

Editor Fusible Link:
Brad Hart &
Ana Crisostomo
Tel: 646-572-3920
Fax: 646-871-3920

Society of Fire Protection Engineers

New Jersey Chapter

FUSIBLE LINK

MARCH 2007

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President's Message

Hello Everyone,

Time is flying by rapidly and the weather people are saying an early spring. We still have good presentations coming up at the meetings and are working on the seminar. More information to follow on the seminar as it promises to be one that many people will want to attend.

As always we look forward to seeing many of you at the meetings. We hope the new year is treating everyone well.

Best Regards

Glenn Deitz
NJSFPE Chapter President

SFPE Greater Atlanta Chapter to hold March Fire Safety Conference

— The SFPE Greater Atlanta Chapter will be holding a fire safety conference on March 6th in the Gwinnett Center located in Duluth, Georgia. There will be a multitude of topics to choose from in each of 3 main sessions, a total of 15 in all. The following link will take you to the registration form and schedule of sessions.

http://www.sfpeatlanta.org/downloads/annual_conference_registration_for_m.pdf

<http://www.sfpe.org/Chapters/NewJersey.aspx>

NJ SFPE Membership Meeting Minutes February 5, 2007

The meeting was called to order at 6:00 by Dave Gluckman our Vice President; introductions followed the salute to the flag as is our custom.

The General Meeting Minutes for our January membership meeting were read by Ed Armm our secretary and approved by motion as published in the *Fusible Link*. The Treasurer's Report for February was read by Dave Gluckman and accepted by motion as written.

Tonight's speaker, Mr. Daniel Madrzykowski, P.E. was introduced by Chuck Gandy, Dan earned both his B.S. in Mechanical Engineering and his M.S. in Fire Protection Engineering from the University of Maryland, His position at NIST is as a staff engineer in the Fire Fighting Technology Group, Fire Research Division, of the Building and Fire Research Laboratory.

Mr. Madrzykowski has worked in fire suppression and large fire research, at NIST, for the past fourteen years. He began studies at NIST to measure the ignition inhibiting properties of compressed air foam (CAF) fire suppressant. Utilizing new measurement methods developed at NIST, the ignition delay time of "foamed" wood samples relative to untreated wood samples was compared at different heat flux levels. This work has continued with large-scale fire experiments utilizing CAF and gelling agents applied to exterior siding materials. The data from this study is the only information available to characterize CAF and gelling agent exposure protection capabilities. This work has the fire service community evaluating the benefits of CAF and gels for fire exposure protection, especially in the wild land/urban interface areas.

Mr. Madrzykowski has conducted a study with 20 MW gas/oil well fires to determine the radiation reduction effects of small quantities of water spray entrained near the base of the fire. The information from that study is important for blowout fire control on offshore drilling platforms. Mr. Madrzykowski utilized his blowout fire research experience as a member of the team from NIST that went to Kuwait to make ground based measurements on the oil well fires in 1991. This unique data set of flame height and radiation measurements and energy release rate analysis has been used by other agencies in their evaluations of the environmental effects of the fires.

Mr. Madrzykowski has led projects to determine the effects of sprinklers and water mist systems on temperature and toxic gas concentrations of fire gases. These studies, along with a post-flashover exposure study, provide information to enable fire protection engineers to make educated decisions on means of protecting an area adjacent to a fire and the people in that area.

Mr. Madrzykowski has also been the project leader for a sprinkler fire suppression study. The heat release rates of several office furniture fuel packages were measured, in a free burn condition and under the influence of a sprinkler spray. He used the heat release rate data to develop a sprinkler fire suppression algorithm, which is used as the suppression model for FPETOOL and FASTLITE.

As part of a multi disciplinary team, Mr. Madrzykowski made two trips to Kobe, Japan in 1995 to investigate the post-earthquake fires which destroyed more than 6,400 buildings. The study

focused on the perimeter of the fire areas to determine what physical features halted the fires progress.

