

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

**Fiscal Year (FY) 2011**

**Summary**

This annual report to Congress for FY 2011 is required by the National Construction Safety Team (NCST) Act. NIST Director Pat Gallagher established a team under the NCST Act to study the building performance and emergency communications during the tornado that struck Joplin, MO on May 22, 2011. According to the National Weather Service (NWS) and the Federal Emergency Management Agency (FEMA), the multiple-vortex storm impacted an area approximately three-quarters of a mile wide by 14 miles long, destroyed some 8,000 structures in its path<sup>1</sup>, killed 162 people, and injured over 1,000 people<sup>2</sup>. This was the single deadliest tornado in the United States in the 61 years that official records have been kept. This study is ongoing, and NIST expects to release its final report with recommendations in fiscal year 2012.

**Introduction**

In October 2002, the President signed into law the National Construction Safety Team (NCST) Act (P.L. 107-231), which authorized the Director of the National Institute of Standards and Technology (NIST) to establish Teams for deployment after events causing the 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 in the United States. 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 to the Committee on Science of the House of Representatives and to the Committee on Commerce, Science, and Transportation of the Senate by February 15 of each year a report that includes:

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<sup>1</sup> US Army Corps of Engineers and Jasper County Geographic Information Services

<sup>2</sup> National Weather Service ([http://www.crh.noaa.gov/sgf/?n=event\\_2011may22\\_survey](http://www.crh.noaa.gov/sgf/?n=event_2011may22_survey))

- (1) a summary of the investigations conducted by Teams during the prior fiscal year;
- (2) a summary of recommendations made by Teams in reports issued under Section 8 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 National Institute of Standards and Technology during the prior fiscal year in response to reports issued under Section 8.

This report summarizes NIST's activities under the NCST Act for FY 2011 and related NIST activities.

## **1. Investigations Conducted by NIST During FY 2011**

### **a. Investigations Conducted by Teams During FY 2011**

On May 22, 2011, a massive tornado impacted Joplin, MO. The tornado was rated EF5, the most powerful on the Enhanced Fujita scale. According to the National Weather Service (NWS) and the Federal Emergency Management Agency (FEMA), the multiple-vortex storm impacted an area approximately three-quarters of a mile wide by 14 miles long, destroyed some 8,000 buildings in its path, killed 162 people, and injured over 1,000. This makes it the single deadliest tornado in the United States (U.S.) in the 61 years that official records have been kept.

The loss of life occurred despite a warning time of about 24 to 26 minutes, which is nearly double the National Weather Service (NWS) national average warning lead time of approximately 14 minutes<sup>3</sup>. On the order of 8,000 buildings in Joplin were damaged or destroyed, including a wide range of building types and construction types. Insured losses for the Joplin tornado alone have been estimated to be between \$1 billion to \$3 billion<sup>4</sup>. To provide context for these loss estimates, the average annual property/insured loss, in 2005 dollars, is \$6 billion for earthquake, \$6 billion for windstorms, \$5 billion for flood, and \$13 billion for fire<sup>5</sup>. This tornado is therefore significant and thus presents a unique learning opportunity.

NIST sent four employees to Joplin during May 25-28, 2011, to conduct a preliminary reconnaissance of building performance and emergency communications during the tornado. Based on the recommendations of the preliminary reconnaissance and analysis of the additional criteria set forth in the regulations implementing the NCST Act, NIST Director Pat Gallagher established a Team under the NCST Act to proceed with a more comprehensive study of the impacts of the disaster. The primary objectives of the NIST technical study of the Joplin tornado are to:

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<sup>3</sup> National Weather Service average for 2008 ([http://www.nws.noaa.gov/cfo/program\\_planning/doc/FY-2009%20NOAA's%20NWS%20National%20Performance%20Measures%20-%20Graph%20Update.pdf](http://www.nws.noaa.gov/cfo/program_planning/doc/FY-2009%20NOAA's%20NWS%20National%20Performance%20Measures%20-%20Graph%20Update.pdf))

<sup>4</sup> Eqecat, Inc (<http://www.eqecat.com/catWatchREV/secureSite/report.cfm?id=321>)

<sup>5</sup> National Oceanic and Atmospheric Administration

- Determine the tornado hazard characteristics and associated wind fields in the context of historical data.
- Determine the pattern, location, and cause of fatalities and injuries, and associated performance of emergency communications systems and public response.
- Determine the response of residential, commercial, and critical buildings, including the performance of designated safe areas.
- Determine the performance of lifelines as it relates to the continuity of operations of residential, commercial, and critical buildings.
- Identify, as specifically as possible, areas in current building, fire, and emergency communications codes, standards, and practices that warrant revision.

The expected outcomes of this study will include findings and recommendations that provide the technical basis for:

- Assessing tornado hazard probabilities at the local, regional, and national levels;
- Potentially improving emergency communications systems and public response to those communications; and
- Potentially improving tornado-resilient design and construction of buildings and structures, including residential buildings, designated safe areas within buildings, and lifeline facilities as related to maintaining building operations.

