

## **56-SDMS-07**

**Rev.02**

### **UNIT SUBSTATIONS UP TO 36 kV ALUMINUM TRANSFORMER, ALUMINUM BUS BARS DUAL LOW VOLTAGE LVDP WITH MAIN CIRCUIT BREAKER AND OUTGOING MCCBs.**

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## 1. SCOPE

This SEC Distribution Material Specification (SDMS) specifies the minimum technical requirements of design, engineering, manufacturing, inspection; testing and performance of outdoor unit substation intended to be used in MV system of the Saudi Electricity Company (SEC), Saudi Arabia. A unit substation combines power transformer and LV distribution panel in a single transportable unit ready for operation on being fixed in position on prepared plinth and connected to the power system. The MV switchgear is not an integral part of the unit substation.

## 2. CROSS REFERENCES

This SEC material standard specification shall always be read in conjunction with SEC specification No. 01-SDMS-01, titled “General Requirements for All Equipment/Materials”, which shall be considered as an integral part of this SDMS, These standard specifications shall be also read in conjunction with SEC Purchase Order (PO) requirements.

## 3. APPLICABLE CODES AND STANDARDS

The latest revisions of the codes and standards listed in the SEC specifications as given below 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 51-SDMS-03	Distribution Transformer Up to 36 kV 400/230V with Aluminum Windings.
3.2 31-SDMS-07	Dual low voltage distribution panel with aluminum bus bar, Main circuit breaker and outgoing MCCBs.
3.3 37-SDMS-02	LV Molded Case Circuit Breakers For LV distribution panels 400 A.
3.4 37-SDMS-04	Interface Low Voltage Main Circuit Breakers
3.5 11-SDMS-03	XLPE Insulated Power Cables from 15 kV up to 36 kV
3.6 IEC 62271-202	High-voltage / low-voltage prefabricated substation
3.7 IEC- 60529	Classification of degree of protection provided by enclosures
3.8 12-SDMS-01	Cable, Joints, Terminations and Accessories up to 36 KV



3.9 12-SDMS-02	Lugs and Connectors for MV/LV Distribution Systems
3.10 50-SDMS-01	Current Transformers up to 36 KV
3.11 DES-P03	protection system requirements for SEC distribution s/s
3.12 38- SDMS-03	Low Voltage Digital Panel Meters.
3.13 40-SDMS-02A	SPECIFICATIONS FOR ELECTRONIC REVENUE CT AND CT-VT METER

## 4. DESIGN AND CONSTRUCTION REQUIREMENTS

### 4.1 System Characteristics

The unit substation shall be suitable for installation in system characteristics as given in SEC specification 01-SDMS-01 and including the following:

MV Neutral arrangement	LV Neutral arrangement
Solidly grounded or low resistance	Solidly grounded

Table 1: MV/LV neutral arrangement.

### 4.2 Unit substation Components /Compartment

#### 4.2.1 General Requirements

- 4.2.1.1 Each unit substation shall contain transformer with medium voltage termination box and detachable low voltage compartment in a single transportable on common skid and ready for operation on being placed in position and joined into the system. The Skid shall fit to the dimensions of Foundation drawings as per SDC-02. The unit substation shall not be supplied with a medium voltage ring main unit. SEC shall provide and install the ring main unit at site, if needed. See Figure -1 for layout of unit substation.
- 4.2.1.2 The medium voltage termination box and low voltage compartment shall be weatherproof and robust construction and shall be provided with watershed top. It shall be manufactured from galvanized sheet steel or Alum-zinc of thickness at least 3 or 2 mm respectively.
- 4.2.1.3 Adequate ventilation for the medium voltage termination box to the back side of low voltage compartment shall be provided to permit natural air circulation. The ventilation apertures shall be screened with galvanized double steel mesh to prevent entry of vermin and other foreign bodies.

