Long Island Bus
NaS Battery Energy Storage Project

DOE Peer Review

Energy Storage & Power Electronics Systems Research Program

Washington, DC

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New York Power Authority

This project is part of the Joint Energy Storage Initiative between the New York State Energy Research and Development Authority (NYSERDA) and the Energy Storage Systems Program of the U.S. Department of Energy (DOE/ESS), and managed by Sandia National Laboratories (SNL). Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration, under contract DE-AC04-94AL85000

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Project Team

- NYPA – Overall project implementation
- MTA/Long Island Bus – Host site, end user
- NGK Insulators, Inc. – NaS battery manufacturer
- ABB – PCS, Controls, Design and Installation
- DOE/NYSERDA Energy Storage Initiative – Project funding and guidance
- EPRI – Technical assistance, technology transfer
- LIPA – Grid Integration, technical assistance

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- A public benefit energy corporation founded 1931
- Largest non-federal public electric utility in United States
- NYPA owns and operates 17 power plants and 1,400 circuit-miles of transmission lines, and supplies one-fifth of New York State's electricity.

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Site Description

- Natural gas refueling station for 220 buses
- 3 x 600 HP compressor load
- Dedicated LIPA feeder

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LI Bus Motivation

Current 3rd shift operation to avoid peak rate

LIPA Tariff	Time	Energy ($/kWh)	Demand ($/kW/month)
I, off peak	Mid-7am	$ 0.0440	$ -
II, peak	June - Sep Mon – Sat 10am -10pm	$ 0.0762	$ 34.350
III, intermediate	All other	$ 0.0737	$ 3.420

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Project Goals and Objectives

- Achieve cost savings by eliminating third shift and allow daytime fueling
- Increase back up power for the bus fueling to meet regional emergency response plan
- Reduce peak demand on the heavily loaded utility grid
- Demonstrate long term, commercial operation of a high-efficiency peak shift energy storage system

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Energy Storage Solution

- 1.2 MW, 7.2 MWh NGK NaS battery
- Grid parallel configuration
- Automated load shift
- 75% system efficiency
- Low maintenance
- Low noise
- Zero emissions

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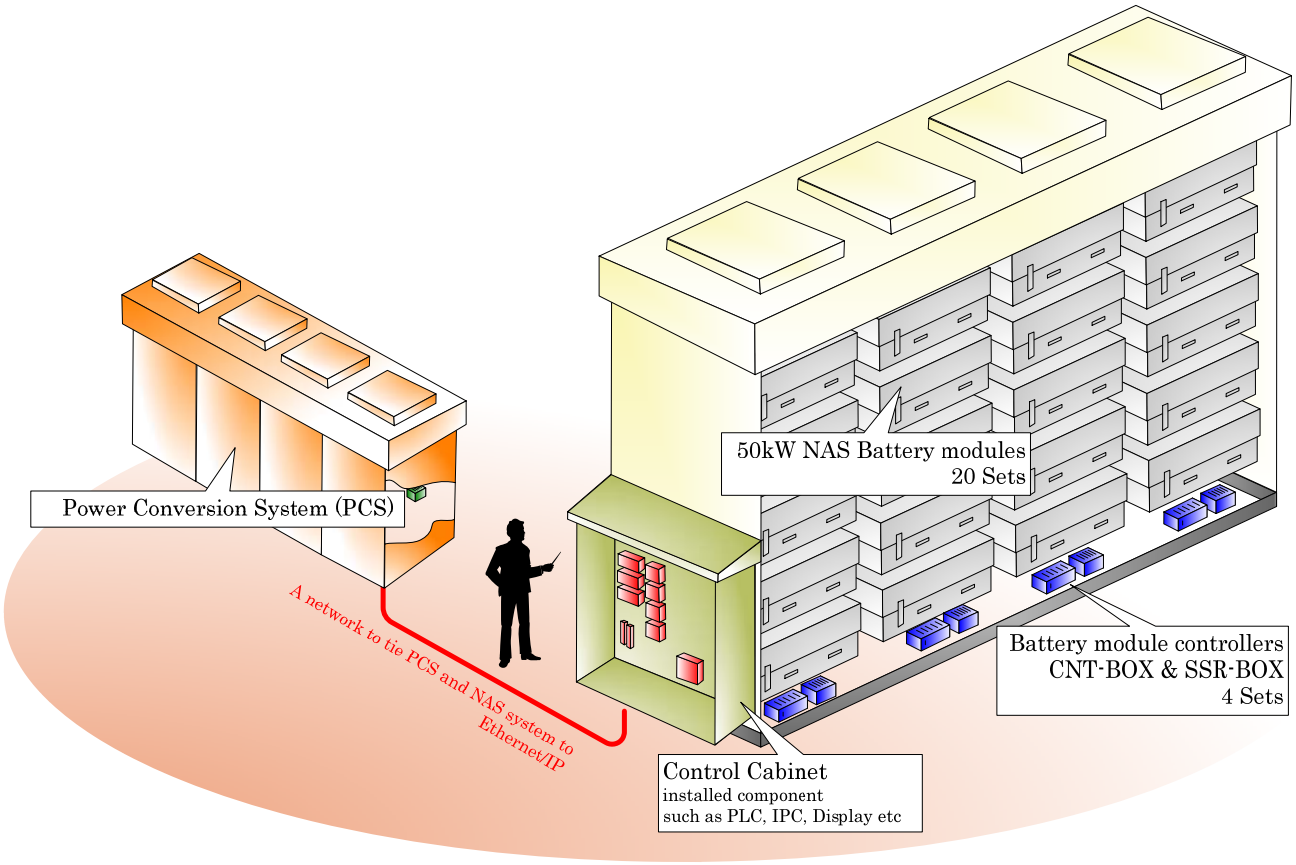
NAS Battery System Overview



