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UNDERSTANDING FIRE PROTECTION ENGINEERING

Best practices for successful projects

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Keeping costs down while maintaining the highest standard of safety and meeting building requirements is a goal for any project. In most cases, this is easier said than done. But following best practices in fire protection engineering can provide often-overlooked ways to achieve this goal.

Neglecting to consider the big picture when making specifying decisions is a common oversight; minor points can quickly add up. This practice often leads to choices that benefit a specific area without taking into account other disciplines (i.e., building classification, fire alarm, passive fire protection, etc.). This could result in increases in capital or maintenance expenses. For example, to reduce the cost of a fully sprinklered boiler room enclosure, the smoke partition exception may be provided instead of a one-hour fire barrier. However, this may now require smoke dampers to be installed in the air transfer grilles that were previously not required, in addition to smoke detection for initiation.

Image 1: A hydrocarbon product storage tank uses an exterior water spray system for cooling, internal protection via foam (AFFF) chambers and dike area protection with high-volume foam/water monitors.

Image 2: High-expansion foam has become a preferred option for fire suppression in large, open facilities such as aircraft hangars.

Two of the most effective ways to employ a consolidated life safety and asset protection method are merging systems and eliminating unnecessary ones. Incorporating fire-resistive construction, using the building code and its exceptions to benefit the specific project, and employing proper design techniques also provide opportunities to implement a holistic approach. Given there are multiple fire protection systems installed to achieve the desired level of protection, it is vital to have a coordinated and cohesive plan.

Achieving Simplicity Through Multidisciplinary Coordination

Harmonizing multidisciplinary systems — such as egress, public address, fire alarm and commodity storage arrangements — presents an opportunity to simplify maintenance and design while also lowering project costs. Because fire protection is a multidisciplinary practice (i.e., architects for egress and fire barriers, mechanical engineers for sprinkler assemblies, and electrical engineers for fire alarm systems), synchronizing these systems is often overlooked.

By coordinating and understanding a building's classification and egress system early in the design phase, projects are more likely to stay on schedule and see increased interdisciplinary coordination. If changes in the building classification or modifications to the floor plan to address egress issues (e.g., number of exits, dead-end corridors, common paths of travel or maximum travel distances) happen after the fact, the design budget and project schedule can be considerably hampered. It is always best to solidify these long before the permit review set is issued.

When it comes to building systems, more is not always better — this is certainly true for public address and fire alarm systems. Some buildings have separate public address and fire alarm

systems, but integrating them into one, such as a fire alarm voice evacuation and paging system, is an efficient and effective way to control project costs.

Merged systems can sometimes provide all the same functions as two separate ones as well; fire alarm voice evacuation systems can be zoned and programmed to take audio input from a phone paging system, or provide background music, just like a public address system.

Additionally, human behavior studies have demonstrated building's occupants respond more quickly and effectively during an emergency when given voice instructions. Consequently, it is critical that the performance criteria for intelligibility and sound power are clearly noted in the voice evacuation system's specification, so it meets a building's life safety requirements and paging needs.

Just as with fire alarm and public address systems, synchronization is critical when planning storage arrangements and sprinkler systems. Coordinating the two makes for a more effective design. An inefficient storage system can drive up fire water demand for the sprinkler systems, even to the point where a fire pump becomes required. By harmonizing these two systems in the design phase, including limiting the product storage height, providing open shelving, using wood instead of plastic pallets, increasing the aisle width between racks, or providing single- versus double-row rack systems — all strategies that can reduce fire water demand.

Using the Code and the Exceptions Within

Knowing and using the building code and its exceptions to benefit a specific project can pay dividends. This all begins with planning that happens before converting the schematic design into a building.

Constructing a building with the most restrictive occupancy requirements in mind can reduce passive fire protection such as fire walls, fire barriers and fire partitions. As an example, when designing for a building with both business and assembly occupancies, one may be able to eliminate the fire barrier around assembly areas. If the whole building can be constructed within the allowable area of the most restrictive occupancy — in this case, the assembly occupancy — the building can then be classified as a mixed-use, nonseparated and assembly/business occupancy. This removes the need for a fire-rated barrier.

Being aware of the 10 percent rule to reduce fire-rated construction will also help a project team take advantage of the building code and its exceptions. With this rule, when the limiting occupancy is less than a tenth of the overall building area, it can be considered an accessory to the main occupancy, removing the requirements for fire-resistive construction between the occupancies. It is important to remember this is the aggregate of all accessory occupancies involved.

