



Exploration & Production

GENERAL SPECIFICATION

ELECTRICAL

GS ELE 135

Low voltage switchgear assembly
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Contents

1. Scope	3
2. Reference documents.....	3
3. Service conditions	4
4. Construction requirements	5
4.1 Degree of protection	5
4.2 Internal separation of assemblies (IEC 60439 §7.7)	5
4.3 Functional units electrical connection type (IEC 60439 §7.11)	5
4.4 Electromagnetic Compatibility (EMC)	5
4.5 Structure	5
4.6 Busbars	6
4.7 Earthing	6
4.8 Withdrawable part	7
4.9 Secondary wiring	7
4.10 Instrument transformers	8
4.11 Metering, protection, control and indication	8
4.12 Cable terminations	9
4.13 Neutral earthing system	10
5. Switchgear	10
5.1 Particular characteristics for circuit breakers	10
5.2 Motor starters.....	10
5.3 Interface with the process control system.....	11
5.4 Miscellaneous	11
6. Interface with Electrical Control System (ECS) (Optional)	12
7. Inspection and testing	12
7.1 General.....	12
7.2 Type tests	12
7.3 Factory acceptance tests	13
8. Documentation	13

1. Scope

This specification covers the minimum requirements for the design, manufacture, and supply of withdrawable and disconnectable low voltage switchgear assemblies.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Design and engineering shall conform as a minimum requirement to the current edition of the following in order of preference:

- Applicable laws and regulations of the country in which the system will be operated. In cases where no “local” regulations exist, then French laws and regulations shall be used.
- COMPANY Particular Specifications and data sheet (if any)
- COMPANY General Specifications
- Applicable International Electrotechnical Commission (IEC) publications
- Applicable CENELEC Standards
- Applicable recognised standards and codes (e.g. UTE-NFC, BSI, VDE, etc.) where IEC publications have not yet been issued.

Switchgears shall be designed, manufactured and tested in accordance with the latest applicable sections (with amendments) of the relevant IEC standards.

Standards

Reference	Title
IEC 60044 1& 2	Instrument transformers
IEC 60050	International Electrotechnical Vocabulary
IEC 60068	Environmental testing
IEC 60071	Insulation co-ordination
IEC 60073	Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators
IEC 60255	Electrical relays
IEC 60269	Low voltage fuses
IEC 60439	Low voltage switchgear and controlgear assemblies
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60664	Insulation coordination within low voltage systems
IEC 60706	Guide on maintainability of equipment.
IEC 60947	Low voltage switchgear and controlgear

Reference	Title
IEC 61000	Electro Magnetic Compatibility (EMC)
IEC 61293	Marking of electrical equipment with ratings related to electrical supply - Safety requirements
IEC 61641	Enclosed low-voltage switch gear and control gear assemblies - Guide for testing under conditions of arcing due to an internal fault
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
Not applicable	

3. Service conditions

The equipment shall be suitable in all aspects for continuous operation at full load service.

The equipment shall be installed indoor, in accordance with environmental installation conditions given in the data sheet.

Outdoor installation is not allowed.

The equipment shall be suitable for operation, without deleterious effect, with variations of voltage and frequencies as follows:

- Voltage supply: $\pm 10 \%$
- Frequency: $\pm 5 \%$

4. Construction requirements

4.1 Degree of protection

The minimum degree of protection against direct contact for the enclosure shall be at least: IP31 and IP20 when any door (if any) is open.

When a withdrawable unit has been removed from the assembly, the live parts inside the fixed part shall be protected against touch with a degree at least IP 20.

4.2 Internal separation of assemblies (IEC 60439 §7.7)

For withdrawable switchgear, the separation shall be Form 3b minimum.

For disconnectable type, the separation form shall be 2b minimum.

4.3 Functional units electrical connection type (IEC 60439 §7.11)

For withdrawable switchgear, the withdrawability shall be complete for the power connection as well as for the auxiliary connections (W.W.W.).

For disconnectable type, the connection type shall be D.D.F. minimum .

