# **EZP.270.75.2023**

# **Volume III SWZ – Order discription**

**„Delivery of DC Power Supplies dedicated for the PolFEL line accelerator with division to parts.”**

**Technical Specification of the DC Magnet Power Supplies dedicated for the Free Electron Laser PolFEL**

1. Introduction

National Centre for Nuclear Studies represents a leading scientific institution performing fundamental and interdisciplinary applicable research. It operates advanced and unique scientific and technological infrastructure. Performed studies are dedicated for:

* Nuclear physic and high energy physics, astrophysics, plasma physics and fusion engineering
* Materials science and engineering oriented for materials interactions with radiation studies dedicated for functional modifications and endurance improvement against highly radioactive environments and other degrading agents
* Biophysics and radio-chemistry, radio-pharmaceutics production
* Computer science, computations, complex system modelling, big data processing

Polfel is an experimental scientific facility included electromagnetic radiation sources: THz FEL and optical laser sources of high harmonic VUV beams, and electron beam source for time resolved ultrafast diffraction of high-energy electrons, as well as for high-energy electron beams applications in other experiments. DC power supplies will be used in electron optic systems of both PolFEL accelerators.

1. Plant Utilities available at PolFEL hall

The following system utilities and conditions shall be available in PolFEL hall for use by the PS. The PSs shall be designed to operate within the constraints of those systems and conditions.

* + Main power: 400/230 VAC 50Hz, TN-S-system.
	+ In a long term the supply voltage varies within ± 10% range around nominal value.
	+ In the time shorter than half of period, the supply voltage may change by less than 1.5%.
	+ Ambient Temperature: 15 to 35 °C (21°C +/- 5°C normal).
	+ Ambient air Humidity 5 - 75 % RH.

Power supplies should be furnished with screws for grounding bar installation.

1. Scope of Supply

The subject of the order is the supply of DC power supplies in accordance with parts 1-6 presented in Table 1.

The Contractor is obliged to provide the DC Power Supplies System (DCPSS) listed in Table 1, together with the equipment necessary to start up and connect to the accelerator control system.

Table 1. Assignment list

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Part** | **Model** | **Q-ty** | **Purpose** | **Current range** | **Voltage range** |
| Part 1 | Model 1 | 11 | Small correctors | 0 A - 6 A | 0 V - 20 V |
| Model 2 | 19 | Large correctors, small quadrupoles, undulator coils | 0 A - 15 A | 0 V - 15 V |
| Part 2 | Model 3 | 2 | Small dipoles (spectrometer , dogleg) | 0 A - 10 A | 0 V - 20 V |
| Part 3 | Model 4 | 13 | Large quadrupoles (linac optics) | 0 A - 50 A | 0 V - 18 V |
| Model 5 | 3 | Large dipoles (compressor and dump bend) | 0 A - 45 A | 0 V - 35 V |
| Part 4 | Model 6 | 5 | Solenoids | 0 A - 90 A | 0 V - 70 V |
| Part 5 | Model 7 | 1 | Main power for BLM | 0 A - 10 A | 0 V - 20 V |
| Part 6 | Model 8 | ≤4 | Control BLM | 0 A - 1 A | 0 V - 5 V |

Current and voltage ranges cannot be narrower than those listed in Table 1.

Order execution, for all Assignments, shall proceed in two steps:

Step 1. Presentation of the Inspection Report performed of the fully assembled power supplies within 15 weeks from the date of signing the contract

Step 2. Delivery of power supplies within 20 weeks from the date of signing the contract

* 1. Part 1

The matter of the contract are power supplies for normal conducting electromagnets and solenoids:

* 11 pcs PS providing current range at least 0 A – 6 A and voltage range at least 0 V – 20 V, for small correctors
* 19 pcs PS providing current range at least 0 A – 15 A and voltage range at least 0 V – 15 V, for large correctors and small quadrupoles and undulator correction coils

Table 2. List of minimal general requirements for power supplies in part 1.

