

**TESTIMONY OF
DR. JOHN R. HAYES, JR.**

**DIRECTOR
NATIONAL EARTHQUAKE HAZARDS REDUCTION PROGRAM
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE**

**BEFORE THE
UNITED STATES SENATE
COMMITTEE ON HOMELAND SECURITY AND GOVERNMENT AFFAIRS
AD HOC SUBCOMMITTEE ON STATE, LOCAL, AND PRIVATE SECTOR
PREPAREDNESS AND INTEGRATION**

**HEARING ON
“THE NEW MADRID SEISMIC ZONE: WHOSE FAULT IS IT ANYWAY?”**

DECEMBER 4, 2007

INTRODUCTION

Chairman Pryor, Ranking Member Sununu and Members of the Subcommittee, thank you for conducting this hearing on the impact that a major earthquake in the New Madrid seismic zone would have on the Nation and what can be done to prepare for and mitigate those impacts. The New Madrid seismic zone covers parts of eight states: Illinois, Missouri, Arkansas, Kentucky, Tennessee, Indiana, Alabama and Louisiana. I appreciate the opportunity to appear before you today, to discuss both the overall coordination activity of the National Earthquake Hazards Reduction Program (NEHRP) and the research program that supports NEHRP at the National Institute of Standards and Technology (NIST). NEHRP addresses the earthquake threat for the entire Nation and of course, the New Madrid region is one of the areas of potential major seismic activity. As you know, NEHRP is an interagency effort involving the National Science Foundation (NSF), the Department of Homeland Security's Federal Emergency Management Agency (FEMA), the U.S. Geological Survey, and the National Institute of Standards and Technology (NIST). I shall break my presentation into three broad areas – an overview of NEHRP, a summary of recent NEHRP coordination activities, and, finally, a brief description of the role that NIST plays in NEHRP.

It is important to set the stage for this brief discussion by mentioning that:

- Earthquakes strike without warning – there is no “getting out of the way” or the opportunity to pre-positioning emergency relief supplies as can be done with hurricanes.
- Damaging earthquakes have struck in many places around the U.S. - within the past 200 years, very large magnitude, potentially damaging earthquakes have occurred in Alaska, California, South Carolina, and the New Madrid region. There is paleoseismic evidence that such earthquakes have occurred in the more distant past in the Pacific Northwest, Utah, and other areas. A 2006 report from the National Research Council¹ noted that 75 million people and 50 percent of the total number of buildings that have been constructed in the U.S., worth \$8.6 trillion in 2003 dollars, are located in areas of the U.S. that are prone to damaging earthquakes.
- The U.S. has been relatively fortunate in recent years not to have had hugely damaging earthquakes. But, considering the significant changes to the “built environment” (buildings and other infrastructure), higher population densities, and much higher societal interconnectivity, the consequences of earthquakes such as those that are known to have occurred in the past and are projected by experts to happen again could lead to a catastrophic disaster; beyond the obvious potential for injury and loss of life, the economic and national security consequences are huge. In the New Madrid region, for example, the relatively brief economic impacts of the 1993 Mississippi River floods on cross-river rail and highway transportation give but a minor glimpse of what could happen in long-term earthquake-induced losses of multiple major bridges or fuel pipelines. Experts consistently estimate that a “big one” that strikes a major U.S. urban area may cause over \$100 billion in losses.

¹ *Improved Seismic Monitoring, Improved Decision-Making: Assessing the Value of Reduced Uncertainty*, National Research Council, 2006.

NEHRP provides technical assistance for pre-earthquake mitigation activities by State and local governments, industry, and the private sector. NEHRP -- as opposed to several of the NEHRP agencies -- has no operational responsibilities for planning and responding to earthquakes, but in the aftermath of an earthquake, NEHRP resources provide notifications and assessments. Following is a brief discussion of the statutory basis for NEHRP.

AN OVERVIEW OF NEHRP

Created in 1977 and most recently reauthorized in 2004 (P.L. 108-360), NEHRP is national in scope. As delineated in the reauthorization, the three overarching NEHRP program activities are to:

- Improve the understanding of earthquakes and their effects on communities, buildings, structures, and lifelines, through interdisciplinary research that involves engineering, natural sciences, and social and economic sciences;
- Develop effective measures for earthquake hazards reduction; and,
- Promote the adoption of earthquake hazards reduction measures by federal, state, and local governments, national standards and model (building) code organizations, architects and engineers, building owners, and others with a role in planning and constructing buildings, structures, and lifelines.

