Workshop Report

Standards for Disaster Resilience for Buildings and Physical Infrastructure Systems

Report prepared December 2011

1.0 Background

Presidential Policy Directive / PPD-8: *National Preparedness*[1] (PPD-8) seeks to strengthen the security and resilience of the United States through systematic preparation for the threats to the nation's security, including acts of terrorism, cyber attacks, pandemics, and natural disasters. The directive aims to establish a public/private partnership approach to preparedness and resiliency.

Since 2003, the American National Standards Institute (ANSI) Homeland Security Standards Panel (HSSP) has worked to accelerate the development of voluntary standards for homeland security and emergency preparedness in support of the U.S. Department of Homeland Security's (DHS) Science and Technology Directorate.

As part of that continuing effort, the HSSP convened the workshop: *Standards for Disaster Resilience for Buildings and Physical Infrastructure Systems*, on November 10, 2011, in Arlington, VA. This interactive workshop provided an opportunity for all participants – government, standards developers, program developers, and small businesses – to engage in an open dialogue and gain knowledge about all related issues and challenges.

2.0 Workshop Structure

The goal of the workshop was to identify information needed to develop a framework document that will help guide the development of standards and codes for disaster resilience.

The one day event opened with introductory remarks highlighting the importance of disaster resilience. It was noted that as a multifaceted issue, further insight on disaster resilience is needed in order to develop standards- and conformance- based solutions that can be used nationwide.

This introduction was followed by a panel discussion, *Introduction to Resilience of the Built*

[1] http://www.dhs.gov/xabout/laws/gc_1215444247124.shtm

Environment, which identified the workshop goals, provided background on current resilience efforts, and examined a successful case study. The next panel, *Focus on Building Systems*, examined standards for building systems as well as the insurance perspective on building and infrastructure resilience. The third panel of the day, *Focus on Lifelines*, discussed the need for resilience standards and codes in electric power systems, transportation systems, and water and wastewater systems.

The day concluded with an open discussion aimed at determining a path forward for this effort. Workshop participants provided input for the proposed framework in the following key areas: community resilience, water and wastewater, electric power, transportation, and buildings.

All workshop-related presentations posted by participants are available online.[2]

3.0 Welcome and Opening Remarks

Opening remarks were provided by:

- Michelle Deane, Director, Homeland Security Standards, American National Standards Institute (ANSI)

- Stephen A. Cauffman, Deputy Chief, Materials and Construction Research Division, Engineering Laboratory, National Institute of Standards and Technology (NIST)

Ms. Deane began her remarks by welcoming the attendees and thanking them for their participation. Ms. Deane added a special thanks to the workshop co-chairs, Stephen Cauffman, Deputy Chief, Materials and Construction Research Division, Engineering Laboratory, National Institute of Standards and Technology, NIST and Chris Poland, Chairman and Senior Principal, Degenkolb Engineers, for their leadership in convening an esteemed group of individuals. For their generous sponsorship of the workshop, Ms. Deane acknowledged the National Fire Protection Association (NFPA) and the Homeland Security Studies and Analysis Institute. Ms. Deane also thanked Dr. Bert Coursey of the U.S. Department of Homeland Security for his leadership and support of the ANSI-HSSP.

Mr. Cauffman began his remarks by welcoming the participants and noting that this workshop was intended to expand upon a roundtable discussion held on September 26, 2011. Underscoring the importance of resiliency for built environments, he noted that there has been a history of built environments failing during hazard events. Mr. Cauffman added that the performance of the built environment is dependant on codes and standards, their interoperability, and the level of enforcement of those codes and standards. According to Mr. Cauffman, currently existing codes and standards for the built environment focus on resistance to hazards or liability of service, but do not currently address resilience.

[2] http://www.ansi.org/meetings_events/events/2011/HSSP_Plenary_1111.aspx?menuid=8

Mr. Cauffman defined the workshop objective as an information exchange to identify gaps in current codes and standards that need to be addressed in order to develop a framework for the development of new standards and codes for resilient buildings and infrastructure systems.

