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Society of Fire Protection Engineers

New Jersey Chapter

FUSIBLE LINK

JUNE 2010

President's Message...

Our June Business meeting is coming up. Remember it is June 14th, not the first Monday of the Month. Elections will be held and we have a representative from the SFPE Education Foundation speaking who will brief us on the great work they do for our profession. Since this is our last meeting until September we have an extended menu for dinner. Please join us. Last month's speaker who presented his company's Pop Up flammable liquid barriers was very informative. If you missed it see our meeting minutes for details. Our Annual Golf Outing is fast approaching. As you know the proceeds benefit our scholarship fund. Please join us in a round of golf. We are also looking for hole sponsors as well. Your board of directors thanks you all for your support of the Chapter this past year. If any of you are interested in working on committees or maybe filling in as a Director please let any of the people listed on the left know and we will be happy to talk to you further. See you on the 14th.

Rich Reitberger
NJ Chapter President

NJ Governor Upholds IRC Recommendation for Sprinklers in Residential Occupancies

In related news, the state-by-state battle between residential sprinkler advocates and opponents continues.

On February 24, the South Carolina Building Code Council voted, by a six-to-three margin, to adopt the International Residential Code® (IRC), which requires the installation of sprinklers in all new homes effective January 1, 2011. A coalition comprised of fire service officials, sprinkler associations, contractors, design professionals, homebuilders, insurance agents, and government officials backed the decision. A bill introduced in the state Senate challenges the adoption, however, and would prohibit jurisdictions from requiring fire sprinklers in one- and two-family homes. The measure has moved out of the committee stage with "favorable recommendation," according to Maria Figueroa, regional manager of NFPA's Fire Prevention Field Office.

In Pennsylvania, a judge denied the Pennsylvania Builders Association's request for a preliminary injunction, which would have reverted the state back to its 2006 building codes, which do not permit residential sprinklers. Last year, the Pennsylvania Independent Regulatory Review Commission decided to adopt the IRC, requiring the installation of sprinklers in townhouses effective January 1 this year, and in new one- and two-family homes in 2011. Pending final resolution of the case, the IRC requirements remain in effect. There's also a bill pending in committee that prohibits fire sprinkler requirements for homes not connected to a reliable municipal water supply or located within five miles of a fire station.

Elsewhere, a New Jersey review commission, formed as part of an executive order by Governor Chris Christie, has recommended the state go forward with an amended IRC requiring home sprinklers. "That executive order says that there should be no rule held up that is against citizen safety," Figueroa says. "That's why the fire service and the New Jersey sprinkler coalition are saying that sprinklers are a life safety issue and shouldn't be held up."

In New Hampshire, the state's Code Review Board voted to adopt the 2009 IRC with an effective date of April 1, 2012. However, a bill introduced this year bumps the date to 2013.

"We're in a situation that's not unexpected," says Gary Keith, NFPA's vice president of Field Operations, of the sprinkler fights going on around the country. "It's an incremental process we're going through. Compared to where we were two years ago—where we had minimal state level activity on the issue — the debate is now occurring."

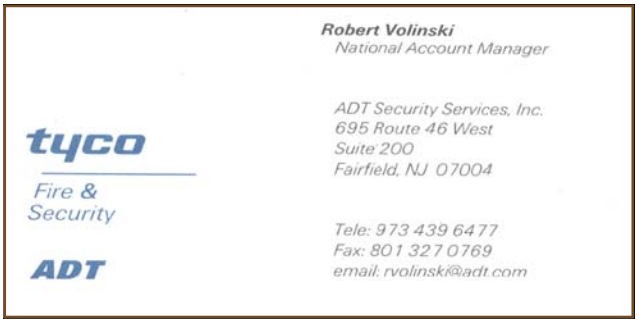
2010-2011 New Jersey SFPE Nomination for Officers and Directors

In compliance with the Nomination Section of the Constitution and By-Laws of the New Jersey Chapter of the Society of Fire Protection Engineers, the Nominating Committee submits the following slate of Officers and Directors. The election will be conducted at the Annual Business Meeting, scheduled for Monday, June 14, 2010 at the Hanover Manor.