Mr. Madrzykowski is a registered professional engineer. He is a member of the National Fire Protection Association and serves on their technical committees for automatic sprinklers, water mist systems, life safety, means of egress, mercantile and business occupancies, and forest and rural fire protection. Currently he is the Chairman of the NFPA Residential Sprinkler Systems Committee. He is also a member of the Society of Fire Protection Engineers, chairs the Engineering Task Group on Computer Model Evaluation and serves on their publications committee.

Tonight's presentation was a report from the National Construction Safety Team Investigation of The Station Nightclub Fire. The NCST is sponsored by the National Institute of Standards and Technology (NIST), Technology Administration and the U.S. Department of Commerce. The report was completed on June, 2005.

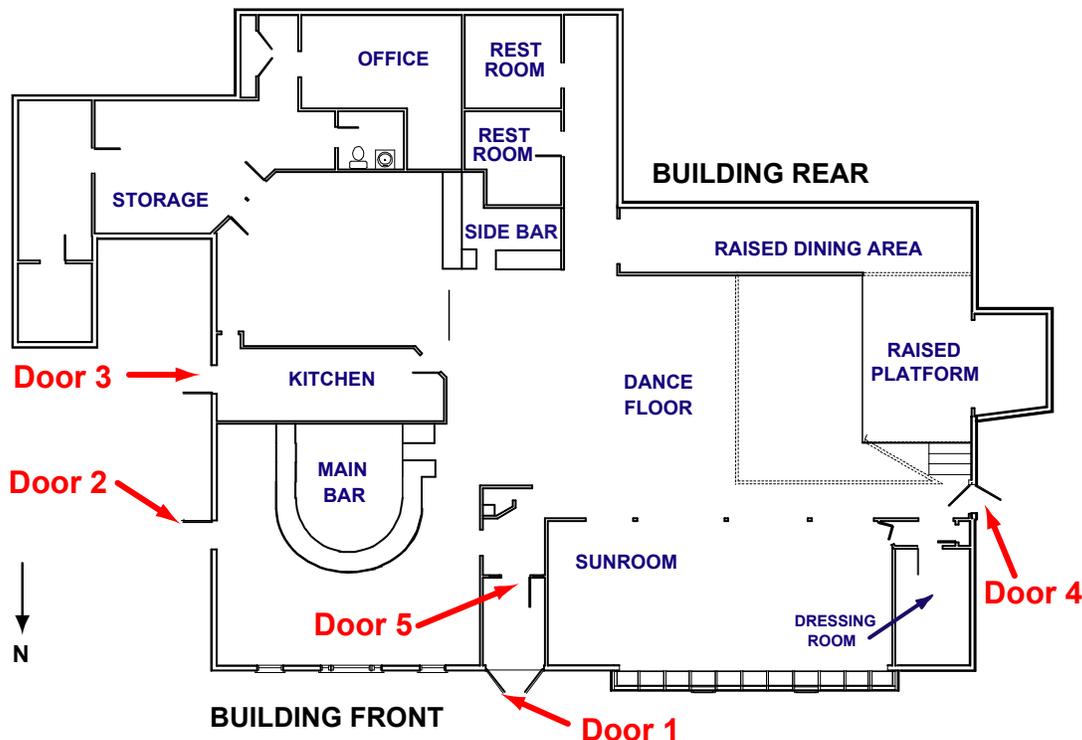
Dan opened his presentation by defining just what the realities of 5, 10, 15 and 25-megawatt fires were to give everyone a good basis to understand the intensity of the fire at the Station Nightclub. Dan explained the duties of the National Construction Safety Teams which are; to establish likely technical causes of building failure. To evaluate technical aspects of evacuation and emergency response procedures. To recommend specific improvements to model building standards, codes, and practices based on findings; and to recommend

research and other appropriate actions needed to improve structural safety of buildings, evacuation and emergency response procedures, based upon findings of their investigations. The teams were set-up after September 11, 2001 when the need for the investigation of large fires was made clear.