4.4 Electromagnetic Compatibility (EMC)

The MANUFACTURER shall ensure that effects of induced voltages, electromagnetic interference and “noise” are carefully considered, and means taken to prevent any miss-operation, erratic performance or failure due to these effects. Compliance with the IEC 61000 is mandatory.

4.5 Structure

The switchgear assembly shall be entirely prefabricated and tested in factory.

The switchgear assembly shall be arranged to form a single structure with a common bus-bar assembly.

The switchgear assembly shall have facilities for extension with panels of similar construction to the panels previously forming the end.

The switchgear assembly shall be complete with eyebolt/lifting eyes, etc to facilitate installation

The switchgear assembly shall be self-ventilating.

When tropicalisation is required in the Data Sheet, MANUFACTURER shall indicate in his proposal the additional treatment performed.

The switchgear assembly and their components shall be of standard type and similar parts and components shall normally be interchangeable.

The number of module type shall be limited.

The switchgear assembly cubicles shall be at least self-extinguishable, free-standing, floor mounting, flush fronted construction.

Civil works guideline drawings shall be given to Civil works contractors in due time with the minimum requirements for the switchgear assembly installation (holding bolts location, rails, etc).

Unless otherwise specified, no key or locking device to open enclosure and doors is required. Only door handles shall be provided.

Internal width dimension of cubicle's incoming/outgoing cable shall be designed in accordance with quantity, type and dimension of cables to be connected to make sure that connection will be performed easily and safely. For front access design width of power cable compartment shall be 400 mm.

For incomers and large power feeders, the distance between base plate and cable connection plates shall be at least 400mm.

Switchgear assembly shall be designed and constructed to facilitate inspection site installation cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance. All components shall be easily accessible.

It shall also be arranged in such a way that the operations mentioned in § 7.4.6. from [IEC 60439-1](#) shall be performed when it is in service and on live.

4.6 Busbars

Busbars shall be installed in compartments separated from the switchgear and without transverse partitions at the level of each cell except at bus section(s). Insulating screens shall be installed between horizontal and vertical busbars. In event of internal fault, the damage shall be confined to that unit.

Bolted panels shall be provided to allow periodic checking of busbar mechanical fasteners.

Accidental contact of people or tools with live parts shall be made impossible.

Main busbars shall be of the same cross-sectional area through out the switchboard and made of hard drawn bare copper. They shall be rated for the nominal current over the entire length of the assembly and shall not be rated lower than the incoming unit.

When the atmosphere is highly corrosive, busbars shall be protected with heat shrinkable sleeves, tinned copper or similar.

Busbars and connections shall be adequately sized, braced and supported to withstand the mechanical constraints and thermal effects resulting from the switchboard rated short circuit current

Main busbar shall allow an easy expansion at its two extremities (holes already drilled).

4.7 Earthing

An earth busbar shall be provided along the full length of the switchgear assembly with terminals for connection of external protective conductors at each end. Earthing busbar shall be made of hard drawn copper (minimum 35mm²).

All metallic non-current carrying parts of the switchgear assembly including hinged doors shall be bonded together and connected to the earth busbar.

Provisions shall be made, adjacent to the cable terminations, for earthing cable armour and screen to the earth busbar.

Each wiring circuit shall be identified by green/yellow strips.

4.8 Withdrawable part

Withdrawable parts shall have the following positions (module or switch):

- Connected (power and auxiliary contacts)
- Test: auxiliary circuits connected but power contacts disconnected in order to test the whole control and automation circuits
- Disconnected (isolated)
- Removed.

Each unit shall be withdrawable without using tools except for breaker above 630 A.

Withdrawable parts shall be effectively earthed until they are completely withdrawn with all power and control connections disconnected.

Withdrawable part shall be interlocked to prevent :

- disconnection of part in service
- closure of the switching device if the rack is not fully engaged in the service position.
- insertion with switching device closed

A mechanical full proof system shall prevent insertion of a mobile part with a lower rating or a different design than normally assigned to the compartment.

All withdrawable units shall be lockable in the disconnected, test and removed position with padlock.