President	Rich Reitberger
First VP	John Cholin
Second VP	Ed Armm
Secretary	Joe Janiga
Asst. Secretary	Brad Hart
Treasurer	Bob Murray
Asst. Treasurer	Rich Ravaioli
Board of Directors (2-year term)	Dave Kurasz

Chapter members, Glenn Buser (second year of second term), John Warnet (second year of second term) and Jerry Naylis (second year of second term) will remain as Board of Directors member-at-large.

Dave Gluckman will be Immediate Past President, a voting member of the Board of Directors and Chair of the Nominating Committee. The Nominating Committee and the Board of Directors welcomes volunteers to serve in leadership capacities within the organization including Committee activities and the Board itself. No other members made their interests and willingness to serve known to the Nominating Committee prior to this report. Any member with a desire to run as a candidate for Chapter Officer or Director is encouraged to do so. They must contact the Chapter Secretary, Joe Janiga (973-541-6774) at least four weeks prior to the Annual Business Meeting. In accordance with the New Jersey Chapter By-Laws, candidates must submit the signatures of five voting members of the New Jersey Chapter SFPE along with their letter of intention to run for any of the above positions. According to the calendar, the deadline is Monday, May 17, 2010.



LPG Fire at the Valero McKee Refinery

The following is the second part of a loss investigation conducted by the CSB (Chemical Safety Board) that will contain certain sections of the report.

3.5.2 Chlorine Release

Post-incident examination revealed that three one-ton chlorine containers in a cooling tower water treatment shed were subjected to radiant heating due to their proximity to the PDA unit (100 feet to No. 2 Extractor) and pipe rack (20 feet). All three containers vented when their fusible plugs, installed to prevent container rupture, melted as designed. One container ruptured despite the operation of its fusible plugs, and another vented completely. The third developed a leak through a partially melted plug that was repaired by emergency responders using self-contained breathing equipment for protection against the toxic vapor. More than 2.5 tons of chlorine, an extremely toxic material, were released.18

Fortunately, emergency responders and other refinery personnel had pulled back from the area before the major chlorine release likely occurred.19 There is no evidence that personnel on- or off-site were exposed to hazardous levels of chlorine gas. However, if responders had been nearby when the cylinders released their contents, significant exposures could have occurred.

4.0 Incident Analysis

This section provides detailed analysis of the sequence of events and causal factors leading to the origin and spread of the February 16, 2007, fire and its impact on adjacent equipment.

4.1 Incident Sequence

In this incident, water settling out of a propane stream likely leaked through a 10" NPS[20] (250 DN) inlet block valve and accumulated in the low point formed by a control station (Figure 5). The control station was connected to the process, but had not been used for approximately 15 years. A period of cold weather likely froze the water, fracturing the pipe elbow upstream of the control valve. Warmer weather then melted the ice, resulting in a release of highly pressurized liquid propane through the fractured elbow. Appendix B contains a detailed time line of the incident.

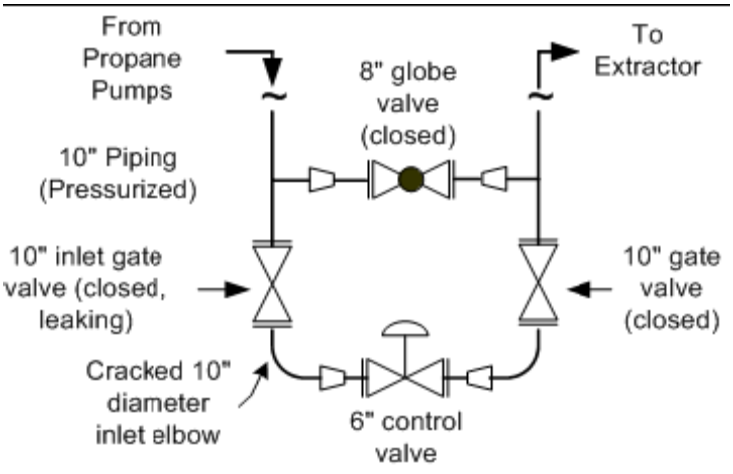


Figure 5. Propane mix control station schematic (not to scale)

