Resiliency and Emergency Preparedness Workshop

FINAL PROCEEDINGS BY:

Kathleen Almand, P.E.
National Fire Protection Association
Quincy, Massachusetts, USA

Held: 16 December 2016 at NFPA Headquarters, Quincy, MA

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In the aftermath of recent disasters with major impacts on the built environment, the building and emergency response communities are reassessing their resiliency and preparedness capabilities. On December 16th, 2015, the Fire Protection Research Foundation (FPRF) convened a workshop at NFPA headquarters to bring together leaders from NFPA Technical Committees, with a focus on those related to emergency preparedness and resiliency, and those of our stakeholders who own, manage, and insure facilities. The goal of this workshop was to review recent national and international resiliency initiatives, including a recent guidance document developed by the Foundation for technical committees, and to discuss the resource needs of the community. This report presents an overview of the workshop presentations and findings.
Acknowledgements

This workshop was supported by:

This workshop summary report has been prepared by Kathleen Almand, Vice President, Research at National Fire Protection Association. The information contained herein is based on the input of numerous professionals and subject-matter-experts. While considerable effort has been taken to accurately document this input, the final interpretation of the information contained herein resides with the report author. The content, opinions and conclusions contained in this report are solely those of the authors and do not necessarily represent the views of the Fire Protection Research Foundation, NFPA, Technical Panel or Sponsors. The Foundation makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

About the Fire Protection Research Foundation
The Fire Protection Research Foundation plans, manages, and communicates research on a broad range of fire safety issues in collaboration with scientists and laboratories around the world. The Foundation is an affiliate of NFPA.

About the National Fire Protection Association (NFPA)
Founded in 1896, NFPA is a global, nonprofit organization devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards. The association delivers information and knowledge through more than 300 consensus codes and standards, research, training, education, outreach and advocacy; and by partnering with others who share an interest in furthering the NFPA mission. All NFPA codes and standards can be viewed online for free. NFPA’s membership totals more than 65,000 individuals around the world.

Keywords: Resiliency, Disaster, Fire safety, Guide, Community, Emergency, Preparedness, Standards

Report number: FPRF-2016-06
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1) Background and Overview

In the aftermath of recent events with major impacts on the built environment, such as Hurricane Sandy, the building and emergency response communities are reassessing their future preparedness.

In 2014, NFPA’s Research Foundation initiated a project to identify those provisions in NFPA codes and standards that embody the concepts of resiliency, compile available information to serve as a technical reference for those documents, and provide guidance to NFPA Technical Committees. In order to share the results of that project and learn about other emerging needs of our stakeholders related to this topic, the Foundation convened a workshop at NFPA headquarters on December 16th, 2015. Participants included leaders from NFPA Technical Committees, with a focus on those related to emergency preparedness and resiliency, and those of our stakeholders who own, manage, and insure facilities.

The workshop agenda (Table 1) began with an overview of some of the international initiatives related to resiliency in the built environment. The afternoon began with a detailed presentation of the results of the Research Foundation project on resiliency and NFPA codes and standards, followed by an interactive discussion on how our codes and standards and other information products can better meet the needs of our constituents for this important topic.

Table 1: Workshop Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Presenter(s)</th>
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<tbody>
<tr>
<td>8:00 am</td>
<td>Welcome; Workshop Goals</td>
<td>Don Bliss, NFPA</td>
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<tr>
<td>8:15 am</td>
<td>NIST Activities – Resiliency Guides and Related Research</td>
<td>Jason Averill, NIST</td>
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<tr>
<td>9:00 am</td>
<td>Northeastern University Center for Resilience Studies Update</td>
<td>Steve Flynn, Northeastern</td>
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<tr>
<td>9:30 am</td>
<td>Virginia Tech Disaster Risk Reduction Program</td>
<td>Fred Krimgold, VA Tech</td>
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<tr>
<td>10:00 am</td>
<td>Break</td>
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<tr>
<td>10:30 am</td>
<td>ISO 268/292 Resiliency Activities</td>
<td>Ken Willette, NFPA</td>
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<tr>
<td>11:00 am</td>
<td>NFPA 1600, 1616 – what’s new</td>
<td>Don Schmidt, Preparedness, LLC</td>
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<td></td>
<td>Dean Larson, Larson Performance Consulting</td>
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<tr>
<td>12:00 noon</td>
<td>Lunch</td>
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<tr>
<td>12:30 pm</td>
<td>New Resiliency Guide</td>
<td>Ken Dungan, Performance Design Technologies, LLC</td>
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<tr>
<td>1:30 pm</td>
<td>Breakout Sessions</td>
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<tr>
<td>3:00 pm</td>
<td>Reports from Breakout Sessions</td>
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<tr>
<td>3:45 pm</td>
<td>Concluding remarks; NFPA’s next steps</td>
<td>Don Bliss, NFPA</td>
</tr>
<tr>
<td>4:00 pm</td>
<td>Adjourn</td>
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</tbody>
</table>
2) Presentations Overview

**NIST Activities – Resiliency Guides and Related Research** - Jason Averill, NIST presented the activities underway in the Community Resilience Program at NIST. He highlighted the recently published community resilience guide which assists communities to organize effectively to address resilience risks, goals, and priorities. A companion Economic Decision Guide, to be published in late 2015, provides a standard economic methodology for evaluating investment decisions aimed to improve community resilience. Other initiatives include a community resilience panel and plans to work with selected communities through the NIST Center of Excellence on this topic, in collaboration with other federal agencies.

**Northeastern University Center for Resilience Studies Update** - Steve Flynn, Northeastern University provided an overview of the concepts of resiliency using a private and public sector case study from the Hurricane Sandy disaster. He presented a framework for prioritization of facility resilience: Elemental capacity, Essential function, or Full / Normal function and described the five attributes of resilience, emphasizing the interdependence of infrastructure components. He emphasized the need to develop the tools to quantify the economic impacts of disaster against the costs of investment in resiliency to make the business case for these investments.

**Virginia Tech Disaster Risk Reduction Program** - Fred Krimgold, VA Tech. described approaches to build resiliency in low and middle income countries using the experience gained in the developed world. He described the learning process that has taken place in the U.S. where codes and standards have evolved based on lessons learned from disasters and noted that a basic infrastructure for participative code development and enforcement is needed to transfer this approach to the developing world. He identified segmented opportunities for advancement in resilience and described the various components of the infrastructure that is required.

**ISO 268/292 Resiliency Activities** - Ken Willette, NFPA provided an overview of ISO Technical Committee 268 on Sustainable Development in Communities and the ISO standards for which it has oversight. These include a standard for City Services and Quality of Life which includes the development of indicators. NFPA serves as the US TAG secretariat for this TC. He also reviewed ISO Standard 292 on security and resiliency.

**NFPA 1600: “Standard on Disaster/Emergency Management & Business Continuity Programs”** - Don Schmidt, Preparedness, LLC and chair of NFPA 1600, prepared an overview of this standard whose goal is to establish a common set of criteria for all hazards disaster/emergency management and business continuity programs. He reviewed its coverage of disaster prevention program management, risk assessment, prevention and mitigation strategies, resource needs assessment, emergency operations and business continuity plans, crisis communications, continuing education and testing, and program maintenance and improvement. He noted that the standard has evolved considerably in its seven editions and highlighted recent changes.
**NFPA 1616: Standard on Mass Evacuation, Sheltering, and Re-entry** - Dean Larson, Larson Performance Consulting described the origins of this new standard and its foundation on NFPA 1600. He reviewed the scope of the document and its content by chapter and noted that the Committee had dealt with two major complex issues: people with disabilities and animals. He reviewed the comprehensive annexes to the standard which include a self-assessment checklist, guidance on risk management, and an evaluation of evacuation, mass sheltering and re-entry requirements, animals, people with disabilities, mandatory Evacuation, Emergency Communication: Public Alerts and Warnings, Social Media Support, Just-in-Time Training Support, and Evacuation, Sheltering and Re-entry Data Interoperability.

