

EXECUTIVE SUMMARY

Purpose

The purpose of this project is to identify those provisions in NFPA codes and standards that embody the concepts of resiliency and compile available information to serve as a technical reference for those documents, identifying key gaps in knowledge.

Report Content

This report includes:

- Literature Review
- Codes and Standards Mapping, and
- Gap Assessment

The literature review provides relevant extracts from a variety of sources and is intended to include a pathway for understanding how the concepts of resilience could apply to the wide range of NFPA codes and standards. The mapping is intended to be both a benchmarking of the current codes and standards and an identification of a path forward for incorporating resilience concepts. The gap assessment is intended to identify knowledge gaps or other barriers to implementation.

Literature Review

Definitions of Resilience

The common themes from the many definitions of resilience can be summarized for their use in characterizing the role of NFPA codes and standards as follows:

1. Resilience includes technical, organizational, social and economic dimensions.
2. Resilience requires actions described as planning, preparing, preventing, protecting, mitigating and responding.
3. Resilience requires preparation and response to be adaptive.
4. Resilience should focus on minimizing damage and disruption to public health and safety, the economy, environment, and national security.

Specific to design standards activities, a fifth theme can be added regarding continuity of functionality:

5. Resilience includes the ability of structures and systems to withstand these external events, whether natural or human-created.

Performance Goals and Objectives

The establishment of specific performance goals and objectives is a critical first step in the process of pursuing Community or Disaster Resilience. NFPA has both documents and processes that could be applied for defining these goals and objectives.

Frameworks for Resilience

The concepts of frameworks for developing or enhancing resilience are common in the literature. Because of the complexity and interconnection of the many elements identified in the definitions outlined above, frameworks are presented to provide a means of facilitating successful interactions.

Role of Codes and Standards

Several of the references discuss the design aspects of building resilient infrastructure. The built environment in the USA is significantly influenced by the development and enforcement of codes and standards.

Other Parallel Approaches

Other regulatory agencies in the USA offer insight into possible approaches to incorporating disaster resilience into codes and standards, including approaches from the United States Department of Energy (USDOE) and the United States Nuclear Regulatory Commission (USNRC).

Risk-informed Criteria

Both the PPDs and the implementing activities at DHS recognize that resources to achieve resilient infrastructure or community disaster resilience are not inexhaustible. Therefore the approaches recommended all emphasize risk as the basis for decisions.

Codes and Standards Mapping

Many of the NFPA documents currently address resiliency, but focus on fire as the disruptive event. Although the resiliency terminology may not be familiar to the technical committees, the concepts of prevention, protection, mitigation, response, and recovery related to fire are well understood and incorporated into NFPA activities.

NFPA Technical Committees currently produce 34 documents that carry the title of Code, which address a variety of subjects. Some are hazard specific, some are occupancy/building related, and others are system related. It is a risk to generalize, but some conclusions can be made for the use of the term Code to describe these documents.

Nearly all of the NFPA documents carrying the title of Code has a chapter that includes a scope and purpose statement. The paradigm expressed in most of these scopes and purposes is to prescribe minimum requirements. Another paradigm expressed in most of these scopes and purposes is fire and life safety and hazards of fire and explosion. Incorporating disaster resilience into these Codes may require a shift in these paradigms.

Since, by NFPA's official definition, these codes are intended to stand alone, they should be complete and comprehensive enough to accomplish their objectives. The examination of how those objectives support disaster resilience or could be adjusted to do so is referred to as mapping.

It is important to note that many NFPA documents address **administrative features**, exclusively or in addition to **engineered features**. Virtually all of the references on resilience, whether critical infrastructure, community, or disaster, identify *prepare for*, *plan for*, *respond to*, and *recover from* as essential elements. These elements are largely **administrative features**. Emergency planning is vital to

resilience. It supplements **engineered features** and allows adaptation to changing circumstances far quicker.

Gap Assessment

Paradigm Shift

The greatest number of NFPA codes and standards focus on fire and life safety. Applying many of the concepts of *resiliency* to fire related incidents would introduce some new language, but would not radically change the fire safety requirements. Applying the concepts of *Disaster Resiliency* to NFPA documents will require developing a new set of performance objectives for response to other disruptive events.

One paradigm regarding the requirements in NFPA codes and standards is that they are intended to be those minimums necessary to achieve a consensus based level of fire safety. As stated above, the provision of minimum requirements does not lend itself to providing *High Performance* when desired. Implementation of resilience concepts throughout all NFPA documents would likely require guidance documents rather than codes and standards and may need to focus on process first, rather than specific **engineered features**.

In some cases, the current NFPA concept of suitability after exposure may not be sufficient for resiliency. Structures, systems, and components may be required not only to survive the event, but to remain functional after the event. The new minimum must focus on continuity of function and on defining what those functionalities must be. Translating these site specific or facility specific criteria into prescriptive standard language could be problematic.

Fire Protection Systems

With the limited exception of some seismic support requirements, NFPA standards do not adequately address the role of the fire protection system during and after natural disasters, or other disruptive events. Defining this role is an important element to *disaster resilience*.

Hazard Standards

NFPA codes and standards devoted to specific hazards address some external events such as floods or earthquakes but not in a comprehensive way or at least not apparently so. As with the fire protection systems, the questions regarding the effect of a disaster on the fire and explosion risk may lead to additional **engineered features** to mitigate those risks.

Risk Categories

Both of the prescriptive approaches of NFPA 5000's risk categories and ASCE/SEI 7-10 use of *Importance Factor* fall short of the performance goal approach outlined in the proposed NIST framework. The risk to people during the event creates a different set of performance requirements than the post-event use

Recovery

Disaster recovery may require the occupation or reoccupation of facilities that have not been fully restored to their pre-disaster functionality. To facilitate rapid recovery, while still managing the risks associated with occupying a building, enforcement questions will arise.