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The National Earthquake Hazards Reduction Program (NEHRP): Issues in Brief

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Summary

Under the National Earthquake Hazards Reduction Program (NEHRP), four federal agencies have responsibility for long-term earthquake risk reduction: the U.S. Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute of Standards and Technology (NIST). These agencies assess U.S. earthquake hazards, deliver notifications of seismic events, develop measures to reduce earthquake hazards, and conduct research to help reduce overall U.S. vulnerability to earthquakes. Congressional oversight of the NEHRP program encompasses how well the four agencies coordinate their activities to address the earthquake hazard. Better coordination was a concern that led to changes to the program in legislation enacted in 2004 (the National Earthquake Hazards Reduction Program Reauthorization Act of 2004; P.L. 108-360; 42 U.S.C. 7704).

P.L. 108-360 authorized appropriations for NEHRP through FY2009. Although authorization for appropriations expired in 2009, Congress has continued to appropriate funds for NEHRP activities. Congress made available $169.5 million for program activities in FY2018 appropriations, $30.6 million more than FY2017 spending of $138.9 million. The budget request for FY2019 would reduce total funding for NEHRP activities at the USGS and NSF by $35.1 million and $13.7 million, respectively, compared to FY2018 enacted amounts for those agencies.

Legislation introduced in the 115th Congress, S. 1768 and H.R. 6650 (the National Earthquake Hazards Reduction Program Reauthorization Acts of 2017 and 2018, respectively), largely would leave the current four-agency NEHRP program intact, while providing some new areas of emphasis. The bills would emphasize activities to promote greater resilience to earthquakes and activities that would enhance the effectiveness of an earthquake early warning system, among other changes. Both bills would remove statutory language referring to an original purpose of the program to seek a capability to predict earthquakes; earthquake prediction has proved to be virtually impossible. In its 1990 reauthorization, NEHRP shifted its program emphasis from prediction to hazard reduction. S. 1768 and H.R. 6650 would continue that emphasis, along with a focus on enhancing the concept of resilience. Resilience would include, for example, designing and building structures that not only protect human lives during an earthquake but also continue to be functional structures after an earthquake. Those structures then could be reoccupied instead of being total losses.

S. 1768 was referred to the Senate Committee on Commerce, Science, and Transportation, which held a markup on December 13, 2017. The committee ordered the bill to be reported with an amendment in the nature of a substitute, which made several changes to the original legislation. Notably, the amended bill added a section authorizing appropriations for FY2018 through FY2022. H.R. 6650 was introduced on August 3, 2018, and was referred to the House Committees on Science, Space, and Technology; Natural Resources; and Transportation and Infrastructure. The bill is largely similar to S. 1768, although total appropriation amounts authorized by H.R. 6650 would slightly exceed the amounts authorized by S. 1768 over the four-year period FY2019-FY2022.

One persistent question has been how to establish a precise relationship between NEHRP activities and reduced earthquake risk and actual losses from earthquakes. Section 4 of S. 1768 and H.R. 6650 appears to address that question by requiring the Comptroller General of the United States to review the program's activities and produce a report for Congress that addresses earthquake risks and hazards. The review and report would look at how states, tribes, and local governments use NEHRP-generated information and implement measures to reduce their earthquake risk.

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Introduction

Portions of all 50 states and the District of Columbia are vulnerable to earthquake hazards,[1] although risks vary greatly across the country and within individual states.[2] Seismic hazards are greatest in the western United States, particularly in California, Washington, Oregon, Alaska, and Hawaii. Alaska is the most earthquake-prone state, experiencing a magnitude-7 earthquake almost every year and a magnitude-8 earthquake every 13 years, on average, since 1900.[3] Because of its low population and low infrastructure density, Alaska has a relatively low risk for large economic losses from an earthquake. In contrast, California has more earthquake risk than any other state because of its frequent seismic activity, large population, and extensive infrastructure.

The federal government has supported efforts to assess and monitor earthquake hazards and risk in the United States under the National Earthquake Hazards Reduction Program (NEHRP) since 1977. Four federal agencies responsible for long-term earthquake risk reduction coordinate their activities under NEHRP

- U.S. Geological Survey (USGS);
- National Science Foundation (NSF);
- Federal Emergency Management Agency (FEMA); and
- National Institute of Standards and Technology (NIST).

Congress last made changes to NEHRP under the National Earthquake Hazards Reduction Program Reauthorization Act of 2004 (P.L. 108-360; 42 U.S.C. 7704), which authorized appropriations through FY2009 for a total of $902.4 million cumulatively over five years. Congress has continued to appropriate funds for NEHRP activities since authorization for appropriations expired in FY2009.

