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1 Subject of specification

This specification used in conjunction with standard technical specifications of LOTOS Group S.A., establishes minimal requirements regarding design and execution of 6kV Medium Voltage Switchgears.

2 Scope of validity

This specification shall be used when preparing both quotations and Purchase Orders concerning planned LOTOS Group S.A. new investments and modernizations.

It shall also be a base for preparation of other detailed specifications and quotations relevant for package units or other equipment deliveries.

The Contractor is independently responsible for selection of equipment and materials to be purchased on the basis of technical design particularly in relation to instruments and equipment made in explosion – proof execution.

2.1 Deviations

Any deviation from this specification and the relevant specifications, standards and related documents including proposals, which the bidder claims to be economically and / or technically superior solutions must be submitted in writing for review and approval by Grupa LOTOS SA. Non-approved exceptions are not acceptable by Grupa Lotos S.A.

The supplier must report in writing any ambiguity in this or any other specifications of Grupa LOTOS SA or non-compliance with the referred documents / standards and obtain a written explanation from Grupa Lotos SA.

2.2 Exclusions

The scope of this specification does not include requirements concerning medium voltage switchgear room. Such requirements are covered in civil specification – standard N° 5200 „Buildings”

3 Hierarchy of documents

In case of conflicts existing between this specification and other documents, the following order of precedence shall govern:

- The current Polish legislation
- Terms of purchase order/contract and other requirements agreed in writing with GL SA
- Data Sheets approved by GL SA
- This Specification
- Other Specifications
- Drawings and other documents
- Standards

4 Definitions and designations

CONTRACTOR: Grupa Lotos S.A., LOTOS Group Inc. / BUYER

SUPPLIER: BIDDER/ SUPPLIER

4.1 Designations

GL SA – Grupa LOTOS S.A.

SN – medium voltage

DC – direct current

IT – electrical network with isolated neutral point

SZR – Auto Transfer Switching system

PPZ – Scheduled Supply Switching-over

DOL – Direct online Motor Start-up

CSNiM – Central Monitoring and Supervision System

KiA – Control Systems and Instrumentation

EMC – Electromagnetic Compatibility

Shall – Indicate a mandatory requirement.

5 Description

5.1 Ambient conditions

- Atmosphere: marine, aggressive industrial, chemical and dusty
- Ambient temperature (max/min): +36°C/-25 ^{o}C
- Relative humidity (max/min): 90%/70%
- Elevation above sea level: 1m
- Wind speed: 26 m/s
- Work conditions: refinery, sea coast

5.2 Electrical network parameters

- Medium voltage: 15kV (LOTOS Railway, North Marine and 6000V,Przejazdowo Water Supply Point), 3-phase, IT (isolated network)10.5kV (GPZ3), 3-phase, IT (isolated network)6kV (GPZ1, GPZ2), 3-phase, IT (isolated network)
- Frequency: 50Hz with +4%/-6% allowable tolerance
- Low voltage: 400V, TN-C/S with +/-10% allowable tolerance
- Low voltage (lighting, heating): 230V, TN-S

- Low voltage (emergency lighting) 110V DC
- Alternate current control voltage 230V, 1-phase
- Direct current control voltage 110V DC. 220V DC (for GPZ1,S7 and S9)

5.3 Basic design requirements

5.3.1 Documentation

The bidder (supplier) shall submit to GL the following documents:

- List of documents
- Catalogues
- Dimensional drawings
- Data sheets filled by supplier
- Schematic diagram of the switchgear
- Inside switchgear equipment arrangement drawings
- Arrangement drawings of control and signalling equipment, terminal strips
- Wiring connection diagrams
- List of equipment
- Spare parts list
- Painting procedure
- Transport and storage procedure
- Tests schedule
- Certificates
- EMC declarations
- Declaration of conformity
- Assembly Instruction, Operating Manual

5.3.2 General requirements

For all used devices, reliability, smooth operation and easy handling are required. Typical equipment shall be used. Application of prototype equipment, not registered and not approved for production is forbidden.

Spare parts shall be accessible through 10 years minimum.

Rated data for equipment shall correspond to continuous operation rated data of the equipment, at specified (previously given) working conditions.

Nominal working conditions of equipment shall fulfil requirement for at least nominal voltage and nominal current ranges, for all applications and with voltage tolerance ±10%.

The supplier shall deliver thermal balance emitted by equipment, on assumption that all equipment is working at full load.

The switchgear must fulfil requirements of EMC directive, which means that it shall properly operate in defined electromagnetic environment, while not introducing additional electromagnetic interferences.

