NYSERDA/DOE Energy Storage Initiative Data Management and Analysis

Jeff Lamoree, EnerNex

Sandia is a multiprogram 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

Acknowledgements

- The Data Acquisition and Analysis for these demonstration projects is provided by the U.S. Department of Energy.
  - Project Manager - Georgianne Peek, Sandia National Laboratories

Project Statement

- Core Requirements – PON 846
  - The proposed Energy Storage System (ESS) must include a Data Acquisition System (DAS) for the purpose of providing system operating data to be used for evaluation and generation of reports on the overall performance of the EES.

Approach

- Transport to monitoring center via secure communications link over Internet
- Convert data from vendor systems into standard formats
  - IEEE 1159.3 PQDIF
  - IEC 61850 data models for metering
- Expose via dynamically generated tables, graphs on demand on project web site
- Provide project information, archived data and real-time data on open project web site
  - www.storagemonitoring.com

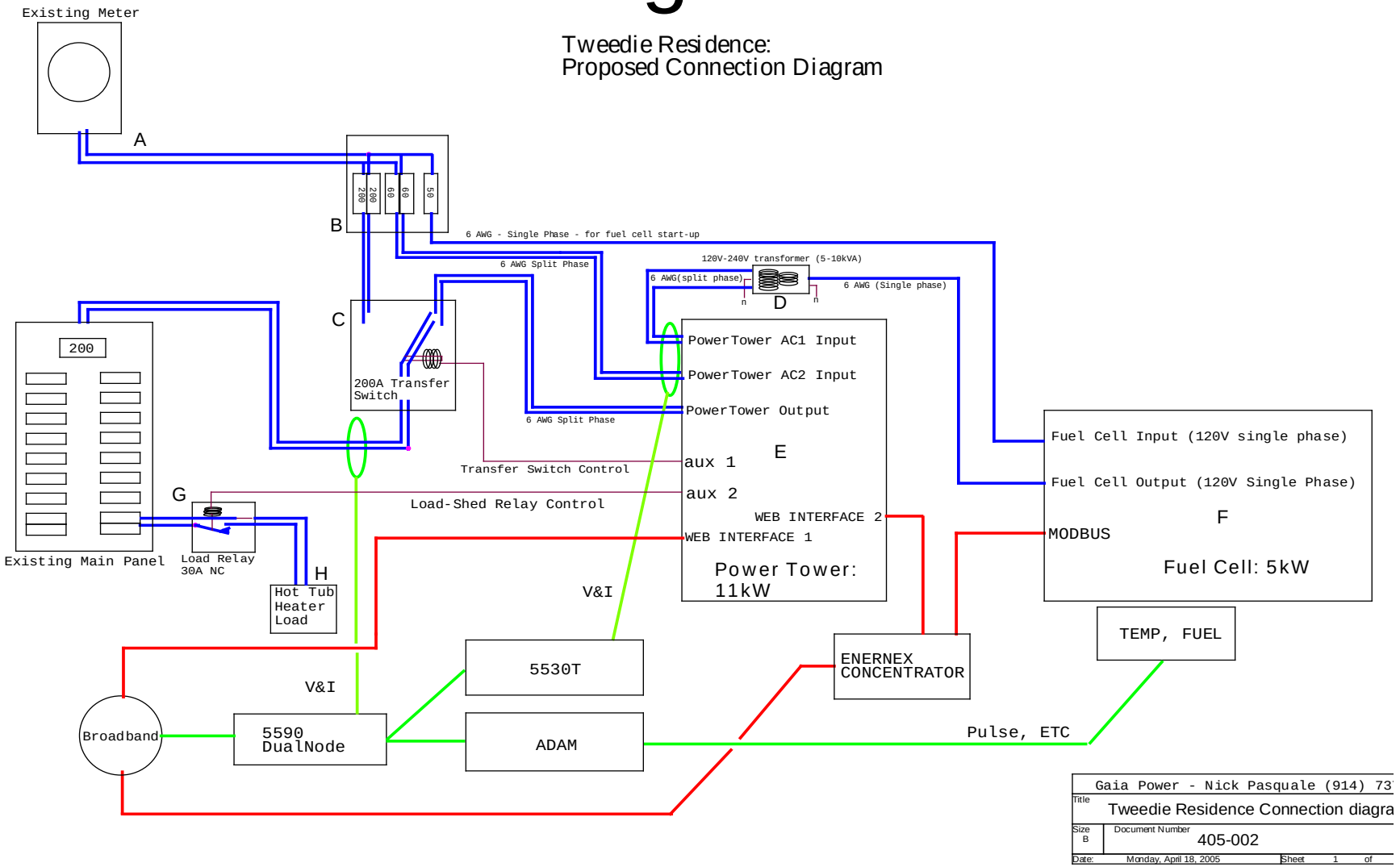
Site 1

- Gaia Power Technologies/Delaware County Electric Cooperative, Inc. – Edge of grid residential application that includes an 11 kW PowerTower battery-based energy storage and delivery system fed by a Plug Power 5 kW fuel cell in Delhi, NY

Timeline

- Gaia Power Tower and Plug Power Fuel Cell installed in June, 2005
- System operational in July 2005
- Fuel cell shut down in June, 2006, removed July, 2006
- System restarted in August, 2006 with grid supplying Power Tower
- Briggs 15 kW generator to be installed later in 2006
- Monitoring to continue until March 2007

