Physical Environment Portal: Module 6, LS.02.01.30 Leadership

Fire Safety: Background

Most fire deaths are not caused by burns, but by smoke inhalation. As the person inhales smoke their ability for self-rescue is diminished to the point where they cannot escape to an exit. As a fire grows it consumes oxygen. When oxygen levels are at 21%, there is normal air to breath; if the oxygen level is reduced to 17% judgement is impaired; at 12% headache, dizziness and fatigue occur; at 9% unconsciousness and at 8% respiratory arrest.

Often the smoke of a fire incapacitates people so quickly that they are overcome and cannot make it to an area of refuge or exit. In the smoke are synthetic materials used in construction and are common in the healthcare environment. These materials are often small enough to affect the respiratory systems protective filters and lodge in the lungs. Some particles in the smoke are also toxic. Mixed with heat, smoke can also create vapors of fog-like droplets of liquid that can poison on contact or if ingested. Finally, toxic gases (i.e. carbon monoxide or CO) can be deadly.

In addition to producing smoke, fire generates heat, which is also a respiratory hazard. Superheated gases burn the respiratory tract. When the air is hot enough, one breath can kill.

Fire Safety: Intent of the Life Safety Chapter, LS.02.01.30

LS.02.01.30 states: the organization provides and maintains building features to protect individuals from the hazards of fire and smoke.

While LS.02.01.10 focuses on the building to protect occupants from fire, Standard LS.02.01.30 focuses mostly on the hazards of fire and smoke. Fire destroys buildings; Smoke kills the occupants. Although fire barriers have higher fire ratings, managing the development of smoke in a fire is also extremely important in saving lives.

The specific focus is on minimizing the effects of smoke and heat. Healthcare buildings are built with a series of smoke barriers, designed to restrict the movement of smoke in a building. Smoke barriers are a system of walls, floors, doors, smoke dampers, and managed penetrations. The smoke barrier is not a single component. If a smoke door fails, the smoke barrier fails; if there are unprotected openings (i.e. holes) in the smoke barrier walls, the smoke barrier fails.

Most fire-related deaths are not caused by burns, but from smoke inhalation. As a fire develops smoke is generated. Restricting the movement of smoke directly saves lives. Any breach in the smoke barrier system may result in loss of life. [NOTE: In an earlier module we explored fire barriers that are designed to protect occupants' lives from fire.]

If a smoke barrier is more than walls, just what is a smoke barrier? As mentioned above a smoke barrier is several components, that when properly maintained protect the structure and

its occupants. Each component has been tested to establish how much protection can be anticipated. For example, what does it mean if a smoke door is required? The smoke door must be substantial so LS.02.01.30 EP 20 requires the smoke door be 1-3/4 inches thick with either self-closing or automatic-closing devices and the gaps between the meeting edges of door pairs are no more than ⅛ inch wide with the undercut being ≤ ¾ inch. What is different from a fire door is that the smoke door is not required to latch.

In a similar manner, the walls that hold the doors must be built to resist the passage of smoke. All components that affect the smoke barrier must be able to resist the passage of smoke.

Suggested Solution to Managing Fire Barriers:

Many organizations use a Barrier Management Program, restricting the access above ceilings to prevent unknown breaches in the smoke barriers. This program is discussed in greater detail in the June 2012 Perspectives article on Barrier Management (pages 3 – 5). However, leadership can be an important part of the solution as well. Supporting facilities by endorsing the Barrier Management Program is an important first step. But also, supporting facilities by insisting staff do not smoke doors open, do not compromise closing devices and providing support during construction activities.

Principles of Fire Development

For most common fires to burn there must be three elements: ignition source, oxygen and fuel (material to consume). If any one of these are missing, the fire cannot develop. Once ignited, a chain reaction occurs where a fire can be sustained by its own heat and further release of energy and consumption of fuel-oxygen. Fire can be extinguished if any of these are removed. (NOTE: there are certain exceptions to this rule, certain chemicals can generate heat/fire without oxygen, etc.)

