33-SDMS-03

REV. 1

SPECIFICATIONS FOR SMART MV AUTO-RECLOSER UP TO 36KV

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Revision History:

#	Date	Revision No.	Revised By	Major Revision Description
1				
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3				
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Prepared by:

No.	Name	Department / Sector	Signature	Date
1				
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1 Scope

This SEC Distribution Materials Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, inspection, testing and performance of pole mounted electronic type medium voltage line Smart auto-recloser, intended to be used in the overhead distribution system of Saudi Electricity Company (SEC) in Saudi Arabia.

2 Cross References

This specification shall always be read in conjunction with SEC General Specification No. 01-SDMS-01 (latest revision) titled "General Requirements for all Equipment/Materials" which shall be considered as an integral part of this specification. It shall also be read in conjunction with SEC purchase order and/or contract schedules, and scope of work/technical specifications for projects, as applicable.

3 Applicable Codes and Standards

The latest revision/amendment of the following codes and standards shall be applicable for the equipment/materials covered in this specification. In case of conflict/difference, the vendor/manufacturer may propose equipment/material conforming to alternative codes or standards; however, the provisions in SEC standards shall supersede the provisions in these standards.

Standard	Description
IEC 60815	Polymer insulators for A.C. systems
IEC 62271-100	High voltage Alternating Current Circuit Breakers
IEC 60137	Insulated Bushings for Alternating Voltages above 1000 Volts
IEC 60376	Specification and Acceptance of New Sulphur Hexafluoride
IEC 60437	Radio Interference Test on High Voltage Insulators
IEEE 1815	IEEE Standard for Electric Power Systems Communications-Distributed Network Protocol (DNP3)
IEC 60870-5	Telecontrol equipment and systems - Part 5: Transmission protocols
IEC 61850	Communication networks and systems for power utility automation
IEEE C37.60	Requirements for overhead, pad mounted, dry vault and submersible SMART Circuit Re-closers and Fault Interrupters for AC system
ISO 2063	Metallic coatings – Protection of iron and steel against corrosion, metal spraying of zinc and aluminum
BS EN ISO 1461	Guidelines for Zinc Coating
ASTM-A 123	Standard Specification for Zinc (Hot dip galvanized) coatings of iron and steel
ASTM-A 153	Standard Specification for Zinc Coating (Hot dip) on iron and steel hardware
15-SDMS-02	Specification for Overhead Line Polymer Insulators

4 Design & Construction Requirements

4.1 Ratings

Ref	Description	Unit	Specification Values	
1	Nominal Voltage	kV	13.8	33
2	Continuous Current Rating	Amps	560	560
3	Short Time Current	kA/sec	12/3	12/3
4	Max. Symmetrical Interrupting Current	Amps	12000	12000
5	Minimum Phase Trip Rating	Amps	20-1120 (Adjustable)	20-1120 (Adjustable)
6	Minimum Ground Trip Rating	Amps	10-560 (Adjustable)	10-560 (Adjustable)
7	Sensitive Earth Fault	Amps	2-40 (Adjustable)	2-40 (Adjustable)
8	Minimum Creepage Distance of Bushings	mm	472	1116
9	Radio Influence Voltage (max.) for 1 MHZ	µV	500	650

It shall be noted, that based on the specific case calculations, higher values of short time current and maximum symmetrical interrupting current could be required.

4.2 Performance Characteristics

The mode of operation of the Smart auto reclosers shall be as follows:

4.2.1 The auto recloser shall be capable of performing a sequence of four trips prior to lockout even when the line fault is so close to the station that the station voltage is essentially zero at the instant of the trip

4.2.2 Means shall be provided to enable the auto recloser to trip for the first or second time under fast operation and for the second or third and fourth time under delayed openings. The total operations to lock out on phase trip shall be determined by a suitable device. Thus, the auto recloser may lock out on all phase trip operations that reach the lock out setting. The selection of the number of fast trips shall be adjustable

4.2.3 If upon the first, second or third reclosing, normal conditions are restored on the line, the auto recloser shall Automatically reset at adjustable times and be ready for a complete new sequence of operations. Means shall be provided to lock out the auto recloser after one, two, three of four reset trip operations. The selection of the reset time and the number of trip operations shall be through RTU.

4.3 Adjustments and Settings

One over-current device shall be provided for fault detection in each phase. The over-current device shall have adjustable minimum phase trip-current settings and adjustable time-current characteristics from very inverse to definite time.

Each auto recloser shall be equipped with a means of sensing, and operating on, an earth fault current, which may be lower than the minimum phase tripping current. Adjustable time-current characteristics from very inverse to definite time shall be provided.

Provision shall be made to adjust the time interval, between opening and re-closing (dead time), and reset time (reclaim time).

Both local configuration and setting through Laptop PC and remote configuration and setting from distribution control center shall be possible.

4.4 Operating Mechanism

The operating mechanism should be capable of performing the sequence of opening and closing as specified in this specification. The breaker should also pass the operational tests, which ascertain the capability of the operating mechanisms. Further, the operating mechanism shall be capable:

a) To provide means whereby circuit breaker can be closed rapidly without hesitation at all currents from zero to rated making current capacity.
b) To hold the circuit breaker in closed position by toggles or latches till the tripping signal is received.
c) To allow the circuit breaker to open without delay immediately on receiving tripping signal. To give optimum contact level characteristics (time versus stroke).
d) To perform the auto reclosing cycle.
e) To perform the related functions such as, indication, control, alarm, lock out on low pressure.
f) The mechanism shall be capable to open and close the three phases of the equipment simultaneously.

Auto recloser shall be provided with manual tripping facility and lock out of the auto recloser locally / through operating rods. The SMART reclosing shall be locked out after the manual tripping.

