



The Flame Spread

A Newsletter of
The Board of Certified Fire Protection Specialists

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Why No NIST?

By Daniel B.C. Gardiner, CFPS

A woman and male friend escaped an early morning blaze that killed the woman's three daughters and her parents at her Stamford, Connecticut home on Christmas Day. The girls' mother, Madonna Badger, escaped the fire along with a friend, Michael Borcina.

The Stamford Fire Department received the first report of the fire which engulfed her five-bedroom 3,349 SF Victorian style waterfront home at 4:52 AM.

Smoke was still rising from the charred building early Christmas afternoon as Stamford Mayor Michael Pavia and Acting Stamford Fire Chief Antonio Conte spoke to reporters during an emotional news conference at the scene. Conte, a 38-year fire department veteran, held back tears as he spoke.

The roof of the house was collapsing Sunday morning and Conte said structural damage would hinder investigators from determining the cause of the blaze. "With the condition of the building it will remain (under investigation) for a number of days until the fire marshal can get in," Conte said. "I would say it's a number of days before we actually find out how this occurred and what happened." Stamford property records list the house as a single-family five-bedroom house with 10 rooms and 3.5 baths. The house was built in 1895, had one fireplace and central heat.

It was reported on January 3rd that the Stamford Police Department was asked to assist in the investigation, a full 9-days after the fire. Captain Richard Conklin, commander of the Stamford

Bureau of Criminal Investigations, said "we're trying to answer a lot of questions; the department will specifically look into whether there were working smoke detectors, the renovations going on at the house and other areas that the fire marshals have not yet probed. The police department's experience in running investigations will help determine answers that the fire marshals have not yet found. This is what we do all the time. "They only do it sometimes," Conklin said of the fire marshals' investigators.

Two officials briefed on the investigation say that ashes were removed out of concerns for Santa Claus. They spoke to The Associated Press on condition of anonymity Tuesday January 3rd because the investigation was still under way. Authorities have said embers in a bag of discarded ashes started the blaze.

The home was under extensive renovation at the time of the fire. The issue of permits could figure in the investigation because the Connecticut Department of Consumer Protection has stated that neither Michael Borcina, whom along with the homeowner escaped the early morning blaze, nor his company, Tiberias Construction Inc., was registered to perform home improvement work in Connecticut.

Contractors are required to register with the state, though numerous building and other permits are issued by local officials. The Connecticut Department of Consumer Protection said it did not yet have enough information about what type of work may have been done or completed at the home, and would not comment on whether it will investigate.

In my view, the cause of the fire deaths outweighs the cause of the fire. It took several days before the subject of a lack of early warning was mentioned as a contributing factor in the deaths of the fire victims.

Additionally, officials rushed to demolish the house, eliminating any chance that experts like the folks at the National Institute of Standards and Technology (NIST) could look into the cause of the fire and the subsequent deaths. The demolition occurred less than 36-hours after the fatal fire.

NIST has been on the technological "front line" of issues such as smoke and flame detection, fire sprinklers, flame retardants, and other "before-the-fire" issues. Their computer modeling skills are second to none. NIST, an agency of the U.S. Department of Commerce, was founded in 1901 and is the nation's first federal physical science research laboratory. NIST led in the development of performance standards and placement recommendations for smoke alarms and detectors.

NIST researchers utilize a Fire Dynamic Simulator (FDS) which is a computer fire model to reconstruct the fire conditions in buildings. They have utilized their modeling in dozens of scenarios where firefighters or civilians have been killed such as in the June 18, 2007 Charleston, SC Super Sofa Store where nine firefighters were killed, and the February 20, 2003 West Warwick, RI Station Nightclub where 100 patrons were killed.

The bottom line is that one of the best ways to determine where a fire started, how it spread and **why people died** is to use all of the resources available. When an unusual and significant fire event occurs, local fire investigators should reach out to those resources, such as NIST or the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF). Regrettably, in the Stamford case; without a building to examine, measure, and model because it was torn down in haste, NIST can be of little or no value now.

I think it is important for the fire protection community to address the issue of demolition at any future fatal fire site. A fully executed fire investigation utilizing all available resources such as NIST might lead us to answers from which we may learn from such a tragedy in the future.

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He retired as the Fire Chief of Fairfield Connecticut after a career of over 30-years. He remains a Nationally Certified, Fire Officer II, Fire Instructor II, and Certified Fire Protection Specialist. He currently is a member of the Certified Fire Protection Specialist Board of Directors, serving his fourth term. He is a former president of the Fire Department Safety Officers Association, as well as the International Society of Fire Service Instructors.

Chief Gardiner holds a Bachelor's Degree in Fire Science and holds two Masters Degrees, one in Public Administration and one in Fire Science Technology, and speaks nationally on fire fighter safety, fire department operations, fire service finance, fire department training, and futuristic fire suppression and fire protection issues.

The Need for Fire Protection System Upgrades

By Kristopher W. Johnson, CFPS

The economical environment over the last four years has brought about a change in the way brick-and-mortar business owners spend money. These owners, no matter if they are large or small, are concentrating on the bottom line more than ever in an effort to protect profits. This conservation of money has caused a greater effort for these businesses to search harder to find lower cost materials and services to have their stores built or remodeled. However, the trend to build new brick-and-mortar stores is decreasing rapidly. All this put together has shown that it is more economical to take over an existing space such as an old Circuit City or Linens-N-Things space, both victims of the economic downturn, or simply just remodel their existing stores. When remodeling existing brick-and-mortar stores, it may be as simple as a coat of paint and some new hanging signs or it may be as thorough as a complete reset of the space with new racking and product arrangements. Some remodels go as far as demising the space and subleasing the remaining space to a new tenant in an effort to bring in additional revenue.

This remodeling trend has brought about many questions, circumstances, and possibly inadequate fire protection systems across the country in many stores that we all visit. Some of the questions that have been posed are:

- Does the sprinkler/fire alarm system need to be upgraded if we change racking/shelving?
- Does the sprinkler/fire alarm system need to be upgraded if we demise the space?
- If the AHJ doesn't require the systems to be upgraded, even though Code does, do they need to be upgraded?
- Since we aren't changing occupancy, do the systems need to be reviewed and/or upgraded?
- Is the sprinkler contractor liable if the system isn't upgraded?

Some other situations include:

- If we aren't told to upgrade the systems by the AHJ, do we really need to upgrade them?
- Does it matter if we are self insured?
- The sprinkler system has never gone off so we will be fine.
- We have never had a fire, so how concerned should we be?

As you can see from the above questions and statements, there are several different mindsets as to how fire sprinkler and fire alarm systems are approached for reviews/upgrades and the apprehensive approach some business owners may have to spend money on these systems. In reviewing the above questions and situations, it is important to keep in mind that the current Building Code issued by ICC, for which most jurisdictions are under, states: "Additions or alterations to **any building or structure** shall comply with the requirements of the code for new construction. Additions or alterations shall not be made to an existing building or structure that will cause the

existing building or structure to be in violation of any provisions of this code." It also states that: "Portions of the **structure** not altered and not affected by the alteration are not required to comply with the code requirements for a new structure." It is also our responsibility to help these business owners and buildings owners understand the requirements of each of their situations.