Dan next showed us a floor plan of the

Station Nightclub to give us a better idea as to the layout of the building, its features and exits. This was necessary for us to understand the fire growth and egress issues. Dan paid special attention to an alcove constructed behind the bandstand which was no more than a raised platform off of the dance floor. The 'drummers' alcove was built out as an extension of the building and was fully finished with egg crate

non-fire retarded foam for sound deadening. This non-fire retarded foam was also found on the walls of the band platform and to a lesser degree out into the dance floor area. After a question of cost was asked Dan responded that his best guess was that the additional cost per sheet of fire retarded foam was an additional eight to twelve dollars.



This same graphic was sadly later used to show where the fatalities were found after the fire.

Once we were familiar with the layout of the club Dan developed the below overall time line of events for us;

- 11:08 pm - ignition of foam by pyrotechnics
- band stops playing, crowd begins to evacuate
- 11:09 - cell phone callers report fire to 911
- fire alarm sounds and strobes begin to flash
- report received of fire at Station nightclub; off-duty police on scene
- people caught in doorway, smoke pouring out above
- 11:10 - 4 fire engines, a ladder truck and battalion chief assigned and dispatched
- 11:13 - Engine 4 on scene; running first hose line (1 3/4")
- 11:20 - master stream off Engine 2 operational
- 11:23 - Fire Chief 1: implement mass casualty plan
- 11:32 - roof over main bar appears down
- 12:15 am - partial collapse of poolroom area begins
- ~ 12:45 - State Fire Marshal on scene
- ~1:00 - all patients transported

Once the time line was covered, we were shown stills of the actual fire from video footage taken by a photojournalist who was filming as part of a report he was working on. After viewing the actual or real time video stills we were treated to videos of the full-scale burn tests both with and without fire sprinklers and computer-generated graphics from the FDS program. The FDS models were also run with and without fire sprinklers; it was very interesting to note the similarities with the full scale test fires and the modeling. Dan explained the difficulties that NIST had in working with the simulation model as some of the aspects of the fire were unavailable in the earlier FDS program, from the testing done in this project FDS was revised to revision 4 and currently there is a fifth revision of the modeling software ready for release.

Full scale testing clearly demonstrated the dramatic increase of tenability in a sprinklered environment, to a degree this was preaching to the choir, however, the test data affirms what fire protection engineers have been saying for years. Temperatures, oxygen levels and toxic gas levels all were tested and clearly showed that the loss would have been far less with even one sprinkler located in the drum alcove. During the full scale testing only three sprinklers fused containing but not fully suppressing the fire. In the non-sprinklered test, once the drum alcove flashed over (approximately 60 seconds into the event) the toxic gas and smoke descended to within inches of the floor in seconds (approximately 20 seconds). Other factors were discussed such as one's natural response in emergency egress conditions, which is try to leave by the same path used for entry.

Direct contributors to substantial loss of life in The Station fire were listed as; hazardous mix of building contents, the inadequate capability to suppress fire during its early stage of growth and the inability of exits to handle all of the occupants in the short time available for such a fast growing fire.

The major conclusions of the study called for; a strict adherence to 2003 model codes available at the time of the fire that would go a long way to preventing similar tragedies in future. That change to codes subsequent to the fire must make them stronger and finally by making some additional changes (and state and local agencies adopting and enforcing them) we can strengthen occupant safety even further.

The key findings regarding building contents were; Non-fire retarded foam sample purchased by NIST ignited within 10 seconds when exposed to a pyrotechnic device; under similar condition, a fire retarded foam sample did not ignite. Computer simulation of the nightclub fire shows that flames spread rapidly over foam finish material, igniting the wood paneling adjacent to the foam and generating intense heat in the first 90 seconds. Fire transitioned to more traditional, ventilation-limited wood frame building fire in about 2 minutes.