[20] NPS refers to U.S. Nominal Pipe Size. Dimensions of NPS pipe and fittings are specified in the American Society of Mechanical Engineers (ASME) standard B36.10. The metric equivalent is given in millimeters, nominal diameter (DN).

freezing until the morning of February 16, approximately five hours before the incident (Weather Underground, 2007).

4.1.2 Propane Mix Control Station Inlet Elbow Freezing and Failure

The 6" NPS (150 DN) propane mix control valve originally mixed liquid propane into the pitch fed into the No. 1 Extractor. Due to a change in extractor control in the 1990s, use of the control valve was discontinued; however, this subsection of the No. 1 Extractor was left connected to the process under high pressure.[21] The block valves around the control valve were closed, but the subsection was not removed or positively isolated from the process using slip blinds.[22] The refinery conducted no formal process safety management of change (MOC) review of this idled control station.[23]

The station's configuration made it a dead-leg: a section of piping connected to the process with no flow through it. Water in the propane likely sank into the dead-leg, leaked by the inlet block valve, and accumulated in the control station piping.[24]

The extended period of cold weather and the lack of freeze protection on the control station allowed the water to freeze and expand, cracking the elbow upstream of the control valve. The crack propagated along the inner radius of the elbow, the line of highest stress (Timoshenko , 1958), opening wider as it developed (Figure 6). Appendix C contains a more detailed discussion of the CSB's analysis of crack formation and propagation. The damage to the inlet elbow and the post-incident leak rate determined for the inlet block valve are consistent with the estimated initial propane release rate during the incident.

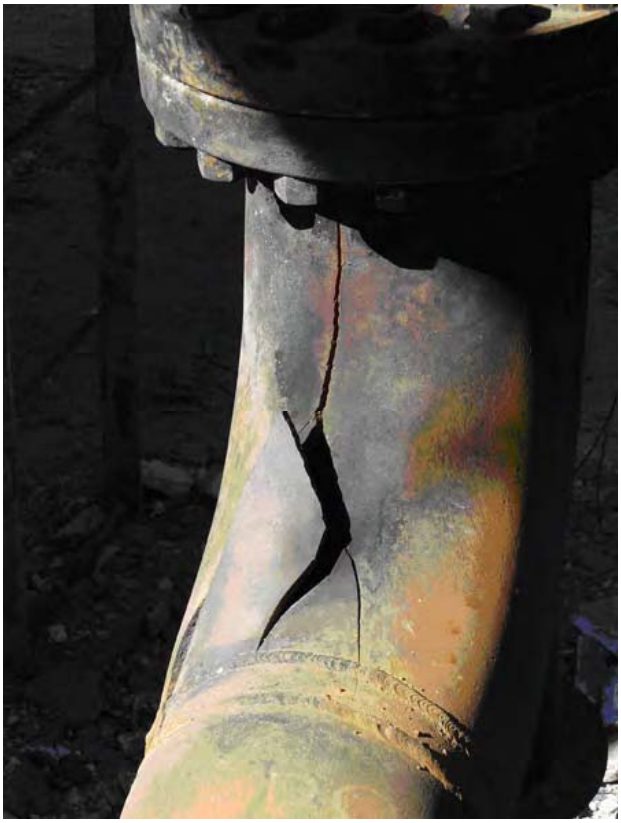


Figure 6. Crack in the 10" diameter propane mix control station inlet elbow

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21 Senior operators in the PDA unit could not recall the exact time the control valve was last used. The change in extractor control occurred approximately 15 years before the incident.

