Disaster and Failure Studies Program Update

NCST Advisory Committee
December 11, 2013

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NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Presentation Outline

- Decision Criteria Update / Management Memo
- Recent Disasters
- Update on Hurricane Sandy study with FEMA

NIST Decision Criteria and Guidelines

- NIST updated the Decision Criteria and Guidelines that provide a rational basis for evaluating whether NIST should conduct a study.

Old Categories of Decision Criteria

- Substantial Loss of Life or Disabling Injury
- Significant Potential for Loss of Life: Exposed Population
- Level of Hazard
- Consequences (Extent of Damage and Loss of Functionality)
- Need for NIST involvement
- Stakeholder Concern
- Evacuation / Emergency Response
- International Events

Updated Categories of Decision Criteria

- Substantial Loss of Life or Disabling Injury
- Significant Potential for Loss of Life: Exposed Population
- Level of Hazard => Hazard and/or Failure Event
- Consequences (Extent of Damage and Loss of Functionality) = > Consequences to Resilience
- Need for NIST involvement
- Stakeholder Concern
- Evacuation / Emergency Response
- International Events

Engineering Laboratory, Disaster and Failure Studies Program
Screening Criteria and Summary Assessment for Disaster and Failure Studies

Date **Event**
General Principles and Summary Assessment for Preliminary Reconnaissance
Responses to Questions Addressing General Principles
1. What is the unique new knowledge that would be potentially gained from this study?
2. What is the anticipated potential impact on standards, codes and practices?
3. Does NIST have primary authority? If so, would NIST collaborate with other agencies where NIST provides complementary expertise or would NIST have primary authority and/or provide unique expertise that would not be available otherwise?
4. What is a current assessment of how site conditions would affect safety for a field deployment? Would current site conditions affect the timing of the field deployment?
5. Is there a request for NIST to conduct a study by others (local, state, Federal)? If so, would NIST provide complementary expertise or would NIST provide unique expertise that would not be available otherwise?
6. Do we have sufficient resources (people and funding) to support a study? If there is an existing study in the same hazard area, what is the impact on the current study?
Summary Assessment:

Disaster and Failure Studies
Table 1. Preliminary Reconnaissance Screening Criteria

Date and Event Description			
Preliminary Reconnaissance Criteria[1]	Low (1)	Med (3)	High (5)
1. Substantial Loss of Life or Disabling Injury			
A. Facility context	0	1 to 2	>2
B. Community context[2]	0 to 3	4 to 9	>10
C. Regional context[3]	0 to 5	6 to 19	>20
2. Significant Potential for Substantial Loss of Life: Exposed Population			
A. Facility context	<100	100 to 499	≥500
B. Community context	<1 000	1 000 to 9 999	≥10 000
C. Regional context	<100 000	100 000 to 999 999	≥1 000 000
3. Hazard and/or Failure Event(s)			
A. Earthquake	≤ MMI IV	MMI V to VII	≥MMI VIII
B. Hurricane at Landfall	≤Cat 3	Cat 4	Cat 5
C. Tornado	≤EF3	EF4	EF5
D. Coastal Inundation	< 3 ft	3 to 9 ft	≥ 10 ft
E. Fire Spread in Structures	Fire spread not beyond area of origin	Fire spread throughout a structure	Fire spread beyond structure of origin
F. Wildland Urban Interface Fire (WUI)	High Forest Service Fire Danger Rating	Very High Forest Service Fire Danger Rating	Extreme Forest Service Fire Danger Rating
G. Blast	< 99 lbs. TNT-equivalent	100 - 999 lbs. TNT-equivalent	> 1000 lbs. TNT-equivalent
H. Impact	< 1×10^6 ft lb/sec	1×10^6 to 1×10^7 ft lb/sec	> 1×10^7 ft lb/sec

Disaster and Failure Studies

Table 1. Preliminary Reconnaissance Screening Criteria

Date and Event Description			
Preliminary Reconnaissance Criteria[1]	Low (1)	Med (3)	High (5)
4. Consequences to Resilience[2]			
A. Failure during Construction or in Service[3]	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
B. Engineered Building Systems[4]	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
C. Transportation & Utility Systems[5]	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
D. Non-Engineered Building Systems	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
Score: __/__ = __ Sum	__ x 1	__ x 3	__ x 5
5. Evacuation and Emergency Response[6]			
A. Evacuation	Normal evacuation	Moderate evacuation challenges	Severe evacuation challenges
B. Emergency Response	Normal operations	Moderate operational challenges	Severe operational challenges
Score: __/__ = __ Sum	__ x 1	__ x 3	__ x 5
6. International Events			
A. Codes, standards and enforcement	No building codes, standards, or enforcement	Building codes and standards, with minimal enforcement	Building codes and standards, with enforcement
B. Construction practices similar to the US	Minimally similar	Moderately similar	Significantly similar
Total Score: (From 1-4) __x__ = __ Sum	$(0.8)^n$	$(0.9)^n$	$(1.0)^n$

