Testimony of

Jason Averill
Deputy Director
Engineering Laboratory
National Institute of Standards and Technology
United States Department of Commerce

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*"From Risk to Resilience:
Reauthorizing the Earthquake and Windstorm Hazards Reduction Programs"*

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Introduction

Chairman Collins, Ranking Member Stevens, and Members of the Subcommittee, I am Jason Averill, Deputy Director of the Engineering Laboratory (EL) at the Department of Commerce's National Institute of Standards and Technology (NIST). Thank you for the opportunity to appear before you today to discuss NIST's roles in the National Earthquake Hazards Reduction Program (NEHRP) and the National Windstorm Impact Reduction Program (NWIRP). NIST has two important roles in each program: a leadership and convening responsibility and an applied research role aimed at reducing loss of life and property from earthquakes and windstorms. Both programs, and the NIST roles within those programs, align well within the larger mission of NIST, which is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

The NIST laboratory programs work at the frontiers of measurement science to ensure that the U.S. system of measurements is firmly grounded in sound scientific and technical principles. As new technologies are developed and evolve, NIST's measurement research, standards, and services remain central to innovation, productivity, trade, and public safety.

NIST and Earthquake Risk Reduction

NEHRP was created by Congress through the Earthquake Hazards Reduction Act of 1977 (Public Law 95-124), was significantly amended by the National Earthquake Hazards Reduction Program Reauthorization Act of 2004 (Public Law 108-360), and is currently authorized under the National Earthquake Hazards Reduction Program Reauthorization Act of 2018 (Public Law 115-307). The 2004 Reauthorization established the broad outlines of the program as it exists today: designating NIST as the NEHRP Lead Agency with primary responsibility for planning and coordinating the Program, creating the Advisory Committee on Earthquake Hazards Reduction (ACEHR), and the NEHRP Interagency Coordinating Committee (ICC), each providing important input to the Program. NIST coordinates with the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF), and the U.S. Geological Survey (USGS) to fulfill NEHRP's mission.

The ACEHR is a Federal Advisory Committee that assesses trends and developments in the science and engineering of earthquake risk reduction, NEHRP effectiveness in carrying out its mission, any need to revise the Program, and Program management, coordination, and implementation activities. The ACEHR consists today of twelve leading earthquake professionals from across the U.S. and a wide variety of sectors. The ACEHR meets two to four times per year and provides external advice to the NEHRP Program through both regular meeting interactions, as well as more formal biennial reports to the NIST Director, the last of which were transmitted in September 2023.

The Interagency Coordinating Committee (ICC) is comprised of the principals of the four NEHRP agencies, plus the Director of the Office of Management and Budget and the Director of the Office of Science and Technology Policy in the Executive Office of the President. The ICC receives the NEHRP biennial reports, which summarize major activities of the Program within the reporting period. The ICC most recently approved the NEHRP Strategic Plan, released in April 2023.

NEHRP Strategic Plan

The National Earthquake Hazards Reduction Program Reauthorization Act of 2018 required that the NEHRP agencies develop a new Strategic Plan. The plan was the first significant update to long-range planning since the 2008 NEHRP Strategic Plan. Following several years of comprehensive work and approval by the ICC, the agencies released the "Strategic Plan for the National Earthquake Hazards Reduction Program: Fiscal Years 2022–2029[1]." The plan established a new NEHRP vision for the U.S.: *A Nation that is ready and capable to withstand, respond to, and recover from earthquakes and their consequences.*

This vision recognizes the importance of all dimensions of earthquake resilience: planning and mitigation, effective and timely response, and rapid recovery. The earthquake community, with federal leadership from the NEHRP agencies, has been among the first to recognize the vital national need for achieving resilience, a concept woven throughout the NEHRP Strategic Plan.

The current NEHRP Strategic Plan establishes four overarching program goals that engage all four agencies and require significant collaboration:

(1) Advance the understanding of earthquake processes and their consequences;
(2) Enhance existing and develop new information, tools, and practices for protecting the nation from earthquake consequences;
(3) Promote the dissemination of knowledge and implementation of tools, practices, and policies that enhance strategies to withstand, respond to, and recover from earthquakes; and
(4) Learn from post-earthquake investigations to enhance the effectiveness of available information, tools, practices, and policies to improve earthquake resilience.