22 Slip blinds are solid pieces of metal inserted between flanges to positively isolate piping or equipment.

23 MOC requires that changes to equipment, process, or design intent be reviewed for safety implications. It is a required element of OSHA's Process Safety Management regulation, promulgated in 1992, and an element of API Recommended Practice 750, *Management of Process Hazards*, published in 1990.

24 Water, which is insoluble (immiscible) in and denser than liquid propane, was known to be present in the propane. Water droplets entrained in propane can accumulate in the bottom of piping and vessels.

4.1.3 Thaw and Propane Release

On February 16, 2007, shortly after 9:00 a.m., ambient temperatures rose above freezing and the ice inside the elbow began to thaw. Post-incident examination of the control station inlet block valve (Figure 7) revealed that a foreign object was jamming the valve,[25] creating a leak path. When tested in a laboratory after the incident, this valve allowed over 1,025 gpm (233 m3/hour) of water to leak through at process pressure. At approximately 2:09 p.m., melting ice opened the leak path, releasing liquid propane at 500 psig (3,447 kPa) pressure through the cracked elbow. A flammable vapor cloud rapidly formed. Based on recorded data from the PDA unit's computerized control system, the CSB estimated an initial propane leak rate of 4,500 pounds (2,040 kg) per minute (Appendix D describes the propane mass balance calculations used to develop this figure).

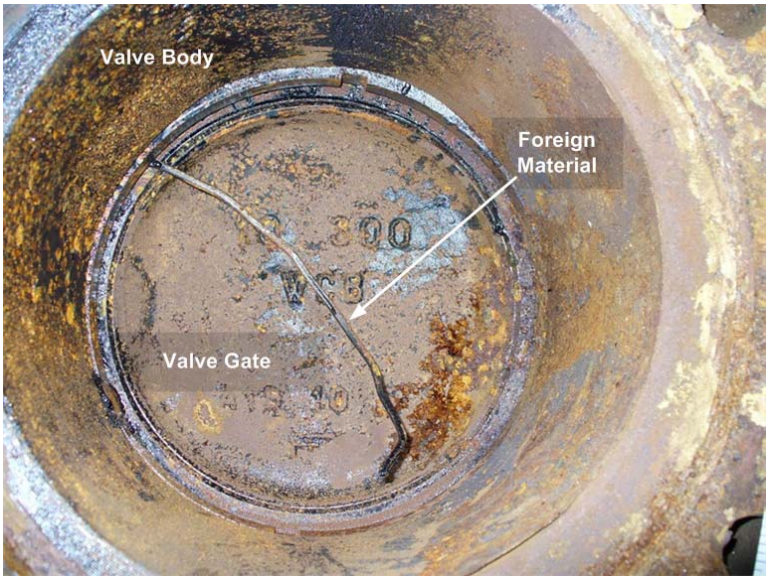

Figure 7. Downstream view of propane mix control station inlet block valve

The wind blew the propane cloud toward the boiler house, where it likely ignited.[26] The flames flashed back to the release point. The size and intensity of the resulting fire blocked access to manual shut-off valves and pump on-off switches that might otherwise have been used to control the propane discharge. Within minutes, the fire damaged piping and pipe rack supports, spreading the fire (Figures 4, 8, 9).

25 In gate valves, a circular gate slides against metallic seat rings, providing a leak-tight seal when the valve is closed. The foreign object in the inlet gate valve prevented a tight fit between the gate and the seat rings.

26 While the boiler house was the most likely source of ignition, nearby fired heaters could not be ruled out.

Figure 8. Damaged 10" propane inlet on Extractor No. 1

4.2 Dead-Leg Freeze Protection

The initial release of propane was due to the McKee Refinery's failure to recognize and address the freezing hazard posed by the propane mix valve control station dead-leg.

