Contents

1 Subject of specification 3
2 Scope of validity 3
2.1 Deviations 3
3 Hierarchy of documents 3
4 Definitions and designations 3
4.1 Designations 4
5 Description 4
5.1 General description 4
5.2 Operating conditions 4
5.3 Electrical network parameters 5
5.4 Main design requirements 5
5.4.1 Documentation 5
5.4.2 General requirements 6
5.5 Technical requirements 6
5.5.1 Operating modes 6
Electrical parameters diesel generator 7
5.5.2 Required performance 7
5.5.3 Variants of design 7
5.5.4 The container 8
5.5.5 Diesel engine 8
5.5.6 The generator 12
5.5.7 Control panels 15
5.6 Painting 18
5.7 Quality control 18
5.7.1 Inspection 18

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5.7.2 Factory tests 18
5.7.3 Acceptance 19
5.7.4 Tests on site 19
5.8 Guarantee requirements 20
5.9 Shipment 20
6 Other releted documents 20
7 Codes and standards 20
8 Attachments 21
9 Record of changes 22

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 emergency diesel generator.

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.

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 / VENDOR

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 General description

The task of emergency diesel generator is to deliver electrical energy, in order to enable continuous operation of selected electrical devices that are feeding and controlling operation of process plant, in case of basic supply failure. The diesel generator shall feature possibility for both automatic and manual starting.

This specification establishes minimum requirements regarding designing, documentation, materials, fabrication, control, tests, deliveries and erection of diesel generator for GL SA

All elements necessary for ensuring safe and condition-based requirements for service have to be taken into consideration, even then if omitted in this specification.

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 diesel generator shall be fabricated and erected according to order, this specification, data sheet presented in Annex 1, as well as the other documents that this specification refers to.

The supplier of diesel generator is responsible for entirety of designing, selection of the generator unit elements, erection, cabling and internal wiring of diesel generator, as well as its start-up, with considerations given to generator unit operating conditions according to p. 4.2.

5.2 Operating 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

- Snow falls 290mm
- Work conditions refinery, sea coast

5.3 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)

5.4 Main design requirements

5.4.1 Documentation

A Bidder (supplier) shall submit for approval the following documents:

- list of documents and drawings
- technical description
- erection and maintenance instruction
- data sheet provided by GL SA and filled by the supplier
- technical description and drawings of equipment elements
- dimensional and assembly drawings for motor and generator
- dimensional and assembly drawings for diesel generator container (if any)
- drawings of free space required around the diesel generator or container
- dimensional and assembly drawings of motor and generator panels
- data sheets of auxiliary equipment
- foundation drawing along with location of anchoring and cable culverts
- schematic diagrams of electrical wiring for the generator
- schematic diagrams of electrical wiring for the engine
- schematic diagrams of electrical wiring for auxiliary equipment
- schematic diagrams of cable connections
- assembly diagrams of terminal strips
- schematic diagram of lubrication system
- schematic diagram of fuel system

- heat balance emitted by equipment while operating at full load
- list of equipments
- spare parts list
- painting procedure
- transport and storage procedure
- transport drawings
- schedule of tests
- certificates
- EMC declarations
- declaration of conformity
- catalogues

5.4.2 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.

All parts and equipment of diesel generator shall be brand new (not used).

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 (given in p. 4.2.) working conditions.

The emergency diesel generator must be designed in such a way, so that high operating reliability, as well as limited to minimum downtime in case of repair or inspection would be ensured.

Generator Unit shall comply with the requirements of the EMC Directive, which means that it needs to work correctly in a specified electromagnetic environment without introducing additional electromagnetic disturbances. The level of electromagnetic interference must be N class.

The level of noise produced by the generator, shall be no greater than 85dB within 1 m from the unit where it is installed as a free-standing (not building). In the case of installation in a building maximum level of noise conditions shall be all times agreed with GL SA. The contents of the higher harmonics can not be higher than 5%.

5.5 Technical requirements

5.5.1 Operating modes

The diesel generator shall be designed and fabricated in such a way, so that two modes of operation would be possible:

- Automatic mode (with automatic start-up and auto – synchronization, when working in parallel with basic supply network)
- Manual mode (with manual start-up and stop, manual load switching on and off)

The diesel generator shall be able to operate as the only independent source of electrical supply, after breakdown and failure of basic supply (emergency operation), as well as simultaneously with basic supply source (working in parallel) during peak load period or testing.