**Resiliency Guide for NFPA Technical Committees** – Ken Dungan, Performance Design Technologies presented an overview of the newly released NFPA Guide. The Guide sets the framework through a review of current national initiatives and a comprehensive discussion of the five pillars of resiliency: Prevention, Protection, Mitigation, Response and Recovery. He reviewed the range of disasters that may be addressed by NFPA standards and gave examples of the types of strategies that might be implemented over the timeline of a disaster. He reviewed the types of features and provisions in NFPA standards today that address resiliency, providing several examples, and identified some gaps in approach, including addressing adaptability and recovery. He then provided an overview of the process described in the guide with a focus on risk assessment and metrics.
3) Discussion on Needs – Summary from Breakout Sessions

Resources for Technical Committees
Participants in the workshop identified other resources that would be useful in assisting NFPA technical committees as they address resiliency in their documents: a primer with standard definitions, approaches, importance factors, templates; a PowerPoint presentation available for committee meetings; guidance through the Manual of Style; and a platform for sharing ideas between committees especially where there are interdependencies. In addition participants noted that the NFPA 1600 document and its technical committee have a wealth of information and expertise in this area that may be of value to other committees. Finally, participants recommended that the NFPA Standards Council be approached to provide overall direction on the degree to which committees should implement these concepts, with a particular reference to addressing more than fire as an initiating event, need for task groups, etc.

Community Resources
Participants in the workshop also identified other tools beyond standards which would assist communities in enhancing disaster resiliency. First among them was the recommendation that NFPA develop a resource platform for stakeholders, NGO’s etc., specifically the NFPA Xchange platform. This platform could include resources from NFPA and other organizations as available through links and serve as a tool for information sharing. The following were suggested resources of value to the community:

- Economic cost/benefit tools to help provide further justification for resiliency
- Comprehensive collection of risk assessment methods
- Data tools
- Guidance document on performance levels – cost/benefit
- Apps with checklists for communities - E-forms, self-assessment checklists with hyperlinks to additional information
- Self - accreditation tools – methodology and metrics
- Case studies, examples on resiliency successes and failures for education and persuasion
- Existing building assessment checklists

What else should NFPA be doing?

Public Education and Advocacy
Participants recommended that NFPA consider integrating the concepts of resiliency in public education and advocacy messaging. The Firewise program was cited as an existing example which could be extended to other disaster prevention. It was noted that public education related to post-event behaviors is a community need.

Collaboration/Integration with Work of Others
Resiliency and emergency preparedness are currently the subject of many organization’s activities, including those of NIST, DHS, and the World Bank as presented at this workshop.
Participants stressed the need to work collaboratively with these organizations and others (for example, the Earthquake Engineering Research Institute, the National Academy of Sciences, the U.S. Army Corps of Engineers, etc.) to leverage resources. Since resiliency crosses the scope of other standards developers as well, continued outreach and collaboration with these groups is also essential. NFPA stakeholders are important constituents in the global resiliency discussion.
4) Summary Observations

Disaster resilience is of increasing importance in the built environment. There are several national and international initiatives underway to support communities in enhancing various aspects of their resilience; this workshop presented several global and national initiatives, including NFPA’s recent development of a guide for technical committees on the subject. The workshop identified more that can be done for committees to further implement resiliency concepts in NFPA codes and standards, and other resources that may be of value to communities as they implement these concepts locally. NFPA can serve as a bridge between our stakeholders and other resiliency initiatives to share information and best practices.
Annex A: Workshop Participants and Attendees

The following were the workshop presenters on “Resiliency and Emergency Preparedness Workshop”, held in NFPA Headquarters, Quincy, MA on 16th December 2015.

<table>
<thead>
<tr>
<th>Speakers</th>
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<tbody>
<tr>
<td>Jason Averill, National Institute of Standards and Technology</td>
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<td>Don Bliss, NFPA</td>
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<tr>
<td>Ken Dungan, Performance Design Technologies</td>
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<tr>
<td>Stephen Flynn, Northeastern University</td>
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<tr>
<td>Fred Krimgold, Virginia Polytechnic Institute and State University</td>
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<td>Dean R. Larson, Larson Performance Consulting</td>
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<tr>
<td>Don Schmidt, Preparedness, LLC</td>
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<tr>
<td>Ken Willette, NFPA</td>
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</table>

The following were the full list of workshop attendees on “Resiliency and Emergency Preparedness Workshop”, held in NFPA Headquarters, Quincy, MA on 16th December 2015.

<table>
<thead>
<tr>
<th>TC on Pre-Incident Planning</th>
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<tr>
<td>Michael E. Carsillo, Stuart Fire Rescue</td>
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</table>
**TC on Emergency Management and Business Continuity**
Kenneth Katz, Travelers Insurance Company
Melvyn Musson, Edward Jones Company
Bobby Williams, Fidelity Investments

**TC on Mass Evacuation and Sheltering**
Breanna L. Medina, City of Rancho Cucamonga
Jim Reidy, San Antonio Fire Department

**NFPA Technical Committee Members/Chairs**
William Connell, PB Americas, Inc, TC on Road Tunnels and Highways, NFPA 502
David Hood, RPA, Inc, TC on Health Care Occupancies, NFPA 101/NFPA 5000
Jay Jablonski, HSB PLC, TC on Liquified Natural Gas, NFPA 59A
Brian Meacham, WPI, TC on Fire Risk Assessment Methods
Donald C. Moeller, The Fire Consultants, Inc., TC on Cultural Resources, NFPA 909
Wayne D. Moore, JensenHughes, Inc., CC Signaling Systems, NFPA 72
Edward P. Plaugher, International Association of Fire Chiefs, TC on Data Exchange for the Fire Service, NFPA 950
Kenneth W. Richards, Jr., Old Mystic Fire Department, TC on Fire Service Training, NFPA 1401
Jeffrey S. Tubbs, Arup, Inc., TC on Assembly Occupancies, NFPA 101/NFPA 5000

**Property Insurance Research Group**
Jason Gamache, Liberty Mutual
Mike Spaziani, FM Global
Mike Widdekind, Zurich Services Corporation
Chris Wieczorek, FM Global
Pete Willse, XL GAPS
Annex B: Workshop PowerPoint Slides

NIST Activities – Resiliency Guides and Related Research - Jason Averill, NIST

Overview of NIST Community Resilience Program

Jason D. Averill
Chief, Materials and Structural Systems Division

Acknowledgments

• Community Resilience Team
  – Steve Cauffman
  – Erica Kuligowski
  – Terri McAllister
  – Nancy McNabb
  – Melissa Banner
  – Ben Davis

• NIST Colleagues
  – Nelson Bryner / Kathy Butler (WUI Fires)
  – Clarissa Ferraris / Stephanie Watson (Inorganic and Polymeric Materials)
  – Jack Hayes / Steve McCabe (Earthquakes)
  – Long Phan / Marc Levitan (Windstorms)
  – Fahim Sadek (Structures)

Why Community Resilience?

