

24kV SF6 INSULATED SWITCHGEAR SPECIFICATION

1.0 REQUIRED EQUIPMENTS & QUANTITY

ITEM NO	MATERIAL	QUANTITY
1	24 kV SF6 Compact Ring Main Unit (Extensible/motorised). Shown in figure 1	
2	24 kV SF6 Fuse Switch (Extensible/motorised). Shown in figure 2	
3	24 kV SF6 Disconnect switch (Load Break switch) (Extensible/motorised). Shown in figure 3	
4	24 kV Dry Type Metering Unit(cable-cable connection type) Shown in figure 6.a	
5	24kV Vacuum Type Circuit Breaker (Extensible/motorised) Shown in figure 5	

Note: All required equipments and quantities that shown in the above table shall be given as a one offer. Complete offer and total prices will be evaluated for this specification. For all equipments that listed above shall have type test certificates from CESI, KEMA or TUV (The type test certificates of compact type switchgears are valid, sufficient and useable for each types of modular switchgears.) and all equipments type test certificates must be supplied in every tender even one of equipment in the table above will be offered. In addition, the bidder shall certify that, it is the authorized dealer of the product it offers and that it can provide the necessary technical support.

2.0 SCOPE

This Specification describes the approved SF6 insulated, extensible (**both left and right side**) and motorised 22kV (24kV Max) Metal Enclosed Switchgears to be installed in secondary distribution substations. The equipment covered includes Ring Main Units and Compact Units comprising load break switches (Disconnect Switch) for feeder control, fuse switches or circuit breakers for transformer control and dry type metering units in different configurations. It also includes individual load break switches (Disconnect Switch), fuse switches, circuit breakers (vacuum Type) and dry type metering units. Units line diagram schematics are shown in Table C.

Switchgears shall be Hermetically tight, welded switchgear vessel made of stainless steel and maintenance-free. Switchgears shall equipped with necessary, motors, protection relays, CTs, capacitive indicators, fault indicators and etc that can support remote monitoring and remote control from SCADA. The SCADA Signal List is given in the APPENDIX 1 and all Switchgears shall be adequate to produce and send these signals to SCADA via RTUs.

Switchgear SCADA input/output signals shall be ready on the switchgear's secondary connection terminals. For circuit breakers Relays shall be adequate to communicate with RTU by using IEC 61850 protocol. For SCADA automation and monitoring, RTU (Remote Terminal Unit) and Cellular modem Router (for IEC 104 communication protocol) specifications are given in the APPENDIX 2.

3.0 REFERENCES

The switchgears and the relevant equipment shall be designed, manufactured and tested according to the latest version of the following standarts :

Standard Number	Title
IEC 62271-200	High-voltage switchgear and controlgear. AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.
IEC 62271-1	High-voltage switchgear and controlgear - Part 1: Common specifications for alternating current switchgear and controlgear.
IEC 62271-100,102,103,105	High voltage switchgear and control gear Part 100: High voltage a.c. circuit breakers Part 102: AC disconnectors and earthing switches. Part 103: High-Voltage switches-part1 Part 105: Alternating current switch-fuse combinations.
EN 60085	Thermal evaluation and classification of electrical insulation.
IEC 60376	Specification of technical grade SF6 for use in electrical equipment.
EN 61869-2	Instrument transformers - Part 2: Additional requirements for current transformers
EN 61869-3	Instrument transformers - Part 3: Additional requirements for inductive voltage transformers
EN 50181	Plug-in type bushings above 1 kV up to 36 kV and from 250 A to 630A 1,25 kA for equipment other than liquid filled transformers.
EN 22063	Metallic and other organic coatings. Thermal spraying. Zinc, aluminium and alloys.
EN 60137	Insulated bushings for alternating voltages above 1 kV
EN 60282	High voltage fuses. Part 1: Current limiting fuses.
IEC 60529	Specification for degrees of protection provided by enclosures (IPCode) .
DIN 43625	High voltage fuses, rated voltages 3,6 to 36kV; fuse-links.
EN ISO 2063	Thermal spraying. Metallic and other inorganic coatings. Zinc, aluminium and their alloys.
IEC 60255	Electrical relays

4.0 DISTRIBUTION SYSTEM DATA

The Distribution System of the Authority for which the SF6 switchgear are intended is three phase, 3-wire at High Voltage, and 4-wire at Low Voltage, with solidly earthed neutral (at the source neutral terminal) and has the following data:

Medium Voltage at 11 kV	Nominal	11 kV
	Maximum	12 kV
	Line to earth (nom.)	6.35 kV
	Line to earth (max.)	6.93 kV
Medium Voltage at 22 kV	Nominal	22 kV
	Maximum	24 kV
	Line to earth (nom.)	12,70 kV
	Line to earth (max.)	13,86 kV
Low Voltage	Nominal	433V
	Maximum	440V
	Line to earth (max.)	254V
Frequency		50Hz
Maximum System fault level		21kA for 3 secs
		95kV
		75kV
Insulation level (Lightning Impulse level) for 22 kV equipment erected on the O/H system		125kV
Insulation level (Lightning Impulse level) for 22 kV equipment installed on the U/G system (inside GM substations)		125kV

Power Frequency withstand voltage of transformers: High Voltage (22 kV) Low Voltage	50kV 10kV
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5.0 SERVICE CONDITIONS

- 5.1 Ambient temperature range (for indoor units) -10 °C to +40 °C
- 5.2 Normally 1000 m above sea level, (1000 m is possible with special manometer)
- 5.3 Height of Installation (max.) 1000m above sea level
- 5.4 Atmospheric conditions Salty, foggy and dusty atmosphere
- 5.5 Maximum relative humidity 100%
- 5.6 Average annual rainfall 400mm approx.
- 5.7 Maximum recorded rainfall 103.6mm for 24 hours

6.0 GENERAL REQUIREMENTS

6.1 Compliance with standards

The SF6 22kV switchgear covered by this Specification (i.e. materials, individual parts and completed units) to be designed, manufactured and tested according to the requirements of this specification and according to the Standards referred to in paragraph 3.0 above.

If the Tenderer offers materials, equipment, design calculations or tests which conform to standards other than those referred to in paragraph 3.0 above, a clear copy of the proposed standards in the English language and also full details of the differences between the proposed standards and the ones referred to in paragraph 3.0 above, must be submitted with the Tender.

6.2 Quality Management System

The Tenderer shall have a valid ISO9001:2000 Quality Management System certificate for the goods offered.

The scope (extent) of the certification shall cover at least the design, development, production, installation and servicing of the offered goods and services.

In case the execution of the whole or any part of the work will be sub-contracted by the Tenderer to another company, the requirement pertaining to the Tenderer's Quality Management System will be satisfied, if the said requirement is possessed by the company which will actually undertake such execution.

6.3 Units of measurement

In all correspondence, in all technical schedules and on all drawings, metric units of measurement shall be used.

6.4 Packing

Each SF6 insulated switchgear shall be packed separately and shall be properly protected for transport and shipment from the place of manufacture to the port of destination.

The motorisation retrofit kits and the fuse links must be delivered in carton boxes which shall be labelled with the Material number and the description of the goods.

Provision shall be made for fork lift handling of the packed switchgear. Each Ring Main Unit and other switchgear to be seated and securely fastened on Europallet, in accordance with .

The switchgear shall be despatched in metal containers. Containers shall be of the fully enclosed weatherproof type (i.e. metal sides and roof).

6.5 Inspection and testing

The whole of the plant covered by this specification shall be subject to inspection and test by the Authority during manufacture and before final despatch from manufacturer's works. The approval of the Authority of any such inspection or test will not, however, prejudice the right of the Authority to reject the plant or any part thereof if it does not comply with the specification when erected or does not give complete satisfaction in service. The contractor shall make available to the Authority for the inspection and testing all required personnel and offer facility (equipment, testing instruments etc.) at no cost to the KIB-TEK. The Authority may, however, use his own instruments and apparatus as a check.

Before any part of the plant is packed or despatched from the manufacture works, all tests called for are to have been successfully and satisfactorily carried out in the presence of the Inspector and a certificate issued to that effect by the Inspector in writing.

Adequate notice is to be given when any part of the plant is ready for inspection or test and every facility is to be provided by the Contractor and his sub-contractors to enable the Inspector to carry out the necessary inspection and to witness the tests.

Duplicate copies of all principal Test Records and Test Certificates are to be supplied to the Inspector for all tests carried out in accordance with the provisions of this specification.

The switchgear and all component parts thereof are to be fully tested in accordance with the provisions of the latest relevant Standards referred to in paragraph 3.0 above, or as may be agreed in writing with the Inspector.

7.0 TECHNICAL REQUIREMENTS

7.1 General

The 22kV switchgear shall be Indoor, free standing, floor mounting, Extensible, SF6 insulated and suitable for the System and Service conditions as described in paragraphs 4.0 and 5.0 of this specification.

All switchgears shall be motorised as specified in paragraph 7.9.

The 22kV switchgear shall be manufactured to the standards mentioned in paragraph 3.0. above and to the specific requirements of this specification. If the specification conflict in any way with any of the standards mentioned in paragraph 3.0. above, the specification shall have precedence and shall govern. The equipment covered includes Ring Main Units and Compact Units comprising load break switches for feeder control and fuse switches or circuit breakers for transformer control. It also includes individual load break switches, fuse switches, circuit breakers and dry type metering units.

The switchgear shall have a minimum degree of protection IP65 for all high-voltage parts of the primary circuit in the gas-insulated panels, IP2X for the driving mechanism and IP3X for the cable compartment as classified in IEC 60529.

7.2 Busbars and busbar connections

The current rating of busbars and busbar connections, shall be 630A and the temperature rise conditions shall be in accordance with the relevant British Standards or the IEC temperature rise requirements.