5.3.3 Technical requirements

The switchgear shall be fabricated as free-standing, two-unit, two-section, single system, in metal cabinet, for indoor use. Other solutions shall be every-time agreed with GL SA

The supplier shall deliver the switchgear fabricated according to applicable standards and regulations, along with certificate of Declaration of conformity and EC type examination.

Equipment and instruments predestined for operation inside a building located outside of explosion hazard areas shall be used.

Cubicles of the switchgear shall be adapted to assembling on a frame installed in electrical substation building, in switchgear room. The frame shall be included in the switchgear scope of supply.

Metal enclosure of the switchgear shall be ready for earthing connection to the grounding system of electrical substation minimum in two places.

Switchgear fields shall be fabricated as cubicle type, according to PN-EN 60298 standard.

Circuit breaker compartment, bus-bar compartment, auxiliary equipment compartment as well as cable compartment, shall be separated one from another with metal or plastic barrier.

The barriers shall be made of materials resistant to impact of big electric, mechanical and thermal forces, which can come out during operation of the switchgear.

Pressure relief for each compartment of switchgear cubicle shall be made with using decompression steel plates or safety valves , in upper part of the cubicle. Pressure control shall be accomplished with pressure switch or position switch, according to manufacturer's standard.

Each cubicle shall be furnished with separate, complete enclosure (possibly excluding medium voltage bus-bar's compartment.

The switchgear cubicles shall be tested for EC type examination included in standard PN-EN 62271-200.

5.4 Design requirements

5.4.1 Electric parameters

Operating voltage	15kV; 10,5kV and 6kV, 3 phase, IT (insulated grounding point)
Nominal voltage of the switchgear	17,5kV for rated voltage level 15kV;12kV in the other Cases, 3-phase, IT (insulated grounding point)
Nominal short-circuit current	min. 31,5kA. 1sec. (for 6 kV it requires final adjustment with GL)
Direct current control voltage	110V DC (220V DC for Station GPZ1, S7 and S9)

5.4.2 Operating conditions

The switchgear shall be installed in electrical substation building, in the room intended for MV switchgear location. Temperature in switchgear room shall not exceed +5ºC ÷ +40ºC range.

5.4.3 Basic constructional requirements

In case of switchgear location in one line: the switchgear shall be arranged that in the center are located power supplies then coupler, the measurement bay, transformer bay and motor bays.

In case of switchgear location in opposite two lines: the power supplies shall be located at the beginning or at the end of switchgear line then the coupler bay, measurement bay, transformer bay.

It is required to locate power supply bay, couple bay measurement bay, transformer on the opposite side of each section.

Adequate transformer cabinets and measurement cabinets shall be arranged symmetrically.

All outgoing feeders cabinets shall be withdrawable type, equipped with vacuum circuit breakers or contactor (after approval by GL SA) shall contain individual surge arresters.

Control and cable compartments shall be equipped with individual lighting.

Between fuses, single-pole switch disconnectors, and knives of three-pole power switch disconnectors, barriers have to be installed.

Cables, busbars and other accessories that usually are live when a circuit breaker is drawn out from a cubicle, shall be encased with curtains or partitions.

Arc Fault interrupting protections of the switchgear shall be proposed as an option, and always subject to GL SA approval.

Arc Fault interrupting protection of the switchgear shall be composed of fibre optic loops and current relays, installed in all outgoing feeders of the switchgear.

The switchgear shall be fully prepared for connection to Central Monitoring and Supervision

System.

5.4.4 Housing

The switchgear shall be fabricated as indoor, free-standing, in metal housing. Required protection class IP30.

During switchgear operation, panel door shall be closed and locked. Switchgear preparation for operation shall proceed with closed door and with observance of all direct and indirect protection requirements:

- isolation of cubicles
- earthing and short-circuit protection
- insulation condition checking on supply side
- shielding of neighbouring live parts

Circuit breakers compartment shall be equipped with full door, resistant to arc-shorting pressure and inspection windows. In case of visual inspection earthing switch position, cable compartment shall be equipped with inspection windows.

Compartments of low voltage auxiliary equipment shall be equipped with separate door.

The housing shall be furnished with barriers preventing migration of ionised gases between chambers, or between chambers and busbars. If partitions are made of non-metal material, than halogen free epoxy resin partitions shall be used.

Each cubicle must be equipped with own pressure relief system.

Control of voltage supply shall be performed at closed door with use reactive insulator mounted in switchgear cubicle door.

Insulation condition checking on supply side must be performed at closed door, with use of capacitive divider mounted in switchgear cubicle door.

Earthing of cable terminals and busbars shall be executed with use of earthing switches. The earthing switches shall be such installed, that their handling can proceed from outside of the switchgear, with closed door and with use of hand operated driving gears.

It is recommended to earth bus bar of switchgear section with use earthing switch located in measurement cubicle of switchgear after setting all withdrawable compartments in testing position.

