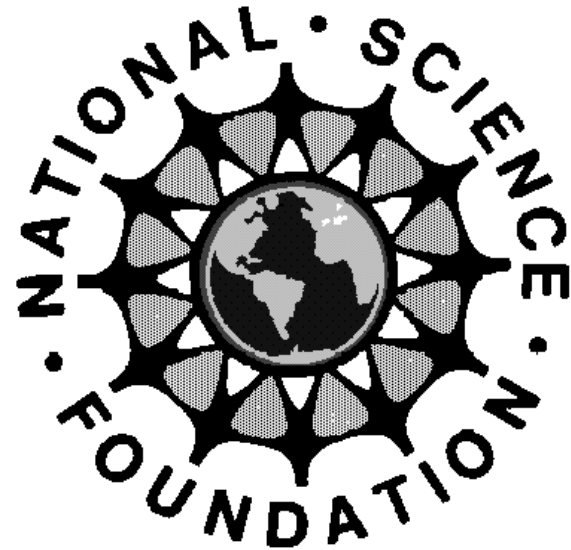


# **NSF PARTICIPATION IN THE NATIONAL EARTHQUAKE HAZARD REDUCTION PROGRAM (NEHRP)**



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**Division of Civil and Mechanical Systems**

**Directorate for Engineering**

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# **The National Science Foundation (NSF)**

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- **NSF was established by Congress in 1950 to “promote the progress of science; to advance the national health, prosperity and welfare; and to secure the national defense.”**
- **Over the past 55 years NSF has been the only agency charged to support and foster research on the frontiers of science, mathematics, engineering, and education.**
- **NSF research is basic, fundamental and intended to “push the envelope.”**
- **NSF does not engage in its own, in-house research.**



# NSF

## **Some Tools that have resulted from NSF funded research**

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- **Doppler Radar**
- **The Internet**
- **Web browsers and Google search engine**
- **American Sign Language**
- **Bar codes**
- **Magnetic Resonance Imaging (MRI)**
- **Computer-aided design (CAD) Systems**
- **Buckeyballs**
- **Nanotubes**
- **camcorders**



# Today's Major Topics

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## **Hazard and Disaster Research at the NSF**

