The GSL energy liquid cooling energy storage system operated stably during the extremely cold winter in Ukraine

CHINA, April 11, 2026 /EINPresswire.com/ -- Deploying energy storage systems in cold-winter regions poses challenges that often extend beyond mere installation completion. The core difficulty lies in achieving long-term stable operation in sub-zero environments. Cold temperature can affect cell activity and charge/discharge capabilities, while also potentially introducing engineering challenges such as condensation, moisture build-up, and thermal stress differentials, placing higher demands on the thermal management and control strategies of the storage system.

Outdoor installation of the GSL ENERGY 418kWh liquid-cooled battery cabinet in Ukraine, operating under winter low-temperature and snow-covered conditions.

System Monitoring Interface Real-time monitoring data showing stable internal battery temperatures and automatic heating response during winter low-temperature operation in Ukraine.

This case study showcases the GSL ENERGY liquid-cooling energy storage system (160kW / 418kWh) deployed at a customer site in Ukraine, where the inverter is installed indoors, and the battery cabinets are deployed outdoors. Under the local winter conditions of sustained low temperatures and snow/ice coverage, the system has maintained stable operation. The battery's internal heating and operational monitoring data have shown favorable performance.

I. Project Overview

The project site will be at low temperatures throughout the winter, requiring the energy storage equipment to operate long-term under outdoor severe conditions. During the planning phase, the customer explicitly stated the following requirements:
The energy storage batteries must support long-term outdoor operation.
The system must possess stable charge/discharge capabilities in low-temperature conditions.
Temperature control and operational status must be monitorable and traceable to facilitate future O&M management.
Based on site conditions and O&M needs, the project ultimately adopted a solution with the PCS inverter installed indoors and the battery energy storage system independently deployed outdoors. This ensured system stability while enhancing the flexibility of project implementation and future maintenance.

II. System Configuration
System Specification: 160kW/418kWh
Battery Type: Lithium Iron Phosphate ($LiFePO_4$), Liquid-Cooling Energy Storage System
Thermal Management Method: Active Liquid Cooling
Installation Method:
PCS Inverter: Indoor installation
Battery Cabinets: Outdoor installation
Application Mode: Renewable Energy Integration/Backup Power/Load Regulation

III. Why "Liquid Cooling + Temperature Control" is More Critical Than Just "Heat Dissipation" in Low-Temperature Conditions
In energy storage projects, thermal management is not solely for heat dissipation during summer highs. In high-latitude or low-temperature winter regions, thermal management more closely resembles a year-round temperature control system. Its core objectives include:
Insulation and heating during low-temperature phases.
Maintaining cells within a more optimal temperature range to reduce performance fluctuation.
Controlling temperature uniformity within the battery compartment.
Minimizing capacity discrepancies and system alarm risks caused by localized overcooling.
Ensuring predictability of temperature control strategies, guaranteeing the stable execution of heating and deactivation logic to avoid frequent cycling.
The engineering value of liquid cooling thermal management lies in using liquid circuits and control strategies to achieve more uniform and controllable internal temperatures within the battery compartment, providing clear, stable boundary conditions for low-temperature operation.

IV. Low-Temperature Operation and Monitoring Data Performance
Based on system monitoring data and environmental temperature records provided by the customer:
Outdoor ambient temperature fluctuated within the low winter range.
The internal temperature of the energy storage system consistently remained within the safe operating range.

Battery temperature control and heating strategies are executed automatically according to set logic.
When the ambient temperature dropped below the set threshold, the system automatically activated the battery heating module. Via the liquid cooling thermal management system, battery cells were heated uniformly, ensuring charge/discharge processes remained unaffected by the low-temperature environment.
Monitoring curves clearly show stable isolation between the battery's internal temperature and the external ambient temperature. System operation was continuous, with no abnormal fluctuations or unplanned protective actions observed.

V. Operational Performance of Liquid Cooling Thermal Management in Winter Low-Temperature Environments

Compared to traditional air-cooling systems, the liquid cooling solution demonstrates superior temperature control precision and consistency management in low-temperature environments:
Effectively reduces temperature differentials between cells.
Avoids performance degradation caused by localized low temperatures.
Enhances the usable capacity and operational stability of the entire battery pack under low-temperature conditions.
During this project's operation, the liquid cooling thermal management system worked continuously under snow/ice-covered conditions. No frequent system protection triggers or power limitations due to low temperatures occurred.

VI. Impact of Installation Method on System Stability

The "Indoor PCS + Outdoor Battery System" layout used in this project demonstrated excellent engineering adaptability during actual operation:
The indoor inverter operates in a controlled environment, facilitating grid-connection management and maintenance.
The battery system's structural design, protection rating, and temperature control scheme meet long-term outdoor operational requirements.
The overall system operation logic is clear, supporting remote monitoring and data traceability.

VII. Project Operation Summary

Up to the current operational cycle, the overall system status remains stable:
No abnormal alarms occurred in the winter low-temperature environment.
Temperature control and heating strategies responded promptly with clear logic.
The system met customer expectations for reliability and continuous operation.
This project validates the engineering maturity of the GSL ENERGY liquid-cooling energy storage system in winter low-temperature climates and outdoor deployment scenarios. It also provides a replicable implementation reference for energy storage projects in Eastern Europe and other cold climate regions.

VIII. GSL ENERGY Project Experience

GSL ENERGY has long provided system solutions for energy storage projects under various

climatic conditions, encompassing high temperatures, low temperatures, high humidity, and complex outdoor environments.
Through a standardized system platform and flexible engineering configuration capabilities, GSL ENERGY can provide stable, sustainable energy storage system support for residential, commercial & industrial (C&I), and utility-scale projects based on actual operational requirements

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