National Fire Service Research Agenda Symposium

Report of the National Fire Service Research Agenda Symposium
June 1 – 3, 2005
Emmitsburg, Maryland

EXECUTIVE SUMMARY

On June 1, 2 and 3, 2005, The National Fire Service Research Agenda Symposium was conducted at the National Emergency Training Center in Emmitsburg, Maryland. The Symposium was conduct by the National Fallen Firefighters Foundation (NFFF) and funded by a grant from the National Institute for Standards and Technology (NIST) through the Center for Fire Research. This work was performed under the sponsorship of the U.S. Department of Commerce, National Institute of Standards and Technology, Award No. 60NANB4D1131. The United States Fire Administration provided the facilities to host the symposium and was directly involved in the planning and all other aspects of the symposium.

The purpose of the symposium was to produce a document that will identify and prioritize the areas where research efforts should be directed to support improvements in firefighter life safety. The emphasis on efforts to address firefighter safety and health concerns coincides with the mission of the National Fallen Firefighters Foundation, as well as the goal of the United States Fire Administration to reduce line-of-duty deaths by 25% within fire years and 50% within ten years. This document is intended to be used as a guide for both research organizations and sponsoring agencies to support the mission of reducing firefighter fatalities.

The overall scope of the symposium included firefighter health and wellness; structural firefighting; wildland firefighting; firefighter training; emergency vehicle design and operations; and reduction of fire risk occurrences. The 53 symposium attendees represented several segments of the research community, including fire protection, building construction, occupational medicine and behavioral science; fire service organizations, individual fire departments and allied professionals. (A listing of all attendees and their affiliations is included at the end of this paper.). Attendees identified opportunities for sharing efforts and results, and organizations that currently or could potentially sponsor, conduct and participate in various projects aimed at improving firefighter life safety.

PROBLEM STATEMENT

Each year, more than 100 firefighters are killed in the line of duty in the United States, and approximately 100,000 firefighter injuries are reported. To that end, the United States Fire Administration has adopted a goal of reducing firefighter fatalities by 25% within the next 5 years and 50% within the next 10 years.

The genesis for this symposium was the identification of 16 Firefighter Life Safety Initiatives at a National Summit on Firefighter Life Safety that was convened by the National Fallen Firefighters Foundation in March of 2004. The 16 Firefighter Life Safety Initiatives identify the key strategies that must be implemented to meet the US Fire Administration's goal. More than 230 participants were involved in developing the 16 Initiatives to form the basis of a major effort to reduce the risks of fire fighting and emergency service delivery. The NFFF accepted the responsibility to lead the effort to implement all of the initiatives, in cooperation with all of the organizations that are concerned with firefighter health and safety.

One of the initiatives specifically called for the development of a national research agenda to support the implementation of advances in firefighter health and safety. Thus, the product of the symposium will be a published comprehensive fire service research agenda with recommendations for accomplishing the Initiatives. The efforts of several individuals and organizations resulted in the award of Grant 60NANB4D1131 to the National Fallen Firefighters Foundation to plan and conduct the National Fire Service Research Agenda Symposium and produce this report.

Summit participants concentrated their efforts on six different areas: structural fire suppression; wildland fire suppression; research and training; vehicles and equipment; health, wellness and physical fitness; and incident reduction. Within each of these areas, research issues were identified. In many cases, the research priorities identified by different groups were inter-related and suggested areas of study that could support multiple objectives. In other cases, existing research efforts were recognized that should be expanded and coordinated with other efforts. There were additional references to research projects that are being conducted for other purposes that could be adapted to meet the needs of the fire service.

SYMPOSIUM PROCESS

A planning group was assembled to develop the concept and the detailed plans for the symposium. The members of the planning committee included:

Jason Campbell	Maryland Fire and Rescue Institute
Dennis Compton	International Fire Service Training Association
Rich Dimmick	US Army Research Laboratory
Steve Edwards	Maryland Fire and Rescue Institute
John Gould	Bureau of Indian Affairs
Robert Kilpeck	National Volunteer Fire Council
Dan Madrzykowski	National Institute of Standards and Technology
Janet Maker	Oklahoma State University, Fire Protection Publications
Lori Moore	International Association of Fire Fighters

Chris Neal	Oklahoma State University, Fire Protection Publications
Brad Pabody	United States Fire Administration
Kevin Partridge	International Association of Fire Chiefs
David Prezant, M.D.	Fire Department of New York, Bureau of Health Services
Gordon Routley	National Fallen Firefighters Foundation
Robert Saba	Fire Fighting Task Force
Ronald Siarnicki	National Fallen Firefighters Foundation
Gary Tokle	National Fire Protection Association
April Walker	Maryland Fire and Rescue Institute

In addition to developing the symposium process, this group identified the broad areas of research that should be included and the list of individuals and organizations to be invited.

The proposed research issues were developed by four separate discussion groups, which then presented their recommendations to a meeting of all the symposium participants. The individual groups were asked to focus on issues relating to:

- Firefighter Health, Wellness and Fitness
- Training and Incident Management
- Technology Applications, Fire Apparatus and Equipment, and Transportation
- Fire Prevention, Public Education and Data

Each group was provided with a list of topic areas that had been identified in advance of the symposium; however they were not limited to these specific subjects. The discussion groups were encouraged to identify additional subject areas and potential projects based on the knowledge and experience of the participants. Each group was asked to develop a number of project proposals for presentation to the general assembly and to provide an indication of the relative urgency and anticipated benefits of each project or area of research.

The group ratings of individual issues were represented by numerical values:

- Priority 1 for the most urgent and critical issues
- Priority 2 for less urgent, but still highly important issues
- Priority 3 for highly valuable issues without urgency

After presentation of the group reports to the general assembly, all of the identified issues were listed on a printed ballot and all of the symposium participants were invited to vote on the relative priorities. This provided an opportunity for all of the participants to consider all of the issues that were identified by all of the groups. In addition, the general assembly was asked to identify any additional critical issues that might have been missed by the group assigned to that particular field of study.