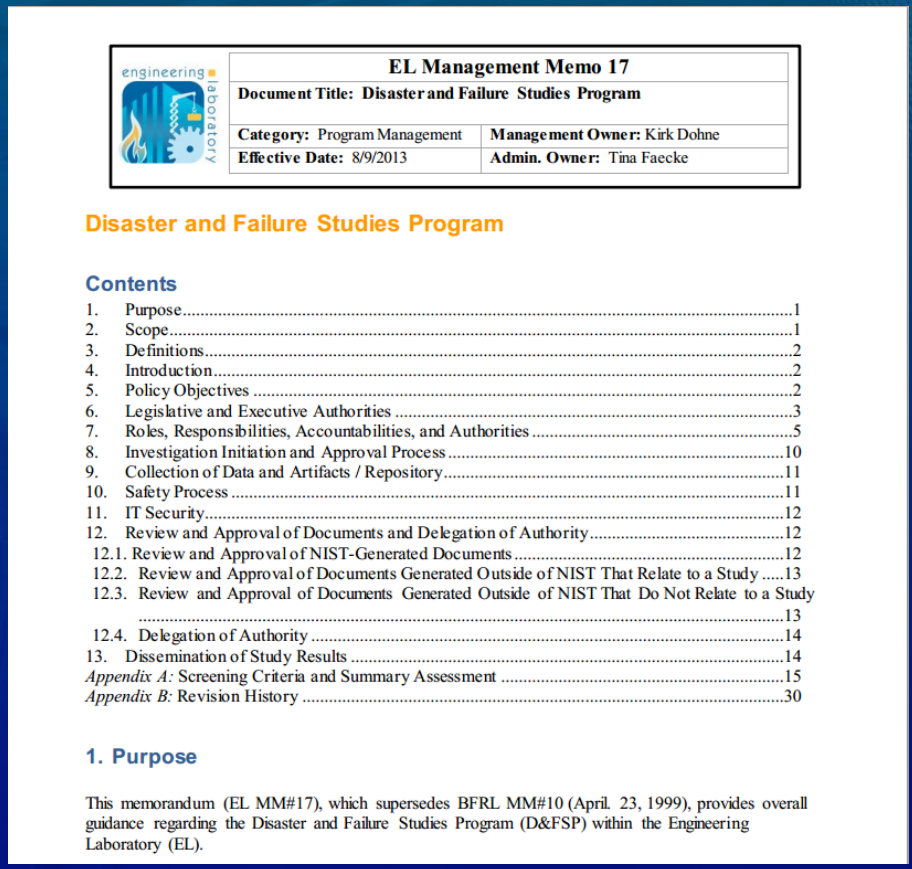
- **n is 0,1, or 2, depending on the number of selected items under each ranking category (i.e., Low, Med, or High) for Criteria 6. The factor applied to the Total Score is the product of all three factors.**

Application of the Decision Criteria

- Weighted score ≥ 4.0 – The score is above the screening threshold for conducting a preliminary reconnaissance. The answers to the 6 questions and the summary assessment will be used to determine whether a preliminary reconnaissance will be conducted.
- Weighted score ≤ 3.0 – The score is below the screening threshold for conducting a preliminary reconnaissance.
- Weighted score between 3.0 and 4.0 – The answers to the six questions and the summary assessment along with the weighted score will be considered to whether the screening threshold for a preliminary reconnaissance is met.

Engineering Laboratory Management Memo

- Management Memo #17 issued on 8/9/13 replaces older memo from 1999
- Provides internal guidance regarding the Disaster and Failure Studies Program



EL Management Memo 17	
Document Title: Disaster and Failure Studies Program	
Category: Program Management	**Management Owner:** Kirk Dohne
Effective Date: 8/9/2013	**Admin. Owner:** Tina Faecke

Disaster and Failure Studies Program

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1. Purpose

This memorandum (EL MM#17), which supersedes BFRL MM#10 (April. 23, 1999), provides overall guidance regarding the Disaster and Failure Studies Program (D&FSP) within the Engineering Laboratory (EL).

