

NCST Panel Review Meeting

Held at NIST campus

Gaithersburg, MD

November 7, 2011

Advisory Committee Members

Jeremy Isenberg, Chair	AECOM
Ronny J. Coleman	Fireforceone
Paul A. Croce	FM Global (retired)
Susan L. Cutter*	University of South Carolina, Columbia
Carlos Fernandez-Pello	University of California, Berkeley
Jeffrey L. Garrett	CTLGroup
Anne S. Kiremidjian	Stanford University
R. Shankar Nair	Teng and Associates, Inc.
James R. Quiter	Arup
Sarah A. Rice	The Preview Group, Inc.

*Member not present at meeting

Biographical information is available at

www.nist.gov/el/disasterstudies/ncst/ncstac_members.cfm

Summary of this Report

The first meeting of this Advisory Committee in several years was held in Gaithersburg, MD on November 7, 2011. All members are new to the Committee, and much of the one-day meeting was devoted to informing the members of the organization and current activities of the NCST program.

Eric Letvin, Director of the NIST Disaster and Failure Studies Program, welcomed the members to the National Construction Safety Team (NCST) Advisory Committee meeting. Jeffrey Harrington, Senior Counsel in the Ethics Law and Programs Division of the U.S. Department of Commerce, briefed members on ethics rules for Special Government Employees. After introductions, the Chair reviewed the charge to the Committee, as set forth in the Committee charter (www.nist.gov/el/disasterstudies/ncst/ncst_charter.cfm). Shyam Sunder, Director, NIST Engineering Laboratory, discussed the work of the previous Committee, which was convened in 2002 to advise NIST and the NCST on the development of the World Trade Center (WTC) report. Another NCST was convened to investigate the Station Night Club fire in Rhode Island. Since the completion of these two reports, the Committee has been dormant.

In response to a request from the Chair, Sunder provided his thoughts on the most important

questions to be answered by the Committee:

1. Does NIST have the correct go, no-go decision criteria in place for launching NCST studies?
2. Is the study of the Joplin, Missouri tornado proceeding as it should?
3. Is the NIST approach for implementing and executing NCST studies appropriate?
4. How can NIST improve its processes for the archiving and dissemination of data?

Patrick Gallagher, Director of NIST, also welcomed the members. He discussed the decision to reinstate the Advisory Committee and reviewed the Committee's charge. Mr. Gallagher noted the charge to the present Committee is to assist NIST in determining how to design and run the Program. Committee members were urged to bear in mind that NIST is fundamentally a science-based organization whose investigations should provide the scientific information required to improve codes and standards.

The major topics of discussion were:

- Procedures for determining when to initiate a NIST investigation
- Procedures for deploying NIST investigation team
- The initiation of a project to create a data repository
- The investigation of the Joplin, MO, tornado

Introduction

In October 2002, the President signed into law the National Construction Safety Team Act (P.L. 107-231) which authorized the Director of the NIST to establish National Construction Safety Teams for deployment after natural and man-made events that cause the failure of a building or buildings and result in substantial loss of life or that pose significant potential for substantial loss of life. In this context, "buildings" is intended to include the entire built environment.

The purpose of these investigations is to improve the safety and structural integrity of buildings in the United States. Infrastructure is included in the pending NCST Act reauthorization S.646, which is interpreted as authorizing NCST to investigate the performance of lifelines in the context of structural integrity and community resilience following a disaster. An investigation team shall:

- Establish the likely technical cause or causes of the building failure;
- Evaluate the technical aspects of evacuation and emergency response procedures;
- Recommend as necessary, specific improvements to building standards, codes and practices based on the findings; and,
- Recommend any research and other appropriate actions needed to improve the structural safety of buildings and improve the evacuation and emergency response procedures, based on the findings and recommendations of the investigation.

This report summarizes NIST activities under the NCST Act for FY 2011 and the Committee's evaluation and recommendations regarding those activities.

NCST Activities in 2011 under the Act and under other Authorities

1. Investigations Conducted by Teams in 2011

An EF-5 (enhanced Fujita scale) tornado touched down in Joplin, MO at 5:34 p.m. CDT on May 22, 2011. Approximately 8000 structures (30% of the city) were damaged or destroyed. There were 162 fatalities and more than 1000 injuries.

A 4-person NIST team was deployed on the afternoon of May 24, returning May 28. Information and data were collected on the tornado hazard; the patterns, locations and causes of fatalities and injuries; the warning system, evacuation, emergency response and occupant behavior; responses of buildings, shelters and safe areas; and damage to lifelines.