With that in mind, let's examine each of the questions:

- **Does the sprinkler system need to be upgraded if we change racking/shelving?** If the height of the products being stored is changing or the type of racking/shelving being used is different, the system needs to be evaluated for compliance.
- **Does the sprinkler system need to be upgraded if we demise the space?** If the sprinkler system itself is not being divided in any way, the system needs to be hydraulically calculated so that the demised space will meet the requirements of protection based on what is going to be in that space. Spacing along the demising wall will need to be evaluated so that the spacing requirements in NFPA 13 are not compromised.
- **If the AHJ doesn't require the systems to be upgraded, even though Code does, do they need to be upgraded?** If Code requires the system to be reviewed, then it should be.
- **Since we aren't changing occupancy, do the systems need to be reviewed and/or upgraded?** This all depends on the extent of the remodel. You cannot base the system upgrade requirements solely on an occupancy change. Just because the occupancy of the building or space is not changing, that doesn't mean that the new 15'

racks of plastic storage will be adequately protected by the existing system, especially if the previous tenant had a sprinkler system designed to protect 6' shelves of ceramic and stone tile.

- **Is the sprinkler contractor liable if the system isn't upgraded?** This is a professional industry. We all have the responsibility to ensure we understand and are following the Codes and standards adopted in the locations we do business in order to provide a safe environment for the occupants of the buildings we assist in designing.

As we all know, there is nothing wrong with asking questions. This ensures we are able to provide proper protection that not only meets the requirements of the Code, but also aids in the owners' ability to save money in the process.

Good housekeeping and proper testing of the systems may delay the affects of not upgrading systems when required, but some buildings will ultimately be affected. The loss of one life in a building that should have had the systems upgraded during a remodel, is one too many. We in the fire protection industry take pride in the statement that nobody has lost their life in a sprinklered building.

CFPS Sign and Seal

By Kristopher W. Johnson, CFPS
Director of National Retail Accounts
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I perform consulting and engineering services for retailers all over the country, so I have had a lot of exposure to many different Jurisdictions and their requirements over the last 13 years. Like many other Jurisdictions, one I encountered had some very specific plan submittal processes and signature requirements for permit documents in order to obtain the permits.

For every project I work on, I do an up-front meeting to better familiarize the Jurisdiction with the project in regards to the fire sprinkler system and the fire alarm system that will be installed, as well as the high piled storage that will be contained within the space. During my upfront meeting with the Building Official and the Fire Marshal, we discussed the sprinkler requirements, fire alarm requirements, specific building details and the need for a high piled stock plan based on the storage configuration. As I suspected during the course of the meeting, a high piled stock plan was identified as being part of the required submission package. We went on to discuss what the requirements for the plan were; the notes, sprinkler information, racking details, and how the plan was to be submitted. In discussing the submittal requirements of the high piled stock plan I had asked if the plan was required to be signed and sealed by a Professional Engineer. The Fire Marshal and Building Official had noticed from my business card that I was a Certified Fire Protection Specialist. The conversation turned and we began discussing the particulars of the CFPS designation. Our conversation continued for another half hour when it finally ended where it began; "Do we need a PE to sign the high piled stock plan?" They decided that since I was a CFPS that it was a competent level of knowledge to be able to sign and seal the plan. When I submitted my plan, my signature was on the plan along with my certification number. The plan was reviewed and approved without comment. My hopes are to see these types of conversations and outcomes continue with local authorities and plan reviewers. I would like to see more and more Jurisdictions continue to be informed about the CFPS designation and the knowledge base that we in the industry have that carry this designation. I am very optimistic that the CFPS designation will be an appropriate signature on design plans that are to be submitted for Jurisdictional review and permit.

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CFPS Update- LinkedIn

By Bruce Clarke

One of the charges this year for the CFPS Board of Directors has been increased communication to certificate holders and CFPS program visibility. One effort that appears to be a good start to increasing & accomplishing objectives has been the creation of the CFPS LinkedIn group.

Starting from the beginning, what is LinkedIn? Most people have heard of Facebook or MySpace. The kids of today sure have! LinkedIn (pronounced Linked In) is similar only it is for one's professional life (as opposed to personal life as with the other two sites). LinkedIn is a social networking web site with a business orientation that is primarily used for professional networking. It has been operating approximately 7 years and in August, 2010, claimed to have approximately 80 million registered users spanning more than 200 countries.

LinkedIn, and the CFPS Group are free, and are open to those with and without a CFPS credential. The CFPS group charter-description is "for the positive communication of fire protection and life safety industry issues, CFPS program information and networking, and related discussions between Certified Fire Protection Specialists and/or those interested in certification." The group is also a primary way announcements about the CFPS program are disseminated (along with the quarterly email blast to all certificate holders).

In just a few short months the CFPS group has already grown to over 235 members and we keep growing daily with great discussions and networking every week. Access can be found at: www.linkedin.com. So, what are you waiting for. And for those that are already members, support program visibility by sending an invite to a friend. Remember, having a CFPS is not a requirement for being part of the CFPS group.

Once you have joined, search either NFPA or CFPS and send a request to join. CFPS is currently a

subgroup of NFPA allowing those "linked" to NFPA to more easily find us.

Bruce Clarke presently serves as the chairman of the Board of Certified Fire Protection Specialists. He currently manages field operations in the eastern U.S. region for XL GAPS with roles in account management; specialized field loss prevention surveys, construction plan reviews, customer technical consulting, and teaching loss prevention related training classes.

Bruce is a graduate of the engineering program at Cal. State University, Chico, CA. He has been a Certified Fire Protection Specialist (CFPS) since 1994 and part of the Board since 2004. He is a Leadership in Energy and Environmental Design Accredited Professional (LEED AP). He is also Six Sigma Green Belt certified.

Bruce has over 20 years of direct career experience in loss prevention consulting throughout the United States, Canada, northern Mexico and China with specialized experience in aerospace, large and ultra high-bay warehousing, hotels and casinos, mining, power generation, pulp and paper industries, and semiconductor occupancies.

He has code consulting, plan review, construction and commissioning experience with over \$35B in new hotel/casino, warehousing, and semiconductor construction projects. He is a current member on NFPA 3 (Commissioning of Fire Protection & Life Safety Systems), NFPA 25 (Testing and Maintenance of Water-based Fire Protection Systems), NFPA 318 (Semiconductor Manufacturing Facilities) and, NFPA 750 (Water Mist Systems). Bruce is also past president of both Carolinas and Arizona Chapters of the Society of Fire Protection Engineers.

Bruce chaired the NFPA Technical Committee Chair on microbiologically influenced corrosion (MIC) in fire systems for NFPA Standard 13 and Standard 25 and is Chapter author of NFPA Standard 13 Handbook, NFPA Standard 25 Handbook, and NFPA Fire Protection Handbook related to microbiologically influenced corrosion.

Water Mist Systems

By Justin Biller, CFPS

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As the name would imply, a water mist fire suppression system refers to a system that incorporates very fine or small water droplet spray. Water mist as defined in NFPA 750, Standard on Water Mist Fire Protection Systems, is a "water spray for which the $D\sqrt{0.99}$, for the flow-weighted cumulative volumetric distribution of water droplets, is less than 1000 microns at the minimum design operating pressure of the water mist nozzle" (NFPA 750, 2010 p. 8). This essentially means that 99 percent of the water droplets formed from the discharge nozzle must be smaller in size than 1,000 microns (μm); a relative size to visualize is to compare that 25,400 microns equals 1 inch (Hague, 2004). While not an entirely scientific definition of what a mist technically is attributed to be (on the range: $5\mu\text{m} < 20\mu\text{m}$), for fire protection purposes as

specified in NFPA 750, it fits the application of a fine water spray consisting of a range of droplet sizes, including some droplets in the true range of a mist, that will extinguish a fire as intended (DiNenno, 2008). This article will discuss the fundamental operation and design of systems that employ water mist and will also consider the evolution of its use in fire protection schemes.