The busbar compartment of the switchgears shall be SF6 insulated and shall be integrated in the cubicle or the busbar shall be outside the gas compartment with screened busbar system and each pole shall be insulated with silicone rubber. For this type of busbar system extension or panel replacement is possible within a very short period of time without requiring any gas work. Screened busbar system shall have a separate metal enclosure part on the cubicle.

Only for metering units busbars inside the cubicle shall be air insulated.

7.3 Insulating medium

The insulating medium for the switchgear shall be Sulphur Hexafluoride (SF6) gas. The SF6 gas shall comply with IEC 60376. The operating pressure of the SF6 gas shall be specified and monitored and also facilities for topping-up the SF6 gas shall be provided, in case of non hermetically sealed enclosures.

In case of the extensible type of switchgear, where applicable the insulation of the busbar couplings and /or busbar end caps shall be specified. The necessary busbar coupling and the materials used for the insulation of the busbar couplings and/or busbar end caps shall be provided with the switchgear and the price must be included in the price of the switchgear.

7.4 Busbar couplings and end caps for extensible switchgear

In the case of extensible type of switchgear, the switchgear shall be capable of using busbar couplings for possible extension with other Ring Main Units or load break switches or fuse switches or circuit breakers or metering units of the same manufacturer. The switchgear shall also be capable of using busbar end cap kits to terminate the busbar run and facilitate future extensions.

The 22kV switchgear shall be supplied complete with busbar coupling kits as follows:

1. Each extensible Ring Main Unit shall be supplied complete with two busbar end cap kits as required by the individual design, in order to terminate the busbar run and facilitate future extensions.
2. Each extensible load break switch, circuit breaker, fuse switch and busbar connected metering unit shall be supplied complete with one busbar coupling kit, to facilitate future extension.

Each busbar coupling kit and each busbar end cap kit shall be supplied complete including busbar coupling pieces, sealing material, flanges etc. Also the necessary materials required for the insulation of the busbar couplings and end caps. Individual panels and panel blocks can be lined up and extended without gas work on site.

7.5 Ring Main Units and Compact Units

Ring Main Units shall be extensible and shall comprise two load break switches for feeder control .

Compact Units shall be extensible and shall comprise load break switches. (Disconnecter switch) for feeder control, fuse switches or circuit breakers for transformer control and/or busbar metering units, all in different configurations.

The Compact Units shall be either in one complete enclosure or they shall comprise separate switches mounted together to form a complete unit.

In the latter case the switchgear shall be assembled together at the manufacturers works, and transported as one unit, to KIB-TEK's warehouse in North Cyprus. The manufacturer shall guarantee that the connection of the units can withstand all the disturbances during transport. In case of special transport requirements, these shall be stated.

The load break switches, the fuse switches or the circuit breakers and the metering units shall be designed in accordance with paragraphs 7.6, 7.7, 7.8 and 7.22 below.

7.6 Load Break switches (disconnecter switch)

7.6.1 General

The load break switch (both busbar and cable feeder switches) shall be extensible, triple pole, load breaking, fault making switch of rated normal current 630A, operating in an SF6 insulated enclosure. It shall be suitable both for manual and remote operation with a motor and all three poles shall be arranged to open and close simultaneously. The speed of operation of the switch shall be independent of the operator's and motor action.

7.6.2 Main parts of load break switches (Disconnecter Switch)

Load break switches shall comprise the following main parts:

One - Busbar chamber containing 3x630A busbars.

1. One - Independent spring operating mechanism having "ON", "OFF" and "EARTH" positions.
2. One - Circuit earthing facility of full short circuit capacity
3. One cable compartment suitable for terminating three 1-core XLPE insulated cables, with stranded Aluminium conductors of max conductor diameter 240 sq mm, copper wire screened, non-armoured and with PE oversheath of maximum size 240 sq.mm.and 3 core XLPE insulated cables with armoured and PE oversheath of max conductor diameter 3x240 sq.mm. The cable compartment shall have a minimum height of 700 mm.
4. One - Open simultaneously all phases device.
5. One – 3 phase voltage Indicator with sensor on the cable bushings as specified in paragraph 7.19.
6. For Load Break Switches cable connection busing interface shall be type "C" with bolted contact.

7.6.3 Details of the operating mechanism

Load Break switches shall have three operating positions:

- ON - outgoing feeder connected to the busbars
- OFF - outgoing feeder isolated in the tank
- EARTH - outgoing feeder connected to the earthing system of the switchgear.

The operating mechanism(s) of the switch shall be a spring-operated (both can be manual and motor operated) device designed so that the energy stored in the initial part of each operation shall be used to complete the making, breaking, earthing or opening from earth operation as the case may be, independently of the operator and motor. ON and OFF operations can be done separately by mechanical. The switchgear, that have a motor mechanism, is also adequate to operate remotely from SCADA and with electrical buttons for switching operation.

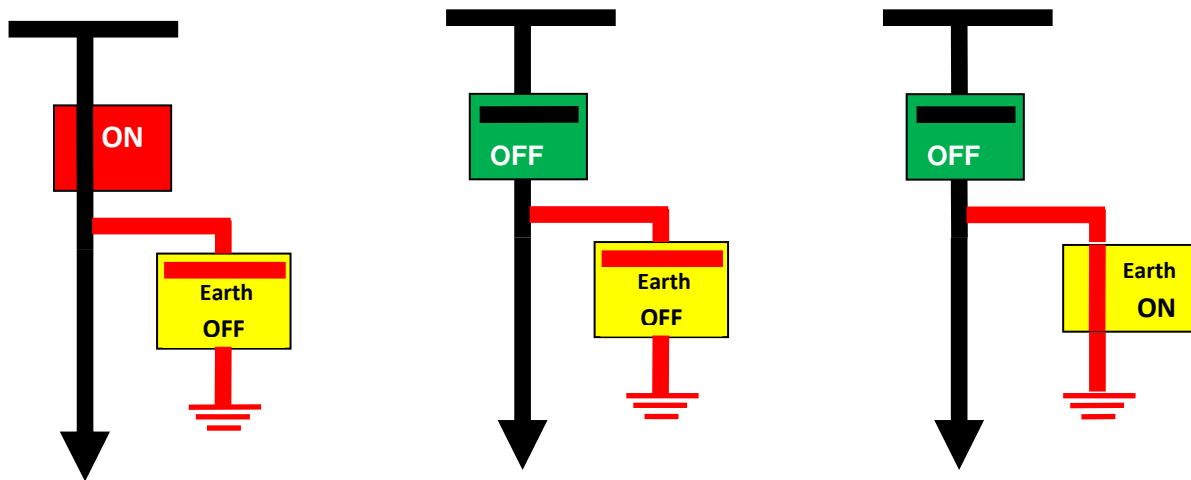
It shall not be possible for the operating mechanism(s) to be left in such a condition that any energy stored in the initial part of an incomplete operation remains in the spring when the switch is in the "ON", "OFF" or "EARTH" position.

It shall be possible to lock the operating mechanism(s) in any operating position and independently to lock off the "EARTH" and "ON" positions.

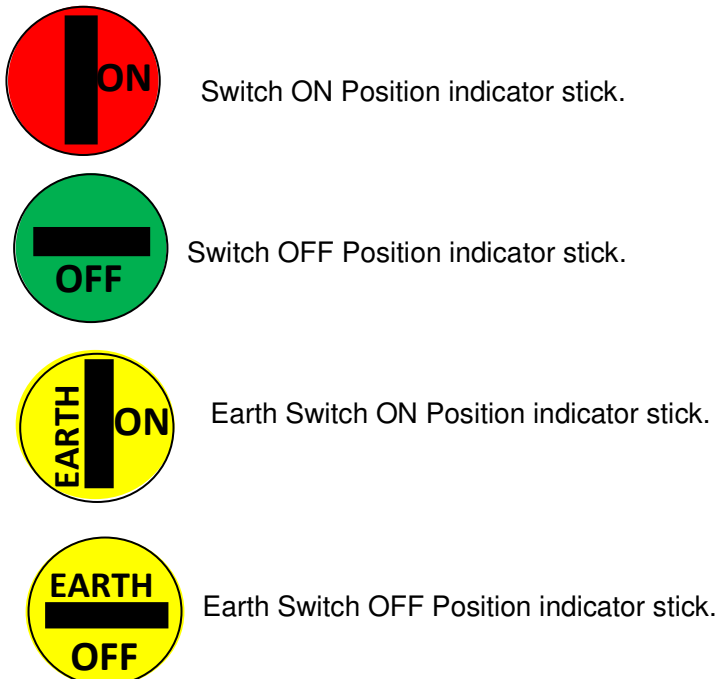
It shall be necessary before it is possible to operate from "OFF" to "EARTH", to move a captive device which can be padlocked and which shall be labelled like "REMOVE TO EARTH".

Mechanical indication of the operating positions of the switch equipment shall be provided. The indicators shall be positively driven in both directions from the switch operating mechanism(s) so as to show whether the equipment is in the "ON", "OFF" or "EARTH" positions. The positions shall be clearly indicated and the indicators shall be inscribed "ON" in white or black letters on a red background, "OFF" in white or black letters on a green background, and "EARTH" in black letters on a yellow background, and a schematical synoptic which shows clearly the position of the switch.

Mechanical indications of the operating positions shall be like in the figures below:



Indicators' sticks shall also be like below:



Operating or spring charging handles shall be preferably arranged to operate in a vertical plane and downward movement shall complete the making/loading spring and earthing operations.

The operating handle for the EARTH Switch shall be so designed so that when reversing the switching direction in the OFF-EARTH operation requires re-inserting the operating handle.

