U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION
COMMITTEE ON SCIENCE AND TECHNOLOGY

HEARING CHARTER

Reauthorization of the National Earthquake Hazards Reduction Program: R&D for Resilient Communities
Thursday, June 11, 2009
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

I. Purpose

On Thursday 11 June, the Subcommittee on Technology and Innovation of the Committee on Science and Technology will hold a hearing to review the National Earthquake Hazards Reduction Program (NEHRP) in preparation for reauthorization. Funding currently expires at the end of fiscal year 2009.

II. Witnesses

Dr. Jack Hayes is the Director of the National Earthquake Hazards Reduction Program (NEHRP) at the National Institute of Standards and Technology (NIST).

Dr. Michael Lindell is the Director of the Hazards Reduction and Recovery Center, and a Professor of Landscape Architecture & Urban Planning at Texas A&M University.

Professor Thomas O'Rourke is the Thomas R. Briggs Professor of Engineering at the School of Civil & Environmental Engineering at Cornell University.

Dr. James Robert Harris, P.E. is the President of J. R. Harris & Company.

Mr. Kenneth Murphy is the Director of the Oregon Office of Emergency Management and the Immediate Past President of the National Emergency Management Association (NEMA).

III. Hearing Issues

- The last NEHRP reauthorization named NIST as the lead agency. How well is NEHRP performing with NIST as the head agency? Where are there opportunities to improve coordination among the agencies? What are the priorities for NEHRP moving forward?
- Understanding the human element of hazard mitigation is crucial to the implementation of mitigation measures. What is the role of social science in creating disaster resilient communities? How has social science research and knowledge been integrated into NEHRP activities? Where are there opportunities for improvement?

- Hazard mitigation tools and products must meet the needs of State and local officials who must prepare their communities for disasters and help them respond. How well do NEHRP activities meet State and local needs? How can these needs be better aligned?
- The damage from an earthquake could be catastrophic. However, other natural hazards, such as hurricanes and wildfires, also pose significant dangers. The Federal Government has focused comparatively less R&D on those hazards. How should the Federal Government address R&D for other natural hazards and what opportunities exist to coordinate hazards R&D across the Federal Government?

IV. Background

Natural Hazard Exposure in the U.S.
Americans' exposure to natural hazards is significant. If populations continue to grow in areas prone to earthquakes, severe weather, or wildfires, this exposure will only increase. Between 1990 and 2001, the Federal Emergency Management Agency (FEMA) paid out over $39 billion in disaster relief. That amount is nearly five times greater than the $7 billion paid out between 1978 and 1989. Although more activities became eligible for funding during the later period, the number reflects the sharp increase in natural disaster losses experienced by Americans. And, as shown below, while the number of casualties from natural hazards in the U.S. is comparatively lower than in many other countries, the potential for loss of life and bodily injury is still very high.[1]

- *Earthquakes.* Eighteen U.S. states are in highly seismically active areas, though nearly all states have some seismic risk. About 75 million Americans live in these seismically active zones, many in growing urban areas. Though infrequent, earthquakes are unique among natural hazards in that they strike without warning. In addition, earthquakes in the U.S and worldwide illustrate that the effects can be catastrophic. The 6.9 magnitude Kobe, Japan earthquake in 1995 killed more than 5,000 people and caused an estimated $200 billion in damages. The 1994 Northridge, California earthquake (magnitude 6.7) resulted in over $40 billion in damage. The fact that it took only 59 lives, in comparison to 5,000, is widely attributed to building code advancements and other mitigation measures. However, in a scenario run by the USGS as part of the Great Southern California Shake Out, a 7.2 Southern San Andreas Fault earthquake would result in an estimated 1800 fatalities in the San Bernadino and a predicted $200 billion in direct losses. Earthquakes are not a hazard confined to the Western U.S. A report prepared by the Central U.S. Earthquake Consortium showed that an earthquake on the New Madrid fault could cause as many as 85,000 fatalities and injuries and over $100 billion in direct economic losses in the states of Tennessee and Missouri.
- *Tsunamis.* U.S. coastal regions are vulnerable to tsunamis generated from submarine earthquakes. The world saw the catastrophic impact of tsunamis in 2004 when an earthquake off the coast of Sumatra, Indonesia unleashed a tsunami that killed approximately 170,000 people and generated $186 million in damages. A high magnitude earthquake in the Cascadia subduction zone off the Pacific Northwest would be devastating to the coastal communities.