- 4.2.1.4 All parts of equal size and shape shall be interchangeable. The general design shall be made with minimum number of joints.
- 4.2.1.5 All Insulating materials shall be non-hygroscopic and resistant to tracking.
- 4.2.1.6 All bolted electrical joints shall be secured by means of corrosion proof steel nuts and bolts. All bolts, nuts, and washers shall be plated to type II of ASTM B 633.
- 4.2.1.7 Except for the transformer, all nuts and bolts shall not be accessible from outside of the unit substation.

## 4.2.2 TRANSFORMER

Transformer shall be suitable for unit substation, outdoor ground-mounted type and generally shall comply with all applicable clauses of SEC specifications 51-SDMS-03 (latest revision) and including the following requirements.

- 4.2.2.1 MV Bushings shall be Type –C interface located horizontally on the right hand side of the transformer (facing unit substation from the front) in a cable termination box. Bushing shall be suitable for termination according to SEC specification 12-SDMS-01 (latest revision) and adequate for M16 bolt to fit inside bushing. The respective bolt outer size shall be M12 for single hole flat pad lug for 50mm<sup>2</sup> copper and 70 mm<sup>2</sup> Aluminum MV cable connection as per SEC specifications.
- 4.2.2.2 MV and LV bushings shall be identified, labeled and printed with black indelible paint as follows:
  - MV bushings: **U V W**
  - LV bushings : **u v w n**
- 4.2.2.3 Oil level & temperature indicators and off-load tap changer operating knob shall easily be accessible / readable and operate-able from LV compartment with adequate safety. Oil temperature indicator shall be equipped with tripping contact if requested and specified in the tender / data schedule.
- 4.2.2.4 Oil drainage / sample and pressure relief valves shall be on the transformer and easily accessible, the oil drain valve shall be provided with removable rigid bumper should/cover for mechanical protection.
- 4.2.2.5 Transformer provided in unit substation shall comply with SEC specification 51-SDMS-03 (latest revision). Internal Arc escape provision shall be made on bottom side of MV cable box.
- 4.2.2.6 Off-Load tap changer, pressure relief device, Oil level/temperature gauge and fill plug/drain valve shall be labelled and engraved with black

paint painted on stainless steel plates material with welding bracket in the transformer tank.

#### 4.2.2.7 Medium Voltage Termination Box.

- i. Medium voltage termination box shall be part of transformer and shall be located as shown in Figure-1.
- ii. Medium voltage termination box shall include cable clamps, grounding connectors and MV termination bushings. Its size shall be adequate for terminating one three core or three single core MV cables as per SEC specification 12-SDMS-03 (latest revision), sizes 50mm<sup>2</sup> Copper or 70 mm<sup>2</sup> Aluminum with heat, cold as well as pre-mold termination. It shall be with single gasket removable bolted cover. Bottom plate shall be in two halves with cable entries steel knockouts suitable for above cables. Loose rubber bushings shall be provided inside of this box for these knockouts. The degree of protection MV termination box shall be IP-54.
- iii. The MV cable clamps shall conform to Figure-2.

#### 4.2.3 LOW VOLTAGE COMPARTMENT

- 4.2.3.1 Low voltage compartment shall comply with SEC specification 31-SDMS-08 (latest revision). In case of any conflict between this specification and 31-SDMS-07 (latest revision), this specification shall apply.
- 4.2.3.2 If requested in the tender, LV Panel for bulk power supply shall be equipped with main LV circuit breaker without outgoing MCCBs and provision for direct connection of customer cables on the bus-bar.
- 4.2.3.3 For the details of the following items, refer to SEC specification 31-SDMS-07 (latest revision):
  - i. Ratings of transformer LV phase links
  - ii. Main / Incomer CT rating
  - iii. Transformer connection with LV panel
  - iv. Number of outgoing circuits
  - v. Clearances between outgoing circuits
  - vi. Bus-bar sizes / ratings
  - vii. Indicating instruments
  - viii. Fault level
  - ix. Provision for installing CT for metering of partial panel
  - x. Degree of protection



