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TECHNICAL SPECIFICATION

HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

DC POWER SUPPLY SYSTEM AND BATTERIES

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2 SCOPE AND OBJECTIVES

This Specification covers the minimum requirements for the design, supply and installation for DC power supply system and batteries for the buildings of the stations and pipelines of the natural gas transmission system.

3 REFERENCES

3.1 Reference Documents

DSF-SPC-ELE-015: Uninterruptible Power Supply System

3.2 Reference Codes and Standards

2014/34/EU	Equipment Explosive Atmospheres Directive
2014/35/EU	Low Voltage Directive
2014/30/EU	Electromagnetic Compatibility Directive
MINISTERIAL DECISION 50/12081/642/2006 F A – GG B / 1222/5.9.2006	Security Home Electrical Installations (E.I.E.). Introduction of a Differential Current Installation of Construction and Fundamental Grounding
ELOT EN 1594 E3	Gas Supply Systems. Pipelines for Maximum Operating Pressure over 16 bar. Functional Requirements
ELOT EN 14161+A1	Petroleum and Natural Gas Industries. Pipeline Transportation Systems
BS EN 62561-1:2017	Lightning protection system components (LPSC). Requirements for connection components
BS EN 62561-2:2012	Lightning Protection System Components (LPSC). Requirements for conductors and earth electrodes

BS EN 62561-3:2017	Lightning protection system components (LPSC). Requirements for isolating spark gaps (ISG)
BS EN 62561-4:2017	Lightning protection system components (LPSC). Requirements for conductor fasteners
BS EN 62561-5:2017	Lightning protection system components (LPSC). Requirements for earth electrode inspection housings and earth electrode seals
BS EN IEC 62561-6:2018	Lightning protection system components (LPSC). Requirements for lightning strike counters (LSC)
BS EN IEC 62561-7:2018	Lightning protection system components (LPSC). Requirements for earthing enhancing compounds
ELOT EN IEC 60079-0 E5	Electrical Apparatus for Explosive Gas Atmospheres - Part 0: General Requirements
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IEC 61643-12	Low Voltage Surge Protective Devices – Part 12: SPDs Connected to Low Voltage Power Distribution Systems – Selection and Application Principles
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IEC 62561-1	Lightning Protection Components (LPC), Part 1: Requirements for Connection Components
IEC 62561-2	Lightning Protection Components (LPC), Part 2: Requirements for Conductors and Earth Electrodes
IEC 62561-3	Lightning Protection Components (LPC), Part 3: Requirements for Isolating Spark Gaps
IEC 62561-4	Lightning Protection Components (LPC), Part 4: Requirements for Conductor Fasteners
IEC 62561-5	Lightning Protection Components (LPC), Part 5: Requirements for Earth Electrode Inspection Housings and Earth Electrode Seals
IEC 62561-6	Lightning Protection Components (LPC), Part 6: Requirements for Lightning Strike Counters

IEC 62561-7	Lightning Protection Components (LPC), Part 7: Requirements for Earthing Enhancing Compounds
ELOT EN 60071-1	Insulation Coordination – Definitions, Principles & Rules
ELOT EN 60071-2	Insulation Coordination – Application Guide
EN 60664-1	Insulation Coordination for equipment within Low Voltage Systems
IEC 61643-11	Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power distribution systems - Requirements and tests
EN 62040	Uninterruptible Power Systems (UPS)
IEC 61439	Low-voltage switchgear and control gear assemblies
EN 60086	Primary Batteries
EN 60146	Semiconductor Convertors - General Requirements and Line Commutated Convertors
EN 61439-3	Low-Voltage Switchgear and Control gear Assemblies - Part 3: Particular Requirements for Low-Voltage Switchgear and Control gear Assemblies
EN 61439-5	Low-Voltage Switchgear and Control gear Assemblies - Part 5: Particular Requirements for Assemblies intended to be Installed Outdoors in Public Places
EN 60896-22	Stationary Lead-Acid Batteries. Valve regulated types. Requirements.
EN 60947-6-1	Specification for Low-Voltage Switchgear & Control gear- Part 6-1: Multiple Function Equipment. Automatic Transfer Switching Equipment
EN 61557-12	Electrical Safety in Low Voltage Distribution Systems up to 1000 V AC and 1500 V D.C. - Equipment for Testing, Measuring or Monitoring of Protective Measures - Part 12: Performance Measuring and Monitoring Devices (PMD)
IEC 61439-1	Low-Voltage Switchgear and Control gear Assemblies- Part 1: General Rules