Recent Disasters and NIST Criteria Scores

- Disasters that were evaluated against the criteria since last Committee meeting (12/10/12)
- Calculated preliminary reconnaissance criteria scores
- NIST action on Hurricane Sandy

Santa Maria (Brazil) Night Club Fire (1/28/13)

- 242 fatalities
- Illegal indoor usage of outdoor pyrotechnics – ignited acoustic foam on the ceiling
- Similarities to Station nightclub fire (2003)

Hattiesburg, MS Tornado (2/10/13)

- Impacted Hattiesburg, MS including University of Southern Mississippi and two high schools
- EF-4, on the ground for 33 minutes (NOAA)
- 0 fatalities, 82 injuries (NOAA and other news sources)

Source: NOAA


Source: NOAA

West, TX Explosion (3/4/13)

- Storage facility for ammonium nitrate, approximately 30 tons detonated (CSB)
- More than 200 buildings were damaged or destroyed (CSB)
- Chemical Safety Board conducting ongoing investigation
  - CSB is an independent federal agency charged with investigating industrial chemical accidents
  - CSB deployed a team of approximately 18 investigators and other technical experts within 24 hours of the incident
- 14 fatalities including 12 first responders, 200 injuries (CSB)

Granbury, TX Tornado (5/15/13)

- EF-4, damaged 97 out of 110 homes in the Rancho Brazos Subdivision (NOAA)
- 6 fatalities, 54 injuries (NOAA and other news sources)

Source: NOAA

Moore, OK Tornado (5/20/13)

- EF-4, total path length of 14 miles and on the ground for 39 minutes (NOAA)
- 24 fatalities, including 7 children (NOAA and other news sources)
- 2,393 structures were impacted, including 1,128 structures that were destroyed and 335 that sustained major damage (FEMA)
- Preliminary reconnaissance team deployed on May 22 – The reconnaissance was conducted in cooperation with NOAA's NSSL

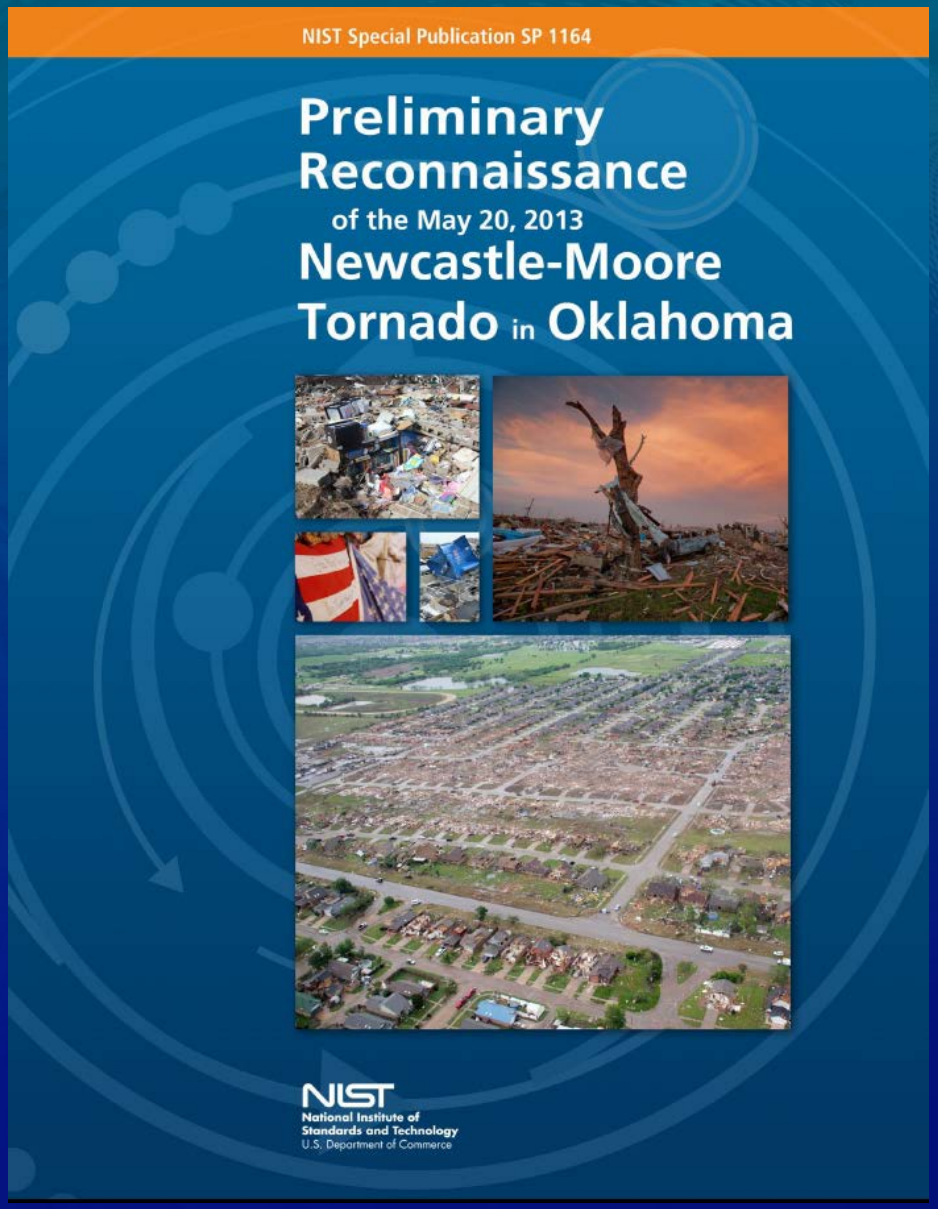
Moore, OK Tornado (5/20/13)