DAS Block Diagram/First Year Configuration



First Year Operation

- Fuel cell supplied about 2kW to the Power Tower on a continuous basis
- Power Tower continuously supplied house load unless either leg went above 5.5kW or 45 amps
- If load went above, load shedding relaying operated, followed by full load transfer back to grid

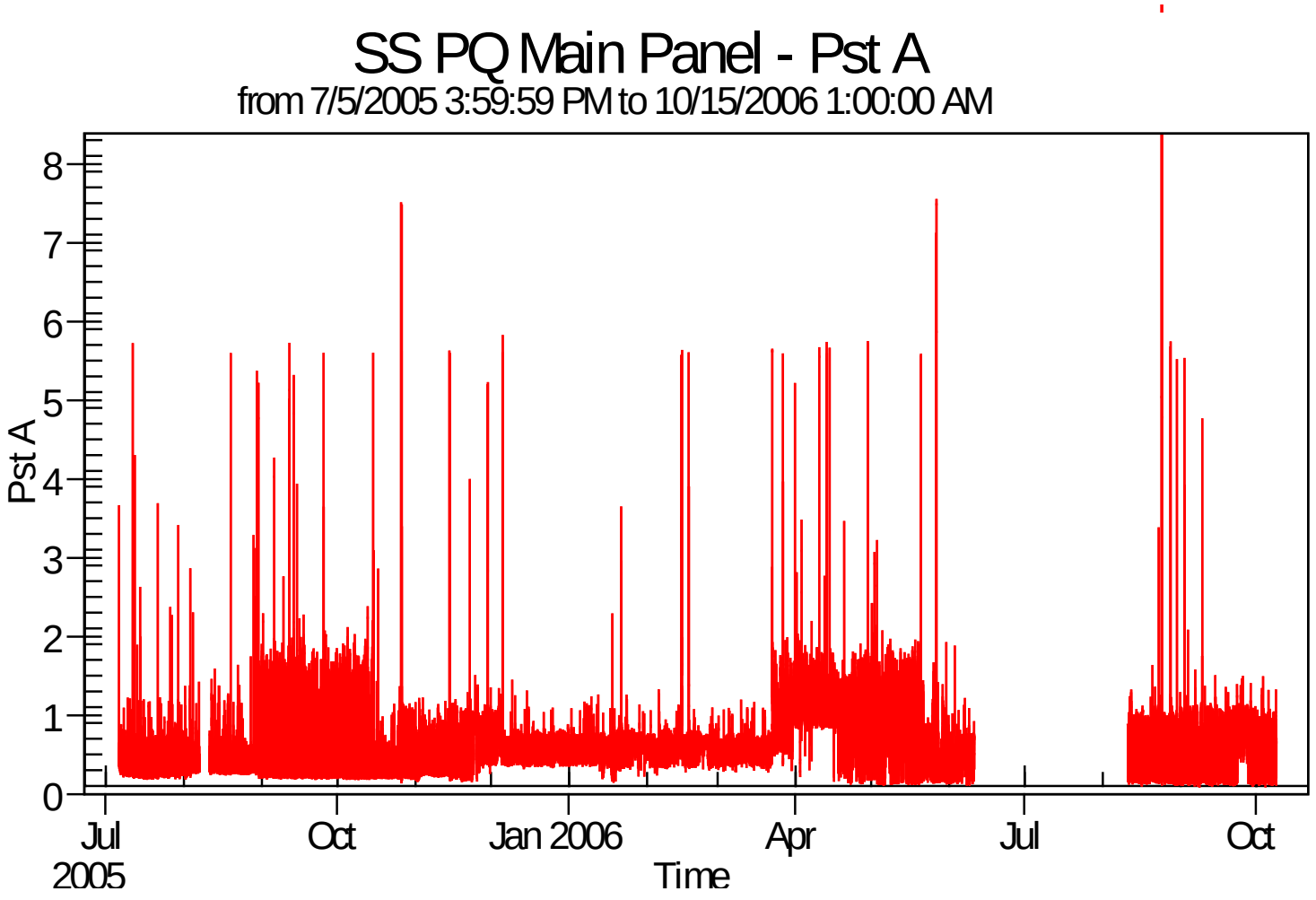
First Year Summary

Month	System Mode
July, 2005	Fuel Cell ON (But new stack was installed during the last week of month)
August	Fuel Cell ON (Net metering but back to full mode on Aug 30th)
September	Fuel Cell ON
October	Fuel Cell ON (Until Oct 26th when outage occurred)
November	Fuel Cell ON (Primarily netmetering then set to OFF position followed by brief operation on Nov 22nd)
December	Fuel Cell OFF
January, 2006	Fuel Cell OFF (Set back to ON position on Jan 15th)
February	Fuel Cell ON (Net metering)
March	Fuel Cell ON (Net metering, Power Tower switched ON March 23rd)
April	Fuel Cell ON (Net metering)
May	Fuel Cell ON (May 20th, switched to Bypass)
June	Fuel Cell OFF (June 5th), Bypass
July	Fuel Cell Removed (July 27th), Bypass
August	Bypass
September	Grid Feeding Power Tower, Power Tower Feeding Loads