4.0 Panel Discussion – *Introduction to Resilience of the Built Environment*

Panelists Included:

- Therese McAllister, Ph.D., PE, Research Structural Engineer, National Institute of Standards and Technology (NIST)
- Chris D. Poland, Chairman and Senior Principal, Degenkolb Engineers

The Stafford Act

The built environment has repeatedly failed in disaster events leading to the *Robert T. Stafford Disaster Relief and Emergency Assistance Act*[3] (Stafford Act), which authorizes the President to issue a disaster declaration in order to provide federal aid to states overwhelmed by natural hazards or other catastrophes. The Stafford Act authorizes grants as well as the repair of public infrastructure and emergency communication systems.

Codes and Standards

The performance of the built environment is dependent on the codes and standards in place at the time of construction, as well as the enforcement of those codes and standards. The current codes and standards for the built environment are generally independent, addressing only one area of a building.

Resilience in the built environment focuses on functionality of community buildings and infrastructure systems after an event. In order to establish resiliency in the built environment there is a need to account for the building as a whole unit by developing interoperable standards and codes. Additionally, the framework document resulting from this workshop must emphasize the ability of the built environment to prepare, mitigate, resist, and recover.

Public/Private Sector Efforts

The *National Strategy for the Physical Protection of Critical Infrastructures and Key Assets*[4] was issued by DHS in 2003 in order to ensure the protection of critical infrastructure and assets that face a threat. Additionally, the strategy aims to identify and assure the protection of assets, systems, and functions deemed most critical for national public health and safety.

The DHS National Infrastructure Protection Plan[5] (NIPP 2009) has a goal of building a safer, more resilient America by strengthening national preparedness and rapid recovery of critical infrastructures and key resource (CIKR) in the event of a disaster or emergency. The NIPP also aims to prevent or mitigate the effects of terrorist acts.

There is a growing awareness within the private sector regarding the need for uniform risk throughout a building, the need for recovery plans, and the need to address interoperability.

[3] http://www.fema.gov/about/stafact.shtm
[4] http://www.dhs.gov/files/publications/publication_0017.shtm
[5] http://www.dhs.gov/files/programs/editorial_0827.shtm

The private sector has been active in the area of resilience and has seen a number of recent efforts including:

- Critical Infrastructure Guidelines - American Society of Civil Engineers (ASCE)
- Prioritizing Critical Infrastructure Security/Resilience – American Society of Mechanical Engineers (ASME)
- All Hazards Consequence Management Plan – American Water Works Association (AWWA)
- White Paper on Infrastructure Resilience & Interdependencies – The Infrastructure Security Partnership (TISP)
- Guidelines for Performance Based Seismic Design of Tall Buildings – Pacific Earthquake Engineering Research Center (PEER)
- National Earthquake Resilience – National Research Council

National Earthquake Hazards Reduction Program (NEHRP)

The National Earthquake Hazards Reduction Program[6] (NEHRP) aims to make the nation earthquake-resilient in order to support public safety, economic strength, and national security. The NEHRP produced a white paper on resilience that notes that unified support is required from all levels of government, as the government should set performance standards for all construction and insist that states adopt and enforce the codes while providing incentives to stimulate mitigation.

San Francisco Planning and Urban Research Association (SPUR)

The San Francisco Planning and Urban Research Association[7] (SPUR) approaches resilience by first defining resilience in the context of disaster planning and recovery. Performance goals then need to be established for the physical infrastructure to support the definition of resilience. Transparent performance measures also need to be defined in order to help reach the performance goals. Transparent design codes and standards are needed and should include hazard definitions for building resilience as well as lifelines and building safety. These standards and codes also need to include performance objectives to support resilience.

Government's Role

The government can provide leadership and focus on the framework for resiliency, with the private sector then assisting in creating the framework. There is no expectation that the government will provide funding; however, the federal government should require that the building standards and codes be adopted. The success of the framework will be dependent on the public-private partnership successfully working together to streamline the standards development and adoption process.

[6] http://www.nehrp.gov/
[7] http://www.spur.org/policy/the-resilient-city

Need for Standards and Codes

In order to achieve resilient communities, there is a need to develop performance-based standards and codes for resilience as well as a comprehensive approach to design guidance for the built environment. Additionally, there is a need for proactive planning by communities in order to achieve resilience.

Physical resilience is the foundation of all resiliency plans, most notably earthquake resilience plans. Furthermore, environmental sustainability must be included in planning to eliminate the costly deconstruct/reconstruct cycle.

