Minimizing Flood Damage to Electrical Service Components

FEMA

HURRICANE RECOVERY ADVISORY *RA2, December 2012*

Purpose

The purpose of this Hurricane Recovery Advisory is to describe practices for minimizing damage to electrical service components during coastal and riverine flood events (see Figure 1). It's primary focus is on services of less than 300 volts, which are typical of residential homes. Considering flood risks when designing and constructing electrical services can ensure that outage durations resulting from flooding are minimized and that utility and code requirements are met.

Key Issues

- Floods can damage electrical utility meters and disconnect switches and other electrical service components. Damaged components can delay recovery time and extend the duration of power outages.
- Preventing flood damage requires placing all electrical equipment above the flood level, but utility company requirements and the National Electrical Code (NEC) place limits on where electrical service equipment can be located.

The following information is intended to help homeowners and builders identify options for locating electrical service components to minimize flood risks. Figure 2 clarifies some terminology and shows some of the necessary clearance requirements.

Figure 1. Electrical components installed below the lowest floor system are subject to increased flood damages and lengthy outage durations (St. Tammany Parish, LA)

National Electrical Code and Local Utility Requirements

Key Issues

- The NEC may dictate the locations for some electrical service components because of clearance requirements
- NEC requirements do not directly address flood protection needs
- Local utilities may have additional requirements that dictate the location of electrical service components
- Local utilities may also require an external disconnection at the metering equipment so that emergency response personnel can safely de-energize all power without entering the structure

NEC Requirements

NEC contains requirements for electrical services that significantly affect their design and construction. The code dictates:

- Clearance to energized conductors
- Means to disconnect electrical power from a home
- Clearances around electrical service components

