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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 execution of lighting systems.

The specification applies to the following systems:

- external lighting (lighting of roads and areas)
- process lighting (process technological structures i.e.lighting of platforms, racks, etc.)
- lighting in buildings.

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 matching of equipment and materials purchased by him/her on the grounds of technical design, and in particular in relation to instruments and equipment of explosion – proof design.

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 requirements concerning:

- Lighting switchgears. Such requirements are covered in standard N° 4170 "Low voltage auxiliary switchgears"
- Cables and wires. Such requirements are covered in standard N° 4400 "Cables and wires"
- Earthing system. Such requirements are covered in standard N° 4500 "Lightning protection and earthing systems"
- Repair socket system. Such requirements are covered in standard N° 4211 "Repair socket – outlet systems"

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

CUSTOMER: GL SA LOTOS Group S.A. / BUYER

SUPPLIER: BIDDER / VENDOR / CONTRACTOR

4.1 Designations

GL SA LOTOS Group S.A.

LV – low voltage

AC – alternate current

DC – direct current

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
- Snowfall: 290 mm
- Work conditions: refinery, sea coast

5.2 Electric network parameters

Medium voltage: 15kV (LOTOS Railway, North Marine and

	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 allowable tolerance +4% /-6%
Low voltage	400V, TN-S, TN-C-S
Low voltage (lighting, heating)	230V, TN-S
Low voltage (emergency lighting)	110V DC
Alternate current control voltage	230V, single-phase
Direct current control voltage	24V DC, 110V DC, 220V DC

5.3 Main design requirements

5.3.1 Documentation

Schedule of documentation, which shall be delivered to LOTOS Group S.A.:

- list of documents and operation manual in polish language,
- assembly drawings
- transport and storage procedure
- test schedule
- EMC declarations
- EC type examination certificate issued by notified body (required for Ex execution)
- declaration of Conformity issued by Manufacturer (required for Ex execution)

Additionally, for explosion-proof devices Ex, scope of delivered documentation shall fulfill specification 1020-Classification of Explosion Hazard Zones requirements.

Preferred manufacturers of lighting fittings and accessories of normal and explosion proof design – according to list of suppliers, prepared and approved by LOTOS GROUP.

5.3.2 General requirements

Installation of lighting and plug-in sockets shall be designed appropriately to ambient conditions, in which it shall operate.

Installation of lighting and plug-in sockets shall be designed and realized according to valid standards, in a manner ensuring its proper functioning and safe operation.

The installation shall be made according to detail design. All deviations from the detail design must be agreed with designer and Lotos Group representative.

20% of spare shall be assumed while designing power supply capacity and selecting lighting panels, distribution circuits, cables and conductors, equipment and accessories.

Directions and guidelines of lighting fittings and accessories manufacturer shall be taken into account and observed during installation works.

Lighting fixtures shall fulfil requirements of EMC Directive , It means that they will properly work in defined electromagnetic environment without creating additional electromagnetic disturbances

Lighting accessories and fittings, which are foreseen to operate in explosion hazardous areas, shall feature explosion-proof design adequate to specific zone, ignition group and temperature class,
-in accordance with the requirements of specification 1020-Classification of Explosion Hazard Zones

All lighting panels, lighting fittings, circuits and cables shall be labelled according to standard N°6120 "Process identification system", chapter "Identification and marking system of electric equipment and devices".

5.4 Design requirements

5.4.1 External lighting system

External lighting system shall be designed with usage of :

- steel zinc coated or plastic lamp posts, or others agreed with GL SA
- sodium discharge, metal halide lighting fittings, or LED (after agreement with GL SA)

External lighting system circuits shall be fed from lighting switchgear ROE and switched on centrally by means of astronomic timer.

Each lamp post shall be provided with terminal strip and post fuse board. Number of fuses shall be matched to number of lighting fittings mounted on the post.

In case of lamp posts installed in explosion hazardous area, the terminal strip, protection devices, lighting fittings shall be made of explosion-proof design selected appropriately to specific explosion zone parameters.

The protection box shall be mounted on lamp post.

All used lighting fittings shall be of class 1.

External lighting system shall be fed with non-armoured, 0.6/1kV, 5-conductor, PVC insulated cables.

Connections inside the post shall be executed with min. DYd 2,5mm^2 cable type.

Aluminium posts shall be connected to main earthing system.

External lighting shall fulfil requirements of PN-EN 12665, PN-EN 13201, PN-EN 12464-2 norms.

