30-SDMS-05

REV. 1

SPECIFICATIONS FOR 33KV AND 13.8KV

SMART OVERHEAD LOAD-BREAK SWITCHES

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Revision History:

#	Date	Revision No.	Revised By	Major Revision Description
1				
2				
3				
4				
5				
6				

Prepared by:

No.	Name	Department / Sector	Signature	Date
1				
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1. Scope

This document specifies the minimum technical requirements for design, engineering, manufacturing, inspection, testing and performance of outdoor, SF_6 insulated, Smart Overhead LBS to be used in 13.8 kV and 33 kV medium voltage system of the Saudi Electricity Company (SEC) in Saudi Arabia.
It is highly recommended that the smart OH-LBS and the Smart line Sectionalizer to be merged in the same smart device.

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.

The latest revisions of the following specifications shall be applicable for the equipment/material covered in this specification:

Specification#	Title
20-SDMS-01	Specification for Octagonal Steel Poles
20-SDMS-02	Specification for Overhead Line Accessories
20-SDMS-03	Specification for Pre-Stressed Spun Concrete Poles
15-SDMS-02	Specification for Overhead Line Polymer Insulators (Latest Revision)

Table 1: Reference SEC specifications

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	Title
IEC 60815	Polymer insulators for A.C. systems
IEC 60600	High Voltage Test Techniques.
IEC 60507	Artificial Pollution Test on High Voltage Insulators to be Used on A.C System.
IEC 60529	Degrees of protection provided by enclosures (IP Code)

Standard	Title
IEC 62271-102	High-voltage switchgear and control gear - Part 102: Alternating current disconnector and earthing switches.
IEC 62271-103	High-voltage switchgear and control gear - Part 103: Switches for rated voltages above 1 kV up to and including 52 kV.
IEC 62271-200	High-voltage switchgear and control gear - Part 200: AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.
IEC 62271-1	High-Voltage Switchgear and Control gear - Parts: Common Specifications
IEC 60587	Electrical Insulating Materials Used Under Severe Ambient Conditions - Test Methods for Evaluating Resistance to Tracking and Erosion
IEC 61869-1/-2	Instrument transformers
ANSI/IEEE C37.90.1	Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE 1815	IEEE Standard for Electric Power Systems Communications-Distributed Network Protocol (DNP3)
IEEE C37.90.2	Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers
IEEE C62.45	Practice on Surge Testing for Equipment Connected to Low- Voltage (1000 V and Less) AC Power Circuit. ASTM G53 (1996) Standard Practice for Operating Light-and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Non-Metallic Materials.
IEC 60870-5	Telecontrol equipment and systems - Part 5: Transmission protocols
IEC 61850	Communication networks and systems for power utility automation

Table 2: List of applicable standards

4. Design & Construction Requirements

4.1 General Characteristics

4.1.1 General

The Smart Overhead LBS shall be outdoor, pole mounted, SF_6 insulated, spring operated, with motor and local/remote control. The LBS and its associated components shall meet or exceed the requirements of this specification in all respects and it shall be manufactured and tested in conformance with relevant international standards.

4.1.2 Service Conditions

4.1.2.1 The Smart load break switch shall be suitable for operation under the service conditions as per SEC latest revision of general Specification No. 01-SDMS-01.

4.1.2.2 The Smart load break switch and fittings shall withstand the effect of direct solar radiation at their installed locations. The temperature of exposed surfaces shall be regarded as 75 °C plus the effect of internal heating.

4.1.3 The rated continuous currents of the LBS are 400A and 600A respectively for both 13.8kV and 33kV system voltages.

4.1.4 The basic insulation levels for 13.8kV and 33kV systems are as specified in Table 6 of the latest revision of 01-SDMS-01.

4.1.5 The LBS shall be capable of switching load currents with full recovery voltage across the switch and interrupting transformer magnetizing current and overhead line charging current. This shall permit all switching to be done live such as disconnecting/connecting tie lines/paralleling of feeders.

4.2 General Design

4.2.1 The Smart Overhead LBS (also identified as LBS or switch) shall be 3-Phase Single Tank type consisting of the main body, control panel and connecting cables. Its structure shall be designed for easy and stable installation on outdoor poles and cross-arms.