The general assembly ranking is presented as three levels, representing the number of prioritization votes cast for each issue. This system provides a reasonable expression of the relative distribution of votes. The issues receiving the greatest number of votes were placed in the “A” category, the next highest were placed in the “B” category and the next group were placed in the “C” category. When considering these priority rankings, it must be remembered that, from the beginning, the participants were asked to limit their discussion to high priority research issues, so a lower ranking for an issue only indicates that the participants considered other issues as more critical.

The order of presentation in this report reflects the assignments of topics to the four discussion groups, with some adjustments to place related issues together. As anticipated, there were several instances where different groups identified similar or related research topics. In compiling this report, an attempt was made to group the related issues and topics. The order of presentation does not infer any prioritization of the issues.

Issue: Firefighter Candidate Selection & Assessment

Need: Collect nationwide data on effectiveness of the IAFF/IAFC Candidate Physical Ability Test (CPAT) programs, analyze findings and publish results. Use this data to expand outreach and provide education regarding the effectiveness of CPAT and NFPA 1582 - *Standard on Comprehensive Occupational Medical Program for Fire Departments*.

- Conduct a study of physical, psychological, medical, behavior issues relating to candidate selection and assessment. Determine best use of the data and implement findings to refine or improve candidate selection and assessment.

- Develop baseline data to define the profile of a healthy firefighter, including physical, psychological and attitudinal factors.

Background: Firefighter candidates must have the capacity to function safely and effectively in the fire service. Physical, medical, psychological and behavioral factors must be considered. NFPA fire service health & wellness standards should reflect current research and findings.

Comments: A continuous process is required to keep this information current.

Group Priority: 1
Symposium Ranking: A

Issue: Health Maintenance

Need:

- Collect nationwide data on effectiveness of the IAFF/IAFC Fire Service Joint Labor-Management Fitness Wellness Initiative. Use this data to expand outreach and provide education regarding the effectiveness of CPAT and NFPA 1582 *Standard on Comprehensive Occupational Medical Program for Fire Departments*.

- Develop a cost-benefit analysis of Firefighter Health & Wellness programs. Define and analyze collateral loss factors for firefighter injuries and fatalities, including both active & retired members

Background: Fitness-wellness programs are designed to maintain healthy firefighters throughout their careers.

Comments: A continuous process is required to keep this information current.

Group Priority: 1
Symposium Ranking: A

Issue: Risk Factors Relating to Cardiovascular Disease in the Fire Service

Need: Conduct analysis of traditional/standard and novel risk factors relating to cardiovascular disease in the fire service. Consider cumulative stress (psychological & physical), the relationship between risk factors and cardiovascular events, and potential risk reduction strategies.

Background: There are three categories of risk factors:

1. Non-modifiable risk factors (age, sex, family history, ethnicity)

2. Modifiable risk factors (high cholesterol, high blood pressure, diabetes, obesity, physical inactivity, smoking)

3. Novel risk factors (blood markers, specifically CRP (C-reactive protein), fibrinogen, apolipoprotein a, homocysteine).

While there is a general understanding of the relationships between these risk factors and the risk of cardiovascular events in the general public, very little is known about the specific relationship between these risk factors and cardiovascular events in the fire service. The firefighter's strenuous activity and hostile work environments could alter the more general relationships.

Both modifiable and novel risk factors are known to be positively affected by diet and exercise, which suggests that greater knowledge of these factors and a commitment to health and wellness programs (i.e., IAFF-IAFC programs) could lead to significant reductions in cardiovascular deaths and disabilities.

Comments: A continuous process is required to keep this information current. Results should be valuable to the appropriate NFPA committees.

Group Priority: 1
Symposium Ranking: A

Issue: Physiological & Psychological Effects of Heat Stress

Need: Research should examine the physiological and psychological effects of heat stress on firefighters, as well as methods to mitigate heat stress.
The analysis should include:

- effective hydration
- acclimatization
- effectiveness of incident scene rehab to address heat stress
- effectiveness of alternative Emergency Incident Rehabilitation strategies and technologies
- Work/Rest Cycles

Background: Heat stress is recognized as a significant risk factor for firefighters. Heat stress is known to limit physical performance, increase the cardiovascular stress related to muscular work and impair cognitive functions. Although the professional sports industry and the military have performed extensive work in this area and the resulting information has been widely published, there is still important research that needs to be done to document the effect of heat stress on firefighters.

It has been documented that the combination of heavy muscular work and hyperthermia present an extreme challenge to the cardiovascular system, but it is not known how the heat stress associated with firefighting (in particular the *rapid* increase in body temperature) affects various systems, including the cardiovascular, immunological, hormonal or neural systems.

Given that conditions of extreme heat and rapidly rising body temperatures are encountered by firefighters more than any other occupational industry and often very suddenly, this issue warrants considerable research effort. Also, given the known dangers of heart attacks during emergency activities, and the cardiovascular stress related to the combination of heat and muscular work, research efforts need to be devoted to understanding the specific relationship between heat stress and acute cardiac events. In addition to studying the effects of heat stress, research in this area should also be directed to finding effective solutions to mitigate against the detrimental effects of heat stress.

Comments: A continuous process is required to keep this information current. Results should be valuable to the appropriate NFPA committees and the USFA.

Group Priority: 1
Symposium Ranking: A

Issue: Acute Physiological Response to Emergency Incidents.

Need: Firefighters are often required to respond very quickly from low intensity to maximum output, causing extreme physiological stress. Expanded research should focus on new variables and technologies.

Background: Firefighters can be called upon to respond to an emergency at any time of the day or night. Although there is considerable anecdotal evidence about the stress related to going from a resting state to a heightened state of anticipation (when the alarm sounds) to maximal work (as often occurs at a fire), there is little systematic research in this area. Most of the research involving actual fires was done long ago and involved the collection of few variables on a limited number of subjects. Additional studies should be conducted using more advanced physiological research techniques.