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Project Scope of Work

- Battery modules and enclosure
- Power Conditioning System (PCS)
- Balance of Plant equipment and enclosures
- System integration with the grid and the load
- Installation, startup, training and commissioning
- Documentation and O&M manuals
- O&M and performance warranty during 18 month demonstration period
- Build for 15+ year life

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System Performance Monitoring

-Data Acquisition System provided by US DOE-

- AC and DC voltage, current, energy, and power into and out of the system
- Battery state of charge, cycle count and internal/ambient temperatures and conversion efficiencies
- Auxiliary loads and standby losses
- Operating state durations and response times to changes in operating conditions
- Data uploaded daily to central server
- All data time stamped to 1 second, with 15 minute averaging

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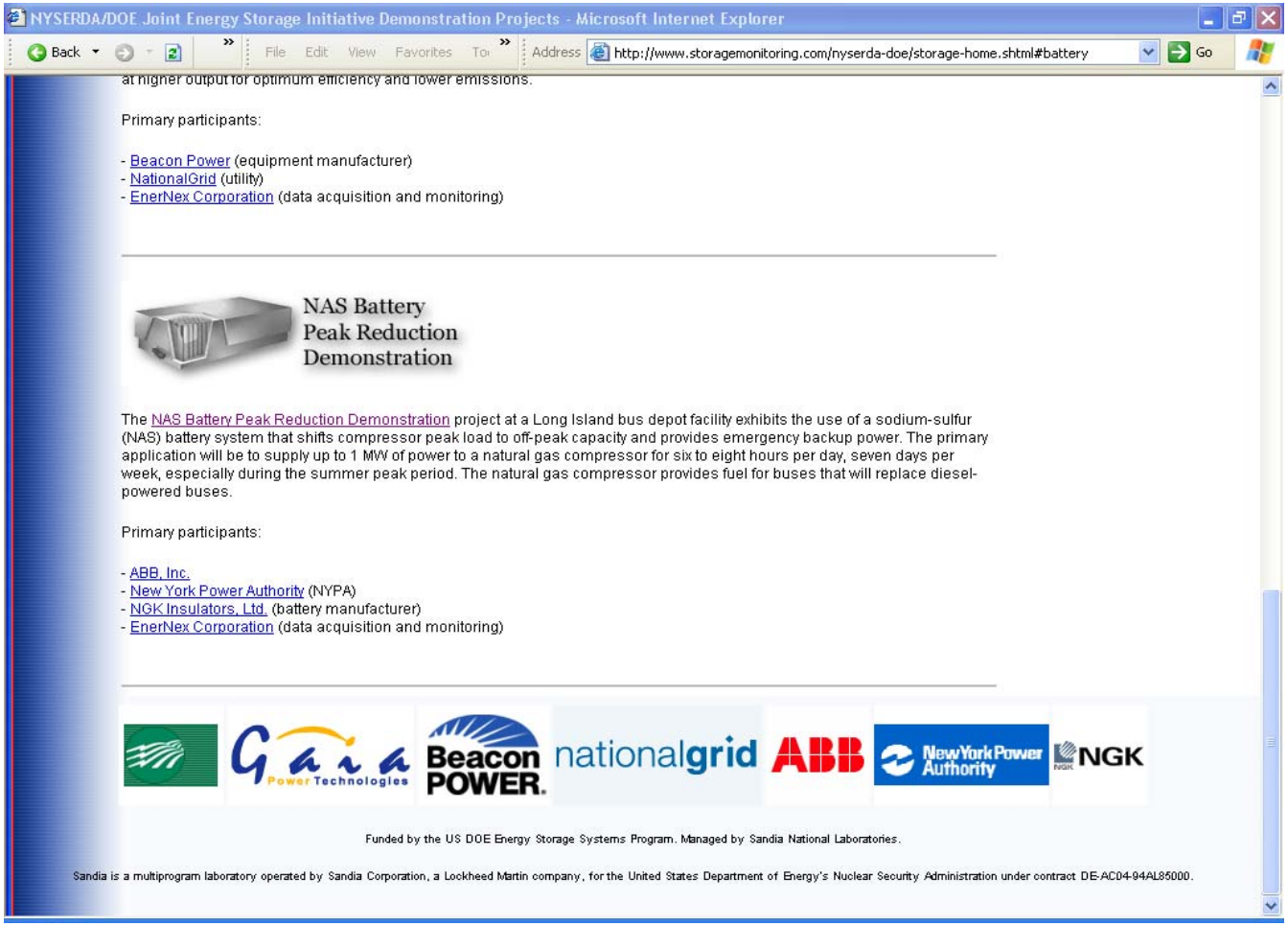
Public Information Website

www.storagemonitoring.com



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LI Bus Gas Compressor Site

Project Installation Area

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PCS Units

Interconnection Issues

- Grounding transformer
- Redundant GE F60 relay
- Direct Transfer Trip
- Keyspan review charges
- Execution of Interconnection Agreement

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Backup Power and Black Start

- PCS units will not operate in parallel
- PCS units are not configured to handle compressor motor black start in-rush current
- Black start capability is essential to LIB
- Backup power for battery thermal management system is required by NGK

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Project Timeline

- Initial System Feasibility Assessment – December, 2004
- Initial Design and Project Bids – Summer, 2005