• All communities face potential disruption from natural, technological, and human-caused hazards.
• Disasters take a high toll in lives, livelihoods, and quality of life that can be reduced by better managing disaster risks.
• Planning and implementing prioritized measures can strengthen resilience and improve a community’s ability to continue to provide critical services in a more timely manner and to build back better.
• The built environment serves a social function (e.g., a hospital provides healthcare services). Therefore, social and economic needs and functions should drive the goals for performance of buildings and physical infrastructure.
• New tools and guidance are needed to measure readiness and plan and implement measures to enhance resilience.

What is Resilience?

• Presidential Policy Directive (PPD) 8: National Preparedness (2011) defines resilience as the ability to “adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies.”
• Presidential Policy Directive (PPD) 21 (2013) defines resilience as the ability to “prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions.”
Key Concept: Recovery of Function

Engineering Laboratory Mission

To promote U.S. innovation and industrial competitiveness in areas of critical national priority by anticipating and meeting the measurement science and standards needs for technology-intensive manufacturing, construction, and cyber-physical systems in ways that enhance economic prosperity and improve the quality of life.

Statutory Authorities

- NIST Organic Act Authorities for Building Failure and Fire Studies
- National Construction Safety Team (NCST)
- National Earthquake Hazard Reduction Program (NEHRP)
- National Windstorm Impact Reduction Program (NWIRP)

NIST Disaster and Failure Studies

<table>
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<tr>
<th>Earthquakes</th>
<th>Hurricanes</th>
<th>ConstructionsBuilding</th>
<th>Tornadoes</th>
<th>Fires</th>
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Highlights of Major NIST Resilience Activities

- Community Resilience Guide
  - Economic Resilience Guide
- Community Resilience Center of Excellence
- Outreach Activities
  - Early-adopter communities
  - Community Resilience Panel
- Overview of Challenges in Community Resilience

Community Resilience Planning Guide for Buildings and Infrastructure Systems

- The built environment exists to serve a social function (e.g., a hospital provides healthcare). Therefore, social and economic needs and functions should drive the goals for performance of buildings and physical infrastructure.

  *Practical, flexible methodology to better set priorities and allocate resources to reduce risks and to build back better.*

****  Page 11 of 49 ****
Step 2. Understand the Situation

Characterize the Social Dimensions
- Community members
  - Present and future needs
  - Demographics and economic indicators
  - Social Capital/Social Vulnerabilities
- Social institutions
  - Social functions
  - Gaps in capacity
  - Dependencies on other institutions
- Community metrics

Characterize the Built Environment

Buildings
- Individual structures, including equipment and contents that house people and support social institutions

Building Clusters
- A set of buildings that serve a common function such as housing, healthcare, retail, etc.

Infrastructure Systems
- Physical networks and structures that support social institutions, including transportation, energy, communications, water and waste water systems

Dependencies
- Internal and external, time, space, source

Characterize
- Location, number, construction, demands and use, etc.

Link Social Dimensions and Built Environment

Some rely more on the built environment
- Services provided to meet needs
- Dependency on other services and systems
- Dependency on built environment
- Consequences of loss

Some functions change
- Schools ↔ Shelters

Step 3. Determine Goals and Objectives

Establish Long Term Community Goals
- Long term goals to improve the community can guide the prioritization and implementation process.
- Improve reliability of infrastructure systems
- Enhance community functions
- Reduce travel time impacts to residents and businesses
- Revitalize an existing blighted area
- Community resilience is achieved over time
- Resilience can be achieved with resources for current maintenance and capital improvements

Determine and Characterize Hazards

- Identify prevalent hazards
  - Wind, Earthquake, Inundation
  - Fire, Snow, Rain
  - Human-caused or Technological

- Evaluate hazards for 3 levels
  - Routine
    - Level expected to occur frequently
    - Should have minimal disruption
  - Design
    - Level used to design buildings
    - Anchor for community planning
  - Extreme
    - Maximum considered possible
    - Plan for critical services

Example Summary Resilience Matrix

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Recovery Time</th>
<th>Desired Performance</th>
<th>Anticipated Performance</th>
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Supercost Sandy
Step 4. Plan Development
Evaluate Gaps and Identify Solutions
- Prioritize gaps
  - Long-term community goals
  - Social needs during recovery
- Identify alternative solutions
  - Multiple stages
  - Temporary and permanent
  - Administrative
  - Construction

Step 5. Plan Preparation, Review, and Approval
Plan Approval
- Document proposed implementation strategy and supporting assessments and solutions.
- Share with all stakeholders and community members
  - Public Meetings, review and comment period
- Finalize and approve community plan.

APPROVED
Final Community Plan: Implementation Strategy

Step 6. Plan Implementation and Maintenance
Implementation
- Formally adopt community plan to guide local government and agencies
- Identify and obtain resources to implement solutions
- Track and communicate progress to stakeholders
Plan Maintenance
- Review strategy and solutions on a regular basis
- Modify or update as needed

Economic Decision Guide
- The Economic Decision Guide (December 2015):
  - Provides a standard economic methodology for evaluating investment decisions aimed to improve community resilience
  - Is designed for use in conjunction with the NIST Community Resilience Planning Guide
  - Identifies and compares present and future stream of costs and benefits for new capital investments
  - Addresses non-market values and uncertainty

Community Resilience Panel for Buildings and Infrastructure Systems
- The Panel will gather the broad interests of the stakeholder community.
  - Inaugural meeting held at NIST on November 9, 2015
  - Open to all interested participants
  - A self-governing entity
  - Co-sponsored by:
    - HUD Office of Economic Resilience
    - DOC National Oceanic and Atmospheric Administration (NOAA)
    - DHS Federal Emergency Management Agency (FEMA)
    - DHS Office of Infrastructure Protection

Community Resilience Panel
- Panel goals and objectives:
  - Engage and connect community and cross-sector stakeholders
  - Identify policy and standards gaps and impediments to community resilience
  - Raise awareness of sector interdependencies and cascading effects of disasters
  - Develop consistent metrics and definitions
  - Reduce barriers to achieving community resilience
  - Improve and develop community resilience documents and guides
  - Develop and maintain a Community Disaster Resilience Knowledge Base
Working with Communities

• Actively seeking community partners to use the Community Resilience Planning Guide
• Online resources for scalable assistance are under development

NIST Centers of Excellence

The NIST Centers of Excellence will:
• Enable collaborations between NIST and Leading Research Institutes in areas of emerging technology important for NIST.
• Provide new opportunities for training in measurement science.
• Enhance technical innovation through early alignment of measurement science with emerging and innovative new fields of research.

