Risktopics

ZURICH

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Guide to emergency power for hurricane-prone regions

Introduction

When a hurricane strikes, the loss of normal electric power should be expected. After a hurricane, a delay in restoring normal electric power should also be expected. During this extended outage, a reliable source of emergency power should be provided to maintain essential electric loads.

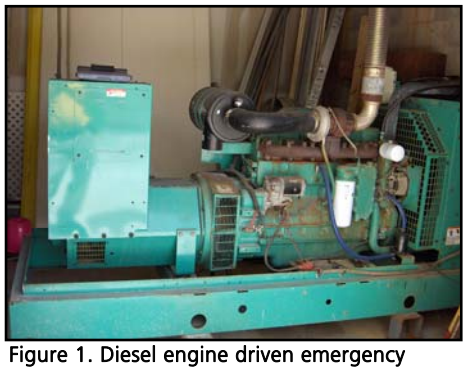

Figure 1. Diesel engine driven emergency generator

Objective

Typically, an emergency generator will be used to provide power during a utility outage. When located in a hurricane-prone region, the reliability of the emergency generator during high wind and high water events should be considered. In addition, electrical loads not normally considered important may become essential during or after a hurricane. This guide outlines factors to consider when sizing and arranging an emergency generator for a building located in a hurricane-prone region.

Figure 2. Bollards provided to protect emergency generator from physical injury

Guidance

Protection from high wind

Hurricanes are accompanied by a variety of severe wind conditions that can challenge an emergency generator. These conditions include high winds and wind-borne debris.

Locate an emergency generator within an enclosure rated for the anticipated wind loads. Wind loads should be determined using ASCE 7-98 "Minimum Design Loads for Building and Other Structures." An importance factor of 1.15 should be applied. If the generator is installed outside within a self-contained enclosure, verify the enclosure is suitable for the expected hurricane wind loads.

Protection from high water

Hurricanes are accompanied by a variety of severe high-water conditions that can challenge an emergency generator. These conditions include flood, storm surge, surface water runoff and wave action.

At a minimum, locate an emergency generator above the elevation of the 100-year flood and 100-year storm surge. Where possible, consider a location where the emergency generator will be above the 500-year flood or storm surge elevations.

Protect the emergency generator from water-borne debris. Where designed for outdoor installation, provide bollards to protect the generator foundation, base and fuel storage tank from the impact of water-borne debris such as dumpsters and automobiles. Such objects can become water-driven missiles with as little as one foot of water.

Protection from wind-driven rain

If an emergency generator is provided, evaluate its source of combustion air. Generators can be shut down due to wind-driven rain being carried over into the engine air intake. Consider the use of Miami-Dade-approved louvers at air intakes to minimize the impact of rain carry over.

Determining essential loads

An emergency generator needs to be sized and arranged to carry an appropriate array of electrical loads. These loads should include systems that may become essential during or after a hurricane.

Typically, an emergency generator is set up to carry life safety systems such as emergency lighting, exit sign illumination, fire alarm systems and fire pumps.

For healthcare facilities, the loads on an emergency generator will be expanded to comply with the standards of the Joint Commission of the Accreditation of Healthcare Organizations (JCAHO). JCAHO requirements under the "Management of the Environment of Care" address loads supported by an emergency power source.

For other occupancies, a variety of factors may determine other loads that may be connected to an emergency generator. Vital business systems including computers, telephones and important production equipment may be supported on an emergency power system to reduce the potential impact of a power interruption on business operations.

Figure 3. Combustion air louvers that allow carry-over of wind-driven rain

Beyond these requirements dictated by codes, jurisdictional authorities or business needs, it is important to consider other systems that may be needed during or after a hurricane. For example:

- HVAC systems – After a hurricane, will control of humidity within the building be essential in maintaining an acceptable internal building environment? Should emergency generators be sized to support chillers, cooling towers, air conditioners, fans and other related systems? Occupancies such as healthcare, hospitality, clean rooms and more may depend upon maintaining the internal building conditions during and after a hurricane to avoid delays restoring normal operations.
- Refrigeration systems – During and after a hurricane, will refrigeration systems be needed to protect goods from spoilage? This could include hotel freezers and coolers; hospital storage units for blood, bone and tissue storage; and warehouses with bulk refrigerated storage.

