Fact Sheet 3.4.2: Building Utility Systems—Electrical

The mitigation objective of this Fact Sheet is to improve the resilience of the components of electrical systems to allow a building to continue to be used or quickly repaired following a hurricane, with an end goal of rapidly returning the building to full functionality.

Electrical systems include the electrical wiring and components that supply electricity to devices and equipment within a building. They also include the wiring and components to distribute utility power and, in some buildings, to distribute power from standby power sources or emergency power sources. Standby power sources generally are considered optional systems and are installed to allow a facility to function when utility power is lost, although usually not at full power. Emergency power systems are those required by building codes and standards for life safety, smoke control and fire protection.

Electrical systems are comprised of two types of components:

- **Primary components**—Electrical components that must function for the system to work. When a primary component is damaged, the entire system stops working. Examples of primary electrical system components include pole- or pad-mounted transformers and service drops or laterals, utility meters, service and distribution equipment, motor control centers, branch circuit panelboards and emergency or standby power system components.
- **Secondary components**—Electrical components that can lose function without preventing the complete shutdown of building system operation. When secondary components are damaged, the system may function at a reduced level of service or cause service interruptions to a portion of the building. Examples of secondary electrical system components include branch circuits, convenience outlets and lighting fixtures.

The typical components of main electrical systems and standby or emergency power systems common to small public buildings before mitigation are shown in Figure 3.4.2.1. The typical components of main electrical systems and standby or emergency power systems common to large public buildings before mitigation are shown in Figure 3.4.2.2

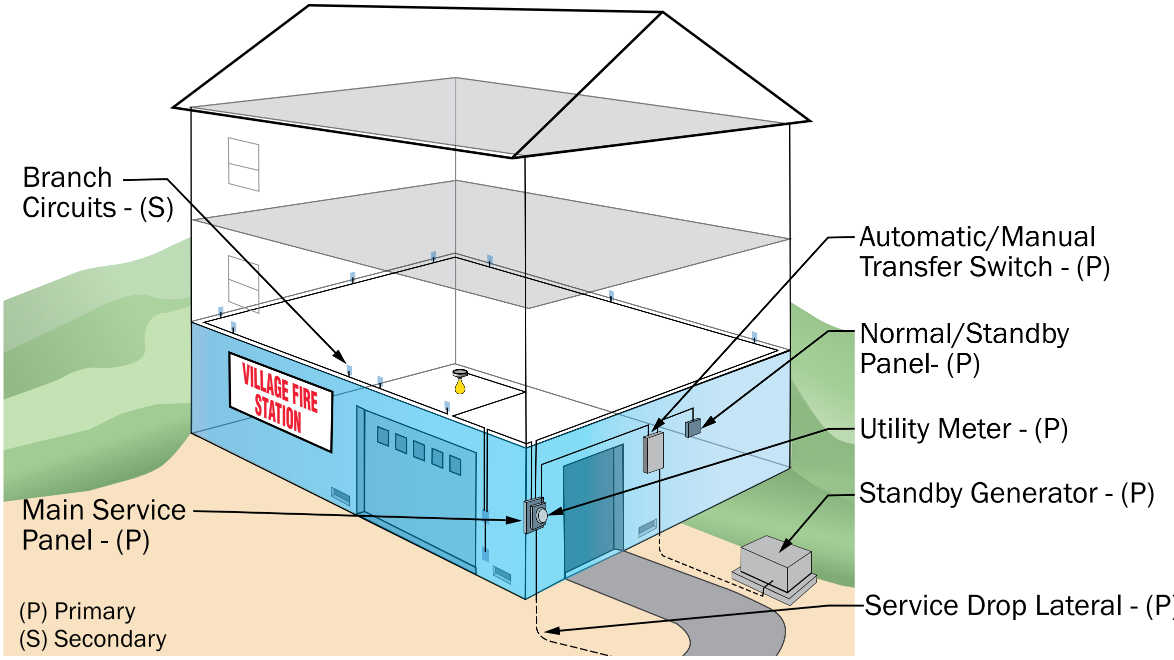


Figure 3.4.2.1. Typical small public building electrical system components with an onsite standby or emergency generator.

