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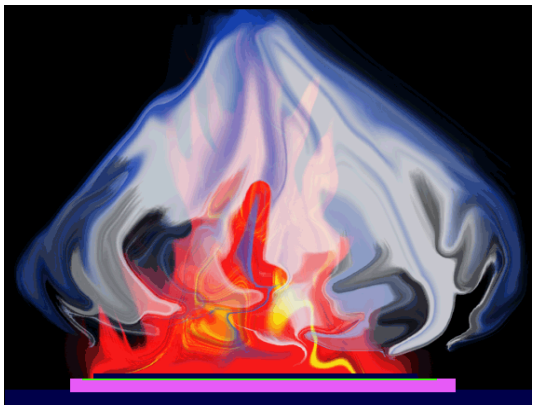
Water-Mist Fire Suppression System

Introduction



Fire suppression systems are an extremely important part of every commercial building that ensures the safety of the occupants and limits damage due to fire. The Memorial Hospital Miramar utilizes both a wet system and pre-action system to meet the needs of fire suppression. Both systems are popularly used in all types of commercial buildings. An alternative system that is being used in the market today is a water-mist fire suppression system. The system was initially developed for protection of lumber drying kilns and later for use on ships. When Halon suppression systems were deemed environmentally unsafe in 1995, water-mist systems became the leading candidate for replacement. Today, water-mist systems are used primarily to suppress fires related to gas turbines, machine rooms, and ships but have also been used in computer rooms and laboratories to protect the equipment. The water mist system has been most recently used in The National Gallery of Art to protect expensive artwork, which received a WBC craftsmanship award for the system.

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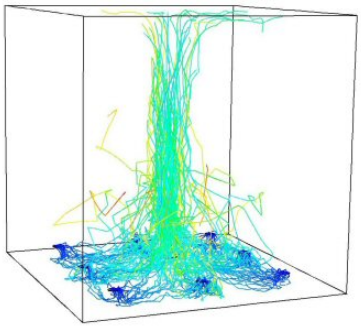
Water-mist systems use pressurized nozzles which release water droplets of varying size. The mist encapsulates the fire and as it turns to vapor, removes heat from the source. As the mist turns to steam, it expands immensely (1700 times) forcing oxygen away from the flame. This denies the fire the necessary oxygen to be able to sustain itself.

One company on the forefront of research in the water-mist category is NanoMist Systems, LLC. The water-mist system they have developed, NanoMist, uses an extremely fine mist that exhibits gas-like dispersion behaviors to absorb the energy of the fire and act as a flooding agent to extinguish fires. Their use of computer simulation models has made it easier, faster, and more affordable for water-mist technology to be developed. Through the use of a computational fluid dynamics (CFD) program called FLUENT, the NanoMist system could be compared to other systems in terms of extinguishment time, the mist's wetting nature, total water needed, and mass flow requirements.



Another high density system that has been proven effective in land-based systems is HI-FOG, a class 1 water mist as defined by NFPA 750, developed by the Marioff Corporation. This is the system used in the National Gallery of Art in Washington, DC which is the first museum in the United States to use this system. The HI-FOG system uses technology similar to that of the NanoMist system to suppress and extinguish fires.

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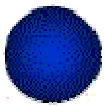
The extremely small drop size used in the HI-FOG system generates a vaporization rate around 400 times that of a conventional sprinkler system. The vaporization absorbs energy and can cool fires much faster than conventional sprinkler systems.

Drop Size Comparison		Drop Size (avg um)	Vaporization Rate	No. of Drops
	Sprinkler	> 1000	1	1
	Class 2/3 Mist	300	10	40
	HI-FOG	50	400	8000

The vaporization effect also locally inerts the environment from the volumetric expansion of the water. This allows for the mist to penetrate the flame where the effect is most pronounced. The small water droplets also have another effect on the fire. The drops effectively block radiant heat. This property enables fire fighters to stand closer to the fire

to extinguish it more efficiently. The radiant heat blocking also helps to protect against structural damage by protecting members from immense heat caused by the flames.

Problems

The Memorial Hospital Miramar is a very MEP intensive project, as is the case with most other healthcare facilities. This means that space is at a premium when trying to coordinate the location of all the mechanical, electrical, and plumbing equipment. A pre-action system requires much piping and controls that add to the complexity of the coordination and installation process.

The main disadvantage of the traditional pre-action system in the Memorial Hospital Miramar is the amount of water it uses to suppress fires.

The main reason this is a disadvantage is because the system is located in computer and IT rooms which contain expensive equipment. If a fire exists, the water from the sprinklers could damage the equipment and any important data within the equipment would be lost as well. The amount of water released also makes clean up and restoration a more difficult process. It would take longer for the water to be removed from the rooms and the restoration would be more extensive due to greater water damage.