On September 6, 2017, Senator Dianne Feinstein introduced S. 1768, the National Earthquake Hazards Reduction Program Reauthorization Act of 2017, together with seven original cosponsors. The bill would largely leave the overall program structure in place, but would modify some of the intents and purposes of the original legislation, such as removing references to the goal of earthquake prediction, and substituting instead the goal of issuing early warnings and earthquake alerts. The bill was referred to the Senate Committee on Commerce, Science, and Transportation which held a markup on December 13, 2017. The committee ordered the bill to be reported with an amendment in the nature of a substitute offered by Senator Cory Gardner. The amendment made several changes to the original legislation introduced by Senator Feinstein.

On August 3, 2018, Representative Dana Rohrabacher introduced H.R. 6650, the National Earthquake Hazards Reduction Program Reauthorization Act of 2018, together with three original cosponsors. The bill is nearly identical to S. 1768 in terms of programmatic changes to the NEHRP program but would authorize slightly different appropriation amounts for FY2019-

[1] Hazard is not the same as risk. Earthquake *hazard* is related to the probability of a certain level of a shaking event caused by an earthquake within a certain time frame. *Risk* could be described as the combination of the hazard and the affected population (which includes the infrastructure supporting that population). Large population centers would therefore be at a higher risk than small population centers for the same degree of earthquake hazard, in general. It is important to note that the original legislation, arguably, mistakenly conflated the terms hazard and risk. More recently, the term *resilience* has been introduced in discussions regarding reducing earthquake risk (i.e., indicating improving resilience to earthquake hazards).

[2] The U.S. territories are not included in this assessment.

[3] State of Alaska, Alaska Seismic Hazards Safety Commission, "Earthquake Risk in Alaska," at http://seismic.alaska.gov/earthquake_risk.html.

FY2022, among some other differences. H.R. 6650 was referred to the House Science, Space, and Technology Committee, the House Natural Resources Committee, and the House Transportation and Infrastructure Committee. The committees have not acted on the bill as of mid-September 2018.

Changes to NEHRP Since Its Inception

In 1977, Congress passed the Earthquake Hazards Reduction Act (P.L. 95-124), establishing NEHRP as a long-term earthquake hazard reduction program for the United States. The program, led by USGS and NSF, initially focused on research toward understanding and ultimately predicting earthquakes. However, earthquake prediction has proved insoluble over time,[4] and NEHRP shifted its focus in 1990 to minimizing losses from earthquakes after they occur.

Agency leadership of NEHRP has also changed since the program's inception. FEMA was created in 1979 under President Carter and designated as the lead agency for NEHRP. In 1980, Congress passed amendments to the Earthquake Hazards Reduction Act (P.L. 96-472), which defined FEMA as the lead agency for NEHRP. The amendments also authorized additional funding for earthquake hazard preparedness and mitigation for FEMA and the National Bureau of Standards (now NIST).

A Shift in Program Emphasis to Hazard Reduction

Congress changed NEHRP's original focus on research to predict earthquakes in the National Earthquake Hazards Reduction Program Reauthorization Act of 1990 (P.L. 101-614). The law decreased the program's emphasis on earthquake prediction, clarified the role of FEMA, clarified and expanded the program objectives, and required federal agencies to adopt seismic safety standards for all existing federal buildings that were designed and constructed without adequate seismic design and construction standards.

In 2004, Congress enacted P.L. 108-360 and adjusted NEHRP again by shifting primary responsibility for planning and coordinating the program from FEMA to NIST. P.L. 108-360 also established an interagency coordinating committee and an advisory committee, both focused on earthquake hazard reduction.

Current program activities focus on several broad areas

- Developing effective measures to reduce earthquake hazards.
- Promoting the adoption of earthquake hazard reduction activities by federal, state, and local governments; by national building standards and model building code organizations; and by engineers, architects, building owners, and others who play a role in planning and constructing buildings, bridges, structures, and critical infrastructure or lifelines.[5]

[4] See, for example, U.S. Geological Survey (USGS), "Can You Predict Earthquakes?" at https://www.usgs.gov/faqs/can-you-predict-earthquakes?qt-news_science_products=0#qt-news_science_products.

[5] *Lifelines* are essential utility and transportation systems. Within the earthquake community, the term *lifelines* has generally given way to the term *lifeline infrastructure*. See the Earthquake Engineering Research Institute white paper, "Improve Reliability of Lifeline Infrastructure Systems," April 5, 2016, at https://www.eeri.org/wp-content/uploads/eeri-policy-lifelines.pdf.

