and tested in accordance with the latest revision of ANSI C37.66 or equivalent IEC: -

- 4.5.1 The switching and protective devices and the connections should be designed to carry continuously a current of 1.3 times the current, which could be obtained with a sinusoidal voltage of r.m.s. value equal to the rated voltage at the rated frequency. Depending on the actual capacitance value, which may be at most equal to 1.15 times the value corresponding to its rated output, this current may have a maximum value of $1.3 \times 1.15 = 1.5$ times the rated current for individual units and lower values for banks.
- 4.5.2 The dielectric insulation of the switch shall be either solid polymer / oil / vacuum / SF₆.
- 4.5.3 Fluorocarbons shall not be used in the manufacture of the switch.
- 4.5.4 Interrupter shall be vacuum interruption type, other types require SEC approval.



- 4.5.5 There shall be no porcelain used on the external portion of the switch. The switch shall not chip, crack or shatter.
- 4.5.6 A manual-operating handle shall be provided as standard with load break opening and closing operations capability. The manual-operating handle also may be used for closing into fault currents up to the rated making current (minimum 12kA).
- 4.5.7 BIL shall be as per 01-SDMS-01.
- 4.5.8 Switching counter shall be provided.
- 4.5.9 The switch shall withstand a minimum of 30,000 mechanical operations. An operation shall be defined as an open and close cycle.

4.6 Capacitor Control Unit

The capacitor control shall have the following features: -

- 4.6.1 Programmable automatic control logic.
- 4.6.2 Ensures effective use and switching of the capacitor bank.
- 4.6.3 Ready for communication.
- 4.6.4 Setup via computer or face plate keypad.
- 4.6.5 User-friendly faceplate with tactile-feedback switches, standard LCD, and test points for sensor input
- 4.6.6 Real-time metering and data logging, including harmonics
- 4.6.7 Optional neutral current or voltage sensing with corrective action and retry features.
- 4.6.8 Designed to withstand with system parameters and service condition as per 01-SDMS-01.

4.7 Terminals

- 4.7.1 Capacitor terminal connectors shall be tin plated, parallel groove clamp or threaded studs type and shall be suitable for connection of copper or aluminum SEC standard conductors
- 4.7.2 Bird-proof terminal caps shall be provided when specified in data schedule.



4.8 Voltage Transformer

A Power Voltage Transformer (VT, conforming to International Standards and to be installed outside capacitor bank), with respective MV rating and preferably dual LV rating of 127V/ 231V (phase-neutral) or 220V/ 380V (phase-phase), as auxiliary source of supply shall be supplied with switched capacitor type and its cost shall be included in the respective bid price.

4.9 Grounding

4.9.1 All units shall be provided with a ground terminal with a 10 mm hole.

4.10 Capacitor Racks (Hangers)

4.10.1 Capacitor racks shall be as constructed as per 20-SDMS-01 in single pole to hold a complete 3-phase capacitor assembly taking into consideration spacing, series-parallel combinations of capacitors.

4.10.2 Racks shall be made of a corrosion resistant aluminum or structural steel (hot dip galvanized), welded or bolted together. Racks, if not galvanized shall be painted. Welding shall be in accordance with SES-W-1. Painting/galvanization shall be per 01-SDMS-01.

4.11 Radio influence voltage (RIV)

4.11.1 Radio influence voltage generated by a capacitor shall not exceed 250 μ V as per IEEE 18.

4.12 Thermal Stability

4.12.1 Capacitors shall be thermally stable in accordance with the operating conditions.

4.13 Capacitor Protection

4.13.1 Capacitor Unit Protection

- a. Each capacitor unit in the bank shall be protected by an external fuse.
- b. Capacitor bank shall have provision for installing three (3) surge lightning arresters.



4.14 Capacitor Bank Assembly

- 4.14.1 The capacitor bank shall be of rack type design and each phase of the bank shall consist of capacitor units arranged in a vertical stack and mounted horizontally on a common elevated hanger. The capacitors shall be so placed that there is adequate dissipation by convection and radiation of the heat produced by the capacitor losses.
- 4.14.2 The arrangement of the capacitor bank shall be such that adequate access for replacement of fuses or capacitor units.
- 4.14.3 The capacitor bank assembly shall include series-parallel combinations of standard voltage capacitors as per IEEE 18 or equivalent IEC standard, connectors, provision for mounting of necessary current and potential transformers/capacitor voltage transformers for capacitor bank protection and measurements, external fuses for capacitor units, surge arrestors and all necessary accessories for complete installation of the capacitor bank.
- 4.14.4 Manufacturer shall supply data on expected lifetime for the capacitor bank(s) at rated service conditions.

