Saudi Electricity Company	الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION	58-SDMS-01 Rev. 00
	DATE: April 2017G

58-SDMS-01

REV. 00

SPECIFICATIONS

FOR

AIR CORE SERIES REACTORS
13.8 kV THROUGH 69 kV
FOR
PRIMARY DISTRIBUTION SUBSTATIONS

TABLE OF CONTENTS

1.0 SCOPE

This SEC Distribution Material Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, inspection, testing and performance of air-core reactors intended to be used for current limiting (damping) in series with shunt connected capacitor banks, 13.8kV through 69 kV and tuning (filter) reactors for filtering harmonics , in the Primary Distribution Substations in Distribution Network of SEC.

2.0 CROSS REFERENCES

This Material Standard Specification shall always be read in conjunction with Specification No. 01-SDMS-01, titled "General Requirements for All Equipment/Materials", which shall be considered as an integral part of this SDMS.

This SDMS shall also be read in conjunction with Distribution Sector Purchase Orders or Contract Schedules for project, as applicable.

3.0 APPLICABLE CODES AND STANDARDS

The latest revision/amendments of the following Codes and Standards shall be applicable for the equipment/material covered in this TMSS. 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 TMSS.

3.1	IEC 60273	Characteristics of Indoor and Outdoor Post Insulators for Systems with Nominal Voltage greater than 1000V
3.2	IEC 60076-6	Power Transformers –Part 6: Reactors
3.3	NEMA C29.9	Wet Process Porcelain Insulators (Apparatus, Post Type)
3.4	IEEE C57.16	Standard Requirements, Terminology, and Test Code for Dry-Type Air-Core Series-Connected Reactors
3.5	NEMA C29.1	Test Methods for Electrical Power Insulators.
3.6	IEC 60168	Test on Indoor and Outdoor Post Insulators of Ceramic Materials or Glass for Systems with Nominal Voltages Greater than 1000V

3.7 NEMA TR1 Transformers, Step Voltage Regulators, AND Reactors

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 Type

The dry type air-core reactor shall be either single phase or three phase as specified in data schedule. Reactor for 69kV shall be self (AN) cooled outdoor type. Reactors rated from 13.8kV up to 34.5kV shall be either installed outdoor or inside self-cooled outdoor type enclosure as specified in data schedule.

4.2 Design and Construction

4.2.1 General

a. The application of air-core reactor shall be either for damping or harmonic filtering as specified in data schedule.

b. Reactor shall be designed per IEC 60076-6 or IEEE C57.16.

c. Reactor shall be made of concentric cylindrical coil, having vertical axis. The coil shall be made of insulated aluminum or copper conductor as specified in data schedule. Outdoor reactor shall be UV resistant.

d. Manufacturer shall furnish minimum magnetic clearances to other reactors and metallic parts not forming closed loops along with magnetic flux versus distance (mean radius) curve per Annexure E of IEEE C57.16. Magnetic field from the reactor shall not cause eddy-current heating in adjacent metallic objects such as fence, ground mat, etc., and equipment.

e. Reactors shall be pedestal mounted on support insulators and associated support brackets and shall include all necessary accessories to complete the installation. Reactor shall be installed side by side or vertically stacked as specified in data schedule. Minimum pedestal height for outdoor reactors shall be 2440mm. The pedestal insulator shall be interchangeable.

f. Support insulator caps, supporting brackets, nut, bolts etc. shall be non-magnetic material.

g. Supporting insulators shall be made of electrical grade wet processed porcelain per 15-SDMS-01. Calculations shall be furnished to justify the mechanical characteristics of the insulators.

h. Suitable lifting arrangements for balanced lifting of the completely assembled reactor shall be provided.

i. The mechanical and thermal withstand capabilities of the reactor to withstand short circuit current shall be demonstrated with calculation to be submitted during base design stage.

j. Current carrying joints shall be brazed and not soldered.

k. Reactor insulation shall be minimum class B and shall be selected per temperature rise. Temperature rise shall be within the limits for the ambient conditions as per respective standards.