Furthermore, there is very little research that documents the extent to which firefighting activity causes changes in physiological function and how long it takes for these variables return to a normal or safe level. A firefighter may remain on duty for many hours after responding to an incident and could respond to subsequent emergency incidents during the recovery period. Research into this important area should include physiological monitoring prior to the incident, during firefighting activities and during the recovery period.

Comments: A continuous process is required to keep this information current. Results should be valuable to the appropriate NFPA committees and the USFA.

Group Priority: 1
Symposium Ranking: B

Issue: Functional Capacity Evaluation testing

Need: Functional Capacity Evaluation (FCE) refers to a series of tests to monitor heart rate and physiological response to stress. The results are used for injury prediction and prevention. This model is currently used in sports and some large manufacturing operations and could be applicable to the fire service.

Background: This type of total body performance evaluation used in professional sports for contract issues. The research project would consider a new application for an existing evaluation tool.

Comments: A continuous process is required to keep this information current. Results should be valuable to the appropriate NFPA committees and the USFA.

Group Priority: 1
Symposium Ranking: A

Issue: Substance Abuse & Mitigation; Tobacco Products (smoking and smokeless).

Need: Identify risk behaviors for the fire service as a result of using tobacco products. Define substance abuse and mitigation programs. Identify cultural and human behavior issues with an emphasis on prevention, identification, & intervention.

Evaluate effectiveness of smoking/tobacco use cessation programs, such as FDNY model. Identify better awareness and coping strategies

Background: Research has indicated there is a relationship between substance abuse associated with high stress levels. It is generally known that there is a high use of tobacco products in the fire service.

Comments: A continuous process is required to keep this information current.

Group Priority: 1
Symposium Ranking: C

Issue: Reproductive Health Issues

Need: Data mining of past history - Still births, birth defects, conception anomalies and infertility issues involving firefighters.

Background: Anecdotal reports indicate high incidences of reproductive health issues involving firefighters and clusters of related problems in particular groups. Some by-products of combustion and some hazardous materials have been identified as taratogens. The research would examine the available data possible links and predictive indicators.

Comments: Keeping it current - Continuous process.

Group Priority: 1
Symposium Ranking: C

Issue: Analysis of Fire Service Culture.

Need: Identify attitudes, beliefs, and behaviors that contribute to high-risk behaviors and resistance to changes that would improve health and safety. Also identify effective motivators to promote positive changes.

Background: The current fire service culture is widely recognized as a barrier to making important improvements in firefighter safety and health. Cultural values often place bravado and heroism ahead of firefighter safety.

Comments: This issue is believed to be one of the key factors in reducing firefighter's injuries and fatalities.

Group Priority: 1
Symposium Ranking: A

Issue: Development of a Scientifically Based Community Risk Assessment Tool

Need: The role of the fire service has expanded to include response to emergency medical incidents, hazardous materials incidents, technical rescue situations, terrorist acts and a broad range of risks and potential disasters. Each type of service or potential situation introduces new challenges and risk factors. Fire department leaders need the ability to systematically identify and assess the specific risk factors that are present in a particular community in order to develop emergency response systems that will be able to respond safely, efficiently & effectively to events that can be anticipated to occur.

Background: A variety of fire risk assessment systems and software packages have been developed, however the methodologies were not scientifically derived and have not been extensively validated. The intent of this study would be to provide a scientific foundation for community risk assessment, which could then be incorporated into improved software packages.

Comments: Community risk analysis is an essential component in the development of a fire service resource deployment analysis methodology. This study would establish a scientific foundation for the community risk assessment process.

RHAVE (Risk, Hazard and Value Evaluation) was developed for the Commission on Fire Accreditation International (CFAI) as a tool to conduct a fire risk analysis of individual properties within a community. A more advanced community risk assessment software package, known as VISION, is currently under development by CFAI. The scientifically based risk assessment process should be compatible with VISION and could be applied to future models and processes.

Group Priority: 2
Symposium Ranking: A

Issue: Design A Strategic Emergency Response Model based on Known Community Risks.

Need: A systematic process is needed to model the capabilities of alternative fire service resource deployment strategies in relation to identified risks and desired performance levels. This process would allow an agency or jurisdiction to evaluate the anticipated performance of alternative resource deployment decisions and/or determine the resource levels that are required to provide an acceptable level of service in relation to scientifically measured risks and defined performance objectives. The application of this model would allow a community to predict the impact of resource deployment decisions in relation to local risk factors and service delivery expectations. The impact of various alternatives on firefighter health and safety would be incorporated into the process.

Background: This model should provide valuable assistance to support strategic planning and budgetary decision-making at the local level. Increasing service demands and public expectations, coupled with expanding risk factors, have challenged the ability of fire departments and local public officials to make sound resource allocation and service level decisions. The desired model would predict the consequences of resource allocation decisions in relation to the identified and measured risk factors in the community.

Comments: This project would be directly supported by the development of a scientifically based community risk assessment tool.

Group Priority: 2
Symposium Ranking: B

Issue: Develop Emergency Response System Performance Measures for Use by Fire and Rescue Departments

Need: This study would produce a standardized system of performance measures and indicators for fire and rescue service organizations. The standard performance measures and indicators would be clearly defined and could be used by all fire and rescue organizations to measure and report their performance. The resulting system would be particularly valuable to local public officials charged with making budget and resource allocation decisions. It would also provide a common platform for defining, measuring and comparing the performance of different service delivery systems and organizations.

Background: The fire service currently uses a variety of performance measures and indicators, most of which lack standard definitions. Many of the commonly used indicators are of questionable value in relation to actual performance measurement. A standard system to measure performance would support a well-informed decision making process for budget and resource allocation, as well as operations analysis and strategic planning for internal management of the organization.

Examples – Standard definitions of response time, time to assemble an effective fire suppression force on scene and “knock-down” time.

Comments: This system would directly support the development of a strategic emergency response model based on known community risks.

