Beyond 101:
Complying with engineering code requirements

By Krista McDonald Biason, PE, senior electrical engineer, associate vice president, HGA Architects and Engineers, and Jeffrey W. Harris, PE, LEED AP, director of mechanical engineering, vice president, HGA Architects and Engineers

A retail pharmacy at Kaiser Permanente Bishop Ranch Medical Office Building. Photographer: Bernard Andre Photography.

These days facility management seems to be all about CMS and NFPA 101, and sometimes it seems as if "engineering" codes and standards are neglected. Of course, the CMS adoption of the 2012 edition of the *Life Safety Code*® is important, and it does dictate which edition of engineering codes are to be referenced for engineering designs (and it brings adopted codes into this decade!). Life safety issues regarding egress requirements, smoke barriers, doors, and corridor projections are critical for protecting patients, staff, and visitors, but the specific health care engineering code items that have changed in recent code cycles also have a significant impact on life safety, design, and implementation. A passionate engineer could fill this entire edition of *Inside ASHE* with engineering code issues; however, we will contain this discussion to a handful of new code requirements and often-overlooked and misunderstood requirements that are consistently implemented incorrectly in health care facilities. With more than 50 years of combined health care design experience, we have seen a lot of interesting code interpretations and want to share some of the more common items to watch out for in the field. Sometimes just a single article of code can throw an engineering system into noncompliance.

We will kick off the fun with the most important electrical items. In the spirit of prioritizing life safety, let's focus on emergency system items that have been added to, or modified in, the code.

Electrical overcurrent device study

An updated electrical overcurrent device study is important in making sure that a facility has a coordinated system, doesn't blow anything up, and ensures the safety of people working on the equipment, but did you know that having an up-to-date overcurrent device study is actually a code requirement? A selective coordination study is exactly what it sounds like: overcurrent devices working in the correct order to address an unfortunate electrical event somewhere within a facility. A coordinated system has

been a requirement of both NFPA 70: *National Electrical Code®* and NFPA 99: *Health Care Facilities Code* for a while, but having the actual document available upon request is a new requirement that was added in the 2014 edition of NFPA 70. The 2017 editions of the *National Electrical Code* Article 700.32 (Emergency Systems) and Article 701.27 (Legally Required Standby Systems) both require the study to be "completed by a licensed professional engineer or other qualified person engaged in the design, installation, or maintenance of electrical systems." The articles further state that the selection "shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system." The code does not distinguish between new greenfield sites and facilities that have been around for a hundred years and may lack formal documentation of the existing conditions, so existing facilities are not except from this requirement. This requirement becomes challenging because many existing facilities do not have a consolidated, or accurate, document of their installed electrical distribution systems.

The latest iteration of NFPA 70 (2017) now aligns with NFPA 99 in that the essential systems are required to be coordinated to 0.1 seconds. Previous versions of NFPA 70 did not indicate specific duration so, depending on which editions of NFPA 70 and 99 are adopted and enforced and in which state your facility is located, the level of coordination may be either 0.1 or 0.01 seconds. As always, be mindful that your specifying engineer (or local authority having jurisdiction, or AHJ) may have additional requirements, so the code minimum may not always be applicable.

Short circuit value study

The 2017 edition of the *National Electric Code* also requires that the study for available short circuit values, indicated on the electrical service equipment, be made available to the same stakeholders as for the coordination study. Typically, the software for the coordination study is the same software used for the short circuit study (and arc flash study) so these efforts and associated evaluation and documentation can be completed concurrently. The study needs to be completed for the electrical system of a facility with the actual installed equipment, (including detailed information of distribution equipment, ratings, settings, feeder sizes, and lengths), so compliance for an existing facility of any size is going to take time. Unfortunately, this elephant is best eaten in small bites. Each time the electrical distribution system is modified, the owner (and design engineer) should insist that the entire system be modeled to be able to accurately evaluate the distribution additions and modifications. For a small remodel project, if the facility does not already have a study that models the existing equipment and the scope of the existing infrastructure far exceeds the proposed changes to the system, the owner (and design engineer) should work with the AHJ to create a plan for when the task can be completed. All items of the electrical system affect the study so all need to be evaluated.

Generators at St. Anthony Shawnee Hospital in Oklahoma. Photographer: Krista M. Biason.

Temporary power for maintenance of alternative sources of power

One of the new items added in the 2017 NEC that will have the most significant design impact is Article 700.3(F). This article, entitled "Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power," will affect the essential systems design for health care facilities (as well as other occupancy types). The section requires that if an emergency system relies on a single alternate source of power, a "permanent switching means to connect a portable or temporary alternative power source" must be available. A facility can no longer take down their single generator for even a simple oil change without having a back-up source in place. This source could be a temporary generator or a separate utility feeder. The few exceptions to this requirement are if the emergency system source is "…capable of being disabled during maintenance or repair of the emergency source of power" or "the building or structure is unoccupied and fire suppression systems are fully functional and do not require an alternate power source." These scenarios could potentially be feasible in a clinic setting or a facility that is not 24/7 that does not have any persons incapable of self-preservation, but such a situation is not feasible in a hospital. An exception for this new requirement that could be realistic for a hospital is the installation of a permanent second on-site standby generator to handle the emergency load. The electrical distribution could use multiple generators and paralleling gear, a main-tie-main scenario, or a permanent switch to accommodate the loads. This new code requirement does not have only one correct answer, and each facility will need to evaluate their options to determine feasibility, cost

continued on page 66

implications, and how the additional source solution affects maintenance staff and stakeholders.

