

Report of the 2nd National Fire Service Research Agenda Symposium
May 20-22, 2011
National Fire Academy

The National Fire Service Research Agenda is an effort to identify particular areas in which research is needed to contribute to the mission of supporting the Firefighter Life Safety Initiatives of the Everyone Goes Home Program® (NFFF). The resulting document is intended to assist the many different organizations and individuals that have a role in conducting, supporting and encouraging research projects to focus their efforts and resources on the areas that have been identified as important and significant by a group that represents the diverse interests and priorities of the fire service—all with the overarching goal of eliminating preventable firefighter line-of-duty-injuries and fatalities.

There are probably thousands of potential research projects that could produce results that would be significant to the fire service in one way or another, and the range of ideas that have been proposed or considered for research projects is probably even larger. The individuals and organizations that have different roles and responsibilities related to research efforts are faced with the challenge of determining which of those subject areas and which particular projects should be addressed with the limited resources that are available.

The inherent diversity of the nation's fire service and the broad range of subject areas that could potentially contribute to different aspects of the overall mission of firefighter safety make the development of a consensus listing of priorities an even more ambitious undertaking. While some areas of research may find broad support among different constituencies within the fire service, others topics may be identified as critical by one group and insignificant by others. The process that was employed to develop the Research Agenda is intended to produce a broad consensus from the overall fire service community on the most urgent and the most significant priorities, spanning that wide range of interests.

The Research Agenda document is intended to provide a reference source and a starting point to direct research efforts and funding toward those priorities that have been identified by the fire service. Most of the research efforts that focus on fire service issues are performed by universities, public and private sector research organizations and independent researchers, often working in partnership with fire departments or fire service organizations. Many of these projects are funded through government programs or private foundations. The most significant sources of funding in recent years have been grants and contracts from several different Federal Government agencies and programs, most prominently the Assistance to Firefighters Grants (Fire Act) program that is administered by the Federal Emergency Management Agency. Additional research efforts are pursued by private corporations that offer goods or services to the fire service market.

**Firefighter Life
Safety Initiative #7 -
Create a national
research agenda
and data collection
system that relates
to the Initiatives.**

Coordination among all of these parties is essential to ensure that the research efforts that are pursued are relevant, and to ensure that precious dollars are not wasted on insignificant projects or through duplication of efforts. The return on investments in research is enhanced by ensuring that the process is cumulative and that successive efforts are built upon the results of previous research projects.

The 1st National Fire Service Research Agenda

The first edition of a National Fire Service Research Agenda was produced in June 2005 at a symposium that was conducted by the National Fallen Firefighters Foundation (NFFF), funded by the National Institute of Standards and Technology (NIST) and held at the National Fire Academy (NFA) in Emmitsburg, Maryland. The need for research programs specifically directed toward firefighter health and safety had previously been identified as a priority by the representatives of all of the major fire service organizations who participated in the First Firefighter Life Safety Summit in 2004. The Summit produced the 16 Firefighter Life Safety Initiatives; Initiative #7 directly links the development of a national research agenda and data collection system to firefighter safety.

The individuals who participated in the first National Fire Service Research Agenda Symposium represented fire departments and fire service organizations; research organizations; government agencies that are involved in conducting and funding research; and several related interests. They all participated in an intensive two-day exchange of information, opinions and viewpoints to produce the first consensus listing of fire service research topics and priorities. The results of this meeting were published as a report, entitled the *National Fire Service Research Agenda*.¹ This document, while not representing the research agenda of any single fire service organization, articulated a consensus view of fire service research priorities.

Since 2005, the Research Agenda report has been used extensively by researchers and research funders to both guide and prioritize their efforts. It has proven to be a valuable resource to identify areas of research that would quantifiably improve health and safety outcomes for firefighters and the citizens they serve as well as ensure that the limited available resources are directed toward the projects that are most likely to produce valuable outcomes.

The 2nd National Fire Service Research Agenda

The Second National Fire Service Research Agenda Symposium was conducted on May 20 -22, 2011 and was also hosted by NFFF at the NFA campus in Emmitsburg, MD. The project was funded by the National Fallen Firefighters Foundation. The purpose of the second Symposium was to produce an updated edition of the Research Agenda, based on current relevancy, as a guide for future research efforts. Following the model that had been established six years earlier, more than 70 individuals, representing a diverse range of interests participated in the 2011 Symposium.

The participants (who represented 55 different organizations) were asked to self-determine where they would best be able to lend the greatest expertise and guidance, selecting among seven different

¹ The first report can be found on the EveryoneGoesHome.com website.

discussion groups². Each group was assigned a range of subject matter as their primary area to focus upon; however, it was recognized that the individual domains were broad and the boundaries could not be precisely defined. The groups were encouraged to approach their task with a broad perspective and to seek broad consensus as opposed to narrowly defined priorities. Each group produced a set of recommendations that were reported back to the full assembly for further discussion.

The research areas and the facilitators assigned to each research domain are listed below. The facilitators were chosen based upon their reputations as leaders in their respective areas. They provided leadership for discussion within their groups, and wrote the reports contained herein. Kevin Roche of the Phoenix Fire Department was the general facilitator.

- Community Risk Reduction (Vickie Pritchett, Shane Ray)
- Wildland Firefighting (Stan Gibson, Nelson Bryner)
- Data Collection (Lori Moore-Merrell, DrPH)
- Technology & Fire Service Science (Gavin Horn, PhD, Daniel Madrzykowski)
- Firefighter Health and Wellness (Murrey Loflin, Sara Jahnke, PhD)
- Emergency Service Delivery (Christopher Naum, Victor Stagnaro)
- Tools and Equipment (Bruce Varner, Robert Tutterow)



² Appendix A contains the names of all participants and their respective organizations.

Process

The opening session on Friday evening, May 20th provided an orientation for the participants, including an overview of the first National Fire Service Research Agenda Symposium that was conducted in 2005. The participants had all previously received copies of the first report and were invited to comment on the changes that had occurred and the advances that had been realized over the six year period since it was produced.

The opening session included a presentation by Margaret Wilson, Section Chief for FEMA's Assistance to Firefighters Grants (Fire Act) programs, who reviewed the Department of Homeland Security research grant awards process and described how the recommendations from the 2005 symposium had been used as a key reference in determining which projects would receive grant funds.

The program on Saturday May 21st began with presentations by three current AFG grant-holders who reviewed their research projects and discussed their experiences, particularly the process of determining where to direct their efforts. The remainder of Saturday was devoted to work group sessions with the designated facilitators. Each group was assigned a range of topics to discuss and to identify specific research needs and priorities. Several participants noted that the information that had been provided by the three grant recipients was helpful in framing their recommendations. At the end of the day, the participants were invited to spend one hour exchanging information with any other group in which they had a particular interest or a recommendation.

The Symposium planning team asked each group to develop a maximum of ten recommendations for presentation to the plenary session on Sunday morning. The groups were also asked to keep their recommendations broad enough so they could be approached from a number of research perspectives and to include the rationale for recommending those particular subjects as research priorities. This proved to be an efficient process reflecting the high level of expertise represented in each group.

The Sunday session began with a discussion of grant programs and funding sources, led by AFG Branch Chief Cathie Patterson. The recommendations of the seven discussion groups were then presented by the respective facilitators for discussion by the full assembly. All of the 41 recommendations that were presented to the plenary session are included in the 2011 Research Agenda report.

This 2011 edition incorporates one significant departure from the 2005 Research Agenda report; the overall ranking of projects on a Priority 1-2-3 scale was omitted and only the priorities established within the individual discussion groups are included. This decision reflects a consensus of the assembled participants that it is extremely difficult and probably unrealistic to apply this type of prioritization process across such a wide range of subject areas.

There was also concern that a 1-2-3 prioritization might encourage researchers and funding organizations to limit their attention to only the highest priorities and thus to overlook the lower ranked topics. The participants wanted to emphasize that all of the identified projects merit attention and

should be considered on their own merits. After considerable discussion the group voted to set aside the overall 1-2-3 ranking and asked each group identify one project that should be recognized as an immediate concern.

The number one recommendations are:

Community Risk Reduction:

Creation of a community-scale model that evaluates fire prevention and response programs and quantifies their ability to produce a potentially positive outcome. This may include (but is not limited to) data pertaining to: occupancy types and numbers of each, fire prevention, codes adoption, mitigation, response, and recovery.

Wildland:

Development of safe and reliable aircraft operations for suppression and team transportation to reduce wildland firefighting injuries and fatalities.

Data Collection:

Identification of cultural perception of data collection / Identification of barriers to capture of quality data.

Technology and Fire Service Science:

Development of data, implementation of transfer mechanisms and updating of standards that will enable firefighters to learn the science and utilize the technology required to respond to the changing fire conditions in our modern built environment.

Health and Wellness:

Effectiveness of intervention and screening for health and disease related to firefighter wellness and fitness.

Service Delivery:

Development of a scientifically-based community risk assessment tool.

Tools and Equipment:

Assessment of current PPE (entire ensemble) performance, functionality and related safety features for today's fire environment.

Ultimately, the 41 recommendations contained in this report should serve as a roadmap for all researchers and applied scientists who are interested in firefighter safety and survivability. These recommendations must not be limited for use as AFG guidance only, but should serve as a guidance tool for all who seek grants within their various disciplines. It is also hoped that with these recommendations in hand, other potential research sponsors can be identified and successfully petitioned.

Community Risk Reduction

Facilitators:

Chief Shane Ray

Vickie Pritchett

Introduction:

Individuals assigned to the Community Risk Reduction group brought to the table diverse backgrounds and personal experiences. Each member, though, expressed a willingness to challenge the status quo and consider non-traditional means as a way to make our communities safer places for both citizens and emergency responders. The group participated in hours of discussion, centered on reducing community risk through non-typical measures. It was noted repeatedly that there is currently no standard method of evaluating the effectiveness of programs, efforts, models, and risk-reduction practices. Developing such a means of assessment always came to the forefront of group discussions, and was clearly the group's top priority.

Many members felt that the current situation within their agencies prevented them from undertaking such a project. Similarly, limits in available resources also made it difficult to fund other community risk reduction efforts. There was consensus among the members of this section that while guidance of recommendations can be established through this process, prioritization of specific projects should include input from the specific organizations and agencies that have the capacity to address these issues. This will effectively broaden the range of research and will allow more of the recommendations to be addressed.

The group stressed that all risk reduction efforts must take into account the safety of both the community's citizens and its emergency responders. The lives of each member of the community, whether resident or firefighter is important and it will take all stakeholders working in partnership to effectively produce a positive outcome.