The key findings regarding fire protection systems were; that experiments conducted at NIST demonstrated that a sprinkler system installed in test room in accordance with NFPA 13 was able to control a fire initiated in non-fire retardant polyurethane foam panels. Sprinklers were not installed in The Station, nor would they have been required for such existing structures under 2003 editions of the model codes and finally

a heat detection/fire alarm system was installed in the building and was activated (sound and strobe) by the fire 41 seconds after the fire started.

The key findings regarding emergency egress were; that the first patrons recognized danger 24 seconds after ignition of foam; the bulk of the crowd began to evacuate around the time the band stopped playing (30 seconds). Up to 2/3 of occupants may have attempted to leave through main entrance; many were unsuccessful. Prior to 90 seconds, a crowd-crush occurred at main entrance which disrupted flow through the front exit. Event precipitating crowd crush likely related to arrangement of single interior door with merging streams of traffic and pressure to escape rapidly deteriorating conditions in the nightclub. Measurements in a fire test of a reconstructed portion of the platform and dance floor produced, within 90 seconds, conditions well in excess of accepted survivability limits. And finally that a computer simulation of the full nightclub fire suggested that conditions around the dance floor, sunroom, and assembly area behind kitchen would have led to severe incapacitation or death within about 90 seconds after ignition of the foam.

Areas of recommendations for improvements to model building & fire codes, standards and practices in nightclubs were; adoption/enforcement by state/local jurisdictions of model codes, strengthening requirements for sprinklers, increasing the factor of safety on time for occupant egress, tightening restriction on the use of flexible polyurethane foam as an interior finish product, the further limiting of the use of pyrotechnics and lastly conducting research to underpin the recommended changes.

The National Construction Safety Team made a number of recommendations, the first of which concerned model code adoption and enforcement.

All state and local jurisdictions should adopt building/fire code covering nightclubs based on model codes (as a minimum requirement) and update local codes as the model codes are revised. There is a need to implement aggressive and effective fire inspection and enforcement programs that address: all aspects of those codes; documentation of building permits and alterations; means of egress inspection and record keeping; frequency and rigor of fire inspections, including follow-up and auditing procedures; and finally provide guidelines on recourse available to the inspector for identified deviations from code provisions

All state and local jurisdictions must ensure that enough fire inspectors and building plan examiners are on staff to do the job and that they are professionally qualified to a national standard such as NFPA 1031 (Professional Qualifications for Fire Inspector and Plan Examiner).

The second recommendation concerned the use of fire sprinklers, stating that codes should require sprinkler systems for all new nightclubs regardless of size, and for existing nightclubs with occupancy limit > 100.

The third recommendation concerned building contents and finish materials recommending that codes specifically forbid non-fire retarded flexible polyurethane foam, and materials known to ignite and propagate flames as easily, from all new and existing nightclubs. To provide more explicit guidance to building owners, operators, contractors, and authorities

having jurisdiction for when large-scale tests that are covered in NFPA 286 are required to demonstrate that materials (other than those already forbidden above) do not pose an undue hazard for the use intended. Lastly, to modify ASTM E-84, NFPA 255, and NFPA 286 to ensure that product classification and the pass/fail criteria for flame spread tests and large-scale tests are established using best measurement and prediction practices available.

Recommendation four from the NCST concerned the indoor use of pyrotechnics; it recommended a ban on pyrotechnic devices from indoor use in new and existing nightclubs not equipped with an NFPA 13 compliant automatic sprinkler system. It went on to recommend that NFPA 1126 be modified to include a minimum occupancy and/or area for a nightclub below which pyrotechnic devices should be banned from indoor use, irrespective of the installation of an automatic sprinkler system. Finally to increase the clearance between building contents and range of pyrotechnic device.