IEC 61439-2	Low-Voltage Switchgear and Control gear Assemblies-Part 2: Power Switchgear and Control gear Assemblies

4 ACRONYMS

AC	Alternating Current
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ATEX	ATmosphères EXplosibles (Explosive Atmospheres)
ATS	Automatic Transfer System
BMS	Building Management System
BVS	Block Valve Station
BCC	Back-up Control Centre at Nea Messimvria
CCTV	Closed Circuit Television System
CPR	Construction Products Regulation
CP	Cathodic Protection
CPU	Central Processor Unit
CS	Compressor Station
DB	Distribution Board
DC	Direct current
DCS	Distributed Control System
DEG	Detailed Engineering
DIN	Deutsches Institut für Normung (German Institute of Standardization)
DVA	Digital Voice Announcer
DVD	Digital Video Disc
EDG	Emergency Diesel Generator
ELOT	Hellenic Organization for Standardization

ELV	Extra Low Voltage (nominal voltage not exceeding 50 V AC or 120 V DC (ripple-free) between conductors or to earth, as defined by the Standard EN 61558)
EN	European Norms
EPC	Engineering, Procurement and Construction
EU	European Union
ESD	Emergency Shut Down
F&G	Fire and Gas
FACP	Fire Alarm Central Control Panel
FARP	Fire Alarm Repeater Control Panel
FAT	Factory Acceptance Test
FEG	Field Engineering
FC	Floe Computer
FOC	Fibre Optic Cable
GCC	Gas Control Centre at Patima
HEDNO	Hellenic Electricity Distribution Network Operator
HDPE	High Density Polyethylene
HMI	Human Machine Interface
HVAC	Heating Ventilation Air Conditioning
I/O	Input / Output
IEC	International Electrotechnical Commission
ISO	International Organization for Standarization
ITU	International Telecommunication Union
LAN	Local Area Network
LCS	Local Control System
LED	Light Emitting Diode
LFEP	Local Fire Detection & Fire Extinguishing Panel
LV	Low Voltage
LSP	Load Share Panel
MSC/MCS/SMC	Main Station Controller
MV	Medium Voltage

MPS	Master Project Schedule
MPR	Monthly Progress Report
NFPA	National Fire Protection Association
NNGTS	National Natural Gas Transmission System
NTSC	National Television System Committee
O&M	Operation and Maintenance
PID	Piping and Instrumentation Diagram
PA/GA	Public Address / General Alarm
PCS	Process Control System
PED	Pressure Equipment Directive
PEP	Project Execution Plan
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
PMS	Power Management System
POC	Project Organization Chart
PAL	Phase Alternate Line
PPC	Public Power Corporation
PTZ	Pan, Tilt, Zoom
PVC	Poly Vinyl Chloride
QA	Quality Assurance
RCC	Remote Communications and Controls
RFI	Radio Frequency Interference
RTD	Resistance Temperature Detectors
RTU	Remote terminal Unit
S/S	Scraper Station
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition (including Telemetry)
SCS	Station Control System
SFP	Small Form-factor Pluggable
SPD	Surge Protection Device
SPL	Sound Pressure Level

UDP	User Datagram Protocol
UPS	Uninterruptible Power Supply
UV	Ultraviolet
VGA	Video Graphics Array
VMS	Video Management Software

5 DC POWER SUPPLY SYSTEM AND BATTERIES DESIGN

5.1 General

The DC power supply systems and batteries may be used for the uninterruptible power supply of the following circuits (where applicable):

- control circuits for the motorized circuit breakers of the low voltage and medium voltage switchboards
- other control circuits inside low voltage and medium voltage switchboards and control & instrumentation panels
- protection circuits inside low voltage and medium voltage switchboards and control & instrumentation panels
- alarm circuits and indicating lamps circuits inside low voltage and medium voltage switchboards and control & instrumentation panels
- street lighting fixtures circuits powered by solar panel kits

The Supplier of each of the above-mentioned switchboards and panels shall provide the necessary DC power supply system(s) for the equipment included in his scope of work.
The output voltage of each DC System shall be either 110 V DC or 24 V DC or any other output voltage, depending on the supplied circuit. This shall be defined by Supplier for each circuit. As a general principle, the control voltage for the motorized circuit breakers of the

low voltage and medium voltage switchboards shall be 110 V DC and the control voltage for the control & instrumentation panels shall be 24 V DC.

