engineering laboratory

Newsletter • Summer 2012

What's inside

Download the Net-Zero Facility Brochure:
www.nist.gov/el/building_environment/heattrans/upload/netzerofinal.pdf

Download the NFRL Brochure:
www.nist.gov/el/fire_research/upload/nsflweb.pdf

The Engineering Laboratory is growing! New facilities are coming on line that will allow us to extend our research and enhance our impact.

On July 17, NIST officially took ownership of the Net Zero Energy Residential Test Facility. After complete instrumentation and control mechanisms are in place, the facility will be used to demonstrate the capability of a typical residence to reach net zero energy consumption over the course of a year. Subsequently, it will be used as a real world testbed to validate and improve energy models and to improve measurements of systems and components.

October will see us take ownership of a new robotics test facility that will support development of performance standards and test artifacts for intelligent robot systems. These standards characterize the performance of next-generation robots in critical areas such as safety, autonomy, and rapid re-tasking. Testbeds in the facility will support manufacturing applications, urban search and rescue, bomb-disposal, and military ground operations.

Finally, in January we expect to take ownership of the newly expanded National Fire Research Laboratory, a unique research facility capable of hosting real-scale experiments on structure performance in fires under well-controlled conditions. This unique facility will enable researchers to address significant technical problems for the first time, such as the testing of full-scale structures subjected to realistic fires and structural loading and validation of models that predict fire resistance performance of structures. The results of this research will accelerate the transformation to the development and use of performance-based standards for the fire resistance design of structures.

Please visit our website for more information on ongoing activities in the Laboratory: www.nist.gov/el/

Sincerely,

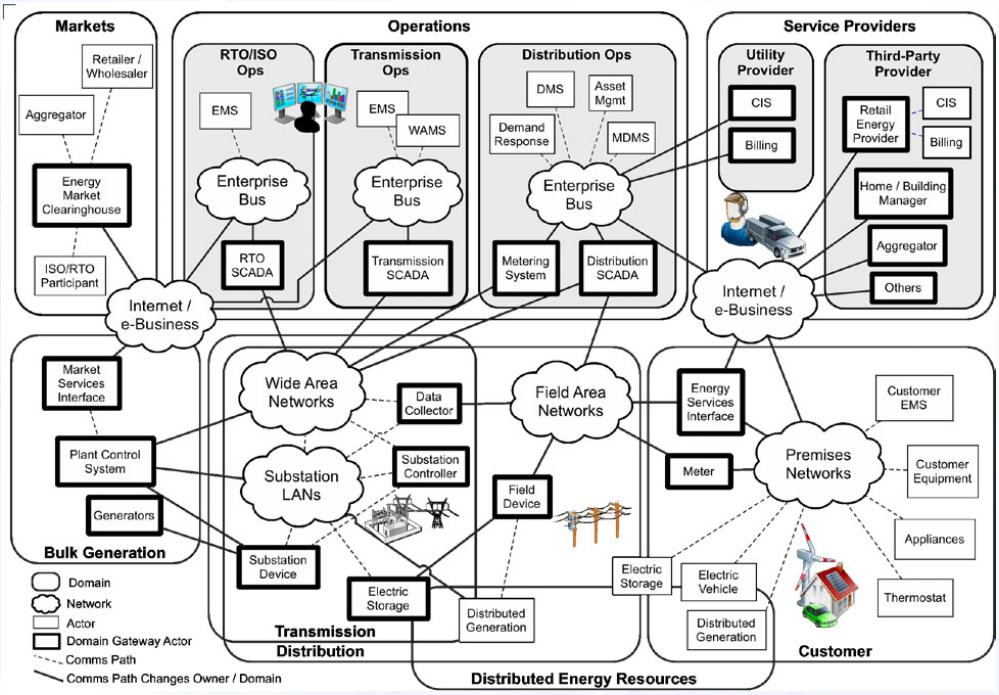
Dr. S. Shyam Sunder
Director, NIST Engineering Laboratory

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

NIST Releases Final Smart Grid 'Framework 2.0' Document

An updated roadmap for the Smart Grid is now available from the National Institute of Standards and Technology (NIST), which recently finished reviewing and incorporating public comments into the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0.