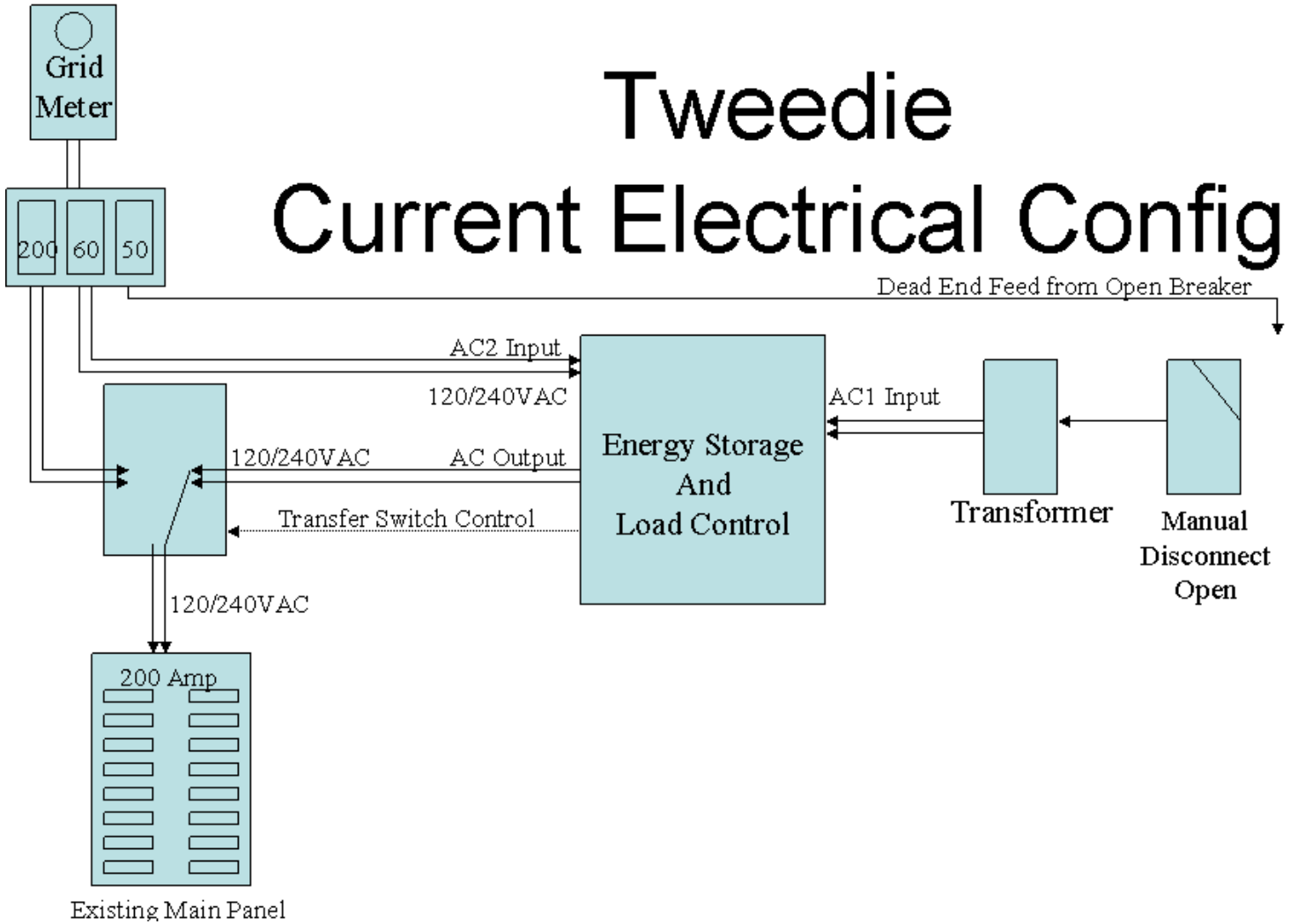
Lessons Learned

- Edge of grid residential application successfully proven
- Battery energy storage system worked as designed
- However, several power quality issues emerged
  - Load shedding relay caused 2 cycle interruptions
  - Inverter operation of Power Tower caused severe voltage flicker that caused homeowner to put system into bypass on numerous occasions

