| Grupa LOTOS S.A. | **TECHNICAL SPECIFICATION** | Spec. N$^{o}$ 4160 |
|---|---|---|
| | **Direct Current Auxiliary Voltage Supply System** | |

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## 1 Subject of specification

This specification used in conjunction with other technical specifications of LOTOS Group S.A., establishes minimal requirements regarding designing and manufacture of DC Auxiliary Supply System.

## 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 deviations from this specification and relevant specifications, standards and documents, including the bidder's proposals indicating a more economic and/or technically better design or solution, shall be submitted in writing for checking and approval by LOTOS Group S.A. No deviation or modification shall be permitted unless confirmed in writing by LOTOS Group 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

Scope of this specification does not include issues regarding:

- rooms of DC equipment and battery room
- UPS units

Requirements regarding DC equipment rooms and battery room are covered in civil branch specification N$^{o}$ 5200 „Buildings".

Requirements regarding UPS unit are covered in electrical branch standard – specification N$^{o}$ 4810 „UPS supply system"

## 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: GL SA LOTOS Group Inc./ BUYER

SUPPLIER: BIDDER/ DELIVERER

### 4.1 Designations

**GL SA** LOTOS Group S.A.

**LV** – low voltage

**AC** – alternate current

**DC** – direct current

**SZNPPS** – DC auxiliary voltage supply system

**NO** – normally open

**NC** – normally closed

**CSNiM** – Central Supervision and Monitoring System

**KiA** – Control and Automatics

**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 °C |
| ▪ Relative humidity (max/min) | 90%/70% |
| ▪ Elevation above sea level | 1m |
| ▪ Wind speed | 26 m/s |
| ▪ Work conditions | refinery, sea coast |

### 5.2 Electric network parameters

Medium voltage
15kV (LOTOS Railway, North Marine and Przejazdowo Water Supply) ), 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 |
| ▪ DC control voltage | 110V DC, 220V DC |

### 5.3 Main design requirements

5.3.1 Documentation

The bidder (supplier) shall submit the following documents for approval:

- List of documents
- Dimensional drawings
- General arrangement of cabinets
- Front view
- Data sheets filled up by supplier
- Schematic diagram of DC supply system, schematic diagram of emergency lighting switchgear, schematic diagram of internal load switchgear
- Equipment of cubicle (layout of equipment)
- Layout of control and signalling equipment
- Assembly diagrams
- Schedule of instruments
- Spare parts list
- Certificates
- EMC declarations
- Declaration of conformity
- Erection and operating instruction

5.3.2 General requirements

Reliability, smooth operation and easy handling are required for all equipment applied. Typical equipment shall be used. Application of prototype equipment, not registered and not admitted for production is forbidden.

Spare parts shall be attainable 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.

DC auxiliary supply system 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 110V or 200V DC auxiliary supply system

5.3.3.1 Technical requirements

110V or 220V DC auxiliary supply system shall consist of:

- Rectifier
- Battery (lead-acid with gas recombination type preffered)
- DC switchgear
- Lighting switchgear (this applies to systems destined for emergency lighting supply)

DC auxiliary voltage supply system shall consist in buffered operation of battery pack with rectifier, fed with alternate current. The battery shall be maintained in full charge state, therefore rectifier output shall be at least equal to power absorbed by equipment being supplied together with power necessary for continuous battery charging, and shall cover demand necessary for casual and periodical charging of battery.

Capacity of batteries shall be established accordingly to battery reserve required for specified conditions, agreed with GL SA.

Auxiliary voltage supply system shall enable simultaneous feeding of consumers during battery charging, without exceeding of limit voltage allowable for it.

Allowable voltage fluctuations on battery busbars during discharge, both for continuous, interference and short-term current, shall be contained within ±10% of rated voltage limits. Allowable voltage drop for consumers drawing short-term currents shall not exceed ±15% of rated voltage.

All low voltage insulators applied shall isolate plus (+) pole from minus (-) pole.