Electrical parameters diesel generator

- output — According to data sheet
- operating voltage — 400/230V, TN-C
- rated insulation voltage — Ui = 1000V
- frequency — 50Hz with allowable tolerance ±1%
- low voltage (anti-condensation heating) — 230V, TN-S
- AC control voltage — 230V, single-phase
- DC control voltage — 24V DC or 110V DC
- battery voltage — 24V DC
- speed — According to manufacturer standard

5.5.2 Required performance

The diesel generator shall start, reach nominal speed, rated voltage and possibility for nominal load during maximum 10 seconds, starting from moment of automatic or manual start-up command reception.

The diesel generator shall be able to operate continuously at rated power output and power factor equal to 0.8.

Design of the diesel generator shall enable overloading it 10% in excess of rated output for one hour, during continuous operation lasting not shorter than 12 hours, at rated operating conditions.

Design of the diesel generator shall also enable exceeding of rated speed by 25% without any damages to the equipment.

The diesel generator shall allow for single overloading it with power equal to 50% of rated output during idle run operation, and with power equal to 30% of rated output while operating at load equal to 50% of rated output and voltage drop not greater than 15% of rated voltage.

The diesel generator must meet requirements of EMC directive, which means that it shall operate properly in defined electromagnetic environment, while not introducing additional interferences into it. The level of electromagnetic interferences shall be of N class.

The level of noise generated by the diesel generator shall be not greater than 85 dB at 1 m distance from the unit in case it is installed as free-standing (not in a building). In case of indoor installation, and with GL SA provision of room with sound absorbing enclosure, maximum noise level and conditions of installation shall be each time agreed with GL SA

Contents of higher harmonics shall not exceed 5%.

5.5.3 Variants of design

The following types of diesel generator design are foreseen:

- In container-type housing – for outdoor operation

All elements of diesel generator equipment shall be built-in inside the container or on its roof. The diesel engine, generator, fuel tank, starting batteries, starting battery charging system and electrical boards, shall be installed inside the container. The cooler can be installed on the container roof, but installation on the engine body is also allowed. The silencer can be installed both inside the container on assembly frame, and on the container roof.

- The container degree of protection IP54 minimum.Without housing, for installation inside a building

All elements of diesel generator equipment shall be mounted on common frame, except for:

- the shutters adjusting air inflow / outflow (electrically controlled)
- air inlet / outlet duct, with protection against weather conditions influence
- the silencer
- flue gases exhaust system.

Fuel tank location according to p. 4.5.5.7.

Protection degree at least IP21.

- Without container-type housing, for outdoor installation, under umbrella roof

All elements of diesel generator equipment shall be mounted on common frame, except for:

- the silencer
- flue gases exhaust system.

Fuel tank location according to p. 4.5.5.7.

Type of diesel generator design, as well as conditions for auxiliary equipment installation in case of indoor installation, or installation under umbrella roof, shall be each time agreed with GL SA

5.5.4 The container

If delivered diesel generator shall be equipped with container-type housing, then it is assumed that typical container offered by the manufacturer / supplier shall be delivered, while fulfilling the following requirements:

- steel structure, walls made of steel sheet
- silencing of the container, such that requirements of p. 4.5.3 would be met
- the container shall be installed outdoor, therefore its structure must provide adequate protection for all accessories against external environment conditions, such as rainfall, snowfall, etc. Degree of protection at least IP54.
- shutters of air inlet and outlet electrically controlled.
- size of the container shall provide possibility for assembly of required equipment, and necessary space for operating and maintenance activities, in case of containers enabling access to inside for operating staff.
- cables going from outside shall be entered to container from below.
- in case of container enabling access to inside for operating staff, its interior shall be provided with lighting, by means of fluorescent lighting fittings and at least one, single-phase, 230V 50Hz socket outlet. The lighting shall be switched on by means of lighting connector located inside the container, at entrance. Heating shall be controlled by thermostat .
- the supplier shall provide information required for design of foundation, such as dimensions, load, anchoring, etc.