Building standards need be enhanced in order to ensure that housing still exists during the recovery process. This would enable business continuity in the business's current community without the need for the business to relocate. Standards need to provide the tools for communities to determine what they need to do in order to be resilient, and community recovery planning should include the usability of buildings and systems after a disaster.

5.0 Panel Discussion – *Focus on Building Systems*

Panelists included:

- James R. Harris, Owner & Principal, JR Harris Company
- Dan Howell, Senior Engineer, FM Global

Codes and Standards

Building standards currently in existence include mandatory safety and serviceability criteria. These criteria are currently based on concepts of structural liability. The existing criteria related to resilience in standards are complex and include risk adjustments for the importance of the structure as well as high levels of safety and functionality.

Standards for resilience in buildings face several obstacles including a rational basis for establishing the performance of a building and the issue of resource allocation. There is a need for an economic analysis to determine the needs of a resilient community.

Economic Assistance

Natural hazards and fires represent significant physical risk and are expensive for communities to recover from. Flood losses represent 35-40% of natural hazard losses and include physical damage and business interruption.

The Federal disaster assistance, response, and recovery program could be more effective if economic assistance is only provided to communities that have adopted and conformed to building standards and codes.

Inspection and Enforcement

Inspection and enforcement is extremely important during the construction of new buildings to ensure that developers are complying with building codes and standards. Insurance is a strong tool in providing incentives for building owners and developers to follow building codes and standards.

6.0 Panel Discussion – *Focus on Lifelines*

Panelists for this session included:

- Woody Savage, University of Nevada, Las Vegas
- Steve Ernst, Senior Bridge Engineer, Safety and Security, Federal Highway Administration
- Don Ballantyne, PE, Principal, Degenkolb Engineers

Existing Efforts

The *Policy on Acceptable Levels of Earthquake Risk for California Gas and Electric Utilities*[8] was prepared by the ASCE Inter-Utility Seismic Working Group at the request of the California Seismic Safety Commission and includes a policy implementation checklist with the goal of meeting societal needs.

The American Lifeline Alliance (ALA) was established as a public/private partnership with the aim of reducing risks to utility and transportation systems from natural hazards and human threat events.

Community Impact

Water system resilience is a critical community issue. Water is needed for fire suppression during and immediately following disaster events making continuity of water service critical to the community. Water treatment plants also need to function properly during all disaster events in order for the community to have useable water.

IT Security

IT security is a chief concern within the utilities industry. Currently there is a limit as to what can be protected against. A risk management approach is suggested for all utilities in order to better protect them from an IT breach.

Interoperability

There is a need for the utility sector to develop an operational level of interaction among the utility lifelines. This interoperability would allow for emergency response planning activities to occur within the utilities sector. Additionally, a common methodology or guidance document for the utility sectors needs to be established in order to define varying levels of service during a disaster. Community needs for resilience will drive performance and the establishment of standards and guidelines in utility lifelines.

Standards Needs

There are several framework issues for performance standards for electric power systems including the issue of lifeline characteristics differing from building to building, multiple ownerships complicating coordination, and limited knowledge of various systems.

Bridge design standards currently do not address security. Bridge standards also need to examine the effect of wave-forces on bridges.

[8] http://cedb.asce.org/cgi/WWWdisplay.cgi?95769

Resilience in the highway community focuses on not only resistance to threats but also the ease of repair. Highway tunnels do not currently have security standards. Existing standards for tunnels are used for fire design of tunnels and bridges and include some security application.

Water systems on the west coast were not built in accordance to any seismic standards. Existing water and wastewaters standards focus on system performance guidelines. There is a need for risk-based performance standards that include specific hazards and their impacts on water and wastewater systems. Additional standards are needed for the design and performance of pipelines.

7.0 Open Discussion – *Path Forward*

A framework document is needed in order to form a holistic approach to community resilience with standards that support integrated systems performance and recovery levels for hazards. The framework document will include tools for planning, performance goals, and tools for developing standards.

Resilience issues, metrics, and examples were discussed in each of the following areas with the goal of including them in the framework document:

Community Resilience

- Including safe havens in urban community planning would provide the community with shelter during disasters as well as recreational facilities.

- A framework document comparable to SPURs methodology is needed in order to provide guidance and tools to communities in planning for and recovering from disaster events.

- There are currently two types of temporary FEMA housing: regular housing and ADA compliant housing. In order to streamline the design process of temporary housing there should be one design for both ADA and non-ADA compliant housing.