All elements between battery terminals and output terminals of the rectifier, and in particular backward diodes, shall be matched to withstand expected interference current of battery pack, for time equal at least to reaction time of fuses protecting the battery, and to limit earth fault current occurring most frequently on assembly and instrument terminals.

Considering possibility for earth faults occurrence, it is recommended for auxiliary voltage supply system to contain the least possible number of elements and the shortest possible battery feeding cable.

Direct current switchgear shall be manufactures as indoor free-standing, single-sectional, in metal enclosure.

Direct current lighting switchgear shall be manufactured as indoor, free-standing, two-sectional in metal enclosure.

A system consisting of typical equipment, manufactured according to valid norms and regulations, as well as having certificate of official testing and declaration of conformity shall be delivered.

It is necessary to use equipment and instruments destined for operation inside building, located outside explosion hazard zones.

Feeders of switchgears shall be adapted to assembly on frame mounted in electrical station building, in low voltage switchgear room. Frames shall be included within scope of delivery.

On switchgear front shall be drawn switchgear one-line diagram with description of power sources on main incomer cubicle, incomer feeder diagram, and main and distribution busbars

5.3.3.2 Design requirements

5.3.3.2.1 Electrical parameters

| | |
|---|---|
| Rated supply voltage | **400V, 50Hz** |
| Allowable changes of supply voltage | **± 10%** |
| Rated output voltage | **110V DC or 220V DC** |
| Stability of rated voltage | **≤ 1%** |
| Pulsations of rated voltage | **≤ 0,5%** |

5.3.3.3 Operating conditions

110V DC or 220V DC auxiliary voltage supply system shall be installed in electrical station building, in room destined for low voltage switchgear and battery room. Temperature in the switchgear room shall not exceed +5°C to +40 °C, while in battery room shall not exceed +22 °C.

5.3.3.4 The rectifier

5.3.3.4.1 Basic design requirements

The rectifier shall be executed as free-standing, digital, with full monitoring of operation and interference recorder, enabling local and remote readout of system condition.

Cabinet of the rectifier shall be fully separated from battery.

Structure of each rectifier's cabinet shall be made as separated enclosure equipped in closed front door. Functional compartments of the rectifier shall be easily accessible from front side and easy to replace. Compartments' door shall be fastened to cabinet structure by means of hinges.Opening angle of door shall not exceed 120°. Opening of door shall not result in damage or actuation of instruments mounted on it.

Easy access to instruments mounted inside the rectifier's cabinets shall be provided. All indicators shall be visible.

Cabinets of rectifier shall be provided with sufficient ventilation by means of air grates, located:

- in bottom part of door
- in upper cover of each cabinet.

Between partition walls of adjacent cabinets, a small clearance shall be foreseen in order to prevent mutual thermal influence.

A pocket, destined for technical documentation, shall be mounted on door of each cabinet.

All instruments shall be unequivocally marked according to rectifier technical documentation.

The supplier shall deliver detailed technical guideline concerning installation of the rectifier, along with data on assembly frame.

5.3.3.4.2 Cable compartment

Cable compartment shall be manufactured in such a way, so that feeding and control cables would be easily connected to adequate terminals of each outgoing feeder.

Earthing terminals, intended for earthing of cable screens or armour, shall be located in cable compartment.

All elements that can be live shall be shielded. Cable compartment shall be adapted for safe routing and connecting of cables.

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

Adequate structures shall be prepared in cable compartment for fastening of cables.

5.3.3.4.3 Instrument compartment

All measures, precluding accidentally getting into rectifier's compartments shall be undertaken. All permanent, insulated contacts shall be shielded.

All compartments of the rectifier shall be encased, including partitions between individual cabinets.

Main current circuits of controlgear, relays, fuses, overcurrent circuit-breakers shall be isolated from auxiliary circuits.

Earthing terminal shall be provided in each feeding cubicle. Earthing terminals shall be easily accessible.