5.5.5 Diesel engine

5.5.5.1 General requirements

The diesel engine shall be 4-stroke, stationary type, air / liquid cooled, preheated, mounted together with the generator on common frame, and directly coupled to it. Rated output and rated speed matched to requirements of the generator for its rated, continuous load, with consideration given to conditions of p. 4.5.2.

5.5.5.2 Engine equipment

The diesel engine shall be equipped with all accessories required for safe and reliable operation.

Minimum required equipment:

- electrical starter along with battery pack
- complete cooling system (closed system) with mechanically driven pump, thermostat, required piping, cooler, equalizing tank of cooling liquid.
- complete lubrication system, with mechanically driven pump, required piping and filters, automatically or manually operated preliminary lubrication.
- complete fuel installation with preliminary and main fuel filter, mechanically driven fuel pump, required piping and fuel valves, as well as injection system.
- filter and silencer of intake air
- exhaust pipe
- silencer
- thermal insulation
- transport holders
- speed governor
- heating system for cooling liquid
- dampers of vibrations between the engine and assembly frame, as well as between the frame and base plate of container (if any).
- flexible coupling between the engine and the generator
- flywheel
- engine ignition switch
- electrical wiring between the engine and panels as well as junction boxes
- dataplate and operating instruction.

5.5.5.3 Cold-start unit

Electrical starter supplied from battery pack of 24V voltage is foreseen for the diesel engine. The battery pack shall be of high-capacity, in closed enclosure, maintenance-free, type according to manufacturer standard. The batteries shall be placed in insulating housing, in order to protect operating staff against electric shock. The housing shall provide easy access to the batteries for maintenance purposes. Proper ventilation from the housing of batteries to external atmosphere shall be ensured.It is necessary to deliver a control panel together with electric starter, provided with thyristor controlled, automatic rectifier. In normal conditions, the rectifier shall be fed from main supply network, 230V 50Hz single-phase supply. The rectifier shall provide maintaining of battery pack fully charged. After starting up of the diesel engine, the system shall ensure cut-off of external rectifier supply, and switching over on supplying from the generator in order to recharge the batteries after engine starting.

Cold-start unit shall be able to perform 6 (six) sequential engine start-up attempts, in the following cycle: 15 seconds starting, 15 seconds idle.

5.5.5.4 Cooling system

The diesel engine shall be furnished with cooling system, capable of cooling the engine operating at continuous, full generator load with 10% of assumed reserve. The cooling system shall be independent, and shall not require external connection of cooling liquid. Capacity of equalizing tank shall be sufficient for providing operation possibility in conditions as stated in point 4.2, for 8 hour period, without necessity for cooling liquid refilling.

The cooling system shall be equipped with thermostatic valve, located in the system between the engine and source of cooling liquid. The valve shall maintain cooling temperature according to manufacturer requirements and directions, at operating conditions as described in point 4.2. Set values for thermostatic valve shall be set by manufacturer / supplier of diesel generator unit.

The cooling system shall be equipped with centrifugal pump, mechanically driven (coupling with engine shaft), in order to ensure cooling liquid circulation in engine block, cylinder heads and cooler.

The cooling system shall be provided with cooler together with fan. The tube carrying away of cooling liquid from the engine shall be adequately insulated, in order to prevent burns of operating staff.

Maximum temperature on the cooler inlet for design purposes, shall be assumed according to environmental conditions, specified in p. 5.2.

Cooler fan shall be protected against direct touch by means of guard.

The cooling system shall be equipped with built-in heater controlled by thermostat, ensuring maintaining of adequate cooling liquid temperature (according to requirements of manufacturer) for idle periods, in order to provide adequate cooling conditions for moment of diesel generator starting.

5.5.5.5 Flue gases exhaust system

The flue exhaust system shall ensure removal of flue gases from the engine to outside of the container, while maintaining noise level according to p. 4..2. Exhaust pipe shall be made of material resistant to corrosion and equipped with spark trap. The terminal of exhaust pipe shall be equipped with rain cover, fastened on hinges in case of vertical mouth; otherwise the flue mouth shall be horizontal. All pipes shall be securely fastened, and in points of high vibration level springs or other dampers shall be used.

All points, where piping system are passing through walls or ceiling shall be armoured with metal ring.