4.2.2 Damping Reactors

In addition to the criteria stated under Section 4.2.1 damping reactors shall meet the following requirements:

a. Shall limit the magnitude and frequency of in-rush currents due to capacitor switching and the out-rush currents caused by close in fault within the withstand capability of associated switching element.

b. Unless otherwise specified in data schedule inductance tolerance shall be per relevant IEC and ANSI standards.

c. Q-factor (X/R ratio) at the in-rush frequency shall be furnished.

d. Unless otherwise specified in data schedule reactor shall be rated for a continuous voltage across the reactor that is five times (harmonic voltage distortion factor) the fundamental voltage drop.

4.2.3 Tuning (Filter) Reactors

In addition to the criteria stated under Section 4.2.1 tuning (filter) reactor shall meet the following requirements:

a. Detune Capacitor Banks in order to avoid resonance with power system as specified in the SOW/TS shall be provided. Detuning shall be based on harmonic measurements carried out at site.

b. If inductance adjustment for fine tuning is required then the tap range for the same shall be as specified in data schedule.

c. For filter applications which require a Q factor at tuning frequency lower than natural Q factor of the reactor, the same shall be achieved without any additional damping resistor.

d. Shall be designed so as to avoid mechanical or acoustic resonances at major audible sound frequencies.

e. Shall withstand short-time current, which is related to system over-current faults for series-connected reactors and in-rush phenomena for parallel connected reactor, with duration as specified in data schedule.

f. Unless otherwise specified in data schedule, maximum tolerance for inductance at the principal and other taps (if applicable) shall be ±2% at the tuning frequency.

4.3 Rating

Inductance value shall be as specified in data schedule.

4.4 Terminals

The terminal of outdoor reactor shall be welded with the coil and the connectors shall be per NEMA CC1, tin plated and suitable for copper or aluminum conductors. Connectors shall be sized to accommodate conductor sizes as specified in data schedule.

4.5 Grounding

Two solder-less ground connectors with one (1) each on two diagonally opposite legs of the pedestal shall be provided which will accommodate conductor sizes of

1x 240 mm² for station fault level up to 40 kA and 2x240 mm² for station fault level above 40 kA.

4.6 Nameplate

Each reactor shall bear a nameplate, which shall be written in English and Arabic and contain the information listed in IEC 60076-6, IEEE C57.16, plus additional information as follows:

a) The words "_____kV Reactor".

b) Place and Year of Manufacture

c) Distribution Sector Purchase Order No. or Contract No. or J.O. No

d) Design Ambient Temperature

e) 58-SDMS-01.

The nameplate shall be readable from the ground. The nameplate material shall be stainless steel and fastened to the equipment by stainless steel screws.

5.0 TESTS

All test results shall be provided for review and approval by SEC.

5.1 Design (Type) Tests

All design (Type) tests prescribed in IEC 60076-6 or IEEE C57.16 standard shall be performed on a complete functional assembly of one representative unit having same design, arrangement and ratings as of those to be supplied or on the first unit of every new design, rating or size to be supplied to Distribution Sector, SEC. For air-core reactor manufactured per IEEE C57.16 standard, dielectric tests shall be carried out as type tests in addition to all other type tests prescribed in ANSI.

In lieu of the actual design (type) tests, certified test reports of design (type) tests performed on an identical unit may be submitted to National Grid Saudi Arabia for review and approval during bidding stage.

5.2 Production (Routine) Tests

5.2.1 General

All production (routine) tests prescribed in IEC 60076-6 or IEEE C57.16 shall be performed on all units prior to delivery to Distribution Sector. Production tests shall be carried out against "Vendor Approved Drawings".

5.2.2 Damping Reactor

For damping reactors manufactured per IEC standard, measurement of loss and Q factor shall be carried out as additional routine tests in addition to all other routine tests per IEC standard.

5.2.3 Supporting Insulator

All routine and type test per 15 SDMS-01 shall be carried out.

5.3 Special Tests

Special tests when specified in the data schedule shall be carried out.