Lessons Learned - cont

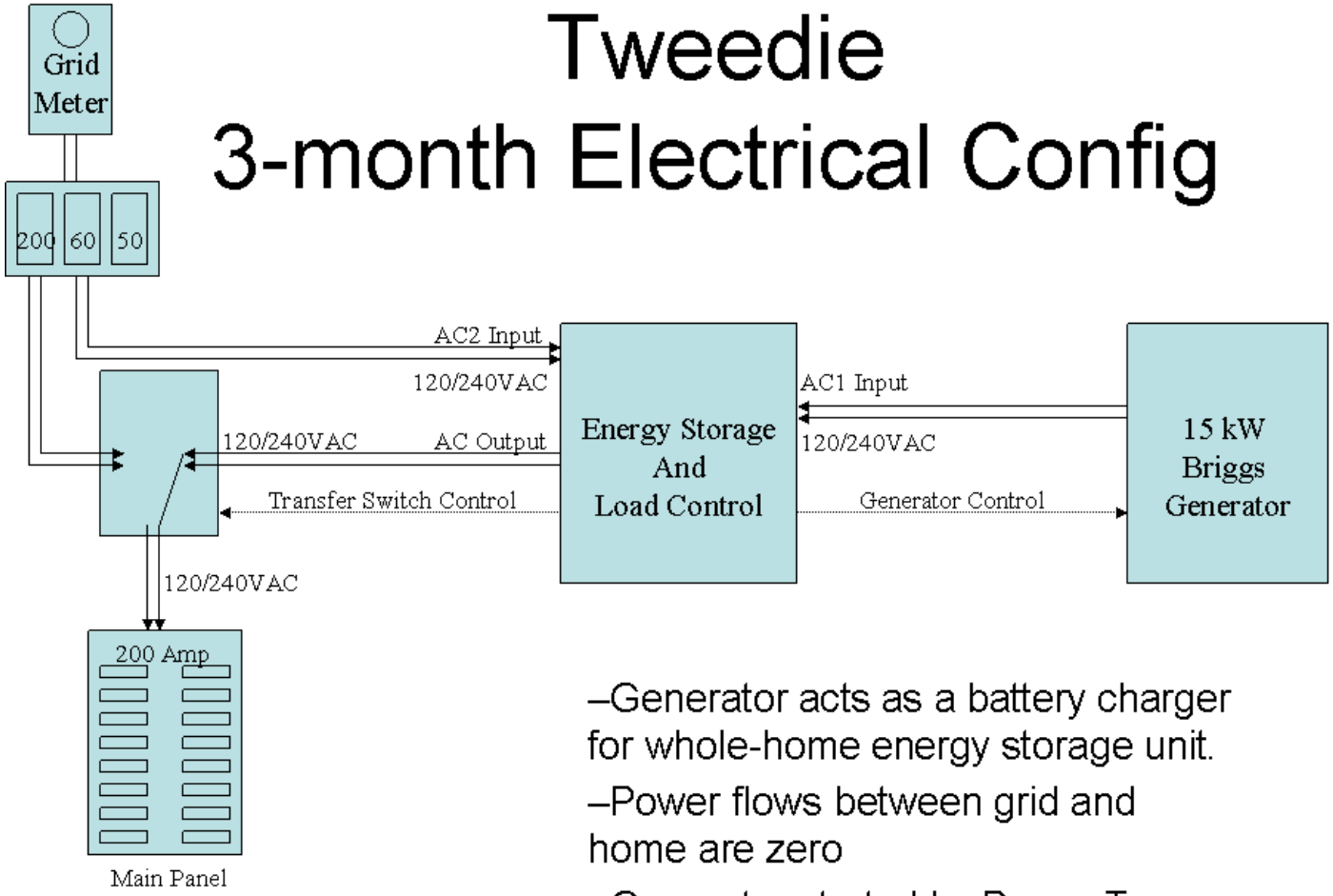


Current Configuration



Future Configuration

Tweedie
3-month Electrical Config



–Generator acts as a battery charger for whole-home energy storage unit.

