

**NATURAL HAZARDS ENGINEERING RESEARCH
INFRASTRUCTURE**

\$11,750,000
-\$1,250,000 / -9.6%

Natural Hazards Engineering Research Infrastructure
(Dollars in Millions)

FY 2016 Actual	FY 2017 (TBD)	FY 2018 Request	Change over FY 2016 Actual	
			Amount	Percent
\$13.00	-	\$11.75	-\$1.25	-9.6%

The Natural Hazards Engineering Research Infrastructure (NHERI) is the next generation of NSF support for a multi-user, natural hazards engineering research facility, replacing the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES). NEES was established by NSF as a distributed, multi-user, national research infrastructure for earthquake engineering research through support of a facility construction phase during 2000-2004, followed by support of an operations phase for research, innovation, and education activities from October 2004 through September 2014. NEES was supported by NSF during FY 2010–2014 through a cooperative agreement with Purdue University. The NEES infrastructure included 14 earthquake engineering experimental facilities and an integrative cyberinfrastructure. During FY 2015, NSF’s cooperative agreement with Purdue University was extended to continue support for cyberinfrastructure operations during the NSF open competition to establish NHERI via program solicitations NSF 14-605 and NSF 15-598.

NHERI is a distributed, multi-user, national research facility that provides the natural hazards engineering research community with access to research infrastructure (earthquake and wind engineering experimental facilities; post-disaster, rapid response research (RAPID) facility; cyberinfrastructure; computational modeling and simulation tools; and research data), coupled with education and community outreach activities. Building upon NEES, NHERI enables new discovery and knowledge through enhanced capacity to test and derive more comprehensive, complete, and accurate models of how constructed civil infrastructure responds to earthquake and wind loading. This will enable the design of new methodologies, modeling techniques, and technologies for earthquake, windstorm, and multi-hazard risk reduction. Research conducted using NHERI supports two federal interagency programs: the National Earthquake Hazards Reduction Program and the National Windstorm Impact Reduction Program.

During FY 2015 and FY 2016, NHERI was established by NSF through eleven cooperative agreements:

- Network Coordination Office (NCO) at Purdue University,
- Cyberinfrastructure (CI) at the University of Texas at Austin,
- Computational Modeling and Simulation Center (SimCenter) at the University of California, Berkeley,
- Twelve-Fan Wall of Wind at Florida International University,
- Large-Scale, Multi-Directional, Hybrid Simulation Testing Capabilities at Lehigh University,
- Large Wave Flume and Directional Wave Basin at Oregon State University,
- Geotechnical Centrifuges at the University of California, Davis,
- Large, High-Performance Outdoor Shake Table at the University of California, San Diego,
- Boundary Layer Wind Tunnel, Wind Load and Dynamic Flow Simulators, and Pressure Loading Actuators at the University of Florida,
- Large, Mobile Dynamic Shakers for Field Testing at the University of Texas at Austin, and
- RAPID Facility at the University of Washington.

Major Multi-User Research Facilities

The NCO serves as the national and international scientific leader, community focal point, and network-wide coordinator for NHERI governance and community-building activities. Key activities include convening the governance groups, working with the Council of Awardees to develop consensus-based policies and procedures for NHERI and the annual Council work plan, implementing the facility scheduling protocol to provide user access to the experimental facilities, leading development of a community science plan, running NHERI-wide education and community outreach programs, and building strategic partnerships. The NHERI awardees and the natural hazards engineering community work together, through governance and awardee activities, to establish a shared vision for NHERI, set natural hazards engineering research and education agendas and priorities, and make NHERI a value-added and productive research infrastructure.

The CI awardee serves as the integrator for enabling NHERI to be a virtual organization for the natural hazards engineering community, by providing an array of information, resources, and services, including the definitive NHERI website; data repository (Data Depot); software service delivery platform with computational modeling, simulation, and educational tools; collaboration tools; access to high performance computing resources; and user training and support. The CI awardee also establishes and implements the NHERI-wide cybersecurity plan with all NHERI awardees.

The SimCenter is developing a portfolio of computational modeling and simulation software and educational modules that reflects a balance of community-prioritized, new capabilities for earthquake, wind, and multi-hazard engineering research and education. The SimCenter’s tools will be integrated into the CI awardee’s software service delivery platform.

The experimental facilities provide well-maintained and fully functioning facilities, services, and staffing to enable earthquake engineering, wind engineering, and post-disaster, rapid response research requiring experimental work and data collection. Data generated by these experimental resources and their users are archived and shared in the publicly accessible NHERI Data Depot.