5.4.2 Process lighting system

Basic lighting of process equipment and installations shall be designed with usage of energy-saving fluorescent lighting fittings.

Application of other fittings, such as:

- sodium discharge
- metal halide
- incandescent fittings
- LED fittings
- others, after agreement with Lotos Group

Lighting installation is divided into:

- basic (normal) lighting
- full day lighting (to light workplaces and communication routes for which daylight is not sufficient). It must be supplied from selected basic lighting circuits with own control system (manual switches located directly by production installation)
- Emergency standby lighting which serves as lighting for installation (devices, machines, platforms, communication routes) in such way and with such intensity to allow continue or stop production process, safe work of staff and safe using of communication routes. Emergency standby lighting for industrial applications shall be realised by selected circuits of normal lighting. In case of modernization of existing technological installations emergency standby lighting shall be separated lighting installation. Emergency standby lighting shall be foreseen in places where lack of lighting could cause life or health danger of humans during work and/or serious dager to environment, significant material losses e.g. emergency stop for production process.

Basic, full day and emergency lighting shall fulfil requirements of :

- PN-EN 12464-2
- PN-EN 1838
- PN-EN 50172

as well as the following orders:

- Minister of Internal Affairs and Administration order of 7 June2010, on fire protection of buildings, other building objects and areas (Journal of Laws2010,nr109,pos.719) (not apply to emergency lighting)
- Minister of Infrastructure order of 12 April 2002, on technical conditions that buildings and their location shall adhere to (Journal of Laws 2002,nr 75,pos.960 and amendments, specially 2010,nr 239,pos.1597
- Specification of Lotos Group: 1020-Classification of Explosion Hazard Zones for lighting installations in hazardous areas

In normal operating conditions, whole lighting system shall play role of basic lighting. In case of supply failure, part of lighting fittings, separated as emergency standby lighting, shall be switched over on power on from 110 V DC or 220 V DC (depending on the substation which supply above circuits) substation central battery bank.

According to Orders Minister of Infrastructure order of 12 April 2002, as well as to PN-EN 1838 standard, system of emergency standby lighting shall operate at least 1 hour starting from failure of basic lighting system.

Design of basic and emergency standby lighting system, , must be each time agreed with Lotos Group and shall have opinion of fire protection expert.

All fluorescent lighting fittings operated in basic and emergency standby lighting circuits shall be factory adapted to supply with 230V AC and 110V DC voltage, for purposes of above-mentioned aims and standardization.

In case of application of sodium discharge lighting fittings, due to their long start-up time after supply failure and its subsequent restore, additional incandescent fitting shall be foreseen.

All circuits of process lighting shall be solely single-phase supplied. Application of three-phase supply of lighting system is forbidden.

Connecting of normal (basic) lighting fittings is allowed both by means of junction boxes and by-through. For emergency standby lighting made as fireproof only through connection is allowed.

Aboveground process lighting system shall be fed by means of non-armoured 0.6/1 kV three-conductor cables, with PVC insulation. Underground part of installation shall be fed by means of armoured cables with PVC insulation.

Design of basic and emergency standby lighting system shall take into account a significant decrease in light intensity for negative temperatures. Lighting instalation must be oversize accordingly, for all critical places, especially for rotating machine sections, to fulfill requirements for . -25 ^{o}C.

To minimize damages of lighting installation during fire shall be foreseen its geographical division on 2 to 6 independent "zones" depends on size of technological installation area.

Each lighting "zone" shall be supplied by independent cables.

5.4.3 Lighting system in buildings

Basic lighting of buildings shall be designed with usage of energy-saving fluorescent lighting fittings, as well as incandescent fittings or fixtures with LED light sources.

Emergency lighting, escape route or standby, depending on requirements and destination, shall be foreseen apart from basic lighting (depends on function and requirement for object).
The system of emergency escape route or standby lighting shall perform the following functions:

- lighten escape route marks
- produce lighting intensity on escape routes and along evacuation paths in such a manner, that safe traffic towards exit to safe place would be possible,
- ensure that fire alarm points and fire equipment arranged along evacuation routes would be easily located and used.

Emergency escape route lighting shall be foreseen in places, where lack of lighting can cause life threat or material losses.

Emergency escape route or standby lighting system shall be fed from battery pack or central UPS unit, with 1-hour back-up time.

Selection and design of emergency escape route lighting system, must be each time agreed with Lotos Group and shall have opinion of fire protection expert.