–Power flows between grid and home are zero

–Generator started by Power Tower Controller

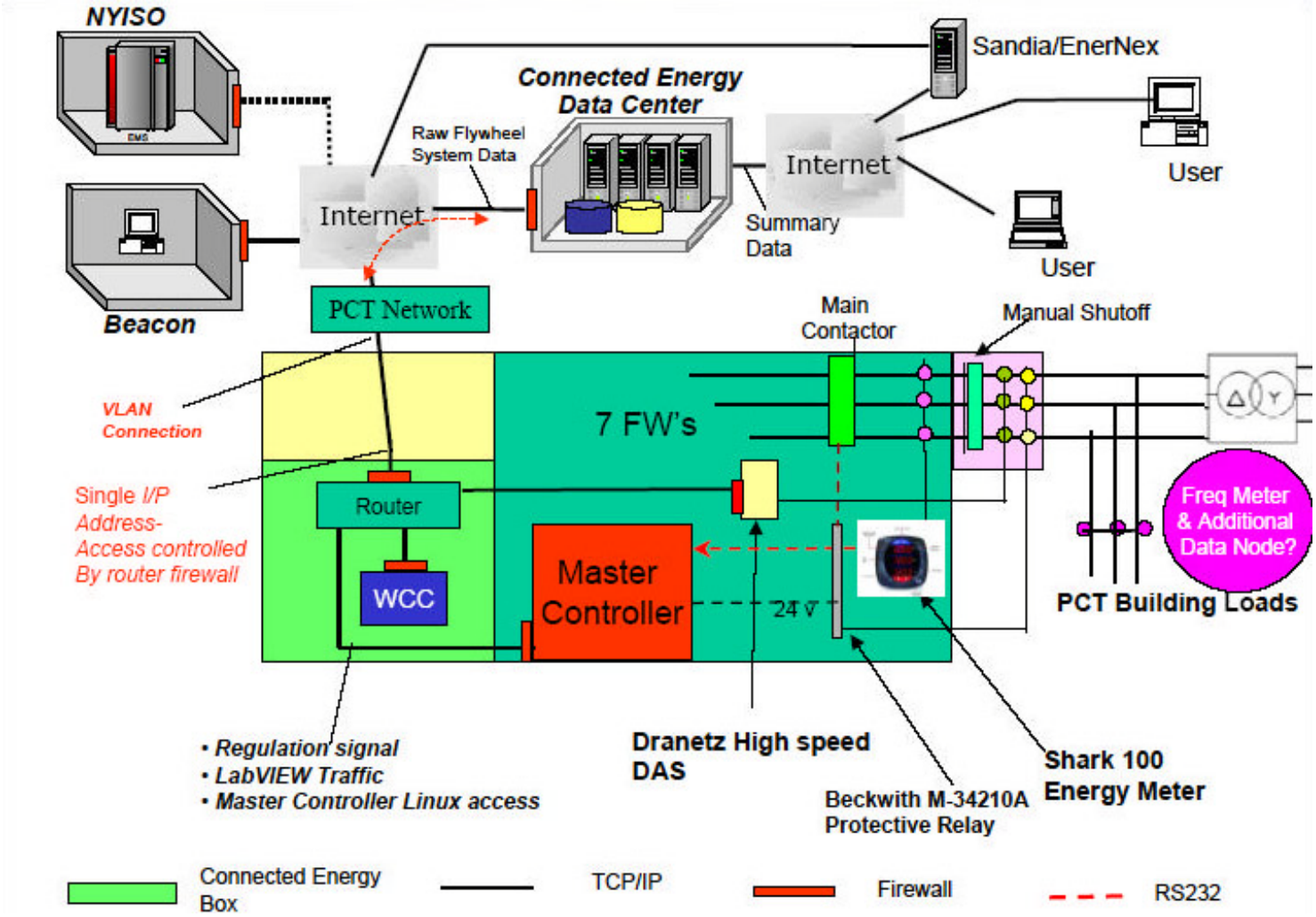
Site 2

- Beacon Power – Grid frequency regulation demonstration at an industrial facility in Amsterdam, NY, using 7 flywheels producing 100 kW for 15 minutes

Timeline

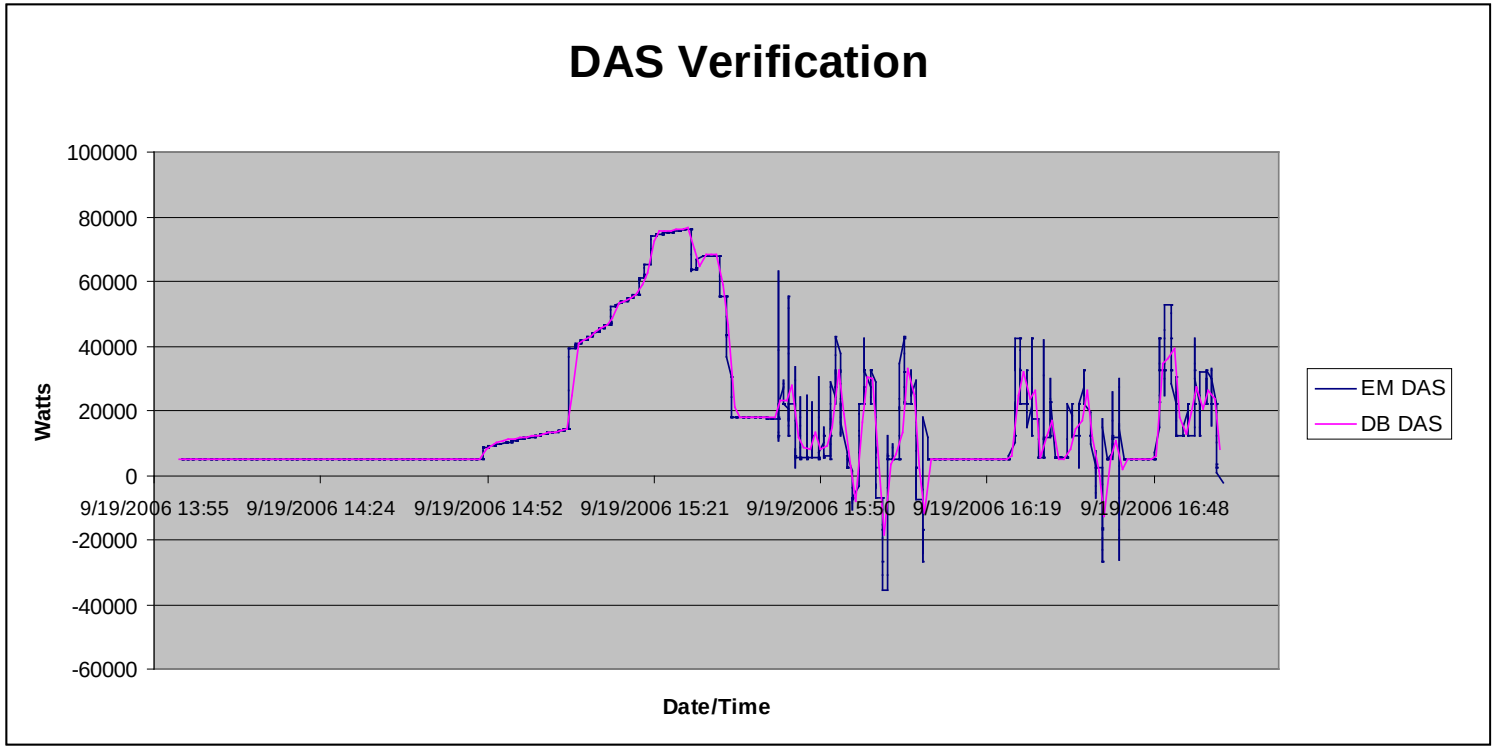
- Service entrance monitored at PCT, Amsterdam, NY from Feb – June, 2006
- Smart Energy Matrix (EM) flywheel system installed in June
- Approximately 1 month of system commissioning and testing
- Monitoring to continue for 18 months