- Improving the basic understanding of earthquakes and their effects on people and infrastructure through interdisciplinary research involving engineering; natural sciences; and social, economic, and decision sciences.
- Developing and maintaining the Advanced National Seismic System (ANSS) and the Global Seismic Network (GSN).[6]

From FY2004 through FY2014, program activities also included the NSF-supported George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES) that consisted of 15 experimental facilities and an information-technology infrastructure with a goal of mitigating earthquake damage by the use of improved materials, designs, construction techniques, and monitoring tools. Currently, NSF supports the successor to NEES, the Natural Hazards Engineering Research Infrastructure (NEHRI).[7]

Responsibilities of NEHRP Agencies Under P.L. 108-360

The House Science Committee report in the 108th Congress on H.R. 2608 (P.L. 108-360) noted that NEHRP has produced a wealth of useful information since 1977, but it also stated that the program's potential has been limited by the inability of the NEHRP agencies to coordinate their efforts.[8] The committee asserted that restructuring the program with NIST as the lead agency, directing funding toward appropriate priorities, and implementing NEHRP as a true interagency program would lead to improvement.

The 2004 law made the director of NIST chair of the Interagency Coordinating Committee. Other members of the committee include the directors of FEMA, USGS, NSF, the Office of Science and Technology Policy, and the Office of Management and Budget. The Interagency Coordinating Committee is charged with overseeing the planning, management, and coordination of the program. Primary responsibilities for the NEHRP agencies break down as follows (see also **Figure 1**):

- NIST is the lead NEHRP agency, with primary responsibility for NEHRP planning and coordination. NIST supports the development of performance-based seismic engineering tools, working with FEMA and other groups to promote the commercial application of the tools through building codes, standards, and construction practices.[9]
- FEMA assists other agencies and private-sector groups to prepare and disseminate building codes and practices for structures and lifelines. FEMA also aids development of performance-based codes for buildings and other structures.

[6] The Advanced National Seismic System is a nationwide network of seismographic stations operated by USGS. The Global Seismic Network is a global network of stations coordinated by the Incorporated Research Institutions for Seismology, a nonprofit organization.

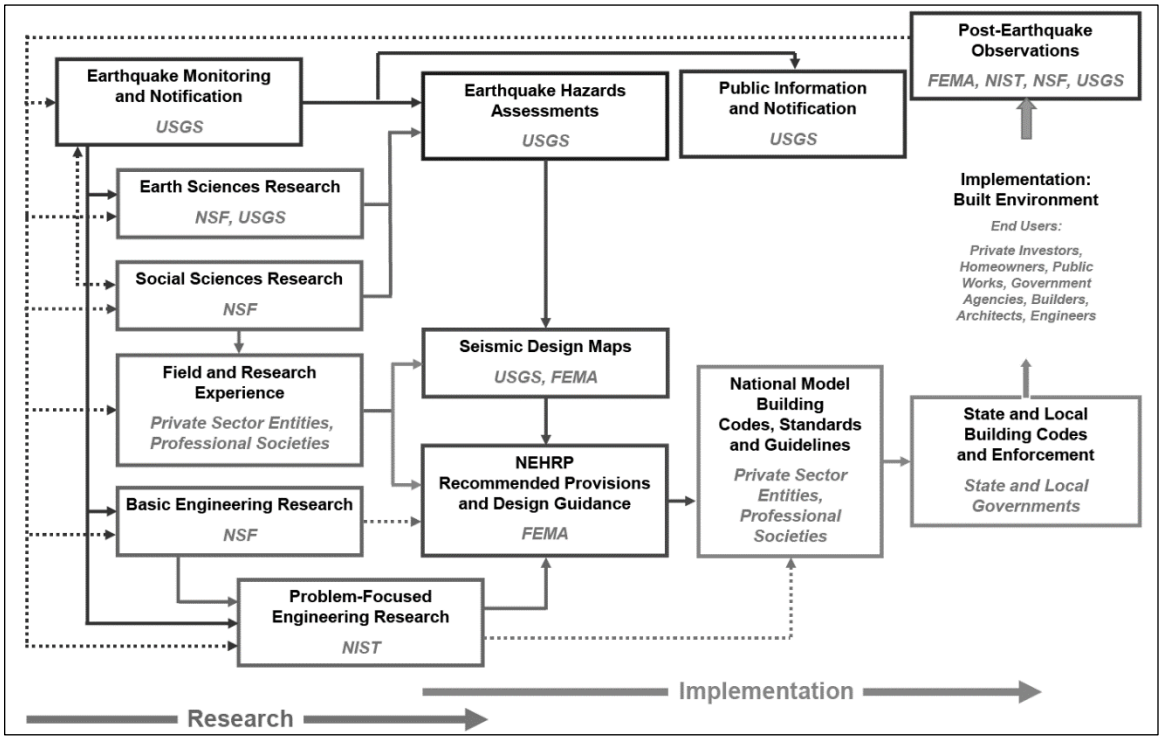
[7] The Natural Hazards Engineering Research Infrastructure (NEHRI) is a distributed, multiuser, national facility that provides research infrastructure for the natural hazards research community, including earthquake and wind engineering experimental facilities, cyber infrastructure, computational modeling and simulation tools, and research data. Personal communication from Karen Pearce, senior legislative affairs specialist, NEHRI, October 6, 2017.