The 2004 reauthorization delineated a fourth program activity that effectively supports the first three activities: develop, operate, and maintain an Advanced National Seismic System (ANSS); the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES); and the Global Seismographic Network (GSN).

By statute, there are four NEHRP agencies: FEMA, NSF, NIST, and the USGS. Through the series of reauthorizations of NEHRP since 1977, the Congress has clearly indicated that NEHRP will provide better earthquake preparedness for the Nation through the synergies gained by interagency coordination and cooperation than would be accomplished by the agencies if they worked separately. The directors of the agencies share this belief and are striving to provide continuous improvement in the agencies' cooperative efforts.

The NEHRP agency leaders' commitment to the program's vision is reflected in NEHRP's Mission Statement:

To work in multi-disciplinary interagency partnerships with end users to create an earthquake-resilient Nation by developing and implementing risk reduction knowledge, tools, and practices that enhance public safety, economic strength, and national security.

In accomplishing the statutory program activities, the four agencies have the following general responsibilities:

- Federal Emergency Management Agency works to translate research and development results into cost-effective loss reduction measures at State and local government levels, develops risk reduction tools and measures, prepares technical guidance for new and existing buildings and lifelines, prepares and disseminates information about building codes and practices, supports public-private partnerships to improve disaster resilience, helps decision makers by providing estimates of potential losses, and develops and supports public education that increases public awareness. Through cooperative agreements, FEMA's Mitigation Directorate supports the Central United States Earthquake Consortium (CUSEC), which is headquartered in Memphis, and other regional consortia around the U.S. CUSEC augments individual State capabilities by facilitating interstate (regional) coordination and information sharing, implementing risk reduction activities, gathering and disseminating earthquake-related information, developing private sector partnerships that support mitigation activities, and facilitating delivery of professional training. FEMA's Disaster Operations Directorate is presenting information at this hearing on its non-NEHRP activities in the New Madrid region, including ongoing development of extensive catastrophic earthquake planning exercise scenarios for localities throughout the New Madrid region.
- The National Institute of Standards and Technology performs problem-focused research and development to improve building codes and standards for new and existing buildings and lifelines, advances seismic-resistant construction practices, develops measurement and prediction tools supporting construction performance standards, and evaluates advanced technologies for improved and cost effective earthquake resistant construction. In the recent reauthorization, Congress directed NIST to assume the NEHRP Program Lead Agency role.
- National Science Foundation supports a broad range of basic research covering geoscience, engineering, economic and social science aspects and impacts of earthquakes through projects conducted by individual researchers, research teams, university-based centers and consortia, and non-profit organizations. NSF-funded research investigates the causes and dynamics of earthquakes, plate tectonics, and crustal deformation; the seismic performance of geotechnical, structural, nonstructural, and lifeline systems; and the social, behavioral, and economic aspects of earthquake hazard mitigation. NSF also supports the collection and distribution of seismographic data through an award to the Incorporated Research Institutions for Seismology and the operation of advanced earthquake engineering research experimental facilities and cyberinfrastructure through an award to NEES Consortium, Inc. NSF-funded projects support the education of new scientists and engineers, integration of research and education, and outreach to professionals and the general public. During 1997 – 2007, NSF supported three earthquake engineering research centers. One of these three centers, the Mid-America Earthquake Center, headquartered at the University of Illinois at Urbana-Champaign, includes member institutions throughout the New Madrid region. The Mid-America Earthquake Center has provided seminars to public officials, government agencies, school boards, business communities, and students of all ages on the earthquake hazard in Mid-America and on the state-of-the-art technologies developed by the Center for addressing this hazard.
- The U.S. Geological Survey conducts and supports basic and applied earth science investigations, produces national and regional seismic hazards assessments, performs ground

Figure 1 on page 8 of this testimony provides a graphic representation of the NEHRP agencies' interactions in accomplishing the program mission.

With respect to this hearing, two additional points are very important in providing an overview of NEHRP.

First, as indicated by the statutory program activities, the NEHRP role is almost entirely one of technical support for pre-earthquake mitigation measures and post-earthquake notifications and assessments. Largely through roles that are specified in the Stafford Act (P.L. 93-288) and the National Response Plan, both FEMA and USGS are involved in operational planning and post-earthquake response activities. The NEHRP reauthorization requires FEMA to develop, coordinate, and execute the National Response Plan following earthquakes, but that legislation otherwise does not address operational planning and response issues. Both FEMA and USGS are providing their perspectives on these responsibilities in their presentations.