- A set of goals and principles need to be determined in order to establish a consistent methodology to assist community resilience. This effort needs to be a public/private partnership with strong leadership from the Department of Homeland Security.

- A list of current activities should be established in order to provide common references to current community resilience planning.

Water and Wastewater

- There is a need for the development of seismic standards for pipelines and sewer systems.

- General system evaluations for multi hazards for water and wastewater should be conducted and be consistent with ALA documents.

- Community based water resiliency is encouraged and aims to determine the interdependencies of local level water systems, fire departments, etc. in order to

- The establishment of a water grid similar to the “smart grid” for electricity is needed in order to manage water systems as a country.

- Other countries have standards and best practices in place that could serve as guidance for U.S. water systems.
- There is a need for the replacement of older systems and the integration of new systems with older components. Additionally there is a need for the replacement of old water lines, as well as the burying of power cables when replacing water lines in order to have both the water and electricity sectors work together.

Electric Power

- There is an overlap with smart grid and electric power resilience and system efficiency, and collaboration with smart grid efforts is needed to ensure resiliency.

- Solar wind farms can be susceptible to damage and should be included in resiliency planning, as should alternative energy sources.

- The ASCE wind turbines recommended practice will be published soon and includes best practices for resiliency planning.

- New standards and codes that are developed should include solar power as a source of back up power for community resilience.

Transportation

- A full system evaluation is needed in all transportation areas.

- In order to calculate the economic impact of transportation system disruption, intermodal dependencies and efficiencies need to be determined.

- Non-traditional hazards need to be incorporated into the planning process.

- The inspection and maintenance of transportation systems needs to be leveraged in order to ensure that all systems are up to date.

- Transportation is a key element in supply chain continuity. A public/private funding mechanism could be utilized to assist in the resiliency planning of transportation systems.

- First line interdependency of transportation needs to be understood and communicated in resiliency planning.

- A risk managed approach needs to be incorporated into resiliency standards for transportation systems.

Buildings

- Public/private partnerships, including local/state/federal partnerships, are needed in order to try multiple solutions for resilience planning in buildings.
- There is a need to encourage the adoption of codes through incentives.
- The robustness of buildings where codes are minimums must be examined, as well as the durability of buildings.
- Inspection and enforcement of codes is critical in the resiliency of buildings.
- There is a need for education regarding past solutions in the resiliency of buildings with the goal of applying those solutions universally.
- A cost effectiveness assessment is needed in order to allocate resources in an effective manner.
- There is a need for standardized building evaluation procedures.
- Information needs to be provided to building owners to build beyond the current codes and standards. If the process is incentivized, building owners may choose to build beyond the codes in order to prevent the impact of disasters and hazard events.
- The National Research Council is currently developing a framework, *Increasing National Resilience to Hazards and Disasters*, that can provide guidance in resiliency planning

8.0 Acknowledgements

Recognition and sincere appreciation are due to the following:

- The National Fire Protection Association and the Homeland Security Studies and Analysis Institute for their sponsorship of the workshop.
- Stephen A. Cauffman, Deputy Chief, Materials and Construction Research Division, Engineering Laboratory, National Institute of Standards and Technology, and Chris D. Poland, Chairman & Senior Principal, Degenkolb Engineers, for their leadership of this workshop.
- Therese McAllister, Ph.D., PE, Research Structural Engineer, National Institute of Standards and Technology (NIST) for leading the path forward discussion and summary.
- All of the speakers listed on the agenda for sharing their expertise and introducing key ideas and concepts utilized during the open dialogue sessions.

Appendix 1 Agenda

Co-Chairs:

Chris D. Poland
Chairman & Senior Principal
Degenkolb Engineers

Stephen A. Cauffman
Deputy Chief
Materials and Construction Research Division
Engineering Laboratory
National Institute of Standards and Technology

ANSI Homeland Security Standards Panel
Workshop on:
Standards for Disaster Resilience for Buildings and Physical Infrastructure Systems