The piping for the pre-action system must be designed for the amount of water flowing through them and the pipes must also be designed to handle the pressure from the

flowing water. In traditional systems, this requires the pipes to be considerably larger than that used in water-mist systems. The larger pipes make it more difficult to fit in the space required due to all the other MEP systems needed in the Memorial Hospital Miramar. The larger size of the pipes in turn makes them heavier than those of the water-mist system, especially when they are filled with water.

Solution Overview

The traditional pre-action system used in the Memorial Hospital Miramar will be replaced with a HI-FOG water mist system. The pipes in the area occupied by the pre-action system are required to be dry by code. In effect, the HI-FOG system will also incorporate qualities of the traditional pre-action system. The pipes will be dry until a detection device (smoke detectors) detects the presence of a possible fire. A supply valve opens and the pipes will then be filled with water ready to be distributed.

The HI-FOG system proposed for use in the Memorial Hospital Miramar will also incorporate a smoke scrubbing element. The plastics used in computer equipment have the potential to produce large amounts of smoke, even with small fires. The smoke produced has the potential to do much damage to the equipment therefore the equipment must be protected from this smoke in order to avoid damage. Pipes will be located in the sub-floor as well as being located in the ceiling. Upon activation of the initial smoke detection alarm, the horseshoe shaped pipes in the sub-floor discharge the water mist in

opposite directions which in turn causes the smoke to be sucked in and scrubbed by the mist. Drops containing the smoke particles condense at the bends in the piping and are collected at a later time for retrieval. The ceiling mounted system then discharges water mist directly into the room to suppress and extinguish the fire. Additional smoke will be absorbed by the fog and fall to the floor.

The piping in the HI-FOG system is also considerable smaller than the existing pre-action system. The HI-FOG system will utilize 1" stainless steel pipes instead of 2 ½" steel pipes. The smaller size of the pipes also reduces the weight of the system. The amount of water discharged by the HI-FOG system is only 10-20% of the water discharged in the traditional pre-action system. This significantly reduces the amount of damage done to the equipment by water discharge.

Comparison of HI-FOG System vs. Traditional Sprinkler Systems

PROPERTY	SPRINKLERS	HI-FOG
Extinguishing	No	Yes
Gas Cooling	No	Yes
Radiant Heat Blocking	No	Yes
Smoke Scrubbing	No	Yes
Safe for People	Yes	Yes
Safe for Equipment	No	Yes

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Conclusions

The initial cost of both systems was analyzed for the existing pre-action system and the proposed water-mist system, respectively. The results were as follows:

- Pre-action system - $810,500.00
- Water-Mist system - $912,000.00

The HI-FOG water-mist system was estimated to be $101,500.00 more than the pre-action system in regards to initial cost. This can be contributed to special parts unique to the water-mist system. The particular system proposed for use in the Memorial Hospital Miramar requires two separate detection systems in order for the system to function properly. This adds to the initial costs of implementing the system. The water-mist system also uses more expensive piping to hold the water. Even though the piping is smaller than the pipes used for the pre-action system, the material used is of better quality and therefore more expensive. Since the technology of water mist systems is still emerging in the computer/data/laboratory sector, most of the parts are all specially made by a small number of manufacturers. This allows the manufacturers to charge premium prices for the equipment used in the systems.

Even though the water mist system was estimated to have higher initial costs, there is the possibility for savings in case a fire does break out in the area occupied by the sprinkler systems. If the existing pre-action system is activated, it is possible that all of the equipment in the room could be damaged. The amount of damage varies on the severity of the fire, amount of smoke created, and amount of water damage sustained. The water damage is potentially much less with the water-mist system proposed. Little to no equipment damage could be realized. Since the system also effectively disperses smoke out of the space, smoke damage is considerable reduced. The water-mist system has the potential to save owners a substantial amount in damage control, which varies depending on the equipment in the rooms.

Initially, the maintenance costs of the water-mist system were thought to be lower than that of the traditional pre-action system. After research though, this was proven to be untrue. Average yearly maintenance costs for pre-action systems ranges from approximately $500 - $1000 for testing and cleaning out of pipes. According to NFPA 750, water mist systems are required to have quarterly checks, and must be fully tested every year. The costs associated with this are approximately $1000 - $2000 per year. The small number of qualified installers and testers along with the special considerations that must be made for this system drives the maintenance costs up.

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Taking into consideration the lower initial costs and lower maintenance costs, it would be advantageous to not implement the HI-FOG water mist system in the Memorial Hospital Miramar. Although the potential for cost savings exists through damage control, it would be more feasible to stick with the current pre-action system used in the Memorial Hospital Miramar.