- xi. Outgoing MCCB clearance
- xii. Details of access doors and its following associated items:
  - 1. Door locks
  - 2. Door stopper and its locking
  - 3. Installation of hinges and its material
  - 4. Door bonding with framework (enclosure)
  - 5. Door gaskets

## 4.3 Dimensions

Maximum overall dimensions of unit substation shall be as given in the Table 2 and Table 3 below:

### 4.3.1 Unit Substation 13.8 KV.

UNISUBSTATION RATING		MAXIMUN OVERALL DIMENSIONS WITH ENCLOSURE		
KVA RATING	SECONDARY VOLTAGE (V)	LENGTH (MM)	WIDTH (MM)	HEIGHT (MM)
500	400/231	1800	1500	2200
1000		2200	1500	2200
1500		2400	1800	2200

Table 2: 13.8 kV Unit Substation Dimensions

### 4.3.2 Unit Substation 36 KV.

UNISUBSTATION RATING		MAXIMUN OVERALL DIMENSIONS WITH ENCLOSURE		
KVA RATING	SECONDARY VOLTAGE (V)	LENGTH (MM)	WIDTH (MM)	HEIGHT (MM)
500	400/231	2000	1500	2200
1000		2300	1700	2200
1500		2400	1900	2200

Table 3: 36 kV Unit Substation Dimensions

#### 4.4 Unit Substation Foundation

Concrete foundation conforming to standards SDCS-02 (latest revision) shall be used for installation of unit substation. This foundation shall be a unified one to accommodate 500, 1000 and 1500 KVA unit substation.

#### 4.5 Provision for Mobile Generator Cables

- 4.5.1 One opening with single gasket and size 250 mm x 250 mm for the generator cables on the front of LV compartment door shall be provided. This opening shall be provided with M8 size, round, non-slotted bolted cover with nuts and washers. Unbolting of this cover shall be accessible from inside of the unit substation only. The gasket of this opening shall be pressure fit type.
- 4.5.2 Two (2) holes for 500 KVA and four holes (4) for 1000 & 1500 KVA unit substations, each 13 mm diameter for installation of mobile generators cables shall be provided on vertically extended LV bus bars.

#### 4.6 Unit Substation Finish

- 4.6.1 Unit substation shall be adequately protected against corrosion and painted as given in SEC specification 01-SDMS-01 (latest revision) SEC may consider alternative proposals for the corrosion protection. Details shall be submitted with the quotation for SEC review and approval.
- 4.6.2 Finish color shall be RAL 7035 conforming to ASTM D1535.
- 4.6.3 13.8 kV or 36 kV rating for respective transformer voltage indication shall be clearly marked at an appropriate location of Unit Substation.

#### 4.7 Name Plates

Aluminum name plates for the transformer and the low voltage compartment with the information required in SEC specifications 51-SDMS-03 and 31-SDMS-08 (latest revision) respectively and item identification number and PO number for the unit substation shall be fixed inside the left door of the low voltage compartment. The Aluminum winding and Aluminum bus bar shall be clearly indicated on respective name plates of Transformer and LVDP

#### 4.8 Circuit Identification

For circuit identification, refer to Labels section of SEC material specification 31-SDMS-08 (latest revision).



## 4.9 Danger Plate and SEC Monogram

Danger plate and SEC monogram as per SEC drawings No. SEC - 01- 01 and FIG. 49A of 20-SDMS-02 respectively shall be provided and installed on the front / SEC approved location of the unit substation using M5 hot dipped galvanized /stainless steel / brass fasteners (oval head rounded neck bolts with nuts and external tooth lock washers) not removable / accessible from the front i.e. without opening the door / front cover.

SEC shall approve location and samples of danger & monogram plates prior to installation.

## 5. TESTING

Unit substation shall be tested in accordance with the latest standards and as specified herein. All test results shall be provided for review and acceptance by SEC.

