Flow Battery Energy Storage System

Two units offer new grid-storage testing, simulation capabilities

Two flow battery units at INL's microgrid test bed allow researchers to study the batteries' ability to stabilize renewable energy within microgrids and to interact with larger-scale grid use cases.

The United States is modernizing its electric grid in part by incorporating more renewable sources and decentralizing into more localized generation and distribution systems. Idaho National Laboratory is researching one challenge the grid faces in developing higher capacity energy storage. To make the grid of the future more reliable and resilient, assemblies capable of storing large amounts of electricity from distributed generation sources such as wind, solar and run-of-river hydro are needed to provide power on demand.

Technological refinements and improvements to flow batteries are making energy storage increasingly appealing for large stationary applications such as data storage centers and military bases, neither of which can afford interruptions to their power. For utilities, flow batteries offer a tool for shaping load: storing excess electrical power during off-peak hours and releasing it during peak demand periods.

To expand its microgrid test bed, INL acquired two Z20-4 zinc/iron flow batteries from ViZn Energy Systems of Austin, Texas. Weighing 25 tons each when filled with electrolyte solution, the two units together are capable of generating 128 kilowatts at full power for 2.5 hours. The units can be integrated with the grid or microgrid, and data collected in real-world conditions allows INL researchers to model and demonstrate energy use and storage scenarios.

WHAT IS A FLOW BATTERY?

A flow battery is a type of rechargeable battery in which the battery stacks circulate two sets of chemical components dissolved in liquid electrolytes contained within the system. The two electrolytes are separated by a membrane within the stack, and ion exchange across this membrane creates the flow of electric current while both liquids circulate in their own respective spaces. Unlike a traditional electrochemical cell, the ionic solution (electrolyte) is not stored in the cell around the electrodes. Rather, the ionic solution is stored outside of the cell and can be fed into the cell to generate electricity.

Flow batteries can be rapidly recharged by replacing the electrolyte liquid while

Idaho National Laboratory

Kurt Myers, project lead for Idaho National Laboratory's microgrid test bed, examines energy data collected from the two flow batteries.

Each flow battery includes four fuel stacks in which the energy generation from the ion exchange takes place.

simultaneously recovering the spent material for re-energization. They can tolerate more discharge-recharge cycling, and they require fewer safety and security precautions than many other battery technologies. High-tech membranes, pumps and seals, variable frequency drives, and advanced software and control systems have brought greater efficiencies at lower expense, making flow batteries a feasible alternative to lithium-ion storage systems.

WHAT CAN FLOW BATTERIES DO?

Although zinc-iron flow batteries have been through some levels of field testing, the flow batteries at INL represent the first time in the U.S. that they are being incorporated and tested in a fully integrated and functional microgrid system, including real-world grid interaction use cases. This addition allows researchers to study how the microgrid can provide a more cost-effective and reliable power system. The input data from the microgrid is sent to INL's Digital Real-Time Simulator (DRTS), where research engineers can simulate how multiple flow batteries combined with other distributed generation sources (such as renewables and other generators) can be used to add resiliency and stabilize a much larger grid.

When filled with electrolyte solution, each of the flow batteries weighs approximately 25 tons. Together at full capacity they are cable of generating 128 kilowatts for 2.5 hours.

FOR MORE INFORMATION

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