5.3.3.5 Battery

5.3.3.5.1 Basic requirements

The battery shall be situated in separate room and shall be of serviceless type.

The lead-acid with gas recombination type (classic) is prefferred.

Each cell shall have sealed cover, of fire retardant type, made of material resistant to mechanical damages. The enclosure shall be provided with adequate quantity of plugs with recombination system (one for each cell). Enclosure of cell shall be made of such material, so that eye monitoring of electrolyte level in the cell would be possible through it.

The battery shall be manufactured as wall-standing, with cells installed on rack. The rack shall be delivered together with the battery pack. Battery cells can be put on the rack in maximum two layers, and shall be accessible from two sides as minimum. Under whole rack battery tray shall be placed with capacity adequate to type of batteries. It is required that minimum battery tray capacity was equal to capacity of leakage from one damaged block of batteries (minumum of three cells)

Shall a need arise for use of two or more parallel set of cells in course of battery selection, each such set shall be connected to maximum voltage in configuration, enabling disconnection of arbitrary cell, without disturbing battery pack operation.

Insulated interconnections of cells, and end insulators shall be used.

5.3.3.5.2 Selection of batteries

On tender stage the Supplier shall submit direct current discharge characteristics adequate for specific cell type / at various discharge end voltage, in tabularised form.

5.3.3.6 DC switchgear

5.3.3.6.1 Basic design requirements

Each cubicle shall be adapted for possible extension of the switchgear, by means of adding additional, new outgoing feeders.

Each cubicle shall be provided with metal external shields, excluding floor as integral part of enclosure, and door locked with standard lock with key. The cubicles shall be fully separated each from another.

Functional compartments within cubicle shall be separated one from another by means of internal partition walls.

Cubicles of the switchgear shall be composed of the following functional compartments:

- Busbar compartment (main busbars, distribution busbars and auxiliary circuits busbars)
- Equipment compartment
- Cable compartment
- Control compartment (for incoming feeders)

Opening of both busbar compartment and cable compartment shall be possible only by means of suitable tools.

Compartments of switchgear cubicles shall be easily accessible from front side, and easy to replace. Compartment door shall be fastened to cubicle structure by means of hinges.

Opening angle of door shall not exceed 120º. Opening of door shall not result in damage or actuation of instruments mounted on it.

The modules shall be mutually separated by means of horizontal partition plates, made of metal or plastic.

Main busbars shall be divided into sections corresponding to transport division lengths. Joining of busbars shall proceed without need for their relocation.

Easy access to equipment mounted inside the switchgear cubicles shall be provided. All indicators shall be visible.

All cubicles of the switchgear shall have sufficient ventilation provided, by means of air grates, located in:

- in lower part of circuit breaker compartment door, in incoming feeders
- in door placed in lower part of equipment compartment, in outgoing feeders
- in roof of each cubicle.

Between partition walls of adjacent cubicles, small clearance shall be foreseen in order to prevent their mutual thermal influence. It is necessary to ensure carrying away of heat generated by equipment mounted inside the cubicle. The switchgear shall be built in such a way, so that at maximum ambient temperature rise additional ventilation would not be required.

Each outgoing cubicle shall have reserve outgoing feeders, according to schematic diagram of the switchgear, approved by GL SA Minimum 20% of spare ougoing feeders in each type is required.

A pocket for documentation shall be fitted on each cubicle door.

For transportable equipment, which weight exceeds normal transport possibilities, conveying device shall be foreseen.

All equipment shall be unequivocally marked, according to technical documentation of switchgear.

The supplier shall provide detailed technical guideline concerning installation of the switchgear, along with data regarding assembly frame.

5.3.3.6.2 Feeding of the switchgear

Direct current switchgear RPS shall be adapted to buffered feeding from rectifier and battery.

Switchgear shall be also equipped in additional outgoing feeder to connect discharge resistor to carry battery capacitance tests without necessity of swich off the whole switchgear.

