Web-Based Energy Storage Monitoring – Interim Results[1]

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Introduction – A key component in articulating the success of an energy storage demonstration project is the ability to acquire relevant data on system performance. This improves public perception, enables more accurate economic assessments, and provides a quick effective means of determining energy performance, availability and reliability. Many demonstration projects fall short in terms of the ability to go back and review the archived performance data to determine how well the project preformed in these areas.

This paper describes the efforts that have gone into the development and implementation of a remote data acquisition system for several DOE/CEC sponsored energy storage demonstration initiatives. The paper describes each of the important aspects of the data acquisition, data storage and query-able website information. These elements were developed from generic functional and design specifications targeted at insuring that not only were the correct energy metering devices specified, but additionally that the captured data would be available for near real time viewing on the website with redundant storage and backup.

To that end, the we detail two specific areas of importance. The first area will be the data acquisition requirements for the CEC/DOE storage demonstrations with emphasis on the monitor requirements in terms of data capture, storage/archive, sample rates and standards compliance. The second area will highlight the remote monitoring controls and analytical capabilities designed into the website to demonstrate the types of information that can be made available on a near real time basis with a state of the art web-based system.

The storage systems and the associated data acquisition requirements that will be described in the paper include:
1. A distribution system congestion relief project utilizing a zinc bromine battery system.
2. An ultracapacitor energy storage device intended for critical load support and dynamic stability for applications involving distributed generation technologies in a simulated micro-grid.
3. A frequency stabilization system utilizing paralleled flywheel energy storage systems that dynamically absorb and deliver power as dictated by a generation control signal.

To track the performance of these technologies, power monitors will be installed at each demonstration site. Energy-related parameters, such as voltage, current, energy in, and energy out, will be sampled, and the resulting data will be stored for subsequent analysis and presentation.

The main website url can be found at www.energystoragedemo.net/cec and is shown in Figure 1.

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[1] This project is part of the Energy Storage Collaboration between the California Energy Commission (CEC) and the Energy Storage Systems Program of the U.S. Department of Energy (DOE/ESS), and managed by Sandia National Laboratories (SNL).

[2] 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.