The introduction of the use of finely divided water, or water mist systems, was during the 1940's and these systems were first utilized for "specific applications such as passenger ferries" (NFPA 750, 2010 p. 1). The use of water mist systems was also considered for passenger aircraft, following a 1984 plane crash in Manchester, England. This initiated an international research activity to examine the feasibility of using these systems funded by the Civilian Aviation Authority in England, the US Federal Aviation Administration (FAA), Transport Canada, Boeing and Airbus. While eventually found not to be economically feasible at the time, the research activities proved helpful to further advances as the technology for these systems increased (DiNenno, 2008). The NFPA Fire Protection Handbook indicates that a renewed interest in water mist fire suppression systems was initiated in the last couple of decades beginning in the early 1990's with an international mandate from a rulemaking body, the International Maritime Organization (IMO), of automatic sprinkler system protection for passenger ships (Cote, 2008). This mandate encouraged innovation in the fire protection engineering community as a search for a viable equivalent to automatic sprinkler systems was undertaken. This research was spurred on even more with a need to establish an acceptable replacement for ozone-depleting substances including halon, or halogenated extinguishing agent, fire suppression systems. As of 1994, the production of halons has ceased due to the international agreement - the Montreal Protocol on Substances that Deplete Stratospheric Ozone, and because of this a transition to an alternative means of fire protection was needed (Cote, 2008). In a Technical Symposium on Halon Alternatives in

1994, sponsored by the Society of Fire Protection Engineers and PLC Education Foundation, Dr. Kathy Notarianni, then with the National Institute of Standards and Technology's Building and Fire Research Laboratory, highlighted water mist fire suppression systems as a "potential replacement [for halon fire suppressants] in many industrial applications as well as in new markets such as commercial passenger aircraft" (NIST, 1994, p. 57). The use of water for a halon replacement had not previously been considered practical, but this emerging technology could provide a low flow water extinguishing agent similar to a gaseous agent in fire fighting capability, with the same desired effect for highly critical equipment sensitive to conventional automatic sprinkler water sprays.

A good portion of the research and development of test protocol for water mist systems was conducted in European laboratories including Sweden, Norway, Finland and the Danish Fire Research Institute. Work has continued in North America at the National Research Council National Fire Laboratory in Canada and by Hughes Associates with the support of the US Navy and US Coast Guard (Cote, 2008). As a result of this research activity, several conferences were held in 1993 to facilitate the development of these systems into the marketplace. The first conference, sponsored by the National Institute of Standards and Technology brought together over 100 experts in the field to unify the stance of academia, government, insurance and system suppliers on the cost, reliability and design criteria. The second conference, sponsored by the Swedish National Testing and Research Institute, was an international event attended by representatives from 19 different countries where test experiments and research material was presented (NIST, 1994). In an effort to standardize the design concepts and installation requirements for these systems, the National Fire Protection Association (NFPA) organized the NFPA Technical Committee on Water Mist Fire Suppression Systems in 1993 to create the NFPA Standard document 750, Standard on Water Mist Fire Protection Systems. Since that time, test

protocols have been established to ensure components of water mist systems will operate properly and be listed for such purposes, and various manufacturers now have approvals from listing agencies such as FM Global Research and Underwriters Laboratory (Cote, 2008). Currently, there are no generalized design criteria for water mist systems, so the criterion for each manufacturer is based on full-scale testing in accordance with the test protocols as specified in NFPA 750, section 8.2 (NFPA 750, 2010 p. 21). Due to the variations in test results, each design and installation parameter is proprietary in nature, and as such only applicable to that specific manufacturer's product.

A water mist suppression system is similar in configuration to other water-based fire suppression systems (i.e. automatic fire sprinkler systems and fixed water spray systems). Water mist systems can be designed with either an open- or closed-nozzle approach. The open-nozzle configuration would be similar to an automatic sprinkler deluge system, whereas the closed-nozzle configuration could be a wet pipe water mist system, dry pipe water mist system, or a preaction water mist system as defined in NFPA 750, section 3.3.22 (NFPA 750, 2010 p. 8).

Water mist systems are further categorized into three groups characterized by the maximum working pressure of the system: low-pressure, intermediate-pressure, and high-pressure systems. Low-pressure systems are those systems defined by NFPA 750 where working pressure in the distribution piping is 175 psi (12.1 bar) or less and are permitted to use similar piping and components as specified in NFPA 13, Standard for the Installation of Sprinklers, 2010 edition (NFPA 13, 2009). Intermediate-pressure systems are those systems defined by NFPA 750 where working pressure in the distribution piping is greater than 175 psi (12.1 bar) but less than 500 psi (34.5 bar) and will typically produce smaller water droplet sizes than those produced by low-pressure systems. High-pressure systems are those systems defined by NFPA 750 where working pressure in the

distribution piping is greater than 500 psi (34.5 bar). High pressure at the nozzle produces very fine water droplets. Systems can also be either single- or twin-fluid systems. In comparison, single-fluid systems have one pipe supplying water to a nozzle, while a twin-fluid system has one pipe supplying water to the nozzle and a second pipe supplying compressed air or nitrogen to mix with water causing a smaller droplet size (NFPA 750, 2010).

Water is a very effective fire extinguishing agent; due to its specific heat capacity and latent heat of vaporization, it is able to absorb massive amounts of heat from the combustion process. It is even more effective as the ratio of water surface area to volume ratio is increased; this equates to smaller water droplets being able to absorb greater amounts of heat. When considering the fundamentals of this system and its fire fighting capabilities, a fire is primarily extinguished using water mist droplets by three primary mechanisms: (1) oxygen displacement, (2) heat extraction, or cooling and (3) blocking the radiant heat (Cote, 2008).

Water mist droplets will vaporize when sufficient heat energy is absorbed and expansion of the mist occurs. This may even occur prior to water mist droplets reaching a flame. With this event, oxygen is displaced; where this occurs sufficiently to reduce the level of oxygen below the level sufficient to sustain combustion, the fire can easily be extinguished (Hague, 2004). The cooling effect of small water droplets is associated with the combustion surface affected by the absorption capability of water coupled with the relative surface area to mass ratio that the fine water droplet size provides. Mist is capable of cooling the air and heated surfaces within the vicinity of the fire, thus slowing down the flame spread (Hague, 2004). Radiant heat in a fire is a mechanism of heat transfer for fires by electromagnetic waves; this mode of heat transfer is especially inherent in compartment fires where fuel surfaces at high temperatures emit these heat waves through radiation. Blocking this mode of heat transfer is important to stopping the fire from spreading to

unignited fuel surfaces and reducing the rate of pyrolysis on a fuel surface. The NFPA Fire Protection Handbook indicates that “theoretical work on radiation attenuation by water sprays indicates that the attenuation of radiation depends on the drop diameter and mass density of the droplets... [as the concentration of small diameter droplets increases] the degree of attenuation of radiant heat increases.” (Cote, 2008 p. 16-145)

Water mist systems have been used as effective fire protection for computer, electrical and telecommunication rooms, as well as in machinery spaces, turbine enclosures, and highly sensitive art galleries/heritage-type buildings. These systems are also widely used to protect marine facilities including yachts, as well as ships and other vessels (i.e., cargo, naval, passenger, etc.) (Cote, 2008). Water mist systems are typically used for three different design applications: (1) Total compartment application, where open nozzles are implemented to flood an entire compartment enclosure, (2) Local application, where a specific object (ie. piece of machinery, etc.) or hazard is protected and (3) Zoned application, where a portion of a compartment is protected – usually done to reduce the overall amount of water flow for fire protection purposes (DiNenno, 2008).

