

Testimony of

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Before the

**House Science and Technology Committee
Subcommittee on Technology and Innovation**

**“The U.S. Fire Administration Reauthorization: Addressing
the Priorities of the Nation’s Fire Service”**

October 2, 2007

Chairman Wu, Dr. Gingrey, and members of the Subcommittee, I appreciate the opportunity to appear before you today to discuss the fire research program at the National Institute of Standards and Technology's (NIST) Building and Fire Research Lab (BFRL). NIST conducts research to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. BFRL supports this mission by anticipating and meeting these needs for the U.S. building and fire safety industries. In relation to fire research, NIST was given specific authority under the Federal Fire Prevention and Control Act of 1974 as amended (15 U.S.C. 278f(a)) for "*performing and supporting research on all aspects of fire with the aim of providing scientific and technical knowledge applicable to the prevention and control of fires.*"

Fire remains a serious problem for our country as evidenced by the continuing high rates of fire deaths in the U.S. Each year, more than 3000 people die in fires and per capita fire deaths are 70 percent higher in the U.S. than in the European Union. Fire codes that are overly prescriptive – that is, detailed and restrictive – can increase the cost of construction and major renovations and possibly stifle innovative new approaches without actually improving the fire safety of the building and its occupants. There is much that we do not know about how the fire-related characteristics of modern furnishings, building materials, and designs affect the time available for safely exiting buildings. This is an issue of particular concern in high rise office buildings and for impaired populations, including those in hospitals, nursing homes, residences, or other facilities. Manmade fire threats - whether they are accidental, intentional, or due to new higher risk technologies – increase the need for strategies to prevent or limit the flammability of materials and structures or to improve the ability of occupants to exit or survive in buildings where fires take place.

NIST fire research is focused on reducing losses and risk by advancing innovative fire protection technologies and increasing the safety of buildings threatened by fire. This research has been highlighted as a critical need in a National Academies study (*Making the Nation Safe from Fire, a Path Forward in Research*, National Academies Press, 2003).

In addition to improving fire safety in buildings, NIST research provides the science and performance measures that are critical for developing and implementing the new technologies necessary to improve the effectiveness and safety of emergency responders. This includes developing science-based standards and testing protocols, fire fighter training tools, and innovative new technologies. We go beyond developing new tools and methods - NIST gets its research results into the hands of fire fighters, incident commanders, and other emergency responders. Over the last few years, NIST research has been used to develop entire courses or has been integrated into modules for use in courses at the United States Fire Administration's (USFA) National Fire Academy (NFA), including the courses *Introduction to Fire Dynamics and Fire Modeling*, *Management of Fire Prevention Programs*, and *Evaluating Performance Based Designs*, as well as several courses in the NFA's Degrees at a Distance Program.

NIST is developing strategies for cost-effectively reducing the nation's fire losses, both human and financial, based on approaches for limiting fire growth and spread. The vast majority of fire deaths occur in residential settings. The key to reducing fire deaths lies in reducing the chance for a fire to reach "flashover", a condition in which the entire contents of a room begin to burn simultaneously and produce the toxic smoke and hot gases that can kill people at remote locations within a building. Flashover can be controlled by: 1) reducing the flammability of the materials and products within our homes, 2) reliably detecting a fire in its nascent state, and 3) automatic suppression systems. NIST researchers have been pursuing – and succeeding – in all three avenues for reducing the likelihood of flashover.

NIST research supports improvements to building and fire codes, standards, and practices that reduce the impact of extreme threats to the safety of buildings, their occupants and emergency responders. As part of the President's American Competitiveness Initiative (ACI), NIST is developing tools for reducing community losses in wildland-urban interface fires. The U.S. faces extreme losses of life and property due to wildland-urban fire. Since 1990 in Colorado, over 450,000 acres, 484 homes and 25 lives were lost to wildland-urban fires.¹ In 2003 alone in California, fires cost an estimated \$2 billion in insured damages and destroyed more than 3600 homes.² During 2000-2003, the cost to Federal agencies fighting wildland fires averaged \$1.3 billion annually (in 2004 dollars).² The NIST tools will assist communities all across the U.S. in their fire risk assessment and choices of economically-balanced mitigation strategies that limit the ignition of residences and improve firefighter and community safety.

Issues associated with the emerging use of hydrogen as a fuel in transportation and domestic/commercial power generation are also being examined by NIST as part of the ACI. NIST is working to remove technical barriers that impede the implementation of a hydrogen economy, and to provide the scientific and technical information, needed to support the development of codes and standards for the design of engineered containment and transport systems, and provisions for the mitigation of potential fire and explosion hazards in both the residential and commercial sectors.

