White Paper

Code Changes After Hurricane Sandy

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When it comes to electrical installations, common sense helps address local issues national codes cannot cover.

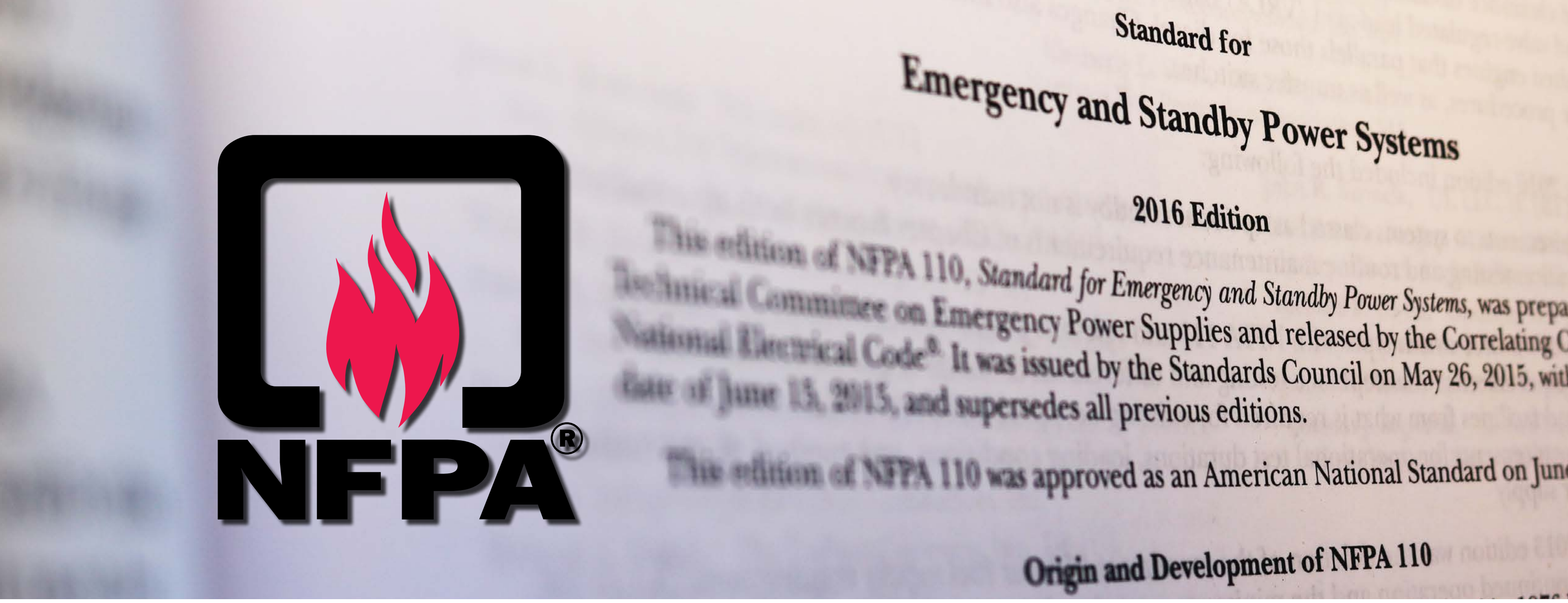
The repercussions on the energy infrastructure of hurricanes and other extreme weather events that impacted primary power up and down the east coast of the United States in recent years have been dramatic and, in some cases, devastating.

These events include Hurricane Katrina, Hurricane Sandy, and, this past October, Hurricane Matthew. Hurricane Matthew caused fresh-water flooding in five states along the East Coast and resulted in power outages for millions of customers in Virginia, North Carolina, South Carolina, Georgia, and Florida. In South Carolina, at peak outage about 1/3 of all customers (800,000 customers) were without power. In Charleston, alone, several hospitals were forced to operate on generator power.

As noted in an earlier paper Can Building Codes Ensure Power Reliability, during and in the aftermath of Hurricane Sandy, rising seas flooded electric substations and high winds took down power lines, more than 8 million utility customers lost electrical power, and fuel distribution networks were interrupted or otherwise rendered inoperable.

New York City's flagship public hospital, Bellevue Hospital Center, evacuated over 300 patients because of loss of electrical power. Although the emergency generators, located on the 13th floor, had initially been operational, fuel issues prevented their continued operation. The fuel pumps that fed the emergency generators were in the basement of the hospital, which remained flooded even after 17 million gallons of water were pumped out.

One issue that arose in the aftermath of Hurricane Sandy and was addressed in the original paper was: why were facilities expected to continue to operate to provide services during disasters allowed to locate critical electrical system components in vulnerable areas? One broad answer is that codes and standards, as extensive as they are, can't cover everything.