- Elevators – After a hurricane, will elevators be needed to facilitate building repairs? For multi-story buildings, elevators will be essential to completing any repairs in a timely manner. Hopefully, repairs will be limited to exterior cosmetic work; however, there may be a need to replace damaged building envelope features. For example, missile-resistant glazing, while successful in keeping water out, may be broken by wind-driven debris.
- Fuel systems – During and after a hurricane, will fuel pumps be needed to transfer fuel from the main fuel storage tanks to the emergency generator day tank? Failure to provide emergency power to fuel pumps could leave a building without power while plenty of fuel remains onsite that could have supported ongoing emergency generator operation.

Figure 4. Outside main fuel tank secured against buoyancy by wrap-around concrete saddle

Take time to prepare an inventory of essential electric loads. Physically confirm which loads are actually connected to the emergency power system. Upgrade or expand the emergency power system as needed to accommodate essential loads.

Figure 5. Fuel tank leg not bolted to floor

Determining needed fuel supply

How much fuel should be maintained onsite to support an emergency generator during and after a hurricane? Typical fuel volumes discussed in NFPA 110 "Standard for Emergency and Standby Power Systems" (2005 edition) can be as high as 96 hours; however, more could potentially be needed.

The volume of fuel maintained onsite should be based on the anticipated fuel usage rate of the emergency generator and the anticipated duration of operation before normal power is restored or fuel deliveries are resumed. The fuel usage rate of the emergency generator should be determined through consultation with the emergency generator manufacturer or a service company representative. Consult with the local electric utility to determine their experience with outages after a hurricane. How long could a normal power interruption last? Consult with the fuel supply vendor and local emergency management agency representatives. What is their experience with resuming fuel delivery service after past hurricanes?

Figure 6. Fuel oil pumps within dike area of outside main fuel tank

Protect the fuel supply

Main fuel tanks may be located underground, above ground or inside a building. Above ground tanks exposed to flood, storm surge or surface water runoff should be secured to resist buoyancy forces.

Fuel pumps used to transfer fuel from a main tank to an emergency generator day tank should be protected from water damage. Avoid locating fuel pumps in areas where they can be inundated by flood, storm surge, surface water runoff or accumulated rain water. For example, avoid locating fuel pumps within the dike of an outside fuel tank. Heavy rain can fill a dike during a hurricane and ruin drive motors. Locate fuel pumps, motors and electric power circuits above all anticipated water levels. Provide two sets of fuel pumps and motors for redundancy.

Provide routine inspection, testing, and maintenance

Does the emergency generator receive appropriate inspection, testing and maintenance? Follow manufacturer's instructions for all periodic services. Consult Chapter 8, "Routine Maintenance and Operational Testing," of NFPA 110's "Standard for Emergency and Standby Power Systems" (2005 edition) for guidance.

Conclusion

Evaluate your emergency power systems before the next hurricane strikes. Identify potential exposures to damage from high winds and water inundation. Determine the essential electrical loads for your facility. Verify they are connected to the emergency power system. Upgrade the system as needed to include all essential loads. Evaluate the fuel supply for adequate volume to support operations until normal power is restored or fuel deliveries resume. Review the reliability of the fuel supply system. Confirm appropriate inspection, testing and maintenance is provided on a continuous basis for the entire emergency power system.

References

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2. NFPA 30 Flammable and Combustible Liquids Code. Quicy: NFPA, 2008.
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4. NFPA 99 Standard for Health Care Facilities. Quicy: NFPA, 2005.
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