- Objective was to document the performance of the emergency communication systems and three critical and institutional facilities, the Moore Medical Center and Plaza Towers and Briarwood Elementary schools
- Complements Joplin investigation

Source: NOAA

Moore, OK Tornado (5/20/13)

- NIST SP published 12/13



http://www.nist.gov/customcf/get_pdf.cfm?pub_id=914721

Philadelphia (6/5/13)

- 2138 Market St, an unoccupied four-story building was under demolition (Philadelphia Inquirer and various news sources)
- Building collapsed onto a one-story building containing a Salvation Army thrift store next door
- 6 people died, 14 injured
- City Inspector General and OSHA conducting investigations

Black Forest Wildfire (CO) (6/13)

- Most destructive fire in Colorado history (14,280 acres)
- 509 homes destroyed
- 2 fatalities

(Source: KKTV and various news sources)

Yarnell Hill Wildfire (AZ) (6/13)

- 8,400 acres burned, 129 buildings destroyed
  (Source: inciweb.org and various news sources)
- 19 fatalities – Prescott Fire Department's Granite Mountain Hotshots

Typhoon Haiyan - Philippines (11/13)

- Over 5,700 fatalities
- Unofficially the fourth strongest typhoon ever recorded based on wind velocity
- http://www.youtube.com/watch?v=rS0gv4Xbw7w#t=20

Recent Disasters		
Date	Event	Total Weighted Score
1/13	Santa Maria (Brazil) Nightclub Fire	2.8
2/13	Hattiesburg, MS Tornado	2.4
4/13	West, TX Explosion	3.4
5/13	Granbury, TX Tornado	3.0
5/13	Moore, OK Tornado	4.0
6/13	Philadelphia Building Collapse	2.3
6/13	Black Forest Wildfire (CO)	3.3
6/13	Yarnell Hill Wildfire (AZ)	4.0
11/13	Typhoon Haiyan – Philippines	4.1