The group calls for an increased emphasis on focusing the message in both matching the message to the population at risk, and selecting the right vehicle to deliver that message. As an industry, we must reach beyond the traditional fire, rescue, and emergency medical services, and utilize unexpected messengers and non-traditional partners. It is through this expanded network of collaborative partnerships, working in service to our communities, that our industry will be able to ensure that the Firefighter Life Safety Initiatives of the National Fallen Firefighters Foundation are fully implemented. While the fire service will naturally never downplay its response capabilities, as stakeholders improve our risk reduction efforts we will effectively be transitioning the fire, rescue, and emergency medical services from a reactive position to a more proactive position in addressing the dangers of fire in our communities.

Community Risk Reduction

Recommendation 1.0

Issue: Creation of a community-scale risk reduction model that evaluates fire prevention and response programs and quantifies their ability to produce a potentially positive outcome. This may include (but is not limited to) data pertaining to: occupancy types and numbers of each, fire prevention, codes adoption, mitigation, response and recovery.

Need: There is a clear need to develop a scientifically-based tool for evaluating the effectiveness of fire prevention and community risk reduction programs. A community risk-reduction matrix should be compiled to determine which programs will be most effective based upon population, density, demographics, available resources, and other community characteristics. This matrix must also include cost/benefit analysis, and potential community return on investment. A systematic approach to development of this community fire risk analysis tool will take into account the following components:

- Occupancy types, building materials and occupant capacity: types of occupancy and their overall occupancy load (capacity) are one of the most important elements of a risk matrix. This information will enable fire departments to set up response capabilities prior to the event, and to assess appropriate response by matching deployment of resources to potential risk events. This match is essentially the basis of firefighter safety on the fireground. For example, when too few resources are sent, or they are sent too late, firefighters are behind the game when they arrive. During a fire, risk escalation is exponential; adequate preparatory information will better prepare firefighters to make better risk assessment decisions earlier.
- Fire Prevention efforts: (define fire prevention comprehensively) Research with metrics (example, smoke alarm installation with occupant education versus without, etc.)
- Response capabilities: Research with metrics (example, delivery of water to the fire)

Data from the community risk and response metrics can then be utilized to create an overall model.

Background: The group combined *Designing a Strategic Response Model based on Known Community Risks* and *Developing a Scientifically Based Community Risk Assessment Tool* from the 2005 National Fire Service Research Agenda Symposium.

Comments: The goal of the group is to support research that identifies measurable variables in prevention and response, which can then be utilized to develop a model for overall community risk and deployment of emergency services. The fire service should build upon existing research and best practices, and utilize input from all stakeholders to determine a decision-making model for the fire service and community leaders.

Who is already involved in the issue and who should become involved in the effort? NIST, IAFF, IAFC and NFPA.

NFFF Life Safety Initiative Numbers: 1, 2, 3, 4, 11, 14, 15

Community Risk Reduction Number 2.0

Issue: Testing to determine the effectiveness of messages on targeted behavior change as well as assessing and promoting best practices in disseminating focused fire prevention messages

Need: The group discussed the need for the following items in relation to this issue:

- What difference does it make if the public does a home fire drill, and should we be asking the public to do something our own personnel won't do?
- How do we measure the public's perception of fire risk?
- How do we find the unifying theme for prevention efforts, and what is the best way to communicate it?
- How do we get people to take proactive approach to their safety?
- What public health research currently exists in the public health domain that could be utilized to predict behavior?
- How do we measure billboard effectiveness?
- What are best teachable moments? (i.e. after the fire?)
- How do we test the effectiveness of specific messages?
- How do we utilize the burn community and the "unexpected messenger?"

Research must take into account the existence of unique cultural barriers to community acceptance, and assess efforts to reach the most vulnerable and often most difficult to reach populations. It was also noted that fire play extending beyond adolescence should be assessed, and appropriate intervention techniques, including social media, must be identified.

Background: Because FEMA's Fire Prevention & Safety grants are only funded for one year at a time, it is often impossible to evaluate the programs during the period of the grant.

Comments: As public safety providers, we must understand our audience and particularly high risk groups, and identify specific ways to influence behavior that leads to improved fire safety in their environment. Some research does exist, including a smoke alarm study in Oklahoma, the work of Vision 20/20. Fire 2020 has also worked with fire prevention based on the culture of the community.

There is also a need to work on coordinating current research and applied efforts.

Who is already involved in the issue and who should become involved in the effort? Vision 20/20, Fire 2020 and the Phoenix Society for Burn Survivors.

NFFF Life Safety Initiative Number: 14

Community Risk Reduction Number 3.0

Issue: Improving citizen and firefighter safety through building and fire code adoption, including the evaluation of impact of local and state codes on citizen and firefighter safety and property loss

Need: Tools should be developed to quantify the impact of building and fire code adoption in the community. Factors that should be evaluated include:

- Evaluation of firefighter line-of-duty deaths and injuries in relation to building age and code compliance.
- Evaluation of firefighter on-scene risk management techniques. These must be based on science (including ISO community risk data, codes and building markings, and multidisciplinary data). There is also a need to establish better communications between firefighters and fire protection engineers, architects, etc.
- Evaluation of low-probability, high-consequence events, such as the collapse of the World Trade Center towers and The Station nightclub fire. Are the needed mitigation capabilities prepared?
- Determination of the long-term consequences of political decisions to reduce the level of codes implemented in the community.

Background: The group built on recommendations made during the first National Fire Service Research Agenda Symposium by amending them to reflect the current political climate. Across the country, cost-cutting measures are being enacted to reduce fire department resources and delay or limit current code adoptions. These decisions, made purely for economic reasons, will ultimately increase risk to the community and to firefighters.

Comments: Utilization of partnerships between entities such as fire service organizations, building officials, burn survivors, burn centers, insurance companies, etc. has been a successful strategy in improving the built environment through the adoption of codes. Advocacy by firefighters and fire service organizations is an important tool to encourage the adoption of local and state fire codes by communities; it is also critical that they participate in the national code development process.

During group discussions, the possibility of mining existing NIOSH data was explored. From this data, it could be theoretically possible to establish correlation between citizen and firefighter injuries and deaths with the building where the fire took place, and its compliance with codes. Discussion also covered events that the community may not be equipped to adequately respond to, and what are the impacts of that lack of preparedness.

Who is already involved in the issue and who should become involved in the effort? ICC, NFPA, IAFC, IAFF, ISO, CFAI, ASTM and the Phoenix Society for Burn Survivors.

NFFF Life Safety Initiative Numbers: 15

Community Risk Reduction Number 4.0

Issue: Development of a systematic process for the evaluation of the effectiveness of community risk-reduction programs

Need: There is currently no standard tool or metrics available to evaluate the effectiveness of community risk reduction programs in terms of their message and its impact on the intended audience. Community decision makers need the capacity to compare and evaluate similar risk reduction models based upon their relative effectiveness in communities with similar risk profiles.

Four factors should be included in this analysis:

- Community risk reduction
- Firefighter safety
- EMS Safety
- Property loss

Background: FEMA's Fire Prevention & Safety grants have funded hundreds of millions of dollars to communities and organizations across the country to develop and implement Community Risk Reduction programs. However, there is currently no means of scientifically evaluating their effectiveness. In 2005, attendees at the National Fire Service Research Agenda Symposium identified two critical issues in relation to the determination of target audiences and the evaluation of public education programs. At the 2nd National Fire Service Research Agenda Symposium, group members expanded upon these issues, and determined that a baseline of metrics was needed to evaluate these programs.

Comments: Target audiences exist in every community and many variations of risk-reduction programs have been developed to address the needs of these diverse audiences. However, selecting the right program to fit the needs of the community remains challenging. Decision-makers need clear metrics to determine which programs will have impact; what programs will require continued maintenance; whether or not the local fire department is capable of delivering the program and maintaining it; and if there other community partners which have the capacity to deliver these programs. Research is also needed to assess the role of social media in disseminating community risk reduction information and programming.

Who is already involved in the issue and who should become involved in the effort? AFG awardees and national organizations currently evaluating risk-reduction programs, US Congress and CFSI.

NFFF Life Safety Initiative Numbers: 14, 15

Community Risk Reduction Number 5.0

Issue: Creation of on-scene risk management tools for company officers and incident commanders

Need: There is a demonstrated need for tools to assist company officers and the incident commander with risk assessments. These tools will guide and support development and implementation of the incident action plan and will promote preplan efforts in every fire department.

Background: Company officers and incident commanders need scientifically-based information to conduct initial assessments of the situation, and to make real-time decisions as the fire event evolves. New technologies can improve situational awareness by aggregating and analyzing incident characteristics (including both fire and personnel evaluation) to support on-scene decision-making which will keep firefighters engaged in risk-appropriate tactics, and reinforce fire officers' decisions to limit risk when that is the most appropriate course of action.

Comments: The Community Risk Reduction section discussed the need for a comprehensive tool that would enable Incident Commanders to make safe, evidence-informed decisions on the fire ground. Pre-determined values such as building technology, pre-incident plan, adopted codes, etc., could be established, and augmented during the incident by initial size-up of the situation, determination of available resources, and commander observations. This tool would then assist fire officers to determine the appropriate course of action, beginning with initial fire ground deployment and through all subsequent resource deployment decisions. Such a tool MUST include a prerequisite for users that includes the completion and uploading of a preplan on every building in a community.

Who is already involved in the issue and who should become involved in the effort? DHS, NIST, IAFF, IAFC, UL, NIOSH, ISFSI and fire service industry associations.

NFFF Life Safety Initiative Numbers: 1, 3, 4, 8

Wildland Firefighting

Facilitators:

Chief Stan Gibson

Nelson Bryner

Introduction:

At the 2nd National Fire Service Research Agenda Symposium, the research needs for all aspects of wildland firefighting were identified, and prioritized according to the ability of research to potentially reduce fatalities and injuries of wildland firefighters. A comprehensive outline of possible research issues relevant to wildland firefighter safety had been developed by the facilitators and was used to initiate group discussion. Research topic areas included firefighter fatalities, privatization, equipment, fire behavior, tactics, health and wellness, and wildland-urban interface issues.

The group broke wildland firefighter fatalities down into aircraft operations and ground operations. Between 2005 and 2009, 94 firefighter fatalities or 20% of total firefighter fatalities were related to wildland operations. Air operations, including suppression and fire team transportation, resulted in 36 fatalities or 40% of the total wildland fatalities. The need for updating the aging aircraft, adequate maintenance, and safe air operations was discussed. Ground operations such as suppression and firebreak creation were discussed in the context of fire behavior and tactics. As another component of ground operations, motor vehicle accidents were discussed briefly, and did not appear to be as significant a contributor to fatalities as air operations.

