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BEFORE

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On the National Earthquake Hazards Reduction Program (NEHRP)

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Chairman Collins and Ranking Member Stevens, thank you for the opportunity to speak to the committee on the National Earthquake Hazards Reduction Program (NEHRP), the associated responsibilities of the U.S. Geological Survey (USGS), and the USGS's activities since the last reauthorization of NEHRP in 2018.

The USGS is a science bureau within the U.S. Department of the Interior. The USGS provides science about the natural hazards that threaten lives and livelihoods; the water, energy, minerals, and other natural resources we rely on; the health of our ecosystems and environment; and the impacts of climate and land-use change. Our scientists develop new methods and tools to enable timely, relevant, and useful information about the Earth and its processes.

Some of that information is about earthquakes. While we conduct seismic research of our own, we do not do so in a vacuum: we enjoy a wide range of partnerships that enhance the science. Among them is a four-agency partnership established by the Earthquake Hazards Reduction Act and its reauthorizations.

NEHRP exists to reduce the losses associated with earthquake hazards, in recognition that although earthquakes are inevitable, their consequences for people and the built environment are not. Efforts to mitigate those effects help to improve the lives of Americans exposed to this nation-wide hazard. As an example, the magnitude 7.5 earthquake in western Japan at the beginning of this year was a sobering reminder of the devastating effects of earthquakes, even in countries that are familiar with and well-prepared for such hazards.

Led by the National Institute of Standards and Technology (NIST), NEHRP also includes the Federal Emergency Management Agency (FEMA) and the National Science Foundation (NSF). NEHRP is a coordinating program for earthquake monitoring, research, implementation, education, and outreach activities. Under NEHRP, and in collaboration with Federal, state, university, and local partners, the USGS is responsible for monitoring and reporting on significant earthquakes and their potential impacts, developing regional and national hazard-assessment maps and associated products, and conducting research necessary to improve our understanding of earthquake hazards, assess earthquake risks, monitor seismic activity, and generate accurate earthquake forecasts, describing the likelihood of earthquakes in a given region over time.

Average annual losses to buildings as a result of earthquakes in the U.S. are estimated to exceed $14.7 billion,[1] which is 140 percent higher than previous estimates made in 2017.[2] This is due primarily to increased construction costs and building stock value in at-risk regions of the nation. The analyses underpinning these figures show that NEHRP efforts to mitigate earthquake hazards have been effective, leading to significant reductions in the ratio of annualized losses to overall building value. However, because urban centers and populations continue to grow in regions of moderate-to-high earthquake hazard and, because the infrastructure to serve that population becomes more valuable with time, annualized loss estimates grow.

At the end of 2023, the USGS updated its National Seismic Hazard Model (NSHM), combining the regular updates for the conterminous United States, last released in 2018, with those for Hawaii, last updated in 1998, and Alaska, last updated in 2007, to produce the first ever 50-state model and maps. Together, these models demonstrate that earthquakes are a national issue. In fact, earthquakes represent one of our Nation's most significant and costly natural hazards. Thirty-seven U.S. States, and all U.S. Territories have experienced an earthquake exceeding magnitude five over the past two centuries, and 50 percent of States have a significant potential for future damaging shaking.

The USGS periodically releases updates to the NSHM, timed to coincide with development of the next generation of building codes, a process that involves close coordination between the USGS, NEHRP partners at FEMA, and a variety of other domestic and international groups. The NSHM is the basis for the seismic provisions in building codes that underpin domestic construction efforts estimated to cost $1.8 trillion per year.[3] Although there are costs associated with building seismic resilience into new and existing structures, the societal consequences of not being prepared are far more costly.

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[1] FEMA, 2023, Hazus Estimated Annualized Earthquake Losses for the United States, FEMA 366, Washington, D.C., https://www.fema.gov/sites/default/files/documents/fema_p-366-hazus-estimated-annualized-earthquake-losses-united-states.pdf

[2] FEMA, 2017. Hazus Estimated Annualized Earthquake Losses for the United States, FEMA 366, Washington, D.C. https://www.fema.gov/sites/default/files/2020-07/fema_earthquakes_hazusestimated-annualized-earthquake-losses-for-the-united-states_20170401.pdf

[3] U.S. Census Bureau, 2023. Construction and Housing Statistics. Retrieved January 19, 2024, https://www.census.gov/construction/c30/c30index.html, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.census.gov/construction/c30/pdf/totsa.pdf