4.2.2 The main body and control panel shall be made of new and first quality materials suitable for outdoor use.

4.2.3 The switch shall be designed to prevent water collection and protect the main body and parts during transportation and storage.

4.2.4 The switch must be structured to maintain the insulation level even when the gas pressure is lowered to atmospheric pressure level.

4.2.5 The switch operation shall be independent of the side to which the primary source is connected (Bi-directional).

4.2.6 It shall be possible to open and close the switch electrically from the control while the switch is not connected to the primary supply.

4.2.7 The switchgear shall be suitable for use as a disconnector providing a fully rated point of isolation suitable to allow the application of temporary earth conductors to enable safe work on the line.

4.2.8 The switchgear shall be provided with arrester mounting brackets, on source and load side of the switchgear, adjacent to the bushings.

4.2.9 All contacts and terminals shall be silver plated with minimum thickness of 4 micron.

4.2.10 The creepage distances are based on the nominal line-to-line voltage intended for outdoor installation as specified in Table 4 of the latest revision of 01-SDMS-01.

4.2.11 The LBS shall be provided with anti-bird protection system.

4.2.12 The Smart Overhead Load Break Switch (LBS) shall be able to be operated electrically from local and remote and manually if electrical operation fails.

4.2.13 The LBS shall be able to be operated in functional cooperation with the Smart recloser and Smart Sectionalizer which are installed in cascade.

4.2.14 The LBS shall be able to break rated load current.

4.2.15 The main body and control circuit shall be provided with mechanical and electrical trip free functions.

4.2.16 The LBS shall be able to be operated safely and certainly by manual operation without the operating power from the control circuit. All required accessories for manual operation shall be included in the supply.

4.2.17 Manufacturer's drawing shall show the outline of the LBS together with all pertinent dimensions of its associated components and pole-mounting accessories. Any variations in these dimensions due to manufacturing tolerances shall also be indicated.

4.2.18 Phase identification of the source-side and load-side bushings shall be labeled as U - V - W and R - S - T, respectively using an indelible black paint of size readable from the ground level. Phase identification using adhesive stickers is not acceptable.

4.3 Main Body

4.3.1 The main body shall be supplied with mounting fasteners which can independently support the self-weight, wind pressure, and the operational vibration from breaking the maximum current when installed on a pole.

4.3.2 The main body must be completely sealed by tungsten inert gas (TIG) or equivalent welding method to prevent gas leak. The internal materials must be resistant against electrical and mechanical impacts and SF_6 gas. Radioactive penetration testing shall be conducted on all welded parts of main body. Parts contacting charged materials shall be silver-plated with a minimum 4 microns thickness.

4.3.2.1 The enclosure of the main body must be made with hot rolled stainless steel (316), or a material equivalent in mechanical and chemical properties, whose thickness is 3 mm or thicker, and protected from corrosion by resin type coating.

4.3.2.2 The O-rings used to seal the gas insulated switch must be made of EPR or FPM rubber or equivalent, which is heat, weather, and gas resistant, and coated with grease which is heat, weather, and gas resistant.

4.3.2.3 Any moisture penetration and generation inside of the SF_6 tank shall be prevented.

4.3.3 Following accessories must be provided to the main body of the Smart load break switch:

4.3.3.1 Ground cable terminal: ground copper wire shall be able to be connected without extra fastener.

4.3.3.2 Operation indicator: the close/open status of the main contacts must have a clear visual indication by a mechanical mean, which is visible from the ground.

4.3.3.3 Provisions shall be included for electrical and manual operation. Electrical operation shall be blocked when the LBS is operated manually. Indication and signaling of the open, closed & earthed position shall not take place unless the movable contacts have reached their open, closed & earthed position.

4.3.3.4 Operating counter: The LBS shall be provided with a mechanical type counter whose reset is prohibited.

4.3.3.5 Gas pressure gauge: LBS must have gas pressure gauge, which shall be installed in a way that checking of gas pressure from ground is easily possible. The gauge shall be equipped with contacts which are wired to the control panel to enable local signalization and remote signal transmission, when gas pressure is low. Low gas pressure lockout device shall be provided to block operation.

