Microgrid in a box opening new possibilities in defense, utilities, disaster relief

February 9 2023

INL's Microgrid in a Box includes 320 kilowatt-hours of battery storage, and can tie seamlessly into a modern electrical grid and coordinate the distribution of electricity for a small village, military base or other critical infrastructure building. Credit: Idaho National Laboratory

In the back lot behind a building at Idaho National Laboratory building in Idaho Falls, energy systems engineer Kurt Myers leads me outside to look at a nondescript shipping container and an enclosed trailer. While at first glance, these generic-looking boxes might be used to transport

anything, a closer look reveals panels of sophisticated hookups, gauges and indicator lights connected to a nest of thick electrical cables. Those cables connect to solar panels and a small wind turbine, which are also tucked away behind this state-of-the-art laboratory.

There is more going on here than meets the eye.

This collection of mobile trailers and containers is a fully functional microgrid. Dubbed the Microgrid in a Box, it includes 320 kilowatt-hours of battery storage, and can tie seamlessly into a modern electrical grid and coordinate the distribution of electricity for a small village, military base, or, in the event of a disaster, a hospital, transportation depot, or other critical infrastructure building.

The project is a collaboration with private industry and government customers. An early version of the Microgrid in a Box has already been deployed for military use in Kuwait.

"While we've developed a lot of this for military applications, especially for overseas bases where a lot of the infrastructure is nonpermanent or semipermanent, Microgrid in a Box can also be used for outage support or essential services during a disaster," Meyers said. "Because it's easy to disassemble and move, Microgrid in a Box sidesteps the need for construction, and enables us to work more effectively with diesel generators—or even to replace them with carbon-free technologies such as nuclear, solar and those that run on clean fuels."

One of a kind

While researchers have built microgrids with similar capabilities in the past, this is the first portable system at this scale with all its advanced control features and specifications. The microgrid can manage about 250 kilowatts of electricity and work in both U.S. and U.K. standard

electrical systems.

For comparison, the Center for Advanced Energy Studies building in Idaho Falls requires an average of about 350kW. "We could power about two-thirds of that building for a period of time, depending on the energy resources utilized during the integration," Myers said. "That would be like a small hospital or a critical part of a large hospital."

"We wanted something portable with some significant size to it," Myers continued. "To make this stuff portable and with all the needed features is not easy. It's not a standard offering in the market. Batteries and inverters of this type weren't typically rated for mobile applications."

But what makes the Microgrid in a Box truly unique is its flexibility to manage and coordinate electricity generation from any number of sources including solar, wind, nuclear, or a diesel generator while also playing nice with the electrical grid, offering grid services options.

Most microgrids are focused on either the needs of the end user (say, powering a hospital) or working seamlessly for a utility on their side of customer meters. The Microgrid in a Box employs several technologies that enable it to play both roles.

"The battery is the shock absorber and a throttle addition for renewable power and utility services," Myers said. "When you have a lot of variable renewables, you need to have the storage to help manage the systems."

The mobile microgrid is also equipped with special inverters—devices that convert direct current (DC) voltage to alternating current (AC) voltage and power. The system is capable of handling about 200kW of AC-coupled, inverter-based generation from sources such as wind, nuclear and/or solar plus an additional 250kW AC of fueled, synchronous generation.

These inverters give the microgrid operators a lot of control. "The level of control depends on how smart the inverter is and what the control systems are," Myers said. "It's a much more fine-tuned control if I can throttle incrementally."

Right now, the microgrid is connected to a solar trailer, multiple rows of deployable solar photovoltaics, a utility grid, a tiltable wind turbine and smaller inverter trailer at INL's Energy Systems Laboratory. In the future, Myers and his team are planning to test with other systems, including a small hydrogen production system, hydrogen or ammonia-based generation systems, and INL's Critical Infrastructure Test Range

As with the early system currently deployed in Kuwait, the Microgrid in a Box will likely be used for Department of Defense application demonstrations first. Yet Meyers acknowledges that there is a broad interest in applying the technology in utility and emergency relief arenas as well.

"There is really nothing like this out there in terms of controls, advanced features, energy content," Meyers said. "We know a lot of people are paying attention to what we're doing here, and we'd welcome the opportunity to talk to them about what it is, how it's different, and compare notes."

Provided by Idaho National Laboratory

Citation: Microgrid in a box opening new possibilities in defense, utilities, disaster relief (2023, February 9) retrieved 27 April 2024 from https://techxplore.com/news/2023-02-microgrid-possibilities-defense-disaster-relief.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.