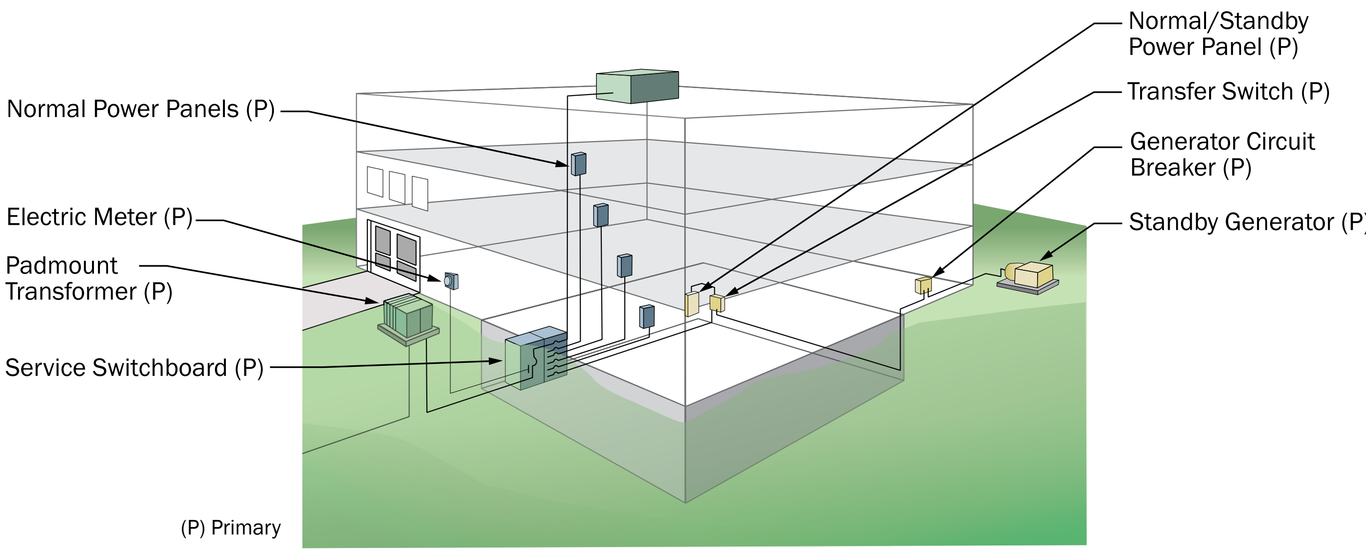


Figure 3.4.2.2. Simplified diagram showing primary components of a large public building electrical system with standby generator (before mitigation).

Mitigation of main and standby power system components typically is best achieved by elevating in place or relocating to an upper floor. If elevation in place or relocation is not practical, dry floodproofing can be considered, but this often is difficult to do and carries its own set of risks. Refer to FEMA P-348, *Protecting Building Utility Systems from Flood Damage,* for additional details.

In addition to main and standby power systems, electrical systems also may include communications systems such as voice communication, information technology (IT), networking, fiber optic, and cable television (CATV). Other electrical systems may include components for security such as alarms and closed-circuit television (CCTV).

Wind and wind-related mitigation measures for electrical system components and equipment located inside the building can be accomplished by making sure that the building envelope is built to resist wind pressures, wind-borne debris and wind-driven rain. Added protection can be accomplished by following best practices, which often go beyond following the minimum codes and standards. Additional information about measures that can be implemented to mitigate against wind are discussed in Fact Sheet 3.2, *Wall Systems and Openings;* Fact Sheet 3.3.1, *Sloped Roof Systems*; and Fact Sheet 3.3.2*, Low-Slope Roof Systems.* Mitigation of rooftop electrical equipment to resist high winds and wind-driven rain is covered in Fact Sheet 3.3.1, *Sloped Roof Systems* and Fact Sheet 3.3.2, *Low-Slope Roof Systems.* Because other fact sheets cover wind-related hazard mitigation of rooftop-mounted electrical system components, this fact sheet focuses primarily on flood mitigation.

