

**National Construction Safety Team  
Advisory Committee (NCST AC) Meeting Summary**

**National Institute of Standards and Technology (NIST)  
Gaithersburg, Maryland  
May 3, 2016**

**Advisory Committee Members:**

Jeremy Isenberg, Chair	Stanford University
Paul A. Croce	FM Global (retired)
Susan L. Cutter	University of South Carolina
James Harris	JM Harris and Company
Anne S. Kiremidjian	Stanford University
James R. Quiter	Arup
Sarah A. Rice	The Preview Group, Inc.

**NIST Representatives, Guests, and Contractor Support:**

Kent Rochford	Associate Director for Laboratory Programs, NIST
Howard Harary	Director, Engineering Laboratory, Designated Federal Officer, NIST
Long Phan	Group Leader, Structures Group, Engineering Laboratory, NIST
Marc Levitan	Acting Director, National Windstorm Impact Reduction Program (NWIRP), Engineering Laboratory, NIST
Erica Kuligowski	Leader, WUI Fire Group, Engineering Laboratory, NIST
Jason Averill	Chief, Materials and Structural Systems Division, Engineering Laboratory, NIST
Terri McAllister	Group Leader, Community Resilience Group, Engineering Laboratory, NIST
Nelson Bryner	Acting Chief, Fire Research Division, Engineering Laboratory, NIST
Dave Jorgensen,	Research Meteorologist and Chief, National Severe Storms Laboratory/R&D Division, NOAA
Ben Davis	Management and Program Analyst, Community Resilience Group, Engineering Laboratory, NIST
Melissa Banner	Administrative Assistant, Community Resilience Group, Engineering Laboratory, NIST
Judith Mitrani-Reiser	Assistant Professor, Department of Civil Engineering, Johns Hopkins University
Melissa Faletra	Wind Engineer, Applied Research Associates
Mat Heyman	Consultant, Applied Research Associates

## **Summary of Discussions**

### **I. Opening Remarks**

Dr. Jeremy Isenberg, Chair of the Committee, opened the meeting at 9:00 a.m. and welcomed the NCST Advisory Committee members and the NIST representatives to the meeting.

He thanked NIST for its responses to the Committee's 2015 report that would be shared during the meeting. Isenberg noted that for several recommendations there was no response, as NIST noted that those recommendations were outside the Committee's scope. He stated that it was important to not have any confusion about this issue and he looked forward to clarification.

Dr. Kent Rochford thanked the Committee for its time, noting that federal advisory committees are important to NIST as it conducts its work. NIST values and depends upon the advice and counsel of advisory committees, carefully reviews reports, and take recommendations and observations seriously. These recommendations are an important part of NIST's decision process. Rochford noted that the Committee would be hearing about related efforts; while these activities are outside the direct scope of the NCST Act, they enhance the members' understanding of the agency's NCST work. Rochford stated that he looks forward to feedback, observations, and advice the Committee would offer.

### **II. NIST Responses to NCST Advisory Committee's 2015 Report**

#### **Overall NIST Response and Committee's Scope**

Dr. Howard Harary thanked the Committee for preparing its 2015 report, most importantly, recommendations regarding the NCST. He clarified the Committee's scope, noting that the Advisory Committee was created specifically to provide recommendations to NIST regarding the NCST Act's implementation. Harary said that previous recommendations have been very helpful to NIST in:

- conducting investigations;
- presenting its findings and recommendations;
- tracking implementation of those recommendations; and
- exploring how those findings and recommendations can have expanded impact on the safety of structures.

Although the Committee's scope is defined by its charter, the Committee's members also share their observations on other matters, which NIST values. He stated that NIST welcomes any comments from members, but cautioned that if they do not relate directly to NCST matters and are offered as consensus recommendations, they legally fall outside the scope of the Committee's charter. At the same time, NIST does not wish to discourage members' discussions or observations; he said that it is not a matter of whether a topic gets discussed at a meeting -- but rather, whether it shows up in a report as a Committee recommendation.