Cable compartment floor shall feature electrical bushing, prepared for entering of cables.

Structure of switchgear cubicle shall be made of galvanized elements. The other components shall be made of sheet steel plate coated with epoxy resins. Painting method will be set during detailed planning stage.

Design of all switchgear units must preclude penetration of rodents, birds etc., to their interior. Housing door must be equipped with gaskets against rodents / insects.

It is not recommended to use heaters in switchgear cubicles for the condensate protection. Switchgear shall be equipped with lamp inside cable and control compartment. Lamp shall be switched on automatically when the door will be opened.

5.4.5 Automatics of the switchgear

Switchgear automatics shall include:

- Auto Transfer Switching System – SZR, including power supplies and coupling, along with Scheduled Supply Switching-over – PPZ
- hand switch for activation of feeder parallel working (independently of SZR and PPZ switch)
- Busbars Protection
- Local reserve for circuit breaker

SZR system task is to minimize effects of partial switchgear supply failure.

PPZ system shall enable uninterrupted switching over of power supplies.

Philosophy of control protection and interlock system as well as connection with secondary circuits, type of apparatus and use protections devices in MV switchgear shall agreed with GL SA

5.4.6 Busbar system

Busbar cross-section must be such selected, that their load capacity is greater, or at least equal to 1.2 times nominal current of incoming feeder.

Thermal and dynamic matching of the buses must ensure withstanding of maximum short-circuit current on incoming side.

Allowable temperature increase for the buses must conform to applicable standards, depending on nominal current of the buses.

The temperature increase in excess of that allowable, requires GL approval and must be confirmed with adequate certificate.

While making selection of number and location of buses fastening, as well as method of their coupling, it is necessary to take into account the following requirements:

- dynamical forces present in failure conditions
- resonance phenomenon
- insulating gaps

Size of the buses shall be constant along whole switchgear. The buses shall be marked with L1, L2, L3 labels from left to right side, and from top to bottom.

Layout of busbar system, i.e. the buses, connections of individual bus sections and fixed contacts for withdrawable buses elements shall be made of electrolytic copper. Connections between fixed contacts and cable terminals, such as in case of measuring current transformers, shall be made with copper buses.

Flexible connections shall be used in case of necessity for compensation of expansion, spreading and short-circuits or vibration transfer on connections or busbar system prevention, which can be harmful to the system.

Stand-off insulators shall be made of the highest quality insulating materials, which are flame retardant and of low moisture absorptivity.

Earthing bus shall be installed on the whole length of switchgear unit.

The following elements shall be connected to earthing bus:

- metal parts of housings
- cable screens or metal shields (if required)
- secondary windings of current transformers.

Earthing bus shall be connected in two places to external earthing system. Adequate terminals shall be provided in switchgear for this purpose.

5.4.7 Circuit breaker switches

The switchgear shall be furnished with vacuum circuit breaker, (preferable manufactured by ABB).. Change of the circuit breaker type, or tmanufacturer of vacuum circuit braker requires GL approval.

Withdrawable module of breaker-switch shall have following standard positions:

- „OPERATION”: main and auxiliary contacts fully closed
- „TEST”: main contacts pulled out, auxiliary contacts closed
- „SWITCHED OFF”: main and auxiliary contacts fully disconnected.

Each of these positions shall be legibly and unequivocally labelled.

Withdrawable module of breaker-switch shall be of such design, that single person can pull it out from a field to the three above listed positions, and push it in again without excessive effort.

Withdrawable module must not be furnished with direct drive, but shall be equipped with hand operated mechanical gear.

Mechanical interlock applied in breaker-switches shall guarantee at least the following:

- breaker-switch movement from, or to working position, if closed

- closing of breaker-switch until its main disconnecting elements are fully coupled, or retracted on safe distance.

Energy storage gear shall be fully discharged, when the breaker-switch is in pulled-out position from the cabinet.

Fields with stationary circuit breaker-switches shall be furnished with interlocks preventing execution of disconnecting elements operation, when the breaker is closed.

The breaker-switches shall enable:

- mechanical interlock of withdrawable module, depends on earthing switch position (in case of circuit breaker module integrated with earthing switch)
- possibility of manual switching on and off, with mechanical indicator of position
- ability to switching on of peak short circuit currents occurring in the system, with no risk for damage nor creation of other hazards

The breaker-switches are to be tripped out mechanically and electrically.

Withdrawable units of circuit-braker-switches with the same technical parameters shall be made in such manner, that one withdrawable unit of circuit-breaker-switch can be replaced by the other one without necessity for additional works execution.

Each breaker-switch for specific operating voltage shall be in a position to switch off and on short circuit currents of minimum value given in p. 4.4.1 of this specification.

