CASE STUDY

This is NEXT LEVEL ENERGY

Powering Innovation: How Blackhillock is Transforming Grid Stability

Powering the Future of Grid Stability and Net Zero Goals

The Blackhillock Battery Project is a groundbreaking initiative aimed at addressing the critical challenges of grid stability and renewable energy integration in Scotland. In 2019, the Scottish Parliament passed legislation to become a net-zero society by 2045, setting a target five years ahead of the rest of the UK. The government also aims to reduce emissions by 75% by 2030.

The development of energy storage projects like Blackhillock is expected to play a crucial role in supporting Scotland in achieving its ambitious net-zero goals and in the most cost-effective way for energy bill payers.

Blackhillock is the first of several projects to be delivered under the National Grid Electricity System Operator's (NGESO) Stability Pathfinder program, designed to address stability challenges in the electricity system. Developed, owned, and operated by Zenobē, the project features Wärtsilä as the Battery Energy Storage System (BESS) supplier and SMA providing Grid Forming and Engineering solutions.

Rising to the Challenge: Solving Renewable Energy Integration Issues

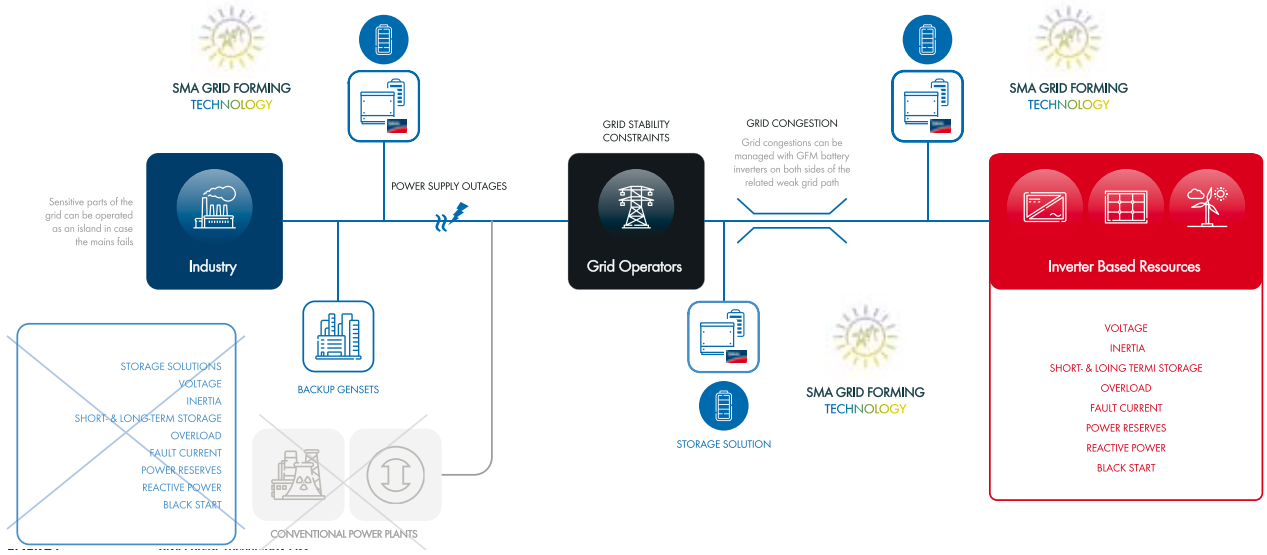
The transition to renewable energy sources has created a unique set of challenges for grid stability. The increasing retirement of conventional fossil fuel synchronous generation plants has led to a lack of inertia and short-circuit capacity, critical components required for a stable electricity grid. The rise in renewable energy power into the grid has further complicated grid dynamics, introducing new vulnerabilities such as voltage dips and phase jumps. These issues were particularly significant in the north-eastern region of Scotland, where the grid needed to accommodate increasing power from offshore wind farms in the North Sea. Traditional infrastructure upgrades, such as expanding or replacing transmission wires, would have been costly and time-consuming. Therefore, there was a pressing need for an innovative, cost-effective solution that could provide comprehensive stability services while also advancing the Government's renewable energy goals.

Pioneering Engineering Solutions Transforming Grid Stability

SMA delivered an innovative solution that played a pivotal role in the success of the project. By providing 62 medium voltage power stations equipped with advanced grid-forming inverters, SMA ensured the project could deliver critical stability services, including 370 MW of inertia and 116 MVA of short-circuit level. These capabilities are essential for maintaining grid reliability and facilitating the integration of renewable energy sources.

What makes Blackhillock so unique and innovative is the use of grid-forming inverters. This innovative approach offers a comprehensive solution to grid disturbances such as voltage dips and phase jumps, paving the way for a significant increase in the uptake of renewable power, including from offshore windfarms in the North Sea, to the nation's electricity grid.