[8] U.S. House of Representatives, Committee on Science, *National Earthquake Hazards Reduction Program Reauthorization Act of 2003*, 108th Cong., 1st sess., H.Rept. 108-246 (August 14, 2003), p. 13.

[9] Building codes typically are developed by independent standards organizations, such as the International Code Council (ICC). According to the ICC, 50 states and the District of Columbia have adopted International Codes© developed by the ICC at the state or jurisdictional level. See https://www.iccsafe.org/about-icc/overview/about-international-code-council/.

- USGS conducts research and other activities to characterize and assess earthquake risks. The agency (1) operates a forum, using the National Earthquake Information Center (NEIC), for the international exchange of earthquake information; (2) works with other NEHRP agencies to coordinate activities with earthquake-reduction efforts in other countries; and (3) maintains seismic-hazard maps, in support of building codes for structures and lifelines, and other maps needed for performance-based design approaches.
- NSF supports research to improve safety and performance of buildings, structures, and lifelines.

Figure 1. NEHRP Agency Responsibilities and End Users of NEHRP Products



Source: National Earthquake Hazards Reduction Program (NEHRP) program office at http://www.nehrp.gov/pdf/ppt_sdr.pdf (modified by CRS).

Notes: FEMA = Federal Emergency Management Agency; NIST = National Institute of Standards and Technology; NSF = National Science Foundation; USGS = U.S. Geological Survey.

Table 1 shows the enacted budgets for NEHRP agencies from FY2005 through FY2018 (and the budget request for FY2019). Enacted appropriations for FY2005-FY2009 totaled $613.2 million, or 68% of the $902.4 million total amount authorized in P.L. 108-360 over the five-year span (see **Table 1**). Authorization of appropriations for the program under P.L. 108-360 expired at the end of FY2009. Congress has continued to appropriate funds for NEHRP program activities.

Table 1. Enacted Funding for NEHRP Since Enactment of P.L. 108-360 Through FY2018 (Including the FY2019 Budget Request)

(in millions of current dollars)

		USGS	NSF	FEMA	NIST	Total
FY2005	Enacted	58.3	53.1	14.7	0.9	**127.0**
FY2006	Enacted	54.5	53.8	9.5	0.9	**118.7**
FY2007	Enacted	55.4	54.8	9.1	1.7	**121.0**
FY2008	Enacted	58.1	55.6	6.1	1.7	**121.5**
FY2009	Enacted	61.2	55.3	9.1	4.1	**129.7**
FY2010	Enacted	62.8	55.3	9.0	4.1	**131.2**
FY2011	Enacted	61.4	53.3	7.8	4.1	**126.6**
FY2012	Enacted	60.4	53.2	7.8	4.1	**125.5**
FY2013	Enacted	55.6	52.2	`7.8	3.9	**119.5**
FY2014	Enacted	58.7	51.0	7.8	3.9	**121.4**
FY2015	Enacted	64.4	52.2	7.4	3.9	**127.9**
FY2016	Enacted	67.0	54.2	8.5	5.2	**134.9**
FY2017	Enacted	71.0	54.2	8.5	5.2	**138.9**
FY2018	Enacted	90.1	65.7	8.5	5.2	**169.5**
FY2019	Request	55.0	52.0	N/A	5.2	**112.2**[a]

Sources: NEHRP program office, 2005-2018 NEHRP Agency Budgets; 2019 Requested Funding for NEHRP Agencies (reported as of June 20, 2018), https://www.nehrp.gov/about/reports.htm.

Notes: According to the NEHRP program office, FEMA and NIST budgets are those agencies' allocations for NEHRP activities from the total agency appropriations through FY2018. The NSF budget is its expenditure for NEHRP activities from total agency appropriations through FY2018. NIST and NSF amounts for FY2019 are those agencies' planned allocations for NEHRP activities from total agency appropriations. The USGS-enacted funding reflects the amount appropriated for USGS NEHRP activities through FY2018, and the USGS amount for FY2019 is what was requested for USGS NEHRP activities. N/A means that the requested amount for FEMA was not available for FY2019 as of September 2018.

a. Total requested amount for FY2019 does not include the amount for FEMA, which is not available as of September 2018.