Motor drive / Magnetic trip

The mechanism of spring engagement shall be motorized and have possibility to switch on by hand in case of motor failure

Isolating switches, switch disconnectors and earthing switches shall feature additional manual gear for spring engagement.

Equipment shall be selected for 110V DC control voltage (220VDC for station GPZ1, S7 and S9)..

Interlocks

The used electrical and mechanical interlocks shall prevent improper circuit breaker-switch operation. The circuit breaker-switches in withdrawable module are mechanically interlocked with disconnector and earthing switch. Closing earthing switch shall be interlocked with withdrawable module in position “OPERATION”:.

5.4.8 Low-voltage compartment

Low-voltage compartment shall be separated from the other compartments, and completely encased with sheet metal plates.

Each field shall be equipped with the following instruments:

- protecting and interlocking relays
- auxiliary switches, local/remote -switches and manual/automatic switches
- terminal strips
- terminal strips for current and voltage transformers (measuring and protecting ones)
- measuring instruments, control lamps, auxiliary relays, failures and damages signalling devices.

In case of outgoing feeders connected with SIL system, compartment shall be additionally equipped in separated connection strip for safety control circuit.

Auxiliary instruments installed inside the compartment, as well as on its door, shall be wired.

Measuring instruments and adjustable relays shall be mounted in low-voltage compartment door and faced to its surface. Non-adjustable relays and other auxiliary relays shall be mounted inside the compartment.

Control cables shall enter the low-voltage compartment from bottom side. Cables that are passing through medium voltage instruments' compartment shall be laid in cable ducts.

Live parts of current transformers shall be terminated with uninterruptible junction blocks. Earthing terminal of current transformer shall be located in the same junction block, and not in the current transformer.

All remote control circuits and own control circuits shall be grouped. Terminal strips and individual terminals shall be marked.

All internal wiring circuits in compartment as well as external circuits located inside the compartment shall have tag name with use address method . It is not allowed to use potential method or other to labelling circuits inside the compartment.

Access to the instruments/control part of compartment shall be at the front side of cubicle.

Wiring in instrument/control part shall be made with flexible cord, black, of cross-section area 1.5 mm^2 as minimum. Wiring of current transformers shall be made with flexible cord of cross-section area 2.5 mm^2 as minimum.

The switchgear shall be furnished with microprocessor protections

- for transformer buys and measurement buy (preferable type is REF 543)
- REF 543/545 for feeder buys and coupling
- REM 545 for motors
- AZRS 3 for SZR (ATS) and PPZ

Change type of protection device, vendor shall be approved by GL SA

In case of modernisation of existing switchgear, type of used protection device shall be the same like existing one, e.g. for switchgears equipped with protection series SPAC:

- SPAC 315 for transformer buys,
- SPAC 320/SPAM 150 for motor buys

Change of microprocessor protection type, or producer and type of microprocessor protection, requires GL approval.

Incoming, measuring and motor fields shall be equipped with measuring transducers featuring analogue outputs.

Motorised breaker-switches must be furnished with anti-pumping devices. If the breaker-switch is switched off by protections, the relay have to prevent switching it on again by the switch still remaining in „ON" position.

5.4.9 Cable compartment

Separate cable compartments shall be prepared for medium voltage cables and for low voltage cables.

If required, entering and outgoing cables shall be laid in cable ducts. Cable terminals shall be adapted for connecting each cable core separately to threaded screw terminals, delivered along with the switchgear.
Fastening of more than one cable terminal, or conductor terminal by means of single bolt and nut is not allowed.

Earthing terminals, intended for earthing of metal cable duct, shall be made in cable cubicle.

Wiring of medium voltage compartment (if required), shall be protected against electric arc.

All cable glands and other insulation materials necessary for completion of connections constitute part of the switchgear, and shall correspond to the number and type of cables used. The cables shall enter from switchgear bottom side through cable entrances fitted with rubber bushings.

Fastening rails resistant to action of mechanical forces, present during short-circuits, shall be prepared in cable compartment for fastening of cables.

It is not allowed to fastening cables in cable compartment with using fastening plastic tapes. Cables shall be mounted with using dedicated cable clamps and bolts. It is also required to use additional mounting supports for cables mounted to cable ladders in cable room. It is not allowed to fastening cables only in cable compartment part when the the rest of cable is free dropping in cable room.

Adequate space for fastenining current transformers, Feranti transformers (if any) and surge fastening shall be foreseen in cable compartment.

Earthing terminal can be used (closed) only then, when breaker-switch module is pulled out from the cubicle. A lock shall perform double function: connection of movable part is possible only when earthing terminal is open (mechanical interlock is required).