Grid Forming based on SMA Inverters provide the same grid stabilization service as conventional technology, plus much more



SMA Engineering Services – Expert Grid Advice and Support

SMA successfully completed the first of its kind compliance process for the new Great Britain grid code (GC0137), including Grid Forming requirements. This solution, seamlessly integrating hardware, software, and controls, has been rigorously tested and validated to fully meet the British grid operator National Energy System Operator (NESO) specifications.

In addition to providing essential grid-forming systems, SMA's Engineering Services team played an integral role in the Blackhillock project, delivering expert advisory support to all key stakeholders, including the NGESO, throughout the entire project lifecycle. These services included:

Grid Forming Advisory Service

A dedicated Customer Project Engineer played a key role in facilitating the communication and collaboration between Zenobē, Wärtsilä and the NGESO to streamline the integration process. The advisory support from the SMA Grid Forming experts ensured that the necessary technical requirements were met and that Blackhillock was fully aligned with all grid protocols.

Control System Integration

SMA provided support and guidance on the integration of SMA devices into the control system of the power plant. Additionally, comprehensive integration testing was carried out using SMA's Hardware-in-the-Loop test bench to verify the synchronization of communication and control devices, as well as operational modes, before commissioning. This proactive approach reduced commissioning time, ensured system alignment, and mitigated potential risks during on-site operations.

Comprehensive Testing

The SMA team developed detailed test cases and conducted in-depth testing to evaluate the performance of the inverters under project-specific parameters. This

extensive testing enabled stakeholders to evaluate the inverter's behavior and grid stability under various operating conditions, ensuring optimal performance.

Grid Studies and Evaluation of the Blackstart Sequence
Detailed dynamic analysis was conducted to assess the Blackstart sequence, with our team ensuring the proper operation of Blackhillock together with the number of the inverters in the power plant. This evaluation allowed the team to optimize the control sequence, ensuring the proper energization of the Blackhillock facility during a grid outage and facilitating a smooth connection.

Expert Grid Modeling Support
In-depth insights into the facility's interaction with the grid under various conditions were made possible with SMA's expertise. Our experts in grid modeling and grid-forming provided essential support throughout, from the project's design phase to the final stages of the grid interconnection studies, ensuring optimal performance of the site in real-world conditions.

The SMA Engineering Services team played a pivotal role in optimizing Blackhillock's integration, working closely with all stakeholders throughout each project phase to streamline the process, reduce challenges, and minimize risks. Their expertise also enhanced the facility's ability to provide critical stability services, marking a significant step toward strengthening the resilience of the energy grid.

Working closely with industry leaders and project partners Wärtsilä and Zenobē, SMA enabled the implementation of a technologically advanced and economically viable solution for a resilient electricity grid, setting new benchmarks for the energy sector.

This is NEXT LEVEL ENERGY

The Blackhillock project has achieved remarkable outcomes by setting a new standard for renewable energy integration and grid stability. Once fully operational, Blackhillock will become the largest transmission-connected battery storage system in Europe, with a total capacity of 300 MW / 600 MWh. Phase 1 of the project, with a capacity of 200 MW, has already been commissioned, and Phase 2, with an additional 100 MW, is slated for completion by 2026.

This pioneering project is the world's first to provide a full suite of energy, ancillary, and stability services using a transmission-connected battery. Blackhillock will play a vital role in enhancing the reliability of Great Britain's renewable power system. Its contributions, including providing short-circuit level and inertia, will support the efficient transition away from fossil fuel plants and alleviate network constraints. The additional renewable energy resources and increased efficiency will accelerate energy independence and lower consumer bills by over £170 million over 15 years.

"Our grid-forming solutions at Blackhillock showcase SMA's dedication to driving renewable energy integration and enhancing grid stability. By providing robust and innovative energy storage solutions, we are building the foundation for a cleaner and more sustainable energy future."

Florian Bechtold, Executive Vice-President of Large-Scale and Project Solutions, SMA.

Pioneering a Sustainable Energy Future

This project represents an innovative step forward Great Britain's journey toward achieving its net-zero emissions targets. By utilizing innovative technologies and strong strategic partnerships, it serves as a model for sustainable energy development and grid stability solutions.

Building on the success of Blackhillock, Zenobē, Wärtsilä and SMA are already working together on the Kilmarnock South battery storage system in Scotland, which will feature a power output of 300 MW and enhanced stability services. As these projects evolve, they will play a crucial role in accelerating the energy transition, ensuring a stable, cost-effective, and renewable electricity grid. With its transformative potential, the Blackhillock battery project is not only a milestone for Great Britain but also a benchmark for global efforts to build a cleaner, more sustainable energy future.

Discover How SMA can Transform your Large-Scale Energy Projects

Transform your large-scale energy projects with SMA's grid-forming solutions and expert engineering services team. Get in contact with an SMA Sales Representative to discover how we can transform your energy project to be next level energy.

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