NEHRP in the 115th Congress: S. 1768 and H.R. 6650

The National Earthquake Hazards Reduction Program Reauthorization Acts of 2017 and 2018 (S. 1768 and H.R. 6650, respectively), largely would leave the current four-agency NEHRP program intact, while providing some new areas of emphasis and specific authorization of appropriations levels for the member agencies. S. 1768, introduced by Senator Feinstein on September 6, 2017, has seven original cosponsors; H.R. 6650, introduced by Representative Rohrabacher on August 3, 2018, has three original cosponsors.

Upon introduction, S. 1768 was referred to the Senate Committee on Commerce, Science, and Transportation, which held a markup on December 13, 2017. An amendment in the nature of a substitute, introduced by Senator Gardner, was accepted by the committee, and the bill was ordered to be reported favorably out of committee. Upon introduction, H.R. 6650 was referred to the House Science, Space, and Technology Committee; the House Natural Resources Committee; and the House Transportation and Infrastructure Committee. The committees have not acted on the bill as of mid-September 2018.

The sections below discuss S. 1768 (as amended) and H.R. 6650, noting where the bills differ.

Changes to Findings, Purposes, Definition (Section 2)

As noted above, NEHRP activities shifted long ago from a goal of earthquake prediction to earthquake hazard reduction. S. 1768 and H.R. 6650 would codify that shift by removing references to earthquake prediction throughout the bill. For example, Section 2 of the bill would modify the congressional findings section (42 U.S.C. 7701) by omitting the linkage between seismological research and earthquake prediction, substituting the finding that "a well-funded seismological research program could provide the scientific understanding needed to fully implement an effective earthquake early warning system."[10] An earthquake early warning system would automatically send an alert to areas in danger of potential shaking after the earthquake is initially triggered. The alert would potentially allow components of the lifeline infrastructure,[11] such as electric utilities, railway systems, and even hospital operating rooms, to cease activities that could be impaired by violent shaking before the first earthquake-triggered surface waves reach them.

Section 2 of S. 1768 and H.R. 6650 also introduces the concept of *resilience* to earthquake hazards. For example, Section 2 cites a National Research Council study that includes goals and objectives for achieving national earthquake resilience.[12] Section 2 also would amend the congressional statement-of-purpose section (42 U.S.C. 7702) to include the purpose of increasing the resilience of communities to future earthquakes in addition to the purpose of reducing the risks to life and property. The bill would define "community resilience" in the definitions section of the law (42 U.S.C. 7703) to mean "the ability of a community to prepare and plan for, absorb, recover from, and more successfully adapt to seismic events."

Section 2 of S. 1768 and H.R. 6650 also takes note of the aspect of resilience that includes design and construction of buildings so that those structures are built to potentially continue functioning, or to be reoccupied, in spite of earthquake damage. The bills note that the built environment historically has been constructed and maintained to prevent severe injuries or loss of life, but not necessarily to continue functioning or to be reoccupied without a complete reconstruction. Section 2 introduces the language of "re-occupancy, recovery, reconstruction" following an earthquake to capture this trend within the seismic community.

Both S. 1768 and H.R. 6650 would add the states of Oregon and Tennessee to the other 39 states identified as subject to major or moderate seismic risk (42 U.S.C. 7701). H.R. 6650 also would add the Commonwealth of Puerto Rico to the rest of the United States deemed vulnerable to the hazards of earthquakes.

Changes to Program Activities and Agency Responsibilities (Section 3)

Within the four broad NEHRP program activities, Section 3 of S. 1768 and H.R. 6650 would add a new component to help promote earthquake hazards reduction. The bill would add to the

[10] An early-warning system would send a warning after an earthquake occurred but before the damaging seismic waves reach a community that would be affected by the seismic waves. In contrast, an earthquake prediction would provide a date, time, and location of a future earthquake.

[11] S. 1768 and H.R. 6650 would replace the term *lifelines* with the term *lifeline infrastructure* wherever it appears in the *U.S. Code*.

[12] National Research Council, *National Earthquake Resilience, Research, Implementation, and Outreach*, 2011, http://www.nehrp.gov/pdf/nrc2011.pdf.

activities listed under 42 U.S.C. 7704(a)(2)(B) the requirement of "publishing a systematic set of maps of active faults and folds, liquefaction susceptibility, susceptibility for earthquake induced landslides, and other seismically induced hazards." If carried out, such a repository of maps could be considered an important tool for reducing earthquake risk by the spectrum of potential users at the federal, state, local, and tribal government level, as well as the developers of national building codes, developers, building owners, and others involved in planning and construction of the structural environment. It is not clear whether this new requirement would involve the compilation and organization of existing maps or the creation of new maps; either could represent a significant undertaking by the NEHRP agencies.

Both bills also would insert language to "continue the development of the Advanced National Seismic System [ANSS], including earthquake early warning capabilities," as part of 42 U.S.C. 7704(a)(2)(D). In addition, they would delete references to the ANSS predecessor—the Advanced National Seismic Research and Monitoring System—along with references to the George E. Brown Jr. Network for Earthquake Engineering Simulation.