|  |  |  |
| --- | --- | --- |
| **Parameter of performance** | **Requirement** | **Vendor declaration** |
| Output | Model 1 current range | Must contain 0 A - 6 A |  |
| Model 1 voltage range | Must contain 0 V - 20 V |  |
| Model 2 current range | Must contain 0 A - 15 A |  |
| Model 2 voltage range | Must contain 0 V - 15 V |  |
| Input (Mains) | AC single phase 50-60 Hz  | 230 V |  |
| Regulation | Setup accuracy in CC in linear range 0- Imax | ≤ 6∙10-4 ∙Imax |  |
| Efficiency at full load AC 230 V input  | ≥0.81 |  |
| Ripples and nose (at full load) | rms for the range of BW=300 kHz) CV | ≤ 4∙10-5 ∙Umax |  |
| p-p (for the range of BW=50 MHz) CV | ≤ 1.6∙10-4 ∙ Umax |  |
| rms (for the range of BW=300 kHz) CC | ≤ 5∙10-4 ∙ Imax |  |
| p-p (for the range of BW=50 MHz) CC | ≤ 2.5∙10-3 ∙ Imax |  |
| Temperature coefficient, per 1°C | CV | ≤ 3.5.10-5 |  |
| CC | ≤ 0.10-5 |  |
| Long term stability (measured after 1 h warm-up) | CV | ≤6·10-5 |  |
| CC | ≤ 9·10-5 |  |
| Monitoring output |  | Yes |  |
| Status output |  | * CC operation
* CV operation
* Voltage limit
* Input failure AC (Mains)
* Output failure DC
 |  |
| Remote shutdown | Yes |  |
| Interlock |  | Yes, emergency shutdown input  |  |
| Front panel indicators | * CC operation
* CV operation
* voltage limit at CC
* current limit at CV
* output enabled
 |  |
| Front panel switches | * Mains on/ off
* remote/local
* Output on/off
 |  |
| Programming switch | Rising time U do 0.9 Umax | ≤ 50 ms |  |
| Decay time U do 0.1 Umax | ≤ 200 ms |  |
| Input impedance  | CV, 0-1 kHz | ≤ 2 mΩ |  |
| CV 1-100 kHz | ≤ 30 mΩ |  |
| Insulation | input / case | ≥ 1000 Vrms |  |
| output / case | ≥ 500 V DC |  |
| Safety standards |  | EN 60950 / EN 61010 |  |
| EMC power supplies standardsGeneric EmissionGeneric Immunity | EN 61204-3,Residential, light industrial environment CISPR 22EN 61000-6-3, residential emission, light industrial environment (EN 55022 B)EN 61000-6-2, industrial environment |  |
| Operation temperature | 0 to + 40 °C |  |
| Temperature protection | Automatic shutdown while cooling failure |  |
| Mean Time Between Failures | > 450 000 h |  |

3.1.1. Control Interface

To ensure communication, a controller must meet the following criteria (allowing the solution to be modular and compatible with the software):

* It has an Ethernet interface controlled by commands using the SCPI/Modbus TCP protocol
* Powered with 230 V/ 50 Hz mains, endurable while voltage falls up to 200 ms long
* Enabling operation status monitoring: current and voltage limits, temperature limits, input and output malfunctions
* Providing at least 16-bits for programming accuracy and monitoring parameters

3.1.2. Inspections and tests

The following inspections will be performed before the delivery

* + - Visual internal and external inspection.
		- Control functions shall be exercised through all states.
		- All interlock functions shall be checked for proper operation and indications. All fault status indicators shall latch until reset.
		- After the PS’s warm up period, the regulation and reproducibility of the PS shall be measured at a minimum of four output values spanning the PS working range, operating for a period of 8 hours for each value.
		- Heat checking shall be done on all critical components at 110% load conditions.
		- Control interface reliability tests.
		- Control interface performance tests.
		- Insulation test
		- Current stability measurement in short term – 10 s (ripples) and long term 10 h.
		- Repeatability of current and voltage setting measurements using external gauges.

The supplier shall submit documentation reporting the performed inspections.

3.1.3. Documentation required

3.1.3.1. Documentation to be provided with the offer:

* PS technical description
* Control system interface/protocol (description with list of commands)

3.1.1.2. Documentation to be provided on Delivery of the PS.

The Supplier shall supply the following documents as part of the PS delivery.

* Block diagrams.
* Operation and maintenance manuals.
* Source code for any PLC (Programmable Logic Controller) software, if used.
* Terms of warranty

The documentation shall describe the final (as-built) configuration of the PS.

All documentation shall be in Polish or English.

3.1.4. Other requirements

The supplier shall provide adequate packaging for safe transport and storage of the PS´s.