Isenberg thanked Harary for clarifying this, and suggested that the Committee's report could be organized into two parts: a set of recommendations and a set of observations. He also suggested that a memo to the Director of NIST could be generated that would provide additional information beyond what was in the report to Congress. A brief discussion followed about the Committee's scope in which members sought additional clarification about specific issues being within or outside their charge. That included NIST's work on the disaster data repository, which will include both NCST and non-NCST work.

### **Specific NIST Responses to Advisory Committee Recommendations and Committee Discussion**

Harary provided NIST's responses to the Committee's 2015 recommendations as follows. Additional detail was provided in charts and by several subsequent speakers.

#### 1. Fire investigations

The Committee commented on several aspects of NIST's fire investigations that are not part of any NCST-related work at this time. The Committee would be updated on NIST's fire research activities and the National Fire Research Laboratory (NFRL) during presentations and the NFRL tour later in the day.

#### 2) Community Resilience Center of Excellence (CoE)

- NIST agreed with the Committee's recommendations about the potential usefulness of tools and methods for NIST's future NCST disaster and failure investigations that result from the CoE's research.
- NIST is placing a high priority on integrating CoE research tools and data into its own investigations as these tools becomes available, and that future NCST disaster and failure investigations will benefit from that work.
- NIST staff, including the acting director of the Disaster and Failure Studies Program, Long Phan, is actively collaborating with the CoE on community models, data architecture and management, and field studies research.

#### 3) Implementation of Recommendations from the Joplin Tornado Report.

- NIST appreciates the Committee's recognition of the traction gained among standards and code organizations regarding recommendations from the Joplin investigation.
- NIST has been working with code developers, state and local officials, and other federal agencies (such as FEMA and NOAA) to follow up on all of NIST's proposed improvements for tornado protection and resilience.
- Among the most significant accomplishments are the first approved *building code* changes resulting from the investigation, slated for publication in ICC's 2018 [International Building Code](#) (IBC) and 2018 International Existing

Building Code (IEBC). These will help to protect schools and their associated high-occupancy buildings from violent tornadoes.

The NIST Joplin team would brief the Committee in detail during the day, covering implementation of recommendations as well as ongoing related research.

#### 4) Disaster Data Repository

The Committee would be updated about NIST's latest work with the disaster data repository during the meeting.

#### 5) Possible Expansion for Deployment of NCST Teams

- NIST has considered expanding its criteria for NCST deployment to address issues related to resilience in addition to reducing risk. Such a change would extend the types and numbers of disasters that NIST might investigate under NCST authorities.
- A primary consideration is the limited resources available within the Disaster and Failure Studies program and the Engineering Laboratory.
- With the variety of current commitments and uncertainties about future budgets, NIST was not currently in a position to modify the criteria. But NIST appreciates the recommendation, understands its value, and will continue to consider modifications, especially if additional resources are available.

### **III. Update on Implementation of Joplin Investigation Recommendations and Discussion**

Dr. Long Phan reviewed NIST's 16 recommendations calling for:

- Nationally accepted standards for tornado-resistant design and design methodologies.
- Uniform national guidelines that enable communities to create safe and effective public sheltering strategies, tornado shelter standard for existing buildings, and installation of tornado shelters in new and existing buildings.
- National codes and standards and uniform guidance for clear, consistent, recognizable, and accurate emergency communications and joint plans by emergency managers, the NWS, and the media to make sure that accurate and consistent emergency alert and warning information is communicated in a timely manner.
- Research, technologies and strategies to advance tornado wind measurements, strengthen emergency communications, increase warning time, derive more accurate tornado hazard maps and improve public response.

Several of the recommendations were being addressed by other organizations that had agreed to serve in a lead role.