5.4.10 The measuring transformers

Rated data of voltage and current transformers shall correspond to rated data of measuring instruments and relays used, installed inside and outside of the switchgear.

Measuring equipment and main protection devices cannot be supplied from the same measuring transformers.

The transformers shall be selected according to requirements of measuring and protecting instruments used.

Rated data of current transformers is to be selected in order to withstand:

- Thermal and magnetic loads resulting from breaking currents of breaker-switches or other protecting devices connected to these transformers;
- Rated primary current, at open secondary winding, through one minute time.

Rated data, such as current, load, class (accuracy) of current transformers shall be matched to their functions, loads and intended use.

The current transformers shall operate uninterruptedly at load equal to 1.2 x rated current.

- Measuring current transformers shall be of class 0.5 (for ammeters)
- Measuring current transformers shall be of class 1 (for measuring instruments, excluding ammeters)
- Current transformers for protecting devices shall be of class 3.
- Voltage transformers shall of class 1.

The voltage transformers shall be protected by fuses with self fuse control circuit installed upstream the transformers. When the fuse fault will be indicated than under voltage section protection will be blocked.

The voltage transformers and their fuses shall be mounted in separate chamber. The chamber shall be of withdrawable or equivalent type, so as to primary connections were disconnected prior to gaining access to the transformers or their fuses on primary side.

Easy access to the current transformers for periodic testing and visual review shall be reached.

5.4.11 Motor field

The motor fields shall be located directly in main switchgear, in planned manner.

- Two drives in parallel cannot be placed in the same section.
- In case of heaters fans, supplying philosophy shall be agreed with GL SA
- Arrangement of motor fields shall be characterized with the following order:

Process drives	Supply from section
MP1A	1
MP1B	2
MP2A	2
MP2B	1
etc.	etc.

* Assuming, that the drives are doubled, i.e. A and B.

All motors of power lower than ≤ 2 MW, shall be foreseen to direct start-up (DOL), while for the other motors this issue shall be agreed – it requires checking of power network capacity.
In motor feeder field, control circuits and anti-condensing heater supply, fed with 230V 50Hz voltage, shall be foreseen.
For motor feeders, the following information shall be sent to central control room (DCS system):

- Common alarm signal protection actuation (excluding tests in pulled-out position of breaker-switch)
- The motor overcurrent
- Ready to start (switch on local control station installed close to motor, set in remote control position)
- The motor switched on
- The motor switched off
- The motor switched off by control and automatics instruments
- Recording of switch-off events by control and automatics instruments.

The signals: motor on, off, ready to start, and motor switched off by control and automatics instruments, shall be separate signals.

All signals shall be sent to central control room by interposing auxiliary relays, separately grouped for each motor in interposing relay cabinet IRC locaten in switchgear room.

In order to ensure work safety, possibility of switching the motor on directly from switchgear with use of pushbuttons or auxiliary switches, shall be precluded – not allowed to switch on motor directly from elevation of switchgear in "RUNNING "position.

Circuit breakes for motors feeders shall have possibility to switch to operating position in TEST position of withdrawable module.

Energy meters shall be installed for all supplied drives in control part of compartment.

For consumers of motor / transformer type, each outgoing shall be furnished with earth-fault current protection devices. (for the motos feeders buys protection devices shall switch off cirvuit braker, for transformers buys protection shall activate signalization.

Control of motor/transformer feeder shall be executed on the basis of control diagram, elaborated by supplier and submitted to GL for approval, after switchgear order reception.

Auxiliary switches

The auxiliary switches shall be installed on cubicle front and marked according to control diagram.

Pilot lamps

LED or neon type pilot lamps shall be used. All installed lamps shall be of uniform type, with glass fitting.

5.4.12 Control and signalling

Control circuits shall be protected with two-pole overcurrent circuit-breakers. Characteristics of these circuit-breakers shall be such selected, that selectivity of protections is ensured.

Overcurrent circuit-breakers shall be manually switched on and off, and they shall be equipped with auxiliary contacts, enabling monitoring of these circuit-breakers.

Control and signalling system shall be supplied with 110V DC voltage with battery back-up (or 220V DC for GPZ1,S7,S9 station) from dedicated and independent output feeders RPS switchgear – DC switchgear).

Depending on process requirements Motor control system shall provide:

- flying start
- automatic restart after voltage failure

if required by process requirements.

Circuit-breakers in motor fields shall be controlled:

- locally, in the field (setting the switch on solely in „TEST" position, emergency switch-off)
- remotely, from control station or through DCS system from control room.

Control selection switch remote/local (from DCS system or local control station next to motor) is foreseen in local control station (control panel), located next to the motor.

