National Institute of Standards and Technology
National Construction Safety Team Act
Annual Report

Fiscal Year (FY) 2015

Summary

This annual report to Congress for fiscal year (FY) 2015 is required by the National Construction Safety Team (NCST) Act. NIST did not undertake any new NCST investigations, nor did it continue any NCST investigations in FY 2015.

In FY 2015, NIST continued carrying out implementation of the 16 recommendations in the Joplin tornado investigation final report (March, 2014).[1] The highlights of FY 2015 implementation activities include the approval of two code change proposals developed by NIST requiring installation of tornado shelters in new construction at new and existing schools in tornado-prone regions for inclusion in the 2018 International Building Code (IBC) and International Existing Building Code (IEBC), and the completion of the collaboration with the Federal Emergency Management Agency (FEMA) to revise and publish FEMA P-361 (Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms, 3rd edition, March 2015).

Additionally, NIST held two meetings of the NCST Advisory Committee (AC) during FY 2015. One face-to-face meeting on March 26, 2015, [2] and one meeting by teleconference on July 2, 2015. [3] In those meetings, NIST briefed the AC on: progress of NIST implementation of the Joplin tornado investigation recommendations; status of the Engineering Laboratory (EL)'s fire studies; status of the Community Resilience Center of Excellence; status of the Disaster Data Repository; and EL's planning for future disaster investigations. A summary of the discussions at these meetings may also be found in the FY 2015 Annual Report of the NCST AC to Congress.[4]

Introduction

In October 2002, the NCST Act (P.L. 107-231) was signed into law by President George W. Bush and authorized the Director of NIST to establish and deploy National Construction Safety Teams (Teams) to investigate events leading to failure of a building or buildings that result in substantial loss of life or that pose significant potential for substantial loss of life.

The purpose of these investigations is to improve the safety and structural integrity of buildings

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[1] Report available at: http://www.nist.gov/customcf/get_pdf.cfm?pub_id=915628

[2] Meeting summary available at http://www.nist.gov/el/disasterstudies/ncst/upload/NCSTAC-Meeting-Summary-2015-03-26.pdf

[3] Meeting summary available at: http://www.nist.gov/el/disasterstudies/ncst/upload/NCSTAC-Meeting-Summary-2015-07-02.pdf

[4] FY 2015 NCST AC Report to Congress available at: http://www.nist.gov/el/disasterstudies/ncst/upload/2015NCST_ReportToCongress.pdf

in the United States (U.S.). According to Section 2 of the NCST Act, a Team shall:

(A) Establish the likely technical cause or causes of the building failure;
(B) Evaluate the technical aspects of evacuation and emergency response procedures;
(C) Recommend as necessary, specific improvements to building standards, codes, and practices based on the findings made pursuant to subparagraphs (A) and (B); and,
(D) 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.

Under Section 10 of the NCST Act, NIST is to provide an annual report to the House Committee on Science, Space, and Technology and to the Senate Committee on Commerce, Science, and Transportation by February 15 of each year. This report is to include:

(1) A summary of the investigations conducted by Teams during the prior fiscal year;
(2) A summary of recommendations made by the Teams in reports issued under Section 8 of the NCST Act during the prior fiscal year and a description of the extent to which those recommendations have been implemented; and
(3) A description of the actions taken to improve building safety and structural integrity by the NIST during the prior fiscal year in response to reports issued under Section 8 of the NCST Act.

This report summarizes NIST's activities under the NCST Act for FY 2015 as required by Section 10 of the Act.

1. Investigations Conducted Under the NCST Act during FY 2015

NIST did not undertake any new investigations under the National Construction Safety Team Act during FY 2015, nor did it continue any NCST investigations during FY 2015.

2. Summary of Recommendations Made by Teams in Reports Issued Under Section 8 of the NCST Act during FY 2015

During FY 2015, NIST did not issue a report under Section 8 of the NCST Act.