4.2.1 Dead-Leg Not Recognized or Addressed

The McKee Refinery had not identified the station as a dead-leg. A piping and instrumentation drawing (P&ID) update project for the PDA unit, completed in 2006, identified only dead-legs that were visually apparent, such as one formed when a control valve was physically removed and its flanged connections slip-blinded. However, the P&ID update did not detect the propane mix control station dead-leg, which was formed by closing block valves in the piping.

A Process Hazard Analysis (PHA)[27] performed on the PDA unit in 2006 did not examine freezing as a threat to piping integrity. Furthermore, the McKee Refinery's freeze protection program did not periodically survey process units for potentially freeze-prone dead-legs.

4.2.1.1 Inherently Safer Approach

According to safety guidance by the CCPS in *Inherently Safer Processes, A Life Cycle Approach* (1996*),* the preferred way to control hazards is to eliminate them where possible. According to *Lee's Loss Prevention* (2005), the best approach for managing dead-legs, such as the propane mix control station, is to remove them. If removing them is impractical, other approaches, in order of decreasing protective value, could include 1) positively isolating the dead-leg by installing slip blinds; 2) freeze-protecting them; or 3) procedures to regularly monitor and drain water from low points.

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27 OSHA defines a PHA as a "thorough, orderly, systematic approach for identifying, evaluating, and controlling the hazards of processes involving highly hazardous chemicals." PHAs must be updated and revalidated at least every five years under the Process Safety Management regulation 29 CFR 1910.119.

4.2.2 McKee Refinery Freeze Protection Program

Sunray, Texas, is in the north Texas panhandle, an area where below-freezing temperatures are common in February. Valero's McKee Refinery protected piping and equipment from freezing by insulating and "tracing" with steam-filled tubing or electric heat tape.[28] It was an unwritten practice to review and repair freeze protection components every fall. However, these activities focused on maintaining existing freeze protection measures, not on periodically reviewing units for dead-legs or other idle/infrequently used piping systems, or surveying process units for areas where water could collect.

The refinery's inspection program contained provisions for more frequent inspection of identified dead-legs, but these focused on identifying long-term corrosion issues, not acute freeze hazards. Freeze protection is both a mechanical integrity (inspection) and operational issue, and requires an integrated approach.

4.2.3 Valero Corporation Freeze Protection Survey

Following the McKee fire, Valero surveyed the freeze protection programs at its US refineries. Most of the refineries in freeze-prone areas had informal programs similar to McKee's, while several had legacy freeze protection guidelines from previous owners. Valero did not have a corporate policy for freeze protection to set minimum standards for freeze protection programs at its facilities.

4.2.4 Other Dead-Leg and Freeze-Related Incidents

In a 2002 brochure, *Understanding the Hazard: Freeze,* FM Global[29] cited "151 freeze incidents in industry with an average estimated gross loss of about $115,000 per incident from 1991 to 2000." The following is a sampling of specific incidents identified by the CSB:

- January 1962, Texas City, TX: An entire refinery was crippled and major process units shut down when the area experienced temperatures below freezing for 66 hours: "Dead-end water lines and steam lines froze, causing valves to break and some pipes to split"(API Publication 758, 1983).

- March 1979, Exxon, Linden, NJ: Seven injured when butane and propane released from a dead-leg formed a large vapor cloud and exploded (Garrison, 1985).

- February 1996, Total Petroleum, Denver, CO: Abandoned pump gland oil piping under process pressure froze and then burst above a vacuum bottom pump, causing a fire (*Denver Post*, June 28, 1996).

- February 2001, Bethlehem Steel, Burns Harbor, IL: Freezing in a dead-leg condensate line near a coke oven led to two fatalities and four injuries (CSB 2001-02-I-IN , 2002).

- January 2008, Chevron, Pascagoula, MS: A freeze-related fire was reported at the refinery. This fire is an example of incidents where freezing temperatures occur occasionally, but not consistently during the winter (AP, January 3, 2008).