4.3.3.6 Gas discharger: A gas insulated LBS must be provided with a gas discharger which can prevent destruction of the main body and protect operator/passers-by in case that the internal gas pressure rises sharply due to internal failure, etc. The gas must be discharged in a direction away from the operator.

4.3.3.7 Gas injection valve: LBS shall be provided with a gas injection valve for gas refill when necessary. The valve shall be protected using gas-tight threaded cap.

4.3.3.8 Spare auxiliary contact points: Three or more “a” and “b” contact points must be wired on terminals in the control panel for future use, and in linkage with the main contact points.

4.3.3.9 Pole mounting brackets, clamps, and fasteners for the LBS and its associated auxiliaries, if any, shall be provided. Mounting brackets and clamps shall accommodate the use of either 13m length octagonal steel or pre-stressed spun concrete poles conforming on the latest revisions of SEC specification 20-SDMS-01 and 20-SDMS-03, respectively.

4.4 Vibration and Impact

The LBS shall be provided with safety feature to prevent mal-operations due to gravity, vibrations, electromagnetic forces, excessive tilt, or shocks caused by vehicular collision on the pole structure to where the LBS is mounted. Design details including proving tests undertaken to comply this requirement shall be submitted in the tender offers.

4.5 Protection Against Corrosion

4.5.1 The stainless-steel tank shall be painted, or powder coated to ensure a maintenance-free service life of 30 years under the environmental conditions of Saudi Arabia.

4.5.2 All current carrying parts of the LBS shall be made of high conductivity corrosion-resistant metal, and those that are exposed in the environment shall be electrolytically bright tin-coated in accordance with ASTM B545 with minimum thickness of 5µm.

4.5.3 All ferrous parts of the LBS like mounting brackets, clamps, fasteners other than stainless steel shall be galvanized in conformance with the latest requirements of 01-SDMS-01 Clause 5.1.

4.6 Operating Devices

4.6.1 The operating device of the switch shall be designed not to require any special skills for operation and handling. All 3-phases of contacting point shall be open and closed at the same time and switching speed shall be consistent all the time regardless of the operation type.

4.6.2 The Smart Overhead LBS shall be operated by electrical control signal from the RTU or by manual operating handle. The electrical operation method shall be selectable between local / remote.

4.6.3 The operating device of Smart Overhead LBS shall be locked by using the lock device both in open and close position, and if the switch is locked, switching operation shall not be possible both in electrical and mechanical way.

4.7 Bushing

4.7.1 The bushing must equal or exceed the designated impulse insulation strength ratings.

4.7.2 All junction points shall be processed not to leak the gas or air and maintain sufficient mechanical adherence strengths.

4.7.3 The LBS shall be fitted with polymer bushings conforming on the requirements of IEC 62217 and the latest amendments applied thereto.

4.7.4 The source and load bushing terminals shall be either NEMA 2-Hole or NEMA 4-Hole based on the switch current ratings.

4.7.5 The joint between the bushing and the terminal shall be waterproof.

4.8 SF_6 Insulation Gas

4.8.1 The purity of SF_6 gas for Smart Overhead LBS shall be over 99.9% and moisture content of gas in enclosure of Smart Overhead LBS shall be sustained below 1,000 ppm during switching the load current.

4.8.2 Rated pressure, peak pressure, minimum guarantee pressure and lock pressure of gas pressure drop shall be determined considering range of operational temperature and gas leakage. Insulation, breaking and making current shall be guaranteed down to the minimum guaranteed pressure.

4.8.3 Gas tightness of the closed pressure systems shall conform to the requirements of IEC 62271-1 Clause 6.16.3.

4.8.4 SF_6 insulation gas pressure gauge indicator shall be provided to check the pressure conveniently.

4.9 Current Sensor

4.9.1 Three (3) current transformers as per IEC 61869-1/-2 for fault current detection and current measurement shall be designed in bushing-type structure to be able to be mounted inside the main body of the Overhead LBS and have sufficient mechanical

and electrical strengths. Alternatively, current sensors shall be provided. For all the solutions, the accuracy class as given in the data schedule shall apply.

4.9.2 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.

4.9.3 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.

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

4.9.5 Accuracy class of the CT shall be 1.0 or better.

4.10 Voltage Transformer

4.10.1 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 LBS and its cost shall be included in the respective bid price. 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.