Half size modules are accepted for ratings up to 32A

4.9 Secondary wiring

Secondary wiring shall be stranded copper, self extinguishable, insulated with black or white PVC 750 V grade with the following minimum cross-sections:

- 2.5 sq. mm for current circuits
- 1 sq. mm for voltage circuits
- 0.75 sq. mm for auxiliary wiring (control, signals, etc)

For electronic circuit wiring, MANUFACTURER standard shall be used.

When required by Project, wiring shall be halogen free.

All wiring for external connections and for analogue circuits shall be brought out to individual terminals on a readily accessible terminal block. Wires shall be terminated using compression type lugs, or crimp sleeves if spring terminals are not used.

Secondary wiring within the switchgear assembly shall be securely held in position (either loomed or run in trunking).

Identification shall refer to the related wiring diagram.

Flexible conductors shall be used for connections on door mounted equipment.

Interconnection between sections separated for shipping shall be made with plug-in type connectors

4.10 Instrument transformers

Current and voltage transformers shall be of dry insulation type (complete coating of thermosetting synthetic resin).

Voltage transformers shall be of the encapsulated type.

Three voltage transformers shall be provided with star connection and neutral earthed.

They shall be disconnectable by live-fuse isolation and protected by adequate fuses situated at the primary and the secondary of the transformers.

The secondary rated voltage shall be 100 V or 110V as required in the data sheet.

Voltage transformers shall be designed with a rated voltage factor of 1.9 Un/30 s as a minimum and 1.9 Un/8 hours when the neutral earthing system is totally isolated.

Voltage transformers shall be designed with a primary rated voltage factor of 1.2 Un continuous.

Voltage transformer accuracy shall be:

- Class 1 for measurement
- Class 3P for protective relays

Current transformer accuracy shall be:

- Class 0.5 for measuring circuits when a high accuracy is required (metering, regulation, power measuring)
- Class 1 for current measuring
- Class 5P for protective relays when required by the MANUFACTURER
- Class 10P for other cases (over current relay).

The secondary current rating for measuring CT shall be either 1A or 5A. However, where remote metering is required, the current rating shall be 1A.

The MANUFACTURER shall provide details on ratio, output, class and accuracy for all instrument transformers in his supply.

The secondary windings of instrument transformers shall be earthed at one point. Bridging terminals for current transformers shall be provided at the outgoing terminals where external connections are required.

Current transformers shall be rated to withstand the thermal and magnetic stresses resulting from the bus-bar rated fault level.

4.11 Metering, protection, control and indication

Metering, protection, control and indication shall be in accordance with the single line diagrams, typical protection diagrams and data sheet if any.

Each current and voltage transformer on the incomers and busbars will be equipped on the switchgear assembly with test/injection boxes.



All meters shall be mounted at a suitable height to allow for a correct reading. All scales shall be properly selected for the expected operating condition.

Meters and relays shall be capable of withstanding without damage the secondary currents associated with the busbar rated fault current flowing in the primary of current transformers.

All indicating lamps shall be multi-LED type.

As a minimum, the following colour code shall be used:

Status:

On / closed / Running:	RED
Off / Open / Stopped:	GREEN
Fault / Trip:	YELLOW
Voltage presence:	WHITE

Push button:

On / Close / Start:	GREEN
Off / Open / Stop:	RED

Interlock and intertrip circuits shall use hardwired auxiliary contacts and, unless otherwise specified, without interposing relays.

Selection and coordination of short circuit protective devices shall be such as to ensure maximum service Continuity.

Unless otherwise specified the auxiliary voltage shall be generated by battery charger units external to the LV switchgear assembly.

Polarity distribution shall be carried out via circuit breakers for each bus section and each bus tie and shall include two separate buses for signalling and control/relaying.

4.12 Cable terminations

Cable terminating facilities and terminals shall be suitable for the specified cable type and conductor size.

Terminals for external conductors shall be so arranged as to be accessible for mounting, wiring, maintenance and replacement.

All spare connection between the drawer and the cable compartment shall be connected.

Terminals for more than one power cable core per phase shall have termination facilities arranged to avoid crossing of phase core.

Terminals shall be identified in accordance with the wiring diagram. The lay out shall be logical and consistent.