Second, NEHRP addresses the earthquake threat for the entire Nation. The New Madrid region is certainly one of the prime focus areas and is of major concern. Significant earthquake activity that occurred there slightly less than 200 years ago produced widespread damage that would be much worse today because of the significantly increased development and urbanization in the area. Paleoseismic research indicates that such earthquakes do recur there, if infrequently.

These earthquake-related research activities include the USGS earthquake activity mapping efforts covering the entire nation as well as NSF research in geosciences, engineering, and social and economic sciences that study seismic issues throughout the United States including the New Madrid region. FEMA works directly with organizations involved in drafting national model building codes to provide recommended earthquake-resistant design provisions for buildings and other structures. These recommendations are used to develop the earthquake-resistant design provisions for national model building codes that are adopted in whole or in part by all 50 States.

RECENT NEHRP COORDINATION ACTIVITIES

In addition to outlining program activities and individual agency responsibilities, the recent NEHRP reauthorization directed several key new program developments.

The reauthorization directed the formation of an Interagency Coordinating Committee (ICC) and an Advisory Committee for Earthquake Hazards Reduction (ACEHR).

The ICC, which is composed of the directors of the four program agencies, as well as the directors of the Office of Science and Technology Policy and the Office of Management and Budget, has met five times since its formation in April 2006. The ICC released its first annual report to the Congress on NEHRP accomplishments and budgets in early 2007. The ICC has also approved the outline for a new NEHRP Strategic Plan that is now under development. The reauthorization requires annual program reports, as well as the new plan. The plan will endorse

several key areas of needed program emphasis that were determined by the ICC through a number of internal analyses in 2006, including:

- Development of performance-based seismic engineering (PBSE) tools;
- Development and promoting implementation of cost-effective retrofit measures for existing buildings;
- Fielding of the entire planned Advanced National Seismic System;
- Development and promotion of earthquake scenarios;
- Development of a post-earthquake information management system for use by both researchers and practitioners;
- Renewed emphasis on mitigation grants to States and localities;
- Support for applied research linking basic research with field application; and
- Increased application of the social sciences in earthquake mitigation activities.

The ACEHR exists to advise the ICC Chairperson (the NIST Director) on the technical direction of the program. Following a rigorous nomination process, the ACEHR was formed in early 2007 and has now met twice. The national earthquake professional community responded enthusiastically to calls for ACEHR nominations, making the member selection process very challenging (over 85 nominations were received for 15 committee seats), but one that resulted in a balanced and diverse group of experts in key earthquake-related professional fields, from state and local governments, academia, and the private sector. At its most recent meeting in October 2007, the ACEHR was briefed on the ICC-approved Strategic Plan outline and provided detailed feedback that is being used to improve and refine the plan.

The ICC expects to complete the new Strategic Plan in early to mid-2008, following a period of public comment. The ICC will also release the second annual report. The 2004 reauthorization further directs the development of a Management Plan that implements the Strategic Plan, as well as a coordinated interagency budget. The Management Plan will be developed following the release of the Strategic Plan, and the ICC recently approved an interagency budget coordination process that will be implemented with the development of the 2010 agency budgets. The process respects the roles of the separate Congressional appropriations committees that have jurisdiction over the budgets of the four agencies.

In its new role as Lead Agency for the Program, NIST was directed to plan and coordinate the program, including leading activities to ensure that the program includes all steps needed to promote implementation of earthquake hazard reduction measures, supporting the development and commercial application of performance-based seismic engineering (PBSE) tools, requesting assistance from other Federal agencies as needed, and developing comprehensive plans for earthquake engineering research.

To support its lead agency role, NIST established in early 2006 the NEHRP Program Office, or Secretariat, within its Building and Fire Research Laboratory (BFRL). The Secretariat addresses

program planning and coordination activities and has created a web site, www.nehrp.gov, to provide a communication conduit to earthquake professionals and the public.

Over the past twenty years, NEHRP, principally through the efforts of FEMA, has developed a well-integrated process for working with the national model building code organizations through the Washington-based Building Seismic Safety Council (BSSC) to ensure efficient implementation of earthquake-resistant construction techniques. FEMA has begun working with the earthquake professional community to develop a first generation of PBSE guidelines, based on knowledge that is available today, and the four NEHRP agencies are working together with the earthquake professional community to develop a plan for research and further development of PBSE. NIST, NSF, and USGS are all actively engaged in developing plans for needed earthquake engineering research.