The use of private companies, or privatization of wildland firefighting, was discussed extensively. Important issues that the group identified included determining the level of effectiveness, establishing the necessary level of oversight, providing adequate training, and documentation and monitoring of training through a credentialing process. It was unclear whether injury and fatality data for private fire service providers was available at the same levels as for municipal, state, and Federal fire service agencies. The lack of data on privatization prevented the group from understanding if there is indeed a problem, and whether or not it is a significant issue.

Equipment discussions included respiratory protection, communications, interoperability, and locator/tracking technology. The use of structural firefighting gear for wildland firefighting operations was also discussed. Additional research on quantifying the respiratory hazard for both smoke and particulates is critical to assessing respiratory protection needs for wildland firefighters. Discussion of measures needed to protect the individual firefighter from smoke broadened into a discussion about the necessity to understand the exposure and protection of communities downwind from the fire.

Tactics and fire behavior research needs were interdependent and discussed together. Research for improving tactics requires having quality data and an understanding of fire behavior in order to make informed operational decisions. Understanding conditions that are conducive to burnover or using fire spread models to predict burnover were identified as critical steps toward preventing associated

fatalities. Additional research needs for tactics included simulation training, wildland/urban interface vs. wildland operations, professional development and predicting fire line effectiveness.

Health and wellness research needs included characterizing the chemical and thermal environment that firefighters are typically exposed to during operations. It is important to understand the acute and chronic exposures experienced by firefighters, as well as those of residents in communities near an incident. The group viewed the issue of smoke migration into communities as important, but determined it to be an issue for local public health authorities since it was unlikely to impact firefighter fatalities or injuries. In terms of data, it was unclear whether line of duty deaths and injuries data from US Forest Service, Bureau of Land Management, California Department of Forestry, and private companies is currently being collected in a standardized format or is readily available. The group prioritized the collection of data in a standardized format and incorporating that data into a central database that would be accessible to firefighters, local, state, and Federal agencies, private companies and the public.

Wildland-urban interface fire research needs centered around the adoption and enforcement of building and fire codes. Lack of scientific understanding and an inability to demonstrate the effectiveness of building and fire codes has thus far made it difficult for communities to adopt and enforce current wildland-interface fire codes and standards. It was noted that currently available data does not demonstrate that these fires are a major source of firefighter fatalities. Although not discussed extensively, additional research into characterizing the exposure to wildland fire, the ignition of and fire spread within communities is critical to improving the safety of firefighters and reducing community losses.

The group focused specifically on research related directly to wildland firefighter fatalities and injuries. Research areas where current statistics demonstrates a clear link to firefighter fatalities/injuries were ranked higher than areas where either data were lacking or available data were less conclusive. The collection of non-standardized data and the lack of data from all agencies and private companies crosscut many of the research areas described above. As a result the need for quality data was combined into a single research area and ranked as one of the top five needs for wildland firefighting. Several important research needs for public safety, such as community health effects due to smoke exposure or wildland-urban interface codes, were ranked lower because these areas did not demonstrate a clear link to reducing firefighter fatalities and injuries. However, these areas are still important research priorities for reducing fatalities, injuries, and losses resulting from wildland fires.

Wildland Firefighting Number 1.0

Issue: Safe and reliable aircraft operations for suppression and team transportation

Need: There is a demonstrated need to study the impact of the aging, replacement, and maintenance of the air operations fleet, in order to increase the safety of firefighters and ensure the availability of reliable aircraft resources.

Background: Between 2005 and 2009, 95 firefighter fatalities or 20% of the nation's total firefighter line-of-duty deaths were related to wildland operations. Air operations, including suppression and fire team transportation, resulted in 36 deaths or 40% of the total wildland fatalities.

Comments: The group was surprised that wildland firefighter fatalities *consistently* constituted 20% of the nation's total firefighter fatalities.

Who is already involved in the issue and who should become involved in the effort? The wildland firefighting community and private and public providers of wildland fire suppression services are currently involved. This issue also requires the involvement of the Federal Aviation Administration.

NFFF Life Safety Initiative Numbers: 3, 8, 9, 16

Wildland Firefighting Number 2.0

Issue: The unknown respiratory hazards and effects of smoke exposure for wildland firefighters

Need: To identify the composition and threshold limit values of smoke and particulates that are potentially hazardous during wildland fire operations.

Background: There is currently no standard for wildland respiratory protection. A recent publication from Missoula identified the presence in wildland smoke of potential hazardous components, including isocyanic acid.

Comments: More information must be determined about the hazards represented by smoke. Undoubtedly there are harmful chemicals in smoke from a wildland fire, but it is not clear to what extent this poses a potential hazard to firefighters. It is also not evident what conditions raise exposure to the level of a significant hazard. Bandanas are probably not optimal respiratory protection for wildland firefighters.

Who is already involved in the issue and who should become involved in the effort? NIOSH, National Personal Protection Technology Lab (NPPTL) and the National Wildland Coordination Group (NWCG).

NFFF Life Safety Initiative Numbers: 1, 5, 8, 11, 16

Wildland Firefighting Number 3.0

Issue: The lack of standardized data and a central database for fatalities and injuries that occur during wildland firefighting

Need: Data and a database for assimilating this information are needed to characterize the safety and cost effectiveness of public and private providers of wildland firefighting services, and to identify gaps and trending of fatalities and injuries in the wildland community.

Background: Recent fatality statistics demonstrate the need to conduct additional research into the number and types of wildland fatalities, and to organize the resulting data.

Comments: It appears that a disproportionate number of fire fighter fatalities appear to be related to the use of private resources. Without sound data, it is unclear as to whether or not private fire service providers meet the same qualifications as public services.

Who is already involved in the issue and who should become involved in the effort? USFA, NFIRS and workers' compensation insurance providers should be involved.

NFFF Life Safety Initiative Numbers: 5, 7, 11

Wildland Firefighting Number 4.0

Issue: An understanding of level of threat represented by changing conditions, and early detection of those conditions that can transition to burnover

Need: Development of detection and alert/warning technology that has the capability to quantify level of threat of rapidly changing conditions or transitions that could lead to burnover. This must include identification of crew members who are at risk of potential harm in such an incident.

Background: A significant number of fatalities have been identified as due to a lack of understanding of fire behavior or rapidly changing conditions that lead to burnover.

Comments: Upper level incident management already has tools, such a Campbell Prediction Model, that can identify conditions, but firefighters themselves are not currently able to identify changing conditions. This could possibly a training issue, or a situation in which a firefighter may be distracted and not be aware of pre-burnover conditions. Ideally this is handled by the incident management team, but when there is a breakdown in communications, there is no back up at the crew level. This would be analogous to a flashover predictor for structural firefighters.

Who is already involved in the issue and who should become involved in the effort? NIOSH, NFPA, US Forest Service, Bureau of Land Management and NWCG.

NFFF Life Safety Initiative Numbers: 3, 5, 8

Wildland Firefighting Number 5.0

Issue: Wildland firefighting research dissemination

Need: The lack of central clearinghouse for wildland fire research limits the dissemination of research results.

Background: Stakeholders feel that there is a lot of research out there that may impact wildland firefighter safety and effectiveness, but don't know how to access it.

Comments: Fire service and researchers don't know what has been done, or is being done in terms of wildland firefighting research.

Who is already involved in the issue and who should become involved in the effort: The US Forest Service, Bureau of Land Management, NIST, NWCG, Fire and Aviation Management under USFS are involved.

NFFF Life Safety Initiative Number: 7

Data Collection

Facilitator: Lori Moore-Merrell, Dr.PH.

The lack of a systematic, coordinated process for collecting, organizing and disseminating data is a pervasive issue through all domains of fire service research. While the industry expends substantial efforts in data collection, the lack of coordination has handicapped local, state, and national fire service organizations which could otherwise utilize this data to justify and validate decisions and expenditures that would prioritize firefighter health and safety.

The Data Collection Working Group at the 2nd National Fire Service Research Agenda Symposium identified three areas of research as priorities. First, research must be conducted to determine the cultural barriers to data collection and the factors that prevent the capture of quality data by the fire service. It is clear to all parties involved that until we are able to educate our stakeholders as to the value of data and reduce or eliminate complacency toward data in the fire service, we will never be able to “tell our story” accurately and effectively, regardless of the actual topic of research.

Secondly, there is a need to identify and describe the data needs in the fire service, and to standardize definitions and methodologies for data collection. Development of a consistent data entry system that is intuitive, user-friendly, lessens the burden during entry, encourages greater participation and ensures integrated quality control must be prioritized. By taking advantage of current technology, and providing adequate training in its use, an intuitive data collection application can be developed that will facilitate real time entry as well as provide timely and accurate reporting.

Lastly, there is a need to create synergy between existing relevant databases while eliminating duplication of effort in research and operations. There are currently numerous databases that exist as a result of individual and group efforts. Compiling a description of the elements contained in these databases and making this compilation accessible to all interested parties would benefit those involved in all domains of fire service research. Such a catalog would also serve to validate previous research, provide cost savings for additional research, and facilitate overall efficacy in future research endeavors.

Ultimately, the prioritization of these Data Collection initiatives will benefit every level of fire service organization. Quality data is needed to provide justification for and validation of decisions and expenditure at the local, state, and national levels; to inform fire service standard setting; to inform code development; and to quantify and qualify fire service issues including resource deployment, scene operations, and firefighter health and safety. In these difficult economic times, fire service leaders at all levels are under significant pressure to justify budgets and programs with empirical cost-benefit data. While there is currently significant anecdotal evidence available, it is our responsibility, as an industry, to make available empirical data based upon scientific research that will demonstrate the impact of all financial decisions, particularly those affecting firefighter safety.

Data Collection

Number 1.0

Issue: Identification of cultural perceptions of data collection / identification of barriers to quality data capture

Need: Identify barriers to quality data including culture, commitment, leadership, motivation, training, value, accountability. Develop strategies to overcome the negative perception and barriers.

Background: The fire service expends substantial efforts in data collection with varied results in the ability to inform critical decisions. Contributing to these variations is the lack of education, understanding, motivation, leadership and commitment by individual firefighters, officers and departments. For example, following a fire event, incident data is entered by most fire departments in the U.S. These data however do not inform data users of actual fire ground operations including “water on fire time”, “time to ventilation” etc. For the departments that do measure these factors, they are not consistent in definition. In addition, we not only don’t use consistent definitions, but it is also not clear that we are actually measuring the critical factors. There must be discussion and clarification on exactly what data should be collected.

Comments: Until we address the lack of education regarding the value of data and also the complacency toward data in the fire service, we will never be able to “tell our story” accurately and effectively, regardless of the actual topic of research. Additionally, we are at risk of conducting research that does not solve a problem because the problem was not accurately identified with data.