Cable supports shall be provided to avoid undue strain on cable terminations.

Termination of single core cables shall be through an insulating or non-magnetic plate.

Power and control cables shall be routed and terminated in separate cable trays.

Spring terminals are preferred.

Cables with voltage higher than 48 V shall be connected on segregated terminals, which are to be fitted with insulating screens and red warning labels.

4.13 Neutral earthing system

The neutral earthing impedance required to limit the earth leakage fault to 150 mA at nominal frequency shall be installed within the switchgear assembly.

Surge arresters shall be provided on each incomer in parallel to the neutral earthing impedance and installed within the switchgear assembly.

The equipment for earth fault detection and the related test facility shall be installed inside the switchgear assembly.

5. Switchgear

5.1 Particular characteristics for circuit breakers

Circuit breakers with electrical closing and opening devices shall have a manual and motor charged stored energy mechanism release.

Circuit breakers with automatic closing facility shall be provided with anti-pumping facilities.

Unless otherwise specified, circuit breakers for distribution feeders will be operated manually from the front of the switchgear assembly. In case of tripping coil use, this shall be of energised to trip type unless otherwise stated by safety requirements

Circuit breakers for incomers and the bus tie of a same switchgear assembly shall be identical.

Mechanical on/off push-buttons shall be padlockable

5.2 Motor starters

Unless otherwise specified, motor starters shall consist of disconnectors and fuses and contactor, of a limited number of different ratings with minimum rating of 25 A.

Thermal overload protection shall be performed as follows:

- Motors < 63 A: Direct thermal protection
- Motors $\geq$ 63 A Three-pole thermal protection against single phase and overload operation supplied by three current transformers (1A) installed in the removable part to ensure interchangeability of racks equipped with contactor of the same rating.
- Motors $\geq$ 110 kW: Digital protection relay may be used when required for following protections: 37-46-49-50-51-51LR-64-66.

Whenever required by the data sheet, earth fault protection shall be achieved with a core balance type relay that gets a clear trip indication. Its reset shall be manual.

Stop/start pushbutton shall be installed on COMPANY's request only.

For motors rated 22kW and above, a space heater shall be used. This space heater shall be automatically energised when motors are not in operation.

The supply shall be distributed from the 230 V AC auxiliary buses and controlled directly from each drawer.

Mechanical endurance for contactors shall not be less than 10,000,000 operations. Category for use shall correspond to conditions stipulated in [IEC 60947-4-1](#) and shall be AC 3.



5.3 Interface with the process control system

The required indications and alarm signals shall be as detailed in typical diagrams or in the particular specification and/or data sheet

Status signals shall be originated from volt free contacts.

Process information can be sent through a communication network if required by the data sheet.

5.4 Miscellaneous

5.4.1 Labels

Cubicles, compartments, withdrawable units, circuit breakers and components shall be identified by labels with circuit numbers. Cubicle label designations (at front and rear of panel, on the fixed and removable parts, at the main and auxiliaries cables terminations) shall be in accordance with the switchgear assembly single line diagram and associated data sheets.

Mimic one-line diagram shall be provided on request, indicating the busbars, incomers, bus-ties and main feeders.

Nameplates shall bear all identification in accordance with the reference standards. Language used for labelling shall be stated in the data sheet.

Nameplates for cubicles, compartments, withdrawable units shall be laminated engraved plastic with black letters on a white background and shall be fixed by rivets or screws or on a dedicated support. Stuck labels are prohibited

Nameplate for circuit breakers and components shall be the MANUFACTURER standard.

Operating procedure when needed (interlocking keys for instance) and warning notices shall be installed at the nearest operating/danger point.

Warning labels shall be provided.

5.4.2 Special tools and accessories

Supply shall at minimum include:

- All necessary materials for fixing the cubicles to the floor (anchor bolts, etc.)
- Portable earth fault leakage detection equipment
- Prefabricated testing link between the drawer removed for maintenance purpose and its control connections inside the switchgear assembly

Handles, tools, and service trucks for operation and maintenance of the switchgear assembly shall be provided.

