

Effectiveness of the National Earthquake Hazards Reduction Program

A Report from the Advisory Committee on Earthquake Hazards Reduction May 2010

Executive Summary

The Advisory Committee on Earthquake Hazards Reduction (ACEHR) of the National Earthquake Hazards Reduction Program (NEHRP) is deeply concerned about inevitable catastrophic earthquakes in the United States and their potential to cause severe economic losses (e.g., topping \$100 billion) and prolonged human suffering. Despite being a strong nation, we are not well prepared. Entire regions will be seriously damaged and permanently impaired, and will take decades to recover. Large gaps exist between current and desired levels of seismic risk because much infrastructure was built long before we understood the underlying earthquake hazards and our communities were not constructed to recover from the resulting damage.

The 2010 earthquakes in Haiti (magnitude 7.0) and Chile (magnitude 8.8) are stark reminders of the value of earthquake preparedness and the importance of building codes. More than 200,000 people died in Haiti where building codes do not exist. In contrast, fewer than 1,000 deaths occurred in Chile where modern seismic building codes have existed since the 1960s. Where does the United States stand? Our communities in seismic regions that span 30 states have implemented seismic building codes to widely varying degrees and at widely varying times over the years. If an earthquake occurred today, we would expect many more deaths in communities that have only recently or have not yet adopted seismic building codes. And we would expect recovery to be slow in most communities due to low levels of resilience.

The activities carried out by NEHRP, such as shaping building codes, make a big difference. NEHRP activities can reduce earthquake casualties and shorten the time it takes for stricken communities to heal. The 2009–2013 NEHRP strategic plan stands as a comprehensive statement of what needs to be done in the near term to provide the information and tools needed for the Nation to build toward resilience. Unfortunately, given the slow pace at which NEHRP is currently able to implement its strategic plan, the Nation's vulnerability to earthquake hazards is steadily increasing and our Nation continues to head towards certain disaster. Human suffering will be intense, mega-losses will occur (from direct physical damage as well as from the cascading economic impacts of lifeline disruptions), and recoveries will be prolonged unless a more aggressive rate of plan implementation is enabled.

To protect society against catastrophic earthquake-induced losses, NEHRP must make lifelines a top priority. The American Society of Civil Engineers reports that more than \$2 trillion needs to be invested in our Nation's aging infrastructure over the coming decades to support our high standard of living and economy. Ongoing investments in infrastructure should incorporate

seismic resilience. Modern nations depend on their lifelines—energy, transportation, water, and communications—both on a daily basis and in post-earthquake environments. The interruption of any of these lifeline services following an earthquake can produce severe economic losses, harm quality of life, and disrupt citizens' livelihoods. Furthermore, the complex interdependencies that exist among lifelines can generate many unforeseen and potentially catastrophic consequences that are likely to compound economic losses and hardships. Presently, the United States is at high risk, because there is no adequate effort to understand lifeline resilience and no development of performance-based design, construction, and renovation of lifeline systems. To achieve resilient lifeline services, the tasks outlined in the NEHRP strategic plan need to be implemented so that the investments needed at national, state, and local levels can be undertaken.

Leveraging the accomplishments of NEHRP requires immediate and universal access to the scientific information generated through those accomplishments. A national earthquake resource library is needed to preserve and disseminate the vast body of knowledge on earthquake science, engineering, social science, and preparedness. This library should include new field and analytical data collected after each major earthquake (which are in essence full-scale field tests of community resilience). Fundamental research findings are critical to advancing our knowledge. It is equally critical to transfer research findings into practice. Integrative research into the political, social, and economic circumstances that motivate society to achieve community resilience is needed to promote implementation of proven earthquake-resistant retrofit strategies.

The NEHRP strategic plan also needs to be expanded to make more effective use of the national resources focused on resilience. Over the past 5 years, the NEHRP Office, under the leadership of NIST, has made enormous progress. The office coordinates successfully with each of the participating NEHRP agencies—FEMA, NIST, NSF, and USGS—and has begun building an internal research team at NIST. Today, outreach beyond the NEHRP agencies would serve to accelerate progress toward needed levels of community earthquake resilience in the United States.

ACEHR's key recommendations are derived from areas within the strategic plan that are not being addressed and from recommendations made in ACEHR's 2008 report that need further attention.¹ They are listed below, and discussed in the body of the report.

Management, Coordination, and Implementation of NEHRP

- **Recommendation 1**—The NEHRP Interagency Coordinating Committee should work to ensure that the amount of funding requested for NEHRP in the President's Budget each year is sufficient to permit full and timely implementation of the NEHRP strategic plan. At the present pace of plan implementation, the program will likely never meet its goals of providing the information and tools needed to achieve resilience nationwide.

¹ The recommendations made in ACEHR's 2008 report are listed within the executive summary of that report, which is attached as Appendix C.