For example, if a factory has a lunch room (assembly) and offices (business), and the sum of the assembly and business occupancies exceed 10 percent of the total floor area, the code will not allow both to be considered accessory to the factory. Given these circumstances, it is most advantageous to consider the assembly occupancy as the accessory occupancy, which is then pulled from the equation and is no longer a restricting factor of the maximum allowable building area.

Having only the factory and business occupancies left offers a larger total building area and could provide the option of calling the building a mixed-use, nonseparated, factory/business occupancy. This classification not only eliminates the fire-resistive construction around

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the lunch room, but around the office area as well. It is important to remember both of these options do not eliminate the need to apply the more stringent egress requirements. However, they do help reduce the need for walls with fire-resistive construction, in addition to any Underwriters Laboratories-listed opening protection at building system penetrations.

Implementing smoke barriers and sprinkler systems only when absolutely necessary offers two opportunities to simplify building maintenance. It is not uncommon to see smoke barriers provided where they are not required. Smoke barriers are only required in a limited number of conditions: creating smoke compartments in underground buildings, in Group I-2 and I-3 buildings, ambulatory care buildings, some elevator lobbies, and for areas of refuge. Although sprinklers provide distinct advantages, such as eliminating fire-rated corridors and removing fire ratings around incidental rooms (e.g., furnace, boiler and laundry rooms), they are often not required in smaller buildings. Consequently, a quick cost-benefit analysis should be done to determine whether adding a sprinkler system is the most advantageous approach for the facility in question.

It is important to note, however, that when removing fire barriers around incidental areas with the sprinkler system exception, smoke partitions are still required. Using smoke partitions rather than fire barriers in these instances is often a more economical approach. Smoke partitions are only obligated to limit the passage of smoke (not restrict it) and therefore have more relaxed construction requirements.

Fire-Resistive Construction

While subtracting fire systems such as sprinklers can help increase project savings, adding fire-resistive construction can also yield the same outcome. For example, if the building has a hazardous area which is increasing the fire water demand for the sprinkler system, it may be beneficial to enclose this single room in fire-resistive construction equal to the duration of the demand, allowing the sprinkler designer to use the room design method to reduce the fire-water demand for the building. Sometimes, these hazardous areas can drive the need for a costly fire pump, but adding fire-rated construction eliminates that necessity.

Fire-resistive construction can also be used to divide hazardous materials (e.g. flammable or combustible liquids) into several control areas, which keeps them under the maximum allowable quantities and prevents having to classify any portion of the building as a Group H (hazardous) occupancy. Once a building is classified as a hazardous occupancy, other systems such as sprinklers, fire alarm, and additional or limiting restrictions on egress routes are required. By subdividing the hazardous areas into individual control areas, the building can remain under the limitations of the primary occupancy.

While many buildings require fire resistance, some may already have that feature built in, negating the need to strategically classify areas. For example, if occupancy separation is required between floors, one should consider checking the second floor slab construction on the underside of a deck before specifying spray-on fireproofing to gain the required fire-rated separation. This is because the deck's 3- to 4-inch (76- to 102-milimeter) concrete floor may inherently provide the required fire resistance. Concrete systems using composite metal deck will require protection of the steel, since the steel deck provides some of the structural support. Steel form deck (noncomposite deck) may not require protection if the concrete is thick enough, since the metal deck is not a structural component of the floor system and is there only to support