In order to increase feeding reliability, and additional feeding shall be foreseen from DC switchgear RPS1/… to switchgear RSP2/… (interconnection between direct current switchgears).

5.3.3.6.3 Busbar system

Direct current switchgear shall be equipped with system of two main busbars [(+) and (-) busbars] mounted in upper part of switchgear cubicles, and PE busbar routed horizontally, along lower part of cubicles.

Thermal and dynamical criteria for busbars selection shall ensure withstanding by them maximum short circuit current on incoming feeder side.

Busbar cross-sections must be such selected, that their load capacity is greater, or at least equal to 120% of rated current of incoming feeder.

Allowable temperature rise of busbars shall amount to 40ºC for maximum load conditions.

Size of the buses shall be constant along whole switchgear. The buses shall be marked with (+), (-), PE symbols 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 transfers on connections or busbar system prevention, which can be harmful to the system.

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

The following elements shall be connected to PE earthing bus:

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

Earthing PE bus as a minimum shall be connected in two places to external earthing system.

5.3.3.6.4 Cable compartment

Cable compartment shall be made in such a way, so that supply and control cables would be easily connected to adequate terminals of each outgoing feeder.

Earthing terminals, intended for earthing of cable screens or armour, shall be made in cable compartment.

All elements that can be live, shall be guarded. Cable compartment shall be adapted for safe routing and connecting of cables.

All cable glands and other insulation materials necessary for making 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.

Adequate structures for fastening of cables shall be made in cable compartment.

5.3.3.6.5 Equipment compartment

All precautions, making access to the switchgear compartments interior impossible, shall be applied. All permanent, insulated contacts shall be guarded.

All compartments of the switchgear cabinets shall be encased, including partitions between individual cabinets.

Main current circuits of controlgear, relays, fuses, overcurrent circuit-breakers shall be isolated from auxiliary circuits.

Earthing terminal shall be provided in each feeding cubicle. Earthing terminals shall be easily accessible.

5.3.3.6.6 Wiring of 110V DC or 220V DC compartment

Main current circuits:

Copper conductor in PVC jacket resistant to high temperatures – minimum cross section 2.5mm$^{2.}$

Control circuits:

Copper conductor in PVC jacket – cross area 1.5 mm$^2$ as minimum. Wiring shall be made in accordance to relewant legislation and standards. Details for wiring execution shall fulfil requirements included in 4400 “Cables and routes” standard.

It is prohibited to connect two conductors to one terminal.

The conductors can be of cord type, single- or multi-wire. Multi-wire conductors shall be used for flexible connections of equipment mounted on cubicle door. Such conductors shall be protected against mechanical damages by means of flexible protective tubes.

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.

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. Terminals of equipment and instruments shall also be marked, which would enable to avoid improper connections with terminals strips.Conductors shall marked in accordance to address method. Potential method is prohibited.

It is required that all conductors shall be in one piece – making connections on one conductor by any kind of junction elements is prohibited

Conductors to telemetry instruments shall be screened. The screen shall be earthed on single end only.

The following colours of insulation shall be used:

AC current circuits: **black for phase, ends and terminals (L1, L2, L3)**

AC neutral conductor: **light-blue**

AC control circuits: **black, with numbering of ends**

DC circuits: **grey, with numbering of ends**

PE protective bus: **yellow / green**

Terminals shall be marked in accordance to 6120 "Process identification system" standard, section "Electric equipment identification system" and agreed with GL SA

5.3.3.7 Terminals

Each incoming and outgoing feeder shall be wired separately and equipped with own terminal strip.

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

All terminals shall be matched to cross sections of used cables.

All terminal strips and all terminals shall be unequivocally labelled.

Connecting terminals shall be grouped in the following way:

- Separately for measuring transformers
- Separately for auxiliary circuits
- Separately for control circuits

Individual groups of terminals shall be separated one from another by means of insulating partitions.

Only single conductor can be led onto single terminal. Interconnections shall be executed by means of bridges..