Water mist systems can either be pre-engineered systems where pre-designed for a specific hazard and compartment sizes, or an engineered system, designed on basic nozzle criteria specific to a given hazard and compartment size (DiNenno, 2008). Water mist nozzles are based on three principles of design: (1) impingement of a water jet, (2) expulsion of high-velocity jet (pressure jet) or (3) use of compressed air to shear water into fine spray (twin-fluid) (Cote, 2008). Nozzles, like other fire protection system components, must be listed in accordance test criteria established for their operation.

Like any hydraulic system, the designer must select pipe sizes and determine the hydraulic effects of piping, components, and available flows and pressure. Low-pressure systems are permitted to be

sized using the Hazen-Williams Equation, a generalized hydraulic calculation typically used for automatic sprinkler design, in accordance with NFPA 750 section 9.3 (NFPA 750, 2010 pp. 22-23). Intermediate – and high-pressure systems must be calculated using the more complex formula, Darcy-Weisbach equation, which takes into account additional design parameters not considered in Hazen Williams equation. Typically, the design of higher pressure systems will also require the installation of a pumping system – most commonly this will involve implementing the use of a positive displacement fire pump, wherein the energy added to the system will displace a quantity of water, and is thus capable of continually adding pressure in the system (Cote, 2008). For more detailed system design information and specifics, it is advisable to consult the NFPA Fire Protection Handbook and the SFPE Fire Protection Engineering Handbook respectively.

As in the design of any fire protection system there are both real advantages and disadvantages for a design engineer to consider in the application of a given system. This is certainly true in the case of water mist systems. Water as an extinguishing agent is highly effective, yet it is worthy of noting that water is not always the proper agent to apply, as in the case of certain metal fires that can react violently with water. Since these systems are still being refined through further research and development, the expense of components and installations for water mist systems must be considered; it is, however, worthy to note that water mist systems are comparable in costs to other gaseous suppression systems (Jones, 2009). In addition, a water mist system will not work in all applications where a deep seated fire may occur (i.e. rack storage arrays, etc.), as smaller droplets may not be able to penetrate the seat of the fire; room geometry will also affect the system’s ability to extinguish a fire. Thus, it is imperative that the design engineer give due consideration to these factors when determining if a water mist system will meet the overall fire protection goals of the facility or structure.

Water mist systems can be a viable alternative to a Halon or Halon replacement system. It can also be employed in special systems where water flow considerations are extremely critical. As innovation and technology improves, the widespread use of water mist systems may increase; additional full-scale mock-ups should help in determining fundamental principles that can in turn be employed into design methods and be codified for use in NFPA 750. While still in its infantile stage, water mist systems can prove to be a very effective fire protection feature in modern fire safety engineering.

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Fire Modeling in Modern Fire Protection Design & Engineering

By Justin Biller, CFPS

May 2010

With the evolution of fire protection engineering and risk-based analysis, an increase in the use of fire modeling has occurred in the US during the last 15 to 20 years (Richardson, 2003). With its widespread use, fire modeling is primarily used in performance-based approaches to fire and life safety by fire protection engineers seeking to obtain code equivalency (Cote, 2008). This paper will consider the various fire models currently in use, their applications and limitations, and will discuss the need for competency in both entering the data and in interpreting the results.

The development of computer fire models was primarily to predict certain fire behavior or other physical characteristics (i.e. heat transfer, fire and smoke spread, detector activation, building egress and human behavior, etc.) and reactions by integrating mathematical equations with known determinants to predict certain outcomes. Computer models, for example, have been used extensively to implement mathematical calculations in the design of water-based and gaseous fire protection systems, but in recent years, more attention has been given to using computer models to evaluate the effects of fire on people and property (Cote, 2008). The development and use of computer fire models can be delineated into two primary types of models for calculation purposes: zone fire models and computational fluid dynamics (CFD) models. Zone models are based on an assumption that two uniform conditions of data exist; zone models usually divide a compartment into two layers or zones, an upper zone filled with hot gases and/or smoke particulate and a lower zone beneath the upper zone where combustion air is supplied and cooler gases are present (Richardson, 2003). Examples of current zone models in use include ASET (Available Safe Egress Time), CFAST (Consolidated Model of Fire Growth and Smoke Transport), LAVENT (Link-Actuated

VENT) and CONTAM (Cote, 2008). Limitations of zone models are usually based on proper selection of model for a given set of parameters as “no existing zone fire model is best for all applications.” (Dinno, 2008). In contrast, computational fluid dynamics models (CFD) avoid the assumptions and simplifications present in zone models by integrating the Navier-Stokes equations into any calculation methodology using multiple small cells or grids “on the order of hundreds of thousands to millions” (Richardson, 2003). Using the fundamental equations for mass, momentum, and energy in a large matrix of grid points, the CFD model uses iterative methods for solving these equations at each grid point. (Cote, 2008)

The CFD models of particular note is the Fire Dynamics Simulator (FDS), developed at the National Institute of Standards and Technology and available free of charge to the engineering community. The FDS is able to calculate temperatures, pressure, species concentrations, as well as calculating the activation of heat detectors and sprinklers and predicting the response of smoke detectors. (Cote, 2008) In addition, Smokeview was written as a companion to FDS to provide a visualization tool for interpreting the CFD outputs. Limitations to CFD modeling are usually attributed to the computing power of associated modeler’s hardware, as the large amount of computations conducted severely limited its use in the past. As computer speeds continue to increase, however, this becomes less of a challenge and the growth and use of this program will no doubt increase.

For any model to be trusted in the design community, validation on the appropriate model must be performed to show its accuracy in predicting unknown outcomes. Since all models are based at least in part on assumptions and approximations, it is important that these assumptions be compared to real test data and other fire modeling programs. ASTM 1355 Standard Guide for Evaluating the Predictive Capability of Deterministic Fire Models is a standard developed to validate such models. (ASTM, 1997) This

standard sets forth methodology to analyze a computer fire model based on established criteria. First, it examines the theoretical basis for the model including the mathematical equations and numerical methods; it also examines the level of sensitivity in the model, as compared to actual test data, other model predictions and calculated results. By using this methodology, the value and sensitivity of the fire model can be determined, as well as enabling the user to recognize the limitations of the model that could affect overall fire safety. (Dinno, 2008)

As with any design computations, the outputs are only as good as the inputs; this harkens to the adage: “Garbage-in equals Garbage-out”. Thus, it is imperative that the fire protection engineer or designer implementing a particular fire model in a design application be familiar and competent with the theory of the phenomena being modeled, the limitations of the fire model being used, and how to read and properly interpret the results. While much work has been done to validate computer fire models, it could still be possible for an unethical engineer to skew the output of the design to meet certain parameters by skewing the input data. Thus, it is imperative for the Authority Having Jurisdiction charged with approving a specific fire protection design to also know the theories and limitations of a particular fire model being used, or to properly implement a third-party peer review process. The SFPE Code Official’s Guide to Performance-Based Design Review and the SFPE Engineering Guide to Performance-Based Fire Protection both include provisions for the designer to employ a peer review in the design process used for any code equivalency. Such methods will help to ensure that computer fire modeling is being properly applied to a specific fire challenge and help to ensure to the AHJ overall fire and life safety is attained.

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Smoke Control Systems – Part II

Chris Butts, SET, CFPS
May 2010

Part I began the first of a series of articles regarding Smoke Control Systems. It addressed their scope, purpose and manner in which it can be accomplished.