The IChemE[30] BP Process Safety Series publication, *Hazards of Water*, also lists numerous examples of process incidents related to water freezing.

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[28] Heat tracing involves providing a source of heat along the length of a pipe, usually by attaching or wrapping steam tubing or heating tape to or around the piping, and then insulating the protected piping.
[29] FM Global, a large process industry insurer, has developed widely used guidance documents.
[30] The Institute of Chemical Engineers (IChemE) is a UK engineering professional organization that publishes widely referenced process safety guidance.

4.2.5 Available Industry Guidance

FM Global's *Freeze* brochure (2002) describes the risk and provides guidance for evaluating susceptible piping systems, with particular emphasis for facilities in regions where the risk of freezing weather is intermittent. The brochure provides general guidance for mitigating the hazard, but does not describe the specifics of freeze protection programs. However, FM Global has also published a Property Loss Prevention Data Sheet, *Prevention of Freeze-Ups*, (2007, latest edition) that does give guidance for establishing and maintaining freeze protection programs.

Zurich, another major insurer, has published a cold weather checklist that tells users to "drain the vessels and piping of idle equipment"(Zurich, 2003).

The CSB reviewed available publications by the API, an industry group that publishes voluntary standards, and found no detailed guidance for refineries on establishing effective freeze protection programs.[31] [32]

[32] API 570, *Piping Inspection Code*, mentions a variety of hazards associated with dead-legs, including freezing. API Recommended Practice 2001, *Design and Construction of LPG Installations*, discusses the importance of winterization and prevention programs in verifying that out-of-service piping and dead-legs are freeze-protected. However, neither document addresses freeze protection management systems, such as requirements for a formal written program or the need for periodic inspections to identify freeze hazards, which pertain to this incident.

[33] A pipe bridge is a reinforced section of a pipe rack that carries piping over a longer than normal span.

4.3 Fireproofing

A non-fireproofed structural support for a pipe bridge33 spanning a 90-foot wide open area north and east of the PDA unit (Figure 9) collapsed early in the incident, greatly increasing the magnitude of the fire. The support was located on a major E-W pipe rack north of the unit, outside the fireproofing distances recommended by API guidance and Valero internal standards. The collapse opened multiple lines carrying flammable and combustible materials from other areas of the refinery, contributing significantly to the damage experienced by adjacent units, and extending the time that the refinery was down for repairs. Fireproofed pipe rack support steel columns inside the PDA unit and at the No. 4 Naphtha Column all survived the fire without collapsing (Figure 10).

Fireproofing is "fire resistant insulating material applied to steel to minimize the effects of fire exposure by flame impingement, to reduce the steel's rate of temperature rise, and to delay structural failure"(API Publication 2510A, 1996). Without fireproofing, exposed structural steel members, such as pipe rack support columns, can rapidly lose their strength and fail, possibly within minutes (API 2218, 1999; CCPS, 2003). Jet fires, such as the pressurized LPG release in this incident, can cause very rapid heating and failure of unprotected structural steel (Appendix E).

To be continued in the next edition of the Fusible Link

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[31] API publication *Safety Digest of Lessons Learned, Section 9, Precautions Against Severe Weather Conditions*, which provided general guidance for preparing a refinery for extreme cold weather, is no longer in print.

[32] API 570, *Piping Inspection Code*, mentions a variety of hazards associated with dead-legs, including freezing. API Recommended Practice 2001, *Design and Construction of LPG Installations*, discusses the importance of winterization and prevention programs in verifying that out-of-service piping and dead-legs are freeze-protected. However, neither document addresses freeze protection management systems, such as requirements for a formal written program or the need for periodic inspections to identify freeze hazards, which pertain to this incident.