The 2.0 Framework lays out a plan for transforming the nation's aging electric power system into an interoperable Smart Grid—a network that will integrate information and communication technologies with the power-delivery infrastructure, enabling two-way flows of energy and communications.



Conceptual Reference Diagram for Smart Grid Information Networks

The final version reflects input from a wide range of stakeholder groups, including representatives from trade associations, standards organizations, utilities and industries associated with the power grid.

"Release 2.0 represents a significant update to the NIST Release 1.0 Framework," said George Arnold, the National Coordinator for Smart Grid Interoperability at NIST. "In addition to the comments received through the public review, we vetted the draft framework in advance with the Smart Grid Interoperability Panel (SGIP) and other groups. The document reflects the consensus-based process the SGIP uses to coordinate development of Smart Grid standards."

The SGIP was created by NIST in November 2009 to provide an open forum for members to collaborate on standards development. Through the SGIP, NIST collaborates with the private sector in coordinating Smart Grid standards. Its more than 1,900 volunteer members from 740 organizations serve as technical experts who work together to create usable standards for the Smart Grid. Hundreds of such standards—covering matters ranging from wireless communication to home energy meters to electric cars—are needed to ensure the many elements of the Smart Grid will work together seamlessly.

Just as its draft version did, the final 2.0 Framework adds 22 standards, specifications and guidelines to the 75 standards NIST recommended in the 1.0 version of January 2010 as being applicable to the Smart Grid. Further improvements and additions to the 1.0 version include:

- a new chapter on the roles of the SGIP;
- an expanded view of the architecture of the Smart Grid;
- a number of developments related to ensuring cybersecurity for the Smart Grid, including a Risk Management Framework to provide guidance on security practices;
- a new framework for testing the conformity of devices and systems to be connected to the Smart Grid—the Interoperability Process Reference Manual;
- information on efforts to coordinate the Smart Grid standards effort for the United States with similar efforts in other parts of the world; and
- an overview of future areas of work, including electromagnetic disturbance and interference, and improvements to SGIP processes.

NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0, is available at www.nist.gov/smartgrid/upload/NIST_Framework_Release_2-0_corr.pdf

Updated Guidelines to Help Ensure Electrical Devices are Smart Grid Ready

Taking a step closer to ensuring that new electrical devices will be ready to plug into the nation's next-generation power grid, the National Institute of Standards and Technology (NIST)'s Smart Grid Interoperability Panel (SGIP) recently outlined the process by which test laboratories and certifying organizations are accredited for evaluation of Smart Grid products.

This update to the Interoperability Process Reference Manual* is a major step forward from the manual's 1.0 version of last year, according to Rik Drummond, chair of the SGIP's Testing and Certification Committee.

"Our objective is to ensure high-quality, easily installed products reach the marketplace that are fully interoperable with the new 'smart' power grid," says Drummond, who is also CEO and Chief Scientist at Drummond Group. "The process of following the guidelines in the IPRM will accomplish that."

Smart Grid technologies aim to transform the nation's aging electric power system into a network that integrates modern communication technologies with the power-delivery infrastructure. These changes will enable two-way flows of energy, communication and control capabilities.

To render the countless devices that connect to the grid fully "interoperable"—able to work together seamlessly—hundreds of new standards are under development by the SGIP membership. Electrical devices—from the largest power generator to the smallest household appliance—will need to adhere to these standards if they are to function as desired. Drummond says accredited testing labs and certification bodies are vital for ensuring broad interoperability and speeding the implementation of the Smart Grid.

There are so many standards and so many products to certify, no one lab can test them all," Drummond says.