Flue exhaust system shall be protected against possibility of accidental touching by operating staff.

5.5.5.6 Lubrication system

The engine shall be provided with oil pump, mechanically driven, delivering pressurized oil to main bearings, crankshaft, pistons, piston pins, timing gear system, timing gear system bearings, and valve rockers.

The engine design shall ensure adequate water- or air-cooling of oil, with built-in by-pass in main oil system. Cooling of oil shall be started by means of thermostat in the moment of allowed operating temperature exceeding.

Oil tank shall be made in form of oil sump located under engine crankcase. Oil filler, oil level probe, breather shall be embedded on the oil tank, and drain valve in bottom part of oil sump. The oil tank shall be equipped with electric heater controlled with thermostat, providing heating of oil up to temperature adequate for engine starting. Oil temperature shall be maintained on the level specified by manufacturer, enabling instantaneous engine start-up while at rest. The heater shall be installed outside the tank, thus enabling its maintenance or replacement without need for the tank opening. Oil temperature shall be maintained on constant level.

Oil filter shall be of typical design, providing possibility for easy replacement.

Provision of oil for first exchange after start-up, as well as supervision over this activity on diesel generator operating site, is included within the manufacturer / supplier scope of responsibility.

5.5.5.7 Fuel tank

The diesel generator shall be delivered jointly with fuel tank, of capacity sufficient for continuous operation at full load for at least 8 hours.

In case of diesel generator built in container, the fuel tank shall be located inside the container, with fuel filler located outside, in place easy accessible for operating staff.

In case of diesel generator without container-type housing, the fuel tank can be installed on the unit frame, or as free-standing.

The fuel tank shall be equipped with vent valve with flame suppressor, fuel level indicator on enclosure, connection of feed and outflow fuel pipes, inspection manhole, water drain connection of the tank, as well as protection against tank overfilling (overfill switch with automatic valve).

Hand operated cut-off valve shall be foreseen between the fuel tank and the engine.

All necessary equipment, as piping system, pump (if required), valves, venting, etc., shall be provided.

In case when separate main fuel tank shall be installed, then auxiliary fuel tank shall be installed on the unit structure, enabling short-term unit operation (0.5 hour.)

5.5.5.8 Air inlet and outlet

In case when diesel generator is installed in container or inside a building, then in order to ensure adequate airflow, air inlet and outlet openings are foreseen in walls of container or building.

Air inlet and outlet openings shall be equipped with:

- electrically controlled shutters
- protecting roof for rain protection purposes
- guards protecting against birds or animals penetration to inside

Air inlet shall additionally be provided with air filter, according to cleanness requirements for planned engine.

Air inlet shall be such located, so that flue gases penetration from engine exhaust system to inside would be precluded.

5.5.5.9 Protections of the engine

The engine shall be provided with the following protections:

- Against excessive speed increase
- Against excessive increase of cooling liquid temperature
- Against excessive increase of oil pressure
- Against excessive increase of oil temperature.

5.5.5.10 The engine nameplate

The engine shall be marked with durable dataplate, made according to valid regulations.

The data plate shall be made of stainless steel and fastened to non-removable frame part by means of stainless steel bolts.

The dataplate shall contain the following information:

- identification number
- manufacturer name
- engine model / serial number
- rated speed
- rated output
- time of rated operation at maximum load
- other rated data, characteristic of the equipment.

5.5.6 The generator

5.5.6.1 General requirements

Current generating unit will consist synchronous generator 2- or 4-pole synchronous generator according to standard of manufacturer, with cylindrical rotor, air-cooled, self-ventilating, rated voltage 400/230V, 3-phase, 50 Hz, power factor 0.8 at maximum load. All parameters must comply with data specified in data sheet (refer to Annex 1).

Neutral point of stator windings shall be led out and connected to PEN busbar, which shall divide into independent N and PE busbars. The generator shall be adapted to connection of power cable (cables) in 5-conductor system.

The generator shall be adapted to assembly on assembly frame together with diesel engine.

5.5.6.2 The rotor

The rotor shall be cylindrical, made of uniform steel forging of high-grade steel. Excitation windings of the generator shall be laid in milled grooves. A fan shall be mounted on the common shaft. The exciter shall be mounted on the generator shaft extension.

