

PNNL CAPABILITIES FOR GRID-INTERACTIVE EFFICIENT BUILDINGS

Thermal Energy Storage System

- 80-ton chiller unit with pumping station and three ice storage tanks
- Connected to a PNNL laboratory and office building
- Tests transactive energy concepts, leveraging building operations to improve power grid reliability and energy efficiency

A UNIQUE CAPABILITY

Installed at PNNL's Systems Engineering Building (SEB), an office and laboratory structure, the storage system and the SEB together comprise a unique testbed capability. The storage system consists of a chiller, three large ice storage canisters, and associated controls. The chiller circulates glycol through the water-filled canisters to create ice, and also generates chilled water to cool the SEB.

The storage system can operate in multiple modes that support various functions and research aims. For instance, when electricity is less expensive, such as at night, the chiller can address SEB cooling needs while also making ice in the canisters. The ice is then used during the day, when electricity costs typically are higher, to provide cool air to the SEB. Learning how processes like this can be optimized to

take advantage of lower-cost electricity—while concurrently maintaining building functionality and occupant comfort—is a key focus of PNNL's buildings-grid research.



The thermal energy storage system, adjacent to PNNL's Systems Engineering Building, includes a pumping station (foreground), chiller unit (middle), and three large ice storage canisters.

INFORMING GRID SERVICE AND CLEAN ENERGY APPROACHES

The shifting of chiller and ice canister operations to times of less electricity demand is one type of a “grid service”—that is, a building uses a method, such as the storage system, to manage its use of electricity in a way that takes pressure off the grid during peak electricity consumption periods. In turn, this enables the grid to better balance supply and demand, improving reliability and flexibility.

Such an approach is particularly helpful in managing and mitigating the ups and downs of clean energy use on the grid. For instance, in a scenario in which the wind suddenly quits blowing and energy generation at a wind farm plummets, the grid could quickly turn to other options, such as electricity load management in buildings, to make up the deficit.

PNNL’s research efforts and capabilities, augmented by the storage system, are informing grid service and other strategies to help make large groups of buildings (campuses, communities, etc.) significant contributors to improved grid operations and energy efficiency.

STORAGE SYSTEM SPECIFICATIONS

- » 80-ton-capacity chiller unit that generates ice and/or chilled water
- » Three ice storage tanks, each with a capacity of 162 ton-hours
- » System operations in six modes: 1) off; 2) cooling with chiller only; 3) cooling melting ice only; 4) cooling with chiller and ice; 5) make ice; 6) make ice and cool.

The storage system is being used in the PNNL-led Clean Energy and Transactive Campus Project (CETC), which is exploring buildings-grid integration strategies to increase availability of clean energy resources.

FUNDING SOURCE

The State of Washington’s Department of Commerce funded the system as part of its efforts to establish testbed capabilities in the state to advance clean energy. The state also was an original CETC funding partner with the U.S. Department of Energy.



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