The three NIST Centers of Excellence cover:
• Advanced Materials
• Community Resilience
• Forensics

Community Resilience Center of Excellence

5-year cooperative agreement for 5 years, renewable to 10 years

Objectives
• Develop an integrated, multi-scale, computational modeling environment (NIST-CDR) for community systems to support development of new standards and tools for assessment and decision making
• Foster the development of data architectures and data management tools to enable disaster resilience planning
• Conduct studies to validate resilience data architectures, data management tools, and models

Community Resilience Center of Excellence

• Awarded to Colorado State University (CSU) and 9 other institutions on 19 February 2015
• NIST researchers and the Center will collaborate and conduct research to develop the science base for decision support tools for local governments
• The decision support system will be embedded in a state-of-the-art computational environment that integrates
  - physics-based modeling of buildings and infrastructure systems, including dependencies and cascading effects
  - networks for transportation, energy, water, and communication
  - a spectrum of hazards and hazard intensities
  - models of socio-economic networks
  - resilience-based performance criteria and metrics

Community Resilience CoE

• Principal Investigators and Co-directors
  - CSU, John W. van de Lindt, George T. Abell Distinguished Professor of Infrastructure
  - CSU, Bruce Ringwood, Professor of Civil and Environmental Engineering
• Associate Directors
  - University of Illinois at Urbana-Champaign, Pablo Gardoni, Professor of Civil and Environmental Engineering
  - Oregon State University, Daniel Cox, Professor of Civil and Environmental Engineering
• Teams
  - Engineering, Economics and Social Science, DataFramework

Community Resilience CoE - Area 1: Computational Modeling

• The CoE will work towards an integrated, multi-scale, computational modeling environment to accelerate development of systems-level models to enable new standards and tools for enhancing Community Resilience
• The CoE scope includes buildings and other structures, energy systems, transportation systems, communication and information systems, and water and wastewater systems.
• Sensitivity studies will examine the effect of parameters, such as event sequence, interdependencies, time, or cost, on the outcomes and community resilience.
Community Resilience CoE - Area 2: Data Management Tools

- The CoE will develop data architectures and data management tools to enable resilience planning, including:
  - standardized data ontology, format, and other informatics characteristics to enable the collection, storage, and data analysis appropriate for a spectrum of hazard types and resilience infrastructure data
  - resilience data architecture that will accommodate system-level computational models with data for model input and validation.

Community Resilience CoE - Area 3: Resilience Field Studies

- The Resilience CoE will conduct studies to validate resilience data architectures, data management tools, and models for a variety of hazard events including:
  - Tornado, hurricane, earthquake, flood, Wildland-Urban Interface (WUI)
  - Effects of climate change
  - Effects of aging infrastructure

- These field studies will be an opportunity to exercise new data formats and collection methods.

Challenges

- Changing design considerations from life safety-driven to functionality-driven
  - Determining how to define and measure the functionality of buildings and infrastructure systems – including structural and nonstructural components

Challenges (cont’d)

- Stochastic nature of hazards and typical decision maker’s understanding of risk

Challenges (cont’d)

- Fully capturing interdependencies amongst systems and prioritize for competing objectives
  - For Example: Gas Station After a Storm
    - Depends upon electricity and communications for credit card processing
    - Pumps, pipelines, and roads for product distribution
      - Which depend on electricity and communications to run pumps and coordinate with ships

Challenges, cont’d

- Modeling impact of physical damage to service delivery for utilities and infrastructure systems

- Scalability of the metrics and modeling methods between local, community, and regional scales
  - Discretization, inputs/outputs, components

- Metrics for social dimensions of resilience and relation to quantitative models
  - Social Capital, Wellness
Challenges, cont’d

- Communication between the many disciplines – physical systems and their services, social services, economics – methods, vocabulary, input and output data
  - Social scientists working at individual/neighborhood level working with economists at the regional/aggregate levels;
  - time and frequency of data (annual versus monthly)

Challenges

- Competing functional requirements (water for sprinklers or potable water for drinking);
  - How to navigate unintended bureaucratic consequences (water quality, e.g.)

- How to account for novel (innovative) or non-technical (administrative) solutions

Contact Info:
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Links of Interest:
Materials and Structural Systems Division:
http://www.nist.gov/el/building_materials/index.cfm

Disaster and Failure Studies Program:
http://www.nist.gov/el/disasterstudies/index.cfm

Community Resilience Program at NIST:
http://www.nist.gov/el/building_materials/resilience/index.cfm
Northeastern University Center for Resilience Studies Update - Steve Flynn, Northeastern University

The Resilience Imperative

A Presentation to
Resiliency and Emergency Preparedness Workshop
NFPA Headquarters
Quincy, MA
December 16, 2015
Stephen E. Flynn, Ph.D.
Professor of Political Science &
Director, Center for Resilience Studies
Northeastern University
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d617-445-3675

The Resilience Imperative

“The abiding strategy of our parents’ generation was ‘containment’ of communism in order to be free. The abiding strategy of our generation has to be ‘resilience’. We will only be free to live the lives we want if we make our cities, country and planet more resilient.”


Community Resilience and Critical Infrastructure
Resilience are Societal Imperatives

“The term resilience refers to the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.”


Major impediments to building infrastructure resilience:

o We lack an adequate understanding of how infrastructure systems operate to produce their functions and the consequences associated with disruptive events.

o We lack adequate designs for “baking-in” resilience

o There are insufficient incentives for investing in resilience.

o There is a need for new frameworks for managing organizational and governance issues associated with advancing resilience for infrastructure systems that regional and interdependent.

o We lack a workforce trained and educated to advance infrastructure resilience.

Case Study: Private Sector Resilience: Oct 28, 2012

Goldman Sachs Headquarters
200 West St., New York, NY

Goldman Sachs Headquarters
200 West St., New York, NY

Citigroup Headquarters
208 Greenwich Street, New York, NY

200 West St. HQ is dry and has electric power, but...

- No employees due to disruption of transportation system.
- Little ability to telecommute due to region wide power outages
Verizon Headquarters & Switching Center 140 West St.

Verizon Headquarters & Switching Center 140 West St.

Cable Vault Room at Verizon Headquarters 140 West St.

Case Study II: Public Sector Resilience

Metropolitan Transportation Authority:
1. Moved Trains to high ground and shelter
2. Provided incentive for workforce to stay on the job
Bolstering Infrastructure Resilience

The stepping off point for establishing resilience priorities is to identify for a given infrastructure:

- Elemental capacity
- Essential function
- Full / Normal function

ELEMENTAL CAPACITY

Elemental capacity represents the prerequisite system conditions that must be in place in order for the infrastructure to provide its function to its users. Examples include:

- Electrical power to support the HVAC system for a hospital operating room.
- Electrical power for a retail filling station be able to operate its gas pumps.
- Fuel to allow public safety vehicles to respond to emergencies.
**ESSENTIAL FUNCTION**

*Essential function* is the minimal level of function an infrastructure needs to provide in order to (1) meet the critical needs of its users, and (2) support recovery. Examples include:
- An airport is able to safely support landings and takeoffs for aircraft providing emergency relief.
- A cellular provider is able to provide sufficient cellular coverage to for users to send text messaging.
- A water utility is able to provide adequate water to support coolant systems required for power generation.

**FULL / NORMAL FUNCTION**

*Full/normal function* is that which an infrastructure provides in order to satisfy the routine needs of its users and to remain economically viable. Examples include:
- A hospital can perform elective surgeries which is an important source of revenue.
- An airport is able to support scheduled daily landings and takeoffs of commercial airliners.
- An electric utility can provide power to support demand for residential and commercial air conditioning on a hot day.

---

**Attributes for Bolstering Infrastructure Resilience**

There are five resilience attributes:
- **Cushionability**
- **Resistance**
- **Robustness**
- **Redundancy**
- **Graceful extensibility**

Collectively these attributes contribute to mitigating the risk of disruption, support rapid response and recovery, and advance adaptation in the face of naturally-occurring and human-made disasters.

---

**RESISTANCE**

*Resistance* involves measures that redirect a threat of hazard away from where it can cause damage to elemental capacity or disrupt essential function. Examples include:
- Creating a fire line around a critical facility so an advancing wildfire will veer in a direction that will cause less destruction.
- Fabricating floodways that channel storm surge into large underground parking garages or on to playgrounds that can serve as temporary reservoirs, reducing the risk of flood damage to other facilities in the flood zone.
- Lowering the risk posed by explosive-laden vehicles by only allowing small vehicles and prohibiting large commercial trucks on streets adjacent to a critical facility.