The PSs shall have a metal nameplate including the following information

* + - Manufacturer’s name and address
		- Equipment type and serial number
		- Output voltage and current ratings
		- Production date
	1. Part 2

The matter of the contract are power supplies for normal conducting electromagnets and solenoids:

* + 2 pcs PS providing current range at least 0 A – 10 A and voltage range at least 0 V – 20 V, for small dipoles

Table 3. List of minimal general requirements for power supplies in part 2.

|  |  |  |
| --- | --- | --- |
| **Parameter of performance** | **Requirement** | **Vendor declaration** |
| Output | Model 3 current range | Must contain 0 A - 10 A |  |
| Model 3 voltage range | Must contain 0 V - 20 V |  |
| Input (Mains) | AC single phase 50-60 Hz  | 230 V |  |
| Regulation | Setup accuracy in CC in linear range 0- Imax | ≤ 4∙10-4 ∙Imax |  |
| Efficiency at full load AC 230 V input  | ≥0.81 |  |
| Ripples and nose (at full load) | rms for the range of BW=300 kHz) CV | ≤ 4∙10-5 ∙Umax |  |
| p-p (for the range of BW=50 MHz) CV | ≤ 1.6∙10-4 ∙ Umax |  |
| rms (for the range of BW=300 kHz) CC | ≤ 5∙10-4 ∙ Imax |  |
| p-p (for the range of BW=50 MHz) CC | ≤ 2.5∙10-3 ∙ Imax |  |
| Temperature coefficient, per 1°C | CV | ≤ 3.5.10-5 |  |
| CC | ≤ 6.0·10-5 |  |
| Long term stability (measured after 1 h warm up) | CV | ≤6·10-5 |  |
| CC | ≤ 9·10-5 |  |
| Monitoring output |  | Yes |  |
| Status output |  | * CC operation
* CV operation
* Voltage limit
* Input failure AC (mains)
* Output failure DC
 |  |
| Remote shutdown | Yes |  |
| Interlock |  | Yes, emergency shutdown input  |  |
| Front panel indicators | * CC operation
* CV operation
* voltage limit at CC
* current limit at CV
* output enabled
 |  |
| Front panel switches | * Mains on/ off
* remote/local
* Output on/off
 |  |
| Programming switch | Rising time U do 0.9 Umax | ≤ 50 ms |  |
| Decay time U do 0.1 Umax | ≤ 200 ms |  |
| Input impedance | CV, 0-1 kHz | ≤ 2 mΩ |  |
| CV 1-100 kHz | ≤ 30 mΩ |  |
| Insulation | input / case | ≥ 1000 Vrms |  |
| output / case | ≥ 500 V DC |  |
| Safety standards |  | EN 60950 / EN 61010 |  |
| EMC power supplies standardsGeneric EmissionGeneric Immunity | EN 61204-3,Residential, light industrial environment CISPR 22EN 61000-6-3, residential emission, light industrial environment (EN 55022 B)EN 61000-6-2, industrial environment |  |
| Operation temperature | 0 to + 40 °C |  |
| Temperature protection | Automatic shutdown while cooling failure |  |
| Mean Time Between Failures | > 450 000 h |  |

3.2.1. Control Interface

To ensure communication, a controller must meet the following criteria (allowing the solution to be modular and compatible with the software):

* It has an Ethernet interface controlled by commands using the SCPI/Modbus TCP protocol
* Powered with 230 V/ 50 Hz mains, endurable while voltage falls up to 200 ms long
* Enabling operation status monitoring: current and voltage limits, temperature limits, input and output malfunctions
* Providing at least 16-bits for programming accuracy and monitoring parameters

3.2.2. Inspections and tests

The following inspections will be performed before the delivery

* + - Visual internal and external inspection.
		- Control functions shall be exercised through all states.
		- All interlock functions shall be checked for proper operation and indications. All fault status indicators shall latch until reset.
		- After the PS’s warm up period, the regulation and reproducibility of the PS shall be measured at a minimum of four output values spanning the PS working range, operating for a period of 8 hours for each value.
		- Heat checking shall be done on all critical components at 110% load conditions.
		- Control interface reliability tests.
		- Control interface performance tests.
		- Insulation test
		- Current stability measurement in short term – 10 s (ripples) and long term 10 h.
		- Repeatability of current and voltage setting measurements using external gauges.

The supplier shall submit documentation reporting the performed inspections.

