ELKPROJEKT SP Z O.O.
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Electrical power installations

Name	**TECHNICAL DESIGN**
Project subject:	**Construction of a container-based energy storage facility consisting of a transformer-inverter station and a battery storage facility, along with the construction of a foundation slab and associated technical infrastructure, in Jasin, Swarzędz commune**
Address of the building:	Plot no. 307/19, precinct 0006 Jasin, Swarzędz Commune, Poznań County
- name of the registration unit - name and number of the cadastral district - cadastral plot numbers on which the facility is located	Plot no. 307/19, precinct 0006 Jasin, Swarzędz Commune, Poznań County
Name and address of the Investor:	**CLIP Logistyka Sp. z o.o. Jasin, Rabowicka 65, 62-020 Swarzędz**

Scope:	Design function performed:	**Designer**	Date:	Signature:
ELECTRICAL INSTALLATIONS	**Designer** Authorization number	MSc Eng Maciej Śliwa Unlimited design authorization in the field of installation of electrical and power grids, installations, and equipment Reg. No. WKP/0188/POOE/11	May 12, 2025	Podpisane elektronicznie przez Maciej Jan Śliwa (Certyfikat kwalifikowany) w dniu 2025-05-16.
ELECTRICAL INSTALLATIONS	**Supervising designer** Authorization number	MSc Eng Przemysław Konieczka Unlimited design authorization in the installation specialty of electrical and power grids, installations, and equipment Reg. No. WKP/0387/POOE/13	May 12, 2025	Elektronicznie podpisany przez: Przemys aw T masz Konieczka Data: 2025-5-16 9:5: 2

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TECHNICAL CALCULATIONS

- Power balance
- Selection of the type and cross-section of cables
- Overload coordination
- Voltage drop
- Fault loop impedance
- Checking the fast overcurrent shutdown
- Occlusal coordination

ATTACHMENTS

- Technical conditions for connecting the installation to the power grid no. WTE-CL-W-0002/25 of April 24, 2025
- Decisions on the professional training of designers
- Certificate of the designers' membership in the Polish Chamber of Civil Engineers
- YKXS cable catalog card

Drawings:

E-1. Area development plan
E-2. Floor plan of the warehouse
E-3. Technological diagram of the 2 MW, 515 MWh energy storage
E-4. Electrical diagram of the energy storage
E-5. RG-nN-0.4kV power supply diagram
E-6. Construction of the RG-nN-0.4 kV switchgear

TECHNICAL DESCRIPTION

refers to: **Design of electrical installations and modernization of the power supply system for "Construction of a container-based energy storage facility consisting of a transformer-inverter station and a battery storage facility, along with the construction of a foundation slab and accompanying technical infrastructure in Jasin, Swarzędz commune"**

1. *Basis of the study*

- architectural and construction design
- technological design
- site visit to the facility
- applicable standards and regulations

2. *General characteristics, power supply*

The planned electricity storage facility with the parameters of 2 MW 5.15 MWh 0.4kV will be located next to the existing storage hall no. 6 in accordance with the presented hall plan and site plan in the town of Jasin, Swarzędz commune, plot no. 307/19.
To power the planned 2MW energy storage facility, the power system in this warehouse will be modernized.
The scope of modernization of the power system of warehouse hall no. 7:

- The 1250 KVA transformer will be replaced with a 2500 KVA one (dry type with resin insulation)
- A new RG-nN-0.4kV switchgear is planned, receiving power from a transformer with a rated current of In = 3600 A. The connection of the above switchgear to the transformer will be made via a KTA 4000 A busbar
- The electricity distribution switchboard for the warehouse will be connected to the new RG-nN-0.4 kV switchboard and replaced with a new one with a higher short-circuit power
- The R-solar switchboard supporting the photovoltaic installation system will be connected to the new RG-nN-0.4 kV switchboard

3. *Transformer station*

In hall 4a there are transformer stations, consisting of a 15 kV MV switchgear, a transformer chamber, and a 0.4kV LV main switchgear. The 1250 KVA transformer is being replaced with a 2500 KVA transformer (dry type with resin insulation)

4. *MV-15 kV switchgear*

The transformer station has an existing MV-15 kV switchgear equipped with line bays, the transformer bays (circuit breaker) of the MV-15 kV switchgear are not subject to modernization.

5. *Transformer*

The transformer station contains a 1250 KVA resin transformer in a meshed space. It will be replaced with a new 2500 KVA transformer (dry type with resin insulation). Given the new transformer power loss conditions of $\Delta P = 25$ kW, a new ventilation (cooling) system for the transformer station must be selected to remove the ~25 kW of heat generated by the transformer. The above guideline applies to the ventilation industry, for selecting a cooling system for the transformer chamber.

6. Main switchboard RG-nN-0.4 kV

A new RG-LV-0.4 kV main switchboard with an In current of 3600 A has been designed for the transformer station. The switchboard will be connected to the transformer's low-voltage terminals via KTA 4000 A busbars. The switchboards will contain a section supplying power to the equipment before the fire switch and a section switched off by the fire button. The LV-0.4 kV main switchboards will contain measurement systems for energy transmission billing. These systems must be suitable for sealing by the Distribution System Operator (DSO).