An operation counter shall be provided. It shall be readable locally or at remote end with the auto recloser in operation. The operating counter shall be well protected against

moisture ingress. The number of operations shall also be readable through the RTU described in clause 4.13.

4.5 Tank

The tank shall be preferably made of stainless steel of minimum thickness 3 mm, strong enough to support the vibration of the auto recloser.

The tank and its accessories shall be adequately protected against corrosion and the supplier shall include a statement of the method of protection proposed.

Hot dip galvanizing is preferred (in case tank is not stainless steel fabricated), otherwise large size tanks shall be sand-blasted and then immediately zinc sprayed to an average weight deposit in accordance with BS EN ISO 1461. This shall be followed by zinc or zinc chromate based primary paint and two coats of durable oil and weather resisting paint shall be applied. The colors of each coat shall be easily distinguishable. The final coat shall be epoxy based. Finish color shall be cement gray RAL 7033, as per Deutsches Institute Normen e.v. Zinc spray shall be in accordance with ISO 2063.

The tank shall be perfectly sealed and dielectric fluid tight, with all fittings in place. The tank shall be weather proof, sealed and suitable to operate under all operating conditions.

The tank shall be equipped with two brackets each to accommodate three nos. lightning arresters (conforming to 35-SDMS-01 for Surge Arresters) both on incoming and outgoing side respectively.

4.6 Manual Operating Handle

It shall be possible to open and to lockout the auto recloser manually with operating rod at ground level.

4.7 Indicators

A contact position indication (OFF in green and ON in red), SF6 gas pressure gauge as well as a "locked-out" indicator shall be provided. These indicators shall be clearly visible from ground level.

4.8 Pole Mounting Frame

All units shall be supplied with a galvanized steel mounting frame with adjustable pole clearance suitable for SEC standard octagonal steel pole and pre-stressed spun concrete pole. Appropriate clamping ring shall be provided for auto recloser and RTU to secure the unit with a pole without using bolts through the octagonal steel pole.

4.9 Lifting Lugs

Lifting lugs shall be provided such that the auto recloser can be lifted with a single hook without damage.

4.10 Grounding Terminal

All units shall be provided with an appropriate ground terminal.

4.11 Bushings

The auto reclosers shall be fitted with Polymer bushings conforming to latest respective International Standards and compatible with SEC service conditions and system parameters. The bushings shall be provided with anti-bird devices / caps. The bushings shall be terminated by flat pad terminals to accept vertical connection with ACSR Conductor size 70 mm^2 to 170 mm^2.

4.12 Interrupting Medium & Insulation

The insulation medium shall be solid or SF6.

The interrupting medium shall be vacuum or SF6

4.13 RTU (Remote terminal unit)

The auto recloser shall be electronic controlled. It shall have separate control cabinet, the control cabinet shall be suitable to be fixed on a SEC standard poles types (octagonal steel/ pre-stressed spun concrete) at a lower level than the auto recloser, by means of adjustable pole clamping ring. Suitable control cable with minimum 10-meter length shall be supplied for connection of RTU to auto recloser.

The cabinet shall be tropicalized to withstand the severity of whether in coastal as well as hot inland areas of K.S.A as per specification 01-SDMS-01. All fittings required for mounting shall be supplied. All operating parameters of the auto recloser i.e. minimum trip current, time-current trip characteristics, reclosing reset times, and operating sequences, shall be controlled from the RTU locally as well as remote end. Communication interface facility shall be provided for local control and automation.

All the RTU components shall support a ambient temperature of 70°C.

The RTU shall have below mentioned salient features:

4.13.1 LCD with high degree of resolution and legibility, valid for life span of auto recloser

4.13.2 Well-protected keypad, easy to operate with easy legibility

4.13.3 Operation History: Non-volatile memory with enough capacity to record Up to 150 operation history events data including the date/time of occurrence, control signal source (remote/local), switch status shall be able to be indicated and stored in the sequence of occurrence, reporting of system events and display 30 different events with date and time

4.13.4 The Non-volatile memory shall at least store (10) fault records and support the COMTRADE format and the fault record data shall be accessible locally and via data communication channels

4.13.5 Chargeable backup power supply with life span not less than 3 years. The backup supply shall be capable to operate the RTU for at least 8 hours during power outage and to operate at least 50 (refer to 4.20.5) switching operations (Open/Close) during this 8 hours' outage interval

4.13.6 The charging unit for the backup supply capable to work at 110 Volts and 230 volts (phase to ground voltage)

4.13.7 Smart Auto Recloser Operating System (Windows Based) shall have programmability and downloading facility via local and at remote end

4.13.8 All the programming and protection function selection shall be password protected

4.13.9 Disturbance Recording Facility shall be available

4.13.10 Capability to withstand lightning surges effecting through respective low voltage line

4.13.11 Protection class IP 65

4.13.12 Telecommunication interface facility or integrated telecommunication module (Cellular modem and/or as per SEC requirement)

4.13.13 Open to the tele-control protocols as specified below

4.13.14 It shall be possible to enable or disable the individual protection function / elements

4.13.15 Ratings shall be clearly marked in relevant units of measure with no interpretation multipliers or conversion being required

4.13.16 Local control for Trip / Close through push buttons

4.13.17 Remote control from Distribution Control Center

4.13.18 Local/Remote change over switch

4.13.19 Fault status indication

4.13.20 Power outlet: One phase AC 230 V.

4.13.21 The Auto-recloser shall be provided with RTU for local and remote monitoring/measuring/operation.

4.13.22 The RTU shall be installed in a control cabinet or panel, which shall have included a backup supply set, backup supply charger, and any required devices/materials for remote communication.

4.13.23 All the monitoring and measuring functions, settings of parameters, and electrical operations of the switch shall be performed at the control panel and remotely.

