

Application Of Energy Storage Devices At American Electric Power

David K. Nichols, Ali Nourai and Harry T. Vollkommer
 American Electric Power, Columbus, Ohio¹

Introduction

AEP has long recognized the need and value of energy storage to the electric utility and, over the years, has applied several energy storage solutions for power quality (PQ) and energy management. As early as 1920, AEP started to use lead acid batteries for equipment protection and control functions to improve the performance, utilization and reliability of the power grid. Our largest bulk energy storage facility is Smith Mountain's 600 MW pumped hydro that was installed in 1965.

Since 1997, AEP intensified its efforts to explore different energy storage technologies. While our initial involvement was driven by PQ needs, it was expanded to include energy management to support peak shaving, upgrade deferral, DC backup of substation's vital control and communications systems and energy arbitrage.

Table I below shows a list of AEP storage applications and current projects with their rated sizes.

Table I – AEP Energy Storage Application and Projects

Year	Technology	Name or Location	Rated Power	Discharge Duration	Application
Since 1920	Lead Acid	Substations DC Controls (4000)	10-30 kW	8 hrs	Backup
Since 1920	Lead Acid	Power Plants DC Controls & lights (40x2)	Up to 140 kW	8 hrs	Backup
Since 1940s	Lead Acid	Telecom Backup (400)	Up to 11 kW	8 hrs	Backup
1965	Pumped Hydro	Smith Mountain, VA	600 MW	11 hrs	Energy Mngmnt
1997	Flywheel	Office Bldg, OH	150 kW	30 s	UPS
2000	High Voltage Cryogenic Caps	Funded Development	5-10 kW	hours (5 Wh/l)	UPS + Energy Management
2001	Lead Acid UPS	Office Bldg, OH	250 kW	30 s	UPS
2002	Sodium Sulfur NaS	Office Bldg, OH	100 kW PS 500 kW UPS	7.2 hrs 30 s	UPS + Peak Shaving
2003	Li-ion	Office Bldgs	100 kW	15 kWh	UPS
2003	Li-ion	Substation DC Controls - Backup	14 kW peak, 0.4 kW cont.	8 hrs	Backup
2003	High Energy Supercapacitors	Distributed on Grid	kW - MW	5 hours	Energy Management

¹ dknichols@aep.com

AEP's Recent Energy Storage Projects (since 1997)

In 1997, AEP needed a UPS system for one of its corporate office buildings that included many computer-based systems. The building is served from a distribution circuit that includes a primary/alternate automatic transfer scheme with 10s transfer time. After a review of options, a 150 kW- 30s flywheel UPS was finally chosen.

In 2000, we funded development of very high voltage cryogenic ceramic capacitors. The goal was to provide compact and low cost UPS and peak shaving functions for residential and small commercial sites.

In 2001 a commercially available 250 kW-30s lead-acid battery UPS was applied to another corporate building that is close to and on the same distribution circuit as the building with the flywheel UPS.

In 2002, AEP installed a 100kW Sodium Sulfur (NaS) battery at one of its corporate buildings for peak shaving and PQ. This battery is equipped with a power conditioning system (PCS) that allows it to function as a UPS device for up to 500kW. This is the first demonstration of this technology in the U.S. through a tailored collaboration agreement with EPRI. Under the sponsorship of the Department of Energy, the system's performance and economic benefits are being assessed. This battery, as well as the above mentioned lead-acid and flywheel UPS systems are all served from the same distribution circuit that includes a primary/alternate automatic transfer scheme. Department of Energy, through Sandia, is sponsoring a comparative study of these three storage systems used as UPS devices. The results of this study would be available and published in Spring 2004.

The figure below shows a 100 kW Li-ion battery from SAFT America and its PCS from SatCon during a recent acceptance test in AEP's Dolan Technology Center. Under the sponsorship of the Department of Energy, this battery will be installed and monitored at several sites on the AEP grid to assess its field performance.



Acceptance Testing of a 100kW Li-ion Battery and PCS in American Electric Power's Dolan Technology Center

Also under the sponsorship of the Department of Energy, AEP is about to start another Li-ion battery project to assess their technical and economic feasibility for replacing the standard high-maintenance lead-acid batteries used for backup of substations' DC operated control equipment.

AEP is presently assessing the feasibility of using high-energy asymmetric electrochemical capacitors for utility applications. Recent performance advances due to improved materials and designs are very promising.