Recent Applications of NAS Battery System in the United States and in Japan

Tetsuya Hatta (NGK INSULATORS, LTD.; Nagoya, Japan; hatta@ngk.co.jp)

1. Abstruct

NGK's sodium-sulfur (NAS) battery is an advanced energy storage system developed for power grid applications. Megawatt scale NAS Battery Systems were first operated in field more than 10 years ago. Although the basic design concept of NAS battery cells and modules has not changed, the technology has been improved through many field demonstrations and commercial installations. Initially, the target application for NAS batteries was load leveling, and that remains its primary use. Later, NAS batteries began to be used as standby power sources with load leveling capability. Recently, NAS Battery applications have focused on stabilizing fluctuating power from renewable energy resources, such as wind turbines or photovoltaic generators. More than 300 MW of NAS Battery Systems have been installed globally. This paper addresses a NAS demonstration project in U.S. and a new, very large project in Japan.

2. NAS Demonstration Project by Xcel Energy [1]

2.1 Introduction

Various demonstrations, including peak shaving, frequency regulation, wind smoothing and wind leveling, have been conducted by using the 1 MW NAS Battery System installed in Luverne, MN, for Xcel Energy in 2008. That demonstration confirmed the technical capabilities of NAS Batteries for these applications. In addition, that project is the first demonstration of NAS batteries in severely cold climates such as occurs in Minnesota. NGK designed a battery enclosure to maintain adequate interior temperatures down to exterior temperatures as low as -45C, demonstrating that NAS batteries can be deployed in very cold climates.

Figure 1: NAS Battery for Xcel Energy.

2.2 System Description

At the Xcel site, a 1 MW NAS Battery System is installed proximate to a 11.5 MW wind farm comprised of 7 wind turbines and connected to a 34.5 kV power grid. The wind generation and battery system connected to a transmission line that operates within the jurisdiction of the Midwest Independent Transmission System Operator (MISO). An objective of this demonstration was to evaluate different ratios of installed wind capacity to energy storage capacity. Generation from the 11.5 MW wind farm was scaled to simulate wind output over the range of 1 MW to 10 MW.

2.3 Demonstration of Wind Leveling

In the wind leveling operating mode, the operator specifies the scheduled power output of the combined wind and battery system at 30-minute intervals. When power output from the wind farm deviates from the scheduled value, the NAS battery system charges or discharges energy to compensate for the difference. The results of variable 1 MW wind generation and 1 MW battery stored energy compensation case are shown in Fig. 2. The NAS Battery system responded to changes in the output from the wind farm rapidly and accurately, and it compensated for the difference between the scheduled power and the power generated by wind farm.