Thursday, November 10, 2011

Final Agenda

Crystal Gateway Marriott
1700 Jefferson Davis Highway
Arlington, VA 22202

8:15am – 9:00am	**Registration**
9:00am – 9:30am	**Welcome/Opening Remarks** • **Stephen A. Cauffman**, Deputy Chief, Materials and Construction Research Division, Engineering Laboratory, National Institute of Standards and Technology
9:30am – 10:45am	**Panel 1 – Introduction to Resilience of the Built Environment** • Introduction to Resilience for Buildings and Infrastructure Systems o **Therese McAllister**, PhD PE, Research Structural Engineer, National Institute of Standards and Technology (NIST) • Community Planning for Resilience – SPUR o **Chris D. Poland**, Chairman & Senior Principal, Degenkolb Engineers • Questions and Discussion
10:45am – 11:00am	**Morning Break**
11:00am – 12:15pm	**Panel 2 – Focus on Building Systems** • Standards for Building Systems

	○ **James R. Harris**, Owner & Principal, JR Harris Company • Insurance Perspective on Building and Infrastructure Resilience ○ **Dan Howell**, Senior Engineer, FM Global • Questions and Discussion
12:15pm – 1:00pm	**LUNCH**
1:00pm – 3:15pm	**Panel 3 – Focus on Lifelines** • Standards for Electric Power Systems ○ **Woody Savage**, University of Nevada, Las Vegas • Standards for Transportation Systems ○ **Steve Ernst**, Senior Bridge Engineer, Safety & Security, Federal Highway Administration • Standards for Water and Wastewater Systems ○ **Don Ballantyne**, PE, Principal, Degenkolb Engineers • Questions and Discussion
3:15pm – 3:30pm	**Afternoon Break**
3:30pm – 4:45pm	**Panel 4 – Path Forward** • Proposed Framework/Roadmap for Developing Resilience Standards ○ Moderator: **Therese McAllister**, PhD PE, Research Structural Engineer, National Institute of Standards and Technology (NIST) • Questions and Discussion ○ Workshop participants will be requested to provide input on the proposed framework and to develop consensus where possible.
4:45pm – 5:00pm	**Closing Remarks** **Workshop Co-Chairs:** • **Chris D. Poland**, Chairman & Senior Principal Degenkolb Engineers • **Stephen A. Cauffman**, Deputy Chief, Materials and Construction Research Division, Engineering Laboratory, National Institute of Standards and Technology
5:00pm	**Adjournment**

Appendix 2 Roster of In-Person Attendees – Tenth Plenary and Workshop

First Name	Last Name	Organization
Don	Ballantyne	Degenkolb Engineers
Dan	Bart	Valley View Corporation
Christina	Baxter	U.S. Department of Defense (DoD)
Victor	Benavides	U.S. Department of Homeland Security (DHS)
S. Joe	Bhatia	American National Standards Institute (ANSI)
William	Billotte	National Institute of Standards and Technology (NIST)
Jami	Blackmon	Environmental Security International
Joseph	Booth	Stephenson Disaster Management Institute
Jerry	Brashear	ASME - Innovative Technologies Institute
Paul	Brenner	ICF International
John	Bridges	The National Graduate School of Quality Management
Joe	Broz	Defense Capital Advisors, LLC
Wayne	Bryden	FLIR Systems
Lydia	Canda	U.S. Department of Homeland Security (DHS)
Jessica	Carl	American National Standards Institute (ANSI)
Stephanie	Carroll	American National Standards Institute (ANSI)
John	Catlett	Department of Code Administration
Stephen	Cauffman	National Institute of Standards and Technology (NIST)
Robert	Chapman	National Institute of Standards and Technology (NIST)
Robert	Connors	Raytheon
Jerome	Conrad	U.S. Department of Homeland Security (DHS)
Richard	Cooper	U.S. Chamber of Commerce
Bert	Coursey	National Institute of Standards and Technology (NIST)
Matthew	Davenport	U.S. Department of Homeland Security (DHS)
Don	Davidson	U.S. Department of Defense (DoD)
Michelle	Deane	American National Standards Institute (ANSI)
Tamara	Dickinson	Office of Science and Technology Policy, EOP
Lucy	DiGhionno	U.S. Department of Homeland Security (DHS)
Robert	Dix	Juniper Networks
Robert	Domenici	HyGie-Tech USA, Inc.
Paul	Domich	CIP-Consulting, Inc.
Chris	Dubay	National Fire Protection Association (NFPA)
Leonardo	Duenas-Osorio	Rice University
Lorraine	Eide	U.S. Department of Homeland Security (DHS)
John	Elinski	Battelle Memorial Institute
Jean-Paul	Emard	ATIS
Elizabeth	English	University of Waterloo School of Architecture
Steve	Ernst	FHWA
Alim	Fatah	National Institute of Standards and Technology (NIST)
Mathew	Francis	URS
Gordon	Gillerman	National Institute of Standards and Technology (NIST)
Sandra	Gogol	U.S. Department of Homeland Security (DHS)
David	Goldbloom-Helzner	U.S. Environmental Protection Agency
Dave	Gorshkov	Digital Grape Business Services
Jennifer	Goupil	Structural Engineering Institute