4.13.24 The RTU shall include real time network condition monitoring of voltage, current, power, power factor and frequency.

4.13.25 The RTU must be able to store the waveform of the fault current 10 cycles prior to the breaking by other devices up to 4 or more times by 12 or more sampling per cycle.

4.13.26 The RTU must be provided with the functionality to monitor normal functions of components, store the results, and trigger warning, and provide the distribution automation system with the information.

4.13.27 Operating, maintenance and setting software, which can collect and manage various operational information of the switch including operating history, fault current waveform, load current measurement data, etc. shall be provided.

4.13.28 The selected RTU shall have adequate protection against reversed polarity, over current/voltage and under voltage condition.

4.13.29 Remote operating time: When RTU receives the command from the ADMS SCADA, FLISR or any other authorized master device, the operation shall be done within three (3) seconds which exclude signal transmission time.

4.13.30 All digital inputs shall be time-stamped to 1ms accuracy.

4.13.31 The RTU shall include the following minimum safety features for control outputs:

- Select-and-execute sequence for control output.
- No control command shall be generated during power up or power down of RTU.
- No more than one control point shall be selected at any given time.
- When the control switch in the AUTO-RECLOSER is placed in the “local control” position, then control outputs of the remote SCADA can be tested without activating the field device.
- The RTU shall send a status indication of the local/remote switch to the master station or SCADA.

4.13.32 Control Outputs

The RTU shall provide the capability for a master station (ADMS SCADA or FLISR functions) to set two control outputs which shall be provided for each controllable device after receiving the command using the check before execute sequence. The appropriate control output shall be operated for a preset time period which is adjustable for each point from 0.1 to 3 seconds

4.14 Communication Requirements

4.14.1 General

The RTU shall either provide an integrated communication module or interfaces to external telecommunication devices as specified below. Via these interfaces communication is realized to the Distribution Management System (DMS) control center and to other Intelligent Electronic Devices (IEDs), the RTU is collecting data from, if applicable.

It is mandatory to apply standardized communication protocols.

The communication protocol towards the DMS shall be selected as per project requirements. The equipment shall be able to handle the following telecontrol protocol types:

- IEC 60870-5-101
- IEC 60870-5-104
- DNP3.0
- IEC 61850 (future).

For communication to other intelligent electronic devices, for example digital protection relays, the RTU shall use the following protocols:

- In case of existing IEDs as per available protocol in the IED
- In case of new IEDs IEC 61850.

The Bidder/Contractor shall include in his bid all co-ordination, engineering and parameterization to guarantee interoperability with equipment from other suppliers via the specified protocols.

4.14.2 RTU Interfaces

All parameters are to be set and configured locally through front panel HMI keyboard facilities, through laptop PC with the respective software and from remote (Distribution Control Center). The following interfaces are the minimum requirement:

- 1 x Ethernet 10/100 Base T for local configuration and setting from Laptop PC
- 1 x Interface to telecommunication equipment (to distribution control center), type as required for selected telecommunication technique.

4.14.3 Communication Channel Speed

All serial channels, if any, shall be configurable between 300-64000 bps. The Ethernet port is 10/100Mbps with auto negotiation.

4.14.4 Communication Options

The RTU's communication port to the DMS shall make it possible to utilize different communication medias such as:

- 2G (GSM, GPRS, EDGE, CDMA)/3G (UMTS, CDMA)/4G (LTE)/5G (5G NR)
- eSIM (Digital SIM card)
- Fiber optics
- Wi-Fi
- Narrowband IoT (internet of things)
- Narrowband PLC and/or Broadband PLC
- UHF/VHF
- Mesh Wireless Networks.

In case of external telecommunication devices will be used, it must be ensured that the telecommunication device (modem, radio etc.) can be installed inside the auto reclosers RTU enclosure. Even though the RTU supplier will confirm that it can communicate through most communication media mentioned above, the supplier shall be responsible to do all necessary actions to ensure system compatibility (testing and reconfiguration) with SECs communication and DMS control center requirements.

For remote operation of auto reclosers, the Bidder/Contractor has to cover and include all necessary actions including coordination with the DMS Supplier to guarantee interoperability between the RTU and the DMS, as well as all necessary adaptation, extension of hardware, software and application of the DMS system and respective test and commissioning of that portion.

4.14.5 Protocol Support

The protocols shall perform a half-duplex operation as a polling protocol.

The Bidder/Contractor shall include in his bid all co-ordination, engineering and parameterization to guarantee interoperability with equipment from other suppliers via the specified protocols.

All protocols shall fully support time synchronization with the DMS System and time stamping in applicable protocols. It shall be configurable or designated on which communication port the DMS will be connected.

There shall be diagnostic functions such as protocol debugger, protocol simulator, tracing etc.

4.14.6 DMS Data Communication Interoperability List

The Bidder/Contractor shall assure the compliance with the DMS data communication interoperability list.