DAS Block Diagram



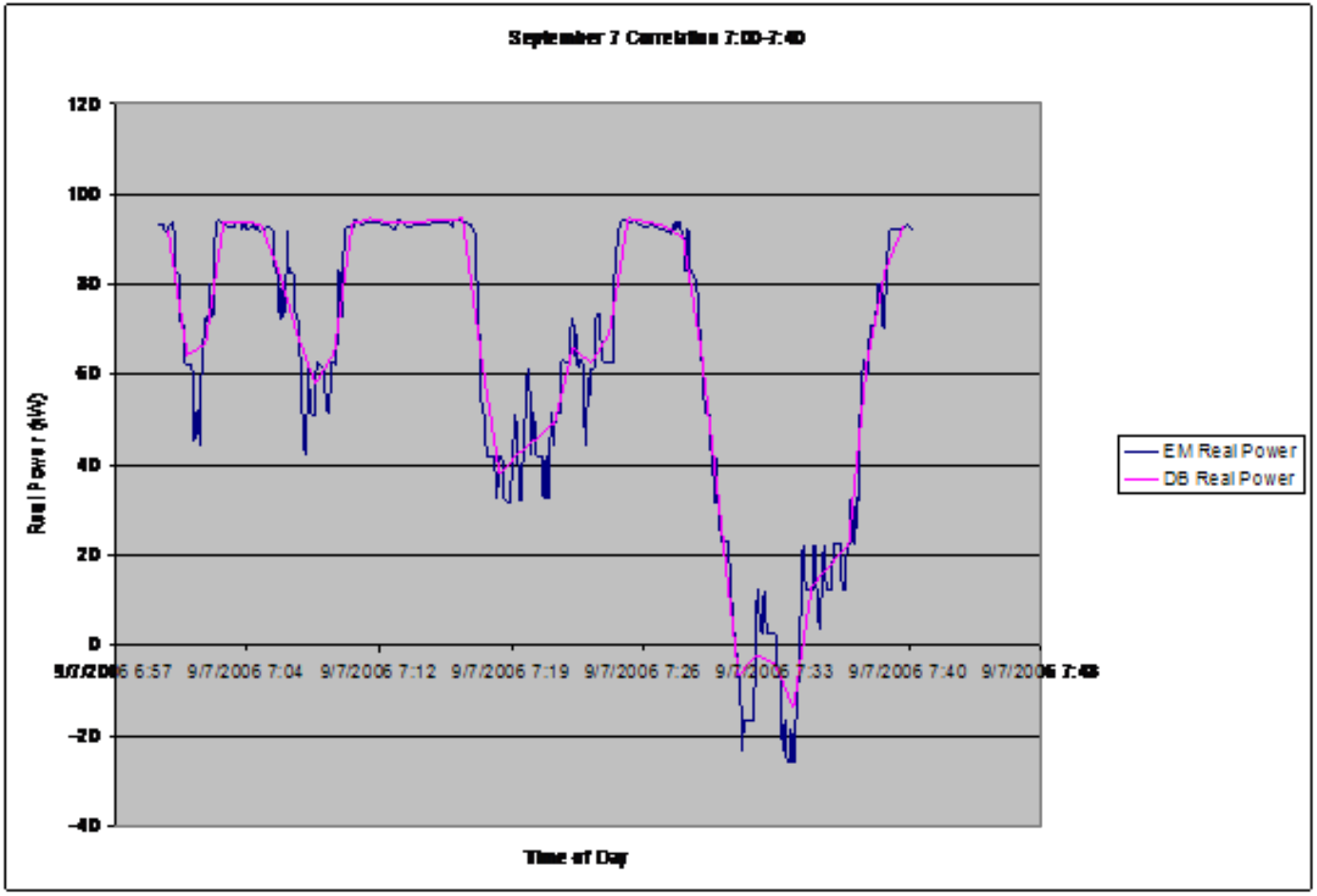
Current Status

- Dranetz being used to verify extensive on board DAS supplied by Beacon Power



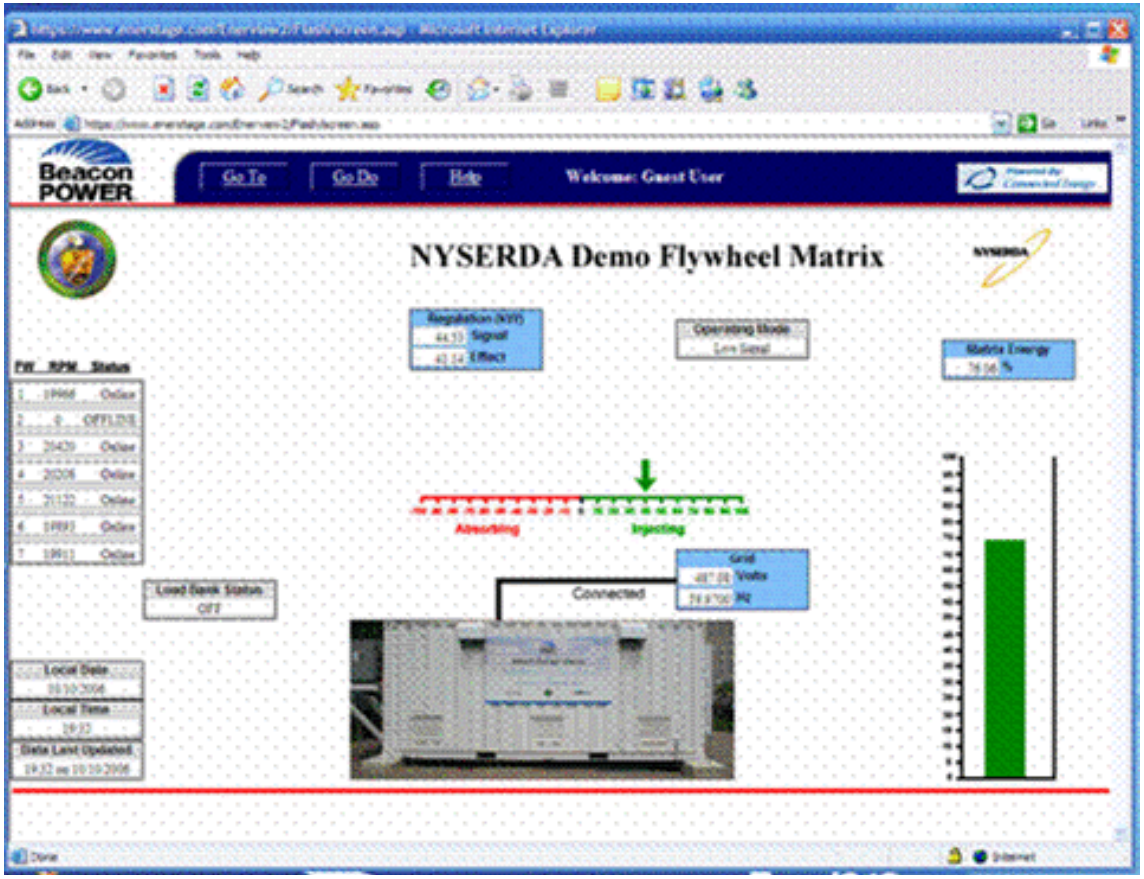