Progression of Codes and Standards

National building codes do not take into consideration every local risk to critical electrical system components in areas vulnerable to extreme weather events. System design to enable electrical components to continue to provide services during disasters takes a great deal of thought and planning and it is difficult to include every possible scenario. Even codes and standards as extensive as they are can't cover everything. Prevailing NFPA codes still call for consideration for local needs.

In 2016's NFPA 110, Chapter 7 Installation and Environmental Consideration, while 7.1.2 reads the same as the 2013 edition ("Minimizing the probability of equipment or cable failure within the EPSS shall be a design consideration to reduce the disruption of loads served by the EPSS), 7.1.3, added a third consideration and now specifically states that the EPSS equipment shall be installed as required to meet the user's needs and to be in accordance with all of the following:

1. This Standard
2. The manufacturer's specifications
3. The authority having jurisdiction

The addition of 3 is a clear allowance for local code to specify placement.

The NFPA 110 in Chapter 7, 7.1.1 does, in both the 2013 and 2016 editions, in the first paragraph call attention to paying attention to "applicable environmental conditions common to geographic locations; and other factors affecting the location of the EPSS equipment."

And in the second paragraph, the text clearly states,

> "The probability and frequency of power failures that do or can occur as a result of lightning, wind, and rain produced by thunderstorms, hurricanes, tornadoes, and similar weather conditions associated with the user's geographic location should be considered." "

The national code does not state specifics for every geographic location but does clearly point out need for common sense conclusions by specifiers who take into consideration local conditions, trends, predictions, etc.

NFPA 110 is continuing to expand and define hazardous environments but as stated they can't take all scenarios into consideration. However, NFPA is has recently introduced recommendations that can help a facility better withstand risks of flooding from extreme weather. Annex A of the 2016 edition of NFPA 110 Standard for Emergency and Standby Power Systems encapsulates some of those recommendations.

According to NFPA 110: Annex A, paragraph A.7.2.4 recommends, "EPSS [emergency power supply system] equipment should be located above known previous flooding elevations where possible" - which is unchanged from the 2013 edition. And A.7.2.5 Annex A in the 2016 edition includes the paragraph: "For natural conditions, EPSS design should consider the '100-year storm' flooding level or the flooding level predicted by the Sea, Lake, and Overland Surges from Hurricane (SLOSH) models for a Class 4 hurricane.

The 2016 edition Annex A – newly adds: "For further information refer to FEMA 543 and FEMA 577, both dated August 11, 2013." FEMA 543 is the "Design Guide for Improving Critical Facility Safety From Flooding and High Winds: Providing Protection to People and Buildings (2007)" and is based on behavior of critical facilities during Hurricane Katrina. FEMA 577 is the "Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds," also published in 2007.

VIEWPOINT

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A former chairman of NFPA committee for revision of NFPA 110 and currently a primary voting member, points out that, in his opinion, the NFPA 110 has evolved over the years since 9/11, Hurricane Katrina, and Hurricane Sandy, with the changes in standards in subsequent editions reflecting lessons learned from failures that occurred in the aftermath of those events.

For several editions back, as early as the 1999 edition, NFPA 110 has required consideration of preventing failures, he notes.

Plan in Terms of Your Local Hazards and Situation

Regardless of lack of specifics in national codes, there are certain actions that, after the recent hurricanes in the U.S., should become more common in specific geographic locations because they make sense there.

A recent report by Climate Control, an independent organization researching and reporting on changing climate and the impact on the public, heavy downpours have increased across the country for the past 50 years in 40 of the 48 lower states and the types of downpours that formerly occurred every twenty years "could occur every 4 to 15 years by 2100." For example, McAllen, Texas, in the southern part of the state near the Rio Grande Valley, has had a 700% increase, while Portland, Maine, had a 400% increase, Philadelphia a 360% increase, and Visalia, CA a 300% increase. In Phoenix and in Minneapolis, rainfall over the past half century has doubled.

In areas where there historically has been flooding from rivers near or distant (as in recent flooding from Hurricane Matthew in North Carolina), installing the generator for backup power on the roof - not just "above known previous flooding elevations" makes sense. Same follow-through for fuel tanks and associated equipment – get them out of the basement and up high where they are much more likely out of harm's way, again not just "above known previous flooding elevations."

In fact, common sense and more and more consensus dictate that in flood zones, breaker boxes, building connections and other critical electrical equipment should not be located in basements or on ground floors, where not only can flood waters disrupt electrical operations but also standing water from receding flooding can delay electric restoration for long periods of time.

Conclusion

Common sense decisions that may not be dictated even by updated code include practices such as, in mountain regions, planning for fuel delivery before the likely first- of-winter snowstorm; or, in earthquake-prone regions, designing in electrical components, such as transfer switches, that are built to withstand earthquake forces.

Yes, increasingly, national codes acknowledge vulnerabilities of power systems during hurricanes and other extreme weather events and make suggestions that can help ameliorate consequences. However, optimized readiness to withstand extreme weather events is a complex undertaking best addressed not only by code but also with attention to consensus and common sense.

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