The anticipated impacts of the NIST technical study include improved resilience of buildings, infrastructure, and communities to tornadoes through recommendations that will address proposed improvements to building standards, codes, and practices. These improvements are specifically focused on life safety objectives and enhanced performance of buildings during tornadoes to better protect building occupants and property. In addition, the study may lead to enhanced emergency communications systems and lifeline performance in future disasters. Finally, the results of this study will inform future research for the development and dissemination of guidance and tools for assessing and reducing vulnerabilities related to tornadoes, and producing the technical basis for cost-effective changes in national codes, standards, and practices.

#### **b. Investigations Conducted by NIST Under Legal Authorities other than the NCST Act in FY 2011**

NIST is including summaries of its investigations conducted under legal authorities other than the NCST Act in this report because the objectives of these studies are similar to those conducted under the NCST Act and also fall within NIST's Disaster and Failure Studies Program. The Disaster and Failure Studies Program establishes teams to assess building and infrastructure performance and emergency response and evacuation procedures in the wake of disaster and failure events that have resulted in substantial loss of life or posed significant potential of substantial loss of life.

NIST completed two studies under its other legal authorities during FY 2011. In March 2011, NIST published a final report on the Sofa Super Store fire that occurred the

evening of June 18, 2007 in Charleston, SC. Nine firefighters from the Charleston Fire Department were killed in the fire. NIST conducted a study to determine the likely technical causes of the rapid fire growth that led to the high number of fire fighter fatalities. Based on its findings, the NIST technical study team made eleven recommendations for enhancing building, occupant and firefighter safety nationwide. The study is available at [http://www.nist.gov/customcf/get\\_pdf.cfm?pub\\_id=908200](http://www.nist.gov/customcf/get_pdf.cfm?pub_id=908200)

On February 27, 2011, a wildland-urban interface fire began in the outskirts of Amarillo, Texas, that destroyed or damaged buildings in three housing developments. Jointly with the Texas Forest Service, NIST deployed a team immediately after the wildfires began to conduct an initial reconnaissance and document the fire losses and wildfire behavior. The overall objectives of this study were to establish the likely technical factor or factors responsible for the damage, failure, and/or successful performance of buildings and/or infrastructure in the aftermath of the wildfire, and to recommend, as necessary, specific improvements to standards, codes, and practices based on study findings. The NIST reconnaissance team examined the wildfire behavior and the effects of topographical features, structural construction and defensive actions on wildfire losses. Field measurements included structure particulars, specifically building construction materials, proximity and type of combustibles near the structure, and damage to wildland and residential vegetation.

In July 2011, NIST published a Technical Note, "Initial Reconnaissance of the 2011 Wildland-Urban Interface Fires in Amarillo, Texas (NIST TN 1708)," that addresses the preliminary findings of the deployment and the data collection methodology. Additionally, this report provides a summary of the primary structures lost. A second more detailed technical report will provide the event timeline reconstruction and general wildfire behavior observations as well as investigate the impacts of structure attributes, landscaping characteristics, topographical features and wildland fire exposure on structure survivability. More information about this study can be found on NIST's disaster and failure studies webpage for this event - [http://www.nist.gov/el/disasterstudies/fire/amarillo\\_texas\\_2001.cfm](http://www.nist.gov/el/disasterstudies/fire/amarillo_texas_2001.cfm)

## **2. Summary of Recommendations Made by Teams in Reports Issued Under Section 8 of the NCST Act During FY 2011**

During FY2011, 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 2011**

### **a. Actions Taken to Improve Building Safety and Structural Integrity During FY 2011 in Response to Reports Issued Under Section 8 of the NCST Act**

NIST's FY 2010 report outlined progress toward implementation of code change proposals. The International Code Council's (ICC) final action hearings for the 2012 edition of the International Codes were held May 15-23, 2010 in Dallas, TX. The ICC's technical committees approved additional significant code change proposals based on the

recommendations resulting from the NIST/World Trade Center (WTC) and the Station Nightclub Investigations.

Since there have been no new reports issued under Section 8 of the NCST Act in FY 2011, there have been no additional actions taken. NIST anticipates that there will be actions taken in FY 2012 as a result of the current Joplin tornado study.

**b. Actions Taken to Improve Building Safety and Structural Integrity During FY 2011 in Response to Studies Conducted Under Other NIST Authorities**

NIST's Disaster and Failure Studies Program coordinates their efforts with the Engineering Laboratory's Codes and Standards Program to promote, enable, and track the adoption of NCST and other NIST studies' recommendations through improved standards, codes, and practices as well as any research and other appropriate actions based on study findings to improve building safety and structural design. NIST takes appropriate action after disaster and failure studies both under the NCST Act, and as a result of studies conducted under other NIST authorities.