3. Actions Taken to Improve Building Safety and Structural Integrity during FY 2015 in Response to Reports Issued Under Section 8 of the NCST Act

During FY 2015, NIST held two meetings of the NCST Advisory Committee (AC): one face-to-face meeting on March 26, 2015, and one meeting by teleconference on July 2, 2015. In those meetings, NIST briefed the AC on: progress of NIST implementation of the Joplin tornado investigation recommendations; status of EL's fire studies; status of the Community Resilience Center of Excellence; status of the Disaster Data Repository; and EL's planning for future disaster investigations.

a. Actions Related to Report on the NIST World Trade Center Investigation:

In its *Final Report on the Collapse of the World Trade Center Towers*,[5] NIST recommended that "progressive collapse be prevented in building through the development and nationwide adoption of consensus standards and code provisions." In FY 2012, based on a proposal from NIST, a new American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) Standards Committee called the "Disproportionate Collapse Mitigation Standard" Committee was established. This voluntary standards committee is currently developing a standard, with substantial contributions from NIST staff who are translating the results of NIST research into the standard. Additional information about changes to building codes and standards as a result of this investigation can be found at http://www.nist.gov/el/disasterstudies/wtc/wtc_recommendations.cfm.

b. Actions Related to Report on the NIST Joplin Tornado Investigation:

NIST has taken the following actions during FY 2015 to implement the recommendations made in this investigation to improve building safety and structural integrity (Note – all references to the recommendations below refer to those made in response to the NIST Joplin tornado investigation final report recommendations provided in Appendix A):

- Completed work with the International Code Council's Building Code Action Committee (ICC's BCAC) to refine proposals developed by NIST requiring the installation of tornado shelters in new construction at new and existing schools and assembly occupancies associated with schools in tornado-prone regions (NIST recommendation #7b). Following positive actions at the code hearings, these proposals have now been approved for inclusion in the 2018 International Building Code (IBC) and International Existing Building Code (IEBC).
- Completed work with the FEMA on the revision of FEMA P-361 (Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms, 3rd edition) in support of NIST recommendation #8. The new guidance was published in March 2015 (available at https://www.fema.gov/media-library/assets/documents/3140).
- Provided assistance to FEMA with the revision of the related document, FEMA P-320 (Taking Shelter from the Storm, Building a Safe Room For Your Home or Small Business, 4th edition), published in December 2014 (available at https://www.fema.gov/media-library/assets/documents/2009).
- Developed code change proposal for the 2018 IBC prohibiting use of aggregate as surfacing for roof coverings and as roof ballast in tornado-prone regions (NIST recommendation #10) and began working with the BCAC to refine the proposal.
- Held a workshop to update key private sector, academic, and governmental stakeholders on the progress of year-one work to develop Tornado Hazard Maps for use in tornado-resistant design of buildings. This effort directly addresses NIST recommendation #3 and provides prerequisite technical underpinning for recommendations #5 and #6.
- Held the first two meetings of the new ASCE/SEI committee that is developing the new ASCE/SEI *Tornado Wind Speed Estimation Standard.* The standards committee, co-chaired by NOAA and NIST staff, will develop standardized methods for estimating the

[5] http://www.nist.gov/customcf/get_pdf.cfm?pub_id=909017

[6] http://www.nist.gov/customcf/get_pdf.cfm?pub_id=915628

wind speeds in tornadoes and other severe wind storms. This new standard directly addresses both NIST recommendations #2 and #4, and supports NIST recommendations #1 and #3.