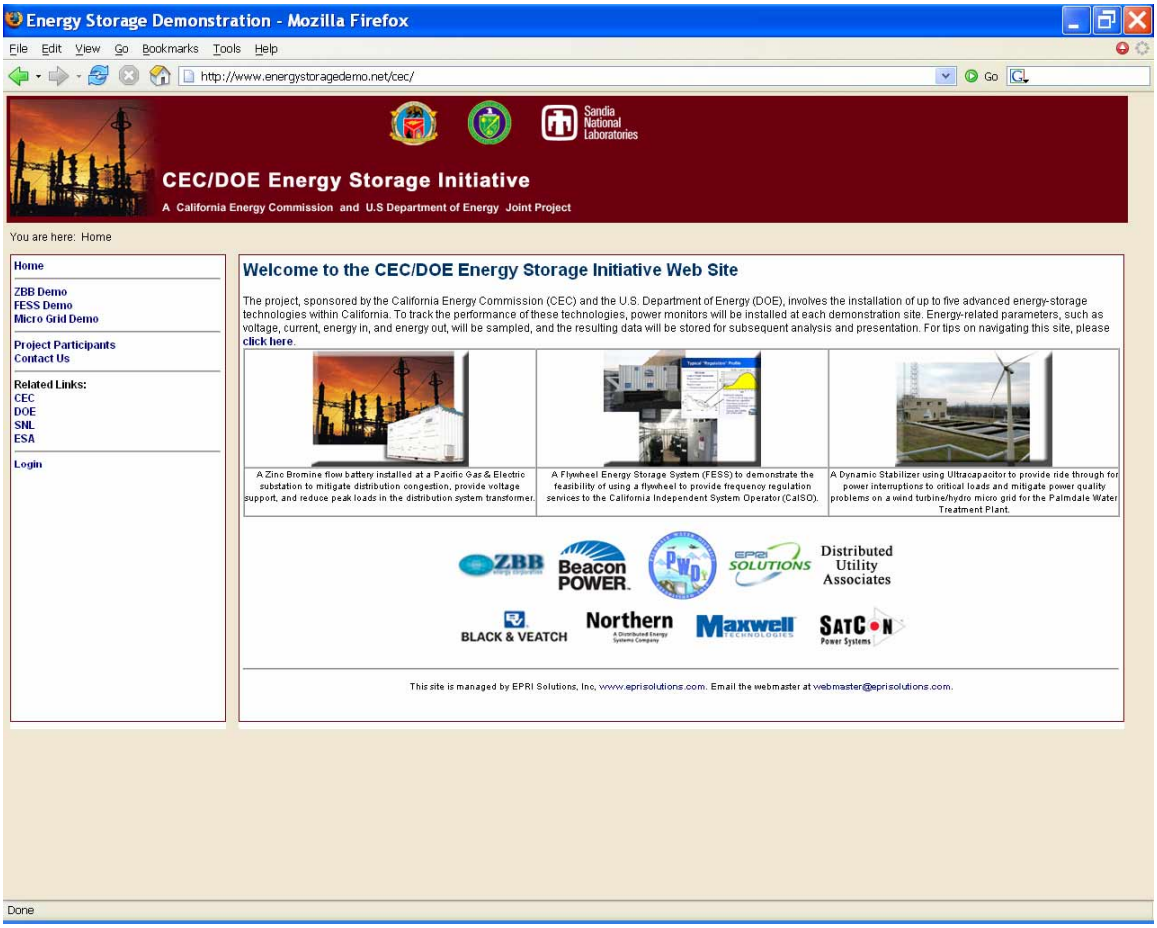

Figure 1. Main Page for the Energy Storage Initiative Website.

Zinc Bromine Battery Project Overview

This demonstration project utilizes a zinc bromine battery storage system installed at an electric utility distribution substation to reduce overloads during peak demand periods. The zinc bromine battery is discharged when the substation circuits exceed a predefined threshold. The objective is to defer a substation transformer upgrade until all associated planning and permitting can be accomplished.

This project offers a unique opportunity to demonstrate and better understand the capabilities of a new energy storage system and compare the economics and lifecycle costs to some of the other T&D deferral options available. The benefits to the state of California, based on a successful demonstration of the Zinc Bromine Battery technology would be the ability to reduce peak demand on the electric power system while continuing to support customers loads and allowing those customers that may normally see a blackout with continuing with process operation and production. The technology has the potential to relieve transmission and distribution capacity at needed times. This is also one of the first demonstration projects where real time monitoring and data collection are being used to measure system performance and validate the system performance.

The main page for the ZBB demo is shown in Figure 2.