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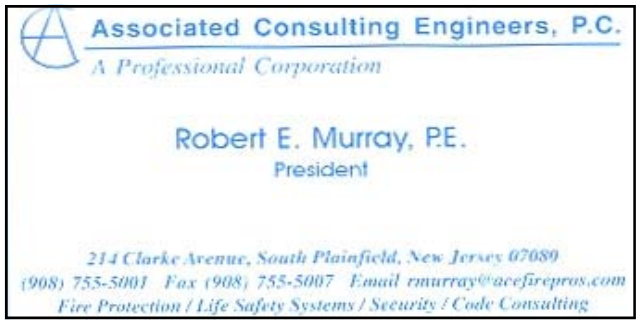
Meeting Dates/Programs 2009-2010

DATE	TOPIC
June 14	FM Global Standards Update—SFPE Education and Scientific Foundation—April Berkol, SFPE National FM Global and the Home Fire Sprinkler Coalition on 'Sprinklers & Sustainability—Joe Janiga
June 28	SFPE Scholarship Fund Golf Outing—West Point Golf Club



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3rd Floor
Parsippany, NJ 07054-1196
Phone: (973) 541-6771
Fax: (973) 541-6909

MEETING NOTICE

Date: June 14, 2010

Place: Hanover Manor
16 Eagle Rock Avenue
East Hanover, NJ

Price: $30.00

Dinner: 5:00-6:00 (Cash bar for mixed drinks)
Dinner at 6 PM

Topic: SFPE Education and Scientific Foundation—April Berkol, SFPE National FM Global and the Home Fire Sprinkler Coalition on 'Sprinklers & Sustainability—Joe Janiga

Please note for this meeting:
All officers, directors and committee chairman are requested to attend a meeting at 4:00 p.m. at the Hanover
Manor.

PLEASE COMPLETE AND RETURN WITH YOUR CHECK PAYABLE TO "SFPE NJ CHAPTER" TO:

Vicki Serafin
Affiliated FM
400 Interpace Parkway, Bldg C - 3rd Floor
Parsippany, NJ 07054-1196
vicki.serafin@affiliatedfm.com

OR PAY AT THE DOOR

NAME: _____

COMPANY:_____TELEPHONE:_____

2008-2009 Chapter Committees

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Richard Ravaioli
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Vicki Serafin, Chairperson

Membership
John Cholin, Chairman

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Joe Janiga, Chairman
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Nicole Smith

Historian
Jim Tolos

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Ana Crisostomo—Coordinator
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Website—Joe Janiga
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ADAAG http://www.access-board.gov/adaag/about/index.htm
AFAA National http://www.afaa.org/
AFSA http://www.firesprinkler.org/
ANSI http://web.ansi.org/
ASHRAE http://www.ashrae.org/
Campus-Firewatch http://www.campus-firewatch.com/
Coffee Break Training http://www.usfa.dhs.gov/nfa/coffee-break/
CPSC http://www.cpsc.gov/
CSAA http://www.csaaul.org/
Municipal Codes (E Codes) http://www.generalcode.com/Webcode2.html
FDNY http://nyc.gov/html/fdny/html/home2.shtml
FM Global http://www.fmglobal.com/
FSDANY http://www.fsdany.org/regs.htm
FSI http://www.firesprinklerinitiative.org/
FSSA http://www.fssa.net/
Fire Tech Productions—Nicet Training (FTP) http://www.firetech.com/
Home Fire Spklr Coalition http://www.homefiresprinkler.org/
HVAC Bld. Control Fire Safety http://www.iklimnet.com/hotelfires/hotelfiresmain.html
AFAA-NJ http://www.afaanj.org/
International Code Council - http://www.iccsafe.org/
International Code Council Residential Sprinkler Exam - http://www.iccsafe.org/news/nr/2009/0709_ResidentialSprinklerExam.pdf
The Joint Commission (JCAHO) - http://www.jointcommission.org/www.JointCommission.org/
Material safety data Sheets (MSDS-OSHA Site) - http://www.osha.gov/SLTC/hazardcommunications/index.html
National of Fire Equipment Distributors (NAFED) - http://www.nafed.org/index.cfm