Basic and emergency escape route lighting shall fulfil requirements of :

- PN-EN 12665
- PN-EN 12464-1
- PN-EN 1838
- PN-EN 50172

as well as the following orders:

- Minister of Internal Affairs and Administration order of 7 June2010, on fire protection of buildings, other building objects and areas (Journal of Laws2010,nr109,pos.719)
- Minister of Infrastructure order of 12 April 2002, on technical conditions that buildings and their location shall adhere to (Journal of Laws 2002,nr75,pos.960 and amendments, specially 2009,nr56,pos.461,§ 181

- Specification of Lotos Group :1020-Classification of Explosion Hazard Zones

All lighting circuits shall be solely single-phase supplied.
Application of three-phase supply of lighting system is forbidden.

Connecting of lighting fittings is allowed both by means of junction boxes, and by-through.

Lighting system in buildings shall be fed by means of non-armoured 0.6/1 kV PVC insulated three-conductor cables and PVC-insulated.

Building lighting system shall be executed in such way, so that its replacement would not spoil the structure of the building.

Lighting accessories (IP protection degree) shall be selected for each room depending on environmental conditions.

If buildings are or include part of technological installation then additionally requirements from point 5.4.2 are required.

5.5 Lighting fittings

Typical fittings shall be used. Number of fittings types shall be limited to minimum necessity.

Service life of the fittings shall reach the following minimum values:

- Sodium discharge fittings 5000 operating hours
- Fluorescent fittings 6000 operating hours
- LED fittings 10000 operatng hours
- Incandescent fittings 2000 operating hours

5.5.1 Posts, brackets and auxiliary fittings

The holders, enabling fastening of a lighting fitting to boom or tubular bracket, shall be included in scope of delivery. The holders shall be complete (i.e. delivered together with all elements necessary for mounting of fitting), made of stainless steel (V2A) and adapted to 2-inch diameter tube.

For fittings mounted on ceilings or built-in in ceilings, pendants or catch pawls for fastening them shall be delivered.

Fittings and brackets shall be consistent with 4900 “Typical installations”

5.5.2 Constructional requirements

All lighting fittings used in external and process lighting installations shall be factory adapted to harsh, outdoor, industrial conditions.

Furthermore, the fittings used in process lighting system shall be adapted to operate in environment, in which combustible substances are present.

All lighting fittings shall ensure safe operation, easy operating and maintenance. Fastening bolts (latches) on enclosures, which are not unscrewed or opened in course of maintenances, shall be blocked.

All bolts, washers, nuts and latches shall be made of stainless steel.

Lampshade and reflector shall be fastened to the fitting in such a way, that after opening them for light source replacement purposes, they would safely hang down and shall not disconnect from enclosure.

5.5.3 Enclosure

Enclosures of metal-halide and sodium discharge lighting fittings shall be made of cast iron, materials resistant to corrosion or reinforced plastic.

Enclosures of fluorescent lighting fittings resistant to weather conditions, shall be made of reinforced plastic.

Enclosures of fittings installed in contaminant-free environment (e.g. offices), shall be made of reinforced plastic or steel sheet, protected with anti-corrosion paints.

All lighting fittings shall be provided with reflectors.

Required degree of protection IP for enclosures shall be:

IP 54 – for external lighting fittings

IP 65 – for process lighting fittings

IP 20 – for lighting in buildings, in contaminant-free rooms

IP 44 – for lighting fittings in buildings, in wet rooms

IP 66 – for lighting fittings in buildings, in contaminated rooms.

5.5.4 Lampshades

Lampshades of sodium discharge and metal-halide lighting fittings shall be made of heat-resistant glass or proper for this purpose plastic.

Lampshades of fluorescent lighting fittings shall be transparent, resistant to impact and resistant to temperature changes. They shall form a whole and shall not have any glued seams or edges. Gaskets between enclosures and lampshades as well as screens, cannot be fastened to the screens.

5.5.5 Ballast

Ballast gear shall be suppressed, of low lossiness, protected against short circuits and closed in tight enclosure. Capacitors shall be replaceable. The ballast gear shall be installed in the fitting.

5.5.6 Wiring

Internal wiring of lighting fitting shall be made with copper conductor of 1.5 mm^2 cross section, and led out on terminal strip installed inside the fitting.

Terminals of the terminal strip shall be adapted for connection of L, N, PE wires of 2.5 mm^2 cross section. The terminal strip shall be rigidly fastened to enclosure of the lighting fitting.

In case of lighting fittings generating high amount of heat, the terminal strip shall be installed in separate junction box, outside the fitting. Connections between the fitting and junction box shall be made with wires of high heat resistance.