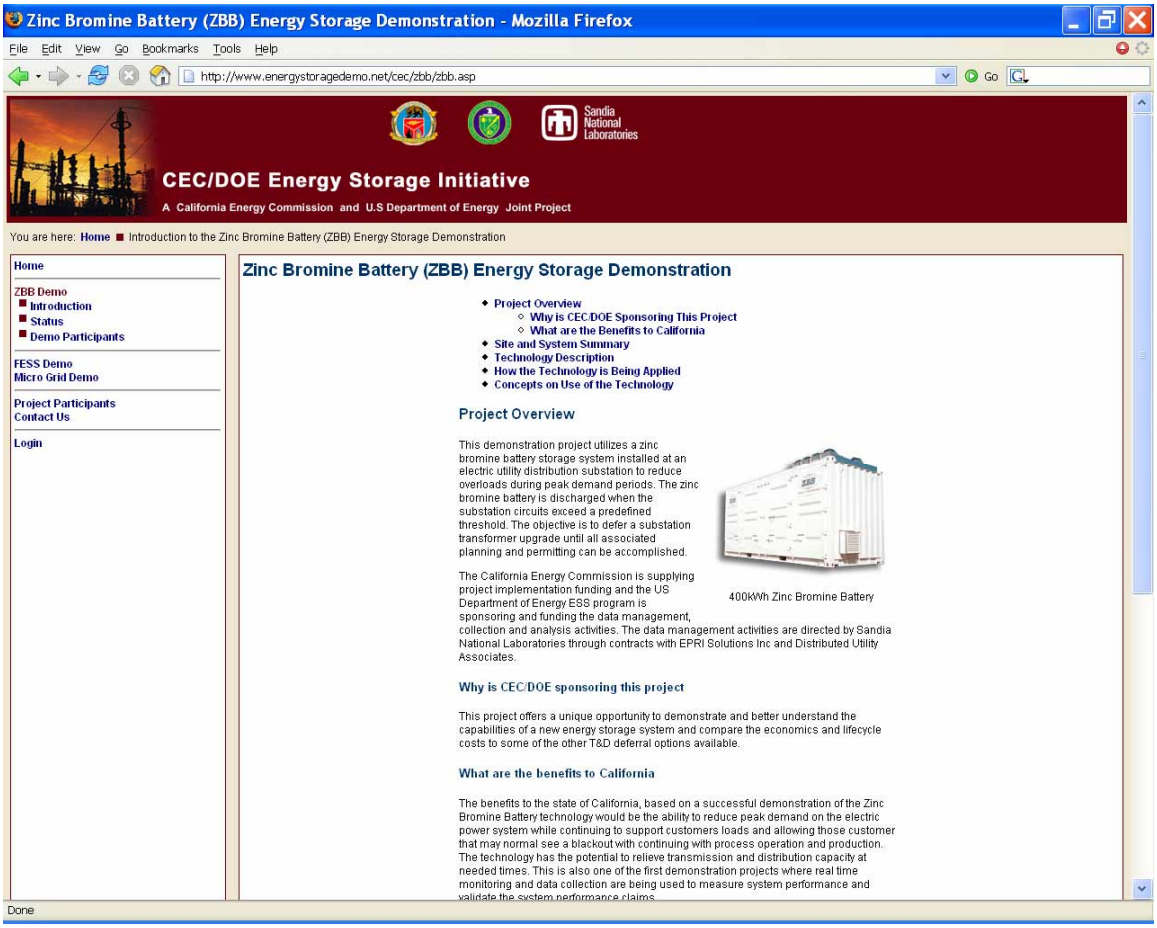

Figure 2. Main Page for the ZBB Demonstration Website.

Frequency Regulation with Flywheel Storage Demonstration Project Overview

California ISO has indicated that if fast responding regulation systems were added in significant quantity to the electric power grid the total amount of regulation services required would be reduced. One concept to provide this frequency regulation would be the use of flywheel energy storage rather than by cycling the output of a generator. A flywheel would quickly add and subtract power (as directed by Regional Transmission Operator signals) but to have a net zero power consumption. Using this concept, the flywheel recycles energy (store energy when generation exceeds loads; discharge energy when load exceeds generation) instead of trying to constantly adjust generator output.

This project is being sponsored to determine the relative benefits of having faster responding generation resources. Additionally, understanding the response time of a flywheel storage system as compared to traditional generator response time will provide a better determination of the required sizing for flywheel and other fast response systems. When aggregated to reach appropriate output/input levels there are many benefits that a flywheel energy storage system (FESS) can offer to the electric grid. The primary benefits are:

- Increased Available energy: Because present day generators need to be operated below their maximum capability to provide regulation, they are not available to provide their maximum power.
- Support Distributed Generation with Local Voltage Support

The main page for the FESS demo is shown in Figure 3.