NIST staff members who participated in the investigation briefed the NCST Advisory Committee ("Panel") on the study plan, including objectives, approach, implementation, outcomes, and impacts. They also made technical presentations on the Tornado Hazard Characteristics; Emergency Communications and Public Response; and Performance of Buildings, Designated Safe Areas, and Lifelines.

2. Other Actions Taken to improve Building Safety

Sofa Super Store Fire, Charleston, SC—Fire started near a loading dock then spread into drop ceiling area of a large showroom. A fast fire trapped and killed 9 Charleston firefighters. A report NIST SP-1118, Vol. 1 "Technical Study of the Sofa Super Store Fire-South Carolina, June 18, 2007" was published. NIST briefed the ICC Code Technology Committee, National Fire Protection Association, US Fire Administration, Society of Fire Protection Engineers, International Association of Fire Fighters and Door and Access Systems Manufacturers Association on the findings and recommendations of the study. The International Fire Code Committee is considering a proposal to change furniture store Use and Occupancy Classification to High Hazard.

Collapse of Dallas Cowboys Indoor Practice Facility, May 2, 2009—A fabric-covered steel framed building of common design collapsed under conditions of below-design wind speeds. NIST briefed the International Code Council's Code Technology Committee on the findings and recommendation of the study. NIST has prepared a draft code change proposal for consideration and implementation in the International Building Code, which will be submitted in the upcoming code cycle.

Amarillo Wildland-Urban Interface (WUI) Fires, March, 2011—Communities were impacted by wildland fires. NIST briefed Texas Forest Service, US Forest Service and American Society for Testing and Materials on the findings and recommendations of the preliminary reconnaissance report. The NIST WUI data collection methodology was adopted by the US Forest Service Region 8 (Southern US), by the National State Foresters Association and Texas Forest Service. A draft exposure scale for WUI fires was completed.

Mineral, Virginia Earthquake, August 2011—Damage was investigated at two schools.

International Earthquake Reconnaissance and Damage Assessments—NIST staff members investigated earthquake damage in Chile (EERI team); New Zealand (ASCE team); and Japan (UJNR team).

Development of NCST Infrastructure

1. Data repository

The Committee received a briefing on the Disaster and Failure Events Data Repository, which will serve as a national archival database where NIST and other organizations can store data collected from disaster and failure event investigations, studies, and analyses. The collected data will greatly assist with improvements to codes, standards, practices and new knowledge and will be made widely available. The data base will include data on significant hazard events; how buildings, other structures, and lifelines performed; emergency response and evacuation procedures; and technical, human factors including social and economic factors affecting pre-disaster mitigation and post-disaster response. The repository is being developed in phases, beginning with a World Trade Center investigation database. Phase 2 will be a pilot project covering the recent Chile earthquake. Data gathered by other organizations and assembled by the Applied Technology Council as consultant to NIST will be incorporated in the database, which will also support NEHRP. System design, development and assessment will be performed between January-August 2012. Phase 3 will be full scale implementation. When implemented the data repository will reside on a NIST server and will be managed by NIST.

2. Decision Criteria and Guidelines

NIST has developed decision criteria and guidelines that provide a rational basis for establishing the value of implementing and conducting a NIST study. Factors considered include staff and resource availability, staff safety and the quality and adequacy of information and artifacts that may be obtained by the study. Factors are weighted based on NIST experience and objectives. Directives by the Congress or Administration will also be considered. Categories of decision criteria include: actual or

potential substantial loss of life or disabling injury; level of hazard; extent of damage and loss of functionality; need for NIST involvement; stakeholder concern; evacuation/emergency response challenges; and for international events, similarity of practices or code enforcement.

Panel Evaluation and Recommendations

1. The decision making criteria are generally supported, and the algorithm appears to lead to pertinent investigations and proper resource allocation. However:
 - a. The Panel recognizes that investigations must, as a primary goal, serve code improvement efforts, the fundamental responsibility of the Teams. In addition, the criteria should also recognize that the investigations are scientific in nature and may increase the body of scientific knowledge. (Clarifying comment: It was noted at the meeting that the Station Night Club fire investigation resulted in no new scientific knowledge.)
 - b. Investigations must be launched immediately; a 72-hour delay was deemed too long for some incidents. It was recommended to remove bureaucratic obstacles to rapid response, and to have two or three current staff trained in accident investigation and able to depart within the 48-hour window, with others joining later if appropriate.
 - c. Lifeline incidents should be afforded proper consideration on par with building incidents; hence, a balance between investigation of buildings and infrastructure should be addressed and achieved.
 - d. An additional criterion should be considered to account for events with non-apparent or unfamiliar hazards, perhaps stressing the absence of a prior similar event or the novelty of a particular event, which would both cover unusual events and be applied objectively to terrorist events.