Group Priority: 2
Symposium Ranking: B

Issue: Identify Fire Ground Factors that Contribute to Fire Service Injuries and Fatalities.

Need: The first phase of this project would be directed toward systematically identifying and analyzing the factors that cause or contribute to firefighter injuries and fatalities. It would involve detailed analysis of individual cases that result in injuries or fatalities, as well as "close call" situations; as well as statistical analysis of associated data at the local, regional, national and international levels.

The second phase of the project would be directed toward developing mitigation strategies to address the critical risk factors and reduce injury and fatality rates.

Background: The rate of firefighter injuries and fatalities occurring on the fire ground is a critical concern. The research component of this effort would be directed toward identifying critical factors that result in firefighter deaths and injuries. After these factors are identified, effective mitigation efforts, such as training programs, can be developed to address them.

Comments:

Group Priority: 1
Symposium Ranking: A

Issue: Application of Risk Management Techniques to Incident Management.

Need: A core set of guidelines and procedures must be developed to apply basic risk management concepts in the context of emergency incident management. These procedures will allow the incident manager to apply the principles of risk management in a manner to reduce firefighter injuries and fatalities.

Background: The theory that realistic risk management concepts should be applied to incident management in order to reduce firefighter injuries and fatalities has been widely accepted. The current challenge is to develop a standard systematic approach to ensure that the risk management principles are consistently applied at all incidents.

Comments: This effort must clearly identify the applicable risk management principles in a manner that is directly applicable to emergency incident management and can be routinely utilized by on-scene command officers. Training and orientation processes must be developed to ensure that the principles are widely adopted and applied.

Group Priority: 1
Symposium Ranking: C

Issue: Technology to Support Incident Command

Need: Apply the best available technology to support incident command in a manner that will improve safety and operational effectiveness at incident scenes. Research, identify, deploy and provide training in the use of integrated tools and technologies that will assist the incident commander to better plan, organize, monitor and control emergency operations. The objectives include improved safety, greater operational effectiveness and more efficient utilization of resources.

Background: The fire service has developed and refined an incident management system model that has been broadly adopted and integrated into the national incident management system (NIMS). Many technological applications have been developed to assist or support the incident management process and many additional advances can be anticipated. Some of the individual applications include support for enhanced communications and interoperability, information management, resource tracking, scene surveillance, physiological and spatial monitoring of personnel, and monitoring of structural integrity. The challenges include identifying the most valuable and critical capabilities, refining their integration into the incident management process, making them available to fire departments and training fire officers to use them effectively.

Comments: There could be significant opportunities for transferring military technologies to fire service use in relation to this initiative.

Group Priority: 1
Symposium Ranking: A

Issue: Educational Methodologies to Effectively Reduce Fire Service Injuries and Fatalities.

Need: Identify educational methodologies that will effectively reduce fire service injuries and fatalities and also reduce the risks associated with firefighter training. The analysis should address inadequacies in current training programs and methods and also research approaches that could enhance training in the future.

The project should include (but not be limited to) the following considerations:

- Practicality of alternative methodologies
- Cognitive versus manipulative skills
- Effectiveness of e-based training
- Quantifiable means of evaluation
- Measurement of impact on skills, practice, health, & safety
- Adult learning styles

Background: Training is a fundamental issue for the fire service and a critical component of any plan to address firefighter health and safety concerns. Training methodologies are currently determined by local jurisdictions, based on available resources, facilities and funds, as well as preferences and traditions. This project would be directed toward identifying the most effective educational methodologies to promote important changes within the fire service.

Comments:

Group Priority: 1
Symposium Ranking: B

Issue: Professional Development for All Fire Service Personnel.

Need: An effort is required to focus on the development of appropriate leadership and management skills at all levels within the fire service. These skills include:

- Decision making
- Management best practices
- Empowerment
- Political science

Background: Fire service members at the lower- and mid-levels are not receiving sufficient training and education in the areas of leadership and management skills. In most cases this type of decision making and empowerment training is only offered to upper level fire command officers through the EFO program or college classes. Selection processes do not allow many firefighters and officers to obtain this valuable training in their early career development. In addition to adequately preparing them for advancement, they would be better equipped to make appropriate field decisions that could contribute to improved personnel safety – and positively influence the overall fire service culture.

Comments:

Group Priority: 2
Symposium Ranking: B

Issue: Recruit Level Training; Design and Effectiveness

Need: Investigate variables that impact the effectiveness of recruit level training, with a particular emphasis on reducing firefighter death and injury rates. The considerations should include (but not be limited to):

- effective supervision
- course length
- levels of training
- educational methodologies and regional acceptance
- cultural impacts
- interrupting unsafe practices
- acceptable safety competencies (Knowledge, skills and abilities).

Background: In many cases recruit training is inadequate, ineffective and too short in duration. There are several different training standards in effect and many jurisdictions have no specific training requirements. Injury and fatality data indicate that less experienced firefighters are at greater risk than those with more experience.

Comments: Recruit training establishes the basic orientation of every new firefighter and is a key factor in future performance.

The project should evaluate the use of paramilitary psychology/mentality and alternatives to paramilitary disciplinary techniques

Users must recognize that different generations may have different learning styles

Group Priority: 1
Symposium Ranking: B

Issue: Instructor Evaluation and Professional Development

Need: There is a need to determine the critical knowledge, skills, and abilities that an effective instructor must possess. Methods should also be developed to regularly evaluate the performance of instructors.

Background: The ability of fire service instructors to effectively and safely design and deliver training to fire service personnel is a key component in addressing firefighter death and injury rates.

Comments: The existing fire service instructor standards should be carefully evaluated with respect to their impact upon firefighter death and injury incidents.

Group Priority: 2
Symposium Ranking: C

Issue: Document Failures & Lessons Learned from Live Fire Training Deaths and Close Calls

Need: This project should analyze research obtained from deaths, serious injuries, and close calls to firefighters at live fire training events. The findings should be prioritized, coordinated, and disseminated to make all firefighters aware of the issues and to reinforce changes or modifications to current live fire training procedures.

