16 Use Cogeneration & Solar During Blackouts

I. Summary

Issue:
Many cogeneration and solar power systems are not set up to run during a blackout. Because of this, they cannot provide heat and power to buildings during these emergencies.

Recommendation:
Cogeneration and solar power systems should be designed to run during blackouts.

II. Proposed Legislation, Rule or Study

As a “best practice”, no legislation is included in this proposal.

III. Supporting Information

Expanded Issue and Benefits:

To provide useful, long-term supplemental power during an extended blackout, both cogeneration and PV solar electric power systems should be capable of operating in “island mode” in a manner acceptable to the electric utility and in compliance with the National Electric Code (NEC) and New York City Construction Code. “Island mode” means a generator capable of self-excitation and black start, supplying power to a distribution system that is electrically isolated from the local utility power supply.

Safety
Any such installation must include 1) an automatic inverter disconnect or shutdown that will prevent any power from being fed back into the grid in the event of an outage, and 2) an approved, break-before-make transfer switch to ensure that the generating equipment is only capable of independent operation when disconnected and only supplies specified and controlled loads during the outage. Automatic switching of cogeneration units from normal utility connections to standby connections/switchgear is preferred, but manual switching is acceptable. The isolation switching should include permissive relaying or other means of automatic notification to the cogeneration units so that isolation from normal utility connections is completed before the cogeneration units are capable of restart.

Loads

It is unclear what loads, if any, such a cogeneration system would be required to supply. Emergency generators are now required for residential (R-2) buildings 125 feet in height or greater and for other high-rise commercial buildings by building code,[1] and must be sized to supply specified loads. However, these emergency generators are not required for existing buildings or new smaller buildings. A Department of Buildings (DOB) memo[2] (TPPN 1/07) describes the loads emergency generators that are installed in existing buildings must provide, and includes emergency lighting, fire alarm systems, and one elevator. However, TPPN 1/07 is not clear on which buildings are subject to its requirements; any building voluntarily installing a generator, or only buildings that would require an emergency generator if constructed today. The proposal "Remove Barriers to Backup and Natural Gas Generators" includes proposed improvements to TPPN 1/07.

Because of limited roof area and temporal variation of the solar resource, the ability of a PV system to service building loads will be limited and vary greatly from one building to another. In large buildings, in some cases the most a PV system could supply would be charging appliances like cell phones or manually controlled water pumping; in other cases, it could supply essential building services, such as limited elevator service. Only in a few cases would a PV system be capable of meeting all the loads specified for emergency generators, and thus, a PV-based system will likely need to be coupled with another system to fully provide "emergency power" in large buildings. It is more likely that solar PV in large buildings will act as supplemental power to provide limited relief during blackouts. In smaller residential buildings, such as detached homes and row houses, PV could support many or all key loads if equipped with battery storage, with a trade-off between the capacity of the batteries and the number of days without bright sun.

For systems in facilities that require emergency generation to meet certain loads by code, the cogeneration system could be used in island mode, in parallel with the emergency generation, to support additional building loads. For systems in larger, new residential, commercial and critical facilities that require emergency generation by code, the PV system would be used in island mode in parallel with the emergency generation to support additional building loads.

Energy Source

Natural gas is the preferred fuel source for cogeneration systems and is a code acceptable fuel source for voluntary standby generator applications. Use of natural gas is recommended for cogeneration installations capable of providing standby power/island mode operation. Natural gas has almost always been available when electric power was lost due to hurricanes; liquid fuel, on the other hand, was often unavailable for some time until the infrastructure could be re-established, demonstrating that natural gas is often a better fuel than diesel during extended outages.

Conversion

PV systems employ inverters (also known as static power converters, SPCs) to convert DC power to grid-compatible AC power. An inverter can be self-commutating, meaning it can operate by itself and provide 60 Hz power at some desired voltage. These systems are common in remote locations. Alternatively, the inverter can be grid-commutated, meaning that it requires

[1] BC 403.11, BC 2702.
[2] Technical Policy and Procedure Notice # 1/07, "Voluntarily Installed Emergency Generators"

connection to the grid and derives its phase and frequency from the grid. This second system is the norm in New York City, with the PV and inverter feeding AC power in the building's electrical system to lower demand on the utility or even feed excess power back when available. Hybrid systems are available that can operate normally in grid-commutated mode, then disconnect and switch to self-commutated operation once the grid connection is securely broken. All of these systems are readily available through reputable suppliers.

The services of a licensed electrical engineer experienced in interconnection with the Con Edison grid should be employed to facilitate the process of installing or upgrading PV systems.

Existing cogeneration and PV systems capable of operation in island mode but not currently employing this functionality should be upgraded to do so, and those systems not capable of operating in island mode should be upgraded to provide this capability. In either case, the building electrical distribution must be reconfigured to provide standby isolation and management of priority loads.

Currently NYSERDA requires new cogeneration units to be capable of stand-alone operation to receive NYSERDA funding.

Implementation:

Inverters are available for reciprocating engine-based cogen systems to enable them to function in island mode. Microturbine-based systems already have such capability.

A licensed electrical engineer experienced in cogen interconnection to the Con Edison grid should be retained to oversee the process of installing or upgrading cogen units to run in island mode. The effort must include defining procedures for transition to island mode operation and overseeing the testing of the transition from grid parallel to island mode operation. Some equipment, such as VFD's, may need to be installed to motors to prevent the starting in-rush current from exceeding the capabilities of the cogen system.

Educating residential property managers to fully understand the value and benefits of cogen in their buildings can be difficult; however, the opportunity for better living conditions during blackouts may help convince managers to implement the recommendations in this proposal.

Cost:

Turner Construction Company did not perform cost estimation for this proposal. The following analysis was provided by the authors of this proposal:

There are minimal ongoing maintenance costs associated with changing from induction cogen systems to synchronous, such as the need to maintain a starting battery. An initial investment will be needed for inverters and for switchgear to enable the separation of priority loads.

The cost of inaction is people living in high-rise buildings for the duration of a blackout without water to flush toilets or fire alarms, which was the experience of many after the widespread damage caused by Superstorm Sandy. In some cases elevators will be available, making shopping plausible for people on high floors. Since the costs of not being able to shop, for instance, are born individually and without recourse, they are hard to quantify.