Recommendation five from the NCST report concerned occupancy limits and emergency egress, it stated that there must be an increase factor of safety on time to egress by; establishing the threshold building area and occupant limits for egress provisions using best practices for estimating tenability and evacuation time; and, unless further studies indicate another value is more appropriate, use 1-1/2 minutes as the maximum permitted evacuation time for nightclubs similar to or smaller than The Station; computing the number of required exits and permitted occupant loads assuming at least one exit will be inaccessible in an emergency evacuation. It goes on to increasing

minimum capacity of main entrance (for nightclubs with one clearly identifiable main entrance) to accommodate 2/3 of maximum permitted occupant level (based upon standing space or festival seating, if applicable) during an emergency; eliminating trade-offs between sprinkler installation and factors that impact the time to evacuate buildings; requiring staff training and evacuation plans for nightclubs that cannot be evacuated in less than 1-1/2 minutes; and finally providing improved means for occupants to locate emergency routes for when standard exit signs become obscured by smoke.

Recommendation six was simple and basic, it concerned portable fire extinguishers and suggested that a study must be preformed to determine the minimum number and appropriate placement (based upon time required for access and application in fully occupied building) of portable fire extinguishers for use in new and existing nightclubs, and the level of staff training required to ensure their proper use.

Emergency response was covered in recommendation seven *The NCST report calls for ensuring effective response to rapidly developing mass casualty events by adopting and adhering to existing model standards on communications, mutual aid, command structure and staffing, such as NFPA 1221, NFPA 1561, NFPA 1710, and NFPA 1720.*

Recommendation eight called for research be conducted to **better understand human behavior in emergency situations**, and to predict impact of building design on safe egress in emergencies.

Recommendation nine called for *research to be conducted to **understand fire spread and suppression better** in order to provide the tools needed by the design profession to address all of the above recommendations.*

Recommendation ten called for *research be conducted to **refine computer-aided decision tools for determining costs/benefits** of alternative code changes and fire safety technologies, and to **develop computer models to assist communities in allocating resources.***

We closed with a review of the actions already taken by the State of Rhode Island which include requiring the use

across the board of up-to-date fire safety codes (elimination of the grandfather clause) and coordinated administration of fire safety building codes. Prohibiting the use of pyrotechnics in places of assembly such as nightclubs, and strictly regulate their use in other large venues. Mandating sprinklers in nightclubs with occupancy of >150 in all class A and B places of assembly, with some exceptions. Providing greater enforcement powers to fire marshals to ensure their ability to make inspections, to require immediate abatement of threats to public safety, and to increase access. And finally to establish comprehensive planning requirements to identify future weaknesses in RI's approach to fire safety.

After a Q & A period Dan informed everyone that there were four NIST handouts, a DVD of full scale fire tests performed at the Cook County Administration Building, a DVD covering the impact of fire sprinklers on college dormitories and day room fire experiments and two CD-ROMs one dealing with the flashover of Christmas trees, living room furniture and office workstations and the second was a more detailed review of the Station Nightclub fire. Dan received a rousing applause for his excellent presentation. Mr. Madrzykowski's dry cynical wit made for an interesting yet very technical presentation that both educational and entertaining.

Our meeting concluded at 8:40.

Assessment of Time to Loss of Tenability Due to Smoke, Irritants, Asphyxiants and Heat in Full-Scale Building Fires - Effects of Suppression and Detection on Survivability

This article was taken from the "Fire Suppression and Detection Research Application Symposium" February 22-26, 1999. This is the second part of this article published in the Fusible Link.