Who is already involved in the issue and who should become involved in the effort? Currently involved are fire service data users and data collectors, including UFSA/NFIRS, NFPA, CDC, IAFF, IAFC, NIST, CFAI and academic institutions.

Parties that should be involved are person(s) with technical expertise, and a person or agency external to the fire service and experienced in finding a solution to the quality data problem.

NFFF Life Safety Initiative Numbers: 1, 7

Data Collection

Number 2.0

Issue: Development of an intuitive data collection system prototype, including standardized data elements, definitions, metrics, and reports (analogous to TurboTax)

Need: There is a need for a consistent data entry system that is intuitive, user friendly, lessens the burden during entry, encourages greater participation and ensures integrated quality control. There is also a need to identify and describe the absolute data NEEDS in the fire service. “Nice to know” information should be honed and eliminated.

Existing programs are time consuming, cumbersome and not user-friendly. These programs encourage shortcuts and frustrate data entry. Additionally, there is limited official training that perpetuates peer-to-peer mistakes and shortcuts.

We must remove the technical barriers to data entry. By taking advantage of current technology, an intuitive data collection application can be developed to facilitate real time entry as well as timely and accurate reporting.

Background: Quality data are necessary to inform decisions, including: the justification and validation of decisions and expenditure at the local, state, and national levels; establishment of fire service standard setting; code development; and the quantification and qualification of fire service issues including resource deployment, scene operations, and firefighter health and safety.

Additionally, quality data are needed to inform, advise and guide regulatory, legislative and funding decisions related to the fire service.

Finally, quality data are necessary to identify trends to evaluate decisions and solutions---- identify a problem, formulate a solution, implement the solution, and measure effectiveness.

Comments: Who is already involved in the issue and who should become involved in the effort?

Currently Involved: data users and collectors, including UFSA/NFIRS, CDC, IAFF, IAFC, NIST, CFAI, NFPA and academic institutions.

Should be involved: Required technical expertise, a person or agency external to the fire service and experienced in finding a solution to the quality data problem,

NFFF Life Safety Initiative Numbers: 7, 8

Data Collection

Number 3.0

Issue: Identify and catalog data sources and data technology formats beneficial to the fire service

Need: There is a need to create synergy between relevant data that exists while eliminating duplication of effort in research and operations. Investigate linkages between the databases (domestic and international) identified, including all research databases created through AFG funded research.

Background: There is a multiplicity of databases that exist as a result of individual and group efforts. A compilation of description and detailed information of the elements contained in these databases would be beneficial to enhancing research efforts including meta-analysis.

Such a catalog would also benefit the validation of previous research, provide cost savings for additional research, and facilitate overall efficacy in future research.

Comments: Efforts to create the intended catalog should consider long term maintenance (update) and sustainability of the project.

Who is already involved in the issue and who should become involved in the effort? NIST, IAFF, IAFC, CFAI, academic institutions, standards-developing organizations, USFA, AFG program and Fire Protection Research Foundation.

NFFF Life Safety Initiative Number: 7

Technology & Fire Service Science

Facilitators:

Gavin Horn, Ph.D.

Daniel Madrzykowski

Introduction:

The technology and science related issues facing the fire service are broad and deep, touching on each of the subject areas covered in the 2nd National Fire Service Research Agenda Symposium. As a group, members focused their recommendations on assembling data, implementing transfer mechanisms and updating standards that will enable firefighters to learn the science and understand the technology required to respond to changing fire conditions in our built environment.

This scientific understanding will also aid firefighters, fire officers, and fire service organizations in recognizing and addressing future hazards. While the number of fires continues to decline, the firefighters' working environment has changed dramatically. Fuel loads have increased, fire behavior in structures and vehicles has changed, and building construction has in many cases optimized the conditions for rapid changes in fire growth and deterioration of the structural integrity of the building. Therefore it is critical that, as an industry, we train and educate our firefighters pertaining to the threats that they face in the modern environment.

To do so, we must study the root causes of all fireground injuries, fatalities and close calls that can be attributed to fire dynamics and building construction factors, in order to identify the areas of high risk. Based on scientific research results, standard best practices for firefighting operations must be identified and disseminated. In order to implement these best practices quickly and inexpensively across the nation, multi-media training and educational materials that can be used with a variety of delivery mechanisms (including blended learning approaches) must be developed. It is equally critical that the fire service stay ahead of evolving building technology, especially in the areas of "green buildings" and alternative energy sources. As an industry, we must understand how these changes may affect both current and future fireground operations. This can be accomplished by continued scientific investigations of the impact of fire on new building technologies as they are developed, as well as by maintaining open lines of communication between the fire service and those who are designing the next generation of buildings and installed systems, such as architects, structural engineers and fire protection engineers.

Once all of this information has been gathered and/or generated, it is critical to "get the science to the streets." Thus far, there has been minimal research conducted to determine the best way to deliver science-based training and educational materials to the diverse fire service audiences throughout the country. An improved understanding of the science of firefighting, along with the development of modern technologies which the fire service must both embrace and utilize in operations, is critical to reducing the risk of firefighter line-of-duty injuries and fatalities, as well as reducing the costs of fire in lives and property to the citizens of the United States.

Technology and Science Number 1.0

Issue: Identify and disseminate standard best practices for structural firefighting operations based on science

Need: The dynamics of fire growth that are often encountered in modern structures have changed from that which was traditionally taught. As a result, traditional firefighting operations may be less effective than expected, potentially increasing risk to firefighters, and may even cause undesirable changes in fire behavior. Fire service operations are often structured around fuel packages and building construction, and may not account for thermal and chemical environments in current structures. To provide an appropriate response, we must improve the current scientific understanding of the tools and technology that are currently in our response cache. Research is needed to quantify these environments, and to determine their impact on PPE, firefighter electronic safety equipment, operations and resources. There is a need for scientific studies to produce data, videos and photos that can be integrated into training curricula to impart an improved understanding of the fundamentals of basic fireground operations (including suppression, ventilation, search, overhaul, etc.) in the current working environment.

Background: Existing education and training materials for firefighters tend to be based on anecdotal evidence and tradition, as opposed to rigorous scientific study. Data that is needed to develop a valid risk assessment model for occupant viability, structural viability, impact of exterior/interior attack (penetration nozzles, CAFS, stream application, transitional attack), effectiveness of vertical ventilation and/or PPA are insufficient or lacking. Information is also needed to support the development of individual fire department tactics based on local operational realities, yet rooted in solid scientific evidence. Dissemination of identified best practices must be made to curriculum and training outlets: publishers, state and local training directors, academies, department training officers and standards-making committees.

Who is already involved in the issue and who should become involved in the effort? USFA, publishers, media, training officers, ISFSI, NAFTD, IAFF, IAFC, NVFC, FDSOA, NIST, UL and other national research laboratories.

NFFF Life Safety Initiative Numbers: 1, 3, 5, 7, 10, 11

Technology and Science Number 2.0

Issue: Impact of evolving building technology on current fire service operations

Need: Current technology is changing rapidly, as demonstrated by the expansive development and construction of “green” buildings, performance-based design, new construction materials and techniques, use of alternative energy sources, high heat release-rate furnishings, etc. Firefighting operations must evolve in tandem with these new technologies, and be based on scientific understanding of these factors and their combined impact on the fire environment. These issues should be approached as a complete system, or coordinated ‘attack’ based on environmental factors as well as the capacity of the response agency. Because structures and contents are constantly changing, new information must be included in all levels of fire service training and education. This should include scientific studies and development of data, video, and photos that can help firefighters to develop an improved understanding of changes to their working environment.

Background: There are multiple new and developing building technologies that must be addressed when making risk assessment decisions on the fireground, including:

- Increased fuel loads inside and outside structures.
- Tighter construction for improved building efficiency (e.g. ‘greening,’ SIPS, increased insulation requirements).
- Building construction techniques that ‘optimize’ construction materials.
- Green construction techniques such as overhangs that introduce new collapse concerns and limit access to structure.
- Ventilation systems that affect fire development and fire service interventions.
- Green roof systems, such as roof top gardens and photo-voltaic panels/shingles that change roof load and ventilation potential.
- Lack of compartmentalization that may lead to larger fire volume and potential for earlier structural collapse, which may reduce the viability for interior operations.
- Additional external fuel load increases exposure risk for multi-structure fires.
- Alternative energy sources create new fire risks and energized system hazard.
- Fire effluents that affect the toxicity of enclosure environment and global environment, increasing the risk factors during search and the need to maintain PPE integrity throughout operations, and toxicity of fire water runoff.

Who is already involved in the issue and who should become involved in the effort?

Currently, no organization is conducting analysis of a complete structure and contents system. UL has looked at photovoltaic (PV) systems as a structural component, and there has been some study of electric vehicles. Fire service organizations must research fuel load, fire spread, and ventilation concerns of the complete system. Other organizations involved should be: DOE, DOC (NIST), USFA, US Green Building Council, Factory Mutual Global and Insurance Institute for Business & Home Safety (IBHS) Research Center.

NFFF Life Safety Initiative Numbers: 3, 7, 8, 10, 11

Technology and Science Number 3.0

Issue: Identify fire dynamics and building response factors that contribute to fire service injuries and fatalities

Need: Studies are needed to systematically identify and analyze the fire dynamics and building response factors that cause or contribute to fireground injuries and fatalities. These should include detailed epidemiological analysis of individual cases that result in injuries or fatalities, as well as close call situations; statistical analysis of associated data at the local, regional, national and international levels should also be documented.

Background: The number of firefighter injuries and fatalities occurring on the fire ground due to lack of knowledge regarding dynamics and building response factors is a critical and growing concern. Identification of critical factors that result in firefighter deaths and injuries must be conducted in order to design effective mitigation efforts, such as training programs that include new data of structural fire behavior. The scope of this effort should also include examining firefighter fatalities and injuries that occurred prior to the NIOSH Fire Fighter Fatality Investigation and Prevention Program, such as NFPA and USFA reports.

Who is already involved in the issue and who should become involved in the effort? USFA, NFPA, NIST, NIOSH, departments which have suffered a loss and epidemiologists.

NFFF Life Safety Initiative Numbers: 2, 3, 7, 9, 10

Technology and Science

Number 4.0

Issue: Closing the knowledge and communication gaps pertaining to the built environment among all stakeholders

Need: Changes to the built environment are generally driven by architects, structural engineers, environmental, energy and performance-based design concerns, and may result in adverse unintended consequences for the building occupants and firefighters in the event of a fire. Consideration of fire issues may be limited to flame propagation and smoke generation of a limited number of residential building components, and do not consider the building system as a whole, particularly if fire protection engineers are not involved in design and construction.

