CAPITAL PARTNERS

"CLIF NOTES" SERIES

(Competent Leveraging of Information and Facts)

Fire Protection

What basic information do you need to know about fire protection systems in buildings and why? The Capital Partners ***Fire Protection CLIF Notes*** will provide you with the buzz words, general definitions and description of the basic components of common fire protection systems. You will now have enough information to be dangerous, yet still impress your clients and colleagues.

COMMON TERMS:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

The NFPA is a national organization whose primary purpose is to promote the science and improvement of methods of fire protection and prevention, electrical safety and to establish quality safeguards against loss of life and property. The standards set forth by the NFPA reflect the minimum standards required. Local jurisdictions use the NFPA information as a base line and modify its information by increasing the requirements to meet specific concerns in their region.

FACTORY MUTUAL RESEARCH (FM)

FM is a non-profit scientific research and testing organization that specializes in research to set higher standards to advance loss prevention practices. They provide an industry benchmark that documents relative risk probability. Their documented engineering solutions are publicly available to support an overall cost of risk guideline. FM's number one priority is to identify the vulnerabilities of products and systems and resolve those issues using documentation while providing laboratory engineering to resolve the issues.

UNDERWRITERS LABORATORIES, INC. (UL)

Underwriters Laboratories, Inc. is an independent, non-profit product safety testing and certification organization. They have been testing products for public safety since 1894. They currently hold the undisputed reputation as the leader in U.S. product safety and certification. Their large-scale fire protection facility allows users to conduct efficient, cost-effective research. Jurisdictional authorities, fire sprinkler design engineers and fire sprinkler manufacturers use this facility to collect data necessary to substantiate code change proposals. UL, with its roots deep in fire safety, understands these fire testing needs and has built the most modern facility of its kind in the world.

AUTHORITY HAVING JURISDICTION (AHJ)

The AHJ is the representative, organization, or office that is responsible for approving fire protection equipment, fire protection installations and fire protection procedures in new construction or remodel. Governance varies by region, with the AHJ being Federal, State, County or City. The actual AHJ may be the local Fire Chief, Fire Marshall, Fire Prevention Bureau, Building Official or others having statutory authority.

POUNDS PER SQUARE INCH (PSI)

PSI is a standard unit of measurement used when measuring pressure of a specific system. For example: The pressure of the domestic water supply in a typical facility is equal to approximately 75 PSI. PSI is used in conjunction with other system data to mathematically model flow characteristics of water supplies thus allowing the fire protection engineers to properly design fire protection systems per the NFPA.

GALLONS PER MINUTE (GPM)

GPM is a standard unit of measure for measuring volumetric flow of liquids. For example: If you took a garden hose and filled up a five gallon bucket in one minute, that would be a measurement of 5 gallons per minute.

POST INDICATOR VALVE (PIV)

A Post Indicator Valve assembly is an underground valve with an above ground indicating post that serves as a one-source supply and isolation valve to the fire protection system. The above ground indicator post has a viewing window that indicates whether the valve is open or closed. The valves are usually electronically monitored by a local monitoring company and/or locked in the open position dependent upon the local authority having jurisdiction. In large multiple riser systems, PIV's are used to isolate sections of systems to aid in service and repairs. They are spaced with a maximum 5 devices (risers or hydrants) between them per NFPA.

FIRE DEPARTMENT CONNECTION (FDC)

The FDC is an auxiliary inlet connection to the fire protection water supply. It is used by the fire department to supplement the fire protection water supply and pressure. It provides the fire department with an unobstructed waterway to the fire sprinkler system. The FDC is installed with a check valve to ensure that the water that is forced into the fire sprinkler system does not come back through the FDC and cause injury or property damage when the fire department uses it. FDC's come in single inlet designs and multiple inlet designs dependent upon the system and type of hazard being protected.