4.14.7 DMS Data List

The Bidder/Contractor shall fulfil the requirements as per DMS standard signal list. The following are the minimum signals required:

4.14.7.1 Alarms/Events (DI: Digital input):

To be sent as spontaneous messages in case of appearance:

- Phase Overcurrent Protection Trip
- Earth Fault Protection Trip
- Sensitive Earth Fault Protection Trip
- Negative Sequence Protection Trip
- Broken Conductor Protection Trip
- Auto-recloser Reclose
- Auto-recloser Lockout
- fault Indication (1Φ/earth - 2Φ - 3Φ): the alarm Should Automatically be reset after restoration of the electricity supply)
- Voltage miss-phase (lack phase)
- Dismatch phases (phases sequence reversed)
- Unbalanced load
- Gas Pressure
- Backup Supply (Battery) Status
- Charger status
- AC power supply status/DC power supply status
- Open door
- RTU alarms

4.14.7.2 Status (DI: Digital input)

To be sent as spontaneous message in case of change or during interrogation:

- Open/Closed

- Local/Remote
- Lock / Unlock
- Auto recloser Out of Service

4.14.7.3 Commands (DO: Digital output)

To be ordered from the control center or from Laptop

- Close / Open
- Fault indication reset: reset remotely & locally even before supply restoration

4.14.7.4 Measurements (AI: Analog input)

To be sent after exceeding the configured limit of change, during general interrogation and after a configurable cycle time:

- Voltage (three phases) on source side and (three phases) voltage on load side.
- Current (three phases).
- Active and Reactive power (three phases).
- Power factor
- All logical calculated functions needed by ADMS.

4.15 Cyber Security Requirements

4.15.1 Application whitelisting shall be implemented on Smart Devices to monitor and ensure that only authorized applications are executed without affecting operations.

4.15.2 Smart Devices shall be configured to produce and store event logs recording activities, exceptions, faults and information security events.

4.15.3 Smart Devices shall have the capability to log the following information and activities:

a. Timestamps for each event. System clocks shall be synchronized to a single reference time source to facilitate forensic analysis of actions taken on the device.
b. Incident management activities.
c. Utility programs that can override system and application controls.
d. Cryptographic key management related activities.

4.15.4 Logging mechanisms shall not adversely affect device critical functions and performance.

4.15.5 Smart Devices shall recover to a secure state in the event of a disruption or failure.

4.15.6 Smart Devices shall have access controls implemented at both the software level (such as operating system and applications level) and hardware/device level. Access controls shall be established with the following principles and capabilities:

a. Least privilege – access shall be limited to only information or resources that are necessary to accomplish a legitimate purpose.
b. Privileged access – access controls shall establish privileged and non-privileged levels for users and processes. Access controls shall prevent non-privileged users or processes from executing privileged functions (such as installing software or changing system configurations).

4.15.7 Smart Devices shall at least enforce the following Password change, complexity, re-use, and lockout constraints for access control:

Minimum Age	Maximum Age	Minimum Length	Password Reuse	Complexity Requirements	Account Lockout Threshold	Account Unlock Action
1 day	2 years	10 characters	10 passwords remembered	4 of 4 (uppercase, lowercase, numbers, symbols)	25 invalid attempts within 1 hour	Admin or Supervisor unlock

4.15.8 Smart Devices shall lock the access after several authentication failures. Device shall be capable of sending an account lock alarm.

4.15.9 All Smart Devices shall implement and enable audit and logging capabilities when possible.

4.15.10 Smart Devices shall be up-to-date with the latest security related patches as much as it is operationally safe and feasible. When it is not possible, a justification shall be provided and countermeasures identified and implemented.

4.15.11 Any security vulnerability Identified by SEC during Smart Devices lifetime shall be remedied and patched.

4.15.12 A list of identified potential security risks and best way to mitigate them shall be provided.

4.15.13 Smart Devices shall be secure by design. Security shall be integrated throughout each phase of systems lifecycle.

4.15.14 Smart Device shall be properly hardened as per the guidelines provided below to harden networks, operating systems, applications and Smart Devices.

4.15.15 Appropriate security test cases shall be created to provide scenarios that detail both how the device is intended to be used and how it should not be used.

Application Hardening and Security

4.15.16 Any time data is input by a user, it shall undergo input validation to ensure only proper authorized characters are accepted.

4.15.17 Smart Devices shall provide the capability to set outputs to a predetermined state if normal operation cannot be maintained because of an attack.

4.15.18 Smart Devices shall identify and handle error conditions in a manner such that effective remediation can occur without disclosing unnecessary information to an attacker.

4.15.19 If session IDs are used on a Smart Device, it shall provide the capability to protect the integrity of sessions and reject any usage of invalid session IDs.

4.15.20 Smart Devices shall support encryption on all supported protocols. If some protocols do not support encryption, then the smart device shall support secure IPsec VPN tunneling.

4.15.21 Where mobile code is not required, it shall be disabled.

4.15.22 Any mobile code that is necessary for application operation shall be presented to the Distribution Cyber Security for review and approval to ensure proper protections and restrictions are in place.

4.15.23 Any approved mobile code shall require proper authentication and authorization of origin and its use shall be monitored.

4.15.24 Smart Devices shall be able to verify the integrity of the mobile code before allowing code execution.

4.15.25 Where cryptography is determined to be required, Smart Devices shall use cryptographic algorithms, key sizes, and mechanisms for key establishment and management according to commonly accepted security industry practices and recommendations.

4.15.26 Established and tested encryption shall be employed to reduce risk of information leakage or tampering.

4.15.27 Smart Devices shall utilize established and tested encryption to protect sensitive data at-rest where required.

4.15.28 Smart Devices utilizing PKI (Public Key Infrastructure) shall provide the capability to operate it according to commonly accepted best practices.

4.15.29 Smart Devices utilizing PKI as part of their identification or authentication process shall employ validity checking of certificates.

4.15.30 Certificates CA (Certificate Authority) signature shall be verified to confirm that the certificate has not been tampered since it was first signed.

4.15.31 Smart Devices utilizing PKI shall consult with CRL or OCSP to determine the revocation status of all certificates.

4.15.32 Smart Devices shall be able to determine whether a given human, software process, or device user took an action based on the use of non-repudiation techniques.