6.0 TECHNICAL DATA SCHEDULE

(AIR CORE SERIES REACTOR)
(Page 1 of 6)

SEC Enquiry/Tender No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Proposed Values
3.0	**APPLICABLE CODES AND STANDARDS**			
	Applicable Industry Standards		*	
4.0	**DESIGN AND CONSTRUCTION REQUIREMENTS** **Model / Designation**			
4.1	No. of phases Type of mounting Type of Capacitor bank Neutral grounding Reactor arrangement **4.2.1** Design and Construction Application Coil Conductor Magnetic clearance (minimum) Reactor coil Centre to center (mm) Edge to edge (mm) Edge to reactor metallic parts not forming closed loops (mm) **Noise level (dB)**		1/3 Outdoor/indoor Weather proof Enclosure Side by side or vertically stacked Damping / Tuning Copper/ Aluminum	

6.0 TECHNICAL DATA SCHEDULE

(AIR CORE SERIES REACTOR)
(Page 2 of 6)

SEC Enquiry No. /TENDER NO._____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
Conti--nued 4.2.1	Complete dimensions with drawing details provided. Reactor weight (kg) Design ambient temperature Class of insulation Maximum temperature rise (◦C) Hot spot temperature (◦C) Supporting Insulator Manufacture shall fill up Column 'B' of (15-SDMs-01 data schedule)			
	Damping Reactors			
4.2.2	Nominal system voltage U_N (kV rms) Inductance per phase (mH) Inductance tolerance Rated continuous current I_N (A) Overload current (A) (suitable for capacitor bank overloading) High frequency inrush current I_{IN} (kA peak) Inrush current frequency f ib (HZ)			

6.0 TECHNICAL DATA SCHEDULE

(AIR CORE SERIES REACTOR)
(Page 3 of 6)

SEC Enquiry No. /Tender No._____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Proposed Values
Continued 4.2.2	High frequency outrush current I_{out} (kA peak)			
	Outrush current frequency f_{ob} (HZ)			
	Rated short circuit withstand (kA) for 1sec.			
	Thermal short time over current (kA peak)			
	Harmonic voltage distortion factor F_{hU}			
	BIL (kV peak)			
	Power Frequency withstand voltage (kV rms)			
	Switching Impulse withstand voltage BSL if applicable (kV peak)			
	Total losses at 75 ◦C and 110 % rated voltage (kW) at inrush current frequency.			
	Q-factor at inrush frequency			
	Impedance at rated frequency (ohm)			
	Thermal class of insulation			
	Temperature rise ◦C			
	Voltage drop (V)			

6.0 TECHNICAL DATA SCHEDULE

(AIR CORE SERIES REACTOR)
(Page 4 of 6)

SEC Enquiry No. /Tender No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
Cont-inued 4.2.3	**Tuning filter Reactors**			
	Nominal system voltage U_N (kV rms)			
	Rated Inductance LA (mH) at tuning frequency			
	Inductance tolerance for principal tap			
	Tapping Range (%) if applicable			
	Inductance step (%)			
	Number of taps			
	Inductance tolerance at other taps			
	Fundamental current rating I_N (A)			
	Rated tuning frequency current I_A (A)			
	Rated tuning frequency f_A (Hz)			
	Rated short time current I_{IN} (kA) and duration. Mechanical peak current (kA peak)			
	Type of filter (band pass/high pass)			
	BIL Power Frequency withstand voltage (kV rms)			

6.0 TECHNICAL DATA SCHEDULE

(AIR CORE SERIES REACTOR)
(Page 5 of 6)

SEC Enquiry No. /Tender No._____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Proposed Values
Continued 4.2.3	Switching Impulse withstand voltage BSL if applicable (kV peak) Total losses at 75 ◦C and 110 % rated voltage (kW) at tuning frequency. Q-factor at inrush frequency Impedance at rated frequency (ohm) Thermal class of insulation Temperature rise ◦C Voltage drop (V) for each tap and principal tap) Power network single line diagram attached?			
4.4	**Terminals (** applicable for outdoor reactors) Type Material No. of holes For conductor size (mm sq.) For conductor material (Al. or Cu) Incoming conductor take off (vertical horizontal, angle to horizontal) **ADDITIONAL INFORMATION** Approximate Shipping Dimensions (mm) Approximate Shipping weight (kG)			
5.3	**Special tests**			

6.0 TECHNICAL DATA SCHEDULE

(AIR CORE SERIES REACTOR)

(Page 6 of 6)

SEC Enquiry 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 the Company		
Location & Office Address		
Authorized Name & Signature		
Date		
Official Seal / Stamp		