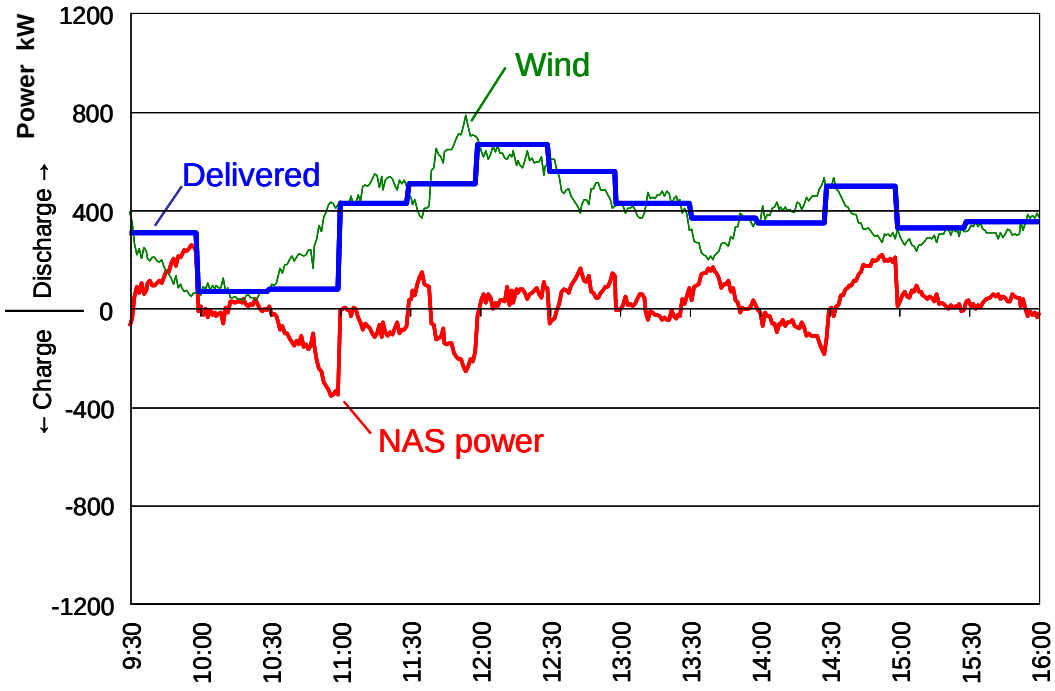

Figure 2: Wind Leveling, 1 MW Wind & 1 MW NAS battery.

3. Planned 80 MW NAS Battery for Northern Japan

3.1 Introduction

During the massive earthquake that occurred on March 11 of this year, several thermal power stations owned by Tohoku Electric Power and located along the Pacific coast were damaged by the earthquake. The damages were so severe that the power supply capabilities of the affected thermal power stations are not reliable for the time being. Tohoku Electric Power is making every effort to procure the power supply needed to meet the demand for power in their service area. They have decided to install 80 MW of NAS batteries as one measure to provide reliable power immediately. The NAS batteries will be charged when demand is low and discharged when the demand is high. The NAS battery system is expected to reduce peak demand and balance supply in the Tohoku area.

3.2 Location of the 80 MW NAS Battery Site

The NAS Battery System will be installed at the Noshiro thermal power station in Northern Japan. The power station is owned and operated by Tohoku Electric Power and was not damaged during the earthquake. The generating capacity of Noshiro thermal power station is 1,200 MW.

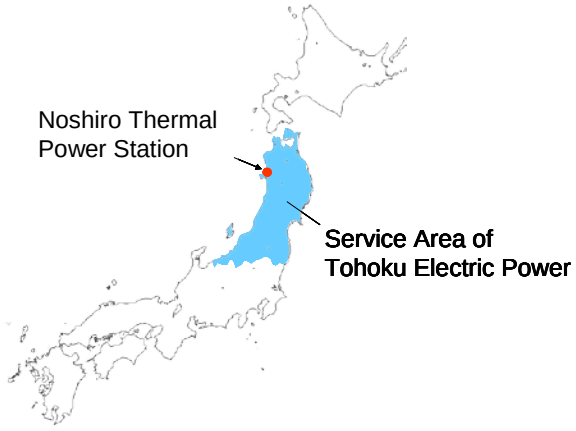

Figure 3: Location of Noshiro Thermal Power Station.

3.3 System Description

The NAS Battery System to be installed at Noshiro is rated at 80 MW and can store 480 MWh of energy. The system consists of 40 sets of 2 MW NAS battery systems. When completed, it will be the largest NAS battery installation in the world. The NAS battery modules and related systems at Noshiro will be installed inside of building. An interior “rack system” to support the NAS battery modules has been adopted to shorten the delivery and construction time. The same rack system was used in the 4 MW NAS Battery installation at Presidio, TX, for Electric Transmission Texas, LLC (ETT) and American Electric Power (AEP). The advantages in lead time offered by this approach were verified through the ETT/AEP project.

Figure 4: NAS battery modules with rack system for ETT/AEP

4. Remarks

A total of about 230 MW of NAS batteries have been installed in Tohoku and Kanto regions of Japan where intense ground motions occurred during the earthquake. Most NAS installations were ready to use soon after grid power was recovered. The NAS Battery's robustness, as well as the short lead time needed for its installation, when compared to other power sources, are being recognized by electric power companies and consumers.

5. References

[1] J. Himelic, F. Novachek, "Sodium Sulfur Battery Energy Storage And Its Potential To Enable Further Integration of Wind (Wind-to-Battery Project), Data Collection and Analysis Report (Milestone 5)", 2010