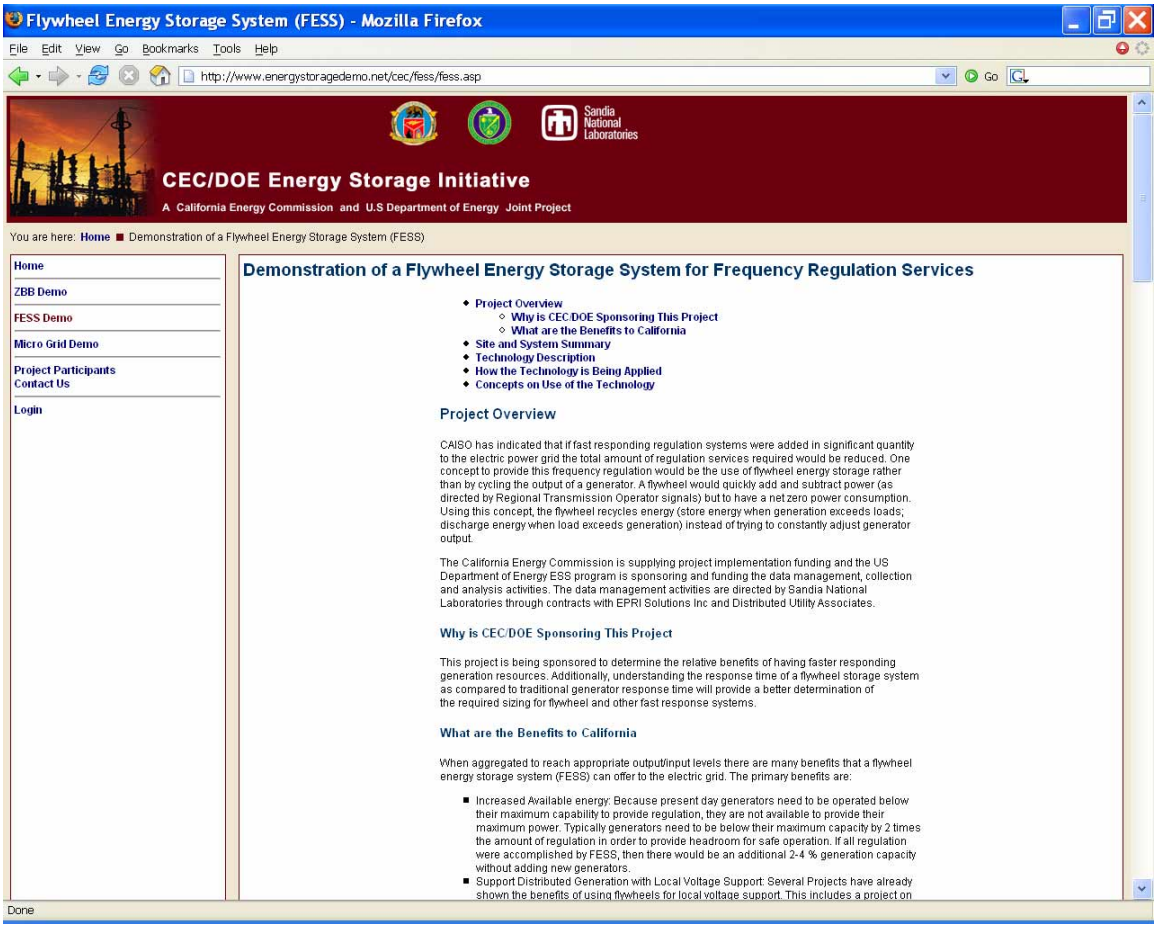

Figure 3. Main Page for the FESS Initiative Website.

Ultracapacitor Energy Storage System

The Palmdale Water District (Palmdale) in California has installed a variety of new distributed energy resources to supply facility power in an environmentally friendly way. These resources include a 950 kilowatt wind turbine, and a 250 kilowatt water turbine generator. It is expected that with these new distributed generation sources, the facility will be able to supply the majority of its electric power needs for the near future.

To supplement the electrical performance of these technologies, Northern Power Systems will develop and demonstrate a 450 kilowatt storage system. The system will be installed at Palmdale's Clearwell Pumping Station. The system utilizes ultracapacitors coupled with advanced power electronics and controls to maintain electric grid stability even during brief power system variations and momentary power interruptions.

This project is being sponsored by CEC and DOE to better understand two key Distributed Energy Storage Technology objectives:

- To evaluate the ability of the Ultracapacitor Energy Storage System to improve power quality for the facilities critical loads.
- To demonstrate the ability of the Ultracapacitor Energy Storage System to isolate part of the facility without shutting down any of the critical equipment during the transition from the grid to the backup generator.

The benefits to the state of California, based on a successful demonstration of the ultracapacitor technology would be the ability to reduce peak demand by enabling facilities to remove load from the power system while continuing with process operation and production. This would potentially relieve transmission and distribution

capacity at needed times. This is also one of the first demonstration projects where real time monitoring and data collection are being used to measure system performance and validate the system performance claims. The main page for the Ultracapacitor demo is shown in Figure 4.

Analytical Capabilities – Each site has been set up such that the collected data can be viewed and graphed on-line. Real time status as well as historical information will be available. Some of the more detailed performance data and proprietary information will be on a secure password protected area, but it is anticipated that the website will provide useful performance information for the general public as well as the project teams. Figures 5 and 6 provide a sample of how the historical data will be set up for display and query.