Section 3 also would add new duties for the Interagency Coordinating Committee. The committee would be required to develop a strategic plan for NEHRP, a management plan to implement the strategic plan, and a coordinated interagency budget on a biennial basis. The committee also would be required to develop memorandums of understanding with other federal agencies, such as the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration, on data sharing and resource commitments in the event of an earthquake disaster. Further, the committee would coordinate with the Secretaries of Agriculture and the Interior on the use of federal lands for monitoring, research, and data collection. The committee also would be required to coordinate with the Secretaries of Transportation and Housing and Urban Development on the effects of earthquakes on transportation and building stocks (part of the lifeline infrastructure described above).

H.R. 6650 would add an additional duty for the Interagency Coordinating Committee under this section, requiring coordination with its counterpart committee on Windstorm Impact Reduction, as well as other natural hazards coordination committees as determined appropriate to share data and best practices. S. 1768 does not contain a similar provision.

NEHRP Agencies

Under S. 1768 and H.R. 6650, NIST would remain the lead agency for the program, with its duties and responsibilities largely unchanged. FEMA also would retain most of its duties and responsibilities, with a few modifications. For example, current law allows FEMA discretion in entering cooperative agreements or contracts with states, local jurisdictions, or other federal agencies to establish demonstration projects on earthquake hazard modification, linking research and mitigation efforts with emergency management programs, or preparing educational materials for national distribution. Section 3 of S. 1768 and H.R. 6650 would require FEMA to enter cooperative agreements or contracts for these purposes (substituting the word "shall" for the word "may" in the bill language). Also, states that enter into these agreements would be required to provide a 25% cost share, unless FEMA lowers or waives the cost share requirement.

The amended version of S. 1768 ordered to be reported out of committee on December 13, 2017, added a requirement that the Interagency Coordinating Committee provide a statement in its reports to Congress whether FEMA lowered or waived the 25% cost-share requirement. The amended bill also changed the criteria under which FEMA may lower or waive the cost-share requirement. The original legislation would have provided FEMA with discretion to reduce or waive the cost-share requirement "in exceptional cases of economic hardship." The amended S.

1768 is more specific and would allow reducing or waiving the requirement for "a small impoverished community," as defined in Section 203 of the Disaster Relief Act of 1974 (42 U.S.C. 5133(a)).[13]

Statutory language requiring USGS to develop procedures for making earthquake predictions would be removed under Section 3 of S. 1768 and H.R. 6650 and replaced with language for developing procedures for issuing alerts and early warnings. Further, the bills would require USGS to issue an actual alert and an earthquake warning, when necessary and feasible, to FEMA, NIST, and state and local officials, in the event of an earthquake.

Language in current law that requires NSF to support earthquake-related research using the George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES) would have been updated in S. 1768 as introduced by replacing reference to NEES with reference to the Natural Hazards Engineering Research Infrastructure (NEHRI), to reflect the facility currently supported by NSF (see footnote 7). The amended bill and H.R. 6650 omit language referring to NEHRI and instead refer generically to "experimental and computational facilities."

Also, Section 3 of S. 1768 and H.R. 6650 would add a new subsection requiring NSF to identify and track grant funding that is part of the NEHRP program and to provide a report at least every two years specifying the amount of NSF funding awarded to conduct research that enhances the understanding of earthquake science.

Review of Earthquake Risks and Review of NEHRP (Section 4)

Section 4 of S. 1768 is titled "Review of Risks Posed by Earthquakes to the United States"; Section 4 of H.R. 6650 is titled "Review of the National Earthquake Hazard Reduction Program." Both bills would require a report from the Comptroller General of the United States. However, S. 1768 would require a report focused on the risks to the United States posed by earthquakes, whereas H.R. 6650 would require a report reviewing federal earthquake hazard risk reduction efforts. Despite that difference, the reports that would be required by both bills contain many similarities, together with some differences. **Table 2** provides a brief comparison of selected portions of Section 4 in both bills.

Table 2. Comparison of Selected Portions of Section 4 in S. 1768 and H.R. 6650

Section 4	S. 1768	H.R. 6650
Title	Review of Risks Posed by Earthquakes to the United States	Review of the National Earthquake Hazard Reduction Program
4(a)	In General—As soon as practicable, but not later than such date as is necessary for the Comptroller General of the United States to submit the report required by subsection (c) in accordance with such subsection, the Comptroller General shall complete a review of risks posed by earthquakes to the United States.	In General—As soon as practicable, but not later than such date as is necessary for the Comptroller General of the United States to submit the report required by subsection (c) in accordance with such subsection, the Comptroller General shall complete a review of Federal earthquake hazard risk reduction efforts.
4(b)(1)(A)	The risks and hazards to the United States posed by earthquakes, including risks and hazards resulting from tsunamis and landslides that are generated by earthquakes.	The extent to which the United States Geological Survey has identified the risks and hazards to the United States posed by earthquakes, including risks and hazards resulting from tsunamis and landslides that are generated by earthquakes.