7.6.4 Interlocks

Interlocks shall be mechanical and when manually operated shall be clearly labelled.

The interlocks shall prevent the following operations:

1. the opening of the cable compartment cover unless the switch is in the "EARTH" position,
2. the movement of the switch from the "OFF" to "ON" position with the cable compartment cover open.
3. the "OFF" - "EARTH" mechanism from being operated unless the "OFF" - "ON" mechanism is in the "OFF" position,
4. the "OFF" - "ON" mechanism from being operated unless the "OFF" - "EARTH" mechanism is in the "OFF" position.
5. the operation from "ON to EARTH" or from "EARTH" to "ON" directly.

7.7 Fuse switches

7.7.1. General

The fuse switches shall be extensible, triple pole, load breaking, fault making switch of rated normal current 200A, operating in an SF6 insulated enclosure. It shall be suitable both for manual and electrical operation with a motor and all three poles shall be arranged to open and close simultaneously. The speed of operation of the switch shall be independent of the operator's and motor action.

7.7.2. Main parts of Fuse switches

Fuse Switches shall comprise the following main parts.

1. One - Busbar chamber containing 3x630A busbars.
2. One - Independent spring operating mechanism having "ON", "OFF" and "EARTH" positions.
3. One - open simultaneously all phases device.
4. One - Circuit earthing switch of reduced short-circuit capacity.
5. One cable compartment suitable for terminating three 1-core XLPE insulated cables, with stranded Aluminium conductors of max conductor diameter 95 sq mm, copper wire screened, non-armoured and with PE oversheath and 3 core XLPE Insulated cables with armoured and PE oversheath cables of max conductor diameter 95 sq mm.

In addition the Fuse Switches shall have a fuse compartment ready to accept three HRC Cartridge fuses as per para. 7.7.6.

7.7.3 Details of operating mechanisms

Fuse switches shall have three operating positions "ON", "OFF" and "EARTH". The operating mechanism(s) of the switch shall be a spring-operated device designed so that the energy stored in the initial part of each operation shall be used to complete the making, breaking, earthing or opening from earth operation as the case may be, independently of the operator. ON and OFF operations can be done separately by mechanical buttons. If the switchgear have a motor mechanism for switching the device is also adequate to operate remotely from SCADA and with electrical buttons.

It shall not be possible for the operating mechanism(s) to be left in such a condition that any energy stored in the initial part of an incomplete operation remains in the spring when the fuse switch is in the "ON", "OFF", or "EARTH" positions. The blowing of a fuse shall cause the opening (trip) of all three phases.

The mechanism shall be designed, so that when the switch closes, the springs are already loaded to open it. No additional step for charging the springs is permitted.

It shall be possible to lock the operating mechanism in any operating position and independently to lock off the "EARTH" and "ON" positions.

It shall be necessary before it is possible to operate from "OFF" to "EARTH" to move a captive device which can be padlocked and which shall be labelled "REMOVE TO EARTH" or similar warning text.

Mechanical indications of the operating positions of the fuse switch shall be provided. The indicators shall be positively driven in both directions so as to show whether the fuse switch contacts are in the "ON", "OFF" or "EARTH" position. The positions shall be clearly indicated and the indicators shall be inscribed "ON" in white letters on a red background, "OFF" in white letters on a green background and "EARTH" in black letters on a yellow background and schematical synoptic which shows clearly the position of the switch (similar with the drawings in 7.6.3).

Operating or spring charging handles shall be preferably arranged to operate in a vertical plane and downward movement shall complete the making/loading spring and earthing operations.

The operating handle for the EARTH Switch shall be so designed so that when reversing the switching direction in the OFF-EARTH operation requires re-inserting the operating handle.

7.7.4 Fuse-link Inspection and Replacement

Means shall be provided for isolating both sides of the fuses for inspection and replacement. Unless the fuses are bodily removed from their service position before being made accessible and/or isolation is clearly visible, earthing switches shall be provided upstream and downstream of the fuse links so as to prevent access to the fuse-links unless they are earthed. The earthing switch can only be cancelled after the fuse cover has been closed. Both earthing switches shall be switched simultaneously.

It shall be possible to remove and replace fuses readily and with safety; when the fuses are isolated all parts which may be alive shall be so shielded that an operator using normal access cannot touch them.

7.7.5 Interlocks

Mechanical Interlocks to IEC 62271-200 shall be provided and when manually operated shall be clearly labelled. Their design shall prevent the following operations:

1. Access for fuse-link removal unless the fuse switch is in the "OFF" position.
2. Opening of fuse-switch cover unless the fuse switch is in the "OFF" position.
3. The movement of the circuit switch to the "ON" position with blown fuse in circuit.
4. The "OFF" - "EARTH" mechanism from being operated unless the "OFF" - "ON" mechanism is in the "OFF" position.
5. The "OFF" - "ON" mechanism from being operated unless the "OFF" - "EARTH" mechanism is in the "OFF" position.
6. The operation from "ON" to "EARTH" or from "EARTH" to "ON" directly.

7.7.6. Fuse-links

Each Fuse Switch should be capable of accommodating fuse-links complying with IEC/EN 60282 - Part 1 and with dimensions according to DIN 43625. The fuse links shall be fitted with striker pins to provide short-circuit protection on the circuit supplying distribution transformers of up to 1000 kVA capacity. The fuse links shall be purchased separately. The Fuse carrier to be initially suitable for 11kV fuses length 292mm. The fuse carrier shall be suitable to be modified in the future to accept 22kV fuse links, length 442mm. In case it would be required to use any extra adaptors, for the above modification, this has to be stated, including the cost of any such adaptor.

Tenderers are required to submit tables regarding the suggested fuse ratings, both for 11kV and 22kV, for transformer sizes 315kVA, 400kVA, 500kVA, 630kVA, 800kVA and 1000kVA. The suggested fuse rating to be accompanied by data regarding the max permissible power loss of the fuse to comply with the requirements of the EN 62271 - Part 105 (Switch fuse combinations).

7.8 Circuit breakers (Vacuum Type)

The CBs shall be extensible, triple pole, shall have a minimum rated normal current of 200A for its feeder with 630A busbar connections. All requirements for the fuse switches (ratings, main parts, interlocks, type test certificates etc.) as described in paragraph 7.7 shall also apply for the Circuit Breakers (instead of fuse mechanism there should be vacuum interrupters, CTs and relay). So that the breakers shall be combination of switch and vacuum interrupters.

Arc interruption shall be by vacuum interrupters, switch mechanism and main busbars shall be situated in the SF6 environment.

Circuit Breaker shall have a manual loading mechanism and can be spring loaded by manually and can be spring loaded with motor. Breaker shall also have a spring load indicator.

Circuit Breaker shall also have an operating counter.

The protection of the circuit breaker shall be done by electronic protection relay (powered by 24Vdc \pm % 25) as described in this specification.

7.8.1 Current transformers/Sensors for Circuit Breakers

The current transformers shall be toroidal-core current transformers. The power range for the transformers is the same as the switchgears. The transformers are typically factory-installed in the cable bushing of the cubicle, which greatly simplifies field assembly and connection. Once the medium-voltage cables are connected to the cubicle, the facility measurement/protection is ready.

Current transformer ratings shall be as below:

- Rated primary current: 200A
- Current sense ratio: 200/5 or 200/1 depends on the relay current sense features)
- Protection Class: 5P20
- Burden: 0.5-5 VA
- Thermal Short Circuit current: 21 kA/3s
- Frequency: 50Hz

- Insulation: 0.72/3 kV
- Enclosure: Self-extinguishing polyurethane resin
- Thermal class: B (130°C)
- Reference standard: IEC/EN 60044-1 or EN 61869-2

7.8.2 Protection Relays for Circuit Breakers

The relay shall be equipped with separate processors for for communication and protection related functions. Whole defined switchgear I/O signals (given in the Scada Signal List in this specification) shall be connected to the I/Os of the relay and whole SCADA signals can be transferred to RTU with defined protocols.

Its obligatory to select protection relays from companies producing Medium and/or High Voltage switchgears. Relays shall have type test certificates from international agredity laboratories that match our origin conditions for the switchgears.

- Insulation : IEC 60255-5
- Electromagnetic Compatibility : IEC 60255-11; IEC 60255-22-1,2,3,4 ; IEC 61000-4-5,6,8 ; EN50081-2/55011
- Mechanical : IEC 60255-21-1,2
- Climatic tests: IEC 60068-2-1,2,3
- Power test: IEC 60265 , IEC 60266

Relays shall have at least following main features:

- Supply input voltage adequate for 24 Vdc \pm % 25
- 8 Binary input (with 24 Vdc \pm % 25 contact)
- 2 Binary output (with 24 Vdc \pm % 25 contact)
- Measuring/protection class : Class 1 / 5P20
- Communication features:
 - RS-232 or USB port for local programing
 - 2 x RJ45 (for IEC 61850) or 2 x Fiber Optic Ethernet port (for IEC 61850)
 - Protocol : IEC61850 (for RTU communication for scada aplications)
- Relay current tests shall be possible
- Relays shall support user defined programmable logic
- Event recorder for at least last 3 event

PROTECTION

Relays shall have Protection Functions at least as follows:

- Phase overcurrent 50-51
- Earth overcurrent 50N-51N
- IEC inverse time curves
- Thermometer (external trip) 49T (with 24 Vdc \pm %25 contact)
- 1 trip output + 1 external trip input
- At least 2 groups of settings for protection , dynamic reconfiguration of the protection elements due to changed conditions such as system configuration changes, or seasonal requirements.

PROGRAMMABLE LOGIC

- Relays shall support user defined logic (programmable logic) to build control schemes supporting logic gates, timers, nonvolatile latches etc.
- The relay shall have a configuration tool and configuration software with graphical user interface to build programmable logic.

