

ENERGY STORAGE

Demonstration Projects

Prepared for

NYSERDA / DOE

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**Second Quarter 2009
April Through June 2009**

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This project demonstrates the utilization of a sodium-sulfur (NAS) battery system to shift compressor load from peak time to off-peak time and to provide emergency backup power at a Long Island Bus depot facility. The primary application will be to supply up to 1 MW/7.2 MWh of power to the three 600 horsepower natural gas compressors for six to eight hours per day, seven days per week, especially during the summer peak period. The natural gas compressors provide fuel for buses that will replace diesel-powered buses. The NAS batteries are being supplied by NGK Insulators of Japan.

ABB is supplying the on-site data acquisition system that samples a variety of parameters at 1 second intervals and will be able to store up to 365 days worth of data. The signal list was finalized by ABB and the project team on July 10th, 2006. Table 1 contains a copy of the signal list as provided by ABB. ABB provides a high speed connection into the on-site DAS computer so that a file can be retrieved periodically and then archived for later analysis and long term trending.

The recording and communications system was placed into service early in 2009. This quarterly report summarizes the operation from April through June, 2009.

The operation was uneventful during this quarter. The signals provided from the battery system to the data acquisition system are shown in Table 1.

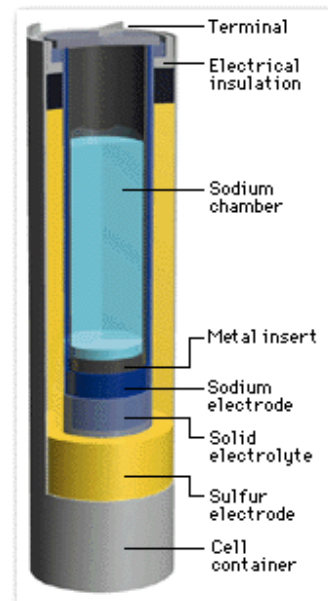


Table 1 – DAS PCS Signal List

Signal	Description	Range
Grid RMS Voltage	Actual AC Voltage, measured at 4160 V point of common coupling (PCC)	0 – 4200.0 Volts AC
Grid RMS Current	Actual AC Current, measured at 4160 V PCC	0 – 500.0 Amps AC
Grid Real Power	Actual AC Real Power, measured at 4160 V PCC	0 – 4000 kW
Grid Reactive Power	Actual AC Reactive Power, measured at 4160 V PCC	0 – 4000 kVAR

Grid Apparent Power	Actual AC Apparent Power, measured at 4160 V PCC	0 – 4000 kVA
PCS Real Power	Actual AC Real Power, Calculated by PCS Control System.	0 – 1500 kW
PCS Reactive Power	Actual AC Reactive Power, Calculated by PCS Control System.	0 – 1500 kVAR
PCS Apparent Power	Actual AC Apparent Power, Calculated by PCS Control System.	0 – 1500 kVA
Load Real Power	Actual AC Load Real Power, Calculated by PCS Control System	0 – 4000 kW
Load Reactive Power	Actual AC Load Reactive Power, Calculated by PCS Control System.	0 – 4000 kVAR
Load Apparent Power	Actual AC Load Apparent Power, Calculated by PCS Control System.	0 – 4000 kVA
PCS Real Energy Accumulated – Absorbed Real Energy	Actual Accumulated AC Real Energy absorbed by the PCS, Calculated by PCS Control System.	0 – 65,536 MWHr
PCS Reactive Energy Accumulated – Absorbed Reactive Energy (Inductive)	Actual Accumulated AC Reactive Energy absorbed by the PCS, Calculated by PCS Control System.	0 – 65,536 MVAHr
PCS Real Energy Accumulated – Discharged Real Energy	Actual Accumulated AC Real Energy discharged by the PCS, Calculated by PCS Control System.	0 – 65,536 MWHr
PCS Reactive Energy Accumulated – Discharged Reactive Energy (Capacitive)	Actual Accumulated AC Reactive Energy discharged by the PCS, Calculated by PCS Control System.	0 – 65,536 MVAHr
System Charge / Discharge Cycle Counter	Counter for tracking Charge / Discharge Cycles. Counter increments by 1 after each completed Discharge Cycle.	0 – 10,000
System Operational Mode	Power Supply Mode of operation	0 = Shutdown 1 = Standby 2 = Charge 3 = Discharge