Background: There is a need for fundamental information examining the fire behavior of a structure as an entire system. Closing this gap would also enable the fire service to take a more proactive approach to new construction materials and trends, prior to their implementation. The fire service and fire protection engineers could provide insight into the potential fire response of the structure that would aid the building design community.

Fire service organizations also need to increase their activities in the building code arena. Building Information Modeling (BIM) should be integrated into fire department pre-plans and standard operating procedures (SOPs).

Who is already involved in the issue and who should become involved in the effort? SFPE, AIA, ASCE, ASHRAE, US Green Building Council, fire marshals, USFA, Building Owners and Managers Association International (BOMA), Fire Service organizations, UL, NIST and other national research laboratories.

NFFF Life Safety Initiative Numbers: 3, 7, 10, 11, 15

Technology and Science Number 5.0

Issue: Transferring science-based fire behavior and operations information to the fireground, also known as “getting the science to the streets”

Need: In the United States, the fire service is a very diverse group, both based on geography and resources, and most fire departments have limited budgets for training and travel.

However, in many cases, the fire dynamics within the built environment have changed considerably from methods that were (and continue to be) traditionally taught. As a result utilizing traditional firefighting operations when involved in a structural fire response may result in undesirable changes in fire behavior that increase risk for both building occupants and firefighters.

In recent years, new studies have provided insight into fire behavior in modern structures. Unfortunately, this information and any new information generated ongoing research studies is reaching only a limited fire service audience, when in fact this information is critical to all fire departments.

Background: It is imperative that the use of different means of technology transfer be examined, including: train-the-trainer workshops at the national level, webinars, DVDs, internet-based training programs, and blended learning models. One of the most critical challenges is encouraging the fire service to engage. Options might include professional development for instructors, officers, and firefighters; re-certification training; additional requirements in NFPA Professional Qualification Standards; and inclusion in Insurance Services Office (ISO) ratings. Equipping firefighters with knowledge of current structural fire behavior is a key factor to increased safety on the fireground.

Who is already involved in the issue and who should become involved in the effort? Publishers, training officers, IAFF, IAFC, ISO, ISFSI, NAFTD, FDSOA, UL, NIST and other national research laboratories.

NFFF Life Safety Initiative Numbers: 1, 3, 5, 7, 10

Health and Wellness

Facilitators:

Murrey E. Loflin

Sara Jahnke, Ph.D.

Introduction:

The Health and Wellness Working Group of the 2nd National Fire Service Research Agenda Symposium consisted of 14 individuals who represented a wide range of experience relating to occupational health, medical research and support, and included both active and retired fire service personnel. The group acknowledged that firefighter health, wellness and fitness are essential to ensuring a safe and healthy workforce. In discussing the current state of research pertaining to firefighter health and wellness, they stressed that the leading cause of line-of-duty fatalities is cardiovascular-related incidents. However, there also were numerous other issues identified that can affect firefighter performance and survivability, including health maintenance programs, physical fitness and exercise programs, behavioral wellness, nutrition, issues relating to substance abuse, and other wellness areas.

In addition to discussing current issues, the Health and Wellness Working Group reviewed recommendations that emanated from the 2005 National Fire Service Research Agenda Symposium. The group identified research that had been completed since that time, and expanded on previous recommendations where a need for further research efforts was indicated.

From these discussions, group members determined the following eight Health and Wellness areas to be priorities for the development of initial research projects, or recommended continuance and/or expansion of current research efforts. Beyond determining an overall top priority, there was no ranking of these issues; participating members felt that each topic was important enough to merit inclusion. As a group, the Health and Wellness Section is very supportive of the process to identify areas of research that support the Firefighter Life Safety Initiatives put forth by the Everyone Goes Home[®] program; members are optimistic that research will be developed to address each one of the following issues.

Health and Wellness

Number 1.0

Issue: Health and disease related to firefighter wellness and fitness

Need: Research is needed to determine the effectiveness of interventions designed to improve nutrition and fitness and disease outcomes. Additional research is needed for evidence-based protocols for advanced medical screening for cardiovascular disease. Additional research also is indicated for medical conditions associated with sudden incapacitation and for return to work decisions.

Background: Considerable research has been conducted and programs implemented addressing basic medical and fitness evaluations. While sub-maximal exercise stress tests are useful for estimating aerobic capacity, symptom limiting (maximal) exercise stress testing should be used for diagnostic and prognostic purposes. In addition to conducting maximal stress tests, the use of advanced non-invasive screening for sub-clinical coronary heart disease (e.g. coronary artery, calcium scoring, etc.) should be evaluated for integration in the fire service and current evaluation tools need to be re-examined. Additional research should also be conducted to address the interplay between fitness, nutrition and wellness as a means of optimizing firefighter performance and health.

Who is already involved in the issue and who should become involved in the effort? NFPA, IAFC, IAFF, NVFC, NIOSH, AFG grantees, iWomen, IABPFF, NAHF and academic institutions.

NFFF Life Safety Initiative Numbers: 2, 6

Health and Wellness

Number 2.0

Issue: Health and disease related to exposures

Need: There is a need for continued research on fire service exposures and their relationship to the cancer, cardiovascular disease, and injuries.

Background: Hazardous inhalation exposures have been well documented in the fire service; however, exposures involving heat stress, dermal contact, and sleep disturbances need further characterization related to health outcomes. To date, most research has focused on catastrophic injuries. The cumulative and chronic effects of recurrent burn and musculoskeletal injuries need to be studied.

Who is already involved in the issue and who should become involved in the effort? NIOSH, NFPA, IAFF, IAFC, NVFC, iWomen, IABPFF, NAHF, DHS's Physiological Health Assessment for Emergency Responders (PHASER), AFG grantees and academic institutions.

NFFF Life Safety Initiative Numbers: 2, 6

Health and Wellness

Number 3.0

Issue: Implementation/transitional research

Need: There is a need for research on barriers to implementation of current best practices in areas such as candidate screening, maintenance of fitness and health, tobacco cessation, and policy and standards implementation (e.g. SCBA, seatbelt use). There is also a demonstrated need to assess the effectiveness of education and training protocols in these areas for candidate and incumbent firefighters. In addition, continued research on effective mechanisms for translating research from other domains to effective use in the fire service is needed.

Background: Much research has been done regarding identifying occupational risk factors and developing prevention programs to enhance firefighter occupational health and safety. Despite this knowledge, many fire departments are unaware of or do not use these prevention initiatives. The laboratory research that has been done for the fire service must be applied in fire service practices and adopted into fire service standards and operations.

Who is already involved in the issue and who should become involved in the effort? IAFF, NFPA, IAFC, NVFC, iWomen, IABPFF, NAHF and academic institutions.

NFFF Life Safety Initiative Numbers: 2, 6, 7

Health and Wellness

Number 4.0

Issue: Tobacco use in the fire service

Need: Research is needed to examine and overcome barriers to implementation and enforcement of tobacco control policies and explore innovative interventions for tobacco cessation to eliminate all forms of tobacco use in the fire service.

Background: The adverse health effects of tobacco use are well documented and unequivocal. Despite this knowledge, some fire departments continue to allow the use of tobacco products. Due to the addictive nature of tobacco and its deleterious effects on health, comprehensive and evidence-based cessation programs need to be offered to firefighters.

Comments: The assembled members of the 2nd National Fire Service Research Agenda Symposium universally endorse a tobacco-free fire service.

Who is already involved in the issue and who should become involved in the effort? IAFF, IAFC, NVFC, iWomen, IABPFF, NAHF and academic institutions.

NFFF Life Safety Initiative Numbers: 1, 2, 6

Health and Wellness

Number 5.0

Issue: Development, implementation, and delivery of firefighter behavioral health

Need: Research is needed to better identify and/or develop evidence-based tools and approaches for behavioral health screening and clinical assessment. Research also is needed to evaluate evidence-supported practices in prevention and treatment for use in the fire service environment and to promote dissemination and adoption.

Background: Behavioral health concerns have strong impacts on the occupational health of the fire service but are frequently given inadequate priority, attention and rigor. Practices lacking empirical support or even contraindicated by solid empirical evidence have been found in common usage while evidence-supported practices and techniques are not always recognized or employed. Consequences such as substance abuse and suicide rates underscore the importance of enhanced research in this domain.

Who is already involved in the issue and who should become involved in the effort? NFFF, IAFC, IAFF, NVFC, iWomen, IABPFF, NAHF, NAEMSP, Federation of Fire Chaplains and academic institutions.

NFFF Life Safety Initiative Numbers: 2, 13

Health and Wellness

Number 6.0

Issue: Hazardous exposures among women firefighters and their unique health outcomes

Need: Research is needed to further characterize occupational risk factors and disease outcomes specific to women firefighters. In particular, focus should be paid to reproductive health, maternal health, cardiovascular risk factors, injuries and cancer.

Background: Knowledge about the occupational health of women in the fire service is extremely limited. In addition, research on the unique impacts of hazardous occupational exposures on women firefighters also is extremely limited including cardiovascular disease, reproductive and maternal health, injuries, cancers, etc.

Who is already involved in the issue and who should become involved in the effort? NIOSH, IAFC, IAFF, NVFC, iWomen and academic institutions.

NFFF Life Safety Initiative Numbers: 2, 6

Health and Wellness

Number 7.0

Issue: Optimization of performance and reducing risk

Need: Continue to explore the physiological responses and its relationship to recovery during and after fire suppression/ventilation activities. Refine the role of incident rehabilitation, functional capacity assessments, and operational risk management practices on performance and reduction of injuries among firefighters.

Background: Previous studies have examined practical strategies for conducting emergency incident rehabilitation. However, gaps in knowledge remain, including optimizing the functional capacity of the firefighter for safe performance during the emergency incident and long term physiological and cognitive recovery following the conclusion of the emergency response.

Risk management programs have been shown to be effective in reducing injuries in both the fire service and other occupational settings. Further research is needed to optimize the implementation of risk management practices.

Who is already involved in the issue and who should become involved in the effort? IAFF, IAFC, NVFC, iWomen, IABPFF, NAHF and academic institutions.

NFFF Life Safety Initiative Numbers: 2, 3, 6

Health and Wellness

Number 8.0

Issue: Cost effectiveness of health and safety systems

Need: Continued research is needed to support occupational health and safety programs in the fire service; to evaluate the cost-effectiveness and efficiency of investing in such programs; and to identify best practices. Further cost/benefit research is needed to address the economic impact by calculating program costs and identifying related improvements in health outcome to determine a more accurate overall return on investment in health and wellness and safety programs.

Background: Wellness and fitness programs have been shown to improve health outcomes. These programs should be implemented regardless of cost because of their positive impact on the health of firefighters and fire officers. However, information about the cost-effectiveness of these programs is limited. This information is important to support in the sustainability, further development and refinement of these programs.