COMMUNICATIONS

- The relay shall support the IEC 61850 Goose file transfer communication protocol
- Relays shall provide two RJ45 or two fiber optic Ethernet ports
- An USB or RS232 port that shall provide connectivity to configure settings and retrieve records from relay.

RELAY CONFIGURATION

- Entire relay settings communication related and also protection & control functional settings shall be a single setting file.
- The relay shall be configured through IEC 61850-6 standard based Configured IED Description format file.
- Time synchronization via Ethernet with SNTP .
- Integrated switch redundant optical and electrical Ethernet rings
- Relay shall be able to receive this single configuration/setting files via from the direct connection on the relays ports or via RTU from remote with TCP/IP.

FRONT-PANEL VISUALIZATION

- User interface shall provide a LCD front panel display, and navigation keys
- The front panel shall be capable of displaying measured values, calculated values, I/O status, device status, events, and configured relay settings .
- The front panel shall have user-programmable LEDs and pushbuttons.

INPUTS /OUTPUTS

- The relay shall support at a minimum 2 Digital Outputs for remote controlling switchgear and 10 Digital Inputs for remote signaling (SCADA signals).
- The Digital Inputs should be capable of accepting input signals , input voltage shall be 24V DC \pm %25 source.
- The relays I/O contacts should be rated for a minimum of 5A continuous .

7.9 Motorisation requirement

For all type of RMU,CRMU, Disconnect switch, Fuse switch and circuit breakers shall be Motorised.

7.9.1 Motorised Units shall be delivered with following motorisation supervisory features factory assembled.

7.9.1.1 Actuator/motor for all units shall be enable electrical motorised operation (OPEN - CLOSE commands only). The supply of the motor shall be 24V dc \pm % 25. The motor shall be protected for overloads by an appropriate MCB with auxiliary contact for SCADA signal.

7.9.1.2 The status position of the Load Break switch (ON, OFF, Earth ON, Earth OFF) shall be monitored by means of e.g. limit switches.

7.9.1.3 All wiring from actuators/motors, CT, auxiliary contacts, limit switches shall be concentrated on a terminal block, in order to facilitate interconnection with the RTU (Remote Terminal Control Unit).

7.9.1.3 The LOCAL/REMOTE selection switch shall be situated on the switchgears.

7.10 Cable Compartment

Cable connection system shall be according to DIN EN 50181.

For Load break Switches , circuit breakers and fuse switches cable connection bushing interface shall be type "C" with bolted contact .

The cable compartment shall be suitable both 1-core and 3-core 18/30 (36) kV XLPE, copper wire screened, armoured cables up to 240mm² . For the fuse switches and circuit breakers the cable compartment shall be suitable both 1-core and 3-core 18/30 (36) kV XLPE, copper wire screened, armoured cables up to 95 mm² .

The type of terminations to be used shall be of the screened and seperable type , therefore suitable front covers of the cable compartment shall be provided. The terminations shall be provided.

The cable entry **shall be covered**. Facilities for securing the cables on the cable entry shall be provided.

7.11 Padlocking

Padlocking facilities are required and provision shall be made for a padlock as per one.

7.12 Circuit labels

Each type of unit, switch or circuit breaker be fitted with a circuit label, size 150mm x 50mm x 3mm. All circuit labels shall be engravable with black lettering on a white background.

7.13 Earthing

Each equipment shall be provided with a main earth bar of not less than 25X3mm Hard Drawn High Conductivity copper strip or equivalent cross-section. The earth bar shall be bolted to the main frame and located so as to provide convenient facilities for earthing cable sheaths and earthing devices. The earth connecting point shall be marked with the "EARTH" symbol.

7.14 Lifting facilities

The switchgear covered by this specification shall be provided with lifting facilities.

7.15 Cleaning and painting

The use of stainless steel in the fabrication of the tank enclosure is preferred. The grade of the stainless steel shall be stated.

All ferrous exterior surfaces shall be cleaned of scale and rust by shot-blasting or other approved method and shall then be treated on the same day without outdoor exposure with a zinc spray. The zinc shall be applied by the flame gun process and the nominal thickness of the resultant coating shall be not less than 0.1mm in accordance EN ISO 2063.

This treatment shall be followed by the application of one coat of Zinc Chromate base priming paint, an undercoat and a final coat of durable oil and weather resisting paint. The final coat shall be Dark Admiralty Grey colour 632 to BS 381C or RAL 7033.

Other systems may be used if specifically approved by the Authority. In such an event Tenderers are required to include in their tender full details of the cleaning and painting process they are proposing.

7.16 Earth Fault Indicator

Earth Fault Indicators (EFI's) shall be provided to assist in rapid location of earth faults in the ring cable circuit. The EFI's shall be provided as follows:

1. For Ring Main Units, one EFI fitted on the left hand load break switch of each Ring Main Unit.
2. For Compact Units with two or more load break switches, one EFI shall be provided fitted on the left hand switch.
3. For single load break switches, one EFI fitted on each of the switches.

The EFI's shall be provided complete with the necessary current transformers, mounted inside the cable compartment, or around the bushings and mounting brackets where necessary. They shall be of the electrical automatic reset type once the earth fault is cleared and the line voltage is restored.

The performance characteristics shall be such that the EFI will not be subject spurious operation caused by transient switching currents whilst maintaining a good sensitivity to low magnitudes of earth fault current.

The earth fault indicators (EFI) shall have additional visible light indication lamp with 10m cable long for to mount this lamp on to the substation's roof and EFI shall have auxiliary contacts (adequate for 24V DC) for remote (SCADA) indication.

7.17 Gas Pressure Indicator

Each Ring Main Unit or individual unit, shall be provided with a pressure indicator to monitor the SF6 gas pressure, showing Red and Green zones.

The indicator shall be independent of outside temperature and pressure.

The indicator must be equipped with auxiliary contacts (adequate for 24V DC) for remote (Scada) indication.

7.18 Pressure Relief devices/Vent Outlets

Each Ring Main Unit or individual unit, shall be provided with a Pressure Relief device. The device shall direct the SF6 gas away from the operator down to the back gas outlet compartment within the SF6 compartment or compartments.

The tenderer shall provide information regarding any necessary requirements for the distance of the switchgear from the substation wall or any minimum requirement for the volume of the substation building, to cater for the hot gases and overpressure in the event of an internal failure and ensure safety to personnel.

7.19 Capacitive voltage indicators

One set of capacitive voltage indicators shall be installed on each load break switch feeder. The indicators shall indicate whether the cable feeder is live or dead. For this purpose units' plug in bushings shall have capacitive sensors to detect voltage and have necessary connections for indicators. Capacitive sensors and indicators shall be appropriate both for $11/\sqrt{3}$ kV and $22/\sqrt{3}$ kV Line-Earth voltage levels. ***The capacitive indication device shall have an SCADA contact (24 V***

DC) to send a binary input to the protection relay that the relay can sense the feeder is energised with line voltage or not. The voltage indicators shall satisfy the requirement of IEC61243-5 standard.

7.20 Arc Testing

For safety of the operators the design of the switchgear including the cable compartment, shall be proven that the arc fault is tested in accordance with EN 60298 sub-clause 6.108.

The duration of the test shall be 1 sec.(20 kA)

7.21 24kV Bushings

The 24kV bushings, preferably gasket free, shall be of the plug-in type and shall comply with EN 60137 and EN 50181. Plug-in bushing is a bushing, one end of which is immersed in an insulating medium and the other end is designed to receive a separable insulated cable connector, without which the bushing cannot function. Bushings shall be equipped with a capacitive sensor to operate capacitive voltage indicators that defined in 7.19.

For the ring circuits the bushing contact shall be of the bolted type and for the transformer circuits the bushing contact shall be of the sliding type.

The separable insulated cable connectors shall not be provided.

The tenderer shall provide test certificate for the 24kV plug-in bushings as required by EN 60137.

7.22 Dry type metering units

7.22.1 General

The metering units shall be dry type, suitable for busbar or cable connection, containing 3 metering current transformers and 3 metering voltage transformer. They shall be fully compatible with the extensible or nonextensible load break switches or the fuse switches or the circuit breaker units specified in paragraphs 7.6, 7.7 and 7.8 respectively of this specification.

7.22.2 Busbars and connections to switches

In the case of individual extensible units the current rating of busbars and busbar connections shall be minimum 200A and the temperature rise conditions shall be in accordance with the relevant IEC temperature rise requirements.

7.22.3 Busbar couplings

In the case of individual extensible units these shall be capable of being extended with other 22kV switchgear of the same manufacturer. Each metering unit shall be supplied complete with one busbar coupling unit which shall include all necessary coupling pieces, seals, flanges, nuts, washers etc. In case the material required for the insulation of busbar couplings is heat shrink material, the required materials shall be supplied in a separate kit form, together with the metering unit, and the relevant cost must be included in the price of the metering unit.

7.22.4 Current transformers for metering units

The current transformers shall be dry type and comply with EN 61869-2. They shall be of class 0.5 for metering. They shall be of ratio, 100-50-25/5A . The rated burden of the current transformers shall be 3.5 to 5 VA at the low ratio. They shall be connected to phases L1, L2 and L3 . Rated short time withstand current (kA) and Duration (sec) for CT's shall be 21kA/3sec.

7.22.5 Voltage transformer

The voltage transformers shall be dry type and comply with EN 61869-3. It shall be 3 pieces 1-phase (Phase-earth), dual ratio $22000\sqrt{3} - 11000\sqrt{3} / 100\sqrt{3}$ volt, burden 5-10 VA/phase and class 0.5 accuracy for metering.