Background: Live fire training can be extremely valuable; however it also exposes the trainees to many of the same risks as actual emergency incidents. Over the years live fire training has resulted in many firefighter deaths and serious injuries. Most of these situations are predictable and should be preventable. Unsafe training methods promote the use of equally unsafe emergency operational methods.

Comments:

Group Priority: 1
Symposium Ranking: A

Issue: Effective Integration of Simulation into Training

Need:

- Research existing simulation training programs
- Determine their applicability to fire fighting and the fire service
- Identify most critical and commonly encountered issues from actual incidents
- Develop virtual reality training scenarios based on item 3
- Implement the simulation training with multi-station participation
- Measure effectiveness of training to a present standard of best practices response to actual real life incidents.

Background: The military and private sector organizations have made tremendous advances in simulation programs. This project should examine the applicability of existing simulation capabilities to the fire service and also identify priority areas for the development of specific fire service applications.

Comments: Carnegie Mellon University (Edutainment Dept) has worked with FDNY and most recently with Pennsylvania's Region 13 Weapons of Mass Destruction Task Force to develop and critique effective simulation programs.

Group Priority: 3
Symposium Ranking: B

Issue: Situational Awareness of Firefighter Physiological and Environmental Conditions.

Need: The ability to continuously monitor the location and physiological status of firefighters who are working in hazardous areas is a critical life safety issue. The ability to monitor external conditions within the firefighters' work environment is equally important, in order to identify imminent threats and changing conditions. The information should be available to the firefighter and should also be transmitted to an external command post, where it can be monitored and recorded.

Background: Each year, over a period of 15 years, an average of 11 firefighters have died from asphyxiation or burns while performing interior structural firefighting operations. Many of these fatalities occur in scenarios that involve factors of disorientation, physical exhaustion, running out of air and/or being overcome by rapidly changing conditions while operating within a dangerous environment. The basic technological capability to monitor several individual factors currently exists. The challenge is to integrate and adapt these technologies to operate effectively and reliably in the firefighter's work environment. The desired solution would make the firefighter aware of dangerous situations and transmit the data in real time so that it could be monitored and recorded outside the hazardous area.

Comments: This effort involves the adaptation and refinement of several existing technologies. Location tracking and the ability to transmit data to and from the firefighter inside buildings are high priority research issues at this time. Data transmission is problematic inside many buildings. The ability to measure and monitor the firefighter's physiological condition and environmental factors requires a parallel effort to adapt existing technologies.

Group Priority: 1
Symposium Ranking: A

Issue: Fire Department Communications - Operability

Need: The ultimate goal of this project would be to improve fire department communication systems and procedures in order to enhance scene safety and prevent firefighter deaths and injuries, as well as to promote effective tactical operations. A comprehensive analysis of operational communications requirements must be conducted in order to document all of the required capabilities.

An effective incident scene communications system must provide the ability to coordinate operations, provide warning of dangerous situations and request assistance when firefighters are in imminent danger. The ability to provide reliable two-way radio communications with all firefighters operating on the scene of an incident is a critical life safety issue.

The communications system must also support the overall management of the incident, providing reliable communications with the dispatch center and with all units assigned to the incident, including units that are still en route. This need also includes effective communications procedures and the ability to transmit data and critical information to support incident scene operations.

Background: Inadequate dispatch and incident scene communications are often cited as contributing factors in fatality and injury investigation reports. The need to improve operational communications systems and procedures has been identified on several occasions. Most fire department communications systems have evolved without an overall plan for systems integration or utilization. This project requires a comprehensive analysis of the operational communications issues that must be addressed by fire departments and the evaluation of several technological alternatives. The desired outcome would be the definition of one or more fully integrated solutions that meet all of the identified requirements.

Comments: Despite technological advances in radio communications, several recent incidents involving firefighter fatalities demonstrate failures to provide effective operational communications at emergency incidents. In many cases important information is not adequately communicated to the incident scene or among units operating on the scene. Inadequate communications can have a negative impact on the safety of emergency personnel as well as civilians.

Group Priority: 1
Symposium Ranking: A

Issue: Fire Department Communications - Interoperability

Need: This project would focus on issues relating to communications interoperability among agencies and organizations involved in emergency operations. The needs of all participating agencies must be defined and integrated into overall system performance requirements. In addition, procedures must be adopted to provide effective, clear, and understandable communications at all levels of emergency response.

Background: While a major emphasis has been directed toward enhanced communications interoperability since 9-11, most of the effort has been directed toward technology. While technological solutions can provide a tremendous range of interoperable communications capabilities, the actual needs of individual agencies and organizations involved in emergency response communications have not been well documented and integrated. Where a technological solution has been provided, there are often problems involving coordination and standardization of procedures.

Comments: Several projects have been conducted by federal, non-profit, and industrial organizations and on-going efforts continue to provide substantial research in communications technology. The gap appears to be adequate analysis of user requirements and operational issues.

Group Priority: 3
Symposium Ranking: C

Issue: Data Access to the Information Infrastructure

Need: Analysis of user needs, technological capabilities and interoperability issues involved in providing useful information to the incident commander from multiple data sources. Tremendous quantities of potentially useful information exist in variety of technological infrastructures. Potential uses for this information include pre-incident planning, real-time monitoring of building systems, resource tracking, response routing and remote monitoring of complex situations. The emphasis of this project would be to identify the types of information that are available, where it is located, how it can be accessed and how it can be used effectively in the management of emergency operations.

Background: The fire service needs to take advantage of the rapidly expanding resources of data that can be obtained from building systems, GIS systems, traffic cameras, surveillance systems and similar systems to enhance the effectiveness and safety of emergency operations.

Comments: This effort should address data that can be obtained from private and individual sources, as well as community and public access systems.