Recommendation #3 called for tornado hazard maps to be developed for use in the engineering design of buildings and infrastructure. The maps will consider spatially based estimates of the tornado hazard instead of point-based estimates. Key points included:

- Existing tornado hazard maps do not account for biases and increased risk of strike on large spatial systems.
- NIST had contracted with ARA to develop Tornado Hazard Maps for Building Design, and is 1.5 years into a four-year effort.
- Progress to date included:
  1. Reviewed the state-of-knowledge on tornado climatology, biases in tornado databases, and tornado risk assessment.
  2. Conducted data analysis and sensitivity studies of factors affecting tornado data to inform tornado hazard maps development plan.
  3. Quantified tornado risk metrics for pilot municipality (Joplin) and sensitivity analysis to guide prioritization of maps development.
  4. Held stakeholder workshop to update key private sector, academic, and governmental stakeholders on progress of the tornado hazard maps development effort (September 2015).

The Committee discussion included questions, observations, and recommendations:

- A suggestion was made that a milestone-based indicator would be helpful, in addition to information about how far into the project NIST was in terms of time that has passed. Phan responded that this would be possible.
- Whether tornado hazard maps could be developed with spatially based estimates of the tornado hazard rather than today's point-based estimates that rely on damage to structures. NIST had hosted a workshop in September 2015 to ensure that the methodology for developing the new tornado map is understood and supported by the community, so that at the end of four years, the mapping approach would be acceptable to everyone.
- NIST anticipates updating these maps over time. NIST considers its new tornado hazard map would be V1.0, similar to the way that tsunami mappings are managed.

### **Progress in Developing Tornado Hazard Maps**

- Melissa Faletra, Wind Engineer with Applied Research Associates (ARA), provided additional details about the tornado hazard maps project and offered an overview of the tornado hazard modeling process. She pointed out one of the first task involves review and compilation of tornado data, which come from different sources and databases, and database cleansing to correct errors and biases in the databases due to differences over time with data collection methods and procedures as well as data entry and database management and administration. She emphasized that it was important to capture in modeling that a particular tornado (e.g., EF-4) is not at that constant force throughout its full path. Faletra also presented ARA's effort in

modeling of wood frame walls' performance in tornado as a way to validate tornado wind speeds. She summarized the NIST/ARA's tornado hazard maps development effort by stating that tornado hazard analysis is a complicated, iterative process with many components, but NIST and ARA are making steady progress.

The Committee discussion included questions, observations, and recommendations about:

- Has work so far given an indication of whether the maps we have been using are too low for this hazard? Faletra stated that the work done to date indicates that the risk of tornado strike for a particular building shown by the current maps is lower than it should be.
- How building density is accounted for in these maps.
- Whether the use of satellite imaging had been considered in constructing maps; for example, damage to vegetation could be helpful in identifying length and width of the tornado, and to infer wind speeds. Phan noted that an ASCE Standard on Tornado Wind Speed Estimation was being developed so that in the future, tornado databases could include that additional information. Committee member Kiremidjian noted that new tools could be developed to extract data from existing images, and that the effort would not be very costly.
- How the technology ultimately would find its way into the IBC, and what that was going to look like. Would these approaches be embedded in software in the same way that seismic hazard assessments are conducted? If so, who is going to have access to and know how to best use that software? How would it be used by urban planners and building officials, and structural engineers? Phan said that the plan was to incorporate new technological approaches into ASCE 7, for example, and that the map would be digitally based. Details about how it would be made public were being worked through with the appropriate ASCE committee, with the final format envisioned as software.
- The usefulness of USGS's seismic hazard mapping that is available online; a suggestion was made that NIST should look at the USGS website as an analog to see how such a tool can be offered to the broader community.
- The selection of structure types in databases and their validity.
- Whether NIST was making any efforts to develop the right kinds of instruments to better measure wind velocities from tornadoes. Committee member Kiremidjian stated that "We shouldn't just be getting wind speeds by reverse engineering via structural damage," and suggested that cameras or small sensors could be used to get wind speeds/directions that could help to improve measurements of wind velocities due to tornadoes. Members were informed by Levitan that NIST is working with ASCE standard committee on improving wind speed measurements from radar and in situ, and that NST was funding some related work, including on new technology approaches. It was noted that NOAA is working on other technologies; they are the lead for recommendation #1.