This Plan is the result of close collaboration between the NEHRP agencies, is closely aligned with current legislation and consensus reports, and builds off the results of previous work. The implementation roadmap established by the Strategic Plan is being used by the program agencies.

NEHRP and Functional Recovery

The design of structures in the U.S. has historically, and appropriately, focused on life safety. Preventing collapse so that occupants could safely leave damaged buildings has been the primary goal of U.S. building codes since the early twentieth century. However, as modern building codes have made significant progress in achieving life safety when they are adopted and enforced, there has been a growing recognition of the tremendous local, regional, and national economic impacts that natural hazards can have. Significant disruptions to the critical functions of a community (including, but not limited to basic services such as housing, medical care, schooling, businesses, and critical infrastructure (power, water, roads)), due to earthquake damage are no longer acceptable.

While major U.S. earthquakes are fortunately relatively infrequent, their impacts can be existential for communities, as highlighted by two major international earthquakes. The 1995 M6.9 earthquake that struck Kobe, Japan, severely damaged its major port facilities. What was once the world's sixth busiest container port immediately dropped to 25th in the world and has not regained its pre-earthquake status nearly three decades later. The 2011 M6.3 earthquake that struck Christchurch, New Zealand, was "moderate" in terms of its magnitude, but still caused extensive damage, much of which was due to older construction and to soil liquefaction (a shaking-induced phenomena where soil loses its ability to

[1] https://nehrp.gov/pdf/FY2022-29%20NEHRP%20Strategic%20Plan%20-%20Post%20Version.pdf

support buildings). The Christchurch City Centre was so seriously damaged that it was completely cordoned off from public access for over two years.

The 2018 reauthorization of NEHRP recognized the need for a fundamental shift in how we design buildings, moving beyond an exclusive focus on life safety and beginning to require buildings and infrastructure recover their basic functions in a timely manner, commensurate with the hazard. NIST and FEMA collaborated closely to produce NIST SP-1254 / FEMA P-2090, entitled "*Recommended Options for Improving the Built Environment for Post-Earthquake Reoccupancy and Functional Recovery Time*[2]." NIST and FEMA, with the assistance of the Applied Technology Council, solicited input from an array of stakeholders through five regional meetings, convened national experts covering a broad array of disciplinary expertise, and reconciled diverse perspectives to create a unique path forward for codes and standards to utilize time-based metrics for the rapid recovery of the built environment and increase resilience of communities after earthquakes.

Based primarily on the NIST/FEMA Functional Recovery Report, the Building Seismic Safety Council[3] has established a Functional Recovery Task Committee, comprised of dozens of leading experts in the earthquake and building code community. The Functional Recovery Task Committee is charged with developing technical proposals and other resources regarding design of new buildings to meet post-earthquake functional recovery performance objectives within the context of the 2026 NEHRP Provisions. These technical proposals and other resources will also serve as source material for proposals for possible adoption and use in other codes and standards for new buildings such as *ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures* and the *International Building Code*. The Functional Recovery Task Committee oversees Topic Subcommittees established to study particular topic areas which will each develop proposals and other resources relevant the given topic area and its relationship to functional recovery objectives. NIST, FEMA, and USGS staff are key contributors to the Functional Recovery Task Committee and we look forward to strong recommendations for meaningful changes to building codes and standards at the conclusion of the process that will make significant improvements to recovery time for communities faced with seismic hazards.

NIST and Windstorm Impact Reduction

NWIRP was established by the National Windstorm Impact Reduction Act of 2004 (PL 108-360). Designated Program agencies are NIST, FEMA, the National Oceanic and Atmospheric Administration (NOAA), and NSF. The Federal Highway Administration (FHWA) has also participated in NWIRP from its inception. Other federal agencies are invited to participate in NWIRP activities; among those already involved are the Department of Housing and Urban Development (HUD), the U.S. Army Corps of Engineers (USACE), and the Department of Energy (DoE).

