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Improving Power Availability with Microgrids

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Portions of the electrical power grid in the United States often fail, leaving millions of people without power, sometimes for weeks. In 2012, Superstorm Sandy, the second most costly hurricane in U.S. history, caused six million people to be without power in several states along the Eastern Seaboard. Hurricane Matthew took down power for three million people in the U.S. Southeast. These storms also disrupted diesel fuel supply, hindering attempts to keep emergency power-generation stations operating.

Now more and more, communities are looking into the feasibility of deploying microgrids to ensure the continuation of power should the major power grid go down. Let us look at what microgrids are, how they work, and some examples of their planned deployment.

What is a Microgrid?

Microgrids are local energy networks that are able to separate from the larger electrical grid during extreme weather events or emergencies, providing power to individual customers and crucial public services such as hospitals, first responders, and water treatment facilities. Microgrids offer refuge from power outage disasters. By automatically disconnecting from cascading destruction, they protect their customers from power outages in the larger grid. They then activate their own distributed generators to continue to supply electrical power.

A microgrid usually comprises distributed energy resources with clearly defined electrical boundaries. It acts as a single, controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in either a grid-connected or an independent mode.

In addition to classic diesel generators, a microgrid may receive much of its power from renewable energy resources such as wind, solar, biomass, and hydro power.

How Do Microgrids Work?

Our power grid connects homes, businesses, and other buildings to central power sources. This allows us to use appliances, heating/cooling systems, electronics, and other electrically powered devices 24 hours a day, seven days a week. However, if there is a fault in the grid, or if the grid requires repair, everyone is affected by a power outage. Massive storms are a major cause of grid power outages.

A microgrid connects to the grid at a point of common coupling that maintains the microgrid's voltage and phase angle at the same values as the main grid. If there is some sort of problem on the main grid, the microgrid can be separated from the main grid automatically or manually. The microgrid then functions autonomously as a power-generation island, providing continuous power to its customers.

A microgrid can power a single facility, or it may power part of a town. The microgrid itself may be powered via several means, including distributed diesel generators, batteries, and renewable energy sources such as solar panels or wind power. Multiple power sources may be involved in supplying power for a single microgrid.

A microgrid not only provides backup for the grid in case of emergencies, but it can allow communities to be more energy independent and, in some cases, more environmentally friendly.

The New York Prize

The U.S. Northeast has embarked on a campaign to build microgrids to serve shelters, hospitals, police, fire stations, water treatment plants, grocery stores, and gas stations.

New York State in the United States is actively encouraging microgrids. The USD $40 million New York Prize is a state program that is aimed at helping communities create microgrids. Through this program, the state has funded 83 projects throughout New York State to evaluate the feasibility of installing and operating a community microgrid.

The NY Prize helps communities reduce costs, promote clean energy, and build reliability and resiliency into the electric grid via microgrids. The NY Prize is part of a statewide endeavor to modernize New York State's electric grid, spurring innovation and community partnerships with utilities, local governments, and the private sector. Its mission is to enable the technological, operational, and business models that will help communities reduce costs, promote clean energy, and build reliability and resiliency into the grid.

NY Prize is designed to support new local energy microgrids that will provide power to multiple customers, including residential and commercial customers as well as crucial public services such as hospitals, first responders, and water treatment facilities.

Community microgrids will often build on existing infrastructure and equipment, connecting multiple users in a neighborhood in the event of a power outage, offering energy independence as well as local power generation and distribution.

The microgrids will allow the use of clean, efficient distributed energy resources such as wind, solar, combined heat and power, and energy storage, thus improving the environmental and economic health of the community.

The NY Prize aims to broaden the scope of microgrids, which today serve only a single user such as a university or a hospital. New microgrids will connect multiple users through a network relying on clean, reliable, and affordable energy sources.

New York's Lower East Side

New York City's Lower East Side won $100,000 in the first round of funding in the New York Prize competition to evaluate its proposal for a microgrid. Named the Two Bridges/Beyond the Grid Community Microgrid, the microgrid will serve a mix of public and private residential, institutional, and commercial sites on Avenue C between East 10th Street and East 14th Street in the East Village. This area was severely impacted by flooding and power outages during Superstorm Sandy.

The team is proposing a USD $15.4 million community microgrid project that will provide 100% of the power requirements for about 4,000 residents in eleven buildings, including four schools, a community center, a pharmacy, a supermarket, and a variety of apartment buildings.

The microgrid will include a mix of natural gas and renewable energy generation sources. It will provide two megawatts of power and will contain eight megawatt-hours of storage capacity. The microgrid will connect to the Consolidated Edison power grid and will be able to supply power to it. In the event of a grid

problem, the microgrid can disconnect from the main power grid and continue to provide power to its local customers.

The hope is that this project will create a demonstration project that could be replicated in other parts of the Lower East Side, the rest of New York, and across the country.

The Two Bridges/Beyond the Grid Community Microgrid Project Area, with participating sites outlined. (Microgrid Knowledge)

Alaska's Microgrids

41% of Alaskan residents reside in Anchorage. The rest live in small rural communities spread throughout the state. 90% of these communities generate their electricity via diesel-generated power. However, due to transportation costs and other logistical challenges, rural communities pay up to four times more for diesel fuel that those elsewhere in the state.

Nevertheless, Alaska's energy sector has excelled in one area – the microgrids that are located in remote communities. Alaska operates 12% of the world's microgrids. Almost 250 microgrids generate power ranging from 30 kilowatts to 100 megawatts.

Most of these microgrids run on diesel power. However, over 70 of these microgrids integrate some sort of renewable energy such as hydro projects, wind, solar, and biomass.

Energy Storage

Energy storage within a microgrid can play a major role in facilitating the use of renewable energy sources by protecting the power stability and reliability of the microgrid. A microgrid's reliability is predicated on its ability to offer a seamless supply of local electricity. However, renewable energy sources such as wind and solar are intermittent. On a windless day, there will be no wind power. Nor is there any solar power at night.

There must be a balance between load demand and generator output. In a centralized grid, fossil-fueled generators will ramp up and down to ensure their output is kept in balance with demand.

The same kind of capability is needed in a microgrid. Energy storage devices can act as a buffer, either absorbing excess energy generation or discharging energy to meet load requirements.

Energy storage can also provide a source of power during outages that last for an extended period of time. In addition, the availability of energy storage solves the problem of providing power during the several seconds that it takes for a microgrid diesel generator to spin up when the microgrid is disconnected from the grid.

Summary

Microgrids are a fairly new technology. They are just now being planned in many communities, though they have been in service is such areas as Alaska for a while. As microgrids become more widespread, the power outages we experience due to major storms and other causes should become less and less frequent.

Acknowledgements

Information for this article was taken from the following sources:

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