### 5.1 Type Test:

The unit substation shall be tested (complete type test) in accordance with the specifications listed under Clauses 3 and 4 above and IEC 62271-202 for heat run test for dissipation of heat at the required temperature and mechanical tests, etc. as well as internal arc test of respective transformer cable box. Tests shall also cover and verify the degree of protection IP-54 per IEC-60529 for LV compartment.

### 5.2 Routine Test:

Complete routine testing of Transformer up to 51-SDMS-03 latest revision as well as LVDP up to 31-SDMS-07 latest revision shall be performed during factory acceptance testing.

## 6. SUBMITTALS

6.1 The vendor shall complete and submit filled-in the Data Schedule and clause by clause compliance of (latest revision) of the following specifications with the quotations:

01-SDMS-01.

12-SDMS-01.

31-SDMS-07.

37-SDMS-02.

50-SDMS-01

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38-SDMS-03

37-SDMS-04.

51-SDMS-03.

6.2 The following dimensional drawings shall be provided with the quotation for each unit substation rating:

6.2.1 Outline of Unit Substation showing position of fittings, attachments and mountings.

6.2.2 Single line diagram of unit substation with all electrical components.

6.2.3 Details of transformer medium voltage termination box, and low voltage compartments.

6.2.4 Details of all fittings and attachments including catalogs.

6.2.5 Details of hardwood cable clamps.

6.2.6 Name plates information.

6.2.7 Mounting and installation details of unit substation installed on pre-fabricated concrete foundation

6.2.8 Comprehensive list of manufacturer's recommended spare parts with complete details including drawing, catalog number / part number, manufacturing / supplier name of each items shall be submitted.

6.2.9 Copy of type test report

6.2.10 List of customers in case of new manufacture / vendor

6.2.11 Vendor shall provide the details of manufacturing and testing schedules and routine test reports after signing the purchase order.

## 7. DATA SCHEDULE

### UNIT SUBSTATION UP TO 36 kV (Sheet 1 of 3)

SEC Inquiry No. \_\_\_\_\_

Item No. \_\_\_\_\_

Clause	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES
<b>4.0</b>	<b>DESIGN AND CONSTRUCTION REQUIREMENTS</b>		
	1. Nominal Unit S/S rating	500 KVA 1000 KVA 1500 KVA	
	2. MV Rating	13.8 kV 36 kV	
	3. LV Rating	400/231 V	
	4.. Number of Distribution units	6, 12, 14	
	5. <b>Main Circuit Breaker</b> Type, Model & Make Rated current	800 A 1600 A 2500 A	
<b>4.2</b>	<b>UNIT SUBSTATION COMPONENTS /COMPARTMENTS</b>		
	1. Length, mm		
	2. Width, mm		
	3. Height, mm		
	4. Length of MV termination box, mm		
	5. Center to center distance between MV bushings, mm		
	6. Horizontal clearance between the outer MV bushing(s) and the wall of the MV termination box, mm		
	7. Center to center distance between MCCBs, mm	150	
	8. Space between MCCBs, mm	10	
	9. Phase bus-bar current rating, A		
	10. Phase bus-bar size, mm		
	11. Neutral bus-bar current rating, A		
	12. Neutral bus-bar size, mm		

Table 4: Technical Data Schedule 1.



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## DATA SCHEDULE

### UNIT SUBSTATION UP TO 36 kV (Sheet 2 of 3)

SEC Inquiry No. \_\_\_\_\_

Item No. \_\_\_\_\_

Clause	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES
<b>4.5</b>	<b>PROVISION FOR GENERATOR CABLES</b>		
	Diameter of hole on the bus-bar, mm	13	
	Number of holes on each phase bus-bar	4 each for 1500kVA & 1000kVA 2 each for 500kVA	
	Number of holes on neutral bus-bar	2 each for 1500kVA & 1000kVA 1 each for 500kVA	
<b>4.6</b>	<b>ACCESSORIES</b>		
	1. Oil temp. indicator with trip contact	Yes/ No	
<b>4.7</b>	<b>SPECIAL TYPE TESTS</b>		
	Internal Arc fault withstand Type test of cable box of transformer	16 kA for 0.3 sec	
<b>4.8</b>	<b>FINISH OF ENCLOSURE</b>		
	Finish method	As per 01-SDMS-01	
	Finish color	RAL 7035	

Table 5: Technical Data Schedule 2.