7.22.6 Meter cabinet and secondary terminals (LV cabinet)

Metering Unit shall contain a metal meter and secondary terminations cabinet on the top of the metering unit. This cabinet shall contain the meter, CT secondary terminals, VT secondary terminals. Terminals for the CT and VT, with provision for selection of the CT and VT ratio and also for shorting and earthing the CT's without open circuiting the CT's or disconnecting any wires. It shall also contain voltage transformers LV fuses or MCBs. The terminals shall be sealable or shall have a locking facility.

7.22.7 Meter

Meters will be supplied by KIB-TEK.

7.22.8 Tests

The current transformers and the voltage transformers must be subjected to Type tests and Routine test as required by the relevant standards. The test certificates must be submitted with the tender.

Each completed metering unit must be subjected to routine testing to verify that the wiring is correct and also a power frequency dry voltage withstand test must be carried out. Test certificates must be provided with the shipment of the metering units.

7.23 Nameplates

All equipment to be supplied, except metering units, should be provided with a nameplate which shall include at least the following information :

1. **KIB- TEK** Contract number
2. **KIB- TEK** Serial number
3. Manufacturer's name
4. Year of manufacture
5. Type of switchgear and Serial number
6. Rated Voltage (kV)
7. Rated normal current (A)
8. Rated lightning impulse withstand voltage (kV)
9. Rated frequency (Hz)
10. Rated 3 sec short time current (kA)
11. Rated short circuit making current (kA)
12. Rated short circuit breaking current (kA)
13. Weight (kg)
14. Testing standards

For the metering units, in addition to the above information, the following shall be provided.

1. CT ratio, class, burden
2. CT serial numbers
3. VT ratio, class, burden
4. VT serial number
5. Busbar current rating

The **KIB - TEK** Serial Number shall be advised at the time of the award of the tender.

7.24 Type tests

The type tests shall be made on a representative functional unit of each type of switchgear and type test certificates, establishing that the goods offered comply with the specified standards, must be submitted with the tender. The certificates, shall be issued by a reputable and Internationally recognised Testing Body as described in the specifications.

It shall be accepted to submit type test certificates for the Ring Main Unit only, in case the individual Load Break switches or the Fuse switches are of the same design.

Units shall be type tested in accordance with IEC standards 62271-100, 62271-102, 62271-103, 62271-200, 62271-105, IEC 62271-1, and 60529. The following type tests have been performed and available if required

- Short time and peak withstand current test
- Temperature rise tests
- Dielectric tests
- Test of apparatus i.e. circuit breaker and earthing switch
- Arc fault test

Also test to prove that the SF6 gas complies with the requirements of IEC 60376.

7.25 Routine Tests

Each and every unit to be supplied, shall be subjected to the following routine tests, in accordance with IEC 62271-200 standards, carried out at the manufacturers works to ensure that the supplied equipment is in accordance with the equipment on which the type test has been carried out.

Below listed test shall be performed as routine tests before the delivery of units;

- Withstand voltage at power frequency
- Measurement of the resistance of the main circuit
- Gas leakage test
- Withstand voltage on the auxiliary circuits
- Operation of functional locks, interlocks, signalling devices and auxiliary devices
- Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism
- Verification of wiring
- Visual inspection

8.0 INFORMATION TO BE GIVEN WITH TENDERS

The following information shall be submitted with the Tender.

1. The attached schedules shall be completed.
2. Type test certificates of **switchgears** and **protection relays** required by the specification.
3. Quality assurance Certificates.
4. List of recommended spare parts.
5. Full set of dimensioned drawings including installation detail.
6. **Protection Relays, RTUs, Modems and other electronic device specifications. (These devices will be submitted to KIB-TEK approval prior to ordering and installation)**
7. Transport, storage and installation requirements.

9.0 INFORMATION TO BE GIVEN BY THE SUCCESSFUL TENDERER

The successful tenderer should provide the following information.

- 9.1 ***Type and Routine test certificates of the manufactured equipments. (Switchgears and also relays, modems and RTUs)***
- 9.2 Five sets of Installation, Operations and Maintenance Manual. This Manual should include the following:
- 9.2.1 Instructions as regards transport, storage and erection of the 22kV switchgear, including relevant drawings.
 - 9.2.2 Instructions for inspection and test of the 22kV switchgear after the installation and connection which should include at least a list of recommended tests made at site.
 - 9.2.3 Operation and maintenance instructions including frequency and procedure for maintenance, both for preventive maintenance and scheduled overhauls.
 - 9.2.4 Instructions for locating and rectifying faults.
- 9.3 ***Catalogs, descriptive explanatory document for manufactured and ordered equipments. (Switchgears, CTs, VTs, relays, modems, and RTUs)***
- 9.4 Installation instructions for the motorisation upgrade retrofit kit.

TABLE "A"**SPECIFICATION REQUIREMENTS FOR SWITCHGEARS**

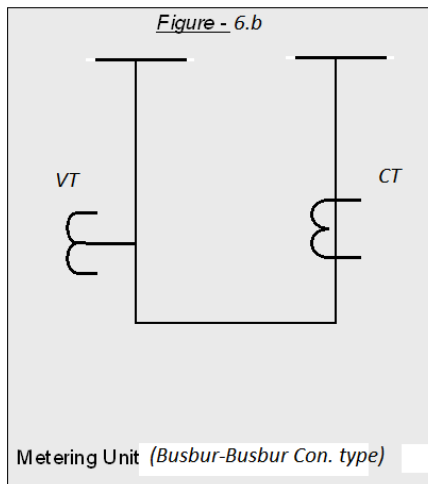
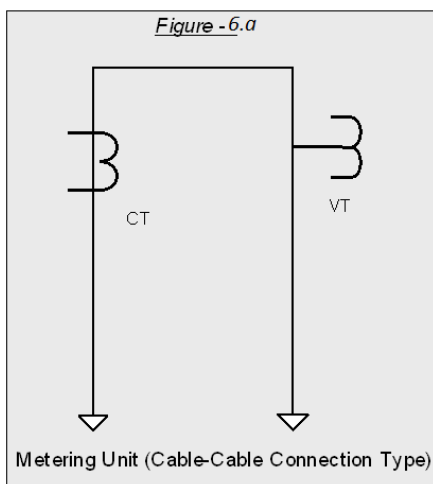
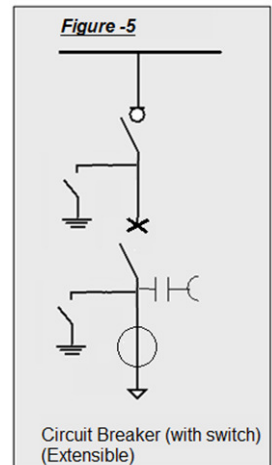
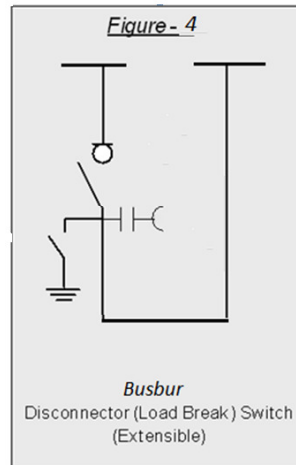
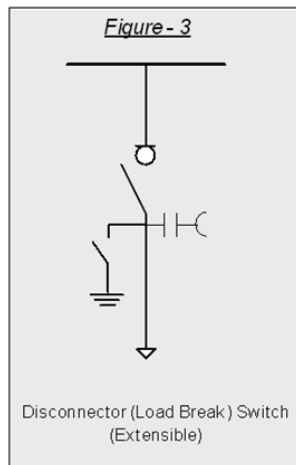
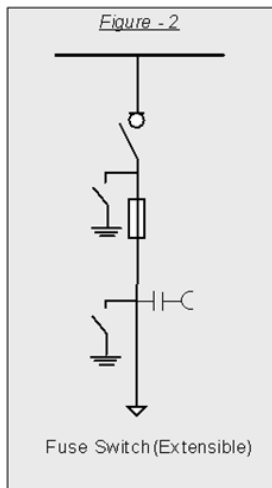
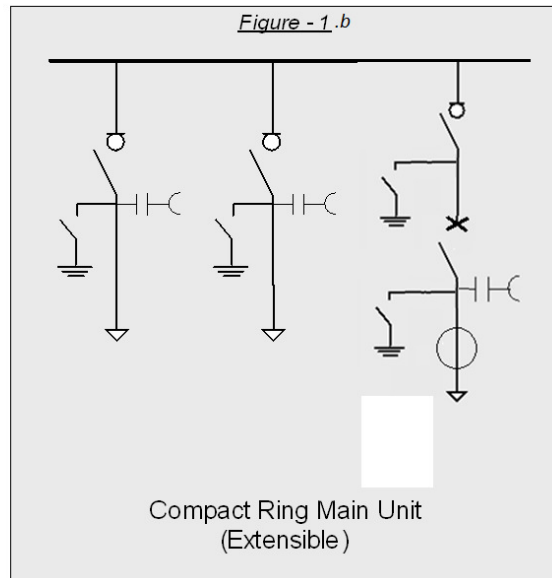
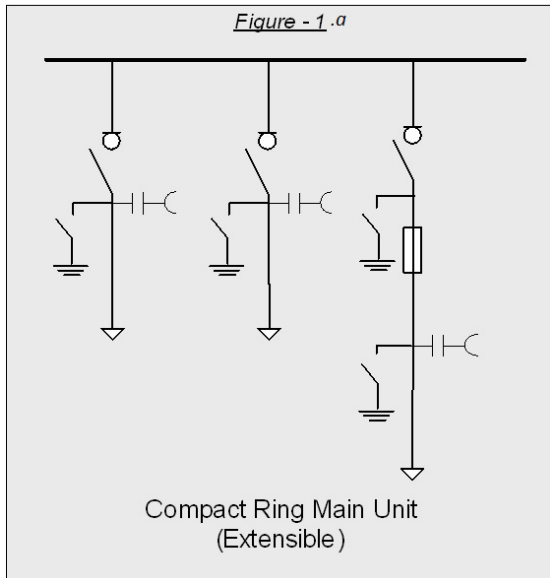
	DESCRIPTION	LOAD BREAK SWITCH	FUSE SWITCH	CIRCUIT BREAKER
1	Type	Indoor	Indoor	Indoor
2	Degree of protection Main tank Driving mechanism Cable compartment	IP64 IP2X IP3X	IP64 IP2x IP3X	IP64 IP2X IP3X
3	Rated Voltage (kV)	24	24	24
4	Nominal voltage (kV)	22	22	22
5	Rated Normal Current (A)	630	200	200
6	Busbar Rated current (A)	630	630	630
7	Rated breaking current (A)	630	200	200
8	Number of phases	3	3	3
9	Rated frequency (Hz)	50	50	50
10	Rated Insulation Level (kV)	125	125	125
11	Rated short time withstand current (kA)	21	21	21
12	Duration (sec)	3	3	3
13	Rated short circuit making current(kA peak)	50	50	50
14	Rated peak withstand current (kA peak)	40	40	40
15	Rated short circuit making current of earth switch (kA peak)	50	50	50
16	Rated peak withstand current of earth switch (KA peak)	40	40	40
17	Insulating medium	SF6 gas to IEC60376	SF6 gas to IEC60376	SF6 for switch side / vacuum tube for breaker side
18	Method of opening and closing	Spring Operated (both manuel and with motor)	Spring operated (both manuel and with motor)	Spring Operated (both manuel and with motor)
19	Protection Relay			YES
19.1	Protection Functions (ANSI)			50-51 50N-51N,49T
19.2	Binary Input			8
19.3	Binary Output (Excluding trip outputs)			2
19.4	Comminication Protocol			IEC 61850
20	Pressure Relief device / Vent outlet	YES	YES	YES
21	Gas Pressure Indicator	YES	YES	YES
22	Padlocking facilities	YES	YES	YES
23	Capacitive indicator	YES	---	YES
24	Protection CT	YES	----	YES
	<ul style="list-style-type: none"> • Current range • Protection Class • Thermal current • Thermal class • Reference standard: 	-----	-----	0- 200 A 5P10 21 kA (3 sec.) B (130°C) EN 61869-2 (or EN60044-1)