NIST Fire Grants Program

For the past 30 years, NIST has been supporting university research through its fire grants program - currently funded at \$1.3 million per year. NIST relies on the special expertise of the academic community to assist in surmounting the complex physical, sociological, and economic barriers to significantly reducing U.S. fire losses. This program has been the primary Federal source for fire research in universities and a source for training the next generation of fire protection engineers and researchers.

Fire Research Agenda Strategic Approach

NIST research priorities are determined in a deliberate and inclusive fashion. We work with a broad range of industries (e.g., building materials and contents manufacturers, fire protection equipment suppliers), codes and standards developing organizations (e.g., International Code Council (ICC), National Fire Protection Association (NFPA), American Society for Testing and Materials International (ASTMI), Underwriters Laboratories (UL), FM Approvals (a business unit of FM Global for commercial property and building insurance), fire service organizations (e.g., International Association of Fire Chiefs (IAFC), International Association of Fire Fighters (IAFF), National Association of State Fire Marshals (NASFM), International Association of Arson Investigators (IAAI), Conference of Fire Safety Instructors (CFSI), National Fallen Firefighters Foundation (NFFF)), professional societies (e.g., Society of Fire Protection Engineers (SFPE), American Society of Mechanical Engineers (ASME), American Society of Civil Engineers (ASCE)), public safety groups (e.g., Skyscraper Safety Campaign, Operation Life Safety, Home Safety Council, Center for Campus Fire Safety), universities, and other government agencies – including USFA, Consumer Product Safety Commission (CPSC), Department of Homeland Security (DHS), US Forest Service (USFS), Department of Transportation (DOT), Department of Defense (DOD), National Aeronautics and Space Administration (NASA), National Institute for Occupational Safety and Health (NIOSH), and the Bureau of Alcohol, Tobacco, and Firearms (ATF).

¹ http://csfs.colostate.edu/library/pdfs/fire/statistics/fire_history.pdf

² <http://www.gao.gov/new.items/d05380.pdf>

NIST identifies the needs of these customers and the capabilities of our collaborators (national and international) through workshops, direct contact at technical meetings, roadmaps, and established national priorities. The NIST fire research program evolves from these needs after considering the potential impact and probability of success, the fit to the NIST mission, the match of the technical challenge to staff capabilities, and the potential for leveraging the investment.

The Federal Fire Prevention and Control Act of 1974 as amended (15 U.S.C. 278f(a)) specifically stipulates that "the content and priorities of the [NIST] research program shall be determined in consultation with the Administrator of the United States Fire Administration." There are many examples of how the NIST research program is coordinated with the USFA.

NIST regularly hosts joint workshops with USFA that include representatives from the fire service, industry, and other laboratories to establish priorities for fire service research. Specific examples include the *National Fire Service Research Agenda Symposium* hosted jointly with USFA in Emmitsburg, MD; the *National Fire Fighter Life Safety Summit* hosted by USFA; and workshops hosted by the National Fallen Firefighters Foundation in Tampa, FL; Indianapolis, IN; San Diego, CA; and Washington, DC. The results of these workshops have helped set the current research agenda for both NIST and USFA. Other Federal programs, such as the DHS Assistance to Firefighter Grants, are incorporating these prioritized research areas as part of their proposal evaluation criteria. Similar workshops are being considered to establish priorities and timelines for the development of measurements, test methods, and consensus standards.

NIST's and USFA's research plans are coordinated through an established liaison arrangement. Together, NIST and USFA jointly fund high-priority research topics, transfer research results to the fire service, and conduct investigations of fire fighter fatalities. Recent research projects include characterizing the performance of personal protective equipment, developing structural collapse prediction technology, and assembling the components of a virtual fire fighter trainer for next generation fire fighting. The research results are transferred to the fire service via incorporation into training courses at the National Fire Academy, an electronic newsletter for fire service personnel (FIRE.Gov), and electronic publications distributed directly to fire departments and training academies. A USFA employee participated as a member of the team formed and led by NIST under the National Construction Safety Team Act to perform a building and fire safety investigation of the Rhode Island Station Nightclub fire in 2003. Currently, USFA and NIST are working together to analyze the Charleston furniture store fire that resulted in nine fire fighter fatalities. The objectives of this study are to understand the unusual and rapid fire spread, the impact of smoke and gases on human life, the effect of ventilation on fire growth and roof collapse, and the possible influence of a sprinkler system had one been installed. In addition, the study is considering fire service response and operations with a focus on establishing a timeline for reconstructing the fire, and to identify areas in building and fire codes, standards, and practices that warrant revision. The recommendations from these kinds of investigations are communicated to the fire service and national voluntary consensus standards organizations to improve the safety of first responders and the public.