Accuracy of the VT sensor shall be 1% or better

4.10.2 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 LBS 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.

4.11 RTU

4.11.1 The LBS shall be provided with a RTU for local and remote monitoring/measuring/operation.

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

4.11.3 Smart MV OH LBS Operating System (Windows Based) shall have programmability and downloading facility via local and at remote end.

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

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

4.11.6 Operation history: Up to 150 operation history data including the date/time of occurrence, control signal source (remote/local), and switch status shall be able to be indicated and stored in the sequence of occurrence.

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

4.11.8 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.

4.11.9 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.

4.11.10 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.

4.11.11 The selected RTU shall have adequate protection against reversed polarity, over current/voltage and under voltage condition. and all the RTU components shall support a ambient temperature of 70^{o}C.

4.11.12 Remote operating time

4.11.13 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.

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

4.11.15 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 OH-LBS 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.

4.11.16 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

4.11.17 Power supply (AC, Charger & backup battery)

1. In case a battery is proposed as Backup Supply, then it shall be crystal led with 3 years warranty.
2. One of the voltage transformers on the source side shall be designed as power voltage transformer (refer to section 4.10.2). The power VT shall be a single phase AC220V (+/- 10%) /60Hz.
3. The power source shall properly charge the battery per RTU which can be integrated into the smart OH-LBS. (motor or Actuator)
4. All functions of the OH LBS including switching, Monitoring, RTU and Control, shall be powered by the same power source and the backup supply (battery) will back up the power source.

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

6. The backup supply 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 LBS , specifying the lifetime and the duty cycle of such period of life.

7. Batteries shall be maintenance free and sealed. No lead acid batteries are allowed.

8. Batteries shall be rechargeable and shall be suitable for temperature of 70 Degree centigrade.

9. The backup supply charger shall have temperature compensated to maximize battery

10. life and usable capacity.

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

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

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

14. “Low Backup Supply Charge” indication shall be available locally and remotely. When low backup supply charge alarm is “on” then the remaining capacity shall allow for at least 4 consecutive close operation and 4 consecutive open operations.

15. It shall be possible to test the battery.

16. All the alarms related to Charger & battery shall be wired to the RTU in order to be transmitted to the control center

4.12 Control Functions: DMS Data-Base I/O List (appended)

4.12.1 Smart Overhead LBS shall be operated electrically, locally at the control panel and remotely from the Distribution Management System (DMS). In case the electrical operation fails, there shall be the possibility to manually operate the switch.

If the signal of open/close operation is received through the communication devices, the operation action shall be completed within 1 second and all changed values and status shall be provided to the RTU and to the DMS.

The status of the backup supply charging device and backup supply itself shall be monitored and indicated at the RTU and transmitted to DMS.

4.12.2 There shall be the possibility to lock/unlock the operation.

4.12.3 The operational information including operating history of the switch shall be able to be monitored and read-out with a laptop at the site.

4.12.4 DMS Data List

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

1) Alarms/Events (Digital input):

To be sent as spontaneous messages in case of appearance.

- fault Indication (1Φ/earth - 2Φ - 3Φ):
  the alarm Should automatically be reset after restoration of the electricity supply)
- Voltage miss-phase (LOP: loss of 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

2) Status (Digital input):

To be sent as spontaneous messages in case of change of the status and during general interrogation:

- Smart OH-LBS Open/Closed
- Local/Remote
- Smart OH-LBS Lock / Unlock

3) Commands(Digital output):

To be ordered from the control center or from Laptop

- Close / Open
- Fault indication reset : reset remotely & locally (lamp + LED) even before supply restoration

4) Measurements (Analog input):
To be sent after exceeding the configured limit of change, during general interrogation and after a configurable cycle time:

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

4.13 Control Panel

4.13.1 The enclosure of the RTU shall be made of stainless steel whose thickness is 1.5 mm or thicker and be protected using proper methods from severe outside conditions such as high temperature and solar radiation. The equipment installed in the control panel shall be capable to operate in service conditions as given in SEC specification 01-SDMS-01 latest revision. The RTU panel shall be manufactured with lifting hook(s) on top and a door with a locking device/hasp for padlocking on front, the door shall be opened by 120° or wider and fixable to allow inside inspection and setting of the equipment. The control panel shall be designed and fabricated mechanically and electrically rigid.