Current Status - Cont

- September 7th verification correlation



Current Status - cont

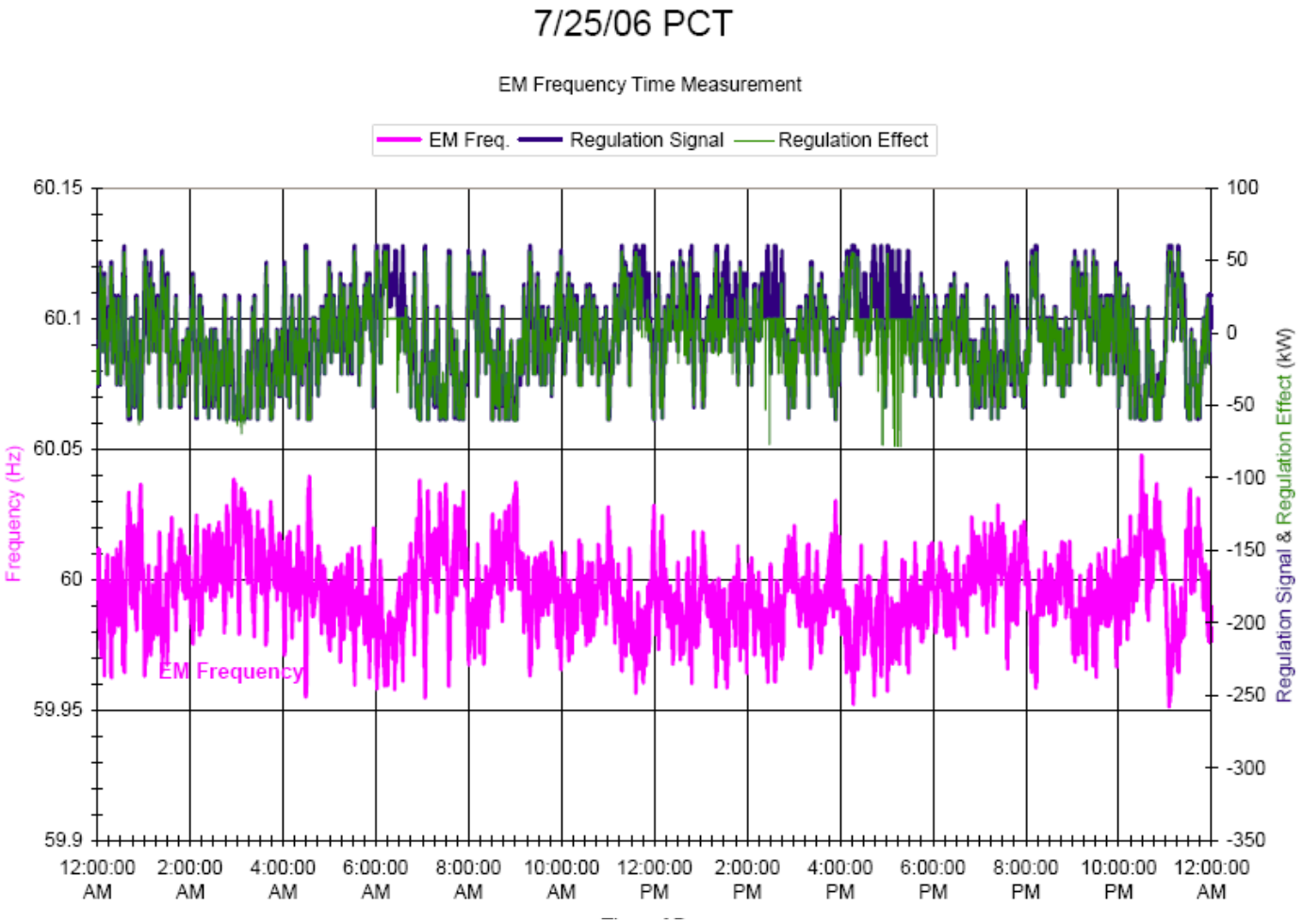
- Real-time data available to public from Connected Energy link on project web page