- **Recommendation 2**—The NEHRP Office should carry out its role of representing the NEHRP agencies with respect to external affairs. This includes facilitating enhanced coordination and collaboration between NEHRP and relevant non-NEHRP federal agencies and earthquake organizations. It ranges from taking advantage of the expertise and programs of the agencies that form the Interagency Committee on Seismic Safety in Construction to facilitating improved earthquake mitigation at the state level and in the private sector.
- **Recommendation 3**—A national road map is needed for developing earthquake resilience of targeted lifelines that are critical to the Nation’s security (e.g., in the energy, telecommunications, transportation, and water sectors) and community resilience. The NEHRP Office should focus on understanding and improving lifeline services during earthquakes to ensure delivery of critical resources and to support community resilience and restoration. This includes establishing performance objectives for lifelines under various seismic conditions, developing and promoting seismic guidelines for new and existing components and systems, and considering interdependencies and cascading effects.
- **Recommendation 4**—A national earthquake resource electronic library is needed. This includes a post-earthquake information management database that houses data ranging from initial field reconnaissance to detailed investigative findings. It also includes information for the public and private sectors on earthquake mitigation and preparedness.

Federal Emergency Management Agency

- **Recommendation 1**—Revitalize state earthquake programs and provide strong support and leadership to state commissions to characterize and mitigate unacceptable risk in communities, with targeted efforts on developing public policies, institutionalizing mitigation programs, and implementing pilot studies and scenarios. Leverage other relevant expertise and programs within the Department of Homeland Security to further the NEHRP strategic plan.
- **Recommendation 2**—Develop and promote improved guidance to enhance emergency management capabilities in preparedness, response, and recovery at state and local levels. Include standards of preparedness for the private sector and guidance on providing post-disaster shelter and housing.
- **Recommendation 3**—Develop and maintain improved guideline documents that will heighten the effectiveness and reduce the cost of seismic protection for new and existing buildings and lifelines, and applied socioeconomic policies for cost-effective mitigation. Promote their adoption and implementation among stakeholders, and measure the impact.

National Institute of Standards and Technology

- **Recommendation 1**—Expand internal and external programs to effectively carry out the agency’s roles in conducting applied research, in facilitating the implementation of cost-effective mitigation through codes and standards for the Nation’s broad range of new and

existing lifelines, buildings, and industrial structures, and in transferring technology for use in actual mitigation.

- **Recommendation 2**—Build multidisciplinary expertise within NIST and foster relationships with other public agencies, private-sector entities, and consultants to accomplish and manage the applied research.

National Science Foundation

- **Recommendation 1**—Commit to supporting future earthquake reconnaissance, coordination, and outreach efforts and needed additional studies for significant earthquakes occurring throughout the world; provide this support in close coordination with the NEHRP Office. Earthquakes are the primary feedback mechanism available to the earth science, earthquake engineering, and social science communities for understanding the responses of actual systems.
- **Recommendation 2**—Assess large-scale experimental facilities throughout the United States, along with the equipment sites of the George E. Brown, Jr. Network for Earthquake Engineering Simulation, to determine how best to ensure that state-of-the-art experimental capabilities for earthquake engineering are available. Experimental facilities are essential to increasing the resilience of the United States by supporting the development of performance-based design provisions for new construction and assessment procedures for existing infrastructure.

U.S. Geological Survey

- **Recommendation 1**—Ensure full implementation of the Advanced National Seismic System. Short of this goal as the first step, the Nation will not have a robust national seismic monitoring system to meet critical needs in the fields of emergency management, earthquake engineering, and earthquake science.
- **Recommendation 2**—Ensure that USGS products are shaped to meet the needs of the engineering community so that products generated under the USGS National Seismic Hazard Mapping Project satisfy needs related to performance-based design.
- **Recommendation 3**—Strive to convey important earthquake information to the public in an understandable manner, by working with social scientists and other earthquake professionals to enhance both the content and delivery of information. This pertains to communications about time-sensitive probabilities of large earthquakes (including instances of possible foreshocks), aftershock advisories, and authoritative interpretations of earthquake hazards in controversial areas such as the New Madrid region.

Call to Action

The NEHRP strategic plan recognizes that the traditional NEHRP goal of protecting lives needs to be expanded to improving resilience. It is critical for NEHRP to start addressing our aging infrastructure and to help steer the Nation toward security and resilience. Our problems will not be fixed overnight. Making progress will require long-term and dedicated efforts. However, the

consequences will be less severe if we start applying meaningful and effective efforts toward fully implementing the NEHRP strategic plan now. If we don't, the consequences could be catastrophic and entire communities may never recover.

ACEHR strongly urges that NEHRP focus on achieving community resilience, most importantly by supporting programs that implement earthquake risk-reduction measures, but also by supporting programs that advance our understanding of earthquake phenomena and that develop and evaluate cost-effective measures for strengthening resilience. Full and timely implementation of the 2009–2013 NEHRP strategic plan is the best next step.