- Final Customer Agreement - January, 2006
- ABB and NGK Contract Executions - January, 2006
- Initial Project Kickoff Meeting – February, 2006
- Battery and PCS factory tests – Summer, 2006
- Bulk of System installed – September, 2006
- Grounding transformer, direct transfer trip installed – December, 2006
- Operator training performed - May, 2007
- Significant delay due to interconnection issues, May – Nov, 2007

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Battery Failure

December 2007

- Batteries were left in a hot standby during the interconnection delay period (6 months)
- Upon startup in December it was determined that the batteries were not able to complete full cycles
- Upon diagnosis by NGK it was determined that many of the battery modules had deteriorated due to lack of cycling
- NGK replaced all modules under the warranty by April, 2008 and identified a need to cycle batteries at the factory to alleviate this condition.

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Current Status

- System commissioned and operational, site operators experience benefits in fueling operations (schedule flexibility)
- Occasional nuisance trips due to control module communication failures and line overvoltage are being addressed by ABB
- Batteries have completed approximately 30 cycles as of August, 2008
- Data acquisition system operational issues being addressed by ABB
- Compressor load analysis underway by ABB to finalize black start design (will require new PCS to act as variable speed drive) – expected to be installed 2009

Lessons Learned

- Batteries are working well but require initial burn in at factory or on site
- PCS units have presented operational problems
- Need for adequate specification of functional requirements
- Grid parallel operation requirements proved complex and costly as this site

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Thank you

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