The rotor shall be supported on two rolling or slide bearings on both shaft ends. In case of slide bearings with forced lubrication, oil-lubricating system shall be provided.

Temperature control of rolling bearings shall be accomplished by means of PT-100 sensors.

The rotor shall be dynamically balanced.

5.5.6.3 The stator

- The stator enclosure shall have form of cylinder welded from steel sheets, and reinforced with longitudinal and transverse ribs, forming structural framework. Inside the structural framework a core shall be embedded, consisting of low lossiness, insulated, magnetic sheet pack. The windings shall be placed inside them. After completion of winding, the stator shall be impregnated.

5.5.6.4 The windings

The windings of stator shall be star arranged.

The windings shall be of copper, insulated according to manufacturer standard. The insulation shall ensure proper operation in conditions of high humidity and dustiness, aggressive gases and vapours, shall feature high resistance to mechanical stresses and shall not change its insulating properties in various temperatures during the whole lifetime period.

Temperature control of stator windings shall be performed by means of 6 (six) PT-100 sensors, 2 in each phase (1 operating, 1 reserve).

5.5.6.5 Excitation system

Brushless excitator is preferred, with rotating system of semiconductor rectifiers. Excitation system shall have protections against excessive increase of generated field intensity.

The exciter shall have its own cooling system (air – cooling – a fan, mounted on common shaft).

5.5.6.6 Voltage regulator

The voltage regulator shall be made in semiconductor technology. Its task is to maintain required value of output voltage, by continuous control of its value, and increasing or decreasing of current in excitation circuit, depending on its changes.

The voltage regulator shall enable to maintain output voltage in range of ±1% of set value, by means of excitation forcing in response to output voltage changes.

The voltage regulator shall have possibility of manual setting of output voltage value, within ± 5% range of rated voltage value.

Defect of voltage regulation system shall activate an alarm, and shall simultaneously set excitation current value on fixed value, set by manufacturer / supplier.

5.5.6.7 Anti-condensation heater

The generator shall be provided with anti-condensation heater, single-phase, 230V 50 Hz. The heater shall operate when the generator is at rest.

5.5.6.8 Junction boxes

The generator shall be equipped with the following junction boxes, at least of IP44 protection degree:

- main junction box:

The main junction box shall be predestined for power cables connection from the generator. Number of cables, their cross section and type, shall be each time specified in data sheet by GL SA

- junction box of main windings star connection

The connections of stator windings shall be led out in junction box. Free space shall be foreseen in junction box for installation of additional current transformers (if required).

Purposefulness of installation, as well as parameters of current transformers in stator windings' system, shall be each time agreed with GLSA.

It is independently required to install an additional, auxiliary junction box with terminals for connection of current transformer secondary windings.

- Junction box of PT-100 temperature sensors

All wires of windings and bearings temperature sensors shall be led out on terminal strip located in separate junction box.

- Other junction boxes

Other junction boxes shall be installed if required.

All junction boxes shall be provided with suitable number of terminals, sized adequately to foreseen cable connections. A terminal for earthing connection shall be foreseen in each junction box. All junction boxes shall be provided with metric cable glands. A number, size and type of cable glands depend on number of cables being connected – basing on data sheet – refer to Annex N° 1.

5.5.6.9 Protections of the generator

A multi-function, programmable protective device shall be installed in order to protect the generator, featuring the following functions:

- protection against change of energy flow direction (towards the generator)
- protection against overcurrents caused by external short-circuits
- protection against phase-to-phase short circuits in stator windings
- protection against interwinding short circuits
- protection against earth faults in stator winding
- protection against excessive increase or decrease of output voltage
- protection against loss of excitation
- protection against excessive increase or decrease of frequency
- windings' temperature control
- bearings' temperature control

5.5.6.10 Nameplates of the generator

The generator shall be marked with durable dataplate, made according to valid regulations.

The data plate shall be made of stainless steel and fastened to non-removable frame part by means of stainless steel bolts.