5.0 MARKING

Capacitor bank shall be fitted with an easily readable nameplate of weatherproof material giving the following details marked in English and Arabic:

- Manufacturer's type, model & catalogue number.
- Serial Number.
- Rated maximum voltage
- Rated Output kiloVars
- Rated frequency.
- Temperature category
- Discharge device
- Rated continuous current
- BIL
- Rated impulse withstand voltage
- Gross weight
- Connection Symbol
- P.O. Number



6.0 INSPECTION AND TESTING

6.1 In addition to the requirements specified in 01-SDMS-01, the following shall be fulfilled:

6.1.1 The Supplier shall make adequate routine tests and inspections to determine the conformity of material furnished under this Specification with the requirements invoked.

6.1.2 Inspection/Routine Test Requirements

6.1.2.1 Inspection/routine tests shall be in accordance with the applicable standards in this specification.

6.1.2.2 Visual inspection shall include checks for satisfactory workmanship, materials, and freedom from surface defects and for compliance with the Purchase Order and the General Specifications.

6.1.2.3 SEC representative may conduct acceptance inspection and witness testing at the manufacturer's plant or conduct testing at SEC facilities.

6.1.2.4 SEC representative shall have free access at any time while work is being carried on, to all areas of the Supplier's plant, which concern the work.

6.1.2.5 Inspection/routine tests may be made during all stages of manufacturing and shipping.

6.1.2.6 SEC representative may conduct acceptance inspection at manufacturer's plant or upon delivery at site. Also, SEC representative may witness testing at manufacturer's plant or conduct the testing at SEC facilities. However, inspection and acceptance shall not relieve the Supplier of his responsibility for conformance with this specification.

6.1.2.7 Materials shall be type tested, in an Independent Testing Laboratory or at manufacturer's laboratory witnessed by SEC representative, in accordance with the requirement of the latest standards in this specification.



6.2 Tests

6.2.1 Type Tests

The following tests shall be carried out in accordance with listed standards latest version: -

- Bushing test.
- Thermal stability test.
- Measurement of tangent of the loss angle of the capacitor at elevated temperature.
- AC voltage test between terminals and container.
- Lightning impulse voltage test between terminals and container.
- Short circuit discharge test.
- Test of an external fuse in combination with a capacitor.

6.2.2 Routine Tests

The following routine tests shall be carried out in accordance with listed standards latest version: -

- Capacitance measurement test
- Measurement of the tangent of the loss angle of the capacitor
- Voltage test between terminals
- AC voltage test between terminals and container
- Test of internal discharge device
- Sealing test

7.0 PACKING AND SHIPMENT

- 7.1 Shunt Capacitors shall be delivered ready for service.
- 7.2 They shall be packed in sea-worthy non-returnable crates.
- 7.3 Packing notes shall be included in each crate giving a description of goods packed.
- 7.4 Packing shall be designed to protect against mechanical damage and ingress of moisture and dust.
- 7.5 Capacitors shall not be packed in any organic material.



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- 7.6 Electrically conducting components shall be marked conducting, clearly and permanently.
- 7.7 Components or materials, if subject to a shelf life limitation, shall have the final date of use prominently and permanently shown on all cases.
- 7.8 Each crate shall be printed with the following information:
- Capacitor catalogue number.
 - Purchaser's order number.
 - Manufacturer's name.
 - Year of manufacture.
 - Gross weight in kilogram.
 - Position of slinging points and other relevant handling instructions.

8.0 SPARE PARTS

- 8.1 A comprehensive list of manufacturer's recommended spare parts shall be included.
- 8.2 The quantities offered should be adequate for the initial five (5) years of operation.
- 8.3 A firm price and delivery period shall be quoted for each item.
- 8.4 Spares supplied shall be packed to provide long storage without deterioration. Each package shall be clearly marked and labeled in Arabic and English with the description of its contents.
- 8.5 If any spare part requires special storage conditions, these conditions shall be detailed.

9.0 GUARANTEE

The supplier shall guarantee the capacitors against all defects arising out of faulty design, faulty workmanship or of defective material for a period of two (2) years from the date of delivery.

10.0 TRAINING

The supplier shall provide at site training, regarding programming and commissioning for an adequate period, to be agreed by the SEC and the supplier after supply of the capacitors.