4.15.33 Smart Devices shall be able to produce machine-readable report of deployed security settings.

4.16 Protection Functions & Characteristics

4.16.1 Protection shall communicate to the RTU all the required SEC data

4.16.2 The ratio of drop off current to pick up current shall be at least 95% for all protection functions.

4.16.3 The over-current (O/C), earth fault (E/F) and SEF (sensitive Earth fault) protection functions shall have elements with IDMT and Definite Time characteristics that comply with relevant ANSI standards or IEC 60255.

4.16.4 The Over-current (O/C), Earth Fault (E/F) and Sensitive Earth Fault (SEF) function shall be provided with harmonic filter /Inrush current restraint to prevent operation when harmonics are present in the primary currents.

4.16.5 Delayed protection operation shall be possible by selecting an IDMT protection element with normal inverse (NI), very inverse (VI) or extremely inverse (EI) curve as per IEC 60255 or ANSI Standards. Addition of user programmable curves shall also be provided.

4.16.6 The sequence of trip and auto reclose characteristics for O/C, E/F, Negative sequence protection and SEF shall be programmable and phase segregated to enable the selection of any combination of the available elements for each trip in the trip-and-reclose sequence.

4.16.7 In case of Inverse Definite Minimum Time (IDMT) protection element, the auto recloser shall be provided with adequate reset timer that stimulates the resetting function of an upstream relay. The length of time delay shall be settable so as to stimulate the upstream device.

4.16.8 A zone sequence coordination (ZSC) feature shall be provided to ensure trip close sequence co-ordination for combinations of rapid and delayed protection operations applied to series auto reclosers. ZSC function shall be such that:

- An auto recloser senses the presence of an over-current or earth fault as well as clearance of the fault by another device and proceeds to another protection operation in its own sequence; and
- It proceeds in its sequence of rapid protection operation only allowing the full number of operations to be executed for in- zone conditions.

4.16.9 NPS (Negative phase sequence) and Broken Conductor are protection function to detect the low level of phase-phase fault under load current conditions. It can also be used to detect the series faults.

4.16.10 Cold Load Pickup: When some loads have been without power supply for a longer period of time (a few hours), then it loses its diversity. When the power is restored the load is higher than usual because all the heater, refrigerator or air conditioner thermos-stats have turned on. The longer the period without power supply the greater the loss of diversity and the higher the load current when supply is restored. The purpose of the Cold Load Pickup feature is to allow for this loss of diversity SMARTally without protection trip.

4.16.11 Loss Of Phase (LOP) protection shall be provided to ensure the protection functionality of auto recloser as under:

- Auto recloser should trip to lockout in case there is loss of voltage on one or two phases on the upstream part of line
- Facility to turn LOP ON or OFF without effecting other protection function of the device
- The information about LOP operation in case of the protection trip shall be recorded accordingly with indication of phase(s) causing the trip of auto recloser. The information about LOP operation shall be easily accessible.

4.16.12 Under voltage, Over voltage, Under frequency and Over frequency Protections Elements shall be available for configuration.

4.16.13 Directional blocking shall be provided to ensure the protection functionality of auto recloser as specified below:

- Auto recloser and control element shall be capable to detect the direction of the fault current. Minimum time to determine fault current for O/C and E/F shall be not greater than 50 msec. For SEF the time to determinate the fault direction shall not be greater than 1 sec
- Configuration for directional blocking shall include the separate settings for characteristic angles for O/C, E/F and SEF elements
- The directional blocking shall have the facilities to configure auto recloser SMARTally to trip or block for upstream and downstream faults. This shall be configured separately for O/C, E/F and SEF
- The information about directional blocking operation in case of protection trip shall be recorded accordingly in memory.
- Directional Elements shall be provided with wide range for Max. Torque Angle and possibility to adjust maximum & minimum forward and reverse regions.
- Minimum voltage required for directional EF and SEF shall be settable with minimum value of not more than 4% of Nominal Voltage.

4.17 Auto recloser Operation Parameters

The number of sequential trips to reach lockout shall be selectable to be either 1, 2, 3 or 4. Reset times shall ideally be separately selectable for SEF and the combination of over-current and earth fault functions.The reset time shall be selectable from 0.5 sec to180 sec. Dead times shall ideally be separately selectable for SEF and the combination of over-current and earth fault functions. The dead time shall be selectable from 0.1 to 180 s for the first and second sequence and from 0.5 to 180 seconds for subsequent sequences.
A close instruction initiated locally or remotely during a dead time shall result in lockout if the fault is still persistent up to closure.

a) Operating Electrical Smart Auto-recloser: “ON” and “OFF” separate from RTU
Separate Push bottom open/close (Red: close - Green: open) with Status indication
b) Operation selector switch: Local/Remote separate from RTU

Measurement Functions: Below mentioned quantities shall be calculated/ measured.

a) r.m.s phase to phase and phase to neutral voltage of all three phase.
b) r.m.s current per phase
c) Three phase active power in kW
d) Three phase reactive power in kVAR
e) Total three phase active energy in kWh
f) Power factor
g) Maximum demand

Auto recloser and control element shall have the facility to record the number and time of outages. The information shall be accessible locally or remotely. The following parameters shall be recorded:

a) Cumulative total number of outages
b) Cumulative total outage duration
c) Time and duration of each outage

4.18 Power Voltage Transformer

SF6 Auto recloser

4.18.1 Three (3) single phase Voltage Transformers (VT's) in the source side and three (3) single phase VT's in the load side, complying to IEC-61869-3 or equivalent, shall be delivered and installed together with Auto-recloser. They shall be dry type, epoxy encapsulated. The measuring windings shall have a ratio of 33kV/ √ 3/230V respectively 13.8kV/ √ 3/230V. The VT' s shall be designed for 60Hz and shall have an accuracy class of 1.0 or better. The rated output (burden) shall be selected as required for the equipment to be supplied and fulfilling the requirements as stated in IEC 61869.