Who is already involved in the issue and who should become involved in the effort? IAFF, IAFC, NVFC, iWomen, IABPFF, NAHF and academic institutions.

NFFF Life Safety Initiative Numbers: 2, 6

Emergency Services Delivery

Facilitators:

Christopher J. Naum

Victor Stagnaro

Introduction:

The importance of Emergency Service Delivery within the context of the national fire service cannot be understated in terms of its relevance, influence and far-reaching impact on communities and their residents. The role of the fire service continues to expand beyond the boundaries of firefighting and fire suppression incidents to include response to emergency medical incidents, hazardous materials incidents, technical rescue situations, aircraft fire and rescue response, terrorist acts and a broad range of emergency events 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, assess and communicate both internally within the department and externally to community leaders the specific risk factors that are present in their community in order to develop emergency response systems that will be able to respond safely, efficiently and effectively to adverse risk events that occur. In addition, there is an identified need for the industry to increase the effectiveness and efficiency of emergency services delivery, with amplified personnel proficiencies and competency integrated with innovative management and administrative, operational and fiscal conveyances. Shifting social, economic and governmental discord, coupled with escalating public opinion and political influence for productivity, value and performance metrics that define the parameters for acceptability of emergency services delivery models will continue to challenge fire service leadership, delivery systems and traditional fire service paradigms well into the foreseeable future.

This became readily apparent as the group advanced through the analytical and assessment process within the domain of Emergency Services. Although broad based in scope and magnitude, fundamental gaps, issues and needs that were first identified in the 2005 National Fire Service Research Agenda Symposium initiatives suggested a basis for continuance of specific themes and focus areas in the development of the 2011 initiatives.

The Emergency Service Delivery Working Group further identified common themes and concentrations that reflect continuity and interrelationship within the initiatives and actions defined by the Technology & Fire Service Science Working Group and the Community Risk Reduction Working Group. The shared attributes identified within the assessment and process by three independent symposium working groups suggests validity in the importance and relevancy of identified initiatives.

The future near-term challenges and demands in Emergency Service Delivery constitute the development of a scientifically-based community risk assessment tool, identification of the components

of an effective emergency response system based upon identified community risks, development of emergency response system performance measures, continued emphasis on the professional development of all fire service personnel and the development and evaluation of effective models for translating research into practice in the fire service.

Emergency Service Delivery Number 1.0

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, aircraft fire and rescue response, terrorist acts and a broad range of risks and potential disasters. Each type of service or potential situation introduces new challenges and risk factors. Furthermore, the environments that are *immediately dangerous to life and health* (IDLH) in which firefighters have traditionally operated have significantly changed over the past 10 to 20 years, yet in many cases, the strategy and tactics employed by the fire service have not changed to appropriately deal with the higher levels of danger. Fire department leaders need the ability to systematically identify, assess and communicate both internally within the department and externally to community leaders 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 and effectively to potential events.

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 and communicated both internally within the department and externally to community leaders.

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. Examples include:

- 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.
- New Insurance Services Office (ISO) Public Protection Standard and Evaluation Tools.

The goal of this research involves four components:

1. Identification of the components of an effective emergency response system based on known community risks.
2. Development of an emergency response system performance measures.
3. Development of a scientifically-based community risk assessment tool.
4. Professional development for all fire service personnel.

Who is already involved in the issue and who should become involved in the effort? IAFF, IAFC, NVFC, iWomen, IABPFF, NAHF, NIST, UL and other national research laboratories, the insurance industry, National Alliance for Public Safety GIS Foundation, VAP, Association of Public Safety Communications Officials (APCO) and academic institutions.

NFFF Life Safety Initiative Numbers: 3, 7, 11

Emergency Service Delivery Number 2.0

Issue: Identify the components of an effective emergency response system based on known community risks

Need: A systematic process is needed to model and validate the capabilities of alternative fire service resource deployment strategies in relation to identified risks and desired performance levels, which incorporate a scientifically-based community risk assessment. 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 these resource deployment decisions in relation to local risk factors and service delivery expectations, and assess full economic and social impacts. 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.

Research should evaluate the effective Emergency Response System to include local, regional and state mutual aid systems capabilities. This research should also expand on the current NIST study to include multifamily dwellings, including high rise buildings. Examples include the San Diego Wildland study into total economic fire loss (direct and indirect, short and long term) and NIST Firefighter Safety and Resource Studies. The goal of this research involves the following components:

1. Identification of the components of an effective emergency response system based on known community risks.
2. Development of emergency response system performance measures.
3. Development of a scientifically-based community risk assessment tool.
4. Professional development for all fire service personnel.

Who is already involved in the issue and who should become involved in the effort? ISO, NIST, UL and other research laboratories, NAFTD, IAFF, IAFC, WPI, CPSE, VAP, APCO, ISO and academic Institutions.

NFFF Life Safety Initiative Numbers: 3, 7, 11

Emergency Service Delivery Number 3.0

Issue: Develop emergency response system performance measures

Need: This study would produce a standardized system of qualitative and quantitative performance measures, metrics, 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 include development of 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. No analogous comprehensive set of measures currently exist.

The goal of this research involves the following components:

- Identification of the components of an effective emergency response system based on known community risks.
- Development of emergency response system performance measures.
- Development of a scientifically-based community risk assessment tool.
- Professional development for all fire service personnel.

Who is already involved in the issue and who should become involved in the effort? Accreditation organizations including CPSE, IAFF, NIST, IAFC, APCO, NVFC, iWomen, IABFF, NAHF and WPI.

NFFF Life Safety Initiative Numbers: 3, 7, 11

Emergency Service Delivery Number 4.0

Issue: Professional development for all fire service personnel

Need: An effort is required to focus on the development of appropriate leadership, management and incident command skills at all levels within the fire service. Research should include a study on the risk-based effectiveness of fire service training. The research should provide outreach tools to fire service leaders to implement effective policies and programs that address the risk-based needs and articulate the fiduciary impacts of effective fire department policies and programs to community leaders. These skills include:

- Risk-based decision making
- Communications with elected and appointed officials based on community risk assessment tools
- Incident command
- Management best practices
- Officer development
- Empowerment

Background: Fire service members at the lower- and mid-levels do not receive sufficient training and education in the areas of risk-based decision making, 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, it would better equip them to make appropriate field decisions that could contribute to improved personnel safety, and positively influence the overall fire service culture.

Comments: Existing examples include the use of NIOSH LODD studies and EFO classes.

Examples: The goal of this research involves the following four components:

- Identification of the components of an effective emergency response system based on known community risks.
- Development of emergency response system performance measures.
- Development of a scientifically-based community risk assessment tool.
- Professional development for all fire service personnel.

Who is already involved in the issue and who should become involved in the effort? CPSE (including CFAI and CFOD), NAFTD, USFA (with the EFO program and ISFSI), IFSTA and academic Institutions.

NFFF Life Safety Initiative Numbers: 3, 11

Emergency Service Delivery Number 5.0

Issue: Based effectiveness of fire service training

Need: The operational effectiveness of a fire department is based in part upon the training level of its personnel. Research is needed to determine the risk-based performance measures that quantify the value of training to fire service performance.

Background: Fire service leaders are under significant pressure to justify training budgets and programs with empirical cost-benefit data. While there is significant anecdotal evidence as to the value of training to firefighter safety and emergency response performance, there is little empirical data based upon scientific research to show the operational and safety impact of increasing or decreasing firefighter and fire officer training.

Who is already involved in the issue and who should become involved in the effort? USFA, NAFTD, ISFSI, IFSTA, IAFF, IAFC, NVFC, CPSE, iWomen, IABPFF, NAHF, the insurance industry, VAP and academic institutions.

NFFF Life Safety Initiative Numbers: 1, 3, 4, 5, 7

Emergency Service Delivery

Number 6.0

Issue: Develop and evaluate effective models for translating research into practice in the fire service

Need: To define the barriers, programs, support needs and incentives that are needed to translate the research into practice in the fire service. The goal of this study would be to ensure that there is an identified pathway for each research project that can help translate scientific understanding into fire service practice.

Background: A common gap is the translating of pertinent and relevant research results into practices that can benefit the fire service. There are limited examples of recent research that has transitioned in a timely and effective manner into mainstream emergency service delivery systems, methodologies, practices or organizations.

Comments: Examples include FDNY's integration of the NIST Wind-Driven Fire Studies, tactics and research into operational- and tactical-level deployment capabilities that transitioned from research and recommendations to field implementation.

Who is already involved in the issue and who should become involved in the effort? NIST, UL, IFSTA, IAFF, NFPA, NAFTD, IAFC, NVFC and academic institutions.

NFFF Firefighter Life Safety Initiative Numbers: 3, 5, 7, 8

Tools and Equipment

Facilitators:

Robert Tutterow

Bruce Varner

Introduction:

The Tools and Equipment Section of the 2nd National Fire Service Research Agenda Symposium identified research needs that cross multiple product lines and disciplines. Members of the group stressed that on-going research must be continued and expanded, and identified other areas of focus, where little or no research exists, as priorities. Over-arching areas of interest include, but are not limited to: Personal Protective Equipment (PPE), communications, situational awareness, apparatus ergonomics, emerging technologies and added facilities health and safety as a new domain. Within each these areas of concentration is an underlying need to gather quality data that will serve to qualify and support the funding of these studies.

It must also be noted that in the past, both training and education in the use of fire service tools have often been neglected. As our industry's tools become more and more technologically advanced, it becomes critical that the end-users of these products are fully trained in their proper use and aware of their limitations (both mechanical and human) prior to the use of such tools.

Tools and Equipment

Number 1.0

Issue: Assessment of current Personal Protective Equipment (entire ensemble) performance, functionality and related safety features for today's fire environment

Need: There is a need to assess the capacity of currently available PPE to keep firefighters safe in today's firefighting environment (construction, contents, fire behavior and firefighting tactics).

Background: Contemporary building construction and contents are very different than legacy buildings and contents. These differences, combined with the recent research on fire behavior and extinguishment, require an assessment of current PPE to scientifically determine whether or not it is appropriately designed for the current fire behavior and firefighting tactics. There is also a need to assess if there is redundancy within the PPE elements and if there are features that may not be used (Drag Rescue Devices (DRDs), escape ropes, etc.).

Who is already involved in the issue and who should become involved in the effort? NFPA, NIOSH, NIST, IAFF, UL, FEMSA, college/university research teams, private industry and entrepreneurial efforts.