Fire protection for emergency systems

Another item modified in the 2017 NEC is Article 700.10(D). This article has now added "health care occupancies where persons are not capable of self-preservation" to the list of occupancies that require fire protection for emergency systems. Feeder-circuit wiring for emergency systems is required to either be in a 2-hour fire rating enclosure, be protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours, be encased in 2 inches of concrete, or be fully protected by an approved automatic fire suppression system. Article 700.12 pertaining to emergency equipment was revised to include health care occupancies in which persons are not capable of self-preservation. This section requires that the installation of power sources for emergency systems to be installed "… either in spaces fully protected by approved automatic fire suppression systems (sprinklers, carbon dioxide systems and so forth) or in spaces with 1-hour fire rating."

Typically this is not an issue in a health care facility because most health care facilities are sprinklered as per the requirements in NFPA 101 and pertinent building codes. Carbon dioxide fire suppression systems are typically used in power generation and industrial applications in unoccupied areas.

Fireplaces

In an effort to make the patient care environment as pleasant as possible to speed recovery and provide a healing environment, fireplaces are often used to help create a warm and comfortable area. The 2012 NFPA 101 18/19 5.2 permits this, provided that a direct vent gas fireplace is used, that the fireplace is not located in a patient sleeping room, that the smoke compartment that the fireplace is located in is protected with an automatic sprinkler system, that the fireplace includes a sealed glass front with wire mesh panel or screen, that the controls for the fireplace are locked or located in a restricted area, and that supervised carbon monoxide detection is available. The 2012 NFPA 101 18/19 5.2 also permits solid fuel-burning fireplaces, but these cannot be located within a sleeping area compartment and need to be separated by at least a 1-hour fire separation. The fireplace must meet the same requirements as a direct vent fireplace with a minimum 4-inch hearth and a fireplace enclosure that is "break proof" up to 650 degrees F. While a wood fire is surely considered more romantic than a gas fire, the additional restrictions and operational issues such as where to store the fire wood and who is responsible for stoking the fire make it a less desirable choice. Plus, we're engineers, not romantics.

USP standard revisions

The USP (United States Pharmacopeia) is in the process of publishing revised standards for chapter 797 that addresses

IV sterile compounding and a new chapter 800 that focuses on minimizing caregiver exposure to hazardous drugs (most notably chemotherapeutic agents). Both are expected to have an enforcement date of July 1, 2018. From an HVAC perspective, two items that will be different are that the room pressurization is being described as between –0.01" to –0.03" for the rooms requiring negative pressure and 0.02" for the positive pressure requirement; these requirements suggest a tighter tolerance for the negative pressure room because of the maximum and minimum levels. A second change is that a low sidewall exhaust will be required behind the refrigerator to assist in removing any contaminants entering the room via the packaging itself as the compounds are removed from the refrigerator. A final change affecting the HVAC system is that the room where the drugs are packaged and stored must be kept at a negative pressure and monitored. All of these changes will require coordination and will affect the floor plan as well.

Relative humidity

Relative humidity can invoke hours, and hours, and hours of conversation. While no new changes have been made to the codes, some trends relevant to a health care facility deserve attention. First, a few years ago ASHRAE 170: *Ventilation of Health Care Facilities* relaxed the relative humidity standards for Class B and C operating rooms to a range of minimum 20 percent relative humidity requirement at 75 degrees. However, a number of medical equipment manufacturers have since noted that their equipment must be in an environment in a range of 30 to 60 percent (and a temperature range equivalent to the operating room requirements), meaning that, for all practical purposes, the HVAC system should be designed to support a minimum 30 percent relative humidity at 75 degrees (the outer range of temperature for operating rooms). Some advocate for maintaining even higher relative humidity levels (40 percent relative humidity) based on studies showing that infection rates decrease greatly at this level. The implications for the building envelope at this elevated relative humidity are significant when it is cold outside because of the potential for condensation at or in the building envelope. This affects not only design but also constructability and the finances for the total building design. Because relative humidity affects other components of a project, the discussion of relative humidity levels will be a priority for the design and operation of hospital HVAC systems for some time to come.

Conclusion

These concerns are only the tip of the iceberg for health care engineering system codes and design requirements, and there are plenty more beyond these items. Sometimes you have to look a little harder at engineering system requirements and always remember that codes and standards appearing to be specific to engineering systems are often intertwined with other codes and standards, and the interpretation, intent, and implementation need to be understood in the context of the affected health care facility.