Along with direct operations and maintenance support for NHERI awardees, NSF provides separate support for research to be conducted at the NHERI experimental facilities through ongoing research and education programs. The support for such activities is primarily provided through the Engineering for Natural Hazards (ENH) core research program in the Civil, Mechanical and Manufacturing Innovation (CMMI) division in the Directorate for Engineering (ENG). The ENH program supports fundamental research in single and multi-hazard engineering involving experimental and computational simulations at the NHERI facilities, addressing important challenges in mitigating the impact of natural hazards on constructed civil infrastructure. With the aim of integrating research and education, NHERI engages students through on-site use of experimental facilities, telepresence technology, experimental and simulation data, and computational resources. Coordinated by the NCO, starting in FY 2017, NHERI awardees also will run an annual Research Experiences for Undergraduates (REU) program and a Summer Institute.

Total Obligations for NHERI

(Dollars in Millions)

	FY 2016	FY 2017	FY 2018	Estimates ¹				
	Actual	(TBD)	Request	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Operations and Maintenance	\$13.00	-	\$11.75	\$12.50	\$12.00	\$12.00	\$12.00	\$12.00

¹ Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in FY 2019.

Management and Oversight

- NSF Structure: The NSF program officer for NHERI is located within ENG/CMMI. The Office Head of the Large Facilities Office in the Office of Budget, Finance and Award Management provides advice and assistance.
- External Structure: Each NHERI awardee is led by a principal investigator (PI), who is responsible for the overall award operations. The NCO awardee coordinates NHERI governance and network activities. Governance is comprised of the following groups: (a) a Council, which consists of the PI of each NHERI award, to provide collective and coordinated leadership for NHERI as a national facility, (b) Network Independent Advisory Committee, with diverse representation from the broad scientific and engineering communities served by NHERI, to provide independent external guidance and advice to the Council, (c) User Forum, consisting of representatives from the broad scientific and engineering communities served by NHERI, and (d) Council-identified committees, comprised of internal awardee staff and/or users, to advise the Council on community priorities and needs for NHERI.
- Reviews: NSF will provide oversight to NHERI awardees through cooperative agreements. Individual and joint awardee operations and activities will be reviewed through quarterly and annual project reports submitted by awardees and site visit reviews conducted by NSF. Site visit reviews will include the following:
 - Site visit merit reviews:
 - Annually for NCO, CI, and SimCenter awardees;
 - For EF awardees: Up to four facilities will receive site visits each year.
 - NSF Business Systems Review, for each awardee, to be conducted within the first two years of the award.

Renewal/Competition/Termination

In FY 2010, NSF supported two studies to assess the need for earthquake engineering experimental and cyberinfrastructure facilities beyond 2014, as described in the Dear Colleague Letter NSF 10-071.¹⁵ One study, a workshop held by the National Research Council on the Grand Challenges in Earthquake Engineering Research, was completed in FY 2011; and the second study was completed in FY 2012. These studies provided input to NSF for the determination of support for future earthquake engineering research infrastructure beyond FY 2014. The plan to support a smaller successor NEES (NEES2) during FY 2015-FY 2019 was presented to the National Science Board at their July 2012 meeting and described in the Dear Colleague Letter NSF 12-107.¹⁶ The plan would result in a lower annual operations budget, reflected in the \$8.0 million reduction from FY 2014 in the FY 2015 Budget Request, from \$20.0 million to \$12.0 million, and allow additional investments to be made in earthquake engineering research.

- In 2012, the National Institute of Standards and Technology and NSF jointly supported a workshop that led to a roadmap report for measurement science research and development for windstorm and coastal inundation impact reduction, which was published in January 2014.¹⁷
- In February 2013, NSF released solicitation NSF 13-537 to compete and operate NEES2 for FY 2015-FY 2019. Based on the merit review of proposals submitted under NSF 13-537, NSF made no award.
- Based on the above studies and report, NSF established the plan for NHERI in FY 2014. This led to the release of solicitations NSF 14-605 and NSF 15-598 to establish NHERI through two competitions. NHERI operations awards are supported for a five-year period. The NCO, working with the natural hazards engineering research and education community, is developing the NHERI Science Plan. ENG will separately support the development of a post-NHERI decadal science plan for natural hazards engineering research, education, and research infrastructure. NSF will use this decadal science plan as input for natural hazards engineering research infrastructure support beyond 2019.

¹⁵ <http://nsf.gov/pubs/2010/nsf10071/nsf10071.jsp>

¹⁶ www.nsf.gov/pubs/2012/nsf12107/nsf12107.jsp

¹⁷ www.nist.gov/customcf/get_pdf.cfm?pub_id=915541

Major Multi-User Research Facilities



The University of California, San Diego (UCSD) outdoor shake table allows large structures to be tested against seismic activity. Here, a wooden building shows damage after testing on the UCSD shake table.
Credit: UCSD/Jacobs School of Engineering