Cable entrances in lighting fittings, as well as in junction boxes shall be furnished with cable glands. Not used entrances shall be plugged.

5.5.7 Power factor improvement

Each lighting fitting shall be provided with capacitors improving power factor (excluding incandescent lighting fittings).

5.5.8 Lighting switches

Lighting switches shall be selected for rated voltage 230V ±5%, 50Hz.

Enclosures of lighting switches installed in process lighting circuits, can be made of reinforced polyester.

Metallic elements of lighting switches, such as bolts, springs, washers, terminals, shall be made of stainless steel.

Cable entrances in the switches shall be equipped with cable glands. Not used entrances shall be plugged by plugs which provide proper IP and Ex protection level

In case of switches installed in explosion hazardous areas, requirements specified in p. 5.6 must be met.

Degree of protection provided by enclosures shall amount to:

- IP 65 for process lighting connectors
- IP 20 for lighting connectors in buildings, in contaminant-free rooms
- IP 44 for lighting connectors in buildings, in wet rooms
- IP 66 for lighting connectors in buildings, in contaminated rooms.

5.5.9 Junction boxes

Junction boxes shall be selected for rated voltage 500 V.

Enclosures of junction boxes can be made of reinforced polyester.

Metal holders of junction boxes, such as bolts, springs, washers, terminals, shall be made of stainless steel.

Degree of protection provided by enclosures shall amount to:

- at least IP65 for junction boxes installed in explosion hazardous area
- at least IP56 in the other cases.

5.6 Explosion protection

Live parts of equipment working in explosion hazardous area shall be protected by flameproof enclosures (EEx d design) and fulfil requirements of specification 1020-Classification of Explosion Hazard Zones.

Junction boxes, terminal boxes, interposing boxes shall be of increased safety type (EEx e design).

All equipment of explosion-proof design shall be certified for operation in Zone 1.

Enclosures made of plastics shall feature impact strength better than 7 Nm, dielectric strength better than 2 kV, surface resistance below $10^9\Omega$, and they shall be resistant to action of aggressive chemicals, such as acids, lye, bases, salts, oils and greases.

Glands and plugs Ex made of plastic shall be fire resistant and self-extinguishing.

5.7 Astronomical control timers

Astronomical timers shall be selected for rated voltage 230V ±5%, 50Hz.

Its enclosure must provide degree of protection IP 65 at least.

Timer shall be installed outside of explosion hazardous areas, in vicinity of transformer station buildings, from which external lighting circuits are fed.

There is recommended to control lighting installation from refinery central lighting control system.

There shall be also foreseen manual switch for switching on whole or part of lighting installation for required area from electrical substation level – independently from control by astronomical timer or central lighting control system.

5.8 Required levels of illumination

Lighting system shall be such designed and executed, so that illumination intensity levels, required by PN-EN 12464, PN-EN-13201 and PN-EN 1838 Polish Standards would be guaranteed.

5.9 Scope of designing and deliveries

Scope of design includes:

- Selection of lighting fitting to required luminance level
- Arrangement of lighting fittings
- Selection of cables and wires
- Selection of junction boxes and lighting switches
- Tracing of lighting circuits and selection of lighting panels
- Preparation of plans for the system
- Material list
- simulation for lighting layout and intensity for project scope

5.10 Scope of deliveries

In order assumptions, accepted by supplier (contractor), detailed scope of deliveries and services is not specified, by it is common knowledge that they have to put into practice all technical requirements of this specification, as well as ensure proper and safe operation of the system.

A contractor shall perform control measurements of lighting intensity or other additional, if required by regulations and standards.

If Manufacturer is offering such option then fittings shall be delivered with protective foil for mounting (protection against dirt during painting works)

A contractor can claim an additional payment from GL SA for materials and works exceeding contract limits only then, if they are resulting from errors contained in technical documentation, which even in case of its accurate verification were impossible to discover.

5.10.1 Spare parts

Spare parts necessary for starting up of lighting system shall be included in scope of delivery.

Spare parts for 2-year system operation period, can be ordered based on the prices quoted on tender stage, and in time specified by Lotos Group.

5.10.2 Special tools

Special tools, necessary for maintenance purposes, shall be delivered as part of materials for lighting installation.

5.10.3 Notification of deficiencies

The Supplier (contractor) is obliged to notify, in proper time:

- about necessity for basic data revision (design assumptions)
- about information not included in specification
- that technical documentation is incomprehensible and shall be supplemented according to new technical knowledge, or prepared on the basis of components that are available on market.