11.0 SUBMITTALS

11.1 Submittals Required With Tender

The Bidder shall submit the following along with the Tender.

- a. The Bidder shall complete and return one copy of Technical Data Schedule.
- b. Type test reports complete as per clause 6.2.
- c. The Bidder shall also provide original catalogs giving details of the equipment being offered along with accessories available and the maintenance requirements.
- d. The manufacturer / vender shall clearly state and give a list of deviations or exceptions. Every exception / deviation shall indicate the applicable clause / section of this specification and / or associated specification and the reason for exception/ deviation.
- e. SEC reserves the right to reject any or all of the exceptions / deviations without assigning the reasons.

11.2 Submittals Required Following Award of Contract

The following submittals shall be provided by the supplier following the Award of Contract:

- a. Details of manufacturing and test schedule.
- b. Factory test reports.
- c. Detailed installation and commissioning and maintenance instructions.
- d. Literature, drawings and photographs adequate to explain in detail the functioning of the Shunt Power Capacitor Bank.

11.3 Details of Drawings Required:

The following drawings shall be provided with the tender:

- a. Detailed dimension drawings.
- b. Curve characteristics of Capacitor Bank for ratings being offered.
- c. Mounting details for pole mounted units (Capacitor Bank and Control Unit).



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12.0 TECHNICAL DATA SCHEDULE

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REF. SEC.	DESCRIPTION	SEC SPECIFIED VALUE		VENDOR PROPOSED VALUE
1	GENERAL			
1.1	Nominal System Voltage	13.8 kV	33 kV	
1.2	Maximum Continuous Operating Voltage (kV)	15.2 kV	36 kV	
2	DESIGN AND CONSTRUCTION REQUIREMENTS			
2.1	BIL (kV)	110 kV	200 kV	
2.2	Minimum Creepage Distance (mm)	Dry	345	825
		Wet	552	1320
2.3	Frequency (Hz)	60		
2.4	Maximum Ambient Temperature	50 °C		
2.5	Minimum Ambient Temperature	-5 °C		
2.6	Maximum Discharge Time	5 min.		
2.7	Maximum Continuous Operating kvar	172.5, 230, 345, 460		
2.8	Reactive Power Ratings (kvar)	150, 200, 300, 400		
2.9	Capacitor material	Film / Aluminium Foil		
2.10	Capacitor unit tank	Stainless steel / Al		
2.11	Capacitor Bushing type	Porcelain / Polymer		
2.12	Capacitor Bushing withstand water pressure	3500 kPa		
2.13	Minimum Height of elevated rack	2440 mm		
2.14	Switch insulation media	Solid Polymer / Vacuum / Oil / SF6		
2.15	Interrupting media	Vacuum		
2.16	Switch Capacitor type	Automatic Switching		
2.17	Switch Control Unit	Programmable automatic logic		
2.18	Switch Operation counter	Required		
2.19	Terminal Type	Parallel groove / Threaded studs		
2.20	Voltage Transformer	Required		
2.21	Ground Terminal Hole Size	10 mm		
2.22	Radio Influence Voltage (RIV)	250 μV		
2.23	Provision for three (3) Lightning Arresters	Required		
3	MARKING			
3.1	Nameplate marking as per the spect.	Required		
4	INSPECTION AND TESTING			
4.1	Meet all sub clauses in specification	Required		
4.2	Meet all tests required in specification	Required		



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5	PACKING AND SHIPMENT		
5.1	Net Weight (Kg)	By Vendor	
5.2	Marking as per the Specification	Required	

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6	SPARE PARTS		
6.1	List of Spare Parts	Required	
7	GUARANTEE		
7.1	Guarantee period from delivery date	2 Years	
8	SUBMITTALS		
8.1	All submittals as per the Specification	Required	



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SEC Inquiry No:

Item No:

- A. Additional Technical Information or Features Specified by SEC.
- B. Additional Supplementary Data or Features Proposed by Bidder /Vendor /Supplier.
- C. Other Particulars to be filled-up by the Bidder/Vendor/Supplier.
- D. List of Deviations and Clauses to which exception is taken by the Bidder /Vendor /Supplier. (Use separate sheet, if necessary).

Description	Manufacturer of Material/Equipment	Vendor/Supplier
Name of Company		
Location and Office Address		
Name and Signature of Authorized Representative with Date		
Official Seal / Stamp		