- Continued to lead the *Tornado Working Group* within the ad-hoc ASCE committee on *Performance-Based Design for Wind Hazards*, addressing NIST recommendation #5 and supporting NIST recommendation #6.
- Developed and submitted public comments on the draft of the new National Fire Protection Association (NFPA) 1616 Standard for Mass Evacuation and Sheltering, in support of NIST recommendations #8 and #13.
- Drafted and submitted to ICC, in collaboration with FEMA, a chapter for the new Commentary to the ICC 500-2014 Standard for Design and Construction of Storm Shelters, in support of NIST recommendation #8.
- Worked extensively with FEMA on the development of a new methodology and revised guidance for selection of best available tornado refuge areas in existing buildings. This work is part of a planned update and expansion of the current version of FEMA P-431 (Tornado Protection: Selecting Refuge Area in Buildings, Second Edition). This effort supports NIST recommendation #9.

4. Other NIST Activities Related to the NCST Act

No other NIST activities related to the NCST Act took place during FY 2015.

Appendix A
Recommendations of NIST NCST Act Joplin Tornado Investigation (NIST NCSTAR 3, March 2014)

Recommendation	Interested Parties	Lead
Group 1: Tornado Hazard Characteristics and Associated Wind Field		
Recommendation 1: NIST recommends that a capacity be developed and deployed that can measure and characterize actual tornadic wind fields, including near–surface wind fields, for use in the engineering design of buildings and infrastructure. This would require enhancement and widespread deployment of cost-effective, advanced technologies, including weather radar.	Academia, DOE, FEMA, NWS, NRC, NSF	NOAA
Recommendation 2: NIST recommends that information gathered and generated from tornado events (such as the Joplin tornado) should be stored in publicly available and easily accessible databases to aid in the improvement of tornado hazard characterization.	Academia, FEMA, NGA	NWS
Recommendation 3: NIST recommends that tornado hazard maps for use in the engineering design of buildings and infrastructure be developed considering spatially based estimates of the tornado hazard instead of point–based estimates.	ASCE, DOE, FEMA, ICC, NRC	NIST
Recommendation 4: NIST recommends that new damage indicators (DIs) be developed for the Enhanced Fujita tornado intensity scale to better distinguish between the most intense tornado events. Methodologies used in the development of new DIs and associated degrees of damage (DODs) should be, to the extent possible, scientific in nature and quantifiable. As new information becomes available, a committee comprised of public and private entities should be formed with the ability to propose, accept, and implement changes to the EF Scale. The improved EF Scale should be adopted by NWS.	Academia, ATC, FEMA, NRC, NSF, OSTP	NWS

Recommendation	Interested Parties	Lead
Group 2: Performance of Buildings, Shelters, Designated Safe Areas, and Lifelines		
Recommendation 5: NIST recommends that nationally accepted performance–based standards for the tornado–resistant design of buildings and infrastructure be developed and adopted in model codes and local regulations to enhance the resiliency of communities to tornado hazards. The standards should encompass tornado hazard characterization, performance objectives, and evaluation tools. The standards shall require that critical buildings and infrastructure such as hospitals and emergency operations centers be designed to remain operational in the event of a tornado.	Academia, ATC, Design and construction industry (including ACI, AISC, AWS, NAHB, PCA, SDI, SJI, TMS), FEMA, ICC, NFPA	ASCE
Recommendation 6: NIST recommends the development of risk–balanced, performance–based tornado design methodologies such that all building components and systems meet or exceed the same performance objectives when subjected to tornado hazards.	Academia, ASCE, ATC, Design and construction industry (including ACI, AISC, AWS, NAHB, PCA, SDI, SJI, TMS), ICC, NFPA	NIST, FEMA
Recommendation 7: NIST recommends that: (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 identified in the performance–based standards required by Recommendation 5.	Academia, FEMA, NAHB, NFPA, States and authorities having jurisdiction (AHJ) in tornado–prone areas	ICC
Recommendation 8: NIST recommends the development and implementation of uniform national guidelines that enable communities to create safe and effective public sheltering strategies. The guidelines should address planning for siting, designing, installing, and operating public tornado shelters within the community.	IAEM, IAFC, ICC, NAC, NCSL, NEMA, NFPA, NSF, NWS	FEMA
Recommendation 9: NIST recommends that uniform guidelines be developed and implemented nationwide for conducting an 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.	Academia, DHS S&T, IAEM, IAFC, ICC, NAC, NCSL, NEMA, NFPA, States and AHJs in tornado–prone areas	FEMA
Recommendation 10: NIST recommends 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.	ASCE, NFPA, SPRI, States and AHJs	ICC