Table 3.4.2.1 summarizes some common mitigation solutions that can improve the performance of building electrical system components. These strategies then are discussed in the sections that follow.

Table 3.4.2.1. Common Electrical System Mitigation Solutions

Solutions and Options	***Coastal Flood***	***Riverine Flood***
Mitigation Solution: Elevate or Relocate		
Option 1: Elevate or Relocate	✓	✓
Mitigation Solution: Dry Floodproof		
Option 1: Dry Floodproof	✓	✓

Mitigation Solution: Elevate or Relocate

Since most electrical components are not water resistant and can be damaged or destroyed when exposed to floodwater, elevation is the most effective overall solution for mitigating primary and secondary electrical system components in buildings.

Option 1: Elevate or Relocate

Elevate all primary electrical system components and, wherever possible, secondary components of buildings on platforms or pedestals above the flood protection level, as shown in Figure 3.4.2.3. Elevating electrical system components must comply with National Fire Protection Association (NFPA) 70, which presents the National Electrical Code (NEC) requirements for access and minimum working clearance. Additional information about the flood protection level can be found in Fact Sheet 3.0, *Buildings, Systems and Equipment.*

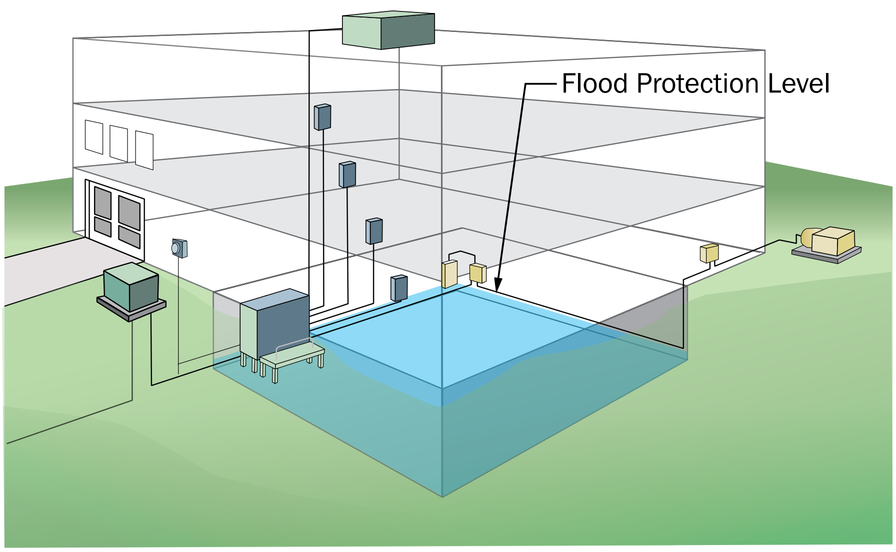


Figure 3.4.2.3. Simplified diagram showing elevation of main and standby power components on elevated platforms above flood protection level for large public building.

If elevation is not practical, relocate all primary and secondary electrical components to higher floors above the flood protection level or move them to the rooftop.

When evaluating these strategies, some things to consider include:

- Transformers need to be located physically close to the building's electrical service equipment. If a transformer is elevated, the service equipment likely will need to be elevated as well.
- In existing buildings, flood mitigation may be more easily included as equipment is replaced at the end of its useful service life, when it becomes obsolete, or during building renovations.
- Secondary components vulnerable to flooding that cannot be elevated or relocated should be designed to be electrically isolated from the rest of the system so that power can be restored before flood-related electrical repairs are completed.