## **Update on Joplin-Related Standards, Codes, and Guidance Development**

Marc Levitan provided the Committee with an update on standards, codes, and guidance development work as a result of the Joplin Tornado investigation recommendations. These included:

### Existing Standards

- ASCE/SEI 7-22, Minimum Design Loads for Buildings and Structures
- ICC 500-2019, Standard for Design and Construction of Storm Shelters

### New Standards

- ASCE/SEI Standard for Estimation of Wind Speeds in Tornadoes.
- NFPA 1616, Standard for Mass Evacuation and Sheltering.

### Building Codes

- 2018 International Building Code (IBC).
- 2018 International Existing Building Code (IEBC).

### Guidelines

- FEMA P-431, Tornado Protection: Selection Refuge Areas in Buildings.
- FEMA P-320, Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business, 4th ed. (December 2014).
- FEMA P-361, Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms, 3rd ed. (March 2015).
- ICC 500-2014 Commentary on the Standard for Design and Construction of Storm Shelters (January 2016).

The final three guidelines listed above represent completed work.

Levitan noted that national model building codes, standards, and practices seek to achieve life safety for the hazards considered in design. He said that a paradigm shift was needed to include tornadoes in design practice, which are not currently considered, except for structures in nuclear power plants, storm shelters, and safe rooms. The Joplin investigation report called for nationally accepted performance-based standards for tornado-resistant design of buildings and infrastructure to be developed in model codes and adopted in local regulations to ensure the resilience of communities to tornado hazards (R5).

The progress of work by NIST and others in tornado design incorporation into standards and codes included a reference to the work on new tornado hazard maps (R3), new tornado wind load design methods (R6), and development of new damage indicators (DIs) for the EF tornado intensity scale to better distinguish between the most intense tornado events (R4). It also included a recommendation (R2) that information gathered and generated from tornado events (such as Joplin) should be stored in publicly available and easily accessible.

Levitan also reported that ASCE had approved a new standard committee called Wind Speed Estimation in Tornadoes. Co-chaired by NWS and NIST, it has 93 members, mainly meteorologists, wind engineers, and structural engineers. The

scope of the new standard includes wind speed estimation by EF scale, radar and in-situ measurements, forensic engineering, tree fall patterns, and remote sensing. The committee's scope also includes requirements for data and metadata, and is intended for adoption by the National Weather Service (NWS). Current NWS requirements do not allow for inclusion of actual wind speeds.

Better guidance for existing Damage Indicators (DIs) are being developed to provide more consistent wind speed estimates (e.g., a large building where half of the building is damaged badly and the remainder of the building suffers little, if any, damage). That work also encompassed the development of new engineering-based DIs (e.g., Jersey barriers, where wind tunnel tests were determining the speeds required for overturning).

A key limitation is that the EF Scale is damage based, and a tornado has to hit something in order to get an estimated wind speed. Recent mobile radar measurements indicate much stronger winds than those estimated by damage, so under-reporting appears to be a major problem.

National guidelines are being developed to enable communities to create safe and effective public sheltering strategies (R8). The guidelines should address planning for siting, designing, installing, and operating public tornado shelters within the community. NIST has worked closely with FEMA on guidance (e.g., multiple "Safe Room" publications), leading development of the ICC 500 standard commentary, and working with NFPA on its proposed 1616 annex (now out for balloting).