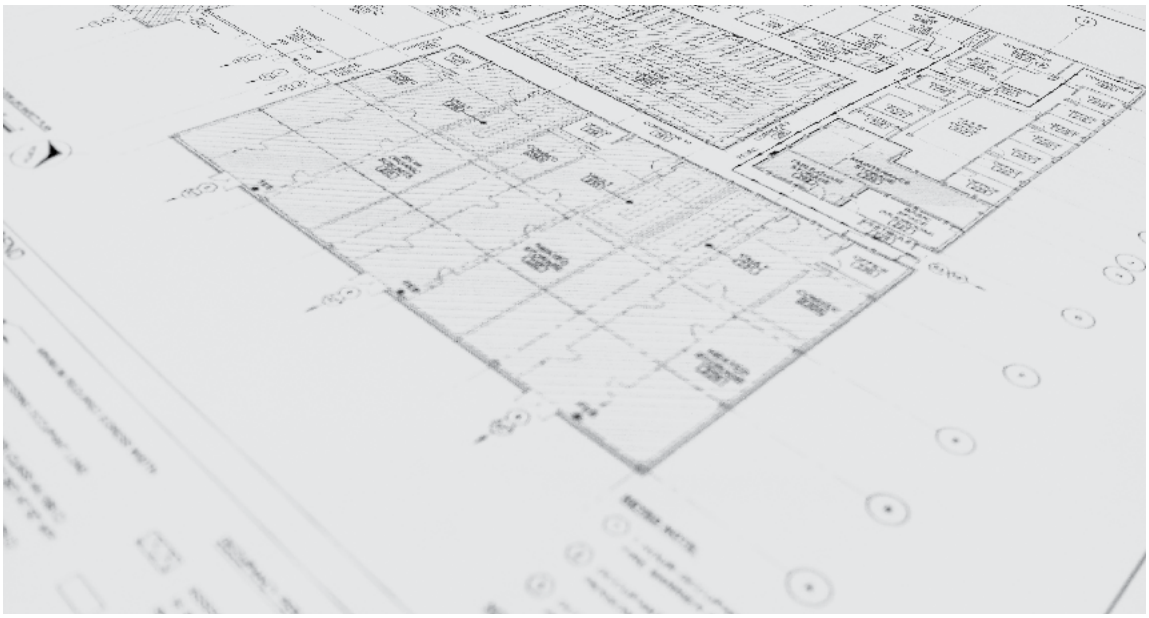

Image 3: Front-end planning to engineer fire protection systems results in more efficient and cost-effective solutions.

the concrete while it cures. It is also important that the primary and secondary supporting structural members are protected.

Design for Low Maintenance Costs

There are several fire protection practices that have lived on due to inertia. Some are simply overlooked, while others still are mislabeled or mishandled, causing unneeded stress and headaches. For a project to run smoothly, it is important to address these issues head-on so they are done right the first time. Better yet, these practices should be designed from the get-go.

One of the most common mistakes in fire protection is adding smoke detectors to areas where codes do not require them. Break rooms, corridors, electrical rooms, and server rooms — these are all common locations for non-required smoke detectors. Duct smoke detectors are often provided in air-handling systems that do not require them, or on both the supply and return when only one is required. An added benefit of installing only code-required smoke detectors is a reduction in the number of nuisance alarms.

Additional smoke detectors are a relatively minor problem compared to the potential long-term maintenance issues presented by mismanaging sprinkler drains and test connections, which are notorious for creating problems in a fire protection system. Since the rusty water discharge can stain sidewalks, erode the landscape, or create icy conditions on walking surfaces, it is important that the water is discharged to a safe area. Although this is not always the most convenient or aesthetically pleasing choice, it can prevent future headaches or safety issues.

Commissioning is another commonly overlooked aspect of fire protection systems. Although acceptance testing is the bare minimum when it comes to commissioning, it is normal for a building owner to receive the acceptance testing certificate and then assume the building system is good to go.

In addition to the acceptance testing, one should consider employing third-party commissioning, allowing for each device to be physically tested in accordance with the requirements of the applicable codes and standards. This process may include testing every sprinkler system valve and alarm device, verifying operation of all detectors and correct reporting to the fire alarm system, and validating the integrity of all the fire alarm circuits.

Commissioning also confirms the correct materials were installed in accordance with the approved drawings — not just the code minimum — and looks at field conditions that may not have been apparent during shop drawing reviews. Most importantly, third-party commissioning agents see that there are no surprises during acceptance testing, allowing the owner to occupy the building without delays.

Mislabeled systems create headaches for building owners. Fire alarm, fire suppression and passive fire protection systems are often not labeled at all, increasing the time it takes to test and troubleshoot problems. Additionally, specifying minimum clearances around and in front of valving and other equipment provides adequate clearances for performance-based systems such as sprinklers. Taking the time to coordinate these items and clarifying them in the specifications can also reduce future maintenance.

Taking a Holistic Approach

The importance of fully coordinated building fire protection systems is often overlooked because of the multidisciplinary nature of fire protection. As a result, building fire protection is frequently not addressed in a holistic manner to look for opportunities to decrease expenses or increase the long-term durability of the building.

Begin the next project using an all-inclusive approach and finish it off with a thorough commissioning effort for a successful, fully code-compliant building.