Pamela	Greenlaw	U.S. Department of Homeland Security (DHS)
James	Harris	JR Harris Company
Jay	Harris	National Institute of Standards and Technology (NIST)
William	Haskell	National Institute for Occupational Safety & Health
Renee	Hendricks	U.S. Department of Homeland Security (DHS)
Gwainevere	Hess	U.S. Department of Homeland Security (DHS)
Kathleen	Higgins	U.S. Department of Homeland Security (DHS)
Dan	Howell	FM Global
Lawrence	Hudson	National Institute of Standards and Technology (NIST)
George	Huff	American Bar Association
David	Karmol	International Code Council (ICC)
Fran	Kernodle	FKA, Inc.
Siraj	Khan	U.S. Department of Homeland Security (DHS)
Kristin	Korte	FLIR Systems
John	Kulick	Siemens USA
John	Laws	U.S. Department of Homeland Security (DHS)
Philippe	LeGoff	HyGie-Tech USA, Inc.
Hai	Lew	National Institute of Standards and Technology (NIST)
Alison	Littlepage	U.S. Department of Homeland Security (DHS)
Jennifer	Marshall	National Institute of Standards and Technology (NIST)
John	Martin	U.S. Department of Homeland Security (DHS)
Harry	Massey	National Electrical Manufacturers Association (NEMA)
Phillip	Mattson	U.S. Department of Homeland Security (DHS)
Evette	Maynard-Noel	U.S. Department of Homeland Security (DHS)
Terri	McAllister	National Institute of Standards and Technology (NIST)
Nancy	McNabb	National Institute of Standards and Technology (NIST)
David	McWhorter	Catalyst Partners
John	Milam	Dynamis
Peter	Misuinas	U.S. Department of Homeland Security (DHS)
Ashley	Moore	U.S. Department of Homeland Security (DHS)
Kevin	Morley	American Water Works Association (AWWA)
Kenneth	O'Dell	MHP, Inc. Structural Engineers
Stephan	Parker	Transportation Research Board, National Academies
Nicholas	Paulter	National Institute of Standards and Technology (NIST)
Will	Peart	William H. Gordon Associates, Inc.
Charles	Piersall	Chairman, ISO/TC 8 (Ships and marine technology)
Chris	Poland	Degenkolb Engineers
Nancy	Pomerleau	U.S. Department of Homeland Security (DHS)
Erik	Puskar	National Institute of Standards and Technology (NIST)
Irmak	Renda-Tanali	University of Maryland University College
James	Rossberg	ASCE
Fahim	Sadek	National Institute of Standards and Technology (NIST)
Mary	Saunders	National Institute of Standards and Technology (NIST)
Woody	Savage	University of Nevada Las Vegas
Fran	Schrotter	American National Standards Institute (ANSI)
Bill	Schweigart	U.S. Department of Homeland Security (DHS)
Everett	Sedgwick	Federal Emergency Management Agency (FEMA)
Peter	Shebell	U.S. Department of Homeland Security (DHS)

Steve	Skalko	Portland Cement Association
Robert	Stenner	Pacific Northwest National Laboratory (PNNL)
Carolyn	Tabarini	U.S. Department of Homeland Security (DHS)
William	Taylor	Washington Metropolitan Area Transit Authority (WMATA)
Adam	Theil	Alexandria Fire Department
Cathy	Tilton	Daon
Richard	Vandame	U.S. Department of Homeland Security (DHS)
Robert	Vondrasek	National Fire Protection Association (NFPA)
Randy	Wagoner	Federal Emergency Management Agency (FEMA)
Erin	Walsh	U.S. Department of Homeland Security (DHS)
Nick	Weber	U.S. Department of Homeland Security (DHS)
Richard	Weisman	U.S. Environmental Protection Agency
Jefferson	Welch	Carnegie Mellon Software Engineering Institute
Heiko	Werner	Federal Agency for Technical Relief (THW) - Germany
Kenneth	Willette	National Fire Protection Association (NFPA)
Marcus	Williams	Homeland Security Studies and Analysis Institute
Kevin	Wong	National Institute of Standards and Technology (NIST)
Robert	Zimmerman	Homeland Security Studies and Analysis Institute