Auxiliary relays

Auxiliary relays shall be used in order to:

- multiplicate of auxiliary contacts
- obtain time delays in control
- monitor of voltage condition in control circuits
- separate signals transmitted to DCS

5.4.13 Measurement Instruments

The instruments supplied directly with 230V voltage and max. current of 10A shall be used, excluding measuring transformers. The instruments mounted in secondary circuits shall be supplied with 110V DC voltage.

Direct current circuits shall be equipped with shunts of measured value 100mV. If instruments' overload is possible, then saturated transformers shall be used.

Glass shields of instruments shall feature anti-reflexive and non-glossy design.

Alternate current indicating instruments shall feature replaceable contacts. The instruments intended for direct current circuits shall have replaceable coil. They shall withstand 20% constant overload without being damaged.

The following dimensions of instruments are allowable:

96x96mm/90° , 72x72mm/90° , 48x48mm/90°

The instruments shall have:

- circular scales, beyond 90°, concentrated in higher ranges
- black frames
- white scales' background with black letters

Required accuracy of the instruments: 1,5%.

Application of digital instruments is allowable, after agreement it with GL in advance.

Position indicators

Positions indicators shall be installed in all fields, in order to unequivocal representation of circuit-breaker state.

The indicators shall represent the following circuit-breakers states:

- „SWITCHED ON"
- „SWITCHED OFF"
- „EMERGENCY SWITCH-OFF"

Position indicators shall be integrated with representation diagram, placed on the field facade.

5.4.14 Protecting devices

Medium voltage switchgear shall be equipped with secondary relays for 110V DC rated voltage and 1 mA rated current.(or 220VD for staton GPZ1, S7, S9) Digital, multi-functional, programmable protection relays shall be used.

Protection diagram shall be approved by GL.

Motor outgoing feeders are to be equipped with microprocessor protections, featuring the following functions:

- Short-circuit module
- Overload thermal module
- Start-up control module

- Supply asymmetry control module
- Earth-fault module
- Control and interlocks module
- Differential protection for motors of power in excess of (≥) 2 MW (optional)
- LCD display showing actual switch position
- Other

5.4.15 Wiring

Not more than two wires can be connected to single terminal, only single wire to single modular terminal.

Each conductor end shall be equipped with connector, enabling connecting it to terminal strip, and with terminal enabling connecting it to specific equipment. For multi-wire conductors sleeve-type cable terminals shall be used.

The following colours of insulation shall be used:

AC current circuits:	violet colour
AC 220V phase leads:	brown colour
AC neutral lead:	light-blue
AC 100V voltage circuits:	grey colour
AC 110V circuits:	black colour
DC circuits:	red (+) / blue (-) with numbering of terminals
Protecting and earthing leads:	yellow /green

For single-wire conductors, yellow and green colours are not allowed, in order to avoid mistakes with yellow- green PE conductor.

All conductors shall be marked next to connection place.

Marking scheme of conductors shall comply with standard No 6120 – „Process identification system", the chapter entitled: „Identification and marking system of electric instruments and equipment".

All internal wiring circuits in compartment as well as external circuits located inside the compartment shall have tag name with use address method . It is not allowed to use potential method or other to labelling circuits inside the compartment.

Access to the instruments/control part of compartment shall be at the front side of cubicle.

5.4.16 Terminals

All incoming and outgoing feeders shall be equipped with separate terminals.

The terminals with short circuiting switches shall be used for main circuits, so that disconnection of one cable shall not result in disconnecting of others.

All terminals shall be selected for cables of cross-section areas listed on switchgear schematic diagram, acknowledged by GL.

Terminal strips for control and measuring circuits shall be installed in low-voltage instruments compartment.

In case of outgoing feeders connected with SIL system, compartment shall be additionally equipped in separated connection strip for safety control circuit.

5.5 Marking

The main and auxiliary buses shall not be painted, but must be marked.

Nameplates shall be placed on the front of field and fixed. It is required placed also description plates on rear of switchgear.

All inscriptions shall be made on Polish language with process no and Power consumption for motor feeder or no and transformer rated power.

The diagram of each field shall be located on its front.

In case of withdrawable units, the nameplates shall be placed both on fixed parts and on movable parts.

Each device shall be described with use of permanent nameplates, according to control diagram and assembly diagram.

All cables and conductors shall be labelled according to assembly diagram.

5.6 Painting

Factory painting standards for determined, harsh ambient conditions, shall be employed.

Minimum thickness of paint layer shall be greater than 60 micrometers.

Final RAL colour shall be adjusted with GL.