Building a society that is "earthquake ready" requires critical information. A second major USGS responsibility under NEHRP is domestic earthquake monitoring and reporting using data and services from seismic and geodetic networks of the Advanced National Seismic System (ANSS). The ANSS involves seismic monitoring partnerships between the National Earthquake Information Center (NEIC) and both internally and externally-participating Regional Seismic Networks (RSNs). The USGS also leads global earthquake monitoring and reporting through the operation and maintenance of the Global Seismographic Network (GSN) in partnership with the NSF. For both efforts, the NEIC functions as a 24/7 service dedicated to the rapid characterization of all significant earthquakes worldwide. These functions allow the USGS to provide rapid reports of potentially impactful earthquakes to the White House, the Departments of Defense, Homeland Security, State, Transportation, Energy, Commerce, and the Interior; to state, Tribal, and local emergency managers; to a variety of private industry partners managing critical infrastructure; to the media; and to the public.

The USGS earthquake web pages are among the most heavily trafficked sites in the Federal Government, receiving about 40 million requests on a typical day, with higher traffic spikes following significant earthquakes. The earthquake data that the USGS collects and analyzes also underpin critical functions at other federal agencies, including NOAA tsunami warning and Department of Defense nuclear test-ban treaty monitoring efforts, and support broader earthquake research, hazard, and risk assessments at the USGS and in academia as a foundation for building an earthquake-resilient nation.

The ANSS was established by the 2000 reauthorization of NEHRP, and since then the USGS and partners have used federal and state funding to add nearly 4,000 new and upgraded seismic instruments out of the targeted 7,100 stations laid out in the ANSS plan to fully implement the system.[4] Approximately 800 of these new stations have been added since the 2018 NEHRP reauthorization. Recent seismic network expansions have been driven by the development of an earthquake early warning capability in California, Oregon, and Washington, which has been built on the foundation of the ANSS. This warning system, called *ShakeAlert*, is managed by the USGS and operated in partnership with West Coast States and academic institutions. *ShakeAlert* has issued public alerts across each of these three States since 2021. The warning system is currently 90 percent built out and seismic station buildout is scheduled for completion by the end of 2025.

USGS earthquake monitoring and hazard assessment activities depend upon a robust program of targeted research. This research improves our understanding of earthquake processes, occurrence, and probabilities, our development of the NSHM, our ability to characterize earthquakes, and our capacity to develop a growing range of information products that provide situational awareness and support risk mitigation. Internal research efforts are complemented by an external grants program that evaluates peer-reviewed proposals and provides funding to university, state, and non-government partners. This grant program provides a tie to fundamental research proposals funded by NEHRP partners at NSF and allows the USGS to leverage the wealth of knowledge on earthquake processes in the broader community.

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[4] USGS Circular 1188

We also learn about earthquakes by investigating their effects when they occur. The Earthquake Hazards Reduction Act (EHRA) calls for the investigation of significant domestic and international earthquakes to learn lessons that can be applied to reduce future earthquake losses in the United States. The most recent EHRA reauthorizations have charged the USGS with the responsibility to coordinate post-earthquake investigations to study the implications of earthquakes in the responsibility areas of each of the four NEHRP agencies and to leverage the expertise of other federal agencies, state partners, non-government organizations, and private contractors. The USGS carries out these responsibilities following the guidelines described in USGS Circular 1242, *The Plan to Coordinate NEHRP Post-Earthquake Investigations*, which is in the process of being updated to align with more modern investigation practices. The USGS implemented elements of this revised plan following the devastating February 2023 magnitude 7.8 and 7.5 earthquakes in southern Türkiye.

Since the 2018 NEHRP reauthorization, the USGS and ANSS RSN partners have also been involved in large-scale operational response efforts for several other significant national and global earthquakes, including: the M7.1 November 2018 Anchorage, Alaska, earthquake; the M 7.1 July 2019 Ridgecrest, California, earthquake; the M 6.4 January 2020 Puerto Rico earthquake; the M 5.6 March 2020 Magna, Salt Lake City, Utah, earthquake; the M 6.5 May 2020 Monte Cristo, Nevada, earthquake; the M 8.2 July 2021 Chignik, Alaska, earthquake; and the M 7.1 August 2021 Haiti earthquake.

The USGS and its partners in NEHRP continue to support research, technology development, and outreach to improve our nation's resilience against earthquakes. We work closely with academic partners around the world to advance our science, and we are grateful for the many decades of support Congress has provided for this work. We do not know when the next large, damaging earthquake will occur, or where it will occur specifically, but due to NEHRP, we can avail ourselves of improved information and data.