NIST has submitted proposals for three new provisions for the 2012 International Building Code that are responsive to the recommendation to improve the safety of fabric-covered frame structures during wind events, issued as part of its report on the collapse of the Dallas Cowboys Practice Facility. These code change proposals address specifically fabric-covered frame structures and include guidance for 1) enclosure classification, 2) lateral restraint of frame members, and 3) progressive collapse. Owners of similar structures have undertaken special inspections and in some cases, instituted restrictions on the use of such facilities when high winds are forecast.

NIST issued its final report on the Sofa Super Store fire that occurred in Charleston, SC in March 2011. The International Fire Code Committee is currently considering a proposal to change furniture store Use and Occupancy Classification (IFC –Chap. 3) from Mercantile (Sec.309) to High Hazard (Sec. 307) as part of ongoing recognition of the hazard of high fuel-load in furniture stores. NIST briefed the International Code Council's (ICC) Code Technology Committee (CTC), National Fire Protection Association (NFPA), US Fire Administration (USFA), Society for Fire Protection Engineers (SFPE), International Association of Fire Fighters (IAFF), and Door and Access Systems Manufacturers Association (DASMA) on the findings and recommendations of the study.

In July 2011, NIST published a report on the initial reconnaissance study of the 2011 wildland-urban interface fires in Amarillo, Texas. NIST briefed the Texas Forest Service, US Forest Service (USFS), and American Society for Testing and Materials (ASTM) on the findings and recommendations of the report. The USFS Region 8 (Southern US), National State Foresters Association, and Texas Forest Service have adopted NIST's wildland-urban interface data collection methodology. This methodology is being used to collect and analyze data from the Bastrop County Complex fire that started on September 4, 2011 outside of Austin, Texas. The Bastrop fire burned 34,356 acres and destroyed

over 1,650 homes, the largest structural losses from a wildland-urban interface fire in the state's history.

#### **4. Other NIST Activities Related to the NCST Act**

In FY 2011, NIST received 48 requests under the Freedom of Information Act (FOIA) for information that NIST collected and created during the NIST WTC Investigation. In FY 2011, NIST closed 45 FOIA requests related to the NIST WTC Investigation. The remaining 3 FOIA requests received in FY 2011 were closed on October 11, 2011. In total, from FY 2006 through FY 2011, NIST received 193 FOIA requests for information related to the NIST WTC Investigation. Six of these FOIA requests have resulted in litigation. Of those six cases, three cases were settled and the other three cases remain open.

Documents responsive to the FOIA requests include tens of thousands of photographs and videos collected by NIST during the WTC Investigation and thousands of documents provided to NIST related to the construction and maintenance of the WTC buildings, as well as images representing the results of engineering models created by NIST during the WTC Investigation. The processing of FOIA requests and participation in the litigation have proven to be extremely labor intensive, requiring significant commitment of NIST and other federal resources, including NIST technical and administrative staff and NIST, Department of Commerce, and Department of Justice legal staff.

In responding to the WTC Investigation-related FOIA requests, where appropriate NIST has withheld certain types of information pursuant to FOIA exemptions 9b)(3) and paragraphs 7(c) and 7(d) of the NCST Act (codified at 15 U.S.C § 7306(c) and (d)). Section 7(c) prohibits NIST from disclosing voluntarily provided safety-related information if that information is not directly related to the building failure being investigated and the NIST Director finds that the disclosure of the information would inhibit the voluntary provision of that type of information. Section 7(d) prohibits NIST from publicly releasing any information it receives in the course of an investigation under the NCST Act if the NIST Director finds that the disclosure of that information might jeopardize public safety.

#### **5. Disaster and Failure Events Data Repository**

NIST is creating a Disaster and Failure Events Data Repository which will host a national archival database of significant hazard events. The repository, which will be accessible on NIST's website, will also help ensure that this valuable information is organized and maintained to enable study, analysis, and comparison with subsequent severe disaster events.

The data repository will be established in three phases:

Phase 1 (launched August 2011) includes data from NIST's six-year investigation of the collapses of three buildings at New York City's World Trade Center (WTC 1, 2 and 7) as

a result of the terrorist attacks on Sept. 11, 2001. Available are thousands of photos and videos collected during the investigation; computer simulations created to model aircraft impact damage, fire spread and structural design characteristics; and the complete set of the technical reports that document the body of the NIST work. See <http://wtcdata.nist.gov/>

Phase 2, which is currently underway, consists of a pilot repository of data from the 2010 Chile earthquake. NIST is also working toward developing minimum requirements for data to be accepted by the repository.

Phase 3 includes full-scale implementation of the repository, which will include a larger collection of information on hazard events (earthquakes, hurricanes, tornadoes, windstorms, community-scale fires in the wildland-urban interface, structural fires, storm surges, floods and tsunamis) and man-made hazards (accidental, criminal or terrorist). This data repository effort also will support the development of standards and new technologies for more efficient collection of data on disaster and failure events.