5.7 Scope of delivery

5.7.1 Incoming feeders

Two incoming feeder cabinets, equipped with:

- Vacuum withdrawable circuit-breaker with motor operated drive for spring engagement and completed auxiliary contacts
- Earthing switch
- Microprocessor protection device
- Current transformers
- Ammeter
- Auxiliary, potential-free contacts
  for connections with programmable logic controller (switch on, switch off, common alarm signal)
- Auxiliary equipment
- 3-phase, reactive voltage indicator on MV cable

5.7.2 Bus-tie cabinet (coupling) cabinet (cubicle)

Two bus-tie cabinets equipped with:

- Vacuum withdrawable circuit breaker with motor operated drive for spring engagement and completed auxiliary contacts
- SZR (Auto Transfer Switching System)
- PPZ (Scheduled Supply Switching-over)
- Earthing switch
- Microprocessor protection device
- Current transformers
- Ammeter
- Auxiliary equipment
- 3-phase, reactive voltage indicator on bus bar between sections

5.7.3 Measuring cabinet (cubicle)

Two measuring cabinets equipped with:

- Current measuring transformers
- Voltage transformers
- Measuring instruments
- Auxiliary equipment

- Earthing switch (for section bus bar)
- Voltage meter for phase and between phase voltage
- Microprocessor protection device
- Auxiliary equipment

5.7.4 Transformer outgoing feeder

Transformer outgoing feeder cabinet (cubicle) equipped with:

- Vacuum withdrawable circuit breaker with motor operated drive for spring engagement and completed auxiliary contacts
- Earthing switch
- Microprocessor protection device
- Current transformers
- Watt-hour and var-hour meters with RS485 comunication
- Ammeter
- Auxiliary, potential-free contacts
  for connections with programmable logic controller (switch on, switch off, collective alarm signal)
- Auxiliary equipment
- 3-phase, reactive voltage indicator on bus bar between sections
- Surge arresters on output feeder cable

Number of fields according to GL requirements.

5.7.5 Motor outgoing feeder

The motor outgoing feeder cabinet (cubicle) equipped with:

- Vacuum withdrawable circuit breaker with motor operated drive for spring engagement and completed auxiliary contacts
- Earthing switch
- Current measuring transformers
- Current transformers for protecting devices
- Voltage transformers
- Microprocessor protection device
- Ammeter
- Watt-hour meter with RS485 comunication
- Auxiliary, potential-free contacts
  for connections with programmable logic controller (switch on, switch off, common alarm signal)
- External signals
  for connections with programmable logic controller (switch on, switch off, common alarm

signal)

- Controlling of motor thermal protections
- External potential-free contacts for interlock of circuit breaker switching on (a signal from current transformer of differential protection)
- Cable connection
- Auxiliary equipment.

Number of fields according to GL requirements.

5.7.6 Tools and spare parts

Contractor shall provide all necessary equipment for mounting and exploration of switchgear like lifting equipment, crank etc.

Contractor shall present spare part list for two years working time of switchgear. Contractor shall submit list of equipment with price to GL SA before receiving the order.

5.8 Links to Central Monitoring and Supervision System

The following signals shall be led out to CSNiM:

5.8.1. Coupling field

- Circuit breaker state – „Closed/Open"
- Withdrawable position of circuit-breaker
- Activation of SZR automatics
- SZR ready
- Activation of protection
- Signalization of blackout
- Circuit breaker switching on and off

5.8.2. Incoming field

- C ircuit breaker state – „Closed / Open"
- Withdrawable position of circuit-breaker
- Protections activation signalling
- Disconnecting switch and earthing switch state
- Circuit breaker switching on and off
- Signalling of auxiliary voltage failure.

5.8.3. Measurement field

- section measuring field
- section voltage measurement (analogue signal 4...20mA)
- phase-to-phase voltage U_{RS} (rms)
- phase-to-phase voltage U_{ST}(rms)
- phase-to-phase voltage U_{TR}(rms)
- voltage U_0
- signalling lack of auxiliary voltage
- signalling protection activation
- earthing swich position

5.8.4 Transformer feeder field

- Representation of circuit breaker state – „Closed / Open"
- Representation of circuit breaker withdrawable unit position (state)
- Representation of disconnecting switch and earthing switch state
- Protections activation signalling
- Circuit breaker switching on and off

5.8.5 Motor feeder field

- C ircuit breaker state – „Closed / Open"
- Circuit breaker withdrawable unit position (state)
- Disconnecting switch and earthing switch state
- Protections activation signalling
- Circuit breaker switching on and off
- Signalling of drive operation
- Signalling of drive failure

The method of signals' transmission to CSNiM shall be adjusted with GL.

5.9 Quality control

The quality control shall be carried out according to requirements of valid ISO 9001 standards and regulations. The manufacturer procedures shall be employed as a minimum.

5.9.1 Inspection

Inspection of the switchgear shall be carried out in presence of Buyer, or representatives assigned by him.