**History**

**Breadth**

**Focus**

## **National Earthquake Hazard Reduction Program (NEHRP)**

**Nature of The Program**

**Nature of NSF Participation**

## **Components of NSF Participation**

**George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES)**

**Learning From Earthquakes**

**Earthquake Centers**

**Social and Economic Investigations**



# NSF Strategic Goals

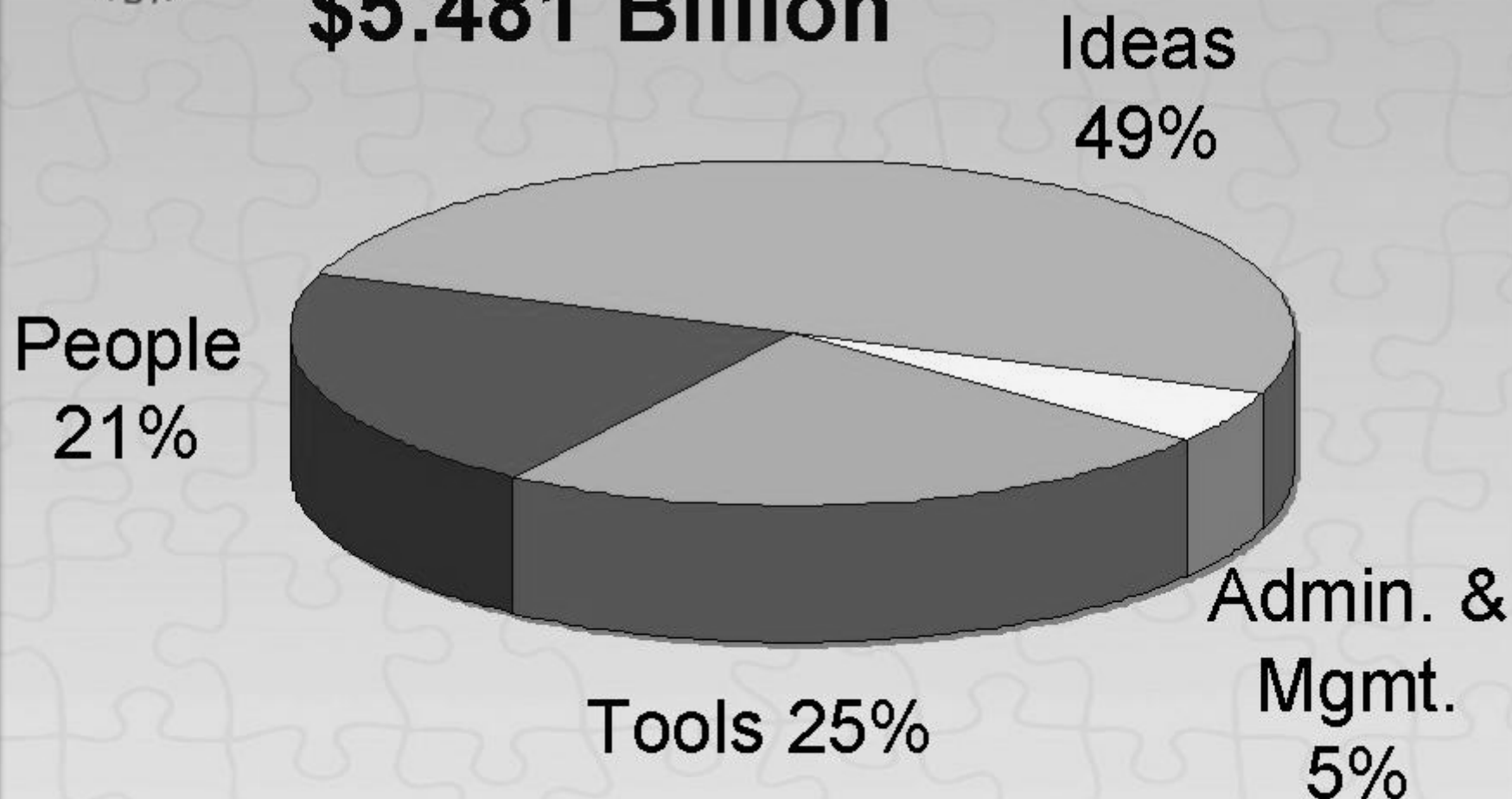
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- **People** - Diverse, internationally competitive and globally-engaged workforce
- **Ideas** - Discovery across frontiers, connected to learning, innovation and service to society
- **Tools** - Broadly accessible, state-of-the-art and shared research and education tools



# NSF FY 2004 Budget Request

**\$5.481 Billion**





# **Hazard and Disaster Research at NSF**

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- **Research on hazards and disasters goes back to the beginning of the foundation.**
- **Research has tended to focus upon the atmospheric sciences, the geosciences, engineering, and the social sciences.**
- **The focus of NSF research has been upon a large number of specific hazards and the engineering and social response to them.**



# NSF Hazards Coding

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CODE	HAZARD DESCRIPTIONS
C	GLOBAL, CLIMATE CHANGE, COASTAL IMPACTS
D	DROUGHT
E	ENVIRONMENTAL HAZARDS, CONTAINMENT, AVOIDANCE
F	FIRE (NATURAL)
H	HURRICANE, WIND, TORNADO, LIGHTNING; SEVERE WEATHER PREDICTION
I	SEA ICE, ICEBERGS, GLACIER-RELATED HAZARDS, POLAR
IN	INFECTIOUS DISEASE, INVASIVE SPECIES, BIOHAZARDS
IT	CYBER INFRASTRUCTURE AND PERFORMANCE IN CRITICAL EVENT/HAZARDS, ROBOTICS
L	LANDSLIDES, SUB-SEA SLIDES
M	BUILT ENVIRONMENT, MAN-MADE, TECH HAZARDS
Q	EARTHQUAKE
R	NATURAL DISASTER RESPONSE, RISK ASSESSMENT, DECISION
SF	SEISMIC PROCESSES, FAULT MECHANICS, CRUSTAL STRUCTURE
T	TSUNAMI
V	VOLCANISM, VOLCANIC-RELATED PROCESSES
W	FLOOD, SCOUR, HYDROLOGIC FORECASTING
X	METEOR IMPACT, EXTRATERRESTRIAL HAZARDS, SPACE WEATHER