NFFF Life Safety Initiative Numbers: 3, 16

Tools and Equipment Number 2.0

Issue: Adaptation of emerging technologies and research in Personal Protective Equipment design, production and use

Need: There are several ongoing and emerging PPE issues that need further study. These include (not in priority order):

- Base layer garments, and their impact on the firefighter and PPE.
- Improved HazMat garment donning/doffing.
- Improved mobility when wearing all elements.
- Possible need for a duty footwear standard to reduce sprains/strains and slips/falls.
- Assessment of need for electrical hazard protection (solar, voltaic, electric/hybrid vehicles).
- Impact of PPE on situational awareness.
- Improved HazMat barrier materials.
- Reducing weight of elements of the PPE ensemble.
- Long-term health effects of contaminated gear, including exposure-related cancers.
- Determine of optimal Personal Alert Safety Systems (PASS) alarm sound frequencies and patterns.
- Improvements in respiratory protection (lens failure, overhaul protection, flatpack SCBA).
- Use a system approach to testing PPE rather than the current component approach.
- Development of a retirement criteria based on elements of PPE performance rather than age.

Background: Development and production of PPE for firefighters is an ever-evolving industry. The breadth of emergency response calls handled by today's fire service, combined with constantly emerging new technologies demand continuous PPE adaptation and improvement.

Who is already involved in the issue and who should become involved in the effort? NFPA, NIST, NIOSH, IAFF, UL, FEMSA, academic research communities, private industry and entrepreneurial efforts should remain as key players.

NFFF Life Safety Initiative Numbers: 3, 8, 16

Tools and Equipment Number 3.0

Issue: Technology to support improved firefighter situational awareness which includes physiological and environmental monitoring and flashover/collapse prediction capabilities

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. Equally important is the capacity to monitor external conditions within the firefighters' work environment, in order to identify imminent threats and changing conditions. This information should be readily available to the firefighter and able to be transmitted to an external command post, where it can be monitored and recorded. There is also a need for the development of a system or systems that will accurately predict flashover and structural collapse at fire scenes, and provide adequate warning time for firefighters to evacuate. A post-fire environmental monitoring system is also needed, and would determine when it is safe to remove alternative respiratory protection.

Background: Each year firefighters die 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. 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: 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 currently high priority research issues, but data transmission remains 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. 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.

Who is already involved in the issue and who should become involved in the effort? NIST, NFPA, DHS Science & Technology Directorate (including PHASER and GLANSER), private industry and entrepreneurial efforts.

NFFF Life Safety Initiative Numbers: 3, 16

Tools and Equipment Number 4.0

Issue: Technology to support incident command

Need: Best practices utilizing technology to support incident command in a manner that will improve both safety and operational effectiveness at incident scenes must be defined and disseminated. Research, identification, deployment and training should be determined to identify 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 or industrial technologies to fire service use in relation to this initiative. Progress has been made on developing sensors for physiological monitoring but the focus should be on providing the Incident Commander with meaningful and timely information. Spatial monitoring is an important area and needs development to create a useful deployable system. Systems integration is necessary to reduce weight and duplication of system components.

Who is already involved in the issue and who should become involved in the effort? DHS S&T, several universities, NIST and private industry are currently involved in this research.

NFFF Life Safety Initiative Numbers: 8, 16

Tools and Equipment

Number 5.0

Issue: Improved extinguishing agents and fire control methodologies

Need: Research should be dedicated to the development of advanced firefighting agents and methods that can effectively extinguish different classes of fire, while reducing the exposure of firefighters to high-risk conditions, including excessive heat and products of combustion.

Background: The primary objective of this research is to reduce the exposure of firefighters to the risks of interior fire suppression by developing more effective extinguishing agents, delivery systems and fire control methodologies. 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 as foams, wetting agents, gels and other water additives, as well as air and ventilation control methods.

Who is already involved in the issue and who should become involved in the effort? NIST, NFPA, private industry and entrepreneurial efforts.

NFFF Life Safety Initiative Numbers: 8, 16

Tools and Equipment Number 6.0

Issue: Improvement of apparatus ergonomics and design

Need: Apparatus cabs are not ergonomically designed for the safety of the firefighter, especially in the areas of cab entry and egress. Seats are not adequately designed and sized to accommodate firefighters wearing PPE.

Background: In the past twenty years, much advancement has been made in improving cab safety for firefighters. Improved safety features include: slip-resistant steps and surfaces; minimum step heights; under-cab lighting; standardization of grab handle diameters and slip-resistant grab rails; and seat belt monitoring systems. However, despite these changes, firefighters continue to be injured while trying to enter and exit cabs, and these injuries result in lost time and medical costs. In many apparatus, cab steps and grab handles are not appropriately placed. NIOSH recently conducted an anthropometric study of firefighters that proved clearly that seat belts were not long enough to accommodate firefighters wearing PPE, and that seating space continues to be inadequate.

Firefighter ergonomics seem to be a design afterthought, and further study is needed to improve the safety and functionality of fire apparatus. Fire apparatus cabs are still being designed around the frame rails and the engine compartment, instead of being designed with the firefighter as the focal point and the engine and frame rails secondary.

Comments: A 22-month study of data from one fire department (1,000 members) showed 22 related injuries, an average of one per month. These injuries resulted in 407 lost work days and \$110,000+ in related medical costs.

Who is already involved in the issue and who should become involved in the effort? NIOSH remains committed to the improvement of apparatus safety. NFPA (including the Research Foundation), FAMA, college/university research teams, private industry and entrepreneurial efforts should also be involved.

NFFF Life Safety Initiative Number: 16

Tools and Equipment Number 7.0

Issue: Fire department communications – functionality and interoperability

Need: The goal of this recommendation is to support research that will improve fire department communication systems and procedures in order to enhance scene safety; prevent firefighter deaths and injuries; and promote effective tactical operations. Communications interoperability among all agencies and organizations involved in emergency operations must also be a primary focus. The needs of all participating agencies must be defined and integrated into overall system performance requirements. In addition, policies and procedures must be adopted to provide effective, clear and understandable communications at all levels of emergency response.

An effective incident scene communications system should 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 personnel operating on the scene of an incident is a critical firefighter life safety issue.

The communications system must also support the overall management of the incident, providing reliable line of 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 other 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 industry's need to improve operational communications systems and procedures has been identified repeatedly by most fire service agencies and organizations. Most departmental communications systems have evolved without an overall plan for systems integration or utilization. This project recommendation 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, and can be scaled to accommodate the needs and resources of different departments.

Who is already involved in the issue and who should become involved in the effort? APCO, DHS S & T, private industry and entrepreneurial efforts.

NFFF Life Safety Initiative Numbers: 1, 3, 8, 11, 16

Tools and Equipment Number 8.0

Issue: Development of specialized equipment (robotics and simulators) with fire service applications

Need: There are environments where robots might be better suited than humans to fulfill the role of firefighters. The fire service needs to assess the current functional capabilities of robots, and determine their potential application in emergency response. To do so, the fire service needs to engage with the robotics industry for input for fire service robots and adaptability/modification of existing technology. This should be followed by on-going interaction with the robotics industry for constant assessment of their effectiveness, and continued improvement of their capabilities.

Simulation training modules for firefighters and fire officers should be developed and/or expanded. Realistic training platforms, similar to video games, can be created to help firefighters better understand fire behavior and refine their firefighting tactics. The same applies to incident management training to help develop and refine emergency incident strategies. Also, simulation can be used in other areas such as driver training. Web-based applications not only allow firefighters and officers to individually train anywhere, anytime, but offer a cost-effective alternative to other training modalities.

Background: Manufacturing facilities have relied on robotics in their production processes for many years. This is another area that has not seen adaption and usage except in some HazMat and bomb units. Simulation has proved to be a valuable tool for the military in conducting vehicle-based combat training, particularly in tanks and armored vehicles. There are a number of training systems utilizing video-based scenarios for command training. “Blue Card” utilizes simulation to instruct, train and certify Command Officers. There are several command training centers currently operating in the mid-west states. Los Angeles City Fire Department operates a regional command training center. There are a couple of computer based simulation games for fire operations available on the internet.

Comments: Simulation is an excellent tool to use in firefighter training. This is a largely untapped area that has significant potential. Imagine the ability to place entry-level firefighters in a room with the ability to project video-type scenes, drag hose lines, to operate on the “fire” and conduct search and rescue operations, in an environment that heat and smoke can be rapidly changed. Bringing the military simulation vendors and university research working in virtual or augmented reality has great potential for training in a much safer environment.

Who is already involved in the issue and who should become involved in the effort? Military and robotics engineers, university researchers, game developers, SBIR contractors, USFA, DHS S & T, NIST, FEMA, NIOSH, and private industry and entrepreneurial efforts.

NFFF Life Safety Initiative Number: 18

Tools and Equipment Number 9.0

Issue: Facility health and safety guidance for fire departments

Need: Many firefighters suffer preventable injuries and illnesses because of conditions in the fire station. However, there is a lack of data and few resources available to guide fire departments with design decisions when building new stations or renovating/expanding existing stations. Some of the issues that need to be addressed include:

- Americans with Disabilities Act (ADA) compliance
- Alarm activation during sleep
- Decontamination policies and procedures
- Exhaust removal
- Bio-hazardous waste
- Food preparation and storage practices
- Planned foot traffic flow
- Gender accommodations
- Hygiene
- Infection control
- Mold
- PPE inspection, cleaning, drying and storage
- Slide poles
- Lighting
- Overall space requirements
- Wellness/fitness rooms
- Doors and door hardware
- Slip-resistant flooring
- Fire station hardening
- Roadway visibility/accessibility

Background: In 1997, FEMA/USFA released a manual titled *Safety and Health Considerations for the Design of Fire and Emergency Medical Services Stations*. However, building materials and design and the needs of fire service organizations have changed considerably in the past fourteen years. The new body of knowledge needs to be captured and made available to the fire service in a user-friendly format.

Comments: There are as many non-incident scene injuries as there are incident scene injuries, and the majority of the non-incident scene injuries occur at the fire station. Though these injuries do not receive much attention, the number of days lost, workers' compensation costs, and overtime pay required to cover the injured have the same negative impact on service delivery and fire department budgets as on-scene injuries.

Who is already involved in the issue and who should become involved in the effort? There is currently no research being conducted on facility design. IAFF, IAFC and other research agencies should be involved.