[13] Commonly referred to as the Stafford Act.

Section 4	S. 1768	H.R. 6650
4(b)(1)(B)	The efforts of the Federal Emergency Management Agency and the National Institute of Standards and Technology to improve the resilience of the United States to earthquakes and to identify important gaps in the resilience of the United States to earthquakes.	Identical to S. 1768.
4(b)(1)(C)	The progress made by the National Institute of Standards and Technology and the Interagency Coordinating Committee to coordinate effectively the budget and activities of the program agencies (as defined in Section 4 of the Earthquake Hazards Reduction Act of 1977 (42 U.S.C. 7703)) in advancing the plans and goals of the National Earthquake Hazards Reduction Program and how coordination among the program agencies can be improved.	The progress made by the National Institute of Standards and Technology and the Interagency Coordinating Committee (as defined in Section 4 of the Earthquake Hazards Reduction Act of 1977 (42 U.S.C. 7703)) to coordinate effectively the budget and activities of the program agencies (as defined in such Section 4) in advancing the plans and goals of the program (as defined in such Section 4) and how coordination among the program agencies may be improved.
4(b)(1)(D)	The extent to which the federal government, states, local, and tribal governments and the private sector are already implementing strategies to improve resilience of the United States to earthquakes.	The extent to which the results of research in earthquake risk and hazards reduction supported by the National Science Foundation during the 40 years of the program have been effectively disseminated to federal, state, local, and private sector stakeholders.
4(b)(1)(E)	The extent to which the research done during the 40 years of the program has been applied to both public and private earthquake risk and hazards reduction.	None
4(b)(2)	Identification of such legislative or administrative action as may be appropriate to improve the program and the resilience of the United States to earthquakes.	Recommendations to improve the program and the resiliency of the United States to earthquake risks.
4(c)	Report—As soon as practicable, but not later than three years after the date of the enactment of this act, the Comptroller General shall submit to the Committee on Commerce, Science, and Transportation; the Committee on Energy and Natural Resources; and the Committee on Homeland Security and Governmental Affairs of the Senate and to the Committee on Science, Space, and Technology; the Committee on Natural Resources; and the Committee on Homeland Security of the House of Representatives a report on the findings of the Comptroller General with respect to the review completed under subsection (a).	Identical to S. 1768.

Source: S. 1768 and H.R. 6650.

Notes: "None" means that there is no corresponding subsection.

Seismic Standards (Section 5)

S. 1768 and H.R. 6650 would replace the language in current law that called for the adoption of seismic safety standards for buildings constructed or leased by the federal government with a requirement instead for an assessment and recommendations for improving the built environment and critical infrastructure specifically "to reflect performance goals stated in terms of post-earthquake reoccupancy and functional recovery times." This language highlights one of the changes in overall NEHRP program direction to enhance the aspect of earthquake resilience, meaning building structures that would allow for continued use and reoccupancy following an earthquake. The assessment and recommendations would come from a committee of experts, appointed by the directors of NIST and of FEMA, representing federal agencies, nongovernmental organizations, the private sector, disaster management associations, engineering associations, and construction and homebuilding industry associations. Section 5 would require a report to Congress with recommended options no later than June 30, 2020. The bills would specify that the report be submitted to specific committees in the House and the Senate.[14]

Management Plan for Advanced National Seismic System (ANSS) (Section 6)

The ANSS is a nationwide network of seismographic stations operated by USGS. It consists of a "backbone" network of about 100 seismic stations throughout the United States, the National Earthquake Information Center, the National Strong Motion Project, and 15 regional seismic networks operated by USGS and partner institutions.[15] S. 1768 and H.R. 6650 would require a new five-year management plan for ANSS, which would include the following:

- strategies to continue developing an earthquake early warning system;
- a mechanism for securing participation of state and regional earthquake monitoring entities in ANSS;
- a plan to encourage and support integration of geospatial data products into monitoring activities in earthquake-prone regions; and
- a plan to ensure a geographically diverse management and advisory structure for ANSS.

H.R. 6650 would add one additional requirement not included in S. 1768: "A plan to identify and evaluate existing data sets available across commercial, civil, and defense entities to determine if there are additional data sources to inform the development and deployment of the Advanced National Seismic System and an earthquake early warning system."