4.13.2 The control panel must be incorporated with devices listed below. Arrangement of the devices shall be properly planned. Drawing of the control panel design shall be subject to approval by SEC.

4.13.3 The control panel shall have an entrance hole in the bottom of the enclosure prepared for the installation of communication wire. The holes shall be covered if cables are not installed.

4.13.4 The RTU panel shall be adequately sealed, and dust protected and shall be internally treated to prevent moisture condensation. The degree of protection shall be as given in SEC specification 01-SDMS-01 latest revision.

4.13.5 Supplier shall ensure that both the panel and its door are fitted with suitable earth studs and that good electrical contact can be made between the earth, the panel and door. Connecting of all metal parts to the earthing point is included in the contractor’s scope.

4.13.6 The door of the panel shall be fitted with a robust fastening arrangement with three-point locking (i.e. at the top, center and bottom by rods operated by the door handle) and a door lock as per SEC standard.

4.13.7 The panel shall be easily removable for workshop repair purposes. A nameplate shall be attached to the front door.

4.13.8 The control panel shall be furnished with the following:

4.13.8.1 RTU

4.13.8.2 Remote communication device (modem and/or as per SEC requirement)

4.13.8.3 Main contactor status: closed (red) / open (green)

4.13.8.4 Lock indication of low gas pressure Normal/Abnormal

4.13.8.5 Operation lock indication (RTU/main body)

4.13.8.6 Backup supply and charge circuit status

4.13.8.7 Disconnection/open-phase: each phase on the power and load sides

4.13.8.8 Live line: on the power and load sides (for all 3 phases)

4.13.8.9 Control panel operation status: Normal/Abnormal

4.13.8.10 Operating Electrical Smart OH-LBS: “ON”and”OFF”separate from RTU
Separate Push bottom open/close (Red:close-Green:open) with Status indication

4.13.8.11 Manual operating switch: Close/Open

4.13.8.12 Operation selector switch: Local/Remote separate from RTU

4.13.8.13 Smart (Line sectionalizer /OH LBS) Mode selector separate from RTU

4.13.8.14 Operation lock switch: Lock/Unlock

4.13.8.15 Terminals for backup supply testing

4.13.8.16 Lamp test switch

4.13.8.17 Control power switch (On/Off) and mini circuit breaker

4.13.8.18 Status indicator lamp (LED)

4.13.8.19 Power outlet: 1 phase AC 230 V.

4.13.8.20 The fault indicator shall have the local lamp & LED indication and the remote signal available.

4.13.9 The control circuit shall be provided with protective devices against over-voltage and current. The discharge of the backup supply must be minimized except when the door of the panel is opened. The control circuit must be designed to be protected from malfunction or wrong information by the malfunction of the devices or elements used for over-voltage protection.

4.13.10 The RTU enclosure must be provided with a ground cable connector terminal which allows direct connection of ground copper wire without extra fastener.

4.14 Control Cable

4.14.1 The control cable must be of the same or equivalent specification of shield cable, easy for installation and operation. The cable must be ultraviolet resistant and protected against external damage and its length shall be at least 10 m.

4.14.2 Both ends of the control cable must be weather proof and quick coupling with the main body and control panel of the switch and provided with lock devices to prevent unwanted decoupling.

4.14.3 The main body and control panel of the switch must be provided with a male, quick coupling type receptacle and a lock-up device to prevent miss-matching of the wiring, respectively.

4.14.4 The receptacles on the main body and the control panel for cable connection must be designed to be protected from damage in transportation, storage, or handling.

4.14.5 The control cable can be disconnected at the control unit while the switch is energized, live, and carrying load, without causing damage or mal-operation. Removing or connecting the control cable while the switchgear is in service shall not result in the switchgear changing open/closed state.

4.14.6 Two-core cable whose length is 7 m or longer must be supplied for the AC operating power supply for the control circuit. The cores of the cable shall be colored in black (ground) and red (voltage). The connector specifications for connection with the control panel shall be the same as those of the control cable.

4.15 Communication Requirements

4.15.1 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.

4.15.2 It is mandatory to apply standardized communication protocols.

4.15.3 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).