---

**CUSHIONABILITY**

*Cushionability* is the capacity to support graceful degradation of non-essential function during periods of stress. Examples include:
- Hospitals who evacuate non-critical patients to make additional beds and medical personnel available in advance of a hurricane to better respond to post-storm emergencies.
- Highways that are closed to all non-emergency vehicles just prior to a major snow storm to facilitate snow removal operations and rapid recovery of road transportation after the storm.
- Commercial buildings and other large power consumers who enter into arrangements with large electric utilities where they agree to reduce their normal demand during peak load days.

---

**ROBUSTNESS**

*Robustness* involves investing in measures that harden or protect elemental capacity and essential function. Examples include:
- Installing back-up generators on a high-floor where they will not be damaged by storm surge.
- Deploying inflatable plug at the entrance of a tunnel in advance of a storm.
- Constructing a floodwall around a low-lying electrical substation.
- Placing protective conduit around bridge cables so they cannot be severed by a cutting torch.
REDUNDANCY

Redundancy involves investing in back-up systems or spare components to support immediate recovery of elemental capacity and essential function. Examples include:

- Back-up data processors located in another region
- Back-up air compressor to keep cable conduit under pressure so as to prevent floodwater from seeping in and causing damage to the wiring.
- Back-up turbine engine to operate a compressor for moving gas or fuel along a pipeline.
- Sufficient protective clothing on-hand at a hospital to support providing emergency medical care in the event of disruption to the transportation/supply system.

Understanding the Interdependency Challenge

Examples of Interdependency Challenges

- Refineries and pipelines need electricity to operate.
- Vehicles for repairing electrical distribution lines need a reliable supply of gasoline or diesel fuels.
- Transportation conveyances are required to move fuel to commercial and residential users.
- Transportation conveyances require fuel to operate.
- Gas stations require electricity to operate pumps and telecommunications to support credit/debit card purchases.

Multi-jurisdiction & interdependency Challenges

- Petroleum supply and distribution system spans multiple states though key infrastructure for a region is concentrated in only a few places.
- Refineries and pipelines need electricity to operate.
- Vehicles for repairing electrical distribution lines need a reliable supply of gasoline or diesel fuels.
- Transportation conveyances are required to move fuel to commercial and residential users.
- Transportation conveyances require fuel to operate.
- Gas stations require electricity to operate pumps and telecommunications to support credit/debit card purchases.

Enhancing Resilience has economic value by reducing loss of function

RED area represents loss of infrastructure function when there is a disruption:

A = Mitigation; B = Response; C = Recovery


Investment in resilience prior to a disaster and swift adaptation after a disaster can result in a net gain in infrastructure function.

Visualizing a Large Scale Lifeline Network

Loss of Connectivity: Aftermath of Hazards

How to Advance Societal Resilience?

It will require accomplishing 4 things concurrently:

1. Conducting research that informs resilient engineering and community resilience
2. Devising resilience applications, tools, and protocols to include establishing standards and codes
3. Identifying and deploying economic incentives for early and widespread adoption of resilience standards and codes
Building Regulation for Resilience
In Low and Middle-Income Countries

The Contribution of Experience

Fred Krimgold
Virginia Tech

NPRR Resilience Workshop
Quincy, MA December 16, 2015

Challenges

- Urbanization
- Globalization
- Climate Change
- Complexity and Interdependency

What Has Worked?

- Urban Conditions of 19th Century
- Protection of Public Health Safety and Welfare
- Evolutionary Process
- Regulatory Ecology

Implementation Failure

- Poverty
- Ignorance
- Corruption
- Inept Transfer of Practice
- Washington Consensus

© GFDRR
Reconsideration and Innovation

- Locally Based
- Participatory Process
- Include Non-engineered Structures
- Support for Compliance
- Benefits of Formal & Efficiency of Informal
- Mobilize Private Sector
- Inspect and Enforce

Effective Codes:

1. They are developed through an open and participatory process

2. The risk reduction measures are affordable and consistent with local capabilities.

3. They encompass non-engineered construction to support gradual improvements in quality and safety.

4. They establish a proportional response to risk through hazard maps and occupancy importance factors

5. They allow alternative compliance solutions to support innovation or traditional practices that meet safety requirements.

6. They are accessible, clear, and understandable for building practitioners.

7. They are regularly updated to reflect changes in surrounding circumstances such as new building technology and materials, emerging risks, and evolving economic conditions.
Establish a Sound Legislative and Administrative Foundation at the National Level

Develop Building Code Suitable to Local Social and Economic Conditions that Facilitate Safe Use of Local Building Materials and Practices

Strengthen Implementation of Building Code Through Plan Review, Site Inspection and Permitting at the Local Level

Provide Advisory Services to Support Code Compliance in Additions to Inspection and Enforcement

Take Advantage of Opportunities for Regulatory Intervention
Clearly Identify Hazards Zones and Restrict Development According to Exposure

Advance Supporting Institutions

Process vs. Product
- Legal Foundation
- Administrative Structure
- Participatory Consensus Process
- Professional Certification
- Agency Accreditation
- Dispute Resolution
- Maintenance and Revision
- Adaptation to Local Conditions/Culture

Cases
- Chile
- Turkey
- Indonesia
- Pakistan
- Nepal
<table>
<thead>
<tr>
<th>Regulation and Reconstruction</th>
<th>Regulatory Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Learning from Loss</td>
<td>• Technical/Engineering Component</td>
</tr>
<tr>
<td>• Pattern of Progress</td>
<td>• Legal Component</td>
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<tr>
<td>• Institutionalization and Continuity</td>
<td>• Economic Component</td>
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<tr>
<td>• Necessity of Urban Management</td>
<td>• Public Policy Component</td>
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<td>• Social Component</td>
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<td></td>
<td>• Cultural Component</td>
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<td>• Public Health Component</td>
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</tbody>
</table>
ISO 268 & 292

FPRF Resiliency Workshop

December 15, 2015 | Ken Willette, NFPA

ISO

International Organization for Standardization

- Independent, non-governmental international org.
- Membership of 162 national standards bodies
- Brings together experts to share knowledge
- Develops voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges.

WHY?

- “The world is becoming turbulent faster than organizations are becoming resilient.”
  
  Gary Hamel  
  Harvard Business Review

What is a ....

“...resilient organization is one that is able to achieve its core objectives in the face of adversity.”

ISO Builds a Framework

ISO/TC 268 - Sustainable development in communities

ISO 37120 Sustainable Development of Communities: Indicators for City Services and Quality of Life

- World Council on City Data (WCCD);
  
  Coordinates all efforts on city data to ensure a consistent and comprehensive platform for standardized urban metrics.
  
  The WCCD has created the first ever certification system and Global City Registry for verified ISO 37120 data.

THE INDICATORS

<table>
<thead>
<tr>
<th>CITY SERVICES</th>
<th>QUALITY OF LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Living environment</td>
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<tr>
<td>Energy</td>
<td>Culture</td>
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<td>Housing</td>
<td>Sustainability</td>
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<td>Transportation</td>
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<tr>
<td>Urban Planning</td>
<td></td>
</tr>
</tbody>
</table>
The case for a planned approach to resilience

ISO/TC 292 - Security and resilience

Average lifespan of an S&P listed company

- 1930 - 90 years
- 1990 - > 25

ISO/TC 292 - Security and resilience

ISO/TC 292 - Security and resilience

NFPA

- US TAG Administrator to TC 268
- Participant in WG 2 of TC 92 and US TAG

ISO Draft 22316 defines resilience

“Outcome of an organization’s capability to anticipate and respond to disruption related risks and its capacity to adapt to complex or changing circumstances under conditions of uncertainty.”
Organizational Resilience is an outcome not a system

- Effective business as usual capability
- Ability to change and adapt
- Ability to shape the environment

Thank You

kwillette@nfpa.org
NFPA 1600, 1616 – what’s new?
NFPA 1600: “Standard on Disaster/Emergency Management & Business Continuity Programs” - Don Schmidt, Preparedness, LLC

What is NFPA 1600?
- American National Standard applicable to public and private sectors, NGOs, etc.
- Seven (7) editions, first edition in 1995, most recent 2016 (adoption pending)
- Recognized by 9/11 Commission as “National Preparedness Standard”
- Designated by DHS/FEMA as criteria for the voluntary accreditation of private sector preparedness programs under PS-Prep™
- Establishes a common set of criteria for all hazards disaster/emergency management and business continuity programs...