Authorization of Appropriations (Section 7)

The previous NEHRP reauthorization bill, P.L. 108-360 (42 U.S.C. 7704), authorized appropriations for NEHRP through FY2009. As introduced, S. 1768 would have repealed the section of current law authorizing appropriations entirely. However, the amended bill and H.R. 6650 would provide a new authorization of appropriations for each NEHRP agency for fiscal

[14] For the Senate, the report would go to the Committees on Commerce, Science, and Transportation; Energy and Natural Resources; and Homeland Security and Governmental Affairs. For the House, the report would go to the Committees on Science, Space, and Technology; Natural Resources; and Homeland Security.

[15] For more information, see U.S. Geological Survey, Earthquake Hazards Program, *ANSS—Advanced National Seismic System*, at https://earthquake.usgs.gov/monitoring/anss/.

years 2018 through 2022. **Table 3** shows the amounts authorized for each year and by agency in S. 1768 and H.R. 6650.

Table 3. Authorization of Appropriations for NEHRP Agencies, S. 1768 and H.R. 6650

(in millions of dollars)

FY	USGS		NSF		FEMA		NIST		Total	
	S. 1768	H.R. 6650	S. 1768	H.R. 6650	S. 1768	H.R. 6650	S. 1768	H.R. 6650	S. 1768	H.R. 6650
2018	72.42	—	55.08	—	8.67	—	5.30	—	**141.47**	—
2019	73.87	83.40	56.18	54.00	8.84	8.76	5.41	5.90	**144.30**	**152.06**
2020	75.35	83.40	57.31	54.00	9.02	8.76	5.52	5.90	**147.20**	**152.06**
2021	75.85	83.40	58.45	54.00	9.20	8.76	5.63	5.90	**149.13**	**152.06**
2022	78.39	83.40	59.62	54.00	9.39	8.76	5.74	5.90	**153.14**	**152.06**
2019-2022	**303.46**	**333.60**	**231.56**	**216.00**	**36.45**	**35.04**	**22.30**	**23.60**	**593.77**	**608.24**

Source: S. 1768 and H.R. 6650.

Note: Both bills would require that $30 million of the total USGS authorization of appropriations each year be made available for completion of the Advanced National Seismic System (ANSS). Authorized appropriations for FY2018 in S. 1768 are not tallied in the bottom line of the table.

As **Table 1** shows, both bills would authorize appropriations over the four-year period FY2019-FY2022 in roughly similar amounts: $593.77 million and $608.24 million overall for S. 1768 and H.R. 6650, respectively (H.R. 6650 would provide about 2.5% more overall than S. 1768). The amounts authorized for each agency also differ, although by relatively small amounts. S. 1768 authorizes appropriations over a five-year period beginning in FY2018; H.R. 6650 does not authorize appropriations for FY2018.

The findings section (Section 2) of both bills recognizes that the National Research Council in 2011 recommended funding of approximately $300 million annually for 20 years (in 2009 dollars).[16] That amount would be approximately two times the average annual amount authorized for appropriations for the total NEHRP program in S. 1768 and H.R. 6650.

Outlook

At present, earthquakes cannot be accurately predicted. In its 1990 reauthorization, NEHRP shifted its program emphasis from prediction to hazard reduction. Since then, the program's focus has been on understanding the earthquake hazard and its risk to populations and infrastructure in the United States, developing effective measures to reduce earthquake hazards, and promoting the adoption of earthquake hazard reduction measures in vulnerable areas002E

Legislation enacted to modify NEHRP in the 108th Congress (P.L. 108-360) reflected congressional concerns about how well the four NEHRP agencies coordinated their efforts to maximize the program's potential. Legislation introduced in the 115th Congress, S. 1768 and H.R. 6650, would leave the program largely intact, while emphasizing activities to promote greater resilience to earthquakes and activities that would enhance the effectiveness of an earthquake

[16] National Research Council, *National Earthquake Resilience, Research, Implementation, and Outreach*, 2011, p. 4, http://www.nehrp.gov/pdf/nrc2011.pdf.

early warning system, among other changes. The bills would authorize annual appropriations levels for NEHRP at slightly higher levels than the amount of enacted appropriations for the program in FY2017. The bills also would remove statutory language regarding earthquake prediction.

Since NEHRP shifted its emphasis toward reducing losses during an earthquake, one persistent question has been how to establish a precise relationship between NEHRP activities and reduced earthquake risk and actual losses from earthquakes. Section 4 of S. 1768 and H.R. 6650 appears to address that question by requiring the Comptroller General of the United States to review the activities of the program and produce a report for Congress that addresses the earthquake risks and hazards in the nation. The review and report would look at how federal activities are addressing those risks and hazards, including how states, tribes, and local governments are using NEHRP-generated information and implementing measures to reduce their earthquake risk.

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