Recommendation (R7) has two parts: (a) a tornado shelter standard specific for existing buildings be developed and referenced in model building codes and (b) tornado shelters be installed in new and existing multi-family residential buildings, mercantile buildings, schools and buildings with assembly occupancies located in tornado hazard areas. Code changes approved for the 2018 IBC and IEBC were developed in coordination with the Building Code Advisory Committee (BCAC) and FEMA and expand requirements for incorporation of ICC 500 storm shelters at both new and existing schools.

Less successful efforts to date include those seeking to implement recommendation (R11) that aggregate used as surfacing for roof coverings and aggregate, gravel, or stone used as ballast be prohibited on buildings of any height located in a tornado-prone region. Changes were proposed for the 2018 IBC; they were not successful in recent balloting, but NIST is revising the code change proposal.

For recommendation (R9) (that uniform guidelines be developed and implemented nationwide for conducting assessment of tornado risk to buildings and designating best available tornado refuge areas as an interim measure within buildings until permanent measures fully consistent with Recommendations 5 and 7 are implemented), NIST is working with FEMA to update FEMA P-431. The current version deals almost exclusively with schools; the revised version will have a new,



engineering-based selection methodology that will cover a broader array of building occupancies and types and incorporate quantitative as well as qualitative factors.

Committee members asked about:

- Plans to expand shelter code-related implementation beyond schools. Levitan confirmed plans to do that, but also noted that those are more complicated and likely will engender greater resistance. Consequently, NIST had decided on a phased approach. He offered that there will be more shelters constructed, more products developed to bring the cost down, and more designers and developers familiar with these issues, and that these developments likely would improve the prospects for code adoption.
- How new construction was being handled versus renovated buildings in proposals to improve various codes.
- The economic impact of no longer using aggregate roofs, and whether it was feasible to use the same kind of rooftop to encapsulate the pebbles and keep them from blowing away—rather than replacing them. NIST staff noted that aggregate surfaced roofs are becoming less and less common and now represent only a small percentage of market share. Economic impacts would be large for those involving with aggregate roofs, but that there now were many alternatives to those systems. After further discussion, NIST said that it could bring in its Applied Economic Office to help assess the situation, if the agency is not successful during the next code considerations. Committee members' ideas about this topic were welcomed.

### **Emergency Communications**

Erica Kuligowski described work to develop guidance for community-wide public alerts in emergencies. She noted that this was an outgrowth of a NIST Joplin investigation report recommendation calling for the development of codes, standards, and guidance for emergency communications and a joint plan by emergency managers, the media, and the NWS for consistent alerts.

There is a two-year project to develop guidance for communities for public alerts via outdoor siren (warning) systems and social media (including mobile alerts). The guidance will 1) focus on alerting strategies for relevant hazard and threat scenarios in communities in the U.S. and 2) provide technical foundation for NFPA 1616 on alerting requirements.

After reviewing the multiple elements of a community-wide emergency communication system, Kuligowski stressed the highly collaborative nature of the ongoing work, with NFPA as the designated lead for implementing the Joplin report recommendation. This work is organized into two distinct, but related areas:

- 1) NFPA 1616 Technical Committee, with Annex K on Emergency Communication: Public Alerts and Warnings and Annex L on Social Media Planning.

- 2) Fire Protection Research Foundation (FPRF), with a Project Panel consisting of the Department of Homeland Security (S&T), NOAA/National Weather Service, U.S. Department of Veterans Affairs, Local (and State) emergency management and response community, siren/alarm manufacturers, the research community (including social dimensions of disasters), and the NFPA 1616 Chair.

NIST has previously collaborated with FPRF and NFPA in related work.

The Joplin investigation identified confusion about what the siren signals meant, and that communities used the sirens in various ways. The project is looking at current siren technologies, limitations, and capabilities in alerting. It also is examining how people respond to alerting sounds and patterns – and is reviewing methods that leading communities have adopted to standardize siren systems. In the second year, a guidance document will address standard alerting strategies and point to effective usage of mobile devices and social media tools.