**DATA SCHEDULE****Low Voltage Distribution Panel  
(Sheet 3 of 3)**

SEC Inquiry No. \_\_\_\_\_ Item No. \_\_\_\_\_

- A. Additional technical information or features specified by SEC:
- B. Additional supplementary data or features proposed by vendor/supplier:
- C. Other particulars to be filled up by vendor/supplier:  
(use separate sheet if needed)

Address	Manufacturer	Vendor/Supplier
Name of Company		
Location and Office Address		
Authorized Name and Signature		
Date		
Official seal / stamp		

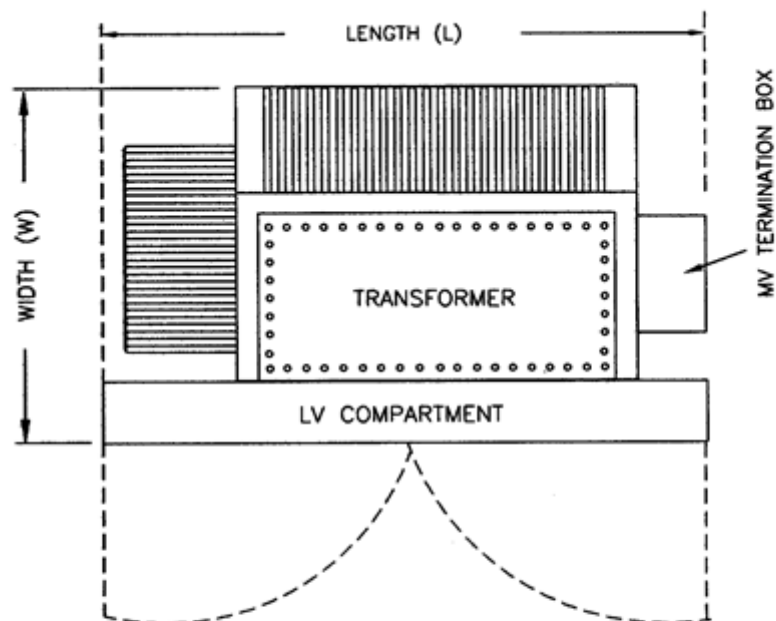
*Table 6: Technical Data Schedule 3.*

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**FIGURE-1: UNIT SUBSTATION COMPONENT LAY-OUT**

ALL DIMENSIONS ARE IN MILLIMETER

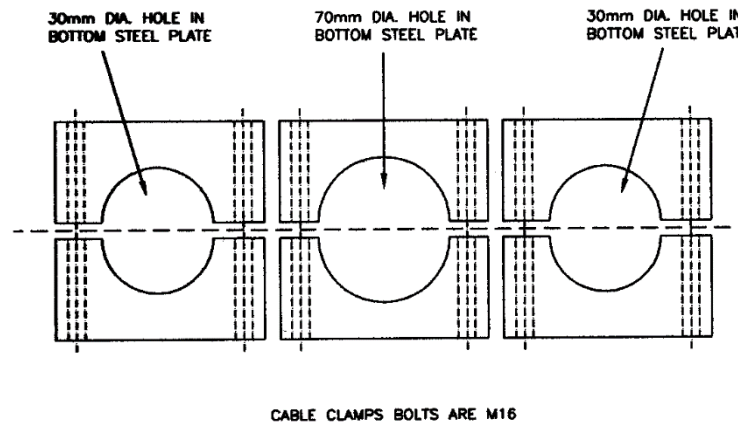


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**FIGURE-2: WOODEN CABLE CLAMP FOR MV TERMINATION BOX**

ALL DIMENSIONS ARE IN MILLIMETER