The Buyer acceptance does not release the supplier from liability for keeping to purchase terms, delivery of required documents and fulfilling all requirements of this specification.

5.9.2 Factory tests

The supplier shall carry out all required tests according to factory procedures, this specification, relevant data sheets and adequate domestic and international regulations.

Filled certificate of completed tests shall be issued after their positive completion.

The supplier shall submit to GL for revision schedule of factory tests and activities, resulting from procedures regarding these tests, 8 weeks in advance of their beginning date.

The supplier is responsible for delivery of copies for current operating conditions of tests, confirmed with certificate of completed tests.

All measuring equipment and instruments shall have up-to-date certificates, issued by independent firms.

Below listed tests and trials shall be carried out for each field, and confirmed with a certificate:

- Standard tests according to PN-EN 60439. All vacuum circuit breakers and other equipment in outgoing fields shall be inspected visually and functionally, with consideration given to overloads.
- Tests of dielectric strength, described in detail in PN-EN 60439 standard
- Insulation resistance measurement by means of insulation resistance 1000V meter
- Graduation and polarity check for all current and voltage transformers at original, unequivocal representation
- Original, unequivocal representation for protecting relays of vacuum circuit breaker
- Detailed simulation test for selectivity of protections

The supplier shall specify number and type of tests, which have to be carried out for working switchgear.

5.9.3 Acceptance

Acceptance of the switchgear by Buyer can proceed after:

- Carrying out of all tests by supplier, with test results being satisfactory for Buyer
- Approving by Buyer of all documents listed in purchase documentation.

5.10 Guarantee requirements

Main requirements regarding the guarantee are contained in purchase documentation. The guarantee shall include all equipment and instruments installed in fields of the switchgear.

5.11 Deliveries

The switchgear shall be delivered to GL according to requirements contained in purchase documentation.

Cubicles of the switchgear shall be packaged in boxes.

All devices shall be protected for period of transport. Particular attention shall be paid on protections of measuring instruments and protecting devices.

The equipment shall be protected against moisture penetration and improper handling during transportation and storage. The supplier shall analyse necessity for anti-condensation heaters installation.

Not connected terminals of cables and conductors shall be protected by means of thermo-shrinkable tips, in order to protect them against leakage current caused by humidity.

6 Relevant documents

Any "Technical Specification" issued by GRUPA LOTOS S.A. listed in Contract Files.

7 Codes and standards

Medium voltage switchgear shall be fabricated according to below listed Polish Standards PN-EN, PN-IEC and European equivalents of IEC/CENELEC standards.

PN-IEC 60050-151	International eletrotechnical vocabulary. Part 151: Electrical and magnetic devices.
PN-IEC 60050-441	International eletrotechnical vocabulary. Part 441: Switchgear, controlgear and fuses.
PN-EN 60265	High voltage switches. Part 1: Switches for rated voltages above 1 kV and less than 52 kV.
PN-EN 60298	Alternate current metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.
PN-EN 62271-100	High voltage switchgear and controlgear. Part 100. High voltage alternate current breaker switches.
PN-EN 62271-102	High-voltage switchgear and controlgear - Part 102: High voltage alternating current disconnectors and earthing switches
PN-EN 62271-105	High voltage switchgear and controlgear - Part 105: High voltage switch-fuse combinations.
PN-EN 62271-203	High voltage switchgear and controlgear. Part 203. Alternate current, metal-enclosed switchgears for voltage above 1 kV and less than 52 kV.
PN-EN 60265	High voltage disconnectors. Part 1. Disconnectors for voltages above 1 kV and less than 52 kV.
PN-EN 50181	Plug-in type bushings above 1 kV up to 36 kV and from 250 A to 1.25 kA for equipment other than liquid filled transformers.
PN-EN 60243-1	Methods of test for electric strength of solid insulating materials. Part 1. Tests at power frequencies
PN-EN 60255	Electrical relays.
PN-EN 60439	Low-voltage switchgear and controlgear.
PN-EN 60073	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators.
PN-EN 60445	Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals and of terminations of

certain designated conductors, as well as general principles of alphanumerical system.

PN-EN 60529 Protection grades provided by enclosures (IP code)

8 Enclosures

- Attachment No. 1, MV Switchgear / MCC Data Sheet

9 Record of changes

No.	Date	Description	Introduced by
0		This specification entirely replaces the former LOTOS Group S.A. standard No. PR 07 422 with the same title.	J. Bućko
1	30-11-2013 (rev.1)	Review, update, standardize and changes to the Standard within scope of order No. OK/990/2012	Editorial board coordinated by T.Wróbel
-	31-08-2015	Page layout corrections, no contents changes.	T. Wróbel