3.2.3. Documentation required

3.2.3.1. Documentation to be provided with the offer

* PS technical description
* Control system interface/protocol (description with list of commands)

3.2.1.2. Documentation to be provided on Delivery of the PS.

The Supplier shall supply the following documents as part of the PS delivery.

* Block diagrams.
* Operation and maintenance manuals.
* Source code for any PLC (Programmable Logic Controller) software, if used.
* Terms of warranty

The documentation shall describe the final (as-built) configuration of the PS.

All documentation shall be in Polish or English.

3.2.4. Other requirements

The supplier shall provide an adequate packaging for safe transport and storage of the PS´s.

The PS’s shall have a metal nameplate including the following information printed:

* + - Manufacturer’s name and address
		- Equipment type and serial number
		- Output voltage and current ratings
		- Production date
	1. Part 3

The matter of the contract are power supplies for normal conducting electromagnets and solenoids:

* + 3 pcs PS providing current range at least 0 A – 50 A and voltage range at least 0 V – 18 V, for large quadrupoles
	+ 3 pcs PS providing current range at least 0 A – 45 A and voltage range at least 0 V – 35 V, for large dipoles

Table 4. List of minimal general requirements for power supplies in part 3.

|  |  |  |
| --- | --- | --- |
| **Parameter of performance** | **Requirement** | **Vendor declaration** |
| Output | Model 4 current range | Must contain 0 A - 50 A |  |
| Model 4 voltage range | Must contain 0 V - 18 V |  |
| Model 5 current range | Must contain 0 A - 45 A |  |
| Model 5 voltage range | Must contain 0 V - 35 V |  |
| Input (Mains) | AC single phase 50-60 Hz | 230 V |  |
| Regulation | Setup accuracy in CC in linear range 0- Imax | ≤2∙10-4 ∙Imax |  |
| Efficiency at full load AC 230 V input  | ≥ 0.81 |  |
| Ripples and nose (at full load) | rms for the range of BW=300 kHz) CV | ≤ 4∙10-5 ∙Umax |  |
| p-p (for the range of BW=50 MHz) CV | ≤ 1.6∙10-4 ∙ Umax |  |
| rms (for the range of BW=300 kHz) CC | ≤ 5∙10-4 ∙ Imax |  |
| p-p (for the range of BW=50 MHz) CC | ≤ 2.5∙10-3 ∙ Imax |  |
| Temperature coefficient, per 1°C | CV | ≤ 3.5.10-5 |  |
| CC | ≤ 6.0.10-5 |  |
| Long term stability (measured after 1 h warm up) | CV | ≤ 6·10-5 |  |
| CC | ≤ 9·10-5 |  |
| Monitoring output |  | Yes |  |
| Status output |  | * CC operation
* CV operation
* Voltage limit
* Input failure AC (mains)
* Output failure DC
 |  |
| Remote shutdown | Yes |  |
| Interlock |  | Yes, emergency shutdown input  |  |
| Front panel indicators | * CC operation
* CV operation
* voltage limit at CC
* current limit at CV
* output enabled
 |  |
| Front panel switches | * Mains on/ off
* remote/local
* Output on/off
 |  |
| Programming switch | Rising time U do 0.9 Umax | ≤ 50 ms |  |
| Decay time U do 0.1 Umax | ≤ 200 ms |  |
| Input impedance  | CV, 0-1 kHz | ≤ 2 mΩ |  |
| CV 1-100 kHz | ≤ 30 mΩ |  |
| Insulation | input / case | ≥ 1000 Vrms |  |
| output / case | ≥ 500 V DC |  |
| Safety standards |  | EN 60950 / EN 61010 |  |
| EMC power supplies standardsGeneric EmissionGeneric Immunity | EN 61204-3,Residential, light industrial environment CISPR 22EN 61000-6-3, residential emission, light industrial environment (EN 55022 B)EN 61000-6-2, industrial environment |  |
| Operation temperature | 0 to + 40 °C |  |
| Temperature protection | Automatic shutdown while cooling failure |  |
| Mean Time Between Failures | > 450 000 h |  |

3.3.1. Control Interface

To ensure communication, a controller must meet the following criteria (allowing the solution to be modular and compatible with the software):

* It has an Ethernet interface controlled by commands using the SCPI/Modbus TCP protocol
* Powered with 230 V/ 50 Hz mains, endurable while voltage falls up to 200 ms long
* Enabling operation status monitoring: current and voltage limits, temperature limits, input and output malfunctions
* Providing at least 16-bits for programming accuracy and monitoring parameters