Program Management
- Leadership and Commitment
- Program Coordinator
- Program Committee
  - Internal members
  - External representation
- Laws and Authorities
- Performance Objectives

Risk Assessment
- Risk identification
  - Natural hazards
  - Human-caused hazards
  - Technological hazards
- Probability & magnitude
- Impacts analysis
  - Injuries & deaths
  - Facility damage
  - Information technology
  - Infrastructure damage
  - Supply chain
  - Interruption of operations

Prevention & Mitigation Strategies
- Invest in strategies to prevent hazards and or mitigate the impacts of hazards
- Priorities:
  - Life safety
  - Facilities
  - Machinery & equipment
  - Infrastructure
  - Information technology
  - Supply chain

Business Impacts/Continuity of Operations
- Business Impacts
  - Revenue
  - Profitability
  - Market share
  - Increased expenses
  - Relationships
- Governmental Services
  - Essential services
  - What services become more important during/following a “disaster”?
- Recovery Time Objective
- Resource Requirements, Dependencies, and Interdependencies
**Resource Needs Assessment**

- Resources
  - People
  - Expert knowledge
  - Facilities
  - Equipment
  - Voice & data communications
  - Information & intelligence

- Considerations
  - Quantity
  - Response time
  - Capability
  - Limitations
  - Cost

**Emergency Operations Plan**

- Responsibilities for carrying out specific actions
- Protective actions for life safety including people with access and functional needs
- Protect property, operations, the environment, and the entity
- Actions for incident stabilization
- Warning, notifications, and communication
- Crisis communication and public information
- Resource management

**Business Continuity Plan/COOP Plan**

- Organization with defined roles and responsibilities
- Incident management system
- Strategies to continue production or service delivery within recovery time objectives
- Provision of required resources when needed
- Manual workarounds for automated technology

**Crisis Communications**

- Disseminate and respond to requests for pre-incident, incident, and post-incident information
- Central contact facility/information center
- System for gathering, monitoring, and disseminating information
- Procedures for developing and delivering coordinated messages
- Pre-scripted information bulletins or templates
- Plan for use of social media
- Protocol to coordinate and clear information for release

**Training & Education**

- Develop and implement a training and education curriculum
- Create awareness and enhance the required knowledge, skills, and abilities
- Comply with applicable regulations

**Testing & Exercises**

- Testing
  - Business continuity/COOP strategies
  - IT disaster recovery

- Exercises
  - Needs assessment
  - Evaluate program plans, procedures, capabilities, and resources
  - Practice to develop and maintain capabilities
  - Clarify roles and responsibilities
  - Measure improvement compared to performance objectives
Program Maintenance & Improvement

- Program reviews
  - Policies, plans, procedures
  - Resource availability and capabilities
  - Performance objectives
  - Program implementation
  - Results of corrective action
- Conduct reviews periodically:
  - Changes in hazards and potential impacts
  - Changes in resource availability or capabilities
  - Infrastructure changes
  - Organizational changes
  - Changes in operations or services
- Corrective action program

NFPA 1600, 2016 Edition

“Standard on Disaster/Emergency Management and Business Continuity/Continuity of Operations Programs”

- “Preparedness” is no longer an element of the program—it is the program.
- Definitions: Added AFN, Crisis, and Supply Chain
- Risk Assessment:
  - Added supply chain vulnerability assessment
  - Added security of information
- Business Impact Analysis: Rewritten
- Crisis Communications: Added social media
- Continuity: rewritten
- Recovery: rewritten
- Appendices: Continued development and strengthening
NFPA 1616: Standard ON Mass Evacuation, Sheltering, and Re-entry - Dean Larson, Larson Performance Consulting

NFPA 1616

- In 2012, NFPA received requests for standard development
  - Evacuation – International Association of Fire Chiefs
  - Sheltering – private citizen
- Opposition
  - “Work already completed”

NFPA 1616

- Process initiated September 2013
- DRAFT finished February 2014
- NFPA Standard Council approved the “Draft” August 2014
- FIRST DRAFT – March 2015
- SECOND DRAFT – March 2016
- Expected publishing – early 2017

PROGRESS

- Four organizations opposed NFPA developing this standard.

PROGRESS

- Four organizations opposed NFPA developing this standard.
- Today, ALL four organizations are active members of the 1616 committee.

APPROACH TO NFPA 1616 DEVELOPMENT

- Planning Assumption:
  - Integrated Business Continuity and Emergency Management Program is in place
  - Program standard
  - Outlined in NFPA 1600
- PDCA
Complete Program

- Evacuation
  - Initial scope
  - Would sheltering be covered in a separate standard?

- Evacuation and
- Sheltering

- Evacuation and
- Reentry

Complete Program

- Evacuation and
- Sheltering and
- Reentry

NFPA 1616 Chapters

- Chapter 1 - Administration
- Chapter 2 - Referenced Publications
- Chapter 3 - Definitions
- Chapter 4 - Mass Evacuation, Sheltering, and Re-entry Program Management
- Chapter 5 - Planning
- Chapter 6 - Implementation
- Chapter 7 - Training and Education
- Chapter 8 - Exercises
- Chapter 9 - Program Reviews

Two Big Issues

- People with disabilities and other access and functional needs

FNSS

- Functional Needs Support Services (FNSS):
  - Services that enable individuals to maintain their independence
  - In a general population shelter.
TWO BIG ISSUES
- People with disabilities and other access and functional needs
- Animals

ANIMAL SHELTER PLANNING
- Considerations:
  - Service animals vs. companion pets
  - Service animals vs. comfort animals
  - Central pet shelter vs. co-located shelter
  - Coordinate and pre-plan with local pet care agencies
  - Develop plan for transport of pets
  - Develop plan for transport and access for owners to pets
  - Develop tracking system to link pets with owners

WRISTBAND AND PET/ASSET TAG

WHY ANNEXES IN AN NFPA STANDARD?
- Standards are prescriptive
  - “Shall” and “Must”
  - The requirements from standards are usually audited
- When audited, compliance or reason what not
- In NFPA, annexes are included for material the committee feels is important to the user
  - “Should” and “May”

ANNEXES
- Annex A – Explanatory Material
  - Information the Technical Committee wants the user to have when using the standard
- Annex B – Self-Assessment Checklist
  - Chapters 4 – 9
- Annex C – Risk Management
  - Hazards/Risk plus Mitigation considerations

ANNEXES
- Annex D – Evacuation Requirements Analysis
- Annex E – Mass Sheltering Requirements Analysis
- Annex F – Re-entry Requirements Analysis
**ANNEXES**

Annex G – Entities

Entity. A governmental agency or jurisdiction, private or public company, partnership, nonprofit organization, or other organization that has emergency management and continuity of operations responsibilities.