TABLE "B"**SPECIFICATION REQUIREMENTS FOR METERING UNITS**

	DESCRIPTION	SPECIFICATION REQUIREMENT
1	Type	
2	Connection	Busbar or cable connected
3	Rated Voltage (kV)	24
4	Nominal voltage (kV)	22
5	Number of phases	3
6	Minimum rating of busbars and busbar connections for individual extensible units (A)	200
7	Rated frequency (Hz)	50
8	Rated Insulation Level (kV)	125
9	Rated short time withstand current (kA)	21
10	Duration (sec)	3
11	Current transformers	
11.1	Type	Dry
11.2	CT ratio for metering units in Compact Units	100-50-25/5A
11.3	CT ratio for individual extensible metering units	100-50-25/5A
11.4	Class	0.5
11.5	Burden (VA)	Min 3.5 at the low ratio
	Rated short time withstand current (kA) & Duration (sec)	21kA/3sec
12	Voltage transformer	
12.1	Type	Dry
12.2	Number of phases	1
12.3	Ratio	$22000/\sqrt{3} - 11000\sqrt{3} / 100 \sqrt{3}$
12.4	Burden (VA/phase)	Min 5 at low ratio
12.5	Class	0.5
13	Meter Wiring	3Phase-4Wire connection

TABLE "C"

22kV SWITCHGEAR SCHEMATICS



KIB – TEK SPECIFICATION
22kV SF6 INSULATED RING MAIN UNITS

TECHNICAL SCHEDULES TO BE FILLED BY TENDERERS

- T1. PARTICULARS AND GUARANTEES FOR SWITCHGEARS
- T2. PARTICULARS AND GUARANTEES FOR METERING UNITS
- T3. RECOMMENDATIONS FOR FUSE RATINGS

SCHEDULE "T1"
TECHNICAL PARTICULARS AND GUARANTEES
FOR SWITCHGEARS

	DESCRIPTION	SPECIFICATION REQUIREMENT	TENDERER'S OFFER
1	Type	Indoor	
2	Degree of protection Main Tank Driving Mechanisms Cable compartment	IP66 IP2X IP3X	
3	Rated Voltage (kV)	24	
4	Nominal voltage (kV)	22	
5	Rated Current (A) for load break switch for fuse switch	630 200	
6	Busbar Rated current (A)	630	
7	Rated breaking current (A) for Load Break switch	630	
8	Number of phases	3	
9	Rated frequency (Hz)	50	
10	Rated Insulation Level (kV)	125	
11	Rated short time withstand current (kA)	21	
12	Duration (sec)	3	
13	Rated short circuit making current (kA peak)	50	
14	Rated peak withstand current (kA peak)	40	
15	Short circuit making current of earth switch(kA peak)	50	
16	Rated peak withstand current of earth switch (kA peak)	40	
17	Insulating medium	SF6 gas to IEC 60376	
18	Method of closing	Spring operated	
19	Method of opening	Spring operated	
20	Earth Fault Indicator	YES / NO *	
20.1	CT or CT's inside cable box	YES	
20.2	Electrical reset	YES	
20.3	Aux contacts for remote indication	YES	
21	Weight of unit (kg)		
22	Pressure Relief device	YES	
23	Gas Pressure Indicator	YES	
24	Rated filling pressure		
25	Padlocking facilities	YES	
26	Type of fuse links for fuse switches	EN 60282-1 DIN 43625	
27	Height of cable compartment		
28	Fuses suitable for 11kV (292mm) and upgradeable to 22kV (442mm)	YES	
29	Capacitive indicators (with 24V dc SCADA contact)	YES	

Signed :

On behalf of:

Date :

SCHEDULE "T2"
TECHNICAL PARTICULARS AND GUARANTEES
FOR METERING UNITS

	DESCRIPTION	SPECIFICATION REQUIREMENT	TENDERER'S OFFER
1	Type	Dry	
2	Individual Extensible units	Busbar or cable Connected	
3	Rated Voltage (kV)	24	
4	Nominal voltage (kV)	22	
5	Number of phases	3	
6	Minimum rating of busbars (A)	200	
7	Rated frequency (Hz)	50	
8	Rated Insulation Level (kV)	125	
9	Rated short time current (kA)	21	
10	Duration (sec)	3	
11	Current transformers		
11.1	CT ratio	100-50-25/5A	
11.2	Class	0.5	
11.3	Burden (VA)	Min 3.5 on the low ratio.	
11.4	Rated short time withstand current (kA) & Duration (sec)	21kA/3sec	
12	Voltage transformer		
12.1	Number of phases	3	
12.2	Ratio	$22000/\sqrt{3} - 11000\sqrt{3} / 100 \sqrt{3}$	
12.3	Burden (VA/phase)	Min. 5	
12.4	Rated short time withstand current (kA) & Duration (sec)		
12.5	Class	0.5	
13	External terminal as per specification requirement	YES	
14	Type of insulation for busbar couplings		
15	Material for insulation of busbar couplings supplied	YES	
16	Meter and Secondary terminal cabinet.	YES	
17	Weight of unit (Kg)		

Signed :

On behalf of :

Date :

**SCHEDULE "T3"
RECOMMENDED FUSE RATINGS
TO EN 62271 Part 105, DIMENSIONS TO DIN 43625**

TRANSFORMER RATING (KVA)	RATED VOLTAGE			
	11kV		22kV	
	FUSE RATING (A)	MAX. PERMISSIBLE POWER LOSS (W)	FUSE RATING (A)	MAX PERMISSIBLE POWER LOSS (W)
50				
100				
250				
400				
630				
800				
1000				
1250				

Signed:

On behalf of:.....

Date:

APPENDIX 1 SCADA Signal List

COMPACT RING MAIN UNIT

FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI	FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI	FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI			
Load Break Switch (Incoming)	COMMANDS	SWITCH OPEN	BO	DC	Load Break Switch (outgoing)	COMMANDS	SWITCH OPEN	BO	DC	TR-Fuse Switch	COMMANDS	SWITCH OPEN	BO	DC			
		SWITCH CLOSE	BO				SWITCH CLOSE	BO				SWITCH CLOSE	BO				
	INDICATIONS	ISOLATOR SWITCH OFF	BI	DP		INDICATIONS	ISOLATOR SWITCH OFF	BI	DP		INDICATIONS	ISOLATOR SWITCH OFF	BI	DP			
		ISOLATOR SWITCH ON	BI				ISOLATOR SWITCH ON	BI				ISOLATOR SWITCH ON	BI				
		ISOLATOR EARTHING SWITCH OFF	BI	DP			ISOLATOR EARTHING SWITCH OFF	BI	DP			ISOLATOR EARTHING SWITCH OFF	BI	DP			
		ISOLATOR EARTHING SWITCH ON	BI				ISOLATOR EARTHING SWITCH ON	BI				ISOLATOR EARTHING SWITCH ON	BI				
	ALARMS	FEEDER LOCAL/REMOTE*	BI	SP		ALARMS	FEEDER LOCAL/REMOTE*	BI	SP		ALARMS	FEEDER LOCAL/REMOTE*	BI	SP			
		SWITCH MOTOR FAILURE	BI	SP			SWITCH MOTOR FAILURE	BI	SP			SWITCH MOTOR FAILURE	BI	SP			
		FEEDER LINE NO VOLTAGE	BI	SP			FEEDER LINE NO VOLTAGE	BI	SP			FUSE PROTECTION TRIP	BI	SP			
							FAULT INDICATOR OPERATED	BO	SP			TRANSFORMER SELF PROTECTION TRIP	BI	SP			
													TR-LV SIDE	MEA VALUE	A PHASE CURRENT	PR	ME
														"	B PHASE CURRENT	PR	ME
														"	C PHASE CURRENT	PR	ME
														"	A PHASE Voltage	PR	ME
										"	B PHASE Voltage	PR		ME			
										"	C PHASE Voltage	PR	ME				