4.15.4 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.

4.15.5 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.

4.15.6 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 (DMS). 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 DMS), type as required for selected telecommunication technique.

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

4.15.8 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 (e.g. UMTS, CDMA)/4G (LTE)/5G (5G NR)
- eSIM (Digital SIM card)
- Fiber optics
- Wi-Fi
- Narrowband IoT (internet of things)
- Narrowband PLC and Broadband PLC
- UHF/VHF
- Mesh Wireless Networks.

4.15.9 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 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.

4.15.10 For remote operation, 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.

4.15.11 Protocol Support: The protocols shall perform a half-duplex operation as a polling protocol. 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.

4.15.12 DMS Data Communication Interoperability List: The Bidder/Contractor shall assure the compliance with the DMS data communication interoperability list.

4.16 Cyber Security Requirements

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

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

4.16.3 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.

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

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

4.16.6 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).

4.16.7 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

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

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

4.16.10 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.

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

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

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

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

4.16.15 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.

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

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

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

4.16.19 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.

4.16.20 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.

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

4.16.22 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.

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

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

4.16.25 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.

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

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

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

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

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

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

4.16.32 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.

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

5 Marking

Each LBS shall have a clearly readable and durable name plate that will remain visible throughout the lifetime of the device, and shall bear the following information in English and Arabic:

- Manufacturer name
- SEC item number
- Serial number
- Year of manufacture
- Country of origin
- Rated voltage
- Rated frequency
- Manufacturer name and reference number
- CT & VT ratio, rating and class
- Rated continuous current
- Rated Short-Time Withstand Current and Time
- Rated insulation level
- 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 LBS shall be type tested in conformance with the applicable clauses of IEC 62271-103 and IEC 62271-1.

6.2.2 The bushings fitted on the LBS shall be type tested in conformance with the requirements of IEC 62217.

6.2.3 Type test shall be performed at SEC approved laboratories and shall consider the environmental conditions applicable.

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

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

6.3 Routine Tests

6.3.1 Routine tests in conformance with the applicable clauses of IEC 62271-103 and IEC 62271-1 shall be performed on all LBS unit.

6.3.2 In addition to the mentioned production tests, the following tests shall be performed on samples:

- Communication & SCADA functionality tests
- Backup power supply test, with temperature raise to 70˚C, to ensure operating the control panel functions for 8 Hours without AC supply and capability to perform ten switching operations within these 8 Hours
- The mounting and fitting test considering the design of standard overhead lines constructions as defined in SEC overhead line standard specification shall be implemented.

6.3.3 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.

6.3.4 SEC reserves the right to attend and witness the routine tests at the manufacturer's facilities.

6.4 Sample Inspection

Sample together with the as-built drawings, user manuals, electrical schematics, specifications of each component of the LBS unit, routine test reports, and packaging details shall be subject for inspection/evaluation prior to issuance of approval for mass production. Sample inspection/evaluation shall be conducted at either supplier's or manufacturer's facilities, whichever SEC advises. The following attributes shall be checked:

- Feature and components' compliance verification
- Markings
- Manuals, drawings, and schematics
- Pole mounting accessories and other auxiliaries
- Packaging
- Functionality.

7. Packing and Shipping

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 LBS shall be packed in a box as a complete unit and shall be delivered ready for use.

7.3 Packing shall protect the LBS 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) LBS Rating
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

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

9.1 The vendor/manufacturer shall guarantee the equipment against all defects arising out of faulty design or manufacturing defects or defective material for a period of five (5) years from the date of delivery.

9.2 The supplier/manufacturer shall guarantee that the backup supply provided shall have a minimum operating life of 10 years.

9.3 The supplier shall guarantee the uniformity of the products delivered with the approved samples.

9.4 In case of SF_6 gas-leak within the guaranteed service life of the LBS, all expenses for the maintenance, SF_6 gas re-filling, repairs, and replacements shall be borne by the supplier/manufacturer.