Appendix C – Speaker Bios

Donald Ballantyne

Donald Ballantyne, PE, is a Principal with Degenkolb Engineers. He received a BSCE from Rensselaer Polytechnic Institute, and an MSCE from the SUNY at Buffalo. He has 37 years of experience focusing on seismic performance and design of water and wastewater utilities. He has conducted more than 65 system seismic risk assessments and upgrades, many for major west coast cities. Post-earthquake reconnaissance has been a major contributor to Mr. Ballantyne's expertise, having conducted assessments following 13 earthquakes, including Loma Prieta in 1989, Northridge in 1994, Kobe in 1995, Nisqually in 2001, and Peru in 2007.

Mr. Ballantyne is widely published, having written or given over 85 papers and presentations. He was the lead author for the NIST publication, "Reliability and Restoration of Water Supply Systems for Fire Suppression and Drinking Following Earthquakes." For the American Water Works Association he wrote, "Minimizing Earthquake Damage, A Guide for Water Utilities." And for the American Lifelines Alliance, Mr. Ballantyne wrote, "Wastewater System Performance Assessment Guideline."

He has been active in professional organizations associated with earthquake mitigation. He is the former chair of the ASCE Technical Council on Lifeline Earthquake Engineering, and a former member of the Board of Directors of the Earthquake Engineering Research Institute.

Stephen Cauffman

Mr. Stephen Cauffman is the Deputy Chief of the Materials and Structural Systems Division in the National Institute of Standards and Technology (NIST) Engineering Laboratory. He manages NIST's program on Structural Performance under Multi-Hazards, and leads NIST's work on Disaster Resilient Buildings, Infrastructure and Communities. Mr. Cauffman led NIST's reconnaissance of building and infrastructure performance in Hurricanes Katrina and Rita. He was also the program manager for NIST's investigation of the World Trade Center disaster. Mr. Cauffman holds a Bachelor of Science degree in Physics from George Mason University.

Steve Ernst

Mr. Ernst is a registered professional engineer in Virginia with a BSCE from the University of Arkansas and a BS in English from Arkansas State University. He has worked with the Federal Highway Administration (FHWA) for 27 years, including 9 years as a bridge designer with Eastern Federal Lands Highway Division and 16 years as a structural engineer in Federal Highways' Office of Bridge Technology. He is currently responsible for bridge technology programs, including policies, procedures, standards and practices related to safety and security in bridge structures engineering.

Mr. Ernst is the FHWA lead for risk management of critical infrastructure and for interaction with the Department of Homeland Security and other federal agencies on bridge and tunnel security issues. He is the FHWA liaison to the AASHTO Technical Committee on Security and the AASHTO Special Committee on Security. Through the U.S. Army Corps of Engineers, he developed workshops to train engineers to

understand and mitigate security threats to highway assets and is involved with efforts to develop research for structural hardening. He is currently developing new training for blast design of concrete structures and serves as liaison to the NCHRP panel investigating fire on bridges.

He was the FHWA lead for the Blue Ribbon Panel on Bridge and Tunnel Security, co-chair for an international scan for underground structures operations, safety and emergency response, and currently leads an engineering assessment team that evaluates critical bridges and tunnels for security and delivers training on bridge vulnerability and risk management to terrorist threats.

James Harris

Dr. Harris is a structural engineer and Owner and Principal of J.R. Harris & Company in Denver, Colorado. He was elected to the National Academy of Engineering in 2005. He is active in the development of standards of practice, serving on numerous committees of the American Society of Civil Engineers, the American Concrete Institute, the American Institute of Steel Construction, and the Building Seismic Safety Council. He also served as a member of the ASCE/SEI Pentagon Team, and the SEI Chile Earthquake Assessment Team in 2010. He received his PhD in Civil Engineering from the University of Illinois at Urbana-Champaign.