NFFF Life Safety Initiative Numbers: 8, 16

Appendix A: Participants and their Organizations

Meri-K Appy	Safe Kids USA
Jason Averill	NIST
Bob Backstrom	Underwriters Laboratories, Inc.
Roger Barker, Ph.D.	Center for Research on Textile Protection and Comfort
John Barrett	Plano (TX) Fire Department
Jim Brinkley	IAFF
Ricky Brockman	United States Navy
Nelson Bryner	NIST
Jeff Burgess, M.D.	University of Arizona
Peg Carson	Carson Associates, Inc. for IFE Vision 20/20
Marino DiMarzo, Ph.D.	University of Maryland
Michael Dubron	Firefighter Cancer Support Network
Jim Duckworth, Ph.D.	Worcester Polytechnic Institute
Rich Duffy	IAFF
David Evans	Cabazon Group
Gregory Frederick	Louisville (KY) Division of Fire
Richard Gasaway, Ph.D.	Gasaway Consulting Group
Stan Gibson	Coos Bay (WA) Fire & Rescue
Richard Gist, Ph.D.	Kansas City (MO) Fire Department
Billy Goldfeder	National Fallen Firefighters Foundation
Randall Griffin	DeWitt Fire District
Thomas Hales, M.D.	NIOSH-CDC
Anthony Hamins, Ph.D.	NIST
Gavin Horn, Ph.D.	University of Illinois Fire Service Institute
David Hostler, Ph.D.	University of Pittsburgh, Department of Emergency Medicine
Tricia Hurlbutt	National Fallen Firefighters Foundation
Stefanos Kales, M.D.	Harvard University
Bill Kehoe	Institution of Fire Engineers
JoEllen Kelly, Ph.D.	Everyone Goes Home®
Steve Kimple	Everyone Goes Home®
Richard Jaehne	North American Fire Training Directors
Sara Jahnke, Ph.D.	National Development & Research Institutes
Chris Jelenewicz	Society of Fire Protection Engineers
Cortez Lawrence, Ph.D.	United States Fire Administration/ National Fallen Firefighters Foundation
Glen Lecomte	Argus Engineering
Murrey Loflin	CDC/NIOSH
Daniel Madrzykowski	NIST
Peter Matthews	Firehouse.com

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Chris McLoone	Fire Apparatus & Emergency Equipment/PennWell
Bruce Moeller, Ph.D.	City of Sunrise (FL)
Lori Moore-Merrell , Dr.PH.	IAFF
Jeff Morris	Honeywell
Patrick Morrison	IAFF
Christopher Naum	International Society of Fire Service Instructors
Michael Nelson	IAFC Safety, Health, and Survival Section
Cathie Patterson	FEMA
Brad Peabody	United States Fire Administration
Michael Petroff	Fire Department Safety Officers Association
Pam Peterson	Phoenix Society for Burn Survivors
Claire Pickart	National Fallen Firefighters Foundation
Vicki Pritchett	FireTeam USA/Common Voices
Kevin Quinn	National Volunteer Fire Council
Shane Ray	Pleasant View Volunteer Fire Department
James Ridley	IAFF
Kevin Roche	Phoenix (AZ) Fire Department
J. Gordon Routley	Montreal Fire Department
Timothy Sendelbach	FireRescue Magazine
Ronald Siarnicki	National Fallen Firefighters Foundation
Karen Simpson	International Association of Women in Fire & Emergency Services
Denise Smith, Ph.D.	Skidmore College/Illinois Fire Service Institute
Chris Spoons	Columbia Southern University
Victor Stagnaro	National Fallen Firefighters Foundation
Adam Thiel	Alexandria (VA) Fire Department
Nancy Trench	IFSTA/Fire Protection Publications/OSU
Bill Troup	United States Fire Administration
Robert Tutterow	F.I.E.R.O./Charlotte (NC) Fire Department
Bruce Varner	BH Varner & Associates
G. Crawford Wiestling	International Association of Arson Investigators
Ken Willette	NFPA/Public Fire Protection
Maggie Wilson	DHS/FEMA Assistance to Firefighters Grant Program

Appendix B: 2nd National Fire Service Research Agenda Symposium Recommendations

Community Risk Reduction 1.0	<i>Creation of a large-scale model that evaluates fire prevention and response programs and quantifies their ability to produce a potentially positive outcome</i>
Community Risk Reduction 2.0	<i>Testing to determine the effectiveness of messages on targeted behavior change as well as assessing and promoting best practices in disseminating focused fire prevention messages</i>
Community Risk Reduction 3.0	<i>Improving citizen and firefighter safety through codes adoption, including the evaluation of impact of local and state codes on citizen and firefighter safety and property loss</i>
Community Risk Reduction 4.0	<i>Development of a systematic process for the evaluation of the effectiveness of community risk-reduction programs</i>
Community Risk Reduction 5.0	<i>Creation of on-scene risk management tools for company officers and incident commanders</i>
Wildland Firefighting 1.0	<i>Safe and reliable aircraft operations for suppression and team transportation</i>
Wildland Firefighting 2.0	<i>The unknown respiratory hazards and effects of smoke exposure for wildland firefighters</i>
Wildland Firefighting 3.0	<i>The lack of standardized data and central database for fatalities and injuries that occur during wildland firefighting</i>
Wildland Firefighting 4.0	<i>An understanding of level of threat represented by changing conditions, and early detection of those conditions that can transition to burnover</i>
Wildland Firefighting 5.0	<i>Wildland firefighting research dissemination</i>
Data Collection 1.0	<i>Identification of cultural perceptions of data collection/ identification of barriers to quality data capture</i>

Data Collection 2.0	<i>Development of an intuitive data collection system prototype, including standardized data elements, definitions, metrics, and reports</i>
Data Collection 3.0	<i>Identify and catalog data sources and data technology formats beneficial to the fire service</i>
Technology and Fire Service Science 1.0	<i>Identify and disseminate standard best practices for structural firefighting operations based on science</i>
Technology and Fire Service Science 2.0	<i>Impact of evolving building technology on current fire service operations</i>
Technology and Fire Service Science 3.0	<i>Identify fire dynamics and building response factors that contribute to fire service injuries and fatalities</i>
Technology and Fire Service Science 4.0	<i>Closing the knowledge and communication gaps pertaining to the built environment among all stakeholders</i>
Technology and Fire Service Science 5.0	<i>Transferring science-based fire behavior and operations information to the fireground, also known as “getting the science to the streets”</i>
Health and Wellness 1.0	<i>Health and disease related to wellness and fitness</i>
Health and Wellness 2.0	<i>Health and disease related to exposures</i>
Health and Wellness 3.0	<i>Implementation/transitional research</i>
Health and Wellness 4.0	<i>Tobacco use in the fire service</i>
Health and Wellness 5.0	<i>Development, implementation and delivery of firefighter behavioral health</i>
Health and Wellness 6.0	<i>Hazardous exposures among women firefighters and their unique health outcomes</i>
Health and Wellness 7.0	<i>Optimization of performance and reducing risk</i>
Health and Wellness 8.0	<i>Cost effectiveness of health and safety systems</i>

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Emergency Service Delivery 1.0	<i>Development of a scientifically based community risk assessment tool</i>
Emergency Service Delivery 2.0	<i>Identify the components of an effective emergency response system based on known community risks</i>
Emergency Service Delivery 3.0	<i>Develop emergency response system performance measures</i>
Emergency Service Delivery 4.0	<i>Professional development for all fire service personnel</i>
Emergency Service Delivery 5.0	<i>Based effectiveness of fire service training</i>
Emergency Service Delivery 6.0	<i>Develop and evaluate effective models for translating research into practice in the fire service</i>
Tools and Equipment 1.0	<i>Assessment of current PPE (entire ensemble) performance, functionality and related safety features for today's fire environment</i>
Tools and Equipment 2.0	<i>Adaptation of emerging technologies and research in PPE design, production and use</i>
Tools and Equipment 3.0	<i>Technology to support improved firefighter situational awareness which includes physiological and environmental monitoring and flashover/collapse prediction capabilities</i>
Tools and Equipment 4.0	<i>Technology to support incident command</i>
Tools and Equipment 5.0	<i>Improved extinguishing agents and fire control methodologies</i>
Tools and Equipment 6.0	<i>Improvement of apparatus ergonomics and design</i>
Tools and Equipment 7.0	<i>Fire department communications – functionality and interoperability</i>
Tools and Equipment 8.0	<i>Development of specialized equipment (robotics and simulators) with fire service applications</i>
Tools and Equipment 9.0	<i>Facility health and safety guidance for fire departments</i>

Appendix C: Acronyms

ADA	Americans with Disabilities Act
AFG	Assistance to Firefighters Grant program
AIA	American Institute of Architects
APCO	Association of Public-Safety Communications Officials
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ASTM	American Society for Testing and Materials
BIM	Building Information Modeling
BOMA	Building Owners and Managers Association International
CAFS	Compressed Air Foam System(s)
CDC	Center for Disease Control and Prevention
CFAI	Commission on Fire Accreditation International
CFSI	Congressional Fire Services Institute
CPSE	Center for Public Safety Excellence
DHS	Department of Homeland Security
DHS S&T	Department of Homeland Security Science & Technology Directorate
DOC	Department of Commerce
DOE	Department of Energy
DRD	Drag Rescue Device
EFO	Executive Fire Officer
EMT	Emergency Medical Technician
FAMA	Fire Apparatus Manufacturers' Association
FDNY	Fire Department of New York
FDSOA	Fire Department Safety Officers Association
FEMA	Federal Emergency Management Agency
FEMSA	Fire and Emergency Manufacturers and Services Association
FFLSI	Firefighter Life Safety Initiative
F.I.E.R.O.	Fire Industry Equipment Research Organization
FPRF	Fire Protection Research Foundation
GLANSER	Geospatial Location Accountability Sensor for Emergency Responders
IAFC	International Association of Fire Chiefs
IAFF	International Association of Fire Fighters
IFE	Institution of Fire Engineers
IWomen	International Association of Women in Fire & Emergency Services
IBHS	Institute for Business and Home Safety
ICC	International Code Council
IDLH	Immediately Dangerous to Life and Health
IFE	Institution of Fire Engineers
ISFSI	International Society of Fire Safety Instructors

ISO	Insurance Services Office, Inc.
LODD	Line-of-Duty Death
NAFTD	North American Fire Training Directors
NFA	National Fire Academy
NFFF	National Fallen Firefighters Foundation
NFIRS	National Fire Incident Reporting System
NFPA	National Fire Protection Association
NIMS	National Incident Management System
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPPTL	National Personal Protection Technology Laboratory
NVFC	National Volunteer Fire Council
NWCG	National Wildfire Coordinating Group
OSU	Oklahoma State University
PASS	Personal Alarm Safety System
PHASER	Physiological Health Assessment for Emergency Responders
PPE	Personal Protective Equipment
PPA	Positive Pressure Attack
PV	Photovoltaic
RHAVE	Risk, Hazard, and Value Evaluation
SBIR	Small Business Innovation Research
SCBA	Self-contained breathing apparatus
SFPE	Society of Fire Protection Engineers
SOP	Standard Operating Procedures
UL	Underwriters Laboratories, Inc.
USFA	United States Fire Academy
USFS	United States Fire Service
VAP	Vulnerability Assessment Program