THE RESEARCH ROLE OF NIST WITHIN NEHRP

Two of the four NEHRP agencies, NIST and NSF, have research as their primary NEHRP missions. NSF is responsible for sponsoring most of the basic, or fundamental, engineering research that is performed at academic institutions around the U.S. (both NSF and USGS support geoscience research). NIST is responsible for performing applied, or problem-focused, engineering research. Engineers in the private sector describe the applied research work as “bridging a knowledge gap” that has existed between fundamental science and engineering knowledge (products of the NSF-sponsored research) and its practical application for cost-effective design and construction of earthquake-resistant structures (via supporting implementation of new or improved practices, standards, and building codes, which is primarily a FEMA responsibility). This research is consistent with the NIST BFRL mission of promoting U.S. innovation and competitiveness by anticipating and meeting the measurement science, standards, and technology needs of the U.S. building and fire safety industries in ways that enhance economic security and improve the quality of life. Fulfilling this mission involves creating critical solution-enabling tools (metrics, models, and knowledge) and promoting performance-based standards that are used by the U.S. building and fire safety industries.

Until Fiscal Year 2007 (FY07), funding had not existed to support the stated NIST NEHRP research role. In FY07, Congress appropriated \$800,000 of new monies in the NIST budget that allowed NIST to initiate NEHRP research. In the FY08 budget request, the President added another \$4.75M for NIST NEHRP research. With the requested FY08 budget increase, NIST would be in a position to undertake a substantial program of coordinated in-house and extramural NEHRP research.

CONCLUSION

This testimony provided a brief overview of NEHRP, and NIST’s role in NEHRP. NEHRP provides technical assistance for pre-earthquake mitigation activities by State and local governments, industry, and the private sector, around the U.S. Those activities take on many forms, including basic and applied research, seismological data gathering and synthesis, transfer of knowledge regarding earthquake hazards and cost-effective building practices, support for

national model building code development, and education that extends from K-12 to the collegiate level, to earthquake practitioners, and to the public-at-large.

While NEHRP is national in scope, issues related to the New Madrid region are certainly very significant to the program. As stated in the USGS testimony, there is much that remains to be learned about the earthquake hazard in the heartland, but what we know highlights many needs for greater preparedness and mitigation. We in NEHRP fully intend to continue our efforts to increase the disaster resilience of all areas, including Mid-America.

It has been my pleasure to provide this brief overview of NEHRP. Thank you very much for your attention. I will be happy to answer any questions you may have.