The dataplate shall contain the following information:

- identification number
- manufacturer name
- model / serial number
- insulation class
- rated speed
- rated output
- rated voltage
- rated frequency
- rated current and maximum current
- power factor
- protection degree
- time of rated operation at maximum load
- other rated data, characteristic for the equipment.
- connections diagram

5.5.7 Control panels

5.5.7.1 General requirements

The entire control accessories and auxiliary equipment, including measuring instruments and local alarms required for proper operation of current generation unit, shall be mounted in metal cabinets located, depending on diesel generator design:

- inside the container (in case of container enabling staff entrance to inside)
- On facade of the container (closed with glazed door, ensuring degree of protection according to p. 4.5.4).
- Built on diesel generator frame in case of power unit without container-type housing.

Front access to control cabinets shall be provided. All panels shall be equipped with anti-condensation heaters.

All cable connections shall be executed through cable glands.

All indicators, switches and lamps, located on facades of control panels shall be marked by means of durably fastened data plates according to their function, and labelled inside according to schematic diagrams.

Two solutions, regarding regulating and control elements of diesel generator are allowed:

- Common panel for the generator and the engine
- Separate panels for the generator and the engine

The requirements, specified separately for engine and generator panels, are given below.

5.5.7.2 Engine control panel

Engine control panel shall be provided with the following functions:

- An indicator and control of oil pressure (alarm + switch-off)
- An indicator and control of cooling liquid temperature (alarm + switch-off)
- An indicator and control of speed (alarm + switch-off)
- An indicator and control of oil temperature (alarm + switch-off)
- An ammeter of battery pack charging current
- An indicator of fuel level in tank and control of minimum level (alarm)
- Battery voltage voltmeter, and indicator of low battery voltage
- An indicator of cooling liquid level in equalizing tank
- Worktime meter
- Indicator of start-ups number
- Pilot lamps for alarm conditions

The engine control panel shall enable the following operations:

- Manual engine operating
- Automatic control

5.5.7.3 Generator control panel

The generator control panel shall be provided with the following control and measuring equipment:

- Control

On the front plate of panel the following equipment shall be located:

- control pushbuttons of generator
- control pushbuttons of circuit breaker
- position indicator for main contacts of circuit breaker
- speed governor with automatic/manual mode selector switch
- emergency shutdown pushbutton
- set of signalling lamps (LED) for indication of interferences
- test pushbutton for pilot lamps

- Measurements

All measured physical values listed below, can be represented by means of separate measuring instruments, or application of multifunction integrated electronic measuring device is possible as well.

Measuring instruments shall have minimum accuracy of 1.5%.

The following values shall be measured:

- current in each phase
- phase, and phase-to-phase voltages
- frequency

- watt power
- power factor
- voltage in excitation system
- watt energy

5.5.7.4 Cooperation with superior system (DCS, SAP, etc.)

The diesel generator shall be adapted to cooperation with superior system. The power unit shall feature possibility of control and monitoring.

- Binary signals

All binary signals shall be transmitted by means of isolated potential-free contacts.

Minimum list of signals being transmitted between current generating unit and superordinated system is presented below.

Signal	Contact operation	Description
1. Signals from superordinated system to diesel generator		
Permission to operate	Continuous	Closed = Permit, Open = Stop
Start	Pulse	Closing (min. 2s) = Start
Stop	Pulse	Opening (min. 2s) = Stop
2. Signals from diesel generator to superior system		
Operation	Continuous	Closed = Running, Open = Stop
Readiness	Continuous	Closed = Ready, Open = Not ready
Automatic/ manual operation	Continuous	Closed = Automatic mode of operation, Open = Manual mode of operation
Confirmation of rated parameters reaching after start-up	Continuous	Closed = Confirmed, Open = Not confirmed
Alarm (common)	Continuous	Closed= No alarm, Open = Alarm
Alarm – low fuel level in tank	Continuous	Closed= No alarm, Open = Alarm
Error / Defect (common)	Continuous	Closed = Correct state, Open = Error / Defect

- Analogue signals

In capacity of optional solution, transmission of analogue signals, representing measured values listed in p. 4.5.8.3 from diesel generator to superordinated system, is foreseen.

The following types of transmission are preferred:

- Analogue signals 4÷20mA
- Modbus
- Profibus
- Supplier dedicated types

Purposefulness of analogue signals transmission, their selection and type of data transmission, shall be each time adjusted with GL.

5.6 Painting

Factory painting standards for determined ambient conditions, according to environmental conditions specified in p. 4.2, shall be applied.