Recommendation	Interested Parties	Lead
Recommendation 11: NIST recommends that enclosures of egress systems (elevators, exits, stairways) in critical facilities in tornado–prone areas be designed to maintain their functional integrity when subjected to tornado hazards.	BOMA	ICC, NFPA
Recommendation 12: NIST recommends that (a) tornado vulnerability assessment guidelines for critical facilities be developed and (b) owners and operators of existing critical facilities in tornado–prone areas perform tornado vulnerability assessments, which includes steps to protect the functionality of (1) backup power supplies, (2) vertical movement within the building (elevator equipment and shaft enclosures), and (3) means of egress illumination (battery–powered lighting in addition to backup power), in a tornado event.	BOMA, DHS IP, DHS S&T, IFMA, NFPA, States and AHJs	FEMA
Group 3: Pattern, Location, and Cause of Fatalities and Injuries, and Associated Performance of Emergency Communications Systems and Public Response		
Recommendation 13: NIST recommends the development of national codes and standards and uniform guidance for clear, consistent, recognizable, and accurate emergency communications, encompassing alerts and warnings, to enable safe, effective, and timely responses among individuals, organizations, and communities in the path of storms having the potential to create tornadoes. NIST also recommends that emergency managers, the NWS, and the media develop a joint plan and take steps to make sure that accurate and consistent emergency alert and warning information is communicated in a timely manner to enhance the situational awareness of community residents, visitors, and emergency responders affected by an event.	Academia, FEMA, IAEM, ICC, NEMA, and NWS	NFPA
Recommendation 14: NIST recommends that the full range of current and next–generation emergency communication "push" technologies (e.g., GPS–based mobile alerts and warnings, reverse 9–1–1, outdoor siren systems with voice communication, NOAA weather radios) be deployed and utilized to maximize each individual's opportunity to receive emergency information and respond safely, effectively, and in a timely fashion.	Academia, DHS, FCC, IAFC, NEMA, NFPA, NWS	FEMA
Recommendation 15: NIST recommends research be conducted to identify the factors that will significantly enhance public perception of personal risk and promote rapid and effective public response during emergencies, including tornadoes.	Academia, DHS, ICC, NFPA, NWS	NSF, NIST
Recommendation 16: NIST recommends that technology 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.	FEMA, IAEM, Media industry, NEMA, NFPA	NOAA

Recommendation	Interested Parties	Lead
Recommendation 16: CONTINUED NIST recommends that tornado threat information be provided to emergency managers, policy officials, and the media on a spatially resolved real–time basis by frequently updating gridded probabilistic hazard information that is merged with other GIS information to supplement the currently deployed binary warn/no warn system.	NOAA	NOAA

Key: ACI, American Concrete Institute; AHJ, authority having jurisdiction; AISC, American Institute of Steel Construction; ASCE, American Society of Civil Engineers; AWS, American Welding Society; DHS, U.S. Department of Homeland Security; DOE, U.S. Department of Energy; FCC, Federal Communications Commission; FEMA, Federal Emergency Management Agency; IBC, *International Building Code*; ICC, International Code Council; IRC, *International Residential Code*; NEMA, National Emergency Management Association; NFPA, National Fire Protection Association; NIST, National Institute of Standards and Technology; NOAA, National Oceanic and Atmospheric Administration; NRC, U.S. Nuclear Regulatory Commission; NSF, National Science Foundation; NWS, National Weather Service; OSTP, Office of Science and Technology Policy; PCA, Portland Cement Association; SDI, Steel Deck Institute; SJI, Steel Joist Institute; TMS, The Masonry Society.