DC power supply system and batteries shall be rated according to the sum of the rated loads connected to them plus a 20% margin (unless otherwise specified).

For DC power supply system and batteries cabinets design, technical specification for Low Voltage Switchboards shall be taken into consideration.

Cables shall be sized in accordance with technical specification for Cables and Cable Routing.

5.2 Battery Design and Sizing

The batteries (where required) shall be of low internal resistance, each consisting of the proper number of identical cells, providing an uninterruptible power supply to the relevant circuits (see paragraph 5.1).

The number of cells and the cell capacity of each battery, even after 15 years of operation, shall be such as required to ensure the safe supply of the relevant circuits.

Supplier(s) shall calculate the capacity and the electrical characteristics of the batteries included in his (their) scope of supply, by determining the discharge time and the characteristics of the loads to be supplied. Contractor shall provide all information about characteristics of the loads, where required.

The calculations must take into account an ageing factor equal to 1.25 for lead acid batteries.

The voltage must remain within the limits of the rated voltage +10%/-12% at the battery clamps.

The batteries shall be sealed (maintenance free) lead acid type (unless otherwise specified or required), sized for at most 10 hours discharge, after having reached a level of 1.8 V/cell up to full capacity.

Only when the batteries are “boost charged” the voltage may exceed the above limits. The voltage per cent at the end of the discharge period shall not be less than 1.8 V for lead acid batteries.

The ampere-hour capacity of each battery cell refers to, at least, N hours discharge rate, where N ≥ 10 hours for lead acid batteries.

Sufficient to supply all necessary D.C. loads for minimum 10 hours within voltage limits +/- 10%.

The batteries shall be protected by suitably selected fuses or circuit breakers. In case that fuses shall be selected, the use a fused load break switch is preferable.

5.3 Rectifier / Charger Design and Sizing

Each rectifier / charger shall be solid state and shall convert the AC power to DC. It shall be furnished with full wave thyristor bridges and it shall be of the completely automatic voltage-regulated type. In case of cathodic protection system, chargers are not applicable.

Each rectifier / charger shall perform the following three operation modes:

- The DC power supply to the loads, charging simultaneously the batteries with Float Charging.
- The DC power supply to the loads, charging simultaneously the batteries with Boost Charging. The duration of the boost charging can be programmed manually by the Control Panel of the cubicle.
- Manual charging of the batteries, required as initial charging etc.

The rectifiers / chargers shall be equipped with an automatically and manually change – over device for float and boost charging (adjustable for different loads).

Voltage adjusting control and load switches for the input, as well as contactors, locally manually and automatically operated, for the output circuits shall be installed in the cubicles of the rectifiers / chargers.

The charging process shall be affected by a constant current / constant voltage characteristic with high temperature stability and shall feature the following characteristics for lead acid batteries:

Initial and boost charging: 2.4 – 2.6 V/cell (adjustable).

Float charging operation: ≈2.23 V/cell (adjustable) in a range 2.0 – 2.4 V/cell.

The recharging time of the battery, after having reached a level of 1.8 V/cell up to full capacity shall not exceed 10 hours.

To take into account the decreasing on battery efficiency, the rectifiers / chargers shall be rated at least 10% greater than the normally required rating.

5.4 Documentation

During detail design, the following drawings and documents shall be developed and submitted to the Client for review, but not limited to:

- Calculations for DC Power Supply System Sizing
- Calculations for Battery Back-Up Sizing
- One Line diagrams for DC Power Supply System and Batteries
- DC Power Supply System and Batteries Layout drawings
- Material Requisition for DC Power Supply System and Batteries

5.4.1 Calculations for DC Power Supply System Sizing

Calculations for each DC Power Supply System Sizing shall be provided, so as that DC Power Supply System should have the capacity to supply all essential loads that have been mentioned in paragraph 5.1 and 5.3.

5.4.2 Calculations for Battery Back-Up Sizing

Calculations for each Battery Back-Up System Sizing shall be provided, in order to fulfil the requirements that have been mentioned in paragraph 5.1 and 5.2.