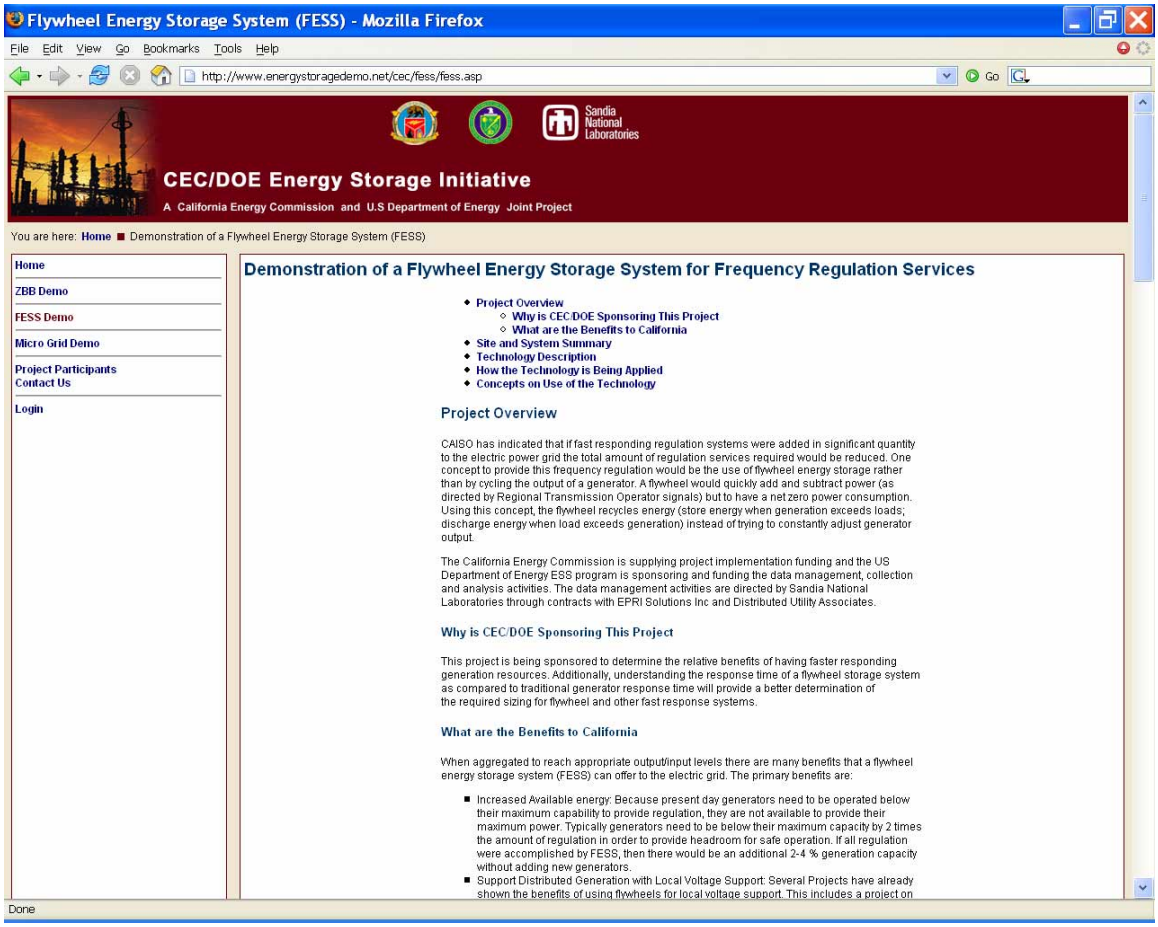

Figure 4. Main Page for the Ultracapacitor Energy Storage System Initiative Website.