FIRE SPRINKLER SYSTEM PIPE SIZING

The pipe sizing of a fire protection sprinkler system is determined by the following variables:

- Occupancy of the structure
- Type of structure
- Type of materials being stored in the building
- Method of storage for the materials
- Type and density of materials being stored
- Height of materials being stored
- Availability of water for the system
- Type of packaging materials the product is stored in
- Availability of water volume and pressure from the local municipal water purveyor
- Whether or not a fire system pump is installed
- Type of sprinkler head and design criteria for the particular head

All of the criteria are taken into account by the fire system engineer to determine the most economical fire sprinkler system with the best coverage for the application.

AUTOMATIC FIRE SPRINKLER

An automatic fire sprinkler is an individually heat-activated device designed to distribute water from the sprinkler piping with specific characteristics to extinguish or control a fire. It consists of a threaded body with a waterway that contains an orifice (opening) of a specific size. It contains a deflector engineered for distributing the water in a specified pattern and method. A closed sprinkler system (dry system) is not charged with water in the sprinkler pipes. The dry system contains a heat sensitive element such as a fusible link, that when activated will charge the sprinkler pipes with water. An open sprinkler system (wet system) pipes are charged with water all times and does not require the heat sensitive element. Fire sprinklers are available in many sizes, styles, finishes, temperatures, thread sizes, orifices, orientation and materials. These variables are taken into consideration by the fire sprinkler engineer in accordance with NFPA standards to select the appropriate fire sprinkler head for the specific application.

FIRE SPRINKLER ORIFICE

The sprinkler system flows water through the aperture or hole within the sprinkler head. The selected aperture or orifice of the head is one of the criteria used to determine the specific coverage capabilities and flow characteristics of the sprinkler heads to be selected for the fire protection system design.

FUSIBLE LINK

The fusible link is the operating element of a closed automatic fire sprinkler head. Operating elements are glass bulb or solder link and lever. Both glass bulbs and solder links are engineered to operate at various temperatures. The different temperatures are for different applications. Example: A fusible link temperature selection for a regular office area would normally be 160 degrees Fahrenheit, while a selection for a bake-on paint booth oven may be 360 degrees Fahrenheit or higher. The following table shows the typical automatic fire sprinkler temperature classifications, temperature ratings and color notation.

Sprinkler Temperature Classification	Nominal Sprinkler Temp Rating	Fusible Link Color
Ordinary	135 Degrees F.	Orange
Ordinary	155 Degrees F.	Red
Intermediate	175 Degrees F.	Yellow
Intermediate	200 Degrees F.	Green
High	286 Degrees F.	Blue
Extra High	360 Degrees F.	Mauve
Ultra High	500 Degrees F.	Black

STANDARD FIRE SPRINKLER SYSTEM

A standard wet pipe fire sprinkler system is a series of pipes, sprinkler drops and fire sprinkler heads filled with pressurized water supplied from a dependable water source that is permanently attached to the structure it is engineered to protect. The sprinkler heads or discharge points for a standard wet pipe fire sprinkler system are thermal-sensitive devices that are engineered to activate and distribute the pressurized water with a predetermined response time.

ESFR FIRE SPRINKLER SYSTEM (EARLY SUPPRESSION FAST-RESPONSE)

An ESFR fire sprinkler system differs from a conventional system by delivering more water with a faster response time. Installing a ceiling mounted ESFR sprinkler system greatly increases the attractiveness to the prospective building occupant for the following reasons:

- For high–rack storage, an ESFR system can eliminate the need for costly and inflexible in-rack sprinklers. ESFR fire systems have been tested under fire conditions and have provided adequate protection of in-rack storage systems, without installing the in-rack fire sprinklers.
- Eliminating in-rack sprinklers removes the risk of a forklift damaging a sprinkler head.
- Eliminating in-rack sprinklers increases the flexibility of the building usage for future occupants, rack relocation and area modifications.
- ESFR fire sprinkler systems are engineered to extinguish a fire, not just control or contain it as are conventional systems.
- An ESFR fire sprinkler system can allow the tenant an option to stack certain products higher.