Group Priority: 1
Symposium Ranking: B

Issue: Respiratory Protection

Need: Efforts must be directed toward continuing technological improvements in respiratory protection equipment for firefighters. As enhanced technological capabilities are developed and proven, they must be integrated and made available to the fire service. Particular efforts should be directed toward:

- integrated intra-squad communications system;
- lightweight and longer duration SCBA;
- environmental monitoring for threats and hazardous conditions;
- improved open circuit SCBAs;
- technology development of closed circuit SCBAs;
- development of high flow rate power air purifying respirators (PAPR);
- development of combination SCBA/PAPR systems.

Background: Respiratory protection is the most critical component of a firefighter's protective ensemble. Continuing efforts are required to develop and incorporate technological improvements in respiratory equipment.

Comments: Research and development of respiratory protection equipment should be a continual process. Numerous independent research studies and technological improvements are currently in progress. This effort should be directed toward coordination of various efforts and systems integration as improvements are developed.

Technological advances that could increase air supply in order to extend the duration of SCBA use are under development. The user duration issue should be linked to the development of definitive standards with respect to firefighter rest, recovery and rehabilitation, as well as physiological and environmental monitoring capabilities.

Group Priority: 2
Symposium Ranking: A

Issue: PASS Failure Analysis

Need: Conduct an analysis of user experience involving PASS (Personal Alert Safety System) failures and unreported performance issues. Concerns have been noted with failures to alarm at high temperatures, and failures caused by moisture getting into electronics and battery components.

The findings could lead to changes in performance standards (e.g. NFPA 1982 – Standard on Personal Alert Safety Systems PASS) and certification tests that more closely simulate fireground heat and moisture conditions.

Background: Anecdotal reports indicate a significant incidence of failures involving PASS devices, including PASS devices integrated into self-contained breathing apparatus.

Comments: This is an urgent issue that requires immediate attention.

Group Priority: 1
Symposium Ranking: A

Issue: Firefighter Fatalities and Injuries Involving Motor Vehicle Accidents.

Need: Conduct a detailed analysis of firefighter fatalities and injuries resulting from motor vehicles accidents in order to identify causal and contributing factors. This analysis should include, but not be limited to:

- Fire department vehicles
- Privately owned vehicles responding to emergency incidents;
- Vehicle age and design;
- Applicable design standards
- Vehicle inspection records;
- Compliance with traffic laws and response procedures;
- Time of day and weather conditions;
- Road surface;
- Seat belt usage;
- Mechanism of injury;
- Driver training and certification;
- Cause of accident.

Background: Detailed information on emergency vehicle accidents is often collected for individual incidents, however it is not compiled or analyzed nationally. This project would involve an effort to obtain and conduct extensive analysis of emergency vehicle accident data.

Comments: The analysis should examine civilian fatality and injury data as well as firefighter injuries and fatalities resulting from emergency vehicle accidents

Group Priority: 1
Symposium Ranking: A

Issue: Improved Extinguishing Agents and Delivery Systems

Need: Develop advanced firefighting agents that can effectively extinguish different classes of fire, while reducing the need to exposing firefighters to excessive heat and products of combustion.

Background: The primary objective of this research should be to reduce the exposure of firefighters to the risks of interior fire suppression by developing more effective extinguishing agents and systems. These advances should also result in reductions in civilian fire deaths and injuries as well as property damage.

Comments: This initiative should include research on more effective use of water as an extinguishing agent, such water-mist technology, as well as foams, wetting agents, gels and other water additives.

Group Priority: 3
Symposium Ranking: C

Issue: Development of Advanced Fire Detection and Extinguishment Methods.

Need: Develop new technologies to interrupt the oxidation process in order to prevent fires from growing beyond incipient stage.

Background: The current methods for fire control are virtually 100% reactive. There is seldom any intervention of fire before it grows to the open flame mode.

Comments: Research exists and needs to be extended to make unwanted fire a thing of the past.

Group Priority: 3
Symposium Ranking: B

Issue: Balance of Active Versus Passive Fire Protection in Buildings

Need: A study should be conducted to compare the effectiveness of alternative fire protection methods for buildings, particularly comparing active versus passive systems approaches. The analysis should include cost-effectiveness issues, taking into account the life cycle expectancy of each alternative as well as maintenance costs. A standard methodology is needed to calculate and compare the costs and benefits of fire protection alternatives.

Background: The pendulum continues to swing from one extreme to the other as it relates to fire protection in buildings. This is a result of a dearth of quantifiable data on the effectiveness of the available options. Over reliance on any one system has the potential for disaster.

Comments: The correct balance is necessary to provide the highest level of firefighter safety possible under our current system.

Group Priority: 2
Symposium Ranking: C

Issue: Flashover and Structural Collapse Prediction.

Need: This effort should be directed toward the development of systems that will accurately predict flashover and structural collapse at fire scenes, providing adequate time for firefighters to evacuate.

Background: Flashovers and structural collapse incidents are involved in a significant number of firefighter fatalities. Technology should be able to provide incident commanders with valuable assistance to determine when interior operations should be abandoned.

Comments: The need for this technology grows as the number of fires drops. Due to the decreasing frequency of structure fires, incident commanders are often lacking in practical experience and less skilled at making predictions through observation of fire conditions. The development of technological solutions must be linked to continuing research and development of predictive models and indicators.

Group Priority: 1
Symposium Ranking: B

Issue: Code Adoption and Enforcement Policies; Interpretation of Codes and Standards

Need: Study relationships involving inconsistent code adoption and enforcement policies and interpretation of codes and standards to determine their impact on preventable fires, deaths and injuries. Conduct an analysis to examine the impacts on fire death and injury rates associated with:

- code adoption;
- alternative codes;
- code enforcement efforts and policies;
- interpretation of codes and standards.

Background: There is no nationally required minimum fire safety standard. States and local jurisdictions have considerable discretion in the adoption and enforcement of codes and standards. Where codes have been adopted, there are often issues relating to the adequate staffing and training of enforcement agencies.

Comments: Political influence is a significant factor in these issues.