The data shown on the website does not match the data ranges shown above. Numerous investigations into the discrepancies have been made, including a rebuild of all of the data and a reconfiguration of the website display. That work continues. The shapes of the plots are now correct. Some calculated values are taken from the ABB point of view, leading to confusing plus and minus signs. The data is collected by ABB for the facility. Some data is then stored on a laptop at the site that is acting as a data server for the collection of data. The calculations and data scaling are done on-site.

The data includes measurements of voltage, current, and power. The power calculations are then made. The utility power is a measurement, while the power related to the inverter and the load are calculated by ABB. The translation from the ABB data to the website requires that the three different power measurements be treated as if they come from three different monitors or sites; the grid, the load, and the PCS or inverter.

Dran-View 6.6.02 HASP : 2092660978 (7CBB78F2h)

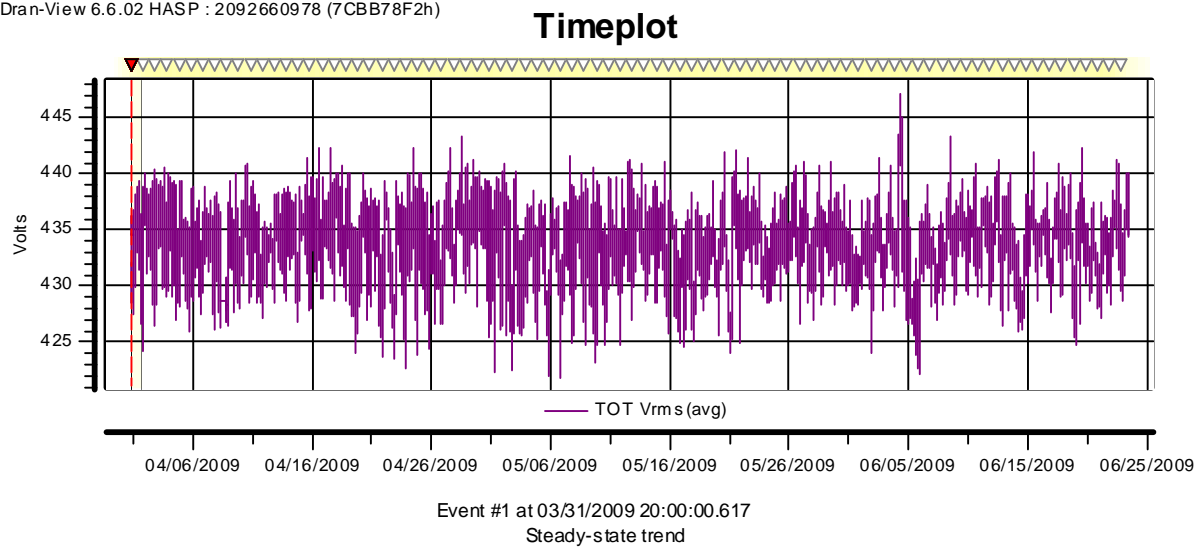


Figure 1 – average grid voltage over the period April –June, 2009

The grid-supplied voltage was within the normal range throughout the quarter. Minor variations are expected and are seen here.