There are considerations and certain restrictions involving an ESFR fire protection system. ESFR systems are normally installed in conjunction with a fire booster pump and possible water storage tank due to the high volume of water needed to meet the design densities. Because of the complexity of the ESFR fire protection system, only experienced fire protection system designers should be utilized.

NOTE: There are incrementally higher costs involved when installing an ESFR system as opposed to a conventional system. However, the higher cost of an ESFR system over a conventional roof mounted sprinkler system is more than offset by the elimination of in-rack sprinklers when in-rack sprinklers are required.

FIRE SPRINKLER DROPS

A sprinkler drop is the vertical piece of fire sprinkler pipe that connects the branch lines of the system to the specific fire sprinkler heads. Sprinkler drops vary in length depending on the construction of the building and the designed location for the sprinkler heads.

FIRE SPRINKLER ALARM VALVE

Fire sprinkler alarm valves are designed to prevent a reverse flow of water in the sprinkler system in the event of low water pressure from the water supply. Jurisdictions require the valves in order to protect their potable water supply. Most fire sprinkler alarm valves also have the capability to initiate mechanical alarms. These alarm valves are fitted with retard chambers that buffer small flows of water to minimize false alarms. In the event of a sustained flow such as a fused sprinkler head, the retard chamber is filled and the mechanical water gong alarm is activated sounding an alarm.

FIRE SPRINKLER SYSTEM ALARM

A fire sprinkler system alarm is usually a simple system consisting of a flow switch, a monitoring panel and an automatic telephone dialer. The flow switch is mounted on the fire sprinkler riser above the fire sprinkler alarm valve. The monitoring panel is generally located in an equipment room or an occupied lobby. The auto dialer is located in the fire alarm panel. The flow switch detects water flow in the riser and electronically reports the flow to the panel. The panel sounds an audible alarm and activates the dialer. The dialer automatically dials the pre-programmed telephone number (usually a listed monitoring company) and transmits a code identifying the location of the system and the specific problem of the system to the monitoring company that reports the alarm to the fire department. The telephone circuit used should always be a dedicated line.

DEDICATED PHONE LINE

A dedicated phone line (for fire protection) is a telephone line that is not used for anything but the alarm panel connected to it. It is not used as a shared line, a back-door line, a roll-over line or a facsimile line.

FIRE PROTECTION SYSTEMS

WET SYSTEMS

A wet pipe sprinkler system is a permanently fixed fire protection system that is filled with pressurized water supplied from a dependable source. Wet pipe systems may only be installed in structures that are heated or not subject to freezing. Closed automatic sprinkler heads spaced in accordance with the AHJ are used to detect a fire. Upon activation, the automatic fire sprinkler heads distribute the system water over the specific area to control or extinguish the fire. If a water flow alarm has been installed with the system, the detection device will detect the flow of water and sound an alarm indicating that the system is operating. Only the sprinklers immediately over or adjacent to the fire will operate thus minimizing water damage to the protected area.

DRY SYSTEMS

A dry pipe sprinkler system is a permanently fixed fire protection system that uses water from a dependable source. The fire sprinkler piping down stream from the specialized dry pipe valve is filled with pressurized air or nitrogen. Dry pipe systems are generally installed in unheated structures that are subject to freezing. Closed automatic fire sprinkler heads spaced in accordance with the AHJ are used to detect the fire. Upon activating the fire sprinkler heads (heat from a fire), the pressure drop in the piping system is detected and the dry pipe sprinkler valve opens and distributes the system water over the specific area to control or extinguish the fire. If a pressure switch has been installed with the system, the detection device will detect the flow of water and sound an alarm indicating that the system is operating. Paddle-type flow switches should be avoided for dry pipe systems. Again, only the automatic sprinklers immediately over or adjacent to the fire will operate thus minimizing water damage to the protected area.