"So the IPRM puts into place a process that allows the accreditation of many testing labs and certification bodies to support all the standards. These processes will help ensure a high quality of testing and consistency of test results between different labs."

Having interoperability standards in place is only a first step. To ensure that products bought by consumers will work as advertised, trusted accreditation organizations evaluate the procedures used by testing laboratories. The IPRM v2.0 outlines the process these objective third parties should follow to accredit a testing and certification lab, as well as what the labs themselves must do to test products.

"The testing and certification process is critical to ensure the interoperability of devices made for the Smart Grid," says NIST's George Arnold, the National Coordinator for Smart Grid Interoperability. "The framework for lab accreditation in the updated manual adheres to international standards, which will be valuable for ensuring products that meet these labs' requirements can reach markets worldwide."

Several accrediting organizations have agreed to offer accreditation that adheres to IPRM v2.0 procedures; three of these are members of the American Council of Independent Laboratories (ACIL, www.acil.org). These accrediting organizations, along with their contact information, include:

- A2LA, American Association for Laboratory Accreditation. Member of ACIL. Contact: Adam Gouker, agouker@A2LA.org; www.A2LA.org
- ANSI-ASQ National Accreditation Board/ACLASS, a joint effort of ANSI and the American Society for Quality (www.asq.org). Contact: Roger Muse, rmuse@anab-aclass.org; www.anab-aclass.org
- ANSI, American National Standards Institute. Contact: Reinaldo Figueiredo, rfigueir@ansi.org; www.ansi.org
- L-A-B, Laboratory Accreditation Bureau. Member of ACIL. Contact: Doug Leonard, dleonard@l-a-b.com; www.l-a-b.com
- PJLA, Perry Johnson Laboratory Accreditation. Member of ACIL. Contact: Tracy Szerszen, tszerszen@pjlabs.com; www.pjlabs.com

*Interoperability Process Reference Manual

Federal Committee Seeks Information on Domestic Forging Capabilities

Does the United States have sufficient industrial capabilities to produce adequate supplies of forged-quality metal parts to meet the needs of the Defense Department and other federal agencies?

That is what the Metal Fabrication Study Group, part of the interagency Defense Production Act Committee (DPAC), wants to know.

Forged-quality parts are essential components of aircraft wheels and landing gear, vehicle armor, energy generation equipment, railroad cars, rocket engines, and other manufactured products.

The study group, led by Howard Harary, Deputy Director for Manufacturing in the Engineering Laboratory of the National Institute of Standards and Technology, conducted an initial survey of domestic forging capabilities. It found that current capabilities stem from investments made several decades ago, yet the need for forged-quality parts has not diminished. As a consequence, supplies of some critical forged-quality parts have been inadequate to meet important government needs.

Martin_Dallaire/Shutterstock

In its request, the study group seeks industry insights into ways to address current limitations on supplies of forged-quality parts, as well as to understand the opportunities to address those limitations. Key areas of interest include process capabilities and limitations, supply-chain-related issues, and alternative manufacturing methods and barriers to their implementation.

Under the Defense Production Act of 1950, the DPAC advises the president on strategies to ensure adequate domestic production of critical components, critical technology items, and industrial resources essential for national security.

Read more about the DPAC at http://www.dpacommittee.com/. The study group's request for information is at https://www.fbo.gov/index?s=opportunity&mode=form&id=bebaebd0f1bc3190b2cd97553dc87dfa&tab=core&_cview=0

NIST Earns Honor for Work Supporting Information Exchange Across Supply Chains

The Open Application Integration Group (OAGi), a U.S.-based, nonprofit consortium, has recognized the Systems Integration Division at the National Institute of Standards and Technology (NIST) as an "outstanding contributor" organization. The award acknowledges the division's role in accelerating the development and adoption of OAGi standards for communicating among industrial suppliers and service providers and their customers.

OAGi develops standards that enable hassle-free exchanges of information and applications across global supply chains. Called BODs, for business object documents, the consortium's standards are now used by more than 3,500 businesses and other organizations in nearly 90 countries.