**HIGH VISIBILITY ANNEXES**

- Annex H –
  - People with Disabilities and other Access and Functional Needs
- Annex I –
  - Animals

**ANNEXES**

- Annex J – Mandatory Evacuation
- Annex K - Emergency Communication: Public Alerts and Warnings
- Annex L – Social Media Support
- Annex M – Just-in-Time Training Support
- Annex N – Evacuation, Sheltering and Re-entry Data Interoperability

**ANNEXES**

- Annex 0 – Glossary
- Annex P – Informational Resources

**SPECIAL THANKS**

Questions?

Dean Larson
deanlarson@larsonperformance.com
NFPA COMMITTEE GUIDE ON RESILIENCY

➢ WHAT IS RESILIENCE?
➢ WHY SHOULD WE CARE?
➢ WHAT IS OR SHOULD BE NFPA’S PARTICIPATION?

NFPA COMMITTEE GUIDE ON RESILIENCY

Defining resilience more precisely is complicated by the fact that different fields use the term to mean slightly different things. In engineering, resilience generally refers to the degree to which a structure like a bridge or building can return to a baseline state after being disturbed. In emergency response, it suggests the speed with which critical systems can be restored after an earthquake or a flood. Though different in emphasis, each of these definitions rests on one of two aspects of resilience: continuity and recovery in the face of change.

Zolli and Healy

NFPA COMMITTEE GUIDE ON RESILIENCY

WHAT IS RESILIENCE?

Presidental Policy Directive (PPD) 21:
The term “resilience” means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.

Zolli and Healy

NFPA COMMITTEE GUIDE ON RESILIENCY

KEY WORDS

Prepare – Planning
Withstand – Robustness, Redundancy
Respond – Proactive and Reactive
Adapt – Learn
Recover – as good as, better than before
Threats or Incidents

NFPA COMMITTEE GUIDE ON RESILIENCY

➢ WHAT IS RESILIENCE?
➢ WHY SHOULD WE CARE?
➢ WHAT IS OR SHOULD BE NFPA’S PARTICIPATION?
NFPA COMMITTEE GUIDE ON RESILIENCY

Comprehensive Preparedness Guide (CPG) 201: Threat and Hazard Identification and Risk Assessment

- **Prevention:** Prevent, avoid, or stop an imminent, threatened, or actual act of terrorism.
- **Protection:** Protect our citizens, residents, visitors, and assets against the greatest threats and hazards in a manner that allows our interests, aspirations, and way of life to thrive.
- **Mitigation:** Reduce the loss of life and property by lessening the impact of future disasters.

NFPA COMMITTEE GUIDE ON RESILIENCY

- **Response:** Respond quickly to save lives; protect property and the environment; and meet basic human needs in the aftermath of a catastrophic incident.
- **Recovery:** Recover through a focus on the timely restoration, strengthening, and revitalization of infrastructure, housing, and a sustainable economy, as well as the health, social, cultural, historic, and environmental fabric of communities affected by a catastrophic incident.

NFPA COMMITTEE GUIDE ON RESILIENCY

- **EXISTING FRAMEWORKS**
  - FEMA’s National Disaster Recovery Framework (NDFR)
  - NIST’s Community Resilience Planning Guide for Buildings and Infrastructure Systems, (CRPG), NIST Special Publication 1190

NFPA COMMITTEE GUIDE ON RESILIENCY

- **WHAT IS RESILIENCY?**
- **WHY SHOULD WE CARE?**
- **WHAT IS OR SHOULD BE NFPA’S PARTICIPATION?**
NFPA COMMITTEE GUIDE ON RESILIENCY

NFPA MISSION

NFPA TODAY

ENGINEERED FEATURES
- Primary Emphasis on Fire as Initiating Event
- Prescriptive Mandatory Requirements
- Fire Prevention
- Fire Safety Features
- Quality, Robustness, Reliability, Redundancy

NFPA COMMITTEE GUIDE ON RESILIENCY

ADMINISTRATIVE/OPERATIONS FEATURES
- Fire Prevention
- Inspection, Testing & Maintenance
- Emergency Planning
- Qualification
- Equipment

NFPA TODAY

TYPES OF DOCUMENTS
- Codes and Standards
- Recommended Practices
- Guides

SCOPES OF DOCUMENTS
- What
- When, Where, How, How Much & Why

NFPA COMMITTEE GUIDE ON RESILIENCY

EXAMPLES OF RESILIANCE
NFPA 72
- Survivability – 23.10.2, 24.5.4.2, & C.2.2.1.4
- Graceful Degradation
  - Backup Power Supplies - 24 hr non-alarm followed by 5 min horn or 15 min voice – 10.6.7.2
  - Circuit Supervision and Performance
- Impairments

NFPA COMMITTEE GUIDE ON RESILIENCY

EXAMPLES OF RESILIANCE
NFPA 13
- Survivability – Seismic Supports – 9.3
- Protection and Mitigation
  - Keep Fire Small – minimize damage and downtime
  - Supervision
- Impairments – NFPA 25, Chapter 15
NFPA COMMITTEE GUIDE ON RESILIENCY

NFPA TODAY
EXAMPLES OF RESILIENCY

NFPA 99, Health Care Facilities Code
- Risk Categories – 3.3.146
- Emergency Management – Chapter 12

NFPA 909, Cultural Resource Properties Code
- Emergency Operations – Chapter 6
- Management Operational Systems – Chapter 10

NFPA 1600, Disaster / Emergency Management

NFPA COMMITTEE GUIDE ON RESILIENCY

NFPA TODAY
PARADIGM SHIFT?
- MINIMUM REQUIREMENTS
- FIRE EVENTS
- SACRIFICIAL PERFORMANCE
GAPS?
- ADAPTIBILITY
- RECOVERY

NFPA COMMITTEE GUIDE ON RESILIENCY

CHARACTERIZE EVENT
- Resilient – A resilient design level is below the expected (design) level and occurs more frequently. Resilient buildings and infrastructure systems should remain fully functional and not experience any significant damage that would slow or stall economic functions in the community.
- Expected – Design intended level, where the design level is often based on codes. The design level is often greater than the minimum required by codes, or may be based on other criteria. Buildings and infrastructure systems should remain functional at a level sufficient to support the response and recovery of the community as defined by the performance levels. This level is based on the design criteria normally used for buildings.
- Extreme – Maximum level is above the expected (design) level. Some hazards refer to the maximum credible event, which is based on the historic record. Extreme events may also include extreme events that can be anticipated due to climate change. Nonetheless, this hazard level is not the best possible design level that can be maintained, but rather one that the community believes is viable. Critical facilities and infrastructure systems should remain at least minimally functional at this level. Other buildings and infrastructure systems should perform at a level that meets or exceeds the occupant’s needs at this hazard level.

NFPA COMMITTEE GUIDE ON RESILIENCY

ESTABLISH RISK METRICS
- Life Safety (public and worker and Responders)
- Property Protection
- Continuity of Operations
- Environmental Protection
- Preservation of Cultural Heritage
- Preservation of National Security

Guidance Document for Incorporating Risk Concepts into NFPA Codes and Standards
NFPA COMMITTEE GUIDE ON RESILIENCY

ASSESSMENT METHODS
LIKELIHOODS
CONSEQUENCES
ACCEPTANCE CRITERIA
QUANTITATIVE
RELATIVE / QUALITATIVE
MITIGATION PLANS
RECOVERY?