This article will address where Smoke Control Systems are required by Code or Code Officials, and outline general minimum design requirements.

Based upon the 2006 edition of the International Building Code (IBC), Smoke Control Systems are required in the following occupancies:

1. Atria – Section 404.4
2. Enclosed Malls when Atrium qualifications are met – Section 402.9
3. Underground Buildings – Section 405.5
4. Smokeproof Enclosures – Sections 909.20 and 1020.1.7
5. Stages, in lieu of Roof Vents – Section 410.3.7.2
6. Elevator Lobby Pressurization Alternative – Section 707.14.2

While the Section 403 for High-Rise Buildings does not require Smoke Control Systems for buildings where the highest occupied floor is located more than 75-ft above the lowest level of fire department vehicle access, some local Jurisdictions and/or States, do.

For example, the 2004 edition of the Florida Building Code (FBC) (based upon the 2003 IBC) added Section 403.15, and states that “Smoke control shall be provided in accordance with Section 909.” This requirement is also continued in the current 2007 FBC (based upon the 2006 IBC). Other examples may include Timed Egress studies, Smoke Protected Seating Allowances (1024.6.2.1), and Alternate Materials and Method Requests (401.11).

There are no specific types of Smoke Control Systems mandated by the IBC. Instead, the IBC requires a Rational Analysis, per Section 909.4, to be performed. However, the IBC does reference one passive method, Smoke Barrier Construction (909.5), and three mechanical methods, Pressurization (909.6), Airflow Design (909.7), and Exhaust (909.8). Each method can be used individually, or in combination, based upon an intended rationale. Because each structure is different from another, the best rationale is dependent upon the building's use/occupancy and

the building's architectural features, namely the means of egress. Additionally, because the purpose of a Smoke Control System is to provide a tenable environment for the evacuation or relocation of the occupants it is important to note that the chosen method be approved by the Authority Having Jurisdiction early in the project development phase, and prior to systems design.

The Rational Analysis is to be performed with "generally accepted and well-established principles of engineering relevant to the design" (909.2), and address five factors: the Stack effect (909.4.1), the Temperature effect of fire (909.4.2), the Wind effect (909.4.3), HVAC systems (909.4.4), and Climate (909.4.5). Additionally, depending on the intended design method, the quantity, location and velocity of supply inlets and exhaust outlets must be addressed.

The application of a Smoke Control System includes various Trades that can include HVAC, Electrical, Fire Alarm, Fire Sprinkler and Test & Balance to name a few. As a Smoke Control system becomes more complex, coordinating the Trades becomes a greater challenge. The more complex a system, the more difficult it becomes for everyone involved to comprehend the overall intended rational and the system's operation.

Smoke Control Systems are unique to each building, and can be complex at times. As such, the IBC requires them to be inspected by a qualified Special Inspector (909.18.8). The Special Inspector qualifications require expertise in fire protection engineering, mechanical engineering and certification as air balancers (909.18.8.2). The role of a Special Inspector is to serve as an independent third-party agency and therefore, should be approved by the Local Authority prior to building permit submission.

It cannot be stressed enough that "simple is better" when rationalizing the best method for a specific Smoke Control System and designing a system to meet the operational objectives and requirements.

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Fire Hydrants Aren't the Answer!

Daniel B. C. Gardiner, CFPS

November 2009

Residents of a secluded North End neighborhood in Connecticut, where two people died during a September 25, 2009 fire demanded Monday that the town provide more fire hydrants to prevent future tragedies. Water tankers were needed to battle the blaze because of the lack of hydrants.

Neighbors who live near the fire that claimed the lives of two elderly people described standing helplessly nearby on the dead-end street and witnessing a "burning inferno that soared high above the trees." Two bodies were found the next day inside the charred shell of the house.

Neighbors told the local Town Council Monday night they have been complaining for years that the single fire hydrant in their neighborhood was not enough to provide protection for their 50 home-community.

Due to limited access to hydrants, tankers from surrounding communities were called in to help. Fire officials said the only hydrant in the neighborhood was 2,500 feet from the scene of the fire.

One neighbor said firefighters had to take "precious time running a hose from the hydrant to the fire. In times of fire, like that terrible night, hydrants can be the difference between life and death. We need more hydrants in our neighborhood and we need them now. Our neighborhood has been described as being secluded. We enjoy that seclusion, but let us not be 'excluded' from services that the rest of town takes for granted."

"We looked across the street and the roaring flames were so high and spreading so fast we feared for those in the house, and then even for ourselves," "The shame and sad fact of this is that it all could have been prevented. But we can't just have one hydrant for 50 homes" a neighbor told the council.

In a petition signed by 55 people presented to the council, it is stated that "no other neighborhood in our town is as poorly protected from fire. That inadequacy was made dramatically clear on September 25 when even the firefighters who fought the blaze were concerned about the 2,500 feet that separated the hydrant from the blaze."

The fire chief, who was at the meeting Monday night, assured neighbors his department was looking into the matter. "There definitely needs to be more hydrants in that neighborhood," he said. "As to why there has been only one hydrant there all these years, I really can't answer that."

In the case of this fire and fires like it, fire hydrants aren't the answer! No-one addressed the lack of working smoke alarms in the structure which would have provided early warning for the occupants to escape! The entire council meeting focused on post-fire, activities, not pre-fire activities such as having working smoke alarms.

An uninformed public is the fire department's fault. In this instance, a strong public education [not public relations] program is needed. The fire chief had a moral duty to mention smoke alarms as a contributing cause of the fire deaths; this was a golden opportunity that has been lost forever.

While fire sprinklers would have all but eliminated this fire from being nothing short of a nuisance, working smoke alarms most likely would have kept this fire from becoming a life taking tragedy.

The School Fire

By Daniel B. C. Gardiner, CFPS
Flame Spread Senior Writer
July 2009

On December 30, 2008, a fire in a storage closet at the Shelton Connecticut high school left a portion of the school severely damaged. Firefighters from more than five communities converged on the school at about 1 p.m. to fight the fire that quickly spread to other parts of the facility.

It took about 45 minutes to put out the fire. An investigation into the fire by the city's police department and Fire Marshal's office determined the fire was accidental; that someone smoking in the building threw a cigarette into a plastic wastebasket.

The fire took place soon after a \$27 million expansion project was completed. The school was fire sprinklered only in the new or renovated portions. Interestingly, months prior to the fire, inquiries were made as to why the entire school, not just the renovated portion, was not fire sprinklered.

The fire sprinkler issue became a political debate (what else is new). Finally, the State Fire Marshal was asked to determine if the code required the entire school to be fire sprinklered, or just the new portions. The fire didn't wait for an answer. Now the community is facing a multi-million dollar loss, and a closed school.

At least one of the school board members has shown their ignorance multiple times, being quoted in the newspapers saying, "fire sprinklers would not have made a difference". He went on to say that "fire sprinklering schools would cost millions of dollars!" Well, one thing is definitely known; if his school was fully fire sprinklered, school would be in session right after the fire, and there would not be a multi-million dollar price tag for clean-up and repair!

Pay for sprinklers or pay for fire damage; you make the call!

Anyone that went to school in the 1950's remembers how fire doors and fire alarms were installed almost overnight following the Our Lady of the Angles School fire in Chicago. The fire occurred on December 1, 1958 and killed 93-children and 3-nuns. You can find writings about this fire that indicate fire codes were immediately changed based on the Chicago tragedy. Well, since fire sprinklers weren't universally required in all schools after that fire, we must assume the real lesson had not been learned.