Over the 11 years that the division, part of NIST's Engineering Laboratory, has been an OAGi member, agency researchers have devised automated methods and testing tools for evaluating prototype software implementations of BOD standards. NIST's evaluations have flagged errors in premarket versions of standards and applications, improving the quality of the resulting commercial software and saving vendors and users time and money.

In the early 2000s, NIST played a key technical role in a proof-of-concept project that demonstrated the usefulness of OAGi BODs in automotive supply chains. These supply chains include not only original equipment manufacturers and their parts and materials suppliers but also transporters, warehouses, retailers, and even customers. Today, according to the consortium, OAGi's standards are used by businesses in 38 industries, including agriculture, chemical processing, metal working and various high-technology sectors.

"Integration and data quality problems impede efficient product development and manufacture and impose significant costs in time and money on American industry," explains Simon Frechette, leader of NIST's Information Modeling and Testing Group within the Engineering Laboratory.

In ongoing work, the NIST-OAGi collaboration is developing new standards intended to make it easier for American small and medium-sized manufacturers to communicate their manufacturing capabilities electronically. "That first electronic handshake is very important," says Frechette. "Understanding how your customer communicates digital manufacturing data is a critical first step in any supply chain relationship." Frechette and his colleagues received the award at the OAGi's annual meeting, hosted at NIST on April 25, 2012.

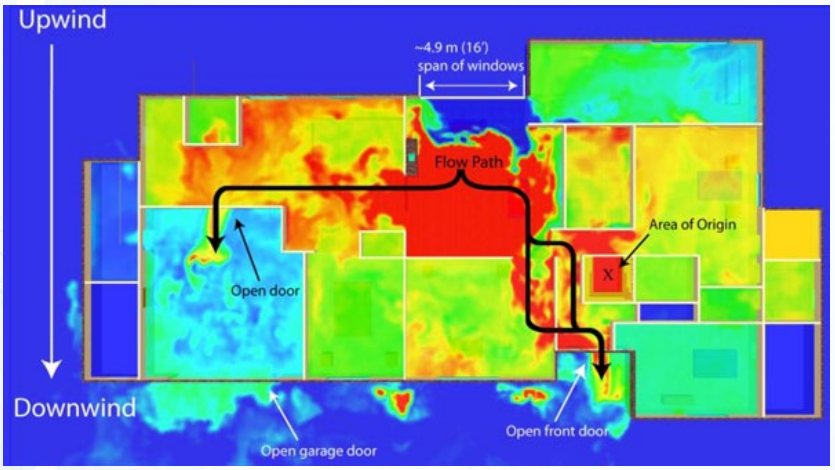
NIST Report on Texas Fire Urges Firefighters to Consider Wind Effects

Wind conditions at a fire scene can make a critical difference on the behavior of the blaze and the safety of firefighters, even indoors, according to a new report by the National Institute of Standards and Technology (NIST). The findings confirm earlier NIST research, but they take on a particular immediacy because they are based on detailed computer models of a tragic 2009 residential fire in Houston, Texas, that claimed the lives of two firefighters.

The NIST modeling was done at the request of the Houston Fire Department (HFD) and the Centers for Disease Control and Prevention's National Institute for Occupational Safety and Health (NIOSH), both of which wanted expert insight into the fire dynamics (behavior) that killed a 29-year veteran captain and a probationary firefighter.

Two NIST fire experts traveled to Houston shortly after the April 12, 2009, fire in a one-story ranch-style home located on the east side of the city. They examined the site and collected data about the behavior of the fire and the factors impacting that behavior—in particular, the wind at the time—in order to unravel the events that led to the deaths of the two men.