DELUGE SYSTEMS

A deluge sprinkler system is a permanently fixed fire protection system that uses pressurized water from a dependable source as an extinguishing agent. The deluge system floods the area with water distributing it through the open sprinkler heads and/or nozzles. Thus when a deluge system is activated, all of the sprinkler heads in the system are activated. The open sprinkler piping system is void of water until the deluge valve is actuated. Deluge valves are activated by means of hydraulic, pneumatic, electric, or manual release. Deluge systems are generally specified to protect extra hazard occupancies by creating a fire buffer zone or to cool down surfaces to prevent deformation of the structure thus preventing collapse of the protected structure. Deluge systems are commonly used to protect tank storage areas where the tanks are filled with combustible solutions. These combustible solutions are low flash points such as fuel storage and transformer equipment. Containment or a diking system is required for these types of systems to prevent transfer of the combustible product or fire to the adjacent areas and to prevent potentially tainted water from getting into the storm drainage system.

FOAM-WATER SYSTEMS

Foam-water systems use foam-water rated automatic fire sprinklers or spray nozzles with foam concentrate material being introduced into the water at a controlled rate at the riser location. Design of foam water systems require extensive design experience in high hazard systems and will require an experienced high hazard design engineer or contractor. The design engineer must select the proper foam for the application and model the proposed hazard using specialized software programs to determine the correct amount of selected concentrate required to protect the specific situation. The engineer also needs to size the foam supply orifice for the foam to be supplied at the proper rate and to determine the duration of concentrate flow needed to extinguish the fire in order to properly select a foam storage container. Due to the extreme hazard and exposure, this design criterion is heavily scrutinized when submitting engineering designs for approval to the AHJ. Foam water systems are specified to protect high hazard occupancies that require a smothering and/or cooling agent where flammable-liquids are stored and could spill. Like a deluge system, containment or a diking system is required for these types of systems to prevent transfer of the combustible product or fire to the adjacent areas and contamination of the public storm drainage system. Examples where foam water systems are installed are aircraft hangars, chemical plants, cogeneration plants, extraction plants and areas where flammable liquids could spill and spread.

PRE-ACTION SYSTEMS

NON-INTERLOCK PRE-ACTION SYSTEM

A pre-action system uses a deluge valve or a dry pipe valve that requires some type of event before charging the sprinkler system with water. Non-interlock pre-action systems contain pressurized air or gas in the overhead piping system. The valve actuation takes place when a head is fused (fusible link melts) or by operation of the detection system. If for some reason the detection system fails to operate, the system will operate as a dry pipe system (if a head is fused or the fire sprinkler pipe is broken, the valve will actuate and water will flow). If the detection system operates, is damaged or malfunctions, the system will fill with water, but the water will be contained in the sprinkler pipe until an automatic fire sprinkler head is fused.

SINGLE-INTERLOCK PRE-ACTION SYSTEM

Single-Interlock Pre-Action System is a system with a deluge valve that will only open when receiving a signal from a detection system. The pipe in the overhead piping system is supplied with pressurized air or gas. The system is filled with water only when it receives a signal from the detection system. If a head is broken or a piece of sprinkler pipe in the system is broken, water will not flow. Because of the pressure loss, a trouble alarm will notify the occupant indicating that there is a problem with the system. Water will only flow when the deluge valve receives a signal from the detection system. If the detection system operates due to fire, damage or a malfunction, the system will fill. However the water will still be contained until a fire sprinkler fuses. Supervision is used to minimize accidental discharge. Typical installations are in areas where it is

desirable to have water at the sprinkler head only when the head fuses and where sprinkler heads are regularly exposed to physical damage.

DUAL-INTERLOCK PRE-ACTION SYSTEM

A dual-interlock pre-action system uses a deluge valve that requires both a signal from the detection system as well as a drop in pressure of the sprinkler pipes. The pipe in the overhead system is pressurized with air or gas as in the other systems. The valve will only operate when it receives a signal from the detection system and the pressure in the system is reduced. If the sprinkler system piping is damaged or a head is damaged resulting in a pressure drop, the valve will not operate, and if the detection system sends a signal to open to the valve without a pressure drop, it will not open the valve. Dual-interlock systems are commonly used in areas where maximum control of accidental discharge is required such as computer rooms or high value storage areas. They area also used in freezers where flooding of the pipe can have serious consequences.