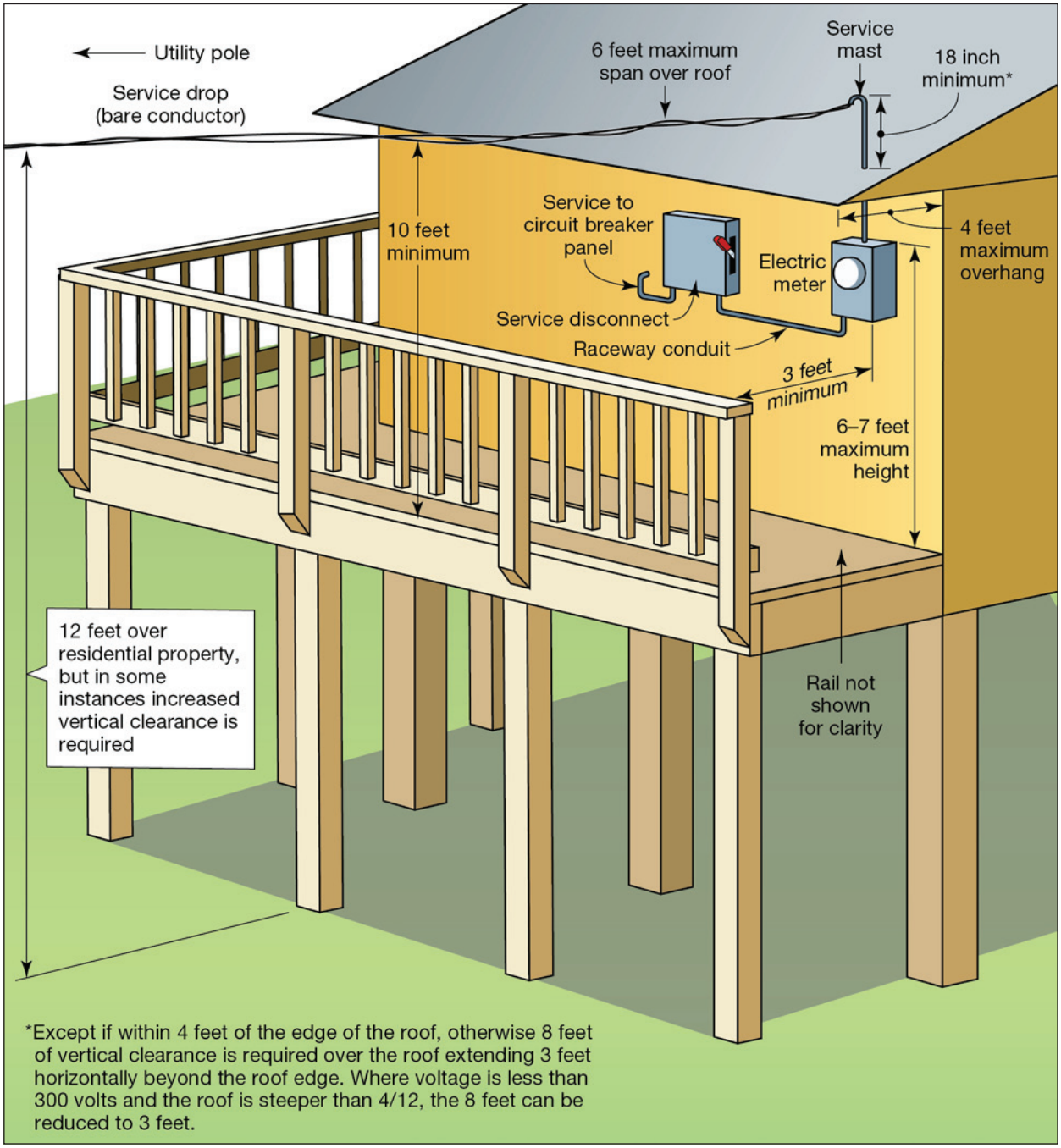

Figure 2. Illustration identifies some of the electrical service components and some of the NEC requirements for residential electrical service. Other clearance requirements come into effect if the service drop (an overhead electrical line running from a utility pole to a home) is attached near a door or window or is attached to the side of the house rather than to the roof as shown in the illustration.

NEC ***clearance requirements*** prevent people from coming in contact with energized conductors (electrical lines). Clearances above roofs, doors, windows, driveways, and walking surfaces (stair landings, decks, balconies, etc.) must meet NEC requirements. When electrical components are elevated to avoid flooding, the NEC requirements for clearance must still be maintained.

NEC requirements for ***service disconnecting means*** ensures power to a building can be shut off in the event of an emergency like fire or flooding, or when electrical equipment must be de-energized for servicing. Main circuit breakers mounted within electrical service panelboards are often used to disconnect the service. Separate enclosed circuit breakers or separate fused disconnect switches mounted between the electrical meters and the electrical panelboards can also be used. The NEC requires that service disconnecting means be readily accessible. The NEC allows the use of remote control as a disconnecting means if the remote control device is readily accessible.

The NEC also governs ***working space around electrical equipment***, and requires a clear area around electrical equipment to allow a utility worker or electrician to work without obstructions. Meeting these requirements often affects the placement and location of electrical service components. Equipment that must be serviced or repaired when energized must have sufficient working clearance to protect electricians as they perform service and repairs.

Electrical Utility Company Requirements

In addition to the NEC requirements for electrical services, electrical utility companies also have requirements that must be met. Utility companies commonly require the center of electrical meters to be placed within 4- to 6-feet of the finished grade to allow access for recording electrical usage from manually read meters. The 4- to 6-foot requirement also allows utility workers to remove the electrical meters from meter boxes if they need to discontinue electric service to a home. The specific requirements for the elevation of the center of the meter above grade should be verified with the utility company. Some utility companies allow electric meters to be accessed from elevated stairs, walkways, or decks, particularly when not used solely for meter access (and thus more likely to be maintained in a serviceable condition). When accessible from elevated structures, the electrical meters and other service components can be elevated to reduce or alleviate flood risk without restricting access for utility company personnel.

National Electrical Code and National Electrical Safety Code

The National Fire Protection Association (NFPA) 70, also known as the National Electrical Code (NEC), is the minimum standard incorporated by many building codes and adopted by many States and municipalities. The NEC governs all wiring downstream of the electrical service point, which delineates on-premise wiring from that operated by the electrical utility. Wiring upstream of the electrical service point is governed by other standards, like the National Electrical Safety Code (NESC, ANSI/IEEE C2).