This was accomplished by creating sophisticated computer models of the fire and then visualizing them using two popular NIST software tools: the Fire Dynamics Simulator (FDS), which numerically characterizes the movement of smoke and hot gases caused by fire, wind and ventilation systems; and Smokeview, which displays the FDS calculation results as animations. The simulations portrayed two different scenarios of the Houston fire. The first demonstrated the actual conditions that firefighters experienced that day, including the contributing role of wind, while the second was intended to show how the fire may have behaved in the absence of wind. The wind-included scenario indicated that the fire followed a wind-driven flow path between the den and the front door after the failure of a large span of windows in the den. Floor-to-ceiling temperatures rapidly increased—in some areas, in excess of 260 degrees Celsius (500 degrees Fahrenheit)—in this flow path where multiple crews of firefighters were working. In the NIST simulation that excluded wind, the flow path was not created, and the temperatures and conditions where the firefighters were working were significantly less hazardous.

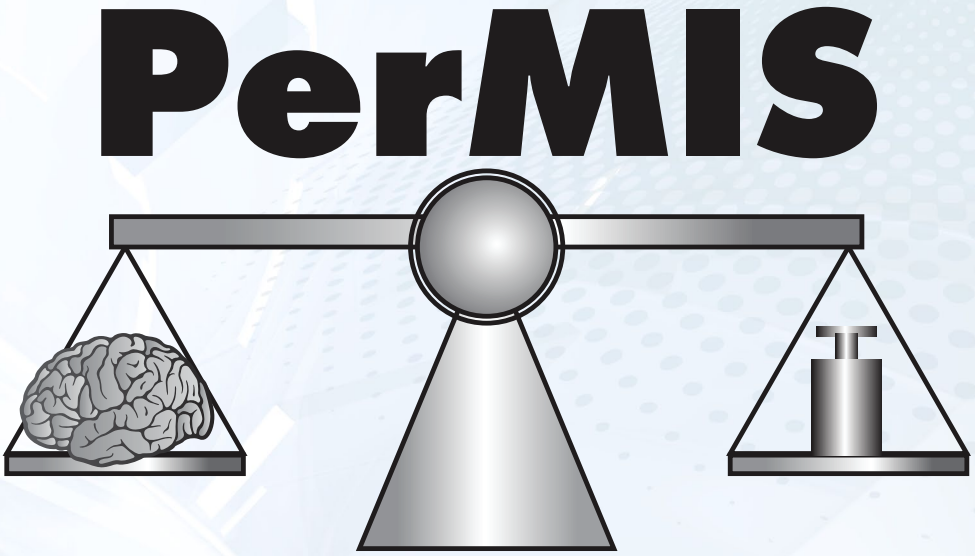


Computer simulation of an April 2009 residential fire in Houston, Texas, showing the deadly wind-driven flow path created by the failure of a large span of windows in the rear of the structure. Credit: NIST

The authors of the NIST report, Adam Barowy and Daniel Madrzykowski, stated that "the 'wind' and 'no wind' simulations clearly demonstrate how wind conditions can rapidly change the thermal environment from tenable (survivable) to untenable for firefighters working in a single-story residential structure fire." They add that the results from the Houston fire simulations are in agreement with those NIST has done in collaboration with the Fire Department of New York City and the Chicago Fire Department for wind-driven fires in high-rise structures. This, the authors said, stresses the importance of including wind conditions for all structural fire scene operations—both before and during firefighting—and adjusting tactics according to changing wind situations, especially regarding interior operations, to enhance the safety, and maximize the effectiveness, of firefighters.

The NIST report that describes the details of the computer models and what was learned from them, Simulation of the Dynamics of a Wind-Driven Fire in a Ranch-Style House—Texas (NIST Technical Note 1729), is available online at www.nist.gov/customcf/get_pdf.cfm?pub_id=909779

11th NIST Workshop on Performance Metrics for Intelligent Systems Focuses on Cyberphysical Systems



The NIST Engineering Laboratory sponsored and conducted the 11th Workshop on Performance Metrics for Intelligent Systems (PerMIS 2012). Held at the University of Maryland on March 20-22, the workshop series is a forum for sharing ideas and experiences related to measuring the performance of intelligent systems used in manufacturing, defense, homeland security, medical devices, and other domains.