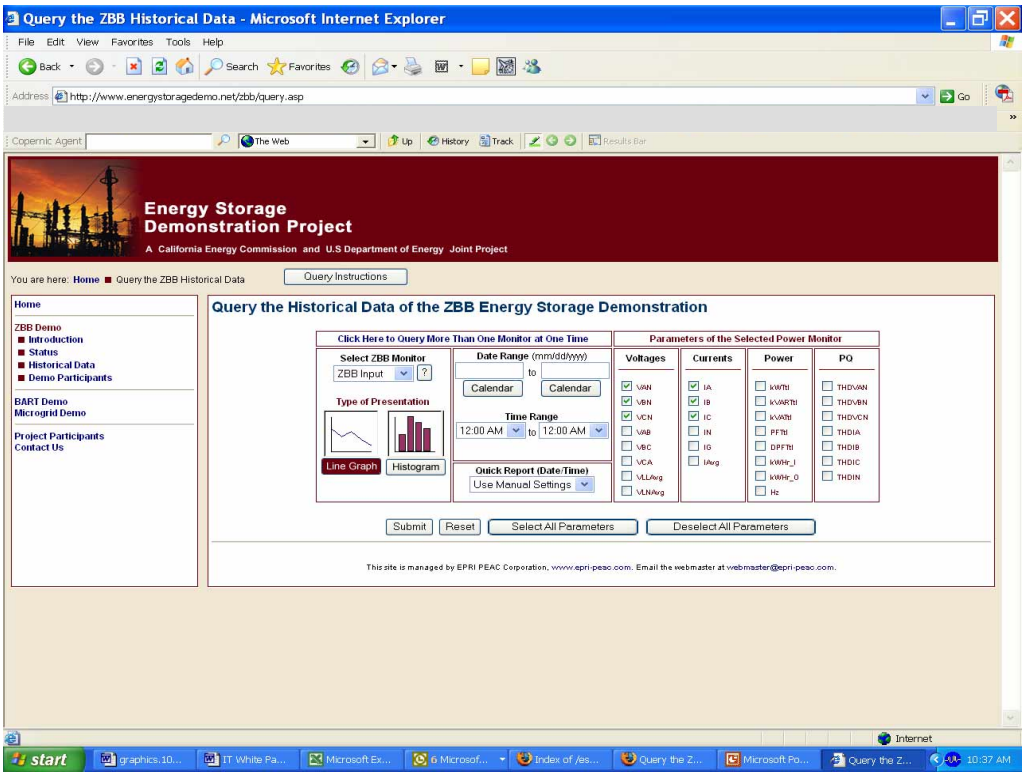

Figure 5. Sample Query Page Information.

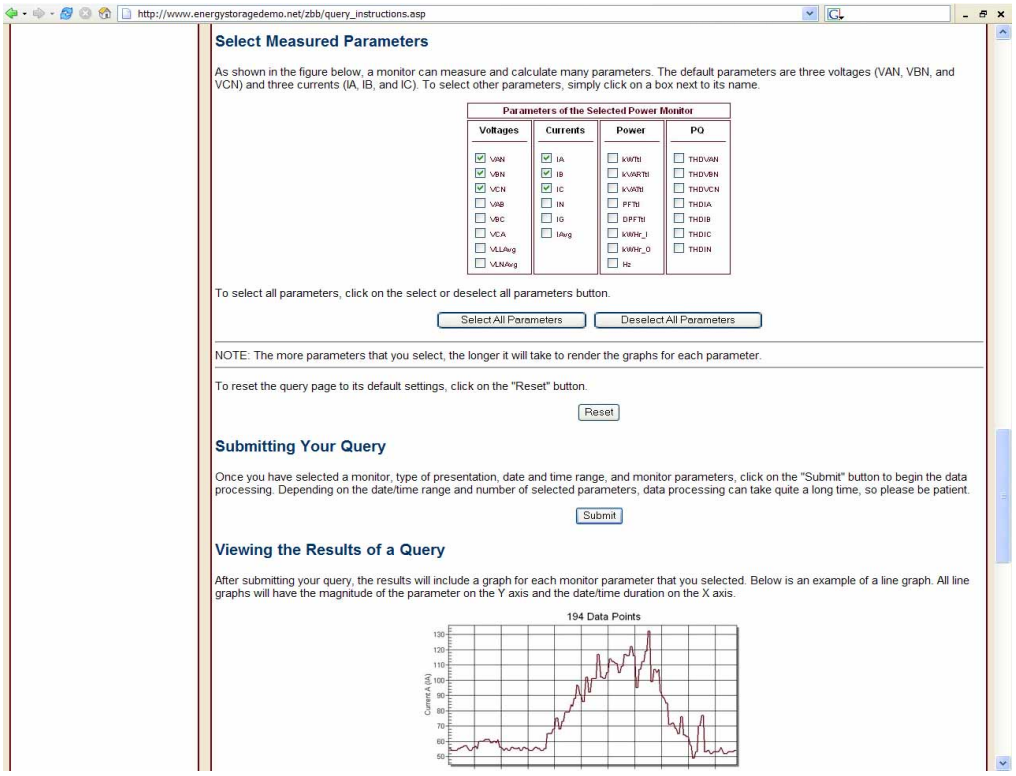

Figure 6. Sample Query Page Information.