The National Windstorm Impact Reduction Act Reauthorization of 2015 (PL 114-52) in 2015 established the current structure of NWIRP, including designation of NIST the Lead Agency, establishment of the National Advisory Committee on Windstorm Impact Reduction (NACWIR, with a two-year sunset provision), the Interagency Coordinating Council (ICC), and development of an NWIRP Strategic Plan.

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[2] https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1254.pdf
[3] https://www.nibs.org/bssc

Like NEHRP, NIST has dual responsibilities within NWIRP: Lead Agency and program agency. As the Lead Agency, NIST has the primary responsibility for planning and coordinating the program, which is accomplished primarily through regular meetings of the Windstorm Working Group and the ICC. NIST program agency responsibilities are to carry out research and development to improve model building codes, voluntary standards, and best practices for the design, construction, and retrofit of buildings, structures, and lifelines. We fulfill program responsibilities through an applied wind engineering research program, as well as technical field studies of wind-related building failures, some of which are described in greater detail below.

NWIRP Strategic Plan

The National Windstorm Impact Reduction Act Reauthorization of 2015 (PL 114-52) in 2015 required that the NWIRP agencies develop a Strategic Plan for NWIRP. The Strategic Plan for the National Windstorm Impact Reduction Program[4] was published in 2017 and established a bold vision for windstorm loss reduction in the U.S.: *A nation that is windstorm-resilient in public safety and economic well-being*.

To accomplish this vision, the NWIRP Strategic Plan established three principal goals:

(1) Improve the Understanding of Windstorm Processes and Hazards;
(2) Improve the Understanding of Windstorm Impacts on Communities; and
(3) Improve the Windstorm Resilience of Communities Nationwide

The Strategic Plan further identifies 14 objectives that prioritize activities to achieve significant progress toward the three goals. The NWIRP Plan was developed following public input from national stakeholders (a process led by NSF), review from the NACWIR, and endorsement from the ICC. Since its release in 2017, the program agencies have followed the roadmap established by the Strategic Plan in a manner that is consistent with existing policies and responsive to changing conditions.

First-ever Tornado Design Provisions Included in U.S. Building Codes

Following the 2011 EF-5 tornado that devastated Joplin, MO, NIST conducted a comprehensive technical investigation, resulting in an important report (NCSTAR 3: Technical Investigation of the May 22, 2011, Tornado in Joplin, Missouri)[5] in 2014. At the time, NIST identified that tornados were not considered for building design, despite the need for some buildings to continue to perform critical functions (such as schools, hospitals, and high-occupancy buildings) and the availability of cost-effective options to enhance the resilience of these critical buildings. This may be part of the reason that tornados cause more deaths per year than earthquakes and hurricanes combined, and storms spawning tornados surpass the collective annual insured losses of hurricanes and tropical storms.

NIST, in partnership with NWIRP agencies and many key stakeholders (including the American Society of Civil Engineers (ASCE) and private consultants at Applied Research Associates), identified two major missing elements that would establish the first-ever tornado provisions for U.S. building codes. The first need was to develop maps that accurately characterized where tornados are a significant hazard. The

[4] https://www.nist.gov/system/files/documents/2018/09/24/nwirp_strategic_plan.pdf
[5] https://www.nist.gov/publications/final-report-national-institute-standards-and-technology-nist-technical-investigation

maps were developed through a rigorous re-analysis of historical tornado data, which established the location, frequency, and intensity of tornados throughout the U.S., accounting for building footprint, which has a significant impact on the likelihood of a structure being impacted by a tornado.

The second need was to establish tornado design provisions to govern the tornado-resistant design of critical buildings. To ensure that the design requirements were both practical and cost-effective, the design provisions did not require protection against the most extreme tornadic winds; this was in part due to the fact that lower wind speeds (up to EF-2, or 157 mph (70 m/s)) can cause 70% of the damages in an EF-5 tornado as the wind speeds decay moving away from the centerline of the tornado path Additionally, smaller tornados are more common than large ones[6]. Adopted by the ASCE, and then referenced by the International Building Code, future U.S. construction for certain critical buildings in tornado-prone regions will resist most tornado impacts.

