Supporting Documentation for Volume 1, Chapter 3

Battery Storage Project

NorthWestern Energy purchased and installed a battery to test using storage for feeder support. Although the source of funding for this project is in the Research and Development Category of the USB Program, it is worth noting here in the context of electric resource planning and distributed generation. The power conversion system is sized for 50 kW. The battery system uses advanced lead acid technology and is designed for 180 kWh of storage with 2,000 charge/discharge cycles at 50% depth of discharge/cycle. Included in the project is a 10.8 kW solar photovoltaic system coupled to the battery. The project features a web based hosted software that gives NorthWestern Energy remote control and operability of the system as well the opportunity to import or export information to other software systems within the NorthWestern operating system or smart grid project. System data evaluation started in the second quarter of 2015.

NorthWestern's objectives for the project are:

- Testing commercial scale viability – gain experience with a small system to evaluate the potential for larger scale energy storage.
- Testing potential for wind integration – analyze the operational model and benefits of having a dispatchable load as an integration resource for renewable energy.
- Testing direct solar photovoltaic system integration – directly integrate solar panels to provide integrated solar firming with the energy storage system.
- Examine and quantify the value streams of this form of distributed energy storage, including feeder support, reduced line loss, potential for transmission and distribution infrastructure upgrade deferral, passive demand response, energy efficiency, or other location-specific energy management solutions.
- Analyze project economics.
- Inform future decisions.

The battery storage system is a complete end-to-end distributed energy storage solution. The Joule.System™ is comprised of two main system components: the Grid.DNA™ and the Grid.Balancer™.

Joule.System™

The distributed energy storage device (battery) creates load during off-peak times, stores the energy at the load site, and ultimately dispatches it on command or on a managed schedule. By storing and distributing the energy at the point of use, the total electrical energy inventory of stored energy and energy storage capacity can be monitored and dispatched within seconds. The Demand Shifter can potentially complement renewable generation sources, contribute to spinning reserves, reduce capital costs, and help avoid dispatching more costly incremental energy generation sources, especially during peak pricing periods.

The device is configured for NorthWestern Energy to test using storage for feeder support. Web based hosted software gives NorthWestern Energy the control and operability of the system as well the opportunity to import or export information to other software systems within the NorthWestern operating system or smart grid project.

Grid.DNA™

The Grid.DNA™ (Distributed Network Architecture) is a comprehensive Graphical User Interface of the energy storage solution. The Grid.DNA™ system provides a user interface for real-time supervisory control and data acquisition of the Grid.Balancer™ elements and other integrated components. Grid.DNA™ can be utilized to initiate Grid.Balancer™ operations on a pre-scheduled basis or can initiate operations on a manual basis from the browser based user interface. Any individual or selected groups of Grid.Balancer™ can be instructed to override its current schedule and operate as requested. Grid.DNA™ provides historical data archiving of all system data points, including a full system assurance package (alarming, events, status, etc.). Grid.DNA™ utilizes the latest in distributed computing, cluster computing, and network security to create the most fault tolerant, scalable and secure environment possible.

The battery has been sited inside NorthWestern's Helena Division Operating Center yard and connected to both the distribution system and the Helena Operating Center Building. Communications to the device are operational and software loading and testing was completed in the fourth quarter of 2013. Construction of the solar photovoltaic ("PV") array completed in the fourth quarter of 2013 and the project became fully operational in the second quarter of 2015. Second quarter results indicate that the system is performing as designed. Scheduled cycles include bulk charging of batteries using both the solar PV system and line power and discharge of batteries during daily peak load at the Helena Service Center.