5.4.3 One Line Diagrams for DC Power Supply System and Batteries

The one Line Diagram for each DC Power Supply System and Batteries shall include the following information, as a minimum:

- Symmetrical short circuit current on which design is based
- Types, quantities and rated current of fuses and switches

- Battery Charger voltage and power output
- Batteries voltage and capacity
- Types and cross-sections of cables feeding DC Power Supply System and batteries

5.4.4 DC Power Supply System and Batteries Layout Drawings

Regarding DC Power Supply System and Batteries layout drawings the following information shall be provided, as a minimum:

- Location of DC Power Supply System and Batteries
- Information about types and cross-sections of feeding cables and their Routing

5.4.5 Material Requisition for DC Power Supply System and Batteries

Material Requisition for DC Power Supply System and Batteries shall provide the whole information about technical characteristics, special requirements, quantity of DC Power Supply System and Batteries etc, is needed for the supply of DC Power Supply System and Batteries.

6 SUPPLY OF DC POWER SUPPLY SYSTEM AND BATTERIES

6.1 General

Supply of each DC power supply system and batteries shall include, but not limited to, procurement planning, purchasing, expediting, inspection and testing, spare parts procurement, packaging, shipment, transportation and delivery at site.

Each DC power supply system and batteries shall be selected to comply with the latest editions of relevant EU Directives, Greek Legislation, European Standards and International Codes or Standards, as well as relevant project job specifications or requirements specified in other project documents or drawings.

Therefore, all latest approval revisions of relevant project documents and drawings shall be forwarded to Supplier(s).

Apart from DC power supply systems and batteries, Supplier(s) shall submit to the Client their documentation package consisting of necessary drawings and data to cover project requirements.

Procurement of each DC power supply system and batteries shall be performed in accordance with technical specification for Supply of Electrical Equipment and Materials.

6.2 Shop Inspection and Testing

Electrical Examination and/or testing shall be as per applicable Codes and Specifications, including EN 60146 and EN 60896-22, as well as IEC 61439-1 and IEC 61439-2.

DC power supply system and batteries must have a CE conformity mark, according to EU Directives 2014/35/EU and 2014/30/EU.

The manufacturer of DC power supply system and batteries should have a Quality Assurance System ELOT EN ISO 9001 E4 for the DC power supply system and batteries construction and assembly.

During fabrication and testing, Manufacturer's Quality Department must perform all the required inspection activities.

After final inspection at Manufacturer's Workshops, the Manufacturer shall release copies of test certificates, as imposed by the applicable codes or specifications to the Client and/or the Contractor.

7 TECHNICAL CHARACTERISTICS, INSTALLATION AND CONNECTIONS

7.1 Responsibility

Contractor shall provide labour, supervision, appropriate tools, equipment, consumables, services and all materials and accessories necessary for each DC power supply system and batteries installation and connections. It is Contractor’s responsibility to execute each DC power supply system and batteries installation and connections according to approved detail design drawings and documents, as have been described in paragraph 5.4 of this specification, as well as all relevant specifications and applicable codes and standards.

Contractor's engineers are responsible for:

- receipt and visual check for damages or omissions of each DC power supply system and batteries.
- visual inspection of the execution of each DC power supply system and batteries installation and connections with reference to the applicable Project's Specifications.
- performing all works according to the safety requirements set by the Supplier and the Local Authorities.
- keeping the corresponding quality records for erection works and examination procedures.
- ensuring the quality of any remedial works that are essential to take place.

7.2 General Notes for DC power supply system and batteries

The batteries (where required) shall be sealed (maintenance free) lead acid type and their containers shall be made of semi-transparent polycarbonate material.

The batteries cells shall be installed on steel racks, provided with adequate acid-proof protection, with polyethylene coated steel strips to support the cells. The racks shall be supplied by the relevant Supplier to facilitate the mounting of the batteries.

Depending on the battery's capacity and physical dimensions, it is also possible to be included in a well-ventilated free-standing cubicle.

The rectifiers/chargers shall be installed in well-ventilated free-standing cubicles, next to those of the relevant batteries.

Supplier must provide information about the ventilation requirements, as well as the necessary space requirements for the battery cells and the rectifiers/chargers installation.

Alternatively, the DC power supply system may be delivered as a separate panel with charger unit, battery and power facilities included, depending on the batteries capacity and physical dimensions.