The Our Lady of the Angles School fire took place fifty years after the Lakeview Elementary School fire in North Collinwood, OH. That March 4, 1908 fire killed 172 children and 2 teachers. Only 194 of the 366-students escaped the blaze. The others were trapped inside the rear first-floor exit, and by the time fire fighters arrived, nothing could be done to save them. More information on that school fire is available at <http://www.deadohio.com/collinwood.htm>

One would think with the Lakeview elementary school fire in the history books, that the installation of fire sprinklers in schools 50-years later would be routine. Unfortunately, this is not the case.

Now we have had a fire in a high school following a \$27,000,000 renovation, but the high school remained largely non-fire sprinklered. Fortunately, no one was killed; this was just one of many non-fatal school fires that occur in the U. S. annually.

Do we need a large death toll in addition to the property damage in order to see the value of installing fire sprinklers?

In the aftermath of the fire, The Shelton Connecticut School Board had to wrestle with issues of where to put the high school students that have been displaced by the closet fire in their partially fire sprinklered school.

While some school board members remained in denial, others asked; "why did we do this to ourselves?" In this case, the board had been informed and still made a bad, foolish, costly, and dangerous decision.

The Exit Sign

By Daniel B. C. Gardiner, CFPS
Flame Spread Senior Writer
April 5, 2008

For as long as anyone can remember, the exit sign has been a beacon to persons in buildings looking for the way out. It is a simple sign, sometimes lighted from within that silently announces an avenue of safety starts here.

Exit signs have evolved over the years, now most are lighted, first by incessant bulbs, then florescent bulbs, now LED's. New generations of exit signs now glow in the dark and need no electricity. Some exit signs are part of a system that includes sounds "walk this way for the exit". Once having only red letters, now exit signs come with bright green letters.

So imagine my surprise when I stopped in a local Subway Sandwich shop for a quick bite of lunch. The shop is housed in half of an old hot dog stand that has been closed since the 1960's. Single story, it has seating for twelve. Two thirds of the shop is for employees making a variety of sandwiches and hot soups.

The public area of the sandwich shop can't be any larger than 600 SF, with large windows on two sides. The entrance/exit is in the middle of the wall that faces the parking lot.

Well, above the door is an internally lighted exit sign with battery backup. There also is a fire evacuation alarm pull station next to the exit. My question is why?

A look at the fire codes in Connecticut, and in the specific jurisdiction where the sandwich shop is

located, indicates that as long as the exit is readily identifiable, there need not be an exit sign. There also is nothing in any of these codes to require this small business to have a fire evacuation alarm with a pull station. So what happened?

This is obviously a case of some fire or building inspector doing what they think is right, regardless of the code. They couldn't care less that the small sandwich shop owner has to spend several hundred dollars on something that is totally not required.

Being code compliant is different from being code official compliant, and is generally less expensive. The next time this small business owner is mandated to install something by any inspector; he would be wise to get it in writing with the code sections attached.

American Society of Safety Engineers Recognize CFPS for Professional Membership

Des Plaines, IL (June 19, 2007) — the American Society of Safety Engineers (ASSE) recently announced they will be accepting the Certified Fire Protection Specialist (CFPS) credential for members and new member applicants who have a bachelor's degree and five years of safety, health and environmental (SH&E) experience for Professional Membership in the Society.

In addition, ASSE Professional Members can be or have a Professional Engineer (P.E.) registration, Certified Safety Physicist (CSP), Certified Industrial Hygienist (CIH), Certified Health Professional (CHP), Certified Hazardous Materials Manager (CHMM), Certified Professional Environmental Auditor (CPEA), Canadian Registered Safety Professional (CRSP), Chartered Fellow of the Institution of Occupational Safety and Health (CFIOSH), or Chartered Member of the Institution of Occupational Safety and Health (CMIOSH) credentials. Along with these, one must have five years of safety experience and a bachelor's degree from an accredited college or university.

Founded in 1911, the Des Plaines, IL-based ASSE is the largest and oldest professional safety organization and is committed to protecting people, property and the environment. Its more than 30,000 occupational safety, health and environmental professional members manage, supervise, research and consult on safety, health, transportation and environmental issues in all industries, government, labor and education.

For more information on membership check ASSE's website at <http://www.asse.org> or contact customer service at customerservice@asse.org

SMOKE CONTROL SYSTEMS – Part I

Chris Butts, SET, CFPS

Smoke has long been recognized as the leading cause of death from fire. Controlling smoke is an inherent feature of fire protection. When required by Building Codes or local Authorities, Smoke Control Systems can reduce the smoke risk to building occupants.

A Smoke Control System is comprised of passive methods, active methods, or a combination of both. Passive methods, also referred to as static, include compartmentalization by means of Smoke Barriers. This method does not require the use of devices to cause air flow. Active methods, also referred to as dynamic, require mechanical systems to cause air flow to create pressure differences between Barriers.

The purpose of a Smoke Control System is primarily life safety. Its function is to provide a tenable environment for safe and timely egress of occupants, away from the fire and associated hazardous conditions, through the building to a safe public way outside the building. It can also be used to provide a safe and tenable area of refuge inside the building, or a combination of both. These provisions are generally not designed to preserve contents, provide for timely restoration of building operations, or to assist in fire suppression or any type of overhaul activity.

A Smoke Control System is a sub-set of a building's over-all Smoke Management System. It is only one factor of a building's polynomial fire protection equation. In this respect, it is sometimes used to reduce property loss from smoke damage, such as high-value equipment, and to aid firefighters both during and after the fire.

A Smoke Control System can be effective to control where smoke will migrate and where it will not. In doing so, the occupants of a building are afforded a greater degree of protection from smoke exposure. This fire protection feature can aid in reducing injuries and deaths related to smoke.

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ESFR (Early Suppression Fast Response) Terminology Clarification By Tom Varney CFPS

ESFR sprinkler systems with placard information in the following format has caused some confusion on how to interpret this and make a comparison to NFPA 13 requirements. A placard may be found with the following information.

1.23gpm/ft² over the most remote 1200ft²
Sprinkler Head K factor is 14.2

This is much different than the terminology of 12 heads @ an end head pressure of X psi, which is in NFPA 13 and is needed for ESFR adequacy analysis. This information can easily be converted into terminology that is recognized and can be used in conjunction with NFPA 13.

All ESFR sprinkler systems are designed for the most remote 12 sprinkler heads. The 1200ft² figure signifies that the sprinkler head spacing is 100ft². This figure is obtained by taking 1200/12.

Utilizing the 100ft² and multiplying it by the 1.23gpm/ft² figure above results in 123gpm. This is the amount of water flowing from one (1) ESFR sprinkler head. The 123gpm figure will be the Q part of the following formula, **Q=K√P**.

Using the formula **Q=K√P** where:

Q = the flow from one sprinkler head or 123gpm in this example.

K = the K factor of the sprinkler head for the system. In this case the K factor is 14.2.

Other ESFR sprinkler head K factors do exist so you do need to confirm the K factor of the sprinkler head used as it does affect the analysis.

P = the end head pressure of the sprinkler system, which in this case needs to be solved for.

Solving for P

$$Q=K\sqrt{P} \quad \text{or} \quad 123\text{gpm}=14.2\sqrt{P} \quad \text{or} \\ 123/14.2=\sqrt{P} \quad \text{or} \quad 8.66=\sqrt{P} \quad \text{or} \quad P=8.66^2 = 75\text{psi}$$

Conclusion

Information given in the format of 1.23gpm/ft² over the most remote 1200ft², K factor of the sprinkler head is 14.2 can be converted to 12 heads at an end head pressure of 75psi, which can be utilized with the tables in NFPA 13.