3.3.2. Inspections and tests

The following inspections will be performed before the delivery

* + - Visual internal and external inspection.
		- Control functions shall be exercised through all states.
		- All interlock functions shall be checked for proper operation and indications. All fault status indicators shall latch until reset.
		- After the PS’s warm up period, the regulation and reproducibility of the PS shall be measured at a minimum of four output values spanning the PS working range, operating for a period of 8 hours for each value.
		- Heat checking shall be done on all critical components at 110% load conditions.
		- Control interface reliability tests.
		- Control interface performance tests.
		- Insulation test
		- Current stability measurement in short term – 10 s (ripples) and long term 10 h.
		- Repeatability of current and voltage setting measurements using external gauges.

The supplier shall submit documentation reporting the performed inspections.

3.3.3. Documentation required

3.3.3.1. Documentation to be provided with the offer

* PS technical description
* Control system interface/protocol (description with list of commands)

3.3.1.2. Documentation to be provided on Delivery of the PS.

The Supplier shall supply the following documents as part of the PS delivery.

* Block diagrams.
* Operation and maintenance manuals.
* Source code for any PLC (Programmable Logic Controller) software, if used.
* Terms of warranty

The documentation shall describe the final (as-built) configuration of the PS.

All documentation shall be in Polish or English.

3.3.4. Other requirements

The supplier shall provide an adequate packaging for safe transport and storage of the PS´s.

The PS’s shall have a metal nameplate including the following information printed:

* + - Manufacturer’s name and address
		- Equipment type and serial number
		- Output voltage and current ratings
		- Production date
	1. Part 4

The matter of the contract are power supplies for normal conducting electromagnets and solenoids:

* + 5 pcs PS providing current range at least 0 A – 90 A and voltage range at least 0 V – 70 V, for small dipoles

Table 5. List of minimal general requirements for power supplies in part 4.

|  |  |  |
| --- | --- | --- |
| **Parameter of performance** | **Requirement** | **Vendor declaration** |
| Output | Model 6 current range | Must contain 0 A - 90 A |  |
| Model 6 voltage range | Must contain 0 V - 70 V |  |
| Input (Mains) | AC triple phase 50-60 Hz  | 400 V |  |
| Regulation | Setup accuracy in CV in linear range 0- Umax | ≤ 10-4 ∙Umax |  |
| Setup accuracy in CC in linear range 0- Imax | ≤ 2∙10-4 ∙Imax |  |
| Efficiency at full load AC 230 V input  | ≥0.81 |  |
| Ripples and nose (at full load) | rms for the range of BW=300 kHz) CV | ≤ 4∙10-5 ∙Umax |  |
| p-p (for the range of BW=50 MHz) CV | ≤ 1.6∙10-4 ∙ Umax |  |
| rms (for the range of BW=300 kHz) CC | ≤ 5∙10-4 ∙ Imax |  |
| p-p (for the range of BW=50 MHz) CC | ≤ 2.5∙10-3 ∙ Imax |  |
| Temperature coefficient, per 1°C | CV | ≤ 3.5.10-5 |  |
| CC | ≤ 6.0·10-5 |  |
| Long term stability (measured after 1 h warm up) | CV | ≤6·10-5 |  |
| CC | ≤ 9·10-5 |  |
| Monitoring output |  | Yes |  |
| Status output |  | * CC operation
* CV operation
* Voltage limit
* Input failure AC (mains)
* Output failure DC
 |  |
| Remote shutdown | Yes |  |
| Interlock |  | Yes, emergency shutdown input  |  |
| Front panel indicators | * CC operation
* CV operation
* voltage limit at CC
* current limit at CV
* output enabled
 |  |
| Front panel switches | * Mains on/ off
* remote/local
* Output on/off
 |  |
| Programming switch | Rising time U do 0.9 Umax | ≤ 50 ms |  |
| Decay time U do 0.1 Umax | ≤ 200 ms |  |
| Input impedance  | CV, 0-1 kHz | ≤ 2 mΩ |  |
| CV 1-100 kHz | ≤ 30 mΩ |  |
| Insulation | input / case | ≥ 1000 Vrms |  |
| output / case | ≥ 500 V DC |  |
| Safety standards |  | EN 60950 / EN 61010 |  |
| EMC power supplies standardsGeneric EmissionGeneric Immunity | EN 61204-3,Residential, light industrial environment CISPR 22EN 61000-6-3, residential emission, light industrial environment (EN 55022 B)EN 61000-6-2, industrial environment |  |
| Operation temperature | 0 to + 40 °C |  |
| Temperature protection | Automatic shutdown while cooling failure |  |
| Mean Time Between Failures | > 450 000 h |  |