10 Training

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

11 Submittals

11.1 Submittals required with Tender

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

11.1.1 Clause-by-clause compliance with the latest revision of this SEC specification and 01-SDMS-01.

11.1.2 Manufacturer's Catalogue in English language.

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

11.1.4 Certificate stating that the material/components have been sampled, tested and inspected in accordance with relevant standards, as applicable

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

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

11.1.7 Manufacturer CAD drawings, e-copy in AutoCAD 2013 (*.dwg) format, for each of the LBS units, their components and auxiliaries, and mounting methods and accessories

11.1.8 Detailed description about what information or signals the LBS can provide and the analysis capabilities of the processing unit

11.1.9 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 Fabrication CAD drawings

11.2.3 Quality assurance tests

11.2.4 Manufacturing and routine test schedules.

11.2.5 Special tests, if applicable

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

12 Technical Data Schedule

33kV and 13.8kV Smart Overhead LBS

SEC Inquiry No. _____ *Item No.* _____

No	Description	SEC Specified Value	Vendor offered Value
1	**General**		
	Reference Manufacturing Standard (LBS)	IEC 62271-1 IEC 62271-103	
2	**Design Requirements**		
	Rated Voltage	17.5kV / 38kV	
	Rated Insulation Level - Impulse Withstand Voltage (Peak), kV - Power Frequency Withstand Voltage, kV_{rms} (Dry/Wet)	95,110 KV / 170,200 KV As per 01-SDMS-01	
	Rated Frequency	60Hz	
	Rated Continuous Current	400A / 600A	
	Rated Short-Time Withstand Current for 1 Second	21kA / 25kA	
	Rated Mainly Active Load-Breaking Current	400A / 600A	
	Rated Peak Withstand Current, kA	**	
	Rated Short-Circuit Making Current, kA	**	
	Minimum Creepage Distance of Bushings	543 mm / 1178 mm	
	Mechanical endurance class		
	Number of mechanical operations		
	Number of load-break operations		
	Electrical endurance class (Load Break)		
	Number of short-circuit making operations		
	Capacitive current class		
3	**Bushings (Polymer Insulators)**		
	Reference Manufacturing Standard	IEC 62217	
	Material / Color	Polymer / Grey	
4	**Accessories**		
	Pole Mounting Accessories Provided	Yes	
	All Ferrous Components are Hot-Dip Galvanized	Yes	
5	**Others**	-	
	Control Unit Backup Power Supply (Type and Life)	Conforming to specs.	
	Product is Type Tested	Yes	
	SEC Approved Laboratory	**	
	Date Tested	**	
	Manufacturer	**	
	Model/Type	**	
	Country of Origin	**	
	Submittals Required with Tender/Inquiry Included or Not?	**	
	Finish Color	RAL 7035	

6	**Communication**		
	Communication Requirements	Conforming to specs	
	SIM Card Slot Available	YES/NO	
	SIM Card Size	Standard	
	Mobile/Cellular Network Type	GPRS/2G/3G/4G/5G/NB-IoT	
	Communication Protocols	IEC 60870-5-104/101 /DNP3.0 /IEC 61850	
	Communication Interface for external comm. modem	Yes (Specify) / No	
7	**Cyber Security Requirements**		
	Cyber Security Requirements	Fully Comply/Not Comply	

33kV and 13.8kV Smart Overhead LBS

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 OH-LBS/LINE SECTIONALIZER
I/O LIST DATA POINTS

Bay / CIRCUIT no.	Point name / Message	IOA / IEC OBJECT ADRESS	
DIGITAL OUTPUT (DO) COMMANDS			
OH-LBS/Sectionalizer	CLOSE COMMAND	1	
OH-LBS/Sectionalizer	OPEN COMMAND	1	
DIGITAL INPUT (DI) GENERAL ALARMS / INDICATIONS			
OH-LBS/Sectionalizer	CLOSE INDICATION	11000	
OH-LBS/Sectionalizer	OPEN INDICATION		
OH-LBS/Sectionalizer	REMOTE	11001	
OH-LBS/Sectionalizer	LOCAL		
OH-LBS/Sectionalizer	OH-LBS MODE	11002	
OH-LBS/Sectionalizer	LINE SECTIONALIZER MODE		
COMMON	LOCK/UNLOCK INDICATION	1000	
COMMON	Battery low	1001	Alarm
COMMON	Gas Low (if the Sectionalizer 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/Close) 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)
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	
Counter	Counter Setting	13015	1-2 or 3