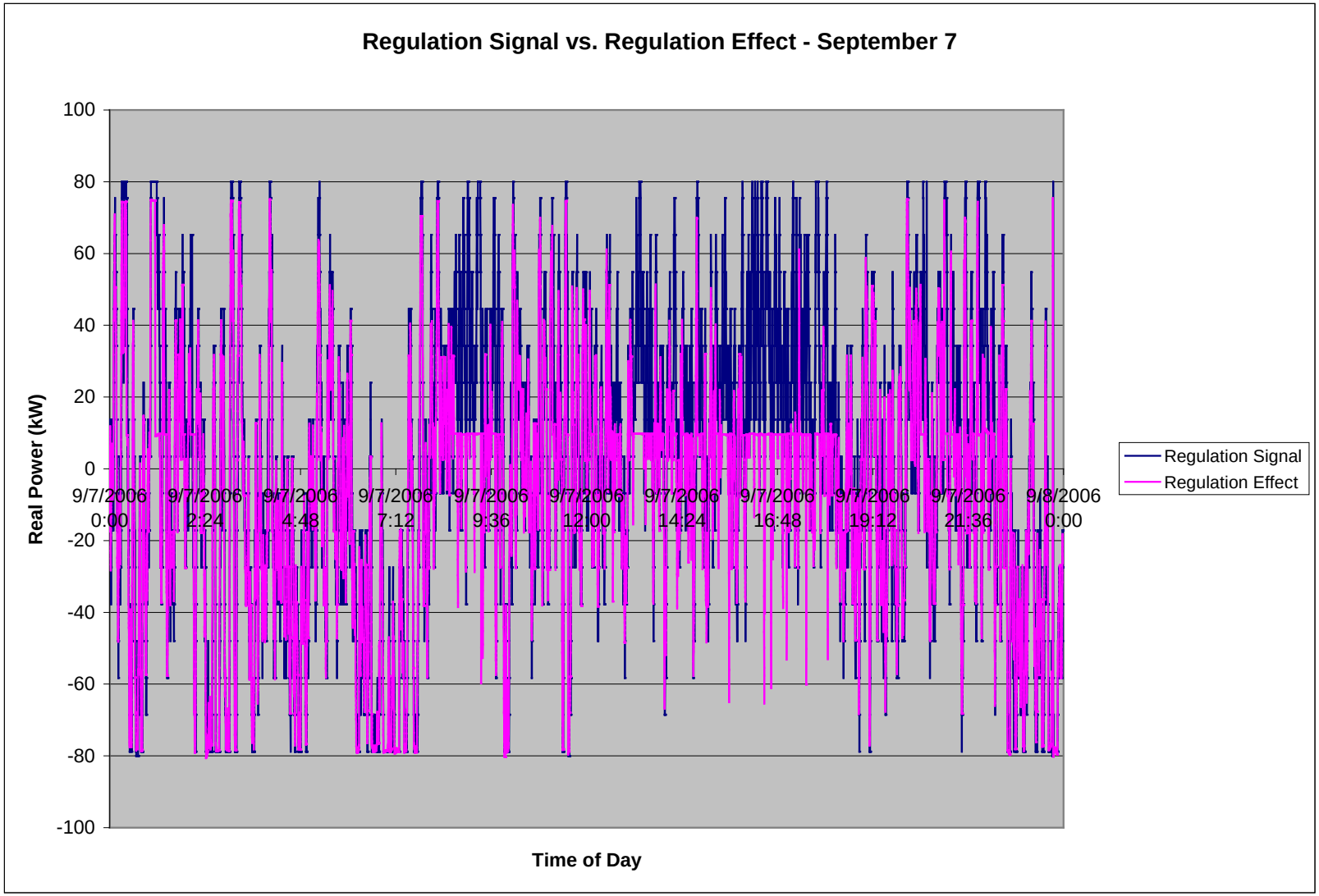
Lessons Learned

- Beacon Power has successfully shown that the EM flywheel system can react to a frequency signal and inject or absorb power as needed assuming energy is available from storage system

Lessons Learned - cont



Lessons Learned - Cont



Site 3

- New York Power Authority/ABB – Peak-shaving and emergency backup application utilizing a 1 MW/7.2 MWh commercial-scale sodium-sulfur (NAS) battery system at a Long Island Bus facility

Timeline

- Signal points list finalized in July, 2006
- System to be commissioned in December, 2006

Signal
Grid RMS Voltage
Grid RMS Current
Grid Real Power
Grid Reactive Power
Grid Apparent Power
PCS Real Power
PCS Reactive Power
PCS Apparent Power
Load Real Power
Load Reactive Power
Load Apparent Power
PCS Real Energy Accumulated – Absorbed Real Energy
PCS Reactive Energy Accumulated – Absorbed Reactive Energy (Inductive)
PCS Real Energy Accumulated – Discharged Real Energy
PCS Reactive Energy Accumulated – Discharged Reactive Energy (Capacative)
System Charge / Discharge Cycle Counter
System Operational Mode

Future Work

- Site 1
  - Continue monitoring and verification of current configuration (grid connected, no backup source)
  - Monitor and verification when Briggs 15 kW generator is installed through March 2007
- Site 2
  - Continue DAS verification and site reporting for 18 months total
- Site 3
  - Work with ABB on file transport mechanism to data center
  - Work on data file conversion and web uploading
  - Monitor and verification after installation in December, 2006