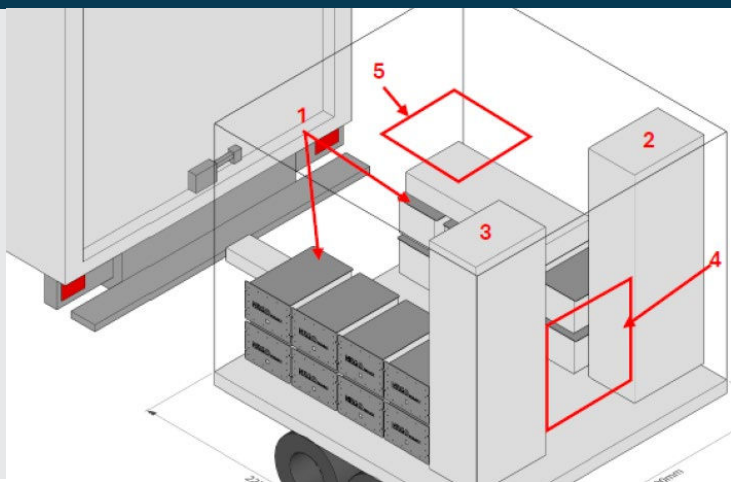
SUCCESS CASE 28.2025

Intelligent System for Stabilising the Operation of Temporary Power Supply in a Grid with Concentrated Prosumer Participation



THE CHALLENGE

The most important duty of a DSO is **safeguarding the uninterrupted supply of electricity** to institutions and consumers for whom a power outage in the power grid may cause a threat to human life or health, a serious risk to the environment, as well as significant material damage. Therefore, **DSOs must strive to reduce the SAIDI** (System Average Interruption Duration Index) **and SAIFI** (System Average Interruption Frequency Index) blackout rates.

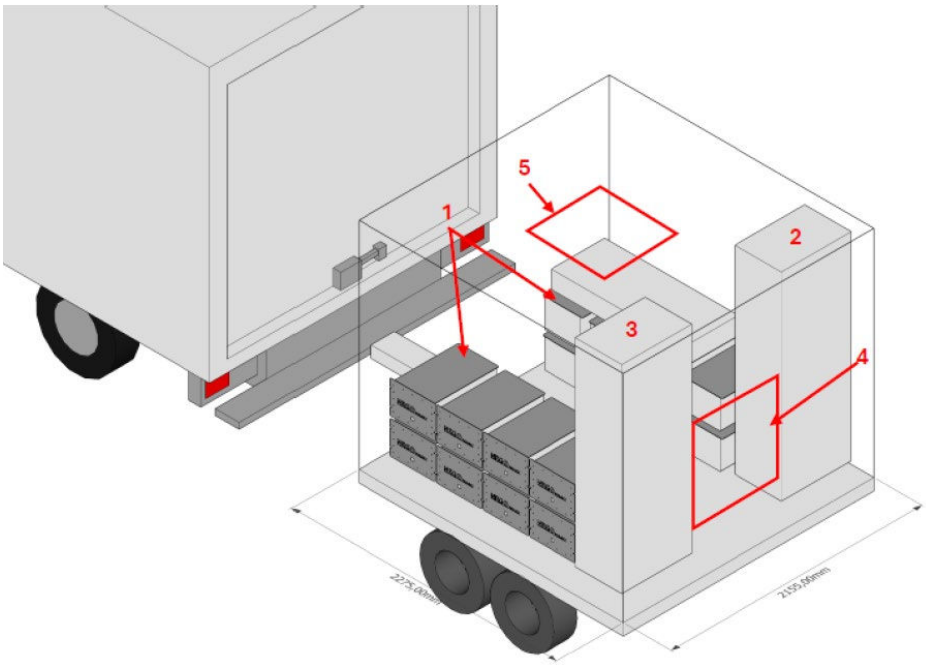
In 2022, the use of PGE Dystrybucja's generators reduced the SAIDI index by a value of 26.6 minutes per customer. However, further reduction of the index through generator operation is becoming increasingly difficult, while **growing prosumer installations can cause disruptions in generator operation and result in an increase in the index**. In fact, during the power supply from the generator, the installed photovoltaic (PV) units switch on, producing a recovery voltage which turns off the circuit supplied by the generator. As a result, maintenance work is carried out without supplying power to consumers despite the activation of the generators, which is not compatible with the trends set for DSOs by the Polish Energy Regulatory Office (URE). On the other hand, the use of mobile energy storage as an alternative solution would entail high costs and difficulties in transport due to its large mass.