7. Fire protection principles for the designed facility

7.1. Fire protection circuit breaker

Fire shutdowns in the facility will be implemented using disconnect switches and circuit breakers with voltage releases installed in the RG-nN-0.4 kV switchboard. Fire shutdown buttons compatible with the switches will be located at the main entrances to the building. Fire shutdown buttons with readiness and fire shutdown activation signals should be used.
The fire shutdown will cover the entire facility, leaving only the fire safety equipment energized.
Fire alarm switch circuits will be equipped with FLAME-X 950 (N)HXH FE180/90 fire-resistant cables, routed along PH90 cable routes and attached to walls and ceilings using certified brackets.
Install the buttons in boxes with an IP54 protection rating and a glass door marked "FIRE PROTECTION POWER SWITCH." The fire protection power switch system should have the appropriate certificates and/or approvals for use in construction.

7.2. Cable passages through fire zones

All installation penetrations between fire zones should be sealed with Hilti foam with a fire resistance of EI120 min, e.g. CP611 or CP620, or similar fire-resistant agents. All penetrations through partitions with a fire resistance class of REI60/EI60 and higher shall be protected up to the class of the partition they pass through.

7.3. Fire protection of container energy storage

The planned 2 MW, 5.15 MWh, 0.4 kV electrical energy storage facility will be equipped with a gas fire suppression system and will be prepared for connection to a water system and sprinkler system. The energy storage facility will be enclosed by walls and a ceiling with a fire resistance of REI 120.

8. Internal power lines

Internal power lines will be run towards the distribution boards, using YKXS cables in the TN-S system. The cables will be run on cable ladders in a horizontal arrangement in the warehouse.
The safety devices will be powered from the existing fire protection system using FLAME-X 950 (N)HXH FE180/90 cables installed in fire-resistant cable trays and on the plaster using fire-resistant brackets. All cable penetrations through partition walls must be sealed to prevent noise transmission. Cables and wires powering rooftop devices should be installed on cable ladders with full covers and in UV-resistant conduits. Ladders and conduits should be attached to the ventilation equipment's supporting structure and/or concrete blocks. Electrical installation penetrations through fire partitions and building components with a specified fire resistance rating should be sealed with a fire resistance material equivalent to the fire resistance of the fire partition or building component.

9. Warehouse receiving switchboards

The warehouse distribution boards will be connected with cable lines according to the power supply diagram. The switchboard structures and equipment should be replaced with new ones adapted to the new power supply conditions and short-circuit power of the power system.

10. Energy storage 2 MW 5.15 MWh 0.4kV

10.1. Battery System

The battery system is built around modular MS-B3 battery cabinets, enabling custom system configuration. For this system, one battery string is used in the battery container. The number of strings depends on the energy storage capacity. The maximum number of strings in a container is 10.

The battery string consists of 32 battery modules. The battery modules consist of series-connected LFP battery cells in an 8S2P configuration. The total number of cells connected in series in the string is 256. The battery modules are housed in MS-B3 cabinets, ensuring adequate insulation. The battery string is connected to the SOZ storage disconnector system.

- LFP ESS cell parameters*:*
  - Nominal voltage of the LFP ESS UN cell = 3.2 V
  - Maximum voltage of the LFP ESS cell UMAX= 3.65 V
  - Minimum voltage of the LFP ESS cell UMIN = 2.7 V
  - Nominal capacity of the LFP ESS EN cell = 314 Ah

- Parameters of the 8S2P battery module
  - Nominal voltage of the LFP ESS module UN = 8 x 3.2 V = 25.6 V
  - Maximum voltage of the LFP ESS cell UMAX= 8 x 3.65 V = 29.2 V
  - Minimum voltage of the LFP ESS cell UMIN = 8 x 2.7 V = 21.6 V
  - Nominal capacity of the LFP ESS EN cell = 2 x 314 Ah = 628 Ah

- Battery chain voltage parameters
  - Nominal chain voltage NCU = 32 x 25.6 V = 819.2 V
  - Maximum chain voltage MAXCU = 32 x 29.2V = 934.4 V
  - Minimum chain voltage MINCU = 32 x 21.6 V = 691.2 V
  - Total chain energy TCE = 819.2 V x 628 Ah = 514.46 kWh
  - Total chain energy available TCEA = K x NCU = 463.01 kWh (for K = 0.9)
  - K = from 0.8 to 1

- System parameters
  - One battery container in a container of 10 chains
  - Total energy of the ECS system = 10 x TCE = 5144.6 kWh
  - Total system energy available TSEA = 10 x TCEA = 4630.1 kWh
  - Total system energy on the AC side nn ECSnn = 0.97 x TSEA = 4491.2 kWh
  - The Contractor reserves the right to use other lithium-ion cell modules with parameters for the system that meet the requirements of the tender specifications

10.2. Cover

The energy storage unit consists of a 3 x 10 m battery container. The number depends on the total storage capacity.