4.18.2 One of the voltage transformers on the source side shall be designed as power voltage transformer. The power voltage transformer, which combines the attributes of an inductive voltage transformer with the application of a small power transformer, shall provide windings for measurement, see paragraph above, and a winding for giving auxiliary power supply to the Auto-recloser electronic equipment of 230V. The rated continuous output power shall be calculated and selected as per consumption present, with safety margin of 20%. The power VT shall be maintenance free.
Accuracy of the VT sensor shall be 1% or better

4.19 Current Transformer

4.19.1 Current Transformers as per IEC 61869-1/-2/-6 and conforming to SEC Specification 50-SDMS-01, shall be part of the auto recloser to allow for the required and specified measurement and protection functions.

4.19.2 Three (3) current transformers, shall be part of the auto recloser to allow for the required and specified measurement and protection functions. Alternatively, current transformers of the non-conventional type or sensors shall be provided. For all the solutions, the accuracy class as given in the data schedule shall apply.

4.19.3 The current transformers shall have primary current as per rated continuous current, and its rated burden and error characteristics shall be suitable for the operational characteristics of the RTU

4.19.4 The current transformers shall have sufficient over-current coefficient to enable transformation without being saturated at the maximum fault current in the distribution line as well as at a current smaller than normal load current and must not affect the measuring circuit when transforming a large fault current.

4.19.5 The main body must be provided with a CT protection unit to prevent exposure of the CT secondary circuit even when the control cable is disconnected.

4.19.6 Ratio error of Current Transformer shall be ±1% and Phase Displacement error shall be ±1º.

4.20 Power supply (AC, charger & backup: battery)

The battery shall be crystal led with 3 years warranty.

3.20.1 One of the voltage transformers on the source side shall be designed as power voltage transformer. The power VT shall be a single phase AC220V (+/- 10%) /60Hz.

3.20.2 The power source shall properly charge the battery per Auto-recloser

3.20.3 All functions of the Auto-recloser including switching, Monitoring, RTU and Control, shall be powered by the live power source and the backup supply (battery) will back up the power source.

3.20.4 A power outlet (AC220V/60Hz) shall be installed in the Control Box to power a portable O&M device such as Lap-top computer.

3.20.5 The battery shall be capable to back up the monitoring, communication and operation of the RTU for 8 hours without AC source. The backup supply shall be capable of providing power to perform at least 50 operation cycles (open-close) without AC source. The supplier shall size the backup supply per Auto-recloser, specifying the lifetime and the duty cycle of such period of life.

3.20.6 Battery -shall be maintenance free and sealed. No lead acid batteries are allowed.

3.20.7 Battery–shall be rechargeable and shall be suitable for temperature of 70 Degree centigrade.

3.20.8 The backup supply charger shall have temperature compensated to maximize battery life and usable capacity.

3.20.9 The charger shall have filter to provide 2% or better ripple voltage when operated on a resistive load (from 5 to 100% full load).

3.20.10 The charger shall be provided with protection against overcharging. The supplier shall specify the proposed charging time.

3.20.11 It shall be possible to test the backup supply.

3.20.12 All the alarms related to Charger & Backup supply shall be wired to the RTU in order to be transmitted to the control center

5 Marking

Each auto recloser shall be fitted with an easily readable nameplate of weather proof material giving the following details marked in English and Arabic:

- Manufacturer name
- SEC item number
- Serial number
- Year of manufacture
- Country of origin
- Rated voltage
- Rated impulse withstand voltage
- Rated frequency
- Rated symmetrical interrupting capacity
- Rated continuous current
- Rated frequency
- Manufacturer name and reference number
- CT & VT ratio rating and class
- Interruption medium
- Insulation Medium
- SEC purchase order number
- Reference to SEC specification
- SEC monogram
- Gross weight.

6 Testing and Inspection

6.1 General

All equipment shall be tested in accordance with the latest relevant standards and as specified in this specification.

6.2 Type Tests

6.2.1 The tests shall be carried out in accordance with ANSI C37.60 except for bushings and insulators, which shall be as per IEC 60437. Tests shall be performed at SEC approved laboratories and shall consider the environmental conditions applicable.

6.2.2 SEC reserves the right to attend and witness the tests.

6.2.3 SEC reserves the right to request the supplier/manufacturer to repeat the type test every five (5) years, or as needed should the supplied devices have frequent faults and failures.

6.3 Routine Tests

Routine tests in conformance with the applicable clauses of ANCI C37.60 and IEC 60437 or equivalent shall be performed on all auto reclosers. Electronic copies of the test reports shall be submitted to SEC in USB thumb drive for each batch to be delivered prior to issuance of the releases.

In addition to the ANCI C37.60 and IEC 60437 production tests, the following tests shall be performed on samples:

- Communication test
- As a special testing requirement, the mounting and fitting test considering the design of standard overhead lines constructions as defined in SEC overhead line standard specification shall be implemented.

6.4 Sample Inspection

Samples together with actual CAD drawings, user manual and routine test reports shall be submitted for inspection/evaluation prior to issuance of approval for mass production. The following attributes shall be checked:

- Dimensional verification
- Markings
- User Manual
- Packaging
- Functionality
- SIM Card Slot.

7 Packing and Shipment

7.1 Packing and shipping requirement shall generally be as per latest revision of SEC General Requirements for Equipment/Materials, 01-SDMS-01 or as per purchase order requirements.

7.2 Each auto recloser shall be packed in a box as a complete unit and shall be delivered ready for use. Accessories shall be supplied in a separate box with printed marking relating to the box of the auto recloser.

7.3 Packing shall protect the auto recloser against damage during shipment and site handling.

7.4 Suppliers shall coordinate with SEC Warehousing Department for additional packing, handling, and or shipping instructions, as applicable.