3.4.1. Control Interface

To ensure communication, a controller must meet the following criteria (allowing the solution to be modular and compatible with the software):

* It has an Ethernet interface controlled by commands using the SCPI/Modbus TCP protocol
* Powered with 230 V/ 50 Hz mains, endurable while voltage falls up to 200 ms long
* Enabling operation status monitoring: current and voltage limits, temperature limits, input and output malfunctions
* Providing at least 16-bits for programming accuracy and monitoring parameters

3.4.2. Inspections and tests

The following inspections will be performed before the delivery

* + - Visual internal and external inspection.
		- Control functions shall be exercised through all states.
		- All interlock functions shall be checked for proper operation and indications. All fault status indicators shall latch until reset.
		- After the PS’s warm up period, the regulation and reproducibility of the PS shall be measured at a minimum of four output values spanning the PS working range, operating for a period of 8 hours for each value.
		- Heat checking shall be done on all critical components at 110% load conditions.
		- Control interface reliability tests.
		- Control interface performance tests.
		- Insulation test
		- Current stability measurement in short term – 10 s (ripples) and long term 10 h.
		- Repeatability of current and voltage setting measurements using external gauges.

The supplier shall submit documentation reporting the performed inspections.

3.4.3. Documentation required

3.4.3.1. Documentation to be provided with the offer

* PS technical description
* Control system interface/protocol (description with list of commands)

3.4.1.2. Documentation to be provided on Delivery of the PS.

The Supplier shall supply the following documents as part of the PS delivery.

* Block diagrams.
* Operation and maintenance manuals.
* Source code for any PLC (Programmable Logic Controller) software, if used.
* Terms of warranty

The documentation shall describe the final (as-built) configuration of the PS.

All documentation shall be in Polish or English.

3.4.4. Other requirements

The supplier shall provide an adequate packaging for safe transport and storage of the PS´s.

The PS’s shall have a metal nameplate including the following information printed:

* + - Manufacturer’s name and address
		- Equipment type and serial number
		- Output voltage and current ratings
		- Production date
	1. Part 5

The matter of the contract are power supplies for normal conducting electromagnets and solenoids:

* + 1 pcs PS providing current range at least 0 A – 10 A and voltage range at least 0 V – 20 V, for small dipoles

Table 6. List of minimal general requirements for power supplies in part 5.

|  |  |  |
| --- | --- | --- |
| **Parameter of performance** | **Requirement** | **Vendor declaration** |
| Output | Model 7 current range | Must contain 0 A - 10 A |  |
| Model 7 voltage range | Must contain 0 V - 20 V |  |
| Input (Mains) | AC single phase 50-60 Hz | 230 V |  |
| Regulation | Setup accuracy in CV in linear range 0- Umax | ≤ 1∙10-2 ∙V |  |
| Efficiency at full load AC 230 V input  | ≥0.81 |  |
| Ripples and nose (at full load) | rms for the range of BW=300 kHz) CV | ≤ 1∙10-2 V |  |
| Output number |  | At least one |  |
| Mounting standard |  | Rack |  |
| Control interface | Type | LAN |  |
| Outputs control | Independent |  |
| Output monitoring | Yes |  |

3.5.1. Control Interface

To ensure communication, a controller must meet the following criteria (allowing the solution to be modular and compatible with the software):

* It has an Ethernet interface controlled by commands using the SCPI/Modbus TCP protocol
* Powered with 230 V/ 50 Hz mains, endurable while voltage falls up to 200 ms long
* Enabling operation status monitoring: current and voltage limits, temperature limits, input and output malfunctions
* Providing at least 16-bits for programming accuracy and monitoring parameters

3.5.2. Inspections and tests

The following inspections will be performed before the delivery

* + - Visual internal and external inspection.
		- Control functions shall be exercised through all states.
		- All interlock functions shall be checked for proper operation and indications. All fault status indicators shall latch until reset.
		- After the PS’s warm up period, the regulation and reproducibility of the PS shall be measured at a minimum of four output values spanning the PS working range, operating for a period of 8 hours for each value.
		- Heat checking shall be done on all critical components at 110% load conditions.
		- Control interface reliability tests.
		- Control interface performance tests.
		- Insulation test
		- Current stability measurement in short term – 10 s (ripples) and long term 10 h.
		- Repeatability of current and voltage setting measurements using external gauges.