5.11 Factory tests

Lotos Group reserves right to perform detailed visual inspection of manufactured products prior to packaging them.

5.12 Quality system

The Bidder shall submit documents confirming implementation of quality system.

If the quality system is confirmed according to ISO 9000 by quality office, then copy of certificate shall be submitted to GL SA.

If the quality system does not comply to ISO 9000, then the bidder shall submit detailed description of the quality system.

In addition lighting installation in Ex execution in scope of documentation shall fulfil requirements of specification 1020-Classification of Explosion Hazard Zones

6 Relevant documents

- Other Technical Specifications, shown on delivered List of Technical Specifications for GL S.A

7 Codes and standards

Lighting system shall be produced according to below listed Polish Standards PN-EN, PN-IEC and European equivalents of IEC/CENELEC standards.

PN-EN 60529	Degrees of protection provided by enclosures (IP Code)
PN-EN 60079-0	Electrical equipment in explosion hazardous zones. Part 0. General requirements.
PN-EN 60079-1	Electrical equipment in explosion hazardous zones. Part 1: Flame-proof, “d” enclosures.
PN-EN 60079-7	Electrical equipment in explosion hazardous zones. Part 7: Degree of protection “e”
PN-EN 60947-7-1	Low voltage switchgear and controlgear. Part 7-1: Ancillary Equipment - Terminal Blocks for Copper Conductors
PN-EN 60947-7-2	Low voltage switchgear and controlgear. Part 7-2: Ancillary Equipment - Protective Conductor Terminal Blocks for Copper Conductors.
PN-EN 60669-1	Switches for household and similar fixed-electrical installations - Part 1: General requirements.
PN-EN 12464-1	Light and lighting. Lighting of work places. Part 1: Indoor work places.

PN-EN 12464-2	Light and lighting. Lighting of work places. Part 2: Outdoor work places.
PN-EN 13201	Lighting of roads (all parts)
PN-IEC 60364-4-41	Electrical installations of buildings. Protection for safety. Protection against electric shock.
PN-IEC 60364-4-42	Electrical installations of buildings. Protection for safety. Protection against effects of thermal influence.
PN-IEC 60364-4-43	Electrical installations of buildings. Protection for safety. Protection against overcurrent
PN-IEC 60364-4-482	Electrical installations of buildings. Protection for safety. Choice of protective measures as a function of external influences. Fire protection.
PN-IEC 60364-5-51	Electrical installations o buildings. Selection and erection of electrical equipment. General provisions.
PN-IEC 60364-5-52	Electrical installations o buildings. Selection and erection of electrical equipment. Wiring.
PN-IEC 60364-5-54	Electrical installations o buildings. Selection and erection of electrical equipment. Earthing arrangements and protective conductors.
PN-IEC 60364-5-523	Electrical installations of buildings. Selection and erection of electrical equipment. Long-term current-carrying capacities of wiring systems.
PN-IEC 60364-5-559	Electrical installations of buildings. Selection and erection of electrical equipment. Other equipment. Lighting fittings and lighting systems.
PN-IEC 60364-7-714	Electrical installations of buildings. Requirements regarding special installations or locations. Installations of external lighting.
PN-EN 60598	Lighting fittings.
PN-EN 60309-1	Plugs, socket-outlets and couplers for industrial purposes. Part 1: General requirements
PN-EN 50172	Systems of emergency escape route lighting
PN-EN 1838	Applications of lighting – emergency lighting
PN-EN 50171	Independent supply systems
PN-EN 50272-2	Requirements for battery safety and installation
PN-EN 12665	Light and lighting — Basic terms and criteria for specifying lighting requirements

Minister of Internal Affairs and Administration order of 7 June 2010, on fire protection of buildings, other building objects and areas (Journal of Laws of 2010, No 109 p. 719) [1]

Minister of Infrastructure order of 12 April 2002, on technical conditions that buildings and their location shall adhere to (Journal of Laws of 2010, No 239, p.1597) [2]

Designs of lighting installation executed according to other norms and standards shall be submitted to Lotos Group for approval.

8 Record of changes

No.	Date	Description	Introduced by
0		This specification entirely replaces the former LOTOS Group S.A. standard No. PR 07 201 with the same title.	J. Bućko
1	28.04.2011	Review, update, standardize and changes to the Standard within scope of 10+ program	J. Bućko E. Wiśniewski M. Rompa
2	30-11-2013 (rev.2)	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