[1] Loss of live and damage estimates from natural hazards vary widely. The figures here are cited from a 2003 RAND study, *Assessing Federal Research and Development for Hazard Loss Reduction.*

- *Severe Weather*. High winds in hurricanes, tornados, thunderstorms, and other weather phenomena cause significant damage to buildings and infrastructure. Annually, such weather is also responsible for an average of 124 American fatalities and over 1600 injuries each year[2]. Total direct property losses in the U.S. from 1996 to 2006 are over $160 billion (in 2006 dollars)[3]. Costs associated with wind-related natural disasters have doubled or tripled each decade over the past 35 years.
- *Wildfires*. Construction of homes and communities at the edge of wildlands is a growing practice. In the Western U.S. alone, almost 38 percent of new construction is in the wildland-urban interface (WUI). The most recent figures are unavailable, but from 1985 to 1994, WUI fires destroyed more than 9,000 homes. The Oakland Hill fire in 1991 that took 3,000 structures caused $1.2 billion in property losses[4].

The National Earthquake Hazards Reduction Program

Congress created NERHP in 1977 with passage of the Earthquake Hazards Reduction Act (P.L. 95-124). Created largely in response to the 1964 Alaska Earthquake and the San Fernando Earthquake of 1971, the original program called on 10 federal agencies to coordinate activities to implement an earthquake prediction system, develop design and construction methods for earthquake resilience, identify seismic hazards and make model code and land-use recommendations, increase the understanding of earthquake risks, and educate the public about earthquakes. The 1980 reauthorization of the program designated FEMA as the lead agency.

The 2004 reauthorization (P.L. 108-360) changed the lead agency from FEMA to NIST. This change reflected concern that FEMA, newly in the Department of Homeland Security (DHS), was no longer as focused on natural hazards mitigation. In addition, the legislation established an Interagency Coordinating Council (ICC) composed of the directors of NIST, FEMA, the National Science Foundation (NSF), the United States Geological Survey (USGS), the Office of Science and Technology Policy (OSTP), and the Office of Management and Budget (OMB). To ensure the coordination processes, the ICC is required to meet at least three times annually and to develop a strategic plan and coordinated inter-agency budget.

The four designated NEHRP agencies support the development of earthquake hazard reduction measures, promote the adoption of these measures, and improve understanding of earthquake phenomena and their effects on structures, infrastructure, and communities, as explained below:

- NIST: In addition to serving as the lead agency, NIST supports the development, evaluations, and testing of earthquake resistant design and construction practices for implementation in building codes and practices.
- FEMA: FEMA develops earthquake risk modeling tools and supports the development of disaster-resistant building codes and standards.
- NSF: NSF supports basic research and research facilities in earth sciences, engineering, and social sciences relevant to understanding the causes and impacts of

[2] Average calculated from National Weather Service data from 1996 to 2006, exclusive of the more than 1000 hurricane deaths in 2005.
[3] http://www.nws.noaa.gov/om/hazstats.shtml
[4] U.S. Fire Administration, Topical fire Research Series, Vol. 2, Issue 16, March 2002.

earthquakes, and with a goal of developing practical tools to reduce their effects. NSF supported earthquake engineering facilities include the George E. Brown Network for Earthquake Engineering Simulation (NEES).

- USGS: The USGS supports research to better understand earthquake causes and effects, produces national and regional seismic hazards maps, monitors and rapidly reports on earthquakes and their shaking intensities in the U.S. and abroad, and works to raise public earthquake hazard awareness. The USGS maintains the Advanced National Seismic System (ANSS) and the Global Seismic Network (GSN). Currently, ANSS is approximately 15 percent deployed (820 out of 7100 planned stations). With money from the American Recovery and Reinvestment Act, USGS plans to modernize 800 analogue stations, brining the network up to 1620 sensors.