Container walls with thermal and fire insulation made of mineral wool.

The battery container contains battery cabinets with disconnectors and contactors for individual battery strings. The battery container is equipped with air conditioning and lighting

.
Each battery string is equipped with an insulation monitoring system, which uses a DC-side insulation condition monitor to monitor both poles based on polarity current analysis. External access to all containers is provided through external doors.

10.3. BMS system compatible with battery system

The BMS system is based on a solution from MY-SOFT. The supplied BMS system can monitor the parameters of individual battery cells. The scope of monitored functional parameters of a battery cell includes the measurement of:
- voltage of each cell,
- current of each string, input and output,
- temperature of each cell.

Monitoring also includes the following parameters of the battery system and individual battery modules:
- SoC,
- SoH,
- number of cycles completed so far,
- maximum and average power consumed and output in a given time period, insulation condition of cells and intermediary devices.

This system meets all the requirements described in the Ordering Party's request for proposals.
The converters, as per the attached catalog card, are housed in a separate container along with the transformer system.
We reserve the right to modify the presented technical solution at the design and implementation stage without compromising the technical parameters while meeting the technical requirements.

11. Power supply installation for technological devices

This installation includes power supply for 3-phase and 1-phase technological devices such as:

- ventilation and air conditioning devices
- sterilizers
- aggregates
- power supply for heating cables

Cables in the TN-S system should be laid on cable trays in the space above the suspended ceiling, and in the room under the plaster.

12. Protection against electric shock

The installation was designed in accordance with PN-HD 60364-4-41
Additional protection against electric shock includes:

- protective earthing system – applies to the transformer station network
- automatic power off after 0.4 s – applies to technological and lighting receiving circuits
- automatic power off in 0.4 s supported by class A differential circuit breakers with a sensitivity of 30 mA – applies to other receiving circuits such as: connection sockets, anti-icing systems, circuits in wet rooms, circuits in boiler rooms, etc.
- accessible conductive parts are protected.

13. Basic equipotential bonding system

Connect this system to the existing equipotential bonding bus. From the local equipotential bonding bus, extend the bus using a YKY 25rm cable with yellow-green insulation and equipotential bonding terminals made of CU40*10 mm copper flat bar. The terminals should be mounted near the technical equipment on the roof.

The equipotential bonding terminals should be connected to:

- ventilation and air conditioning installations
- water and sewage installations
- central heating installations
- gas and medical gas installations
- other installations made of conductive materials
- supporting structures for electrical and telecommunication installations
- structures for ventilation units
- sheath of high-voltage cables of the lightning protection system
- other conductive building elements

As connecting cables to the above-mentioned external conductive elements, use yellow-green YKY16rm cables.

14. Overvoltage protection

In accordance with PN-IEC60364 and Journal of Laws No. 75 with subsequent amendments, overvoltage protection will be designed.

- In main distribution boards, combined type 1 surge arresters, compliant with PN-EN 61643-11, equipped with non-extinguishing spark gaps, must be used. The arresters must have the following parameters:
  - Maximum continuous operating voltage: 264 V AC.
  - Voltage protection level: ≤ 1.5 kV.
  - Surge current (10/350 μs): 100 kA.
  - AC follow current quenching capacity: 50 kAeff.
  - With an expected short circuit current of up to 100 kAeff, selective operation with a 20 A gL/gG fuse.
  - Energy coordination according to PN-EN 62305-4 with SPD type 2 and type 3 as well as with the terminal device.
- In the receiving distribution boards, type 2 surge arresters (according to PN-EN 61643-11) must be used. The arresters must have the following parameters:
  - Maximum continuous operating voltage: 275 V AC (50/60 Hz) / 350 V DC.
  - Voltage protection level: ≤ 1.5 kV.
  - Nominal discharge current: 20 kA (8/20 μs).
  - Short circuit strength at max. fuse: 50 kAeff.
  - Energy coordination according to PN-EN 62305-4 with SPD type 1 and type 3.

15. Working and protective earthing

For the transformer, separate operational earthing is provided using foundation earthing or a Galmar type vertical earthing electrode.
For the transformer station, a protective earth electrode will be used using foundation earthing.
For protective grounding, control terminals should be used.

16. Concluding remarks

- Before starting electrical work, the contractor should familiarize himself with the industry documentation.
- All work must be carried out in accordance with the technical design and applicable standards, regulations and ordinances.
- Strict coordination between industries is essential when constructing electrical mains.
- All technological devices must be connected by specialist companies. Failure to do so may void the warranty on the devices.
- Before putting the electrical installation into operation, appropriate measurements should be performed to confirm their correctness, test reports should be prepared and the user should be informed about the need to test the differential circuit breakers monthly.

- The selected devices are exemplary and illustrative, and equivalent devices with equivalent or better technical parameters can be used.
- The detailed design should be agreed with a fire protection expert.

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