The placement of most utility meters is directed by the utility company based on a maximum height above the ground (typically 6 feet). Placement of meters typically is at a height so meters can be read and, if needed, removed to disconnect power to the building they serve. Consider installing a combination meter socket and circuit breaker service disconnect. This device, as shown in Figure 3.4.2.4

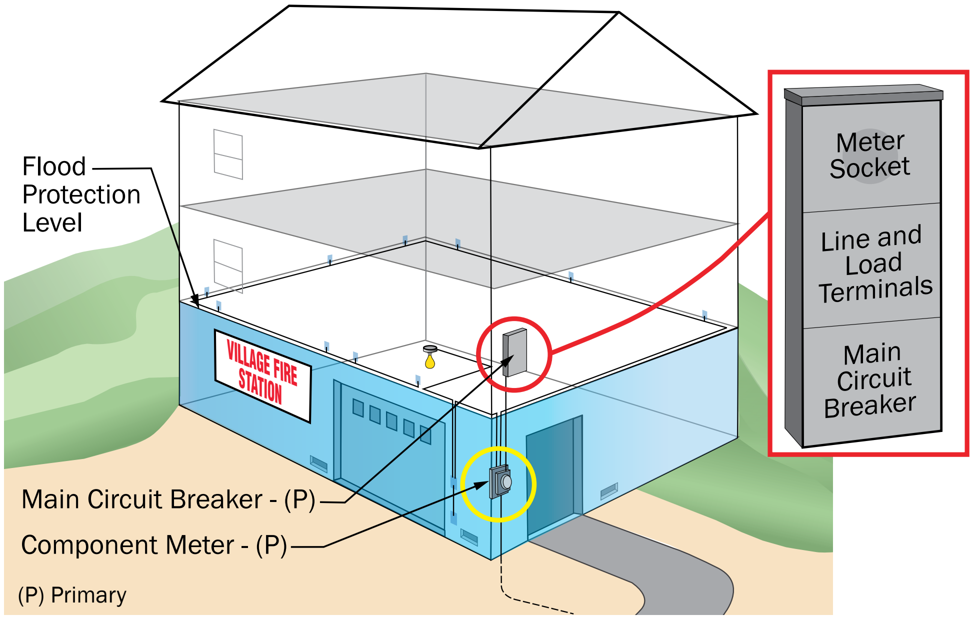
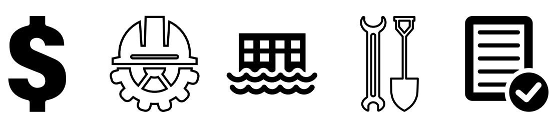


Figure 3.4.2.4. Combination meter socket and circuit breaker service disconnect (circled in red) used to allow the main panel to be elevated and protected from flooding when the meter (circled in yellow) cannot be moved.

When elevation or relocation are not possible, install equipment and wiring below the flood protection level to provide easier access for post-flood repair—for instance, corrosion-resistant conduit systems that allow flood-damaged conductors to be replaced. Where possible, connections, taps and splices that involve removing cable sheaths and conductor insulation should be made above the flood protection level.

CONSIDERATIONS:



Mitigation Solution: Dry Floodproof

When electrical components cannot be elevated above the flood protection level, component protection in place using dry floodproofing may be possible, but effective dry floodproofing often is difficult to achieve and even when it is feasible, residual risks remain. For electrical components, wet floodproofing is not an option since they cannot be operated under submerged conditions.

Option 1: Dry Floodproof

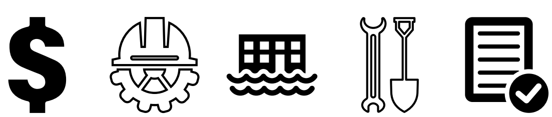
Dry floodproofing for electrical system components is most appropriate and effective when it protects a large portion of the building. Electrical dry floodproofing options should consider the following:

- Because of the sensitive nature of electrical system components in water, including freeboard with any dry floodproofing is recommended to provide additional flood protection.
- Flood walls or flood barriers should be placed to provide access, clearance and working space that meet NEC requirements. When installing temporary flood protection systems, installation of removable components should meet NEC requirements, but since they are typically installed for 90 days or less, NEC requirements for temporary installations as provided in NEC Article 590 may apply if approved by local officials.
- Pump systems are required to remove seepage and rainwater that accumulate inside the protected area.

Do Not Use Wet Floodproofing for Electrical Components

Wet floodproofing should not be used as a flood mitigation solution for electrical components because these components cannot be operated under submerged conditions.

CONSIDERATIONS:



REFERENCES:

Detailed information on hurricane mitigation of building electrical systems can be found in these publications. Much of the residential information applies to non-residential buildings, as well.

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