Focus on What Caused the Disaster, Not the Fire.

By Daniel B. C. Gardiner, CFPS

It was after the 1970's publication of the well regarded report by the National Commission on Fire Prevention and Control America Burning, fire departments, all over the country, realized they had a responsibility for fire prevention. In the minority report, Dr. Anne Phillips, in a brilliant analysis wrote that fire fighters must become fire preventers.

In the ensuing 25 years, many but not all fire departments adopted the philosophy of fire prevention. Some progressive fire departments hired fire safety educators. Many fire prevention programs sprouted up all over the country. We in the fire Service moved from Fire Prevention Week with Smokey the Bear and Stop Drop & Roll being our only fire prevention focus, to the use of smoke alarms to provide life saving warning to humans, fire inspections to identify and mitigate high fire risk conditions, and fire sprinklers to save lives & reduce the severity of fire damage.

Fire inspections have increased. Fire origin and cause investigations now get top priority especially when someone is killed. Many jurisdictions have updated their codes and ordinances to require early warning systems, and in the most progressive environments; automatic fire sprinklers are now mandated. Still, thousands of people die annually in residential fires.

In the United States between February 6, 2007 and February 11, 2007 there were six fires that killed 28-people; of that number, 19 children and 9 adults. Over a 30-day period in early 2007, 65-people were killed in fires. As this article is being written, there is news of a fire in New York City where nine children and one adult died in a residential fire. The fire, which raged for two hours, ignited near a mattress in the building's basement, most likely from a space heater or an overloaded power strip, officials said. The home had two smoke alarms, but neither had batteries.

To his credit; New York City mayor Mike Bloomberg said that the tragedy of that fatal fire could have been avoided if the two smoke alarms had batteries!

So far, it has been impossible to eliminate scenarios like the candle from setting fire to the curtains, the space heater being too close to the overstuffed chair, and the smoker falling asleep with the lighted cigarette subsequently setting the chair or mattress on fire.

Perhaps it is time to shift focus to early warning & home escape! No, we can't give up on fire prevention; but we need to adjust our priorities. Early detection and warning, coupled with automatic extinguishment will virtually eliminate the overwhelming majority of fire deaths. This focus, at least gives the occupants a chance to escape with their lives. It certainly could have made a difference in all the fatal fires previously mentioned in this article.

We live in a time when over a thousand jurisdictions in the United States now require automatic fire sprinklers in new dwellings, thus eliminating the residential fire death potential, and the fire fighter death and injury potential as well. We also live, and die, in a time when most local, state and federal politicians won't consider a mandatory smoke alarm requirement which covers all homes, including existing dwellings because it may impose a cost on residents, albeit a small one, or because it may cause an inconvenience to the residents they serve. .

Fire departments seem to be afraid to perform voluntary smoke alarm surveys of single and two family dwellings citing "nobody will let us in the home" or "the courts won't let us do that". This assertion of course is false. In the early nineties, the Fairfield (CT) Fire Department performed a complete survey of the town's 22,000 plus, single and two family dwellings.

Over fifty percent of the homes were in violation of the local smoke alarm requirements that were enacted in 1981. The survey revealed that 7,341 dwellings needed additional alarms, 1,766 had non-working alarms, and 855 contained no alarms at all!

The survey was done 7 days a week, day and evenings. Fire fighters attempted to enter 4,464 dwellings on six separate occasions; however, entry was not made due to no one being home. There were only 1,073 dwelling occupants (4.77%) who were unwise enough to deny the survey teams entry. One such dwelling had a fatal fire less than six

months after the survey team tried to enter the home.

The National Fallen Firefighters Foundation has identified a number of items that hopefully will reduce firefighter deaths. Those items are:

- Public education and fire prevention should be included in fire department mission statements.
- A data collection system should be established, and incidents should receive a thorough investigation.
- Every firefighter should have training in public education and fire prevention.
- Personnel responsible for code enforcement should possess proper credentials.

These are great goals and should be pursued; but to reduce the chance of a fatal fire and to reduce the number of times firefighters have to go into a burning building looking for occupants; these elements don't cut it.

Purchasing more gear, more trucks, having a variety of fire fighter safety initiatives and conducting general fire prevention activities are failing us. To eliminate fire deaths, we must strongly emphasize early warning and home escape; plain & simple! And for those of us in the advanced stages of fire protection; install automatic sprinklers in anything that is built!

McDonalds: A Burning Problem

Daniel B.C. Gardiner, CFPS

It is going to be a long wait at the drive-thru for anyone who frequents the Drum Hill Chelmsford, MA McDonald's on Drum Hill, after a fire started in a new heating unit causing more than \$1 million in damage.

Fire Capt. James Boermeester said it was not immediately clear how long the McDonald's would remain closed, but said the fire and smoke damage would force owners to at least replace the entire

roof. "Whether or not they bulldoze the whole building will probably be up to the insurance company," he said.

Drum Hill Road was closed as fire fighters stretched fire hoses across it. The fire was under control quickly once attacking the fire from the interior, firefighters pulled down ceilings inside the building to find the flames, which were not initially visible. Twenty-two firefighters battled the blaze.

Fire officials said the restaurant was old enough that it predated laws requiring sprinklers and smoke alarms, and only had fire-suppression systems for the deep fryers. "It was built before they were needed," they said.

Back in February of 2001, it became apparent that McDonalds was a problem. On Feb 4, 2001 the Pennsville, PA fire department was alerted to a building fire at a typical stand-alone McDonald's restaurant.

The first arriving officer advised the dispatcher (command center) of a working fire and requested a second alarm. Engine 7 located 3 blocks from the incident, was the first arriving unit and attempted an interior attack. Heavy thick smoke was pouring out the doors.

Even after aggressive interior attack and ventilation, conditions deteriorated quickly, and the evacuation was sounded and defensive operations took place.

Within five minutes of the evacuation, fire was already blowing through the roof and interior was fully involved. Within ten minutes, there was a partial roof collapse into the structure due to fire/heat damage and a HVAC unit.

The fire was incredibly fast moving with no chance of getting it in control with an interior attack due to the rapid deterioration inside the structure. Upon realization of this, the fire department promptly evacuated and went into a defensive mode.

The February 2001 fire certainly wasn't the first McDonalds to catch fire, obviously it wasn't the last. There have been many, since a February 14, 2000, early morning fire in a Houston, TX McDonalds took the lives of two Houston Fire fighters.

The Houston McDonalds alarm was sounded at 4:31 a.m. the first engine arrived on scene at 4:39 a.m. and reported fire showing on the roof near the back of the building. The front of the building was untouched by fire. As is the custom of the Houston Fire Department, the crew made an aggressive interior attack of the building via a side entrance and proceeded toward the rear in search of the seat of the fire. Fire fighters entered the building and began the interior attack and initial search. More units arrived and joined in the operation. A short time later, a portion of the roof bearing a large air conditioning unit collapsed, causing firefighters to become disoriented.

Evacuation sirens and an announcement to assume defensive operations sounded shortly before the collapse.

While no one was in the McDonald's at the time of the blaze, fire department officials have said they presume that buildings are occupied and interior attacks are the norm if conditions dictate such actions. About 90 fire fighters manning dozens of units eventually responded to the three-alarm blaze. The fire was brought under control in less than an hour, officials said.

No one died in the February 4, 2001 Pennsylvania McDonalds fire, but it is apparent that McDonalds must "step up to the plate" and remove their fire fighter killer buildings from our cities and towns, as all national chains should do.