7.5 Each box shall be printed with the following information:

a) Purchase Order Number/ Tender Number
b) Auto recloser rating and Nominal voltage
c) Manufacturer 's Name and Model/Type
d) Year of Manufacture & gross weight
e) SEC Item Code
f) Position of slinging points and other relevant handling instructions.
g) CT Ratio
h) PT Ratio

7.6 Packing notes in Arabic and English shall be included in each case giving a description of the goods packed.

8 Spare Parts

8.1 A comprehensive list of manufacturer's recommended spare parts shall be included in the tender. The quantities offered should be adequate for the initial five (5) years of operation.

8.2 A firm price and delivery period shall be quoted for each item.

8.3 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.

8.4 If any spare part requires special storage conditions, these conditions shall be detailed.

9 Guarantee

The supplier shall guarantee the auto reclosers against all defects arising out of faulty design, faulty workmanship or of defective material for a period of five (5) years from the date of delivery.

10 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 auto reclosers.

11 Submittals

11.1 Submittals Required with Tender/Inquiry

11.1.1 Summary in table form with the following information: list of items offered, manufacturer, origin, catalogue number, and quantity.

11.1.2 Clause-by-clause compliance with the latest revision of SEC specification 33-SDMS-03 and 01-SDMS-01.

11.1.3 Manufacturer's Catalogue in English language.

11.1.4 User Manual (installation, commissioning and maintenance) in both English and Arabic language.

11.1.5 Time-current characteristics of auto reclosers for ratings being offered.

11.1.6 Certificate stating that the raw material has been sampled, tested and inspected in accordance with relevant standard specifications.

11.1.7 Product type test reports and certificates carried out from SEC approved laboratories.

11.1.8 Filled-up technical data schedule on each of the items offered.

11.1.9 Manufacturer CAD drawings for each of the items offered, including mounting methods and accessories.

11.1.10 USB Flash Drive containing e-copy of all the documents mentioned above.

11.2 Submittals Required Following Award of Contract

11.2.1 Samples in compliance with Clause 6.4 of this specification.

11.2.2 Quality assurance tests.

11.2.3 Manufacturing and routine test schedules.

11.2.4 Special tests, if applicable.

12 Technical Data Schedule

MV AUTO RECLOSER UP TO 36 KV

SEC Inquiry No. _____ *Item No.* _____

Ref. SEC.	Description	SEC Specified Values/ Requirements		Vendor Offer Value
4.0	DESIGN AND CONSTRUCTION REQUIREMENTS			
4.1	Ratings:			
	Nominal System Voltage	13.8 kV	33 kV	
	Maximum Operating Voltage (Nominal)	15.2 kV	36 kV	
	Continuous Current Rating	560 Amp.	560 Amp.	
	B.I.L. (kV)	95, 110	170, 200	
	Minimum Trip Rating	20- 1120 Amps (Adjustable)	20- 1120 Amps (Adjustable)	
	Minimum Ground Fault Setting	10-560 Amps (Adjustable)	10-560 Amps (Adjustable)	
	Minimum SEF Setting	2-40 Amp	2-40 Amp	
	Minimum Sym. Interrupting Current	12 kA	12 kA	
	Short time Current for 3 seconds	12 kA	12 kA	
	Minimum Fault Making Current	12 kA	12 kA	
	One Minute Withstand Voltage Dry	50 kV	80 kV	
	One Minute Withstand Voltage Wet	50 kV	80 kV	
	Minimum Creepage Distance of Bushings	472 mm	1116 mm	
	Radio Influence Voltage (µV)	500	650	
4.5	Tank Material	Stainless		
4.6	Manual Operating Handle	Required		
4.7	Contact Position Indicator	Required		
4.8	Pole Mounting Frame	Required for steel octagonal poles		
4.9	Lifting Lugs	Required		
4.10	Grounding Terminal	Required		
4.11	Bushings	Polymer		
4.12	Current Interrupting Medium/ Insulating Medium	SF6 or Vacuum/ Solid or SF6		

Ref. SEC.	Description	SEC Specified Values/ Requirements	Vendor Offer Value
4.13	Recloser RTU Backup Power Supply (Type and Life) LCD Legibility /Expected Life Degree of Protection Type of Communication port Connection Interface Loop Automation	Conforming to specs. To be mentioned by bidder -do- -do- -do- -do- Required	
4.14	Communication Requirements	Conforming to specs	
4.14.1	Communication Protocols	IEC 60870-5-104/101 /DNP3.0 /IEC 61850	
4.14.4	SIM Card Slot Available	YES/NO	
4.14.4	SIM Card Size	Standard	
4.14.4	Mobile/Cellular Network Type	GPRS/2G/3G/4G/5G/NB-IoT	
4.14.2	Communication Interface for external comm. modem	Yes (Specify) / No	
4.15	Cyber Security Requirements	Fully Comply/Not Comply	
4.16	Protection Functions and Characteristics Phase Overcurrent Protection primary setting range. Earth Fault Protection primary setting range Sensitive Earth Fault Protection primary setting range Negative Sequence Current Protection primary setting range Broken Conductor Protection	Conforming to specs 20 – 1120 A 10 – 560 A 2 – 40 A (Measurement of Minimum Sensitive Earth Fault Current (i.e. 2 A) shall not be due to CT Error) 5 – 100 A 0.1 – 1	
4.17	Operation Parameters and Protection Setting Ranges		
	Variable Trip Time Settings (Over current Fault Current)		
	Trip seq. no	SEC specified Trip time range	Offered Trip Time range
	1	.05--180 sec.	...sec…sec.
	2	.05--180 sec.	...sec…sec.
	3	.05--180 sec.	...sec…sec.
	4	.05--180 sec.	...sec…sec.