2. The approach to investigations, as represented by the Joplin, MO Tornado investigation, is generally supported. Conduct of investigations is holistic, considering both tangible failures and human factors. The panel encourages the following:
 - a. Data gathering should identify information that can ultimately be integrated into code provisions based on risk and formal treatment of uncertainty.
 - b. Data gathering should support understanding of both building and regional impacts of incidents; codes and recovery are increasingly focused on the resilience of communities.
 - c. Data collection should be performed with the understanding that data will be archived in the data repository; specific attention should be given in the field to filling gaps in the database.

3. The data repository is unanimously encouraged and supported. It is considered an excellent reporting platform and adds scientific credibility to investigations by including in electronic form actual data such as accelerograms and wind velocities. The panel recommends that:

- a. NIST take care to adopt database software that will continue to be supported and updated indefinitely,
 - b. NIST develops criteria to decide which data will be accessible to all and which will be restricted.
 - c. NIST develops safeguards to verify and maintain the validity of the data in the repository.
 - d. Criteria for including data from non-NIST sources in the database should be clear and concise. NIST/D&FS should not be the vetting body for the quality or appropriateness of data from non-NIST sources. Professional societies (ASCE, SFPE, ASME, AIChE) may help develop a workable scheme to review and vet outside candidate studies for inclusion.
4. The process for influencing code modifications, enhancements, and improvements based on data collection should be the subject for future discussion between NIST and the Panel.
- a. The Panel encourages the efforts to establish and maintain personal connections between NIST staff and ICC and NFPA committees. Transmission of findings through verbal and written reports is, of course, also supported. The Panel looks forward to more dialogue with NIST to determine if there are other ways to interface with the code process; an example is to initiate dialogue with the users of code provisions such as fire officials who have historically resisted changes.
 - b. Research staff often lack the interest and necessary skills to effectively participate in effecting the code change process. NIST/EL/D&FS should consider retaining additional staff, or training existing staff, to act as liaison between NIST and the codes and standards bodies

Appendices

Individual member comments

Isenberg expressed his appreciation for all of the effort that went into the very comprehensive and well done Committee briefings. He asked the members to briefly discuss what they have learned with respect to the Committee charge.

Ronny Coleman: The briefings were very informative. Understanding the limits of the studies and the criteria used for decision-making are important outreach issues. The receptors should be softened so that audiences and recipients of investigations understand what is going on.

Paul Croce: It is impressive that this work is being done at the national level. Too much time, however, may be spent on determining if the study is a NIST-based study, a NEHRP-funded study, or a study funded by other agencies. Time is of the essence. Trained staff should arrive quickly at events. NIST also should consider adding criteria for unusual events, such as the stage collapse at the Indiana State Fair, and should clearly define what will be included in the data repository.

Carlos Fernando-Pello: The briefings were informative and interesting. The information in the fire reports is of great value. There are questions about separating the interior of buildings from the infrastructure.

Jeffrey Garrett: The purpose of the studies is to produce code changes. The NIST team is to be complimented on the scope of the work and their accomplishments.

Anne Kiremidjian: The work to date is impressive, particularly the repository project. It is noteworthy that the studies are undertaken to support the development of codes. This includes a tremendous amount of science in support of technical credibility.

R. Shankar Nair: The numerical approach of the decision criteria appears sound. With regard to the criterion for NIST involvement, this should be considered at the outset. If there is no requirement for NIST involvement, there should be no need to proceed further.

James R. Quiter: Meeting only once a year will be a challenge if we are to provide meaningful input, particularly as the committee gets started. A cohesive program of all NIST investigations and advisory committees is needed. To facilitate this, the Chairs of the NIST Advisory Committees should speak to each other. With regard to building codes, there is almost no discussion of risk at code hearings. A role for NIST may be greater involvement in risk discussions. In addition, the NFPA is cutting back on investigations, which will leave a large void. The human factors element is very important. In terms of funding, sufficient staff is needed to send out on investigations.

Sarah Rice: The NIST study teams appear to be very qualified. From the engineering perspective, it is encouraging that we are moving into a world where code changes are based on science, data, and statistics.