GASEOUS FIRE SUPPRESSION SYSTEMS

HALON SYSTEM

HALON systems are specialty gas extinguishing systems that chemically inhibit combustion. Due to its environmental controversy, it is currently being phased out. HALON systems are actuated by fire alarm panels that have detectors placed in the protected areas that report to the fire alarm panel. These detectors, due to their sensitivity have the technology to detect a fire before open flames are present. A typical detector basically counts smoke or dust particles and reports back to the alarm panel. When the threshold of sensitivity is reached, a signal is sent from the detector to the panel informing it to sound an alarm. In many cases a person standing in the room when a detector reaches its threshold may not even know that there is a problem. These types of early detection and suppression are valuable for protecting high value items. One of the downfalls to these types of systems is dust. If dust levels become high, a false alarm may occur to the point of discharging the system. These systems are usually installed to protect extremely high value areas such as network computer rooms and telephone switching equipment. Heating ventilation and air conditioning control systems (HVAC) are tied into HALON alarm panel systems to control airflow so that critical design gas density levels can be achieved. To achieve these levels, HVAC systems are shut down and dampers in the HVAC supply and return ducts are closed off thus containing the protected area. Because of the high cost of agent replacement and the environmental issues, it is becoming cost effective to replace old HALON systems with new clean agent gas systems such as FM 200 or Inergon.

CLEAN GASEOUS FIRE SUPPRESSION AGENTS

There are clean gaseous fire suppression agent systems available that fill the HALON replacement application such as FM 200 or Inergen. The products are promoted to be safe, clean, non-toxic, inert, non-corrosive odorless and colorless fire suppression agents. They also advertise to be environmentally friendly unlike HALON. The extinguishing gas systems also can prevent combustion by saturating the subject environment with a predetermined percentage of their

blended gasses. These systems are actuated by control panels that have been specifically designed for their application. Similar to HALON, system smoke detectors can detect a fire before open flames are present by sensing smoke particles. Clean gaseous systems are installed in extremely high value areas such as electronic data storage areas, electronic switching areas and computer rooms. Heating ventilation and air conditioning control systems (HVAC) are typically tied into the system control panels, allowing the extinguishing gas to be effective. Similar to Halon, special gas systems must reach critical design gas density levels to be effective. To achieve these levels, HVAC systems must be shut down and dampers in the HVAC supply and return ducts are closed off thus containing the protected area so that the required gas density levels can be obtained thus suppressing the fire.

FIRE PUMPS (ELECTRIC / DIESEL)

Fire pumps are installed to boost water pressure for automatic fire sprinklers systems where the municipal water pressures are not sufficient to meet the needed automatic fire sprinkler design criteria. Fire pumps are normally rated with capacities between 150 GPM (gallons per minute) and 5000 GPM in various increments. The fire pump is powered by an electric or diesel motor (driver). Selection of the motor is usually based on availability of quality power and location of the site. In either case the pump and driver assembly must be UL and or Factory Mutual listed dependent upon the local authority having jurisdiction. As a result of installing a fire pump with a fire protection system, the engineer may be able to downsize some of the pipe thus providing cost savings to the customer.

WATER STORAGE

On-site water storage is usually required when the municipal water supply is not sufficient to meet the automatic fire sprinkler design volume needs. Water storage can be above or below ground in pools or tanks. Basic criteria for sizing water storage vessels are required design densities and duration of operation of the expected fire protection system. Leading edge fire sprinkler companies are currently using sophisticated modeling software that simulate a fire system flow characteristics of the engineered system to determine precisely the flow characteristics and duration needed thus providing accurate usage information so the storage container can be properly sized.

SPRINKLER DENSITY

Sprinkler density is the gallons of water per square foot over the design area in one minute. Example: .33/2000 would translate to .33 gallons of water per square foot delivered to each sprinkler head in the selected design area of 2000 square feet per NFPA requirements in one minute.