In addition to this challenge, Polish legislation requires that the voltage value in the grid must be kept in the range of 230/400 V +/- 10% (rated values according to PN-IEC 60038; single-phase voltage 230 V and three-phase voltage 400 V). Hence, the integration of distributed energy sources in the distribution network tends to be a major challenge when it comes to supplying consumers with an alternative power source, such as a generator.

THE SOLUTION

For years, generators have played a key role in providing backup power. However, under conditions

of high energy production by prosumers, their operation might be disrupted, leading to voltage problems and shutdowns. To overcome these challenges, PGE Dystrybucja developed an **intelligent system for stabilising the operation of temporary power supply** and ensuring continuous and efficient operation of power generators.



Arrangement of components in the battery section of the stabilisation system: (1) battery + BCU, (2) inverter, (3) switchgear, (4) control panel, and (5) air conditioning. Source: Own materials of PGE Dystrybucja.

The designed and implemented device is an innovative stabilisation system, which allows for **adjusting the generator's operation to current grid conditions**. Thanks to the use of a bi-directional inverter, battery modules and an energy management system, the solution enables the storage of excess energy and its effective use. Thus, the system provides **an uninterrupted source of power when performing maintenance work on grids** with high penetration of renewable energy sources (RES), thanks to the coupling of the energy storage system and the power generator. The entire system consists of two mobile units, a power generator and a storage/battery section. The **modularity of the unit** (generator + grid stabilisation system) increases the **versatility of application and mobility of the overall solution**. The grid stabilisation system part consists of 16 battery modules capable of storing 122.88 kWh of energy, the operation of which is managed by a battery control unit (BCU), a bidirectional inverter with a rated power of 60 kVA, a switchgear, a control panel showing a graphic representation of the operating status, and the air conditioning necessary when using lithium cells.

The inverter's three-level topology allows for the independent power control of each phase. It also has LCL input filters to improve total harmonic distortion (THD) coefficients of harmonic currents and voltages.

The device will be used in case of **emergency or planned disconnection of transformer stations**. In locations with high concentrations of prosumers, which have been affected by incidents of power generator shutdowns caused by voltage fluctuations, the presented technology eliminates the problem of generator destabilisation and prevents shutdowns resulting from voltage changes in the grid. The compact and mobile design allows for the system to be **quickly deployed in areas where emergency power supply is required**, making it a flexible tool suited to the real needs of power operators.

MAIN ACHIEVEMENTS

Currently, there are no ready-made devices on the market that can replace the presented solution. The purchase of a typical energy storage system could not solve the most important problem of the presented challenge, consisting in the stabilisation of the operating parameters of the network in the power supply scheme: *Generator - Distribution grid - PV installations*.

The implementation of this solution brings tangible benefits to both PGE Dystrybucja and the energy consumers. Ensuring a stable electricity supply results in the **increased reliability of the grid** and the **minimisation of power outages**. In turn, by decreasing outages, the quality of service is improved, and the **operational costs associated with the maintenance and operation of emergency systems** and the **need to pay compensation** for undelivered energy **are reduced**. Lastly, the implementation of the smart stabilisation system contributes to fulfilling the stringent requirements of the Quality Regulation document of 2018-2025 for Distribution System Operators, improving the power quality indicators SAIDI and SAIFI.