10% of reserve terminals shall be foreseen for each terminal strip.

All terminals and terminal strips shall be of the same type. Wherever bolting of conductor can cause its damage, latch type terminals shall be used.

Terminal strips shall be made for all internal and external control, measuring, protection and supply circuits.

Terminal strips shall be arranged in cable compartment in such manner, so that enough space would be provided, necessary for execution of connections, conductors and cables change-over and tags placement.

5.3.3.8 Control and signalling equipment

5.3.3.8.1 Signalling lamps

Signalling lamps shall be mounted on front of rectifier and switchgear cabinets using LED dides as a source of light.

Signalling circuits shall be provided with their own protections.

Colours of lamps shall be selected according to valid regulations and norms.

Danger shall be signalled with use of red colour.

5.3.3.8.2 Protection of outgoing feeders

Direct current outgoing circuits of rectifier and switchgear shall be protected by means of fuses in both poles (+) (-). Application of overcurrent circuit-breakers or compact type circuit-breakers instead of fuses is unacceptable.

Fuse bases and enclosures of fuse-links shall be of permanent type, closed design. Fuse disconnectors "TYTAN" type are preffered for fuses up to 63A and SLP type for fuses above 63A.

If exists necessity for use of quick-break fuse-links, then they shall be selected according to PN-EN 60269 norm. All fuse-links for power fuses shall be of „gF" type, according to above-mentioned norm. Fuse-links of „gG" and „gM" class shall not be used.

All non-earthed poles of feeding circuits shall be protected with fuses.

5.3.3.8.3 Auxiliary relays

Auxiliary relays shall be used in order to:

- contact multiplying
- time delay control
- supervision of control circuits
- separate signals transmitted to DCS.

5.3.3.8.4 Current transformers

In case of necessity, current transformer of 1A secondary current at rated primary current shall be used.

Secondary windings shall be unequivocally marked.

Measuring transformers shall be selected according to requirements of measuring instruments used.

Dynamical and thermal strength of current transformers shall correspond to short-circuit parameters of individual elements of the system.

The current transformers shall operate uninterruptedly at load equal to 120% of rated current.

- Measuring current transformers shall be of class 0.5 (for ammeters and settlement systems)
- Measuring current transformers shall be of class 1 (for measuring instruments, excluding ammeters)

5.3.3.8.5 Instruments

Indicating voltmeters and ammeters are preffered (i.e. "traditional" ones). Theres shall be applied separate protections for voltimeter circuits, it is prohibited to supply voltmeters directly from main distribution busbars..

Digital instruments can be allowed after agreement with GL SA

5.3.4 24V DC auxiliary voltage supply system

For purposes of control and signalling circuits of DC switchgear feeding, one DC feeder separate for each section.

Electrical parameters :

Rated power According to data sheet

| | |
|---|---|
| Rated input voltage | 230 V +/- 10 %;50 Hz +4% /- 6 % 1- phase; 3- wires or 110V DC +/-10% |
| Autonomous operation time | minimum 60 min for 230V AC + internal battery |
| Redundancy feeding system | only for 230V AC poper supply from section I and II LV. switchgear |

The DC feeder units shall be built-in into switchgear and symmetrically arranged in following, subsequent incoming feeders, in upper belt of cabinets.

Each DC feeder shall be selected for full input power of specific switchgear / section I + II /

DC feeder shall feed consumers of own section, and consumers of second section through connector (possibility of independent and parallel operation shall be foreseen).

### 5.4 Links to DCS

Details in scope of signals' types and method of their transmission to DCS system shall be agreed with GL SA.
Transmission of signals to DCS system as well as to Emergency Shut Down system, shall be implemented in form of hardwired connections.

### 5.5 Links to CSNiM

Details regarding type of signals and method of their transmission to CSNiM system shall be discussed with GL SA on meeting with the supplier, arranged prior to order placement.
Transmission of signals to CSNiM system shall be implemented in form of hardwired connections.