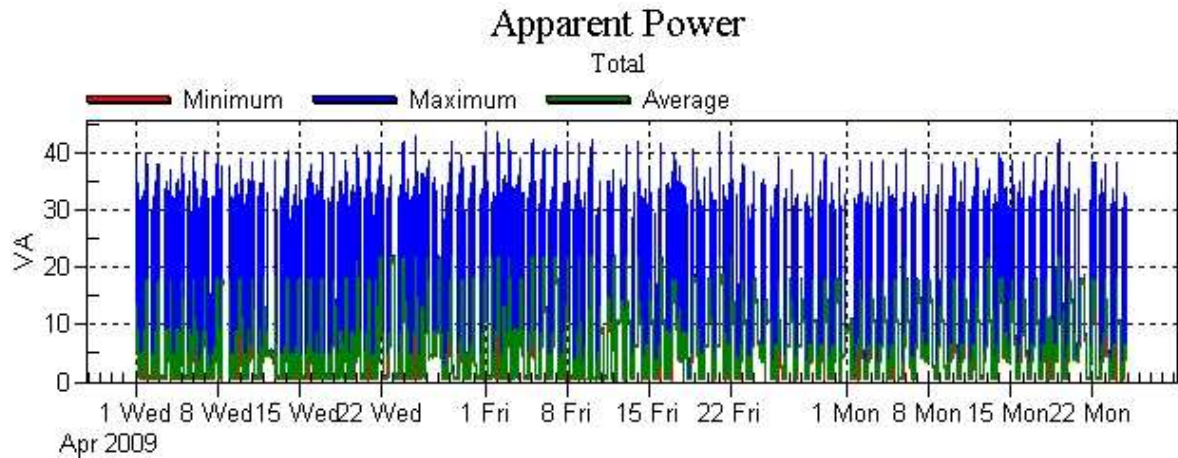


Figure 2 – Grid Apparent Power

The KVA delivered from the utility grid to the system over the quarter shows the power required by the system. The graph shows the daily low, high, and average use.

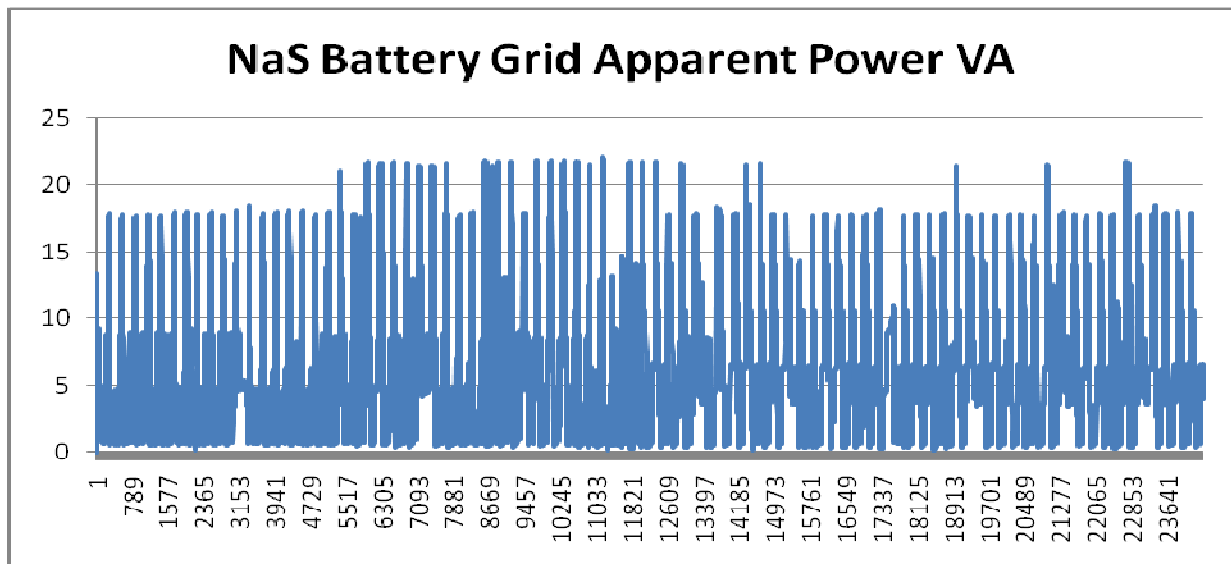


Figure 3 – Daily average power

Graphing just the average power shows the power demand on the utility grid. The maximum and minimum values do not last long and have little effect on the electric power demand.

During this quarter, the system operated on a regular schedule. The power demand graph shows that there were peaks and valleys in usage daily.