IN-RACK SPRINKLERS

In-rack sprinklers are fire sprinklers that are installed within storage racks when the overhead sprinklers are not capable of meeting the storage density design requirements. The installation of these sprinklers allows the occupant to increase their type of storage, density and height of storage within the facility when these systems are installed. They also allow the occupant to store larger

quantities of high hazard materials thus using their storage space more efficiently. When installed properly, the system allows easy access with a forklift without interfering with the usability of the storage rack system. See ESFR systems for additional options.

HIGH-PILED STORAGE

High-piled storage is defined as solid-piled, palletized, rack storage, bin box and shelf storage in excess of 12 feet in height. High-piled storage creates unique design challenges. Primary considerations that need to be addressed when considering high-piled storage are the types and classification of the materials being stored, how the product is packaged, the intended height of the storage, the physical properties of the building and the water supply.

SYSTEM RISER

The system riser is the supply pipe (usually vertical) directly connected to the water supply and the sprinkler system. This is where the fire sprinkler alarm valve and the system alarm flow switch is usually located. This is also the usual location of a water motor alarm bell. Systems risers are usually located on a perimeter wall of the building. Larger buildings have multiple risers.

DOUBLE DETECTOR CHECK VALVE (DDCV)

Double detector check valve assemblies are used to insure the separation of potable water (drinking water) systems from non-potable water systems. By mandating the installation of a DDCV, the AHJ helps insure that the drinking water supply is not contaminated by the fire protection systems that may contain oils and other impurities. The installation of the DDCV is a health consideration mandated by code.

CLASSIFICATION OF OCCUPANCY

When the word occupancy is used, the Uniform Building Code (UBC) definition comes to mind. Examples such as; Group A for assembly areas, Group B for business areas, Group E for educational areas and so on. These classification guidelines have been assembled to aid in design and to protect the occupants and structures. Classification of Occupancy for the fire protection industry relates specifically to automatic fire sprinkler design, installation and water supply requirements. These classifications are used in conjunction with commodity classifications to accurately design automatic fire sprinkler systems using NFPA codes. Occupancy classifications are as follows:

LIGHT HAZARD OCCUPANCY

Product quantity or combustibility of the contents is low and fires with relativity low rates of heat release are expected.

ORDINARY HAZARDS

Group 1

Product combustibility is low for the occupancy and the quantity of combustibles are moderate. Stockpiles of combustibles shall not exceed 8 feet and the expected release of heat from the potential fires is moderate.

Group 2

Product combustibility is moderate to high for the occupancy and the quantity of combustibles is moderate to high. Stockpiles of combustibles shall not exceed 12 feet and the expected release of heat from the potential fires is moderate to high.

EXTRA HAZARDS

Group 1

Product quantity and combustibility of contents is very high with dust, lint or other materials present that increase the probability of rapid developing fires with high rate of heat release but with little or no combustible or flammable liquids.

EXTRA HAZARDS

Group 2

Product in moderate to substantial quantities of flammable or combustible liquids or where shielding of combustibles are extensive.

COMMODITY CLASSIFICATION

By definition, the NFPA identifies commodities as combinations of products, packing, material, and containers upon which the commodity classification is based. There are 4 primary classifications. The following class descriptions have been shortened and should only be used for general knowledge.

- Class I commodities are primarily non-combustible products placed directly on wooden pallets.
- Class II commodities are primarily non-combustible products that are stored in solid wood crates.
- Class III commodities are primarily products that are fashioned from wood, paper, natural fibers with a small specific percentage of specified plastics that are considered to be less hazardous. They can be stored with or without cartons, boxes, crates and with or with out pallets.
- Class IV commodities are basically defined as products that are stored with or without pallets that are partially or totally made up of specified plastics of various types.

A Special Thanks*!* *Most of this information was provided by Randy Nelson of VFS Fire Protection Services. They are available to assist you and your clients with a better understanding of fire protection systems*.

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Please Note: *As with all communicating of information in this way, we are providing CLIF Notes as a helpful service for our friends. They are not intended to be a substitute for professional design, engineering, legal or financial advice or assistance.*

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