NIST continues to work closely with standards organizations to support the development of consensus standards. NIST provides an unbiased source of technical information and data, which is critical to the success of standards development. Recent NIST research has characterized the performance of personal alert safety systems (PASS), demonstrating that serious flaws can cause the alarm signal generator to failed at high temperatures -- precisely when this safety equipment is most needed. Based on data collected at NIST, a joint safety warning was issued nationwide by USFA, NIST, NIOSH, NFPA, IAFC, and IAFF. NIST

research has provided the technical basis for rewriting the test standards for the PASS device, increasing the likelihood that the device will work under the extreme conditions typical of a fire environment.

In a similar fashion, NIST research funded internally and by USFA and DHS has led to the development of a complete suite of performance metrics and standard test protocols for thermal imagers for first responder applications. During the last 5 years, thermal imaging cameras have become more readily available to fire departments for tracking fire spread and locating fallen fire fighters or building occupants. Previously, there were no performance metrics or standard test protocols for fire fighter thermal imagers. The NIST research has provided the technical basis for the development of a new NFPA standard for thermal imagers. With this standard in place, the performance of this critical piece of technology can be evaluated to ensure that thermal imagers are as effective as possible.

Each year, a significant number of fire fighter fatalities are due to structural collapse. USFA and NIST- funded research has identified a promising new technology to continuously monitor the structural integrity of buildings experiencing fire. This emerging technology, when fully developed, could provide incident commanders with early warning of an impending collapse, allowing first responders more time to safely evacuate from the interior of structures before collapse occurs.

Positive pressure ventilation fans are available to many fire departments and could provide cooler and smoke-free stairwells for fire fighter operations or occupant egress. Unfortunately, in the past, this ventilation technology has been under-utilized due to lack of scientific data on the interaction between ventilation and fire growth. A current USFA and NIST collaborative effort has characterized the fan/building interaction in single story residential structures, high rise apartment/office structures, and warehouse type structures. NIST research provides a science-based set of guidelines for the deployment and operation of positive pressure ventilation fans to improve the effectiveness of fire fighting activities and evacuation of building occupants.

As the Nation's primary measurement laboratory, NIST is proud of its roles as a partner and science and technology resource for USFA, helping to play a significant role in the development of science-based consensus standards and reliable, safe, and effective firefighting equipment and techniques.

I am delighted to have had the opportunity to describe the fire research program at NIST. The problems we tackle affect people every day, and the technical challenges require the resources and expertise of institutions like NIST, working together with the USFA and other organizations to improve fire safety and the effectiveness of firefighting in America.

Thank you and I would be happy to answer any of your questions.

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Dr. Shyam Sunder is Director of the Building and Fire Research Laboratory (BFRL) at the National Institute of Standards and Technology (NIST).

BFRL has an annual operating budget of about \$42 million and its staff includes about 175 federal employees and 100 research associates and guest researchers from industry, universities, and foreign laboratories.

Dr. Sunder also:

- is the lead investigator for the federal building and fire safety investigation of the World Trade Center disaster;
- oversees NIST activities as lead agency for the National Earthquake Hazards Reduction Program (NEHRP); and
- co-chairs the National Science and Technology Council's (NSTC) Subcommittee on Buildings Technology (SBT) Research and Development.

From June 1996 to December 1997, Dr. Sunder was on assignment to the Program Office, the principal staff office of the NIST Director, first as a Program Analyst and later as the Senior Program Analyst for NIST.

Dr. Sunder was appointed Chief of the Structures Division in January 1998 and Chief of the Materials and Construction Research Division in June 2002. He was appointed Acting Deputy Director of BFRL in March 2004, Deputy Director of BFRL in June 2005, and Acting Director of BFRL in July 2006.

Prior to joining NIST in 1994, Dr. Sunder held a succession of positions at the Massachusetts Institute of Technology (MIT) beginning in 1980: instructor, assistant professor, associate professor, principal research scientist, and senior research scientist.

Dr. Sunder holds a Bachelor of Technology (Honors) degree in civil engineering from the Indian Institute of Technology, Delhi (1977), a Master of Science degree in civil engineering from MIT (1979), and a Doctor of Science degree in structural engineering from MIT (1981).

Dr. Sunder's awards include the Gilbert W. Winslow Career Development Chair (1985-87) and the Doherty Professorship in Ocean Utilization (1987-89) from MIT, the Walter L. Huber Civil Engineering Research Prize (1991) from the American Society of Civil Engineers, the Equal Employment Opportunity Award (1997) from NIST, and the Gold Medal Award (2005) for his distinguished leadership of the federal building and fire safety investigation of the World Trade Center disaster from the U.S. Department of Commerce.