

Zinc Manganese Dioxide Battery for Long-Duration Stationary Energy Storage



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Startup
Urban Electric
Power
Pearl River, NY

Host
EPRI

Technology Solution

Energy storage is a key enabling technology in the electric grid’s ongoing transformation to generate cleanly, be more resilient, and host ubiquitous distributed energy resources. Battery energy storage systems are being deployed to help increase the value of renewable generation at distributed and utility scales, provide customers with uninterruptible and backup power supply services, and meet grid support needs over durations of up to several hours.

This pilot focused on performance testing of zinc manganese dioxide ($ZnMnO_2$) batteries developed and integrated into an energy storage system by Urban Electric Power (UEP) for long-duration applications. UEP’s technology leverages the same chemistry used in familiar “AA” alkaline battery cells, drawing on abundant and affordable raw materials but instead rechargeable for grid-tied energy storage. Cells are compliant with applicable safety standards and, unlike lithium ion technology, are not susceptible to thermal runaway. UEP manufactures its batteries and assembles its storage systems in New York, and balance-of-system components also are made in the United States. In addition to uninterruptible power supply (UPS) products, UEP is developing energy storage solutions expected to reach commercial readiness in 2022 for customer and utility applications.

Project Overview

In this pilot project, EPRI and UEP collaborated to investigate the performance characteristics of the company’s $ZnMnO_2$ battery storage system, assess suitability for utility use cases, and inform product development. Key project milestones included system manufacturing, shipping to the test site, system installation and commissioning, characterization testing according to Energy



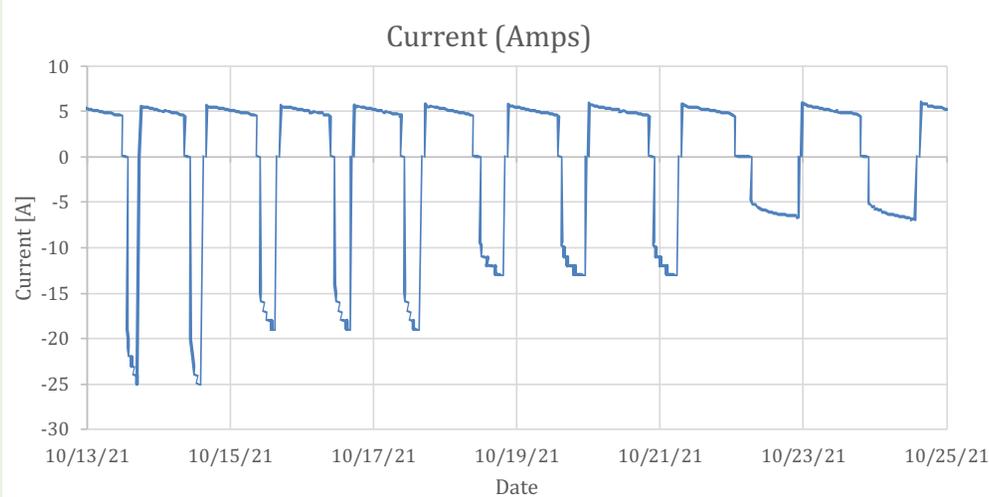
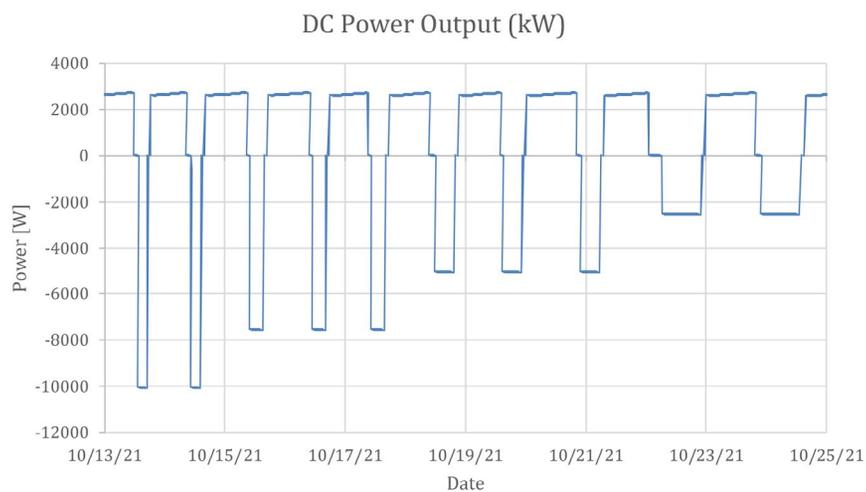
Like other stationary storage battery platforms, UEP’s technology offers the advantages of modularity—but $ZnMnO_2$ batteries also are based on materials that are globally abundant and not subject to thermal runaway.