David A. Purser BRE Ltd. Fire Research Station, Garston, Watford WD2 7JR UK

Historically, the fire safety performance of buildings and their contents has been controlled by prescriptive requirements. Design and construction requirements are applied to the building, while the materials and products used are often specified on the basis of prescriptive test criteria. Such tests are usually applied to construction materials but often only to a limited extent to building contents. Tests are often limited to particular aspects of fire performance, such as ignitability or flame spread, and often have a limited relationship to the end-use situation. Most large-scale tests are conducted in open laboratories or in enclosed rigs with large vents. These tend to be well ventilated, and therefore may not represent realistic models for the development of life hazards from fires in common scenarios occurring in multi-enclosure buildings. The advent of performance-based design, requiring risk assessment methods and standards for fire safety engineering necessitates an ability to predict the overall fire hazard performance of products and systems. Indeed, in order to design buildings (and transport systems) which provide for the needs of the occupants in the most efficient way, while providing an adequate level of fire safety, it is necessary to understand all the processes involved in fire safety and fire hazards. This knowledge can then be applied to performance-based or fire safety engineering design.

As part of this process it is important to be able to evaluate the effects of such hazards on occupant escape capability, since delays in escape may lead to injury or death. This paper describes hazard assessment tools and their application to evaluation of fires in terms of time to effect. Details of the hazard assessment methods are presented in the SFPE Handbook of Fire Protection Engineering (Purser 1995) and within standards under development in ISO/TC92 SC3

(ISO 13344 and ISO DIS 13571). Examples are presented including the evaluation of the effectiveness of detection and the effects of active suppression systems including sprinklers, spray mist systems, Halon 1301 and inert gas suppression systems.

Evaluation of toxic potency, toxic hazard and fire risk

Toxic potency depends upon how much of a toxic substance is required for a given toxic effect. The smaller the amount needed the more potent the toxic substance. For example, in fires, hydrogen cyanide is about 20 times more potent than carbon monoxide, because a much smaller dose of cyanide needs to be inhaled to cause collapse than of carbon monoxide.

Toxic hazard in a fire depends upon the extent to which toxic products in that fire scenario present a danger to building occupants. Put simply it depends upon how quickly and how much toxic products are produced, and how potent the products are. In terms of the fire processes hazard to life in a fire therefore depends upon two major parameters:

1. The time-concentration (or intensity) curves for the major toxic products, optically dense smoke and heat in the fire at the breathing zone of the occupants, which in turn depend upon:
 - a) The fire growth curve in terms of the mass loss rate of the fuel (kg/s) and the volume into which it is dispersed (kg/m³)
 - b) The yield of toxic products smoke and heat in the fire (for example kg CO per kg of material burned).
2. The toxic potency of the products (the exposure concentration [kg.m³], or exposure dose [kg.m⁻³.min or ppm.min] required to cause toxic effects (and the equivalent effects of heat and smoke obscuration). This term requires consideration of three aspects:
 - a) Exposure concentrations or doses likely to impair or reduce the efficiency of egress due to psychological and/or physiological effects
 - b) Exposure concentrations or doses likely to produce incapacitation or prevent egress
 - c) Lethal exposure concentrations or doses.

There are essentially two practical methods for making such an assessment. One way is to carry out large-scale fires tests including measurements of the concentration-time profiles of the major toxic gases, heat and smoke optical density. The other way is to use test data and mathematical modeling of the fire in order to estimate the concentration-time profiles of the various parameters. Once an estimate of the conditions in the fire has been made this information can be used with hazard models derived from existing knowledge of the physiological and behavioral effects of exposure to these agents to estimate the effects on building occupants.

The toxic risk of a fire depends upon the probability that particular fires will occur that will present particular levels of hazard (risk = probability x hazard).

Continued on Page 8

Meeting Dates/Programs 2006-2007

DATE	TOPIC
March 5, 2007	Commodity Classification Changes - Joe Janiga, FM Global
April Meeting/Seminar Day	Homeland Security/Disaster Protection of gas and chemical plants
May 7, 2007	Insurance Industry Update - Steve Fomchenko, Property Manager, XL Insurance, Mike Newman, Johnson & Johnson; Brad Hart, Lockton
June 11, 2007	J&J Explosion - Mike Newman, Johnson & Johnson
June 25, 2007	Golf Outing - West Point

Continued from Page 7

Fire safety depends upon the performance of a system consisting of the building and its services, the construction materials and contents that might become involved in a fire, and the behavior of the occupants. One function of the building and its systems is therefore to protect the occupants from fire hazards.