* FEEDER LOCAL/REMOTE is only one BI for hole CRMU

RING MAIN UNIT

FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI	FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI
Load Break Switch (Incoming)	COMMANDS	CB OPEN	BO	DC	Load Break Switch (outgoing)	COMMANDS	CB OPEN	BO	DC
		CB CLOSE	BO				CB CLOSE	BO	
	INDICATIONS	ISOLATOR SWITCH OFF	BI	DP		INDICATIONS	ISOLATOR SWITCH OFF	BI	DP
		ISOLATOR SWITCH ON	BI				ISOLATOR SWITCH ON	BI	
		ISOLATOR EARTHING SWITCH OFF	BI	DP			ISOLATOR EARTHING SWITCH OFF	BI	DP
		ISOLATOR EARTHING SWITCH ON	BI				ISOLATOR EARTHING SWITCH ON	BI	
	ALARMS	FEEDER LOCAL/REMOTE*	BI	SP		ALARMS	FEEDER LOCAL/REMOTE*	BI	SP
		CB MOTOR FAILURE	BI	SP			CB MOTOR FAILURE	BI	SP
		FEEDER LINE NO VOLTAGE	BI	SP			FEEDER LINE NO VOLTAGE	BI	SP
							FAULT INDICATOR OPERATED	BO	SP

* FEEDER LOCAL/REMOTE is only one BI for hole RMU

Load Break Switch (outgoing)

FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI
Load Break Switch (outgoing)	COMMANDS	CB OPEN	BO	DC
		CB CLOSE	BO	
	INDICATIONS	ISOLATOR SWITCH OFF	BI	DP
		ISOLATOR SWITCH ON	BI	
		ISOLATOR EARTHING SWITCH OFF	BI	DP
		ISOLATOR EARTHING SWITCH ON	BI	
	ALARMS	FEEDER LOCAL/REMOTE*	BI	SP
		CB MOTOR FAILURE	BI	SP
		FEEDER LINE NO VOLTAGE	BI	SP
		FAULT INDICATOR OPERATED	BO	SP

Load Break Switch (Busbar Isolator)

FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI
Load Break Switch (Busbar Isolator)	COMMANDS	CB OPEN	BO	DC
		CB CLOSE	BO	
	INDICATIONS	ISOLATOR SWITCH OFF	BI	DP
		ISOLATOR SWITCH ON	BI	
		ISOLATOR EARTHING SWITCH OFF	BI	DP
		ISOLATOR EARTHING SWITCH ON	BI	
	ALARMS	FEEDER LOCAL/REMOTE*	BI	SP
		CB MOTOR FAILURE	BI	SP

Circuit Breaker: (All input/output/mea. Values shall be connecten In to the Relay - Relay send the signals to the RTU by IEC61850)					Fuse Switch						
FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI	FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI		
TR Circuit Breaker (CB)	COMMANDS	CB OPEN	BO	DC	TR-Fuse Switch	COMMANDS	SWITCH OPEN	BO	DC		
		CB CLOSE	BO					SWITCH CLOSE	BO		
	INDICATIONS	CB OFF	BI	DP			INDICATIONS	ISOLATOR SWITCH OFF	BI	DP	
		CB ON	BI				"	ISOLATOR SWITCH ON	BI		
		ISOLATOR SWITCH OFF	BI	DP			"	ISOLATOR EARTHING SWITCH OFF	BI	DP	
		ISOLATOR SWITCH ON	BI				"	ISOLATOR EARTHING SWITCH ON	BI		
		ISOLATOR EARTHING SWITCH OFF	BI	DP							
		ISOLATOR EARTHING SWITCH ON	BI				ALARMS	FEEDER LOCAL/REMOTE*	BI	SP	
	ALARMS	CB LOCAL/REMOTE	BI	SP			"	SWITCH MOTOR FAILURE	BI	SP	
		CB MOTOR FAILURE	BI	SP			"	FUSE PROTECTION TRIP	BI	SP	
		FEEDER NO VOLTAGE	BI	SP		"	TRANSFORMER SELF PROTECTION TR	BI	SP		
		OC/IEF PROTECTION TRIP	BI	SP							
		TRANSFORMER SELF PROTECTION TR	BI	SP							
	MEA.VALUE	A PHASE CURRENT	PR	ME	TR-LV SIDE	MEA.VALUE	A PHASE CURRENT	PR	ME		
	"	B PHASE CURRENT	PR	ME		"	B PHASE CURRENT	PR	ME		
	"	C PHASE CURRENT	PR	ME		"	C PHASE CURRENT	PR	ME		
						"	A PHASE Voltage	PR	ME		
				"	B PHASE Voltage	PR	ME				
				"	C PHASE Voltage	PR	ME				

METERING UNIT

FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI
METERING UNIT	MEA VALUES	V _{Ab} VOLTAGE	AI	ME
		V _{Bc} VOLTAGE	AI	ME
		V _{Ac} VOLTAGE	AI	ME
		A PHASE CURRENT	AI	ME
		B PHASE CURRENT	AI	ME
		C PHASE CURRENT	AI	ME

Substation General

FEEDER	SIGNAL GROUP	SIGNAL DEFINITION	FROM	TI
STATION	ALARMS	RTU Local / Remote	BI	SP
	"	PS Battery Fault	BI	SP
	"	PS Vac Supply Fail	BI	SP

APPENDIX-2

MEDIUM VOLTAGE (MV) SUBSTATIONS SCADA and REMOTE TERMINAL UNIT (RTU) SPECIFICATIONS

1. RTU General Features

The materials covered in this specification shall comply with the latest editions of the CENELEC / IEC / EN and IEEE (Institute of Electrical and Electronics Engineers) standards. If any other equivalent or superior standards are applied, they will be submitted by their English or Turkish copies.

RTUs shall be used for SCADA systems to monitor, control and display remote MV switchgear units. These RTUs will be used to control the Switchgear devices and collect the status information of the switchgears and other related signals in the KIB-TEK distribution transformer substations.

RTUs shall be able to communicate with the KIB-TEK SCADA (Mikronika- Syndis RV) and the substation devices by using the defined standards in this specification.

The signal list is given in the "Appendix 1 Signal List" to perform all required automation functions.

The analog and digital input data on the power system shall be collected and the field devices (MV switchgears) and the field devices shall be controlled by RTUs. For each piece of equipment for a feeder (breaker, switch, fuse switch, etc) an object shall be defined.

It is obligatory to select RTUs from the companies that produce Medium and/or High Voltage switchgears. The RTU brands that have been used without problems in the KIB-TEK network for at least 5 years can also be offered. RTUs shall have type test certificates from international accredited laboratories that match our origin conditions for the RTUs.

RTUs shall have at least the following main features for main design but for further expanded applications Binary Input/outputs and Analog Inputs shall be expanded by adding extra modules:

- Supply input voltage 230 Vac \pm % 20
- Output supply / battery/control voltage: 24 Vdc \pm % 20
- 36 x Binary input (can be expanded up to 72 Binary Input) (see the details in paragraph 6.1)
- 12 x Binary output (can be expanded up to 24 Binary output) (see the details in paragraph 6.2)
- 9 x Analog Inputs (can be expanded up to 18 Analog input) (see the details in paragraph 6.3)

The data collected in the system should be designed and operated in such a way that the electromagnetic and electrostatic interference is minimized.

2. RTU Parameterization and Diagnosis

RTU parameterization shall be object-oriented and automation functions shall comply with IEC 6113-3 standard.

RTU's parameter values and automation functions can be tested in the parameterization software as "offline" with a Windows based tool and signal engineering can be done easily in accordance with IEC 61346-1 standard.

The RTU diagnostic software shall be provided to continuously monitor RTU operations and report RTU hardware faults to the SCADA Center. The software shall check memory, processor and input / output port errors and any other functional areas defined in the RTU specification.

All diagnostic signals (RTUs, IEDs, Relays, etc.) shall have time labeling with 1 ms resolution.

3. RTU Communication Interfaces

RTUs shall be able to communicate with the upper systems (Substations/RTUs - SCADA centers) with IEC 870-5-101, IEC 870-5-104 and IEC61850 communication protocols and with

subsystems (IEDs, protection relays, etc) IEC 61850, MODBUS RTU,MODBUS TCP/IP, DNP 3 communication protocols.

For upper system RTU communication Wan interface include **3G,4G ,Fibre** and **ethernet** and they all shall be ready to use for IEC 870-5-104 protocol.

The RTUs shall be equipped with necessary communication ports and if required for further applications additional modules that can be added to increase these ports as needed. Through these communication modules, various communication protocols shall be used to communicate with devices in both upper systems (SCADA Center – RTUs) and lower systems (RTUs - Substation Devices).

All Communication protocol firmwares shall be available in the communication modules on the RTUs.

All kind of software and hardware products (programming software, Protocol analyzer programs, database installation software, laptop PC and etc.) necessary for programming, parameterizing or loading the database shall be provided with RTUs. Software shall comply with all communication protocols and adequate to program all parameters including the whole communication protocols (IEC 870-5-101, IEC 870-5-104, IEC 61850 and MODBUS RTU, MODBUS TCP/IP, DNP 3).