The Chair opened the Committee discussion of the NCST program. A summary of the discussion by topic area follows.

Decision Criteria: The Chair stated that the decision-making algorithm adopted by NIST for launching studies appears sound. His hope is that NIST will provide the latitude for the criteria to mature. Refinements, if appropriate, should be based on a backward look as NIST moves forward.

Kiremidjian asked about the current decision-making approach in terms of bias built into the scoring system. For example, is there a bias toward natural hazards? The Committee discussed the E2 nightclub disaster in Chicago; the source of the disaster was a fight between patrons. This type of cause is not found in the criteria. Sunder pointed out that if there are only four out of eight possible factors, the factors are divided by four. Nonetheless, the cause could affect the decision to investigate. He added that NIST has always been satisfied with its decision making. Externally, there have been some issues. This is the first time the decision-making criteria are being reviewed and discussed in a public forum. He revisited the comment that NIST involvement should pre-empt all of the criteria. NIST should determine if it is the appropriate agency. However, he does not believe that this is a pre-emptive factor in terms of the decision to

launch a study.

Data Collection and Codes and Standards: The Chair asked the members about the interface between data collection and codes and standards processes. NIST staff are involved in this process, which is to be commended assuming adequate human resources are assigned to the task. In large part, the successful interface depends on the interpersonal dynamics between staff and the code writing bodies. The Committee may want to consider if NIST has the necessary influence it deserves in this area. NIST will also need to strike a balance between being a pure technical and scientific agency, and being an advocate of change.

The Committee discussed National Fire Incident Reporting System (NFIRS) data. A member stated that NFIRS is not designed to capture data on an incident. NFIRS allows for the study of structures across the United States but not one structure in particular. Coleman remarked that very few fire departments voluntarily participate in NFIRS. Most in the community do not believe it is a reliable source for developing policy. He also remarked on the effects of codes in saving lives. In the 1970s, there were about 10,000 deaths a year from fires. Today, there are about 3,500 a year.

Data Repository: The Chair stated that funds must be committed at the outset so that the repository is supported 3 years from now. The technologies of the future also must be given great weight. Kiremidjian agreed that funding must be in place to guarantee the long-term viability of the repository. Sunder noted previous estimates of \$2 million to operate and maintain the repository. Rice asked about NIST plans to include past studies in the repository. This will be done on a selective basis in Phase 3.

Coordination and Interaction with other Programs: Kiremidjian asked about coordination with other programs, such as the National Science Foundation (NSF) RAPIDS response teams. Sunder stated that NIST makes every effort to coordinate with NSF and other agencies, although this is not always an easy task. In response to a question on turf battles on disaster investigations, he stated that in the world of disaster investigations, people know each other and there are good relationships. There have not been any difficulties in NIST studies. There was excellent cooperation on the WTC study. NIST also tries to build relationships with local authorities, if possible. This was done very well with New York City during the WTC study.

Risk: Coleman stated that risk should be included as part of the equation. The need is to consider low probability but high consequence events. Nair commented that tornadoes, which are very high probability when considered cumulatively, would be an appropriate topic for future studies, with a focus on better communication and warning systems and evacuation procedures. Garrett remarked that the question goes back to the discussion of high risk versus the low probability of killing 162 people again. Croce stated that he would rather have NIST acknowledge that tornadoes are low probability events, and he does not see the need to focus on risk in NCST investigations. (Comment for clarification: Probabilistic techniques, such as fault-tree analysis, can be helpful in an investigation and should be used when appropriate; however, full risk

assessments, while helpful for planning purposes, facility siting, overall safety and risk management, risk reduction, etc., are not usually helpful in post-event investigations.) Kiremidjian commented that risk comes into play because the event will occur in a given area and will cause probable losses. She mentioned Performance-Based Engineering, which the Committee may want to consider.

Topics for Future Studies: The Chair asked the members for their thoughts on tornado hazard preparedness and response as a priority topic given the 500 people who have died from tornadoes in the United States this year. Nair stated that tornado studies should focus on warning systems and interior safety and creating shelters that could save lives. Quiter stated that while recommendations from the Joplin study obviously should be pursued, the scope of tornado-related research should not be restricted to the current investigation. Kiremidjian agreed.

Committee Reports and Recommendations: The Chair asked about the annual report from the Committee. Sunder stated that the statute requires the Committee to prepare an annual report. The Advisory Committee on Earthquake Hazards Reduction alternates detailed annual reports with shorter, summary annual reports. Garrett recommended that the first Committee report be brief, essentially a summary of today's discussion.