NFPA COMMITTEE GUIDE ON RESILIENCY

FIRE – BEFORE & POST “DISASTER”

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NFPA COMMITTEE GUIDE ON RESILIENCY

Figure 2: Estimate Fire Risk

Likelihood of Ignition
- Low
  - Event rarely occurs
  - Event impinges fire prevention element
- Equal
  - Event does not change likelihood of ignition
- High
  - Event eliminates ignition source - energy
  - Event makes ignition difficult - find, code

Consequence of Fire
- Low
  - Event impacts fire safety feature
- Equal
  - Event does not change consequence
- High
  - Event reduces asset population
  - Event reduces damage potential
**NFPA COMMITTEE GUIDE ON RESILIENCY**

**RISK MATRIX**

**NFPA COMMITTEE GUIDE ON RESILIENCY**

**RECOVERY – INTERIM USE**

**NFPA COMMITTEE GUIDE ON RESILIENCY**

**NFPA 5000**

Table 55.3.1 Risk Category of Buildings and Other Structures for Wind, Snow and Earthquake

- Category A – Safe and operational: Essential facilities such as hospitals and emergency operations centers
- Category B – Safe and usable during repair: "Shelter in place" residential buildings, neighborhood businesses and services and buildings needed for emergency operations
- Category C – Safe and not usable: The minimum needed to save lives. These facilities may be repaired or replaced as needed to restore the economy
- Category D – Unsafe: partial or complete collapse: damage that will lead to casualties

**NFPA COMMITTEE GUIDE ON RESILIENCY**

**ESTABLISH RISK METRICS**

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Guidance Document for Incorporating Risk Concepts into NFPA Codes and Standards
Category A – Safe and operational
Category B – Safe and usable during repair

- OPERABLE OR IMPAIRED?
  - NFPA 25, CHAPTER 15
  - NFPA 72, CHAPTERS 10, 14, 24
  - OTHER FIRE SAFETY FEATURE?
  - SMOKE MANAGEMENT
Annex C: Breakout Session

The following were the notes from the Breakout sessions on “Resiliency and Emergency Preparedness Workshop”, held at NFPA Headquarters, Quincy, MA on 16th December 2015.

Blue Group:

- What additional tools would be helpful for NFPA technical committees as they consider incorporating resiliency concepts into their documents?
  - Primer on resiliency for each committee
    - Presentation at a committee meeting (brief, 15 min)
    - Have multiple levels over time
  - Platform for sharing ideas between committees especially where there are interdependencies
  - Include a clear working definition of resiliency in each standard that cannot be modified by individual committees
  - Include a standardized approach in chapter 1 - defining why
  - Consider using NFPA 1600 management systems approach as a model
  - Recommend that the committees use a metric of time for the choreography of critical interdependencies between requirements in different standards
    - Recovery time objectives
  - Guidance on understanding and defining what are considered critical functions and incorporating importance factors/priorities for each
  - Provide opportunities to use the expertise of the NFPA 1600 membership
  - Recommend formation of a Task Group to focus on resiliency
  - Develop a template for defining the components of resiliency

- What tools and resources might NFPA develop to assist you as you address resiliency issues back at the ranch – training, guides, qualifications/certifications, mobile tools, checklists, references materials etc.?
  - Tools to simply the use and implementation of existing standards, make them more consistent in format for ease of application
  - Economic cost benefit tools to help provide further justification for resiliency
    - ASTM standards for economic analysis
  - Public education campaign for helping people understand their individual role/responsibility in resiliency
    - Stop, drop, roll “& get up” campaign for resiliency
  - Develop resiliency tools and education for non-profits that are essential for recovery efforts (similar tools/resources for tribal nations).
  - Resource platform for stakeholders
    - NIST Resilience Knowledgebase
  - Create an Xchange page to continue the current discussions
  - Tools for data
- Tools for mining and collecting data
- Tools to resolve inconsistency in data, data formats, gaps
- Identify proxies for data

- What else do you think NFPA should be doing to further resilient communities? Who should we be interacting with, what programs might we undertake?
  - Apply the “firewise” approach to resiliency
  - Develop case studies on social costs of disasters
  - Ask the TC where they think they are on the topic

Work with other standards developers for build environment – gap analysis

**Green Group:**
- Website with one pagers (brief) attention grabbing, educational and validating
- App for 1600
- Provide case studies, examples on resiliency successes and failures for education and persuasion. More picture would be better
- Stats for the users of standards
- Short, medium and long term
- Philosophy shift
- Identify documents which need a wider than fire scope
- Develop a cross walk between, resiliency frameworks and NFPA docs
- Helping Building owners/communities
- Identify resources for statistical data related to events
- Develop case studies to help guide (gather, disseminate)…different time ranges
- Scoping from standard council. More guidance.
- Gap analysis/cross walk using NIST/others
- Resiliency frame works to NFPA standards
- Existing building checklist
- One stop web shop to explain, validate and educate on different hazards (IBC)
- Provide case studies to policy makers
- Corps of engineers and others for two way information exchange
- Socializing NFPA resiliency priorities
- Data needed – statistical, Start case studies and follow with figures for short, long and medium terms
- Educate leaders
- Interacting with the corps
- Direction from standards council – addressing more than fire as an initiating event, but healthcare
- Being cognizant of skills

**Red Group:**
- What additional tools would be helpful for NFPA technical committees as they consider incorporating resiliency concepts into their documents?
- Five minute summary for TC meeting presentation
- Electronic distribution of guide to TCs
- Table of NFPA standards and resources that aligns resiliency continuum
  - Shared content/subject matter
  - Scope overlap/Sharing of content
- Data centers – levels of protection, Economic, Electric
  - Why? FPRF identifying measures to enhance resiliency above mandatory requirements – NFPA and others
  - Perception of Minimum = Maximum
- TC task groups for resiliency every cycle
  - Initiated at standards council
  - Continued at TC level
  - Pushed back up – Communicate both ways
- Comprehensive collection of risk assessment methods
  - Tools to TC and user
  - More TC work on how to do risk assessment methods
- Over dependency on technology
  - More education needed methodology
  - Defining of process
- TC oversight

- Tools and resources at home – outside of TCs
  - Resiliency library housed by NFPA
  - Educational message to public
    - One voice consistency
    - Educating users
    - Web-based power point of resiliency basics Ex. Smokey the bear
  - Selling Resiliency like
    - Market resiliency concepts
    - Outreach to – variety of stakeholders with acknowledgement of regulations
  - Guidance document on performance levels – cost/benefit
  - Apps with checklists for communities, E-forms, self-assessment checklists with hyperlinks to additional information
  - Push tools out training agencies (Fire, EM, CCM etc.) & states
  - Tools for encouraging current edition use
    - Identifying resiliency components and pertinent updates/changes
  - Filter for new information
  - Taxonomy and tagging – searchable
    - History of requirements including substantiation, timeline, linked section – easy to find
  - Verify resiliency through
    - Manual of style
    - Equivalency statement
Vertical rule
  o Metrics, tool and self-accreditation
  o All hazards IM – All hazards risk assess, what can we steal?
  
- What else do you think NFPA should be doing to further resilient communities? Who should we be interacting with, what programs might we undertake?
  o Global outreach for life safety as benchmark
    - Need life safety to get to resiliency
  o More robust requirements (minimums) for vulnerable systems, areas, communities and promoted to TCs
  o Required risk assessment for buildings, systems etc. by occupancy in order to determine resiliency needs, chosen program objectives, and regulations for all hazards approach
  o NFPA as a strong advocate for post event fire, and potential cascading situations – Ex. Sandy, Katrina, Fukushima
  o Collaborate/learning from Earthquake engineering research institute, National academy of science etc.
  o Resiliency for Overseas Military bases and others