# NSF Hazards Funding in FY04

Hazard Code	FY02 Hazards Funding by NSF Directorate							
	BIO	CISE	EHR	ENG	GEO	MPS	Polar	SBE
C	X			X	X	X	X	X
D	X	X		X	X			X
E	X		X	X	X	X		X
F	X				X			X
H	X	X	X	X	X	X		X
I					X			X
IN	X		X	X	X	X		X
IT		X		X	X			X
L				X	X	X		X
M		X		X	X	X		X
Q			X	X	X	X		X
R		X		X			X	X
SF			X	X	X	X	X	
T				X	X	X		
V	X			X	X		X	
W	X			X	X	X		X
X					X	X		

**Total in  
FY04  
estimated  
at over  
\$150  
million**



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# NEHRP



# NEHRP Mission

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*The mission of the National Earthquake Hazards Reduction Program is to develop and promote knowledge and mitigation practices and policies that reduce fatalities, injuries, and economic and other expected losses from earthquakes.*

The premise of the Program is that while earthquakes may be inevitable, earthquake disasters are not.



# NEHRP RESEARCH FOCUS

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- **NEHRP is organized to conduct basic and applied research on the mitigation of, preparedness for, response to, and recovery from earthquakes and related hazards.**
- **NEHRP is also charged with facilitating the transfer of relevant knowledge and technologies to practitioners and users of that material.**
- **NEHRP is charged by Congress to engage in research in three areas:**
  - **Geosciences**
  - **Engineering**
  - **Social and Economic Sciences**



# NEHRP STRATEGIC GOALS

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- **Goal A: Develop effective practices and policies for earthquake loss reduction and accelerate their implementation.**
- **Goal B: Improve techniques to reduce seismic vulnerability of facilities and systems.**
- **Goal C: Improve seismic hazard identification and risk assessment methods and their use.**
- **Goal D: Improve the understanding of earthquakes and their effects**



# NSF and NEHRP

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- NEHRP - National Earthquake Hazards Reduction Program - four agencies:
  - » National Science Foundation (NSF)
  - » United States Geological Survey (USGS)
  - » Federal Emergency Management Agency (FEMA)
  - » National Institute of Standards and Technology (NIST), designated lead agency
- NEHRP-related research is primarily funded through three NSF Directorates: ENG, GEO and SBE
  - » ENG annual investment has been about \$30 to 36 million
  - » GEO Investment has been about \$11 to 12 million
  - » SBE investment has been about \$1 million
- NSF is the only agency that funds research on social, economic and political issues, including emergency response
- NSF funds basic, fundamental, scientific research.



# **NSF AND NEHRP**

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- **NSF participation in NEHRP centers around the following activities:**

**NEES**

**Solicited and Unsolicited Research**

**Learning From Earthquakes**

**Earthquake Engineering Research Centers**

**Social and Economic Research**



# The George E. Brown, Jr. Network for Earthquake Engineering Simulation - NEES

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<http://www.eng.nsf.gov/nees>

- Earthquake engineering research equipment at 15 sites nation-wide
- Networked collaboratory <http://www.neesgrid.org>
  - Operating subsystem
  - Computational subsystem

All equipment and the collaboratory projects were completed by end of FY04

- Operation and use from FY05 through FY14 managed by the NEES Consortium  
<http://www.nees.org>