Progress to date includes the review of siren policies for several regional organizations around the country. Joplin has taken the lead and is working with other communities in Southwest Missouri. Next steps include literature reviews of how people respond to alerting sounds and patterns, collection of additional siren policies developed by communities, and a workshop to be held in the summer of 2016.

Committee members asked several questions, including whether it was feasible to use or develop technology that would trigger a signal to the building’s alarm system to enhance alert and warning messages. Kuligowski said that she would follow up with alarm manufacturers on the FPRF Panel.

### **NOAA Grid-Based Threat Communication: Forecasting a Continuum of Environmental Threats (FACETS)**

Dave Jorgensen of NOAA reviewed progress in implementing Joplin report recommendation (R16) that calls for technology to be developed to provide tornado threat information to emergency managers, policy officials, and the media on a spatially resolved real-time basis to supplement the currently deployed official binary warn/no warn system. NOAA has the lead for this recommendation.

Jorgensen pointed to issues with the current tornado warning system, especially noting that warning polygons:

- Are messy and inherently “binary” (on/off; in/out)—leading forecasters to make warning areas conservatively large,
- Have huge false alarm rate, and
- Reflect a 1950s Teletype-era paradigm based on air raid sirens.

He told the Committee that “we can do so much better now with new technologies” and believes that warning times can increase from 12 minutes to 45 minutes.

Jorgensen briefed members on NOAA's National Severe Storms Lab (NSSL) work to explore and develop a new grid-based threat communication paradigm, called Forecasting a Continuum of Environmental Threats (FACETS). This is a new, all-hazard watch/warning paradigm (grid-based, probabilistic threats) redesigned with social/behavioral science. It is a multi-year exploration/development effort. To date, the work team has completed a first iteration of probabilistic hazard grids and tools and has run limited tests with NWS forecasters via a Hazardous Weather test bed in Norman, OK. Twelve years of NWS radar data has been analyzed in preparation for statistical based methods for warnings.

The benefit of FACETS is that it would provide a fully-integrated continuum of weather threat information; a reduction in size of "warned" areas (avoiding overwarning); considerable new opportunities for America's weather industry; and offer more useful, actionable, and recipient-specific information (e.g., hospitals may be more sensitive to threats that other occupancies). These advances would help to meet the NWS goal of a Weather-Ready Nation. Considerable work remains to be done, he noted.

Members followed up Jorgensen's presentation by noting:

- There were varying timelines today for alerts/warnings for different kinds of hazards (e.g., seismic warnings) and that there were clear implications for protecting building occupants. For example, seismic warnings offered only limited help (e.g., time for hospitals to stop surgeries, people to get under desks).
- Tsunami warnings are a reasonable comparison of tornado warnings.

#### **IV. National Fire Research Laboratory Tour**

Committee members toured the National Fire Research Laboratory (NFRL) at NIST, a new facility that could be used in future NCST investigations as well as other disaster-related investigations and research. Matt Bundy, NFRL Director for Fire Research, described types of work at the facilities and their relationship to the NCST investigations of the World Trade Center buildings collapses and fires as well as the Rhode Island nightclub fire and other disaster investigations. He reviewed NFRL expansion design objectives and operating principles and processes.

Members asked about commissioning tests for fire and pollution control equipment), facility capabilities, expected types of structures to be tested, and the capacities and limitations of the facilities (e.g. dimensions, multi-story, starting fires at various locations).

#### **V. Disaster and Failure Studies Update**

Jason Averill reviewed the criteria for NCST investigations that evaluate the need for an investigation and considers many factors. He followed with a review of the disasters that had taken place since the last Advisory Committee meeting in March 2015 and how each scored using those criteria. NIST chose not to deploy to any of

the nine recent disasters, although the agency is still monitoring the April Kyushu, Japan, earthquakes.