NIST Hurricane Maria Program

Hurricane Maria impacted Puerto Rico in 2017, damaging buildings that its communities relied on for medical care, public safety, communications, and more. To better understand how the buildings and infrastructure failed, and how to prevent such failures in the future, NIST launched a multi-year investigation to study the characteristics of the storm, how critical buildings performed during the storm, how emergency communications systems worked, and the patterns of mortality and morbidity related to building performance. These goals were within the scope of National Construction Safety Team authorities, conferred to NIST by the National Construction Safety Team Act of 2002[7], following the collapse of the World Trade Center.

NWIRP authorities were critical in scoping the NIST investigation[8], as the performance of critical infrastructure (power, water, and transportation) and the recovery of social functions, as well as small- and medium-sized enterprises and supply chains (including manufacturing, retail, and service sectors), provide necessary context in order to more completely understand the performance of buildings and the subsequent injuries and deaths. The Hurricane Maria reports will be nearing completion next fiscal year and, like the recommendations from the Joplin Tornado investigation, significant improvements to building codes and standards that will improve the resilience of the built environment in hurricane-prone regions of the U.S. are anticipated.

Conclusion

NIST has a long history of improving the quality of life and economic competitiveness of U.S. communities subject to hazards, including windstorms and earthquakes. In leading the federal efforts through NEHRP and NWIRP, NIST is proud to be regarded, as it has for more than a century, as a trusted party that facilitates collaboration among industry, academia, and government agencies to meet critical national needs.

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[6] https://www.nist.gov/news-events/news/2021/06/major-new-building-standard-can-map-out-tornado-threat-first-time

[7] https://www.nist.gov/disaster-failure-studies/national-construction-safety-team-ncst

[8] https://www.nist.gov/disaster-failure-studies/hurricane-maria-program/nists-authority

We greatly appreciate the efforts of the members of these committees and other members of Congress to support Federal agency leadership in the wind and earthquake communities that keep the Nation resilient, economically competitive and secure, and that contribute to our quality of life.

I will be pleased to answer any questions you may have.

Jason D. Averill

Jason D. Averill is the Deputy Director of the Engineering Laboratory (EL) at the National Institute of Standards and Technology (NIST). EL promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology for engineered systems in ways that enhance economic security and improve quality of life. EL carries out mission-related activities in fire prevention and control; national earthquake hazards reduction; national windstorm impact reduction; National Construction Safety Teams; building materials and structures systems integration and engineering; intelligent systems and control; robotics and automation; sustainability and energy efficiency; economic analysis and life cycle assessment; productivity measurement; and safety and environmental performance.

Since joining EL in 1997, Mr. Averill has published over 70 papers on assessment of hazards to building occupants. Key research areas include movement of people, emergency preparedness, effectiveness of building systems and technologies, and emergency response. Mr. Averill has assessed fire safety for passenger rail cars, characterized material toxicity in large and bench scale experiments, characterized the effect of firefighting resources, and evaluated smoke detection technologies in residential housing.

Mr. Averill was leader of the Engineered Fire Safety Group in the Fire Research Division from 2009 to 2012. From 2012 to 2013, he was detailed to the NIST Program Coordination Office, where he provided technical and policy advice to NIST leadership. From 2013 to 2022, Mr. Averill was the Chief of the Materials and Structural Systems Division (MSSD) in the Engineering Laboratory. The MSSD included four groups: the Infrastructure Materials Group, Structures Group, Earthquake Engineering Group, and the Community Resilience Group. The division is also responsible for managing three statutory programs, including the National Earthquake Hazard Reduction Program (for which NIST is the lead agency), the National Windstorm Impact Reduction Program (for which NIST is the lead agency), and the National Construction Safety Team Program. From 2022 to 2023, Mr. Averill was detailed to the National Security Council as the Director for Critical Infrastructure in the Resilience and Response Directorate.

Mr. Averill is currently an advisor to the Natural Hazards Center at the University of Colorado, Boulder. He is a member of the American Society of Civil Engineers, was appointed to two terms on the International Code Council's Means of Egress Committee, has served on the NFPA Life Safety Code Committee (Means of Egress), and was a member of the ASME A17 Task Group developing guidelines for Occupant and Firefighter Use of Elevators During Fire Emergencies.

Education

B.S. in Civil Engineering, Worcester Polytechnic Institute

M.S. in Fire Protection Engineering, Worcester Polytechnic Institute