DC power supply system and batteries panels shall be constructed in accordance with technical specification for Low Voltage Switchboards.

The DC power supply system shall be fed via two separate feeders from UPS. Each feeder shall have each own dedicated circuit breaker. Besides, each feeder shall be supplied by 2 DC power supply units with the additionally batteries back up system.

Cables and cable routing material installation, as well as cable installation accessories and connections related to DC power supply system and batteries shall be in accordance with technical specification for Cables and Cable Routing.

Earthing and lightning protection of each DC power supply system and batteries shall be in accordance with technical specification for Earthing and Lightning Protection System (DSF-SPC-ELE-016) and applicable codes and standards.

7.3 Rectifier / Charger

As it has already been mentioned, each rectifier / charger shall be solid state and shall convert the AC power to DC. It shall be furnished with full wave thyristor bridges and it shall be of the completely automatic voltage-regulated type. In case of cathodic protection system, chargers are not applicable.

Each rectifier / charger shall perform the three operation modes state that have been mentioned in paragraph 5.3.

Rectifiers / chargers shall be adequately protected against overload and short circuit.

7.4 Batteries

The batteries shall be lead acid, sealed type, sized for 10 hours discharge.

Sufficient to supply all necessary D.C. loads for minimum 10 hours within voltage limits +/- 10%. Supplier shall specify the prospective short circuit current at the battery terminals at the following conditions:

- Battery charged
- Battery at the end of discharge

The batteries shall be protected by suitably selected fuses or circuit breakers. In case that fuses shall be selected, the use a fused load break switch is preferable.

7.5 Alarm System

The D.C. power supply shall include an alarm system (where required) with the following main alarms:

- 400/230 V A.C. system supply failure alarm
- Charger unit fault alarm
- High output voltage alarm
- Low output voltage alarm

The system supply failure alarm shall be activated by relays monitoring all the supply phases.

The charger unit fault alarm shall be a common alarm for the standard monitoring equipment of the charger unit.

All the above-mentioned alarms shall be indicated on the front of the D.C. panel.

7.6 Performance Data

Unless otherwise specified, the following performance data shall apply:

RECTIFIER / BATTERY CHARGER	
MANUFACTURER	*
TYPE	*
IP Rating	ELOT EN 60529: IP32 *

Supply Earthing	Yes (TN-S)
Noise Limit	50 dbA at 1 m
Rated Input AC Voltage (at frequency)	400V or 230V (at 50 Hz)
Input Voltage Range	±15%
Rated Output DC Voltage	As per paragraph 5.1
Rated Output DC Voltage Tolerance	±1%
Output Voltage Ripple (with or without battery connected)	≤2%
Overload for 60 sec	≥150% of rated current
Overload for 600 sec	≥125% of rated current
Rated Peak Current Withstand	≥280% of rated current
Load Duty Identification (acc. to EN 60146)	1.25/10 – 1.50/60 – 2.8 - B
Power Factor at Rated Input	≥0.8

BATTERIES	
MANUFACTURER	*
TYPE	*
Battery Type	Sealed (VRLA) *
Quantity	*
AH Rating	AH at 25ºC *
Voltage	V *
Life Expectancy	15 Y *
Discharge Time	(as per paragraph 7.4) *
Charge Operation	Rapid / Float *
Banks	% *
Enclosure	Rack
Dimensions (w x h x d) in mm	____ x ____ x ____ *
Weight	Kg *

GENERAL NOTES: * These data must be filled in by the Supplier in his Technical Offer.

7.7 Field Inspection and Testing

Field inspection and testing of DC power supply system and batteries shall be carried out by properly qualified and experienced personnel with calibrated test equipment provided by the Contractor.

Field inspection and testing shall also be witnessed by Client Representative.

Inspection and testing shall be according to project documentation or / and applicable codes and standards. Minimum test requirements are described below.

DC power supply system and batteries panel inspection and testing shall be in accordance with technical specification for Low Voltage Switchboards.

Charge and discharge tests on each battery and on each battery and charger unit shall be performed.

All alarms and safety trips shall be tested for correct operation.

A complete record of all tests that shall be carried out and their results shall be retained.

7.8 As-Built Documentation

At the completion of the works, a copy of all related project drawings, where all modifications and variations marked in red, shall be provided to Client Representative and as-built drawings shall be issued.