Members asked a series of questions about the criteria and how each disaster was rated. That included the effect of limited resources. Averill advised that if the agency deployed NCST, NIST would need to adjust its other work to reflect the increased resource and workload demands. In this decision making process, the knowledge that might be gained through an NCST investigation and the potential impact on standards and codes would have to be weighed against other ongoing work. Members were reminded that NIST's goal in undertaking an investigation under the NCST authority is not to do a forensic analysis. There was an extended discussion about resource availability and decision making about NCST deployment.

Especially in light of a spectacular New Year's Eve fire in Dubai, Averill said that NIST needed to look carefully at the standards being used to address fires and make sure that we are not overlooking fires where building exteriors were involved. He also noted that recent Wildland Urban Interface (WUI) fires did not score high enough to be investigated, but there is a lot of background detail about WUI fires that is just starting to emerge.

#### **Disaster Data Repository Updates**

Averill advised the committee that recent additions to the Disaster Data Repository cover data from the Chile 2010 Maule and the 1985 Valparaiso earthquakes; this information is now available for public access. The Joplin and Moore Tornadoes Data Repository will be available for public access in summer 2016.

Referring to the Committee's past interest in the potential for expanding data contributors beyond NIST, Averill told members that NIST hopes that the data repository eventually becomes an integral tool for field studies. He said that NIST is moving towards a place where it can begin to think about and accept data from non-NIST sources, as the agency and community get more experience with the database under its belt. Averill noted that there are a variety of questions that must be addressed regarding any special access that would be required to enable those additions, and he stated that NIST must first ensure that the database is fully functional. He noted that NIST would not want to start working with outside contributors and then need to "change the rules" about the database. One member asked specifically about several potential data contributors; Averill requested that information about them be provided to NIST, noting that eventually, the agency would want to pilot with non-NIST contributors.

#### **Center for Risk-Based Community Resilience Planning (CoE)**

Noting that integrating social and economic aspects of communities' built environment with engineering aspects is one of the exciting areas of community resilience, Averill explained the role of the Center for Risk-Based Community Resilience Planning, a NIST Center of Excellence (CoE). It is important that the resilience focus is on recovery; that necessitates longitudinal studies to measure and

track the function of the community over time. He provided updates on the CoE's progress since its establishment in 2015, and noted that the CoE was expected to contribute tools that would assist in future disaster investigations – just as the results of those investigations would be factored into the Center's research by "hindcasting." For instance, CoE researchers could take data from the Joplin investigation as input conditions, and then test and validate the computational models being developed in the CoE. This was another example of the benefit and impact of the Joplin study.

Members posed questions about the inclusiveness of resilience metrics for transportation and communications, potential overlap between CoE field studies and NCST studies, and relationship of the CoE work with other resilience efforts such as the Rockefeller Foundation's 100 Resilient Cities. Averill responded by noting that multiple physical infrastructure systems were being addressed by the CoE, that there was no statutory prohibition on having the CoE investigate a failure that NIST also was investigating – although coordination would be key in those cases and objectives of these studies would be different, and that there have been significant communications with other organizations, including working with Rockefeller's Chief Resilience Officers as part of these officials' training sessions.

## **VI. Wildland Urban Interface (WUI) Fires**

Nelson Bryner reported on NIST's investigations of two major WUI fires in Amarillo, TX (2011) and Waldo Canyon, CO (2012) – neither of which were conducted under the NCST Act.

He noted that the Amarillo fire was the first opportunity to analyze information from an electronic data collection system for equipment. There is not much information to be gathered from destroyed structures, so investigators cannot learn much about fire spread or the impact on nearby structures. But damaged (rather than destroyed) structures allow investigators to begin to identify vulnerabilities and the response of structures to fires. For instance, are decks, fences, or attics playing a significant role in fire spread?