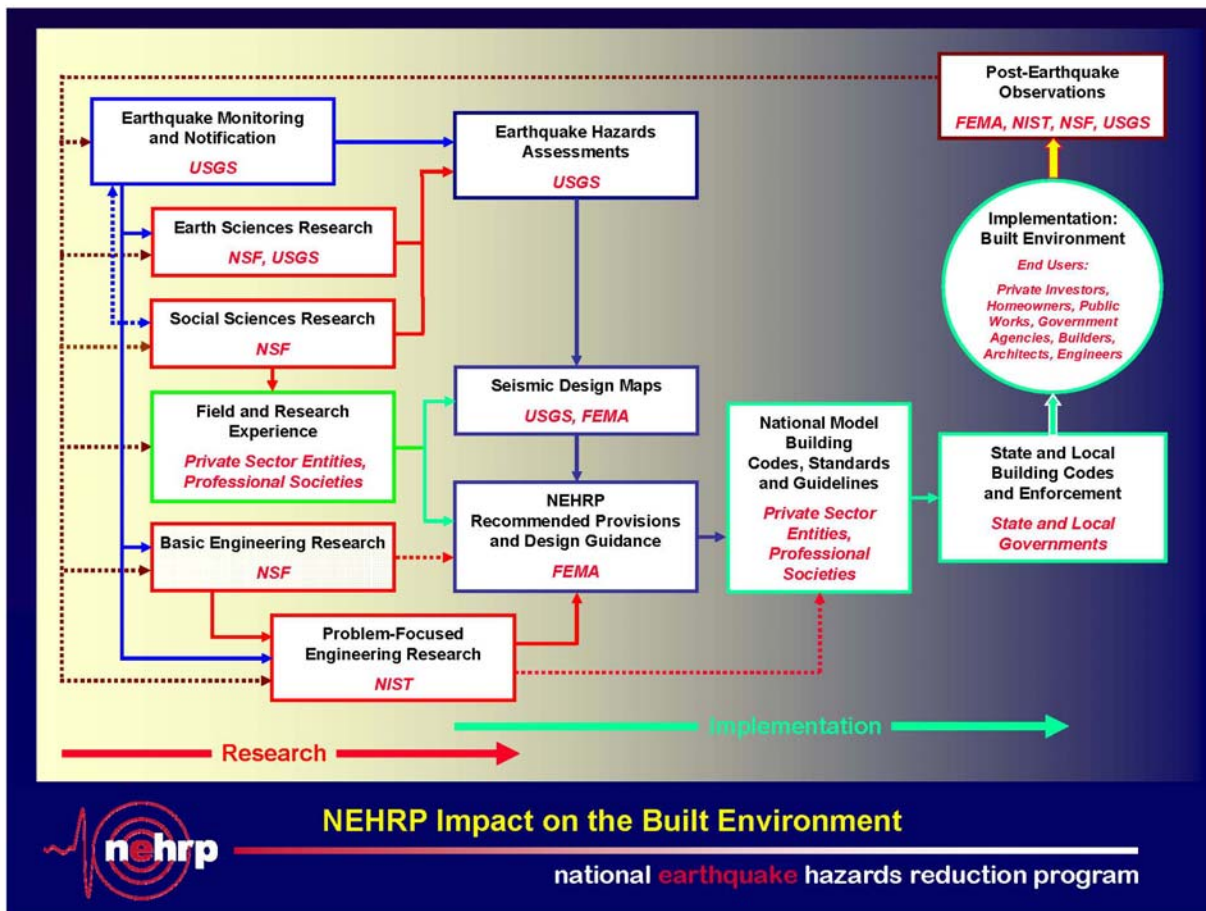


Figure 1 NEHRP Activities that Impact the Built Environment.



John R. Hayes, Jr. ("Jack")

NEHRP Director

[National Institute of Standards and Technology \(NIST\)](#)

100 Bureau Drive, MS 8610

Gaithersburg, MD 20899

(301) 975-5640

jack.hayes@nist.gov

Jack Hayes joined the Building and Fire Research Laboratory in early 2006. He is the [Director of the National Earthquake Hazards Reduction Program \(NEHRP\)](#). NEHRP is the federal government's program to reduce risks to life and property from earthquakes. NEHRP consists of four federal agencies: the Federal Emergency Management Agency (FEMA) of the Department of Homeland Security, the National Science Foundation (NSF), the United States Geological Survey (USGS) and NIST. As director, Hayes provides overall program management, coordination and technical leadership; strengthens program effectiveness by facilitating implementation of earthquake risk mitigation measures; and builds and maintains effective partnerships with NEHRP program agencies and stakeholders in industry, academia and government. Specific duties include strategic and management plan development and implementation; program evaluation and performance measurement; budget review, guidance and coordination; preparation and submission of coordinated annual program budgets; submission of an annual report to Congress on consolidated program priorities, budget and results, including an assessment of program effectiveness; information dissemination on earthquake hazards and loss-reduction measures; and related interagency programs and policies.

Hayes joins NIST after serving since 1988 as leader of seismic and structural engineering research at the U.S. Army Engineer Research and Development Center's (ERDC) Construction Engineering Research Laboratory (CERL) in Champaign, IL. At CERL, Hayes was actively involved in earthquake engineering research for the U.S. Army Corps of Engineers. He also collaborated extensively with the earthquake engineering program at NSF, including work within the Mid-America Earthquake Center, and has been

directly involved with a number of significant earthquake mitigation projects for FEMA. Working with key personnel at USGS, Hayes helped develop the seismic provisions for the American Society of Civil Engineers' ASCE 7-05 standard and a new Department of Defense tri-services seismic design manual.

Prior to his tenure at CERL, Hayes was Research Civil Engineer and Senior Scientist at the Engineering Research Division of the U.S. Air Force Engineering and Services Laboratory (1984-1988); Structural Engineer at the U.S. Air Force Armament Division (1982-1984); Assistant Professor of Civil Engineering at the Virginia Military Institute (1980-1982); Civil Engineer and NATO Infrastructure Staff Officer at the Headquarters U.S. Air Forces in Europe (1977-1980); and Civil Engineer Officer at Tinker AFB, OK (1975-1977).

Hayes is a retired Lieutenant Colonel in the U.S. Air Force Reserves and is a registered Professional Engineer in Florida and Virginia.

Education:

Ph.D. Civil Engineering, 1998, University of Illinois at Urbana-Champaign

M.E. Civil Engineering, 1975, University of Virginia (Tau Beta Pi)

B.S. Civil Engineering, 1973, Virginia Military Institute (Distinguished Graduate)