Ref. SEC.	Description	SEC Specified Values/ Requirements	Vendor Offer Value
	Variable Re-Closing Time Settings (Over Current fault)		
	Trip seq. no	SEC specified Trip time range	Offered Time range
	1	0.1--180 sec.	...sec…sec.
	2	0.1--180 sec.	...sec…sec.
	3	0.5--180 sec.	...sec…sec.
	4	0.5--180 sec.	...sec…sec.
	Variable Trip Time Settings (Earth Fault)		
	Trip sequence no.	SEC specified time range	Offered Time range
	1	0.1--180 sec.	...sec…sec.
	2	0.1--180 sec.	...sec…sec.
	3	0.5--180 sec.	...sec…sec.
	4	0.5--180 sec.	...sec…sec.
	Variable Reclose Time Settings (Earth Fault)		
	Trip sequence no.	SEC specified time range	Offered Time range
	1	0.1--180 sec.	...sec…sec.
	2	0.1--180 sec.	...sec…sec.
	3	0.5--180 sec.	...sec…sec.
	4	0.5--180 sec.	...sec…sec.
	Variable Trip Time Settings (Sensitive Earth Fault)		
	Trip sequence no.	SEC specified time range	Offered Time range
	1	0.1--180 sec.	...sec…sec.
	2	0.1--180 sec.	...sec…sec.
	3	0.5--180 sec.	...sec…sec.
	4	0.5--180 sec.	...sec…sec.
	Variable Reclose Time Settings (Sensitive Earth Fault)		
	Trip seq. no	SEC specified time range	Offered Time range
	1	0.1--180 sec.	...sec…sec.
	2	0.1--180 sec.	...sec…sec.
	3	0.5--180 sec.	...sec…sec.
	4	0.5--180 sec.	...sec…sec.
	Re-Setting Time Settings		
		SEC specified time range	Offered Time range
		0.05--180 sec	Sec - Sec
	Measurement Functions	As per Specifications	

Ref. SEC.	Description	SEC Specified Values/ Requirements		Vendor Offer Value
4.18	Power Voltage Transformers a- Number of Power VTs b- Measurement/Protection Winding Primary Secondary Class VA to be specified by Bidder c- Auxiliary Supply Winding Primary Secondary VA to be specified by Bidder	1 per each phase 13.8kV/√3 0.11kV/√3 0.5/5P 13.8kV/√3 230V	1 per each phase 33kV/√3 0.11kV/√3 0.5/5P 33kV/√3 230V	
4.19	Current Transformers a- Ratio b- Accuracy class -- (to be specified by bidder) c- VA burden (to be specified by bidder)	XXXX/1 -	XXXX/1 -	
6	Testing and Inspection	Type test certificates attached		
7	Finish Color	RAL 7035		

MV AUTO RECLOSER UP TO 36 KV

SEC Inquiry No:…… *Item No:……*

- Additional Technical Information or Features Specified by SEC

- Additional Supplementary Data or Features Proposed by Bidder/Vendor/Supplier.

- Other Particulars to be filled-up by the Bidder/Vendor/Supplier.

- 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		

DISTRIBUTION AUTOMATION PROGRAM
SMART AUTO-RECLOSER
DATA POINTS LIST

Bay / CIRCUIT no.	Point name / Message	IOA / IEC OBJECT ADRESS	REMARKS
DIGITAL OUTPUT (DO) COMMANDS			
Auto-recloser (CB)	CLOSE COMMAND	1	
Auto-recloser (CB)	OPEN COMMAND	1	
DIGITAL INPUT (DI) GENERAL ALARMS / INDICATIONS			
Auto-recloser (CB)	CLOSE INDICATION	11000	
Auto-recloser (CB)	OPEN INDICATION		
Auto-recloser	REMOTE	11001	
Auto-recloser	LOCAL		
COMMON	LOCK/UNLOCK INDICATION	1000	
COMMON	Battery low	1001	Alarm
COMMON	Gas Low (if the Recloser insulation is SF6)	1002	Alarm
COMMON	AC power fail	1003	Alarm
COMMON	Door open	1004	Alarm
COMMON	DC power fail	1005	Alarm
COMMON	Motor/Actuator(Open/Closed) Circuit Fail	1006	Alarm
COMMON	Phase loss (miss-phase)	1007	Alarm
COMMON	Overcurrent (load)	1008	Alarm
COMMON	Unbalance (Load)	1009	Alarm
COMMON	Under voltage	1010	Alarm
COMMON	RTU Self diagnostic (RTU alarm)	1011	Alarm
COMMON	Fault indication	1012	Alarm
COMMON	Dismatch phases	1013	Alarm Phases: (R-S-T) (U-V-W)
COMMON	Protection trip	1014	Alarm
COMMON	Protection Health (Normal/Fail)	1015	Alarm
ANALOG INPUT (AI) MEASURMENTS			
Current	I_Current (A)	13000	
Current	I_Current (B)	13001	
Current	I_Current (C)	13002	
Current	I_Current (N)	13003	Vector sum of three currents

Voltage	V_voltage (R-S)	13004	Phase to phase
Voltage	V_voltage (S-T)	13005	Phase to phase
Voltage	V_voltage (R-T)	13006	Phase to phase
Voltage	Voltage (N)	13007	Vector sum of three voltages
Voltage	V_voltage (U-V)	13008	Phase to phase
Voltage	V_voltage (V-W)	13009	Phase to phase
Voltage	V_voltage (U-W)	13010	Phase to phase
Voltage	Voltage (N)	13011	Vector sum of three voltages
Power	P (KW)	13012	Total of three phases
Power	Q (KVAR)	13013	Total of three phases
Power	Power Factor	13014	