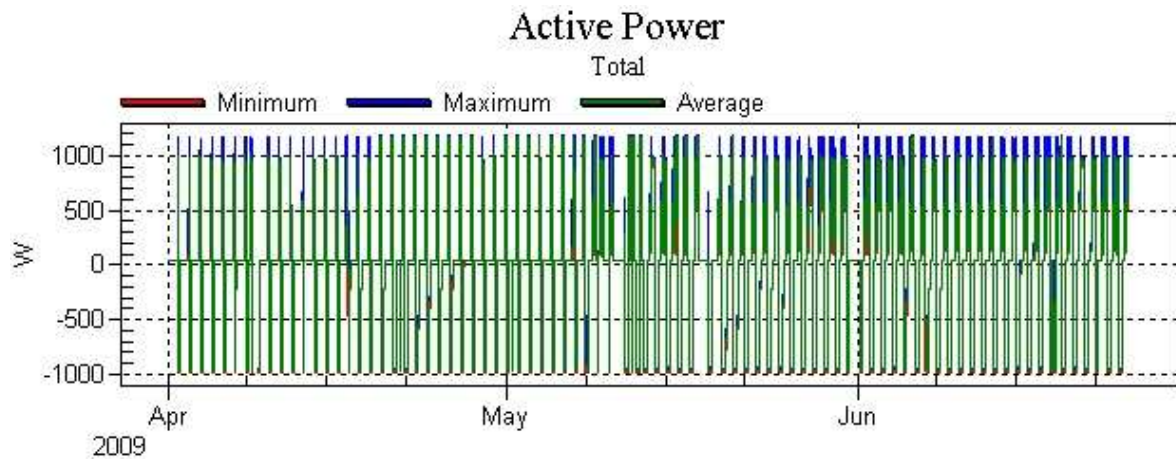


Figure 4 – The PCS real power during the quarter.

During the quarter, the inverter charged the battery system during the night and discharged the system during the day. The discharge was supplying electric energy to the bus compressor systems. Note that the maximum power in each direction is equal to the rating of the system. The electronics limit the charge and discharge power into and out of the battery.

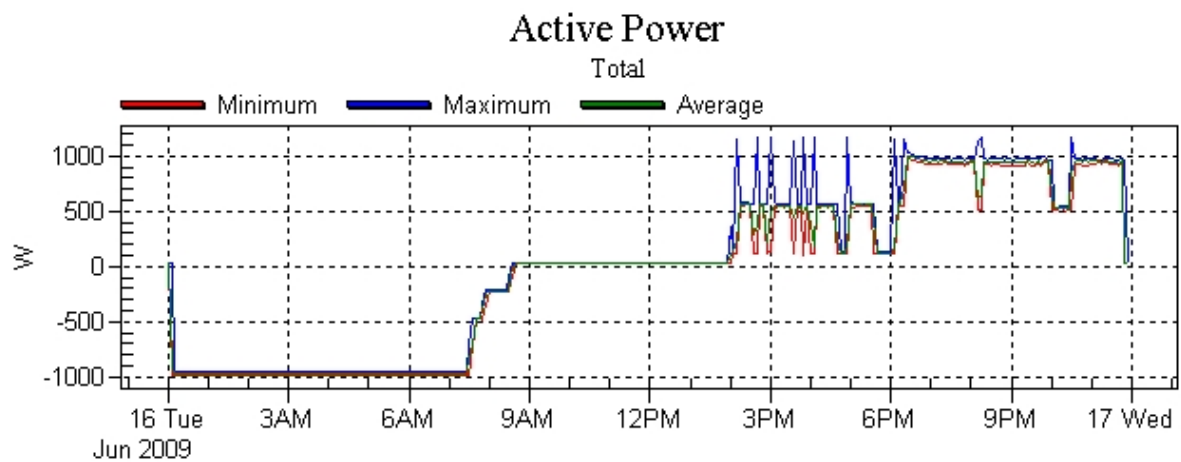


Figure 5 – The operation of the PCS during one day of the quarter

A typical day during the summer shows the battery charge cycle begins at midnight and tapers off at 7:30 in the morning. The discharge cycle begins about 2:00 PM and we can imagine the compressors starting and stopping until about 6:00 PM, when they operate almost continuously. At midnight, the battery charging cycle begins again.