The theme for PerMIS 2012 was "performance measurement for developing and engineering the next generation of cyber physical systems (CPS)." The CPS focus was evident in two of the six plenary talks and in a panel discussion that included experts from NIST and academia. The CPS-related plenary talks were given by Edward Lee of UC-Berkeley speaking on "Time for High-Confidence Cyber-Physical Systems" and by George Arnold, Director of the NIST Smart Grid program, speaking on "Performance and New Paradigms for the Electric Power System."

A special session was devoted to honoring the memory of NIST Fellow Jim Albus and former Guest Researcher Alex Meystel (Drexel University), both instrumental in creating the PerMIS series. The workshop proceedings will appear as a NIST Special Publication and will also be accessible through the Association for Computing Machinery (ACM) Digital Library, which is the leading source for full-text articles in the information and computer science fields.

The Organizing Committee comprised NIST researcher Elena Messina (General Chair), NIST Associate Raj Madhavan (University of Maryland, Program Chair), NIST researcher Brian Weiss (Publications Chair), and Ani Hsieh (Drexel University, Poster Session Chair).

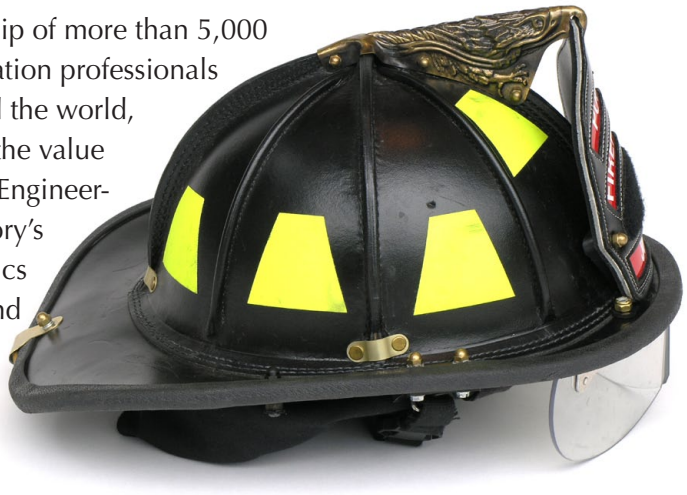
The National Science Foundation (NSF) provided financial support for the student poster session, which was held as part of the welcoming reception. The Defense Advanced Research Projects Agency (DARPA) also provided financial support for PerMIS 2012. Technical co-sponsors included the University of Maryland Robotics Center, the ACM Special Interest Group on Artificial Intelligence, the IEEE Robotics and Automation Systems Technical Committee on Performance Evaluation and Benchmarking, and the IEEE Washington/Northern Virginia Sensors Council Chapter.

NIST Fire Research Earns Honors

Fire researchers at the National Institute of Standards and Technology (NIST) recently were honored by the International Association of Arson Investigators (IAAI), while the Fire Department of New York has just announced that it will name NIST fire protection engineer Daniel Madrzykowski an honorary fire battalion chief.

At its annual meeting on April 25 in Dover, Del., IAAI recognized NIST for helping to organize and provide instructional support for training and certifications programs for federal, state and local fire investigators. These programs often include exercises carried out at supervised burns, which use abandoned structures that are instrumented to accommodate controlled fire experiments. IAAI used video taken at fire experiments in Bensenville, Ill., townhouses as the basis for a training video, "The First Responder's Role in Fire Investigation."

The IAAI Outstanding Accomplishment Award also recognizes the NIST Fire Research Division for using the findings from its technical investigation of the 2007 Charleston Sofa Super Store Fire to assist in preparing an on-line training video that conveys lessons learned from that study (accessible at www.CFITrainer.net). That fire resulted in the deaths of nine firefighters. IAAI, which has a membership of more than 5,000 fire investigation professionals from around the world, singled out the value of the NIST Engineering Laboratory's Fire Dynamics Simulator and its usefulness in reconstructing fire behavior.