For more information, refer to: *http://standards.ieee.org/about/nesc/2012.html.*

Choosing Locations for Electrical Service Components

Key Issues

- Locating electrical service components above potential floodwaters
- Maintaining access for utility workers

National Flood Insurance Program Requirements

The National Flood Insurance Program (NFIP) requires that buildings in a Special Flood Hazard Area:

> *… be constructed with electrical heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.*

Although the NFIP does not regulate equipment owned by utilities, such as electric meters, FEMA recommends that electrical services be designed so that all equipment is elevated above flood levels to prevent flood damage (Figure 3) or that most of the electric service equipment be placed above flood levels to minimize flood damage (Figure 4).

Figure 3. Example of the preferred method of elevating all electrical components (St. Tammany Parish, LA)

Figure 3 shows a house where the electrical meter and all other electrical service components are all located above the elevated lowest floor. For floods that do not rise above the level of the elevated lowest floor, service equipment will not be damaged by flood waters (with the possible exception of an easily repairable grounding conductor that bonds the meter enclosure and service panel to a ground rod below). Workers can easily access the electrical meter from the stairs and elevated deck to read the meter or remove it to shut off power to the home.

In some situations, elevating the meter may not be possible, but all other electrical service components may be elevated (see Figure 4). Because there are no stairs or elevated decks to provide access for an elevated meter, the utility meter is located within 4 to 6 feet of grade and remains vulnerable to flooding, but can be repaired or replaced after floodwaters recede. Flood risks to the electrical equipment, while not eliminated, are greatly reduced at this home. The service disconnecting means is mounted nearly 10 feet above grade; it is equipped with a hookstick that allows remote operation. The electrical service panel (located inside opposite the service disconnect) is also elevated and protected from flooding.

Figure 4. Other than the electrical meter, all the electrical components are elevated and protected from flooding at this home. The system incorporates an electrical service disconnect that is remotely operable with a hookstick (St. Tammany Parish, LA).

Other Considerations

- In addition to adhering to the elevation requirements in areas with high-velocity floodwaters, any utilities located below the design flood elevation should be placed on the landward side of the building and attached to foundation elements, such as piles or columns.
- Utilities such as meters, conduits, or service masts (see Figure 2 for terminology) should not be attached to breakaway walls or elements that are not designed to resist flood loads.
- Conduits and electrical cables should not be mounted on breakaway walls or cross open areas below the design flood elevation.
- All electrical components, both above and below the design flood elevation, should be designed to drain and prevent the accumulation of water.
- Branch circuits and secondary electrical components placed below design flood elevations should be designed so that they can be electrically isolated from the rest of the system. This will allow electrical power to be safely restored to the home before completing all flood-related electrical repairs.
- For additional information regarding the proper installation of electrical components in flood-prone areas, see FEMA P-348, *Protecting Building Utilities from Flood Damage* (1999), and FEMA P-499, *Home Builder's Guide to Coastal Construction* (2010).

References and Resources

The following references and resources provide information on proper installation of other portions of the electrical system and the other utilities.

FEMA. 2010. FEMA P-499, *Home Builder's Guide to Coastal Construction*. (*http://www.fema.gov/library/viewRecord.do?id=2138*)

FEMA. 2008. NFIP Technical Bulletin 5-08, *Free-of-Obstruction Requirements*. (*http://www.fema.gov/plan/prevent/floodplain/techbul.shtm*)

FEMA. 2008. NFIP Technical Bulletin 9-08, *Design and Construction Guidance for Breakaway Walls*. (*http://www.fema.gov/plan/prevent/floodplain/techbul.shtm*)

FEMA. 1999. FEMA P-348, *Protecting Building Utilities from Flood Damage*. (*http://www.fema.gov/library/viewRecord.do?id=1750*)

International Code Council (ICC). *International Building Code*. 2006/2009/2012. (*http://www.iccsafe.org*)

ICC. *International Residential Code*. 2006/2009/2012. (*http://www.iccsafe.org*)

National Fire Protection Association. NFPA 70: National Electrical Code. 2011. (*http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=70&cookie%5Ftest=1*)