Over the past 30 years, NEHRP activities have been instrumental in developing and advancing earthquake knowledge, seismic building codes, and raising the awareness of officials and the general public about earthquake hazards. These contributions include:

- An improved understanding of earthquakes and their effects, such as seismic wave propagation, through research and seismic monitoring. Among other applications, this knowledge has been used in the development of seismic hazard assessments, building codes, and in tools for modeling the effects of an earthquake disaster.
- Improved seismic building codes through research, mapping, and seismic monitoring. The National Seismic Hazards Maps and other research produced the NEHRP *Recommended Provisions for Seismic Regulations for New Buildings and Other Structures*, which is the basis for the seismic elements of model building codes. NEHRP has also supported work to improve the safety of existing structures, supporting work that lead to the development of consensus-based standards to evaluate and rehabilitating existing buildings for seismic safety.
- NEHRP has supported the development of partnerships with State and local governments, professional groups, and multi-state earthquake consortia to raise public awareness and support mitigation efforts. These groups, like the Central U.S. Earthquake Consortium, receive funds from NEHRP and State, local, and private partners.
- USGS products provide real-time earthquake notification, showing the magnitude and location of an earthquake. These products include *ShakeMaps* and PAGER—Prompt Assessment of Global Earthquakes for Response. These products provide near real-time information on the location, distribution, and severity of ground shaking. Officials can use this information in mounting a more effective emergency response and recovery.

Tables 1 and 2 below show the authorized and actual levels of funding for NERHP over the last reauthorization period.

Table 1. Funding authorized for NEHRP, in millions (including funding for NEES and ANSS).

Agency	FY 2005	FY 2006	FY2007	FY 2008	FY 2009
FEMA	21.0	21.63	22.3	23.0	23.64
NIST	10.0	11.0	12.1	13.3	814.6

NSF	58.0	59.5	61.2	62.9	64.7
USGS	77.0	84.4	85.9	87.4	88.9
Total	166.0	176.5	181.5	186.6	191.8

Table 2. Actual funding for NERHP, in millions (including funding for NEES and ANSS).

Agency	FY2005	FY2006	FY 2007	FY2008	FY2009 (Requested)
FEMA	14.7	9.5	7.2	6.1	8.6
NIST	0.9	0.9	1.7	1.7	6.4
NSF	53.1	53.8	54.2	55.6	56.4
USGS	58.4	54.5	55.4	58.1	53.1
Total	127.1	118.7	160.55	121.5	124.5

Network for Earthquake Engineering Simulation

From 1999 to 2004, NSF invested $83 million to build earthquake engineering research facilities at 15 universities, linked by information technology (IT) infrastructure that integrates the facilities and makes them accessible from remote locations. In addition, the last reauthorization authorized an average of $20 million per fiscal year exclusively for operation and maintenance (nearly all of which was received). NEES offers considerable potential to advance earthquake engineering knowledge. However, as reported in a 2007 NSF Site Visit Report, NEES had weak leadership and insufficient direction and planning for its Education, Outreach, and Training activities. Most critical, the Site Visit Committee noted the failure of the NEES IT subcontractor to produce products that fit the needs of stakeholders.

Strategic Plan

In the required Strategic Plan for 2009 to 2013, the NEHRP agencies laid out nine strategic priorities to accomplish the goals of understanding earthquakes and their impacts, developing cost-effective measures to reduce these impacts, and improve earthquake resiliency nationwide. These nine priorities are:

- Fully implement the ANSS
- Improve techniques for evaluating and rehabilitating existing buildings
- Further develop performance-based seismic design
- Increase consideration of socio-economic uses related to hazard mitigation implementation
- Develop a national post-earthquake information management system
- Develop advanced earthquake risk mitigation technologies and practices
- Develop guidelines for earthquake-resilient lifeline components and systems
- Develop and conduct earthquake scenarios for effective earthquake risk reduction and response and recover planning
- Facilitate improved earthquake mitigation at State and local levels.