Dan Howell

Dan Howell, PE, has twenty years of engineering experience, including thirteen years of structural design and resident engineering experience on a wide variety of projects. Additionally, he worked for seven years at FM Global where he has authored or co-authored several FM Global loss prevention engineering data sheets related to natural hazards exposure, building envelope systems, structural behavior, and structural fire protection. Mr. Howell has also conducted physical testing for various natural hazard exposures at the FM research facility, and evaluated losses at FM insured facilities. Mr. Howell received his MS in Structural Engineering at the University of Illinois at Urbana-Champaign and his Bachelor of Science in Civil Engineering from the University of Massachusetts at Lowell.

Therese McAllister

Dr. McAllister is a research structural engineer at the National Institute of Standards and Technology in Gaithersburg, MD. She is conducting research on the resilience of building and infrastructure systems and on the performance of structures in fire. She serves on several standards and technical committees of the American Society of Civil Engineers and on a task group for the National Research Council's Strategic Highway Research Program. She was a co-leader for the Structural Fire Response and Collapse of the NIST World Trade Center Investigation and a member of the U.S. Army Corps of Engineers risk analysis team for the levees around New Orleans. She received her Ph.D. in Civil Engineering from Johns Hopkins University.

Chris Poland

Chris Poland's structural engineering career spans more than 35 years and includes a wide variety of new design work, seismic analysis and strengthening of existing buildings, structural failure analysis, and historic preservation. He currently leads Degenkolb's New Technologies Group and consults on a wide variety of the firms projects. As an internationally recognized authority on earthquake engineering, Mr.

Poland routinely participates in policy-changing research projects sponsored by the NSF, USGS, NIST and FEMA. As a passionate advocate and voice for seismic safety, he actively participates in the academic, ethical and social advancement of his field and lectures often. He has served in multiple leadership roles within EERI, ASCE, SEAOC, and ATC.

Mr. Poland presides as Chair of the congressionally mandated Advisory Committee on Earthquake Hazards Reduction for the National Earthquake Hazards Reduction Program. His latest interests, involving advocacy for resilient cities, lead to his involvement in the SPUR Resilient City Initiative as the chair of the Seismic Hazard Mitigation Taskforce. That work lead to his co-chair appointment to the San Francisco Lifelines Council. He chairs the ASCE Standards Committee on Seismic Rehabilitation, led the effort needed to produce the ASCE 31 and ASCE 41 Standards, and is currently leading the update of both standards. He is a member of the Board of Directors for the San Francisco Chamber of Commerce and the San Francisco Planning and Urban Research Association. Mr. Poland is the 2006 recipient of the Alfred E. Alquist award from the California Earthquake Safety Foundation, and was recently elected to the National Academy of Engineering in recognition of his career long work in support of Performance Based Earthquake Engineering.

William Savage

After finishing his Ph.D. in Seismology at the University of Nevada in Reno and a postdoc with the U.S. Geological Survey (USGS) in Menlo Park in 1974, Mr. Savage joined Woodward-Clyde Consultants in San Francisco and Pasadena, CA and spent 12 years working primarily on nuclear power plant siting and licensing, and seismic studies for major dams and other critical facilities.

He then spent 15 years in the Geosciences Department at PG&E in San Francisco, where he was a member of the Diablo Canyon Long Term Seismic Program leadership team and managed cooperative PG&E research projects with the USGS, the PEER Center at UC Berkeley, the California Energy Commission, and the Southern California Gas Company. He also managed PG&E's Seismic Risk Management Program, a company-wide seismic preparedness activity for the natural gas and electric systems.

In 2001, Mr. Savage joined the USGS as the National Strong-Motion Coordinator, National Strong-Motion Project Chief, and Lifelines Coordinator. In 2007, he was assigned as the USGS Seismotectonics Senior Scientist and Science Advisor to the Yucca Mountain Project in Las Vegas through 2010. During 1999 to 2005, Mr. Savage represented PG&E and the USGS as a member of the American Lifelines Alliance, a FEMA-supported public-private partnership to reduce risk to utility and transportation systems from natural hazards and manmade threats. Mr. Savage is currently an Adjunct Professor in the Department of Geosciences at the University of Nevada, Las Vegas, and works in the Applied Geophysics Center. He is also an Emeritus Scientist with the USGS.