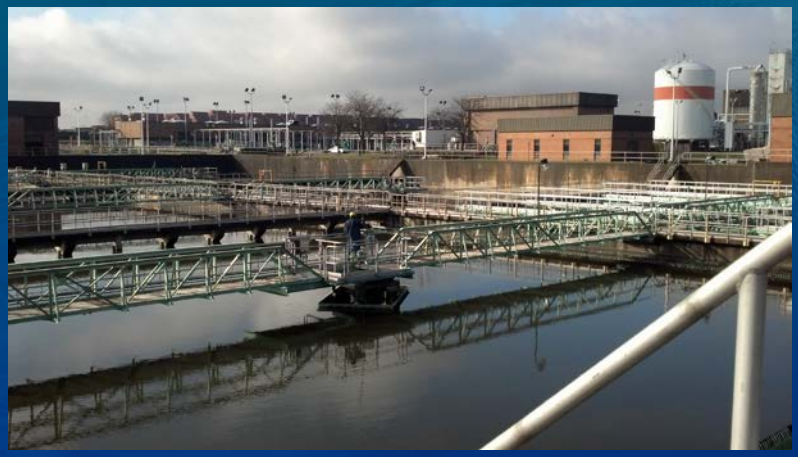
Hurricane Sandy - Update

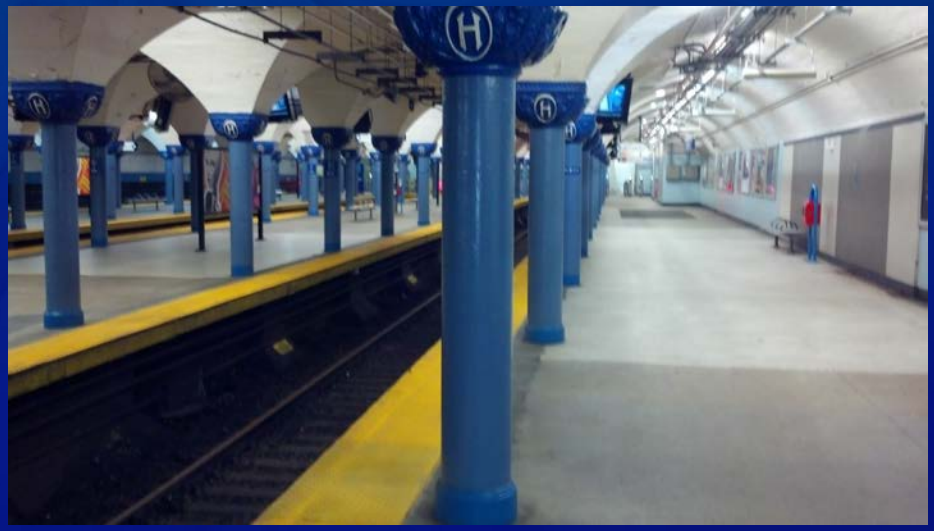
- Dr. Therese McAllister (NIST) participated on FEMA's Mitigation Assessment Team (MAT)
- NIST's Objective within the MAT
  1. Collect data/observations on the performance of critical facilities and infrastructure systems in the affected area
  2. Examine the effect of cascading infrastructure failures on the performance and recovery of critical facilities.
- FEMA's P-942 MAT Report released on 11/27/13

  (http://www.fema.gov/media-library/assets/documents/85922)

Hurricane Sandy – Update

- Dr. McAllister helped assess
  - 8 Hospitals and 4 Senior Centers
  - 3 WWTPs
  - 3 Transit facilities
  - 2 Data centers





Hurricane Sandy - Update

The findings from the Hurricane Sandy study will be used as a case study for research on community resilience.

- Hospitals, WWTP, Data Centers, and Transit facilities experienced significant damage and duration of recovery due to loss of equipment and utilities in basements as well as loss of public power, communication, and transportation services.
- Many of these facilities recovered in stages, but full recovery may take years as these facilities require unique equipment with long lead times.
- The community reliance on public utilities indicates that these services may need to be designed for higher levels of performance and/or recovery rates to achieve the desired resilience levels.

Recent Significant Code Change Activities Based on NIST Non-NCST Studies – Charleston Sofa Super Store Fire

- NIST worked with the ICC's Code Technology Committee (CTC) to move forward with three code change proposals responsive to the recommendations of the study.
- Requirements associated with recordkeeping, periodic inspections and sprinkler system protection for retail, manufacturing and storage occupancies that display, fabricate or store upholstered furniture or mattresses were successful at the ICC public hearings (Dallas, TX)
- An additional proposal concerning fire inspector and fire plan examiner qualifications will be supported at the Public Comment hearings in Atlantic City, NJ.
- A fourth proposal to require risk-based periodic fire safety inspections was withdrawn by the CTC but will be pursued by other allies.
- ICC code changes will be effective in 2015 I-Codes (International Fire Code and International Existing Building Code)

Recent Significant Code Change Activities Based on NIST WTC Investigation

- In the WTC Investigation, NIST recommended that ‘progressive collapse be prevented in buildings through the development and nationwide adoption of consensus standards and code provisions’.

- Based on a proposal from NIST, a new ASCE/SEI Standards Committee called the ‘Disproportionate Collapse Mitigation Standard’ Committee has been established. The Committee plans to have the standard drafted within the next three years.

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Questions/Discussion

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