Extensive data was collected after the Waldo Canyon Fire: over 200 technical discussions with first responders and 4,500 distinct fire observations and/or defensive actions for ~8 hours of incident. After the first hour, structures were being ignited from structure-to-structure rather than from wildland ignitions

Bryner emphasized that WUI fires require rapid response, explaining the difference between responses for urban, WUI, and wildfire responses – with WUI fires being closer to urban. He told the committee that "We've been fighting WUI more like wildfires," and that these investigations show that there is no time for staging firefighters and apparatus. Bryner said that communities need to have pre-plans for WUI fires, just as they have pre-plans for structural fires.

Members asked several questions about radio communications, and were told that there were issues coordinating with multiple jurisdictions' equipment.

## **VII. Reauthorization of the National Windstorm Impact Reduction Program (NWIRP)**

Marc Levitan reviewed NWIRP's mission, history and agency roles, with NIST having lead agency responsibilities, plus carrying out R&D to improve model building codes, voluntary standards, and practices for design, construction, and retrofit of buildings, structures, and lifelines. He reinforced that FEMA and NIST are mandated to work together on standards and codes. There is a separate advisory committee for windstorm impact reduction. That committee is charged with offering assessments and recommendations on: 1) trends and developments in the natural, engineering, and social sciences and practices of windstorm impact mitigation, 2) the priorities of the Program's Strategic Plan, 3) the Program's coordination, 4) the effectiveness of the Program in meeting its purposes, and 5) any revisions to the Program which may be necessary. Windstorm investigations are authorized under NWIRP.

Members had questions about how NWIRP investigations related to the NCST investigations and the potential for a lack of adequate coordination; NIST would be fully aware of any planned investigations. They also asked about whether NIST could conduct an NCST investigation and borrow investigators from other agencies that they would pay for; NIST staff cited NCST Act requirements that at least one member of each team be from outside NIST. They noted that the external Joplin investigator was from NOAA (Dave Jorgensen) and that agency had paid his costs. Levitan added that if another agency owning a facility were damaged, NIST would have a coordination mechanism in place to play a role in an assessment.

A member asked for a definition of "windstorm" and whether there is a crossover with NCST. NIST staff responded that there was no definition in the statute, but that one of the advantages of NIST having the NWIRP lead is that these programs all report to the NIST Engineering Laboratory Director.

## **VIII. Committee Discussions**

### **Asks of the NCST Advisory Committee**

Howard Harary posed several questions to the Committee:

- Can the Committee recommend criteria for deployment teams to various hazard events (EQ, hurricane, wildfire, etc.) to ensure the right expertise is available to collect necessary data and make assessments?
- Can the Committee advise NIST on best practices for standardizing the type and format of data collected during deployment for various hazard events?

He also asked the Committee to review the Engineering Laboratory's First Level Hazard Review for field deployments, and respond with best practices for improving field safety. Harary noted that the Committee could address these requests in small groups, and would need to meet in a full Committee setting in order to reach a consensus.

Committee members indicated that they were interested in following up.

Members had several questions and initial observations regarding recommending criteria for deployment teams:

- What are the difficulties in getting people on the team now, and are there gaps in expertise? Does NIST see areas where investigations could "grow" and where they could make a greater impact?
- What authority does NIST have with respect to working with other agencies to bring in expertise that we don't have within house? NIST staff responded that there are no limitations on NIST's authority in this regard; if it is supportive of an investigation's goals, NIST can find a way to partner with other agencies. The agency has more than 20 MOUs with agencies and private companies in case NIST encounters them during its investigation to avoid roadblocks.
- Can the process be improved by studying past investigations before NCST was in place? Reviewing about a dozen investigations might be appropriate in terms of assessing scope and expertise. The Committee requested a very high-level listing of the principal investigators of prior investigations which of the type that NIST would evaluate seriously for NCST investigations if those incidents were to occur in the future.

### **NCSTAC Preparation of Annual Report to Congress**

Committee members reviewed the day's discussions and issues, including the NIST requests made of them, and agreed on an approach for responding and for preparing the annual report to Congress.

The Committee adjourned at 5:00 pm.