The supplier shall submit documentation reporting the performed inspections.

3.5.3. Documentation required

3.5.3.1. Documentation to be provided with the offer

* PS technical description
* Control system interface/protocol (description with list of commands)

3.5.1.2. Documentation to be provided on Delivery of the PS.

The Supplier shall supply the following documents as part of the PS delivery.

* Block diagrams.
* Operation and maintenance manuals.
* Source code for any PLC (Programmable Logic Controller) software, if used.
* Terms of warranty

The documentation shall describe the final (as-built) configuration of the PS.

All documentation shall be in Polish or English.

3.5.4. Other requirements

The supplier shall provide an adequate packaging for safe transport and storage of the PS´s.

The PS’s shall have a metal nameplate including the following information printed:

* + - Manufacturer’s name and address
		- Equipment type and serial number
		- Output voltage and current ratings
		- Production date
	1. Part 6

The matter of the contract are power supplies for normal conducting electromagnets and solenoids:

* + maximum 4 pcs PS that have in total minimum 12 outputs providing current range at least 0 A – 1 A and voltage range at least 0 V – 5 V, for small dipoles

Table 7. List of minimal general requirements for power supplies in part 6.

|  |  |  |
| --- | --- | --- |
| **Parameter of performance** | **Requirement** | **Vendor declaration** |
| Output | Model 8 current range | Must contain 0 A - 1 A |  |
| Model 8 voltage range | Must contain 0 V - 5 V |  |
| Input (Mains) | AC single phase 50-60 Hz  | 230 V |  |
| Regulation | Setup accuracy in CV in linear range 0- Umax | ≤ 1∙10-2 ∙V |  |
| Efficiency at full load AC 230 V input  | ≥0.81 |  |
| Ripples and nose (at full load) | rms for the range of BW=300 kHz) CV | ≤ 1∙10-2 V |  |
| Output number |  | ≥ 3 outputs (Model 8 power supplies must have together minimum 12 outputs) |  |
| Mounting standard |  | Rack |  |
| Control interface | Type | LAN, and RS232 optionally |  |
| Outputs control | Independent |  |
| Output monitoring | Yes |  |

3.2.1. Control Interface

To ensure communication, a controller must meet the following criteria (allowing the solution to be modular and compatible with the software):

* It has an Ethernet interface controlled by commands using the SCPI/Modbus TCP protocol
* Powered with 230 V/ 50 Hz mains, endurable while voltage falls up to 200 ms long
* Enabling operation status monitoring: current and voltage limits, temperature limits, input and output malfunctions
* Providing at least 16-bits for programming accuracy and monitoring parameters

3.2.2. Inspections and tests

The following inspections will be performed before the delivery

* + - Visual internal and external inspection.
		- Control functions shall be exercised through all states.
		- All interlock functions shall be checked for proper operation and indications. All fault status indicators shall latch until reset.
		- After the PS’s warm up period, the regulation and reproducibility of the PS shall be measured at a minimum of four output values spanning the PS working range, operating for a period of 8 hours for each value.
		- Heat checking shall be done on all critical components at 110% load conditions.
		- Control interface reliability tests.
		- Control interface performance tests.
		- Insulation test
		- Current stability measurement in short term – 10 s (ripples) and long term 10 h.
		- Repeatability of current and voltage setting measurements using external gauges.

The supplier shall submit documentation reporting the performed inspections.

3.6.3. Documentation required

3.6.3.1. Documentation to be provided with the offer

* PS technical description
* Control system interface/protocol (description with list of commands)

3.6.1.2. Documentation to be provided on Delivery of the PS.

The Supplier shall supply the following documents as part of the PS delivery.

* Block diagrams.
* Operation and maintenance manuals.
* Source code for any PLC (Programmable Logic Controller) software, if used.
* Terms of warranty

The documentation shall describe the final (as-built) configuration of the PS.

All documentation shall be in Polish or English.

3.6.4. Other requirements

The supplier shall provide an adequate packaging for safe transport and storage of the PS´s.

The PS’s shall have a metal nameplate including the following information printed:

* + - Manufacturer’s name and address
		- Equipment type and serial number
		- Output voltage and current ratings
		- Production date