Final RAL colour shall be adjusted with GL.

5.7 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.

5.7.1 Inspection

Inspection of the diesel generator 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.

5.7.2 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.

In case when equipment parameters are measured during its operation, the tests shall be performed at least for 25%, 50%, 75%, 100% and 110% of rated load.

Below listed tests and trials shall be carried out at least, and confirmed with a certificate:

5.7.2.1 Mechanical tests and trials:

- easurement of bearing operating temperature
- vibrations level measurement
- fuel consumption measurement

- flue gases emission measurement
- rotational speed measurement
- torque measurement
- noise level measurement
- inspection of fuel, lubrication and cooling systems.

5.7.2.2 Electrical tests :

- load test of generator
- determination of voltage characteristics
- determination of frequency characteristics
- control of sequence and conformity of phases
- measurement of losses and efficiency values
- generator test at exceeded rated rotational speed
- dielectric strength tests
- measurement of insulation resistance
- measurement of windings resistance
- measurement of windings temperature

5.7.2.3 Functional tests and trials

- detailed simulation test of interlocks, alarms and emergency shutdown of diesel generator
- detailed simulation test for local operation of diesel generator
- detailed simulation test for remote operation of diesel generator

The supplier shall specify number and type of tests that have to be periodically performed for installed diesel generator.

5.7.3 Acceptance

Acceptance of the diesel generator 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.

5.7.4 Tests on site

The diesel generator shall be tested on installation site according to directions of erection and operating instruction.

5.8 Guarantee requirements

Main requirements regarding the guarantee are contained in purchase documentation. The guarantee shall include all equipment and instruments constituting elements of diesel generator equipment (including container, if constitutes item of delivery), for whole period of its usage.

5.9 Shipment

The diesel generator shall be protected in such a way, so that its damage in result of moisture penetration, improper handling during transport and outdoor storage would be avoided for one year period.

All equipment shall be protected for transport period. Particular attention shall be paid on protection of measuring instruments as well as control and steering devices.

Places of cable entrances into container (in case of container-type housing) shall be protected in such a way, so that degree of protection not worse than for the diesel generator container itself would be ensured.

Rotor of the generator shall be protected by placement of blocking in factory for transport period, so that damage of bearings would be prevented. The blocking shall be adequately marked, so that it would be easy to notice and remove during unit erection / start-up.

6 Other releted documents

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

7 Codes and standards

PN-EN 60034-1	Rotating electrical machines. Part 1: Rating and performance data.
PN-EN 60034-3	Rotating electrical machines. Part 3: Specific requirements for cylindrical rotor synchronous machines
PN-EN 60034-5	Rotating electrical machines. Part 5: Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code). Classification.
PN-EN 60034-6	Rotating electrical machines. Methods of cooling (IC code)
PN-EN 60034-7	Rotating electrical machines. Part 7: Classification of types of constructions and mounting arrangements (IM code)
PN-EN 60034-8	Rotating electrical machines. Part 8: Terminal markings and direction of rotation.
PN-EN 60034-9	Rotating electrical machines. Part 9: Noise level limits.
PN-EN 60034-11	Rotating electrical machines. Part 11: Thermal protection.
PN-EN 60034-16-1	Rotating electrical machines. Excitation systems for synchronous machines. Definitions.

PN-EN 60034-22	Rotating electrical machines. AC generators for reciprocating internal combustion (RIC) engine driven generating sets
PN-EN 60529	Degrees of protection provided by enclosures (IP Code)
PN-EN 60947	Low- voltage switchgear and controlgear
PN-EN 60439	Low-Voltage Switchgear and Controlgear Assemblies
PN-EN 60255	Electrical relays
PN-EN 50274	Low-voltage switchgear and controlgear assemblies. Protection against electric shock. Protection against unintentional direct contact with hazardous live parts
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.

Emergency diesel generators fabricated according to other norms and standards shall be submitted to GL for approval.

Shall any discrepancies arise between requirements of individual documents, then the following hierarchy of importance is to be observed:

- Polish regulations and GL requirements in force
- This specification
- Data sheets
- Other specifications
- Drawings and other documents
- Norms

8 Attachments

- Attachment No. 1, Data sheet

9 Record of changes

No.	Date	Description	Introduced by
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