Lead/acid batteries in utility energy storage and power control applications*

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Abstract

Several types of benefits can be obtained with installations of lead/acid batteries at strategic locations in service areas of electric power utility companies, and also at large customer sites Examples will be given of representative projects in different countries, some operational, and some to be built Increasing use of lead/acid battery energy and power storage systems could be favored by improving the performance characteristics of sealed, recombination designs

Electric power utility companies are beginning to see many opportunities to improve their use of existing transmission and generation facilities by augmenting capacity with lead/acid batteries. Benefits (Table 1) can be achieved by installing batteries at strategic locations Installations presently operating, or in the planning/construction stage, are listed in Tables 2 and 3

TABLE 1

Application for Battery Energy Storage (BES) in transmission and generating systems

Transmission/distribution systems (T/D)	
1	Defer need for additional T/D capacity
2	Provide operating reserve
3	Perform reactive power compensation
4	Regulate frequency
5	Regulate voltage
6	Damp out subsynchronous oscillations and other system instabilities
Generating systems	
1	Correct area control error
2	Provide ramping (up or down)
3	Provide black start
4	Provide spinning reserve
5	Reduce cycling of thermal units (reduced wear and tear)

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TABLE 2

Lead/acid battery energy storage systems
(By electric power generating utilities)

Company	Size	In service	Application
Berliner Kraft und Licht (BEWAG)-AG Berlin, F R G	17 MW 14 MW h	1986	Frequency regulation and spinning reserve
Kansai Electric Power Company, Ltd Tatsumi, Japan	1 MW 4 MW h	1986	Demonstration[a]
Southern California Edison Company Chino, CA, U S.A	10 MW 40 MW h	1988	Demonstration[a]
Puerto Rico Electric Power Authority Sabana Llana, Puerto Rico	20 MW 10 MW h	1992?	Frequency regulation and spinning reserve
Public Service Electric and Gas Company Princeton, NJ, U S A.	5 MW 5 MW h	1992?	Area regulation Peak-shaving[b]

[a]Multi-purpose test program, see examples in Table 3
[b]Shared facility with customer

The Chino facility has the largest battery, 40 MW h at the *C*/4 rate, comprising 8256 cells of an Exide deep-discharge traction design (3200 A h). Load-following and VAR control are two of the most useful operating modes, relieving a nearly overloaded 12 kV distribution transformer bank (Fig 1). A new modification to the control system is expected to allow a most cost-effective use in stabilizing power on the high voltage transmission system. The 10 MW self-commutating General Electric converter should be able to permit an increase in out-of-state power transfer capability by up to 200 MW

A wide range of lead/acid battery technologies is used in the energy storage systems and includes automotive (Muncie), sealed (Humboldt), submarine (Hagen), and UPS float (Manweb) designs.

Frequency control is the primary need at Berlin and at Puerto Rico, with reserve power as an additional benefit. It should be noted that using batteries for spinning reserve (instead of a 35 MW combustion turbine) has provided enough savings in fuel to pay the entire cost of the Berlin 17 MW facility in just two years.

Non-generating, distribution utilities that are reducing peak-power demand charges from their supplying utilities are at Hammermühle (the oldest in operation) and at Crescent. Each one uses deep-discharge industrial cells.

An experiment in sharing a battery facility is planned at the Princeton Plasma Physics Laboratory, in which the supplying utility — the Public Service Electric & Gas Company — will use the system for area regulation, except for the infrequent demands of the customer for peak power.

TABLE 3

Lead/acid battery energy storage systems (By customers)

Company	Size	In service	Application
Elektrizitatswerk Hammermuhle[a] Selters, F R G	440 kW 400 kW	1980	load-levelling and peak-shaving
Hagen Batterie AG Soest, F R G	500 kW 7 MW h	1986	load-levelling and peak-shaving
Crescent Electric Membership Corporation[a] Statesville, NC, U S A	500 kW 500 kW h	1987	load-levelling and peak-shaving
Delco Remy, Division of General Motors Muncie, IN, U S A	300 kW 600 kW h	1987	peak-shaving
Vaal Reefs Exploration and Mining Company South Africa	4 MW 7 MW h	1989	peak-shaving and emergency power
Johnson Controls, Inc , Humboldt Foundry Milwaukee, WI, U S A	300 kW 600 kW h	1989	peak-shaving, load-levelling
EAB, Berlin, F R G	3 MW 1 MW h	1991?	peak-shaving (subway)
SDTC, San Diego, CA, U S A	200 kW 400 kW h	1991?	peak-shaving (trolley)
KIER, Korea	200 kW 800 kW h	1991?	Load-levelling (demo)
Manweb, Chester, England[a]	40 kW 80 kW h	1990	load-levelling
Spain	1 MW 2 MW h	1991?	load-levelling and peak-shaving

[a]Secondary distribution utilities

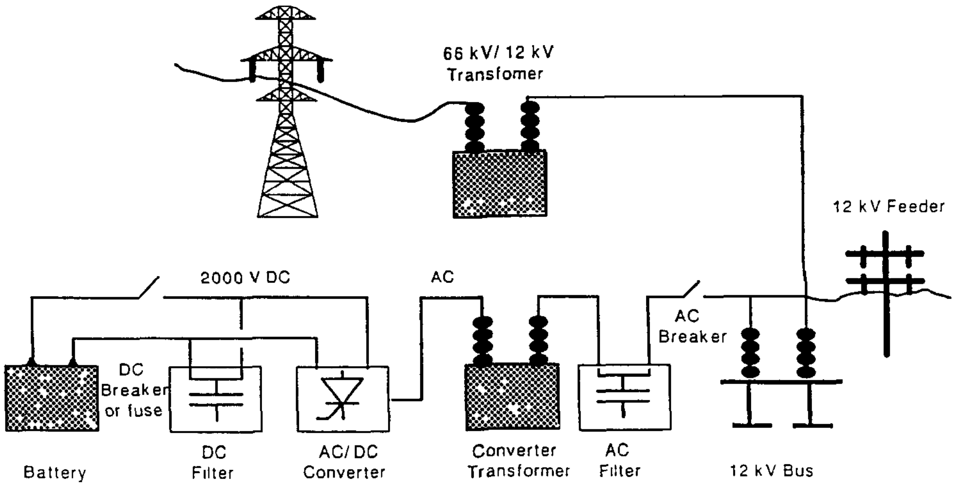

Fig 1 Schematic of 10 MW lead/acid battery energy storage system at Chino

An increasing use of lead/acid batteries in the future may depend heavily on improving the performance versatility and reliability of sealed, recombination designs [1]. The present installation at Humboldt, and the ones planned at San Diego and Princeton, will be indicators of what can be expected from both the gelled-electrolyte and the absorptive-glass-mat types of cells

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Reference

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