5.4.3 Painting

MANUFACTURER standard painting shall be used unless otherwise specified.

5.4.4 Spares

Unless otherwise specified, it shall be planned for the future extension:

- 10 % of equipped drawers inside switchgear assembly (one spare per module type/rating minimum except incomer and bus-tie)
- Provision of 20 % free space in the cubicles for possible future equipment.

5.4.5 Anti condensation space heater

When required in the data sheet, anti-condensation heater shall be provided in each cubicle. It shall be supplied from a dedicated source protected by an earth leakage circuit breaker. Its control shall be done automatically by means of a hygrostat.

5.4.6 Early smoke/fire detection

When required by the Project, an early detection system shall be provided and integrated into the switchgear assembly.

5.4.7 Infrared Monitoring

The MANUFACTURER shall indicate in his proposal the possibilities for infrared monitoring of connections in the switchgear assembly.

6. Interface with Electrical Control System (ECS) (Optional)

When specified, switchgear assembly may be connected to an Electrical Control System dedicated to control the general electrical system.

In this case a Programmable Logic Controller (PLC) or dedicated Remote Control Unit (RCU) from the Electrical Control System (ECS) may be installed within each switchgear assembly by the MANUFACTURER.

The MANUFACTURER shall be responsible for the co-ordination with ECS SUPPLIER to ensure the proper data transmission between the switchgear assembly and the ECS.

It shall be possible to isolate all incoming ECS controls for maintenance and manual operation.

7. Inspection and testing

7.1 General

All equipment covered by this specification shall be subject to inspection and testing by COMPANY at MANUFACTURER works during manufacture. In certain cases these activities may extend to MANUFACTURER's subcontractors.

Inspection and tests shall be performed in accordance with IEC standards.

7.2 Type tests

Type tests in accordance with the referenced standards shall have been carried out on MANUFACTURER'S similar equipment and the type test certificates shall be provided with the quotation. When appropriate type test certificates do not exist, tests shall be made at the time of manufacture of the equipment to which this specification refers, subject to COMPANY approval.

7.3 Factory acceptance tests

Unless otherwise specified Factory acceptance tests shall be performed by MANUFACTURER in the presence of COMPANY representative. The routine tests in accordance with the [IEC 60439](#) shall be performed.

At least the following additional tests shall be performed:

- Visual check (aspect, painting, finish, welding, sheet metal, lifting ring, assembly bolt torque, busbar bolt torque, conformity of torque values for main connections, lining up of measuring apparatus, handling devices, remote control and signalling, labels)
- Dimension controls (terminals, busbar and wires, leakage path and insulation distance, fixation axis, overall dimensions, weight)
- Auxiliary device test
- Check for interchangeability of equipment
- Quality and quantity check for wearable parts and spare parts according to the specification concerned
- Control of protective devices by primary current injection corresponding to the protection setting values (Secondary injection is acceptable when the appropriate relevant certificates of CTs are provided)
- Power-frequency voltage tests on the main circuit
- Mechanical test
- Switchgear electrical operation test
- Minimum functional tests including: Start/stop, remote alarms, intertrip, automatic sequences if any, etc
- Check for validation of the interface link with the ECS. The tests will be carried out in accordance with the tools and support (meeting, procedure and documentation) proposed by the ECS MANUFACTURER
- Participation in the Factory Acceptance Tests of the ECS in order to test all the protection and Measurement Management Units (MMU), and the specific functions (restarting, automatic transfer, load-shedding, etc.)
- When programmable relays or PLC's are provided, complete functional tests shall be carried out.

A test report of the acceptance tests shall be issued.

8. Documentation

Unless otherwise specified in project particular specification, MANUFACTURER shall at least provide the following documents:

- Overall arrangement drawing
- Civil works drawings
- Transportation procedure
- Tropicalisation specification if needed



- One line diagram
- Wiring diagram
- Schematic diagram
- Digital relay setting data sheet
- Maintenance and operation manuals
- Spare parts list
- Detailed equipment information (technical documentation).
- Copy of software and configuration of PLC/digital relays...
- Type test reports
- FAT reports