Urban-wildland interface issues should be included in this study; there has only been limited analysis of the impact of codes on fire protection in these zones, while the losses have been substantial in recent years.

Group Priority: 1
Symposium Ranking: C

Issue: Public Awareness of the Impact of Codes and Standards

Need: The benefits of codes and standards to the consumer are not widely recognized. An effort should be directed toward educating the general public on the positive impact of safety codes and standards on everyday lives. Better informed consumers could become advocates for a safer built environment.

Background: There is no baseline data on consumer knowledge of codes/standards. In many cases codes and enforcement have a negative connotation. People rely on builders to take care of their safety needs.

Comments: Information technology could be utilized to efficiently make information available to consumers.

Priority: 2
Symposium Ranking: C

Issue: Data Requirements to make Quality Fire Safety Decisions

Need: This effort should examine issues relating to resistance and obstacles to documentation of accurate fire problem data that could be used to make quality decisions relating to fire safety.

Background: The project should examine the value of documentation to fire departments and the use of data in planning and execution efforts. Attention should be directed toward methods that would encourage fire departments to collect, report and utilize data more effectively.

Comments: Data collection and analysis techniques should be included in the training curriculum for future leaders and managers.

Group Priority: 1
Symposium Ranking: B

Issue: Capture Data to Determine Firefighter Exposure to Fire Problems.

Need: The existing fire service census information needs to be improved in several areas. The data for volunteer firefighters should include time on duty, number of responses and additional activity data. The time committed to prevention and public education activities should also be documented.

A study (by telephone survey) of unreported fires should be conducted to determine the circumstances and document went right in those situations.

Background: We lack the data that is needed to compare career versus volunteer exposure to fire risks and problems.
We presume lack of commitment to prevention is part of the overall problem, however we do not have data on the overall prevention effort.
We assume that effective public education and awareness programs result in more fires being extinguished in the incipient stage and not being reported.

Comments: The ability to relate data to fire service goals would be valuable. Efforts are needed to determine what data needs to be collected.

Group Priority 1
Symposium Ranking: A

Issue: Data Sharing Opportunities

Need: Determine the systems and agencies that are gathering similar or related data that could be useful in fire prevention, code enforcement and public education efforts. Determine who has what data, how it could be obtained and shared and how it could enhance the quality and timeliness of information. Identify and develop analytical tools to make effective use of shared data.

Background: It is unknown what other valuable information could be available and accessible to fire departments. Local fire departments have limited ability to analyze local and/or comparative data.

Comments:

Group Priority: 2
Symposium Ranking: C

Issue: Fire Prevention and Public Education Efforts to Target Identified Problem Areas.

Need: Develop the ability to more effectively identify target audiences and refine fire prevention and public education to reach those audiences with the appropriate messages and programs. Identify how public education programs can be more effective in reduction of fires. Evaluate the effectiveness of existing fire prevention messages, both positive and negative. Determine root causes of behaviors and attitudes that contribute to fires, injuries and fatalities.

Background: Cultural and economic barriers may prevent messages from reaching the target audiences. More research should be directed toward identifying social and cultural factors that could be used to direct efforts toward specific problems.

Comments: Include public perceptions of the role of the fire department in public safety.

Group Priority: 1
Symposium Ranking: A

Issue: Standardized Criteria for the Evaluation of Public Education Programs

Need: Develop a process and criteria for evaluating public education programs. This would facilitate sharing those programs that have demonstrated success.

Background: There are no standardized criteria for evaluating public fire safety education programs and no national effort to share effective programs. More than 1,000 different programs have been funded through FIRE Act grants, totaling approximately $150 million over the last 4 years. The programs that have demonstrated a positive impact should be identified and replicated in other communities.

Comments:

Group Priority: 1
Symposium Ranking: A

Issue: Risk of firefighter fatalities during wildland firefighting operations.

Need: Analysis of the impact of fire risk regulation in wildland/urban interface zones on firefighter safety. Determine where fire safe practices are in place and enforced and where they are absent. Examine why regulations are not adopted or adequately enforced in different areas.

Background: Constantly expanding interface zones are resulting in greater fire dangers to communities and higher risks to firefighters.

Comments: The fire service must make structure protection a priority over wildland protection. Where adequate regulations are not in place, firefighters may be jeopardizing their safety unnecessarily to protect structures.

Group Priority: 2
Symposium Ranking: B

Additional research topics listed, but not fully documented:

1. Effectiveness of incident scene rehabilitation procedures
2. Physiological monitoring at the incident scene
3. Impact of work/rest cycles and sleep deprivation on firefighter safety
4. Health effects of cellular telephone towers at fire stations
5. Impact of safe cigarette legislation on firefighter injuries and fatalities.

National Fallen Firefighters Foundation

List of Attendees:

Amy Acton	The Phoenix Society for Burn Survivors
Rich Anderson	National Fallen Firefighters Foundation
Allen Baldwin	Pennsylvania Turnpike Commission
Jim Beecken	Montgomery County Fire Rescue Service
Richard Bower	Montgomery County Fire Rescue Service
Denis Bramblette	Responder Magazine/Responder Technology Division
Nelson Bryner	National Institute of Standards and Technology
James Burns	New York State Office of Fire Prevention & Control
Robert Carnahan	Reality Response, Advanced Interactive Systems
Peg Carson	Home Safety Council
Dawn Castillo	National Institute of Occupational Safety and Health
Phil Chovan	Fire Department Safety Officers Association
Dennis Compton	International Fire Service Training Association
Rich Dimmick	U.S. Army Research Lab
Rich Duffy	International Association of Fire Fighters
Steven Edwards	Maryland Fire and Rescue Institute
Rita Fahy	National Fire Protection Association
Ronald Farr	International Fire Marshals Association
Manuel Fonseca	International Association of Hispanic Firefighters
Brian Gray	International Association of Arson Investigators
Randall Griffin	Department of Homeland Security
Bill Haskell	National Institute of Occupational Safety and Health - NPPTL
Christopher Hebert	Firehouse.com
Chris Jelenewicz	Society of Fire Protection Engineers
William Jenaway	Volunteer Firemens Insurance Services
Dennis Jones	Tampa Fire Rescue
Ron Kanterman	Merck Emergency Services
Thomas Kennedy	Center for Technology Commercialization, Inc.
Robert Kilpeck	National Volunteer Fire Council
Cynthia Leighton	Motorola Inc
Murrey Loflin	Virginia Beach Fire Department
Daniel Madrzykowski	National Institute of Standards and Technology
Pam Marshall-Bramblette	Responder Magazine/Foundation for Fitness
Tiffany Melton	Tampa Fire Rescue
Ernie Mitchell	Center for Technology Commercialization
Lori Moore	International Association of Fire Fighters
Ronald Morales	International Association of Hispanic Firefighters
Chris Neal	Oklahoma State University, Fire Protection Publications
Brad Pabody	United States Fire Administration
Kevin Partridge	International Association of Fire Chiefs
Pam Peterson	The Phoenix Society for Burn Survivors
Nathan Queen	International Association of Black Professional Fire Fighters
Jeff Resch	Fire Apparatus Manufacturers Association
Kevin Roche	Phoenix Fire Department
Gordon Routley	National Fallen Firefighters Foundation
Robert Saba	Fire Fighting Task Force
Timothy Sendelbach	International Society of Fire Service Instructors
Ronald J. Siarnicki	National Fallen Firefighters Foundation
Denise Smith	University of Illinois Fire Services Institute
Jim Tidwell	International Code Council
Gary Tokle	National Fire Protection Association
Bill Troup	United States Fire Administration
Robert Tutterow	Charlotte Fire Department
Allen Williams	Anne Arundel County Fire Department

National Fallen Firefighters Foundation

Firefighter Life Safety Initiatives

Since the 2004 Summit, the 16 Firefighter Life Safety Initiatives have received broad support throughout the fire service and from related organizations. The 45-member organizations that belong to the National Advisory Committee to the Congressional Fire Services Institute voted unanimously to endorse the 16 initiatives, and several other organizations have taken similar action.

1. Define and advocate the need for a cultural change within the fire service relating to safety; incorporating leadership, management, supervision, accountability and personal responsibility.

2. Enhance the personal and organizational accountability for health and safety throughout the fire service.

3. Focus greater attention on the integration of risk management with incident management at all levels, including strategic, tactical, and planning responsibilities.

4. All firefighters must be empowered to stop unsafe practices.

5. Develop and implement national standards for training, qualifications, and certification (including regular recertification) that are equally applicable to all firefighters based on the duties they are expected to perform.

6. Develop and implement national medical and physical fitness standards that are equally applicable to all firefighters, based on the duties they are expected to perform.

7. Create a national research agenda and data collection system that relates to the initiatives.

8. Utilize available technology wherever it can produce higher levels of health and safety.

9. Thoroughly investigate all firefighter fatalities, injuries, and near misses.

10. Grant programs should support the implementation of safe practices and/or mandate safe practices as an eligibility requirement.

11. National standards for emergency response policies and procedures should be developed and championed.

12. National protocols for response to violent incidents should be developed and championed.

13. Firefighters and their families must have access to counseling and psychological support.

14. Public education must receive more resources and be championed as a critical fire and life safety program.

15. Advocacy must be strengthened for the enforcement of codes and the installation of home fire sprinklers.

16. Safety must be a primary consideration in the design of apparatus and equipment.

National Fallen Firefighters Foundation

Congress created the National Fallen Firefighters Foundation (NFFF) to lead a nationwide effort to honor America's fallen firefighters and provide resources to assist their survivors in rebuilding their lives. Since 1992, the non-profit Foundation has developed and expanded programs to fulfill that mandate. The Foundation's new emphasis on preventing line-of-duty deaths is a natural extension of those efforts, which are directed equally toward all firefighters and involve no other mission or constituency.

When Congress established the NFFF, it provided neither funding nor financial assistance to carry out its mission. However, since 1992, the non-profit Foundation has developed and expanded programs that fulfill that mandate:

Sponsor the annual National Fallen Firefighters Memorial Weekend

Each October, the Foundation sponsors the official national tribute to all firefighters who died in the line of duty during the previous year. Thousands attend the weekend activities held at the National Fire Academy in Emmitsburg, Maryland. The Weekend features special programs for survivors and coworkers along with moving public ceremonies.

Help survivors attend the Weekend

The Foundation provides travel, lodging, and meals for immediate survivors of fallen firefighters being honored. This allows survivors to participate in Family Day sessions conducted by trained grief counselors and in the private and public tributes.

Offer support programs for survivors

When a firefighter dies in the line of duty, the Foundation provides survivors with a place to turn. Families receive emotional assistance through a Fire Service Survivors Network, which matches survivors with similar experiences and circumstances. Families receive a quarterly newsletter and specialized grief publications. Our Web site provides extensive information on survivor benefits, Foundation programs, and other resources.

Award scholarships to fire service survivors

Spouses, children, and stepchildren of fallen firefighters are eligible for scholarship assistance for education and job training costs.

Help departments deal with line-of-duty deaths

Under a Department of Justice grant, the Foundation offers training to help fire departments handle a line-of-duty death. Departments receive extensive pre-incident planning support. Immediately after a death, a Chief-to-Chief Network provides technical assistance and personal support to help the department and the family.

Work to prevent line-of-duty deaths

With the support of fire and life safety organizations, the Foundation has launched a major initiative to reduce firefighter deaths. The goal of the Firefighter Life Safety Initiatives Program is to reduce line-of-duty firefighter deaths by 25 percent in 5 years and 50% within 10 years.

Create a National Memorial Park

The Foundation is expanding the national memorial site in Emmitsburg, Maryland, to create the first permanent national park honoring all firefighters. The park includes a brick *Walk of Honor* that connects the Memorial Chapel and the official national monument.