All softwares shall be submitted with latest licence (with approved licence codes, hardware and etc.) and necessary hardware tools if required.

4.SCADA Center - RTU - Substation Devices Communication

SCADA central communication shall be done via TCP / IP Ethernet ports. IEC60870-5-104 protocol shall be used for this communication.

One of the Ethernet ports communicates with the SCADA Center via cellular routing modem, the other ethernet port will communicate with the IEC61850 protocol with the protection relays in the station (if available). Other IEDs (Fault indicators, voltage indicators, meters, power analyzers, etc.) that may be located in the station may communicate with other protocols that RTUs can be support.

The RTUs shall have enough RS485, RS232 and ethernet ports according to the communication capabilities of the station's equipments. The required signal lists shall be designed according to the signal Lists defined in the Appendix-1.

In a minimum configuration the RTUs shall have sufficient number of digital inputs, digital outputs and measurement values (analog inputs) for “**One CRMU+ One Isolator Switch+ Substation General**” (see the Appendix-1 signal lists) configuration. Each IED and Device shall be transfer the signals to the SCADA center using the appropriate protocols. **But protection relays shall only use IEC 61850 communication protocol with RTU.**

All field data shall be send time-tagged and time tag information is sent to the upper system.

5.General Features Of RTUs

- All RTUs and modules shall comply with the related following standarts.
IEC 60870-2-1, IEC 61010, IEC 60255-5, IEC 61000-4, EN 55022, IEC 60529
- The design shall be based on standard modules. It will be in modular construction and all modules shall be added as needed.
- Microprocessors shall form the basis of RTUs. All RTUs have the same basic hardware, but the environmental interfaces shall be in various numbers. The basic equipment of the Remote Terminal Units will consist of the following modules and parts:
 - Housing and racks
 - Power Supply Module
 - Digital Input Module

- Digital Output Module
- Analog Input Module
- CPU and Communication Module
- Racks, cabinets and constructions
- Inner wire cabling
- Special Hardware for service and maintenance if required
- The minimum insulation value of all input-output and communication modules will be 2kV.
- All input and output interfaces shall be galvanically isolated from each other.
- RTU Shall be able to follow itself.
- Operational status shall be displayed.
- Local error shall be detected.
- Output control shall verify that the command is fulfilled.
- It will be possible to time-stamp all monitored value, alarm and position information with accuracy of 1 millisecond.
- The supply voltage shall be 24V DC \pm 20%.
- It shall be possible to ensure that the entire system can be synchronized with the Kib-Tek SCADA by:
 - Inter-range instrumentation group time codes with GPS clock input.
 - Ethernet SNTP server.
 - a telegram message issued by IEC60870-5-104 or IEC60870-5-101.
- The information processing principle shall be priority interrupt method.
- It shall have a buffer to hold time-tagged event messages temporarily in chronological order.
- The environmental conditions of RTUs (all modules of RTU) will be as follows.
 - Ambient temperature: -5 ...+55 °C
 - Operating temperature: adequate for harsh environment for -5 to +70 °C .IEC60068-2-1 / 2
 - Humidity: 5 ... 95% IEC60068-2-1 / 2
 - Temperature change rate: 0,5 °C / min. IEC60870-2-2 class C1
 - Atmospheric pressure: 70 ... 107kPa IEC60870-2-2 class C1
 - AC test voltage: 2.5 kV 50 Hz / VDE 804 safety electrical isolation.
 - Impulse voltage withstand test: 5 kV (1.2 / 50) IEC 255-4 (class III).
 - Electrical fast transient test: 1 kV IEC 801-4 (class 2).
 - High frequency disturbance test: 2.5 kV (1 MHz) IEC 255-4 (class III).
- All documentation and training on RTU's technical features, installation, use, maintenance, programming, database installation shall be provided.
- Any tools necessary for the installation of the RTU (special tools, connector clamps, connectors, apparatus etc.) shall be supplied with the RTU.

6. RTU Module Specifications

6.1 Binary Input Modules

- RTUs shall have at least 36 x Binary input and can be expanded up to 72 Binary Input by adding new modules.
- Module inputs shall be galvanic isolated (with opto-couplers).
- Scanning and processing of inputs shall be carried out with a sensitivity of 1 ms time.
- It may process the following signals;
 - Single indication with time label.
 - Double indications on the time label.
 - Digital measured values.
 - Pulse counters.
- Input signals can be displayed on the device via LEDs.
- If a fault occurs in the digital input module, the fault signal can be monitored and reported .
- Process voltage shall be 24 V DC \pm %20 input.

- Inputs shall have reverse voltage protection.

6.2 Binary output Modules

- RTUs shall have at least 12 x Binary output and can be expanded up to 24 Binary by adding new modules).
- Module Outputs shall be galvanic isolated (with opto-couplers).
- It can be used for the following signal types.
 - 1 or 2 poles.
 - Set-point messages.
- Digital outputs shall be via relay contacts whose characteristics are as follows.
 - The minimum switching voltage is $24V \pm \%20$.
 - Continuous control pulse Current shall be min 4A .
- The control output time can be controlled.
- If a fault occurs in the digital input module, the fault signal can be monitored and reported.

6.3 Analog Input Modules

Modules of the analog inputs shall be galvanic isolated and the modules are shall comply the following features:

9 Analog Inputs

- 6x Current Input 1A/5A with %0.25 accuracy and modules can be expanded up to 15 Analog input.
- 3 x Voltage Inputs 57,7V/100V/230V AC (adequate for all voltage values) with %0.25 accuracy and modules can be expanded up to 6 Analog input.

Alternatively 9 Analog Inputs can be all 4-20mA and supplier shall also submit the following transducers in the RTU Cabinet.

- 6 current transducer for 1A/5A to 4-20mA with %0.25 accuracy and modules can be expanded up to 15 Analog input.
- 3 voltage transducer for 57.7V-250V AC to 4-20mA with %0.25 accuracy and modules can be expanded up to 6 Analog input.

7. RTU Panel cabinet

RTU modules, batteries and battery charger, modem and etc (all necessary communication IEDs and units shall be placed in this panel. The panel, according to IEC 60529 shall be provided for the installation of other necessary equipments (power supplies, battery charger rectifiers, modems, batteries, MCBs, connection terminals and etc.)

Panels shall meet the following requirements:

- The REMOTE / LOCAL switch will be placed on the cover of the dashboard, using the pacho switch to allow remotely control (from the SCADA control center) and to allow local control.
- The heater shall be supplied and installed in accordance with the ambient conditions in the panel.
- Panel shell have a 24V DC battery with at least 40Ah battery and adequate battery charger unit.
- Panel battery charger shall have a 230 VAC, 50 Hz, single-phase supply by using double pole MCB with auxiliary contact protection.
- Panels shall have a 230 VAC, 50 Hz, single-phase BS start socket with MCB (16A) protection.

7.1 Panel Body:

- Protection Class: IP54 (at least)
- Panel structure: Hinged front door and door can be locked.
- Minimum sheet of metal / aluminium thickness: 2 mm on all surfaces
- Manufacturing type: Bolted
- Mounting type: Classic
- Cable entry: Bottom
- Ventilation: At the bottom and top on the side surfaces with dust filter with natural circulation.

7.2 Painting:

- Paint type: inner and outer surfaces are painted with electrostatic powder
- Paint coat adjective: 3 (1 coat primer + 2 coat oven paint)
- Minimum coating thickness: 50 microns
- Painting of inner surfaces: Outer color of panel

7.3 Cabinet interior cabling:

- Minimum cable size: Voltage, 2.5 mm² in AC / DC circuits and control and signal 1.5 mm² from the circuits in the cables.
- Insulation voltage: 1.5 kV / min.
- Conductor type: PVC flexible cable.

7.4 Redundant power supply and Batteries

RTU Panel cabinet delivers with a uninterruptible redundant power supply and batteries. Power supply shall be used for battery charging, supplying the all devices in the cabinet and supplying all switchgear motors and signaling. When the line voltage is present, power is supplied to the equipments with this rectified line voltage and when the absence of the line voltage the energy shall supplied from the batteries.

Power supply shall comply with IEC 60870-2-1 , IEC 61000-4-11, IEC 61000-4-5, IEC 61000-4-4, IEC 61000-4-2. The power supply shall have short-circuit protection and it will not damage with any short circuit in the output circuit.

Batteries shall be lead-acid, sealed and maintenance free.

- Input Power: AC 230 +/-20%
- Insulation level: 5 kV (1.2/50 μ s) Max
- Frequency : 50 Hz +/-1%
- Output power supply voltages : 24 and 12 Vdc
- Batteries : preferably 2x12V (in series).
- Battery capacity : 2 x 18 A/h

7.5 Cellular Modem Router

For communication upper systems (RTUs - SCADA centers) a cellular router modem shall be used for IEC 870-5-104 communication.

The Cellular router modem shall have the following features:

- Cellular Wireless interfaces shall support 3G and 4G
- Adequate for industrial applications
- Operating Environment :
 - Operating temperature -10 to 70 °C
 - %95 Humidity
- Supports 24VDC Input power or submitted with 24V to required input voltage DC-DC power supply .
- Dual module supporting two SIM cards online simultaneously and support redundancy for continuous cellular connections.
- Two fast Ethernet LAN port RJ-45; 10/100 Mbps (auto-sensing) supporting Power over Ethernet (POE) with 1.5 kV RMS insulation level.
- Auto reboot via SMS/Timing
- Shall have Remote monitoring platform, configuration and firmware upgrade.
- Management and upgrading via web user interface
- Anthenna with 3m long cable.