For scenarios involving the escape of occupants from a fire, survival depends upon the outcome of two parallel processes:

1. The developing hazard from the fire: This incorporates ignition, fire growth and the spread of fire and fire effluent. These depend upon a range of variables, such as the nature and disposition of the fire load, potential ignition sources, the reaction to fire properties of the lining materials and contents, the height and ventilation of the compartment and the nature of the fire effluent. The actions of occupants and the provision of passive containment and active smoke extraction or suppression systems also affect the rate of development and extent of the hazard from a fire.

Assessment of these processes for any particular scenario is aimed at calculating the time when an occupant would receive an incapacitating exposure to fire effluent.

2. The process by which occupants escape. This depends upon detection, the provision of warnings, response to warnings (pre-moving time), occupant profile (such as age and physical and mental ability, sleeping or waking, population density) subsequent pre-egress behavior (such as seeking information, collecting belongings, choosing an exit and other activities), egress (including wayfinding, movement towards an exit, crowd flow and other factors), design of escape routes, exit numbers and width, and the psychological and physiological influence of exposure to heat and smoke on escape behavior.

Assessment of these processes for any particular fire scenario is aimed at calculating the time required for escape.

Once a fire has started, the outcome of the situation depends upon the outcome of these two processes. If the occupants have escaped before the fire becomes hazardous then we have to misquote Mr. Micawber) "happiness", but if the fire growth processes result in the fire becoming hazardous before the occupants have escaped, then we have "misery."

I hope it is evident from these lists of parameters that when all the needs of building occupants are considered, there is no single answer to fire safety or fire hazard, and that any practical system involves some compromise between all of these parameters. Fire safety can be improved or compromised in a number of different ways, both in terms of their physiology and their behavior.

SLICER & ASSOCIATES, L.L.C.
Fire Protection and Loss
Prevention Consulting

J. Sargent "Sarge" Slicer

22 Laurel Street Office 973-993-5947
Morris Plains, NJ 07950 Mobile 973-493-0369
VM & Fax 866-395-6172
Member - SFPE & NFPA sargeslicer1@myitocs.com

JMCC

John M. Cholin P.E., S.F.P.E.

J.M.Cholin Consultants, Inc.
Fire Protection Engineering and Consulting Services
101 Roosevelt Drive, Oakland NJ 07436 USA
Telephone: 201-337-8621 Fax: 201-337-5603

Robert Volinski
Regional Account Manager

tyco
Fire & Security
ADT

ADT Security Services, Inc.
695 Route 46 West
Suite 200
Fairfield, NJ 07004

Tel: 973-439-6477
Fax: 801-327-0769
email: rvolinski@adts.com

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RJA

ROLF JENSEN & ASSOCIATES, INC.
FIRE PROTECTION ENGINEERING CONSULTANTS

360 WEST 31ST STREET SUITE 1104 NEW YORK, NY 10001-4082 USA +1 212 695-6670 FAX +1 212 695-6671 earmm@rjagroup.com
A SUBSIDIARY OF THE RJA GROUP, INC.

Vicki Serafin
Affiliated FM
400 Interpace Parkway, Bldg C
3rd Floor
Parsippany, NJ 07054-1196
Phone: (973) 541-6771
Fax: (973) 541-6909

MEETING NOTICE

Date: March 5, 2007

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

Price: In Advance - \$22 At door - \$25

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

Speaker(s): Dan Madrowski, NIST

Topic: NIST - Station Night Club Fire Analysis

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

NAME: _____

COMPANY: _____ TELEPHONE: _____

ALL RESERVATIONS SHOULD BE RECEIVED BY FRIDAY, MARCH 2, 2007. TELEPHONE RESERVATIONS OR CANCELLATIONS SHOULD BE RECEIVED BY NOON OF THE MEETING DAY.



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