Storage Integration Council (ESIC) protocols, and use case testing.

The $ZnMnO_2$ system under test has the following specifications:

- Rated power: 10 kW
- Maximum power: 20 kW
- Rated energy: 40 kWh
- Maximum energy: 60 kWh
- Operating voltage range: 600-350 V_{DC}

Due to technology challenges encountered with characterization testing at EPRI’s SolarTAC facility in Colorado, a duplicate $ZnMnO_2$ system was manufactured and installed at UEP’s factory in New York to support a parallel testing program.



Sample energy capacity testing results show power (left) and current (right) levels through 12 charge/discharge cycles performed at various rates. Discharge periods ranging from 4 to 16 hours demonstrate the UEP storage system’s applicability for long-duration use cases.

Results & Learnings

The tight timeline for this project required expedited battery manufacturing and system assembly, as well as alternative sourcing of some components, such as the battery racks. Nonetheless, manufacturing and installation proved straightforward and were completed on time.

System characterization testing following ESIC protocols—including charging/discharging to establish nameplate power and capacity—was performed at SolarTAC and is ongoing at UEP’s facility, to be followed by use case testing. Test results like those shown in the above graphs have been revealing in demonstrating discharge periods ranging from 4 to 16 hours applicable for long-duration energy storage use cases. Deployment experiences also are providing feedback to product development.

Additional commissioning support for demonstration and pre-commercial energy storage systems will help ensure batteries arrive safely, are monitored during initial use, and set up for optimum operation. The devices tested at SolarTAC and in New York do not incorporate a battery management system (BMS) as $ZnMnO_2$ technology does not require one. Learnings from the testing have prompted UEP to evaluate how BMS integration could improve performance and functionality for end users.

UEP’s batteries are compatible with commercially available power electronics, and inverters from several manufacturers are currently used in its energy storage systems. UEP is actively collaborating with these manufacturers to further optimize system integration and help firm up product supply for future projects.

Implications & Next Steps

Pilot project results highlight the potentially broad applicability of UEP’s stationary storage technology. Use case testing will proceed once characterization testing is complete. Applications to be examined include peak load shifting, resiliency, and even substation power backup.

After successful completion of testing, UEP will look to deploy additional $ZnMnO_2$ storage batteries in collaboration with partner utilities and in demonstration programs administered by the California Energy Commission and New York State Energy Research and Development Authority. While current system controls are sufficient for a test environment, end users may require a more user-friendly control platform. Enhanced battery and energy management systems will be considered for use in future UEP installations.

Resources

Gabe Cowles, Vice President, Finance & Business Development, Urban Electric Power,
gabe@urbanelectricpower.com

Eva Gardow, Technical Executive, EPRI,
evgardow@epri.com

TESTIMONIAL: Urban Electric Power

Gaining traction with a new battery technology can be challenging because prospective users and deployment partners have questions around performance and safety that must be addressed. Incubatenergy Labs has provided an ideal platform to generate a credible data set and demonstrate our energy storage system's characteristics in a collaborative environment while gaining access to leading utilities.

TESTIMONIAL: EPRI

Working directly with the developer of a promising technology for long-duration energy storage is very exciting given the electric sector's great need for new options with potential for broad applicability and many high-value uses. Independent testing under controlled conditions also has provided feedback to help UEP accelerate the commercialization of its rechargeable alkaline battery energy storage system.

Resources

Erik Steeb, Incubatenergy® Lead
esteeb@epri.com; 650.680.6530

Annie Haas, Incubatenergy® Challenge Lead
ahaas@epri.com; 704.608.6314

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labs.incubatenergy.org

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