BUILDING COMPARTMENTATION: *DEFEND IN PLACE*

Units of Defense: Building Compartmentation

Healthcare occupancies are designed to protect occupants by defending in place, rather than evacuation (as in business occupancy). To accomplish this, healthcare occupancies are designed with certain features that protect the occupants. For this to occur, all features of fire safety, including the building construction and fire suppression/alarm systems, need to be fully operable.

In 1978 the Joint Commission released an LSC® model called the Unit Concept. This model was mainly developed to educate the surveyors about the LSC®, but when it caught on, the Joint Commission published the concept and used it to teach health care professionals about code compliance. In a health care occupancy, because of the building type and staff-to-patient ratios, the reaction to a fire is to "defend in place."

The Unit Concept includes the following:

- **Building unit** – The compartmentation of the total structure, including appropriate building construction/type. This is the largest of all units, as it has to do with how well the building will perform in a standard fire. It also includes fire barriers and floor assemblies. Features such as roof construction, fire detection and suppression systems and exiting methods contribute to the building unit.

- **Room unit** – Individual rooms are the first unit of defense, and the room unit is the smallest of the units in the Unit Concept. The term *room unit* is somewhat misleading in a nonsprinklered compartment, as there is no requirement for separation between patient rooms. In a sprinklered environment, due to the rapid response of the sprinkler head, the patient room certainly is the first unit of defense. In a nonsprinklered compartment, the original concept of the *LSC*® was to separate use areas (rooms) from the exit access (corridor) to provide an environment free from the products of combustion.

- **Compartment** – Based on the size of a smoke compartment (22,500 square feet maximum), this unit component includes rooms and corridors, and creates areas that may be accessed horizontally, which is the preferable method to rapidly move patients. The compartment unit includes all the requirements for separating an institutional occupancy into smoke compartments. The maintenance elements include wall penetrations, smoke dampers, and door hardware. Smoke compartmentalization is one of the most important features in the *LSC*®, and a facility must be diligent in making sure these features are properly maintained.

  The smoke barrier is identified as having 30 minute Fire Resistive Rated assemblies, and is easily identified as having cross-corridor doors without latching hardware, but with door closures and a gap at the meeting edges of $\leq$ 1/8". The smoke barrier assembly reaches from the outside wall to the other outside wall, from the deck above to the floor, and is to be without unprotected openings. A fire barrier is similar, however a fire barrier must meet certain criteria related to how long the assembly can resist the penetration of fire from one side to another (typically either 1 hour construction with 45minute doors; or 2 hour construction with 90 minute doors). Like the smoke barrier, the fire barrier reaches from the outside wall to the other outside wall, from the deck above to the floor is to be without protected openings. The major difference is that a two hour rated fire barrier can separate building occupancies, provided certain criteria is met. This includes not exiting from a higher occupancy to a lesser occupancy in a fire situation (i.e. not exiting from a hospital occupancy through a business occupancy). However, in certain situations, it is allowable to exit from a business occupancy through a healthcare occupancy.

- **Floor assembly** – Floor assemblies separate floors, with a fire rating determined by the building construction type and height of the building. The floor assembly unit contains the floor slab and all vertical penetrations of that slab. (If the smoke or fire barriers fail, then the floor assembly becomes the next unit of defense. Vertical penetrations of floor assemblies that are improperly maintained can cause smoke and fire to spread vertically throughout the building.) With the necessity to supply many mechanical, electrical, and patient support systems through chutes and shafts, and to provide vertical access by stairs and elevators, a facility must be diligent in making sure vertical penetrations are properly sealed and access panels are appropriately rated. Floor assemblies vertically separate occupancies.

- **Exit** – A primary feature of life safety is the ability to exit a compartment and, as appropriate, to exit the building. Exits must be maintained so that if a fire (or other incident) occurs, the rapid movement of patients and visitors can take place. In a defend-in-place occupancy such as a health care occupancy, the likelihood of having to totally evacuate a building is rare, but the possibility still exists. Even in a fully sprinklered building, the need to use the means of egress and exits may be necessary due to other internal or external disasters. When an occupant enters this type of component and leaves an unsafe environment, he or she is considered to be out of harm's way. Therefore, exit areas must be considered a priority in a PM Program. The Joint Commission will evaluate business occupancies in regard to the accessibility of the exits. No exit shall be compromised in a business occupancy.