Bravery and Enthusiasm Don't Trump Early Warning & Escape!

By Daniel B. C. Gardiner, CFPS

According to a local Connecticut newspaper, firefighters recently rescued an elderly woman from

a fire in her home using a thermal imaging camera. The firefighters found the victim in the doorway between the dining and living rooms. Rescuers removed the unconscious victim from her burning condo and revived her by administering oxygen. According to a hospital spokesman; she was transported to the local burn center in critical condition and her condition has been upgraded to serious.

"Because of the fast action of firefighters, we definitely saved a life," said the fire chief. According to the Fire Department's incident report, firefighters received the alarm at 11:10 a.m. and arrived at the scene at 11:16 a.m. "When we arrived, there was heavy fire coming out the rear windows and it was issuing heavy smoke," firefighters said.

According to firefighters, the rescue team entered through the front door, carrying hand tools and the thermal imaging camera. The camera essentially "looks through smoke" by sensing body heat, he said. "If there's a warm body on the floor, it picks that up on the cool carpet." When the rescue team located the victim, whom was unconscious and had "shallow breath," personnel immediately removed her from the house and hooked her up to oxygen, which helped her to regain consciousness.

Rescuers also found that a pet cat had died, apparently from smoke inhalation. It took about 45 minutes to extinguish the fire. The fire appears to have originated in the bedroom and the cause is still under investigation. According to the fire report, the home suffered about \$225,000 in damage. "The place isn't livable," said the Fire Chief. While several engines responded to the fire, area fire departments sent an apparatus to cover the jurisdiction's stations during the alarm.

Some important facts missing from the newspaper story were that to control this fire it took 4-engine companies, 1-truck company, 1-rescue company, a variety of lesser fire vehicles and over twenty firefighters, the actual fire was confined to only one

room, and that the condominium was missing working smoke alarms, despite a state law and a local ordinance requiring them.

There is no question that the firefighters acted very bravely and saved the life of the lone occupant. However if there had been working smoke alarms in the home, the occupant and her cat probably would have been able to walk out of the front door without assistance, and the fire department would have been called while the fire was still in the beginning stages. Certainly fewer resources would have been required of the fire department, and there would have been less danger (risk) to all concerned.

The firefighters will undoubtedly receive bravery citations from the fire department; as they should. The fire administration should also receive a citation; the booby prize for not being brave enough to fight for fire sprinklers in new construction, and a silver cluster on the booby prize for not enforcing their own smoke alarm ordinance which saves people before they get trapped by fire and smoke.

Bravery and enthusiasm do not trump early warning and escape! Fire departments should be doing everything possible to ensure that all homes have working smoke alarms or fire alarm systems; this fire department isn't!

Builders Beware

By: Michael Himes M.S., CSP, CFPS

After many years in private industry and the insurance industry, it still amazes me how many contractors and manufacturers are not aware of NFPA's guidelines pertaining to building construction. They do not understand how they interface with insurance companies and also the rating companies such as ISO (Insurance Service Organization).

The 3 most common mistakes I see are with the construction are lack of details in flammable liquid storage rooms, improper construction of firewalls, and improper understanding of sprinkler systems as

they relate to building occupancies and required protection.

When flammable and combustible liquids are stored improperly they become a significant fire hazard. When large volumes are involved the most common solution is to construct a flammable liquid storage room. However, flammable liquid storage rooms are often constructed incorrectly. There are several considerations and variable requirements dependant on the class of materials being stored. However, the most common construction mistakes I observe are lack of a blow-out wall, lack of adequate spill containment and lack of proper bonding and grounding.

Flammable liquid storage rooms must be designed with interior walls capable of withstanding an explosion. If vapors build up within the explosion limits and are ignited the exterior wall must be the 'weakest' construction design to allow the force of the explosion to exhaust outside of the building. This is necessary to protect occupants and interior structures and contents of the building. Sometimes builders and owners have such a lack of understanding, these rooms are built within the interior areas of the building. In this case they cannot construct a safe blow out wall.

The rooms often lack an adequate berm or containment system for the volume of fluids in the room. Each room must provide adequate available storage or remote containment system to contain the maximum amount of liquids that can and or will be stored in that room if each individual container were compromised and all of the liquids were released. When these containments systems are not designed correctly the reduced fire potential created by the use of a flammable liquid storage room is greatly compromised.

The last major area is the lack of bonding and grounding. When flammable and combustible liquids travel through a pipe or through the air, static charges are accumulated. Grounding and bonding is necessary during the transfer of Class I

flammable liquids to prevent a static spark from igniting the flammable vapors. Bonding eliminates the potential for static discharge between two containers. The containers must be connected together via a bonding wire. Grounding eliminates the static discharge between the source and the ground. Then the primary container should be connected to source directly in the ground, possibly a water pipe or building source such as a bus bar. Generally, this is a misunderstood concept. They do not seem to realize the explosion potential from vapors created by these liquids.

Keep in mind flammable liquid storage is very complex and there are many other key construction guidelines that must be followed. These are the most common mistakes I have observed.

Improper firewall construction in general building constructing and design is another common area of deficiency. I recently came across a new building “specifically designed” for a woodworking occupancy. The building is a pre-engineered steel frame, steel clad structure. The manufacturing portion of the building is protected by a hydraulically calculated wet pipe sprinkler system properly designed for this occupancy. After construction of the original building the manufacturer built a non sprinkled cold storage building next to the existing building and then connected the buildings with an unsprinkled breezeway so his employees would not have to drive forklifts outside during inclement weather. (All the buildings and breezeway are identical construction). The same contractor built this entire complex based on local building codes and approval from the local building inspector.

The structure was designed and built with a “firewall” at the opening of the breezeway to create separation from the sprinklered and nonsprinklered sections. The local code allowed the following: The opening was protected with a very nice 3 hour rated roll up fire door connected to a fusible link. The door was installed with the proper fire rated hardware and framing. However, the supporting

wall was constructed on studs covered with a 5/8th layer of sheetrock and a flammable insulating material. The contractor did not construct a parapet walls.

Now the insured has a building constructed to “local codes” that the insurance companies and ISO will not consider sprinklered. This is due to lack of proper firewall construction. The manufacturing area has the proper sprinkler system but the ‘firewall’ does not create the proper separation due to length of the breezeway and the fact that the breezeway and cold storage areas are not sprinklered. This resulted in an unsprinklered area in excess of 50% of the total building space. Since the firewall is constructed of studs with flammable insulation and not a self supporting concrete structure it will most likely fail in a fire. It also does not have a parapet above it to prevent flame spread over the wall either.

Finally, improper sprinkler protection is a major ongoing problem. Generally new buildings are designed with the proper system to match the occupancy. However, when property investment companies build new facilities without a specific tenant, or businesses move to different buildings they forget about evaluating the sprinkler system. The new buildings are usually constructed with a basic ordinary hazard sprinkler system. Many times new tenants are woodworkers, print shops, or warehousing occupancies. Usually these tenants require at least an ordinary II hazard protection system. In these cases, the building owner’s and tenants think they have a properly sprinklered building and should receive sprinkler credits on their insurance policy. However, neither is eligible and both become frustrated.

The primary reference of building construction and sprinkler protection used by most property casualty insurance companies and rating organizations are the NFPA guidelines. These three examples clearly demonstrate why building engineers, contractors and owners need to be much more aware of their occupancy hazards and how they are viewed by

NFPA. These organizations must do a better job of referencing NFPA guidelines for construction, installations and operations.