The National Windstorm Impact Reduction Program

The last reauthorization of NERHP also contained the National Windstorm Impact Reduction Program (NWIRP) in a separate title. The legislation directs the National Oceanic and

Atmospheric Administration (NOAA), NIST, NSF, and FEMA to support activities to improve the understanding of windstorms and their impacts, and to develop and encourage the implementation of cost-effective mitigation measures to reduce these impacts. The statute charges an interagency working group (IWG)--chaired on a rotating basis by FEMA, NSF, NOAA, and NIST--to coordinate the R&D priorities, portfolio, and budget. The program was authorized through FY 2008 (Table 3).

Table 3. Funding Authorized for NWIRP

Agency	FY 2006	FY 2007	FY 2008
FEMA	8.7	9.4	9.4
NSF	8.7	9.4	9.4
NIST	3.0	4.0	4.0
NOAA	2.1	2.2	2.2
Total	22.5	25.0	25.0

The NWIRP implementation plan submitted in April 2006 assessed programs relevant to the goals of NWIRP across eight federal agencies and identified important areas of research that were not covered by current activities. The knowledge gaps covered the three broad categories of research authorized in the Act: understanding windstorms; assessing the impacts of windstorms; and mitigating the effects of windstorms. The implementation plan also recommends that an IWG within the National Science and Technology Council's (NSTC) Committee on Environment, Natural Resources Subcommittee on Disaster Reduction oversee the research portfolio outlined above, with representatives from NSF, NIST, NOAA, and FEMA, as well as the National Aeronautics and Space Agency (NASA), the Federal Highways Administration (FHWA), and the Army Corps of Engineers. The IWG would be responsible for facilitating communication between the agencies on the best means of allocating agency resources to meet NWIRP goals and for coordinating this federal research portfolio.

The Subcommittee on Technology and Innovation held a hearing on NWIRP in July, 2008[5]. The witnesses testified that the funding levels devoted by the agencies to wind hazard mitigation R&D were not adequate to meet the growing need (approximately $7.5 million since FY2004) and that no coordinated program existed. It was also noted that in some cases there were research findings that had yet to be translated into practical applications due to a lack of funding. They identified a number of priorities for wind hazard R&D, including:

- Developing a better understanding of wind phenomena to better estimate maximum hurricane wind speeds, velocity profiles, and turbulence characteristics needed for building design
- Better understanding of wind-structure interactions
- Performance-based design for windstorm hazards

Fire R&D at NIST

In the Federal Fire and Prevention Control Act of 1974 (P.L. 93-498) as amended, NIST has authority for "performance and supporting research on all aspects of fire with the aim of providing scientific and technical knowledge applicable to the prevention and control of fires." As NIST testified for the Technology and Innovation Subcommittee in October of 2007[6], structure fires kill over 3000 people in the U.S. each year. They also cause

[5] http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=2271
[6] http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=1961

approximately $10 billion in damages each year according to the National Fire Protection Association. Through its Buildings and Fire Research Lab (BFRL), NIST supports research to reduce fire hazards within residences and commercial buildings, and supports R&D to improve fire codes, standards, and provisions. In its FY2009 request, NIST also included $4 million for a Disaster Resilient Structures and Communities Initiative, which included R&D to mitigate fire damage for structures in the WUI. NIST reports funding about $1 million each in FY2008 and FY2009 on WUI related research.

Social Science

Because natural hazards affect people and communities, social science is an integral part of understanding and mitigating society's risk. A 2006 National Research Council (NRC) report[7] identified the contributions of NEHRP to this area, noting that social science related knowledge on exposure and vulnerability to hazards expanded greatly under NEHRP, enabling the development of loss estimation tools and related decision support tools. However, the report noted that efforts are needed to compare catastrophic events and to examine societal responses in relation to variables such as warning time, magnitude, scope, and duration of impact. More social science research is also needed on understanding longer-term disaster recovery. The report also highlighted the need for the management of social science data.

[7] *Facing Hazards and Disasters: Understanding Human Dimensions*, NRC 2006