A registered engineer, Madrzykowski conducts research in the areas of fire suppression, large-fire measurements, fire investigation and firefighter safety. He is also a member of the National Fire Protection Association and the International Association of Arson Investigators and is a Society of Fire Protection Engineers fellow.

Madrzykowski and NIST colleagues collaborated with the Fire Department of New York City (FDNY) and the Polytechnic Institute of New York University on research that determined how wind affects fires in high-rise buildings. That study included field experiments in an abandoned seven-story building on Governors Island, N.Y. The results confirmed that conditions created by wind can push hot gases and smoke from the apartment of origin into the public corridors and stairwells.

A set of instructional videos based on the research is available for firefighter training to improve safety for civilians and firefighters. Since the study was completed, Madrzykowski has continued to work with members of the FDNY as they modify their firefighting tactics to incorporate the latest research findings.

New York Fire Commissioner Salvatore J. Cassano appointed Madrzykowski to the rank of honorary battalion chief at a ceremony on May 31.

Staff Awards

Edward Garboczi

NIST Fellow

American Ceramic Society Della Roy Lecture Award

For his lecture entitled: "The Computational Materals Science of Concrete: Past-Present-Future"

Jeffrey Bullard

Materials Research Engineer

American Ceramic Society Stephen Brunauer Award

For his paper: "New insights into the effect of calcium hydroxide precipitation on the kinetics of tricalcium silicate hydration"

Shawn Moylan

Mechanical Engineer

SME Outstanding Young Manufacturing Engineer

For exceptional contributions and accomplishments in the manufacturing industry

Dale Bentz

Chemical Engineer

Honorary membership from the ASTM Committee C01 on Cement

In recognition of outstanding service to this Committee and in appreciation of your devotion to its objectives

Paul Stutzman

Physical Scientist

Award of Appreciation From the ASTM Committee C01 on Cement

In recognition of your outstanding service and active participation as Chairman of Subcommittee C01.23

and the

Best Poster Award International Congress on the Chemistry of Cement

Dan Madrzykowski

Fire Protection Engineer

Honorary Battalion Chief, Fire Department of New York, NY (2012)

and the

Dr. John Granito Excellence in Fire Leadership Award

For Excellence in Fire Leadership and Management Research

Gregory Linteris

Mechanical Engineer

2012 Harry C. Bigglestone Award

For his publication: "Clean Agent Suppression of Energized Electrical Equipment Fires"

Kevin McGrattan

Mathematician

Rolf Jensen Award, Society of Fire Protection Engineers

For unselfish, extraordinary and unusual service on a Society of Fire Protection Engineers committee

Kevin McGrattan, Glenn Forney, Randy McDermott, Howard Baum, and Ronald Rehm

Fire Research Division

International FORUM of Fire Research Directors Sjolin Award

For outstanding contribution to fire science or an advance in the state of the art in fire safety engineering practice of extraordinary significance

Recent Publications

- Framework for hybrid life-cycle inventory databases: BEES case study" Environmental Science & Technology
- Investigation Plan - National Institute of Standards and Technology (NIST) Technical Investigation of Building and Emergency Communications System Performance in the Joplin
- Benefits of Using ASTM Building Economics Standards for the Design, Construction, and Operation of Constructed Facilities
- An Assessment of Methods for Determining Wind Loads
- NIST Framework and Roadmap for
- Smart Grid Interoperability Standards,Release 2.0
  www.nist.gov/smartgrid/upload/NIST_Framework_Release_2-0_corr.pdf
- Comment on: Green Space, health inequality, and pregnancy
- The International FORUM of Fire Research Directors
- A Position Paper on Sustainability and Fire Safety
- Prototype Commercial Buildings for Energy and Sustainability Assessment: Design Specification, Life-Cycle Costing and Carbon Assessment

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