### 5.6 Marking

The main and auxiliary buses, as well as cable terminals, must be marked.

Removable nameplates shall be placed on the front of cubicle. All inscriptions shall be made in Polish language.

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

Reserve outgoing feeders shall be labelled, along with specification of their maximum rated current or maximum rated power.

All cables and conductors shall be labelled according to technical documentation.

Contents of the nameplates shall be agreed with GL SA.

### 5.7 Painting

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

Final RAL colour shall be adjusted with GL SA

### 5.8 Scope of delivery

The delivery shall include the following items:

- Auxiliary voltage supply system shall be built according to this specification and documents relevant to it.
- Documentation of the Supplier shall include calculations, diagrams, installation requirements, certificates of tests and trials and adequate certificates.
- Fine accessories, fuse-links, connectors, nuts, auxiliary materials, etc.
- Spare parts necessary for starting-up and commissioning.
- Spare parts for 2-year operation period.
- Adequate packaging and transport to installation site.
- Supervision on erection, tests, start-up and commissioning.

5.8.1 Tools and spare parts

The Bidder shall deliver:

- tools
- spare parts

necessary for start-up and commissioning of auxiliary voltage supply system.

Furthermore, the Bidder shall submit list of spare parts for 2-year operation. This list, and price list of specified spare parts, shall be submitted to GL SA prior to reception of order on system delivery.

### 5.9 Quality control

The quality control shall be carried out according to requirements of valid norms and regulations. The manufacturer procedures shall be applied as a minimum.

5.9.1 Inspection

Inspection of auxiliary voltage supply system 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 of all other requirements.

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 for completed tests shall be issued after their positive completion.

The supplier shall submit to GL SA for revision schedule of factory tests and activities, resulting from procedures regarding these tests, minimum 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 organizations.

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

- Standard tests according to PN-EN 60439. All circuit breakers and all cassettes in outgoing feeders 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, and for ±10% of random chosen thermal relays.
- Checking of releasing and engaging of contactor contacts.
- other in accordance to manufacturer requirements

The supplier shall specify number and type of tests, which have to be carried out for working system of 110V DC auxiliary voltage supply.

5.9.3 Acceptance

Acceptance of 110V DC system by Buyer can proceed after:

- Carrying out of all tests by supplier, with positive test results
- 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 cubicles of rectifier and switchgear, as well as in battery pack unit, until the end of their operation period.

### 5.11 Deliveries

110V DC or 220V DC auxiliary voltage supply system shall be delivered to GL SA according to requirements contained in purchase documentation.

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.

## 6 Relevant documents

- Other Technical Specifications, shown on delivered List of Technical Specifications for GL SA

### 6.1 Codes and standards

110V DC or 220V DC auxiliary voltage supply system shall be fabricated according to below listed Polish Norms PN-EN, PN-IEC and European equivalents of IEC/CENELEC standards.

| | |
|---|---|
| PN-EN 60146 | Semiconductor converters.(all parts) |
| PN-EN 60073 | Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators. |
| PN-EN 60896-11 | Stationary lead-acid batteries. Part 11 – Vented types.- General requirements and methods of testing. |
| PN-EN 60896-22 | Stationary lead-acid batteries. Part 22 – Valve regulated types. - Requirements. |
| PN-EN 60439 | Low voltage switchgears and controlgears. (all parts) |
| PN-EN 60445 | Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals and of terminations. |
| PN-EN 60947 | Low voltage switchgear and controlgear.<br>(all parts) |
| PN-EN 60529 | Degree of protection provided by enclosures (IP code). |

PN-EN 60269 Low voltage fuses. (all parts)

110V DC or 220V DC auxiliary voltage supply system built according to another norms and standards shall be submitted to GL SA for approval.

## 7 Record of changes

| No. | Date | Description | Introduced by |
|---|---|---|---|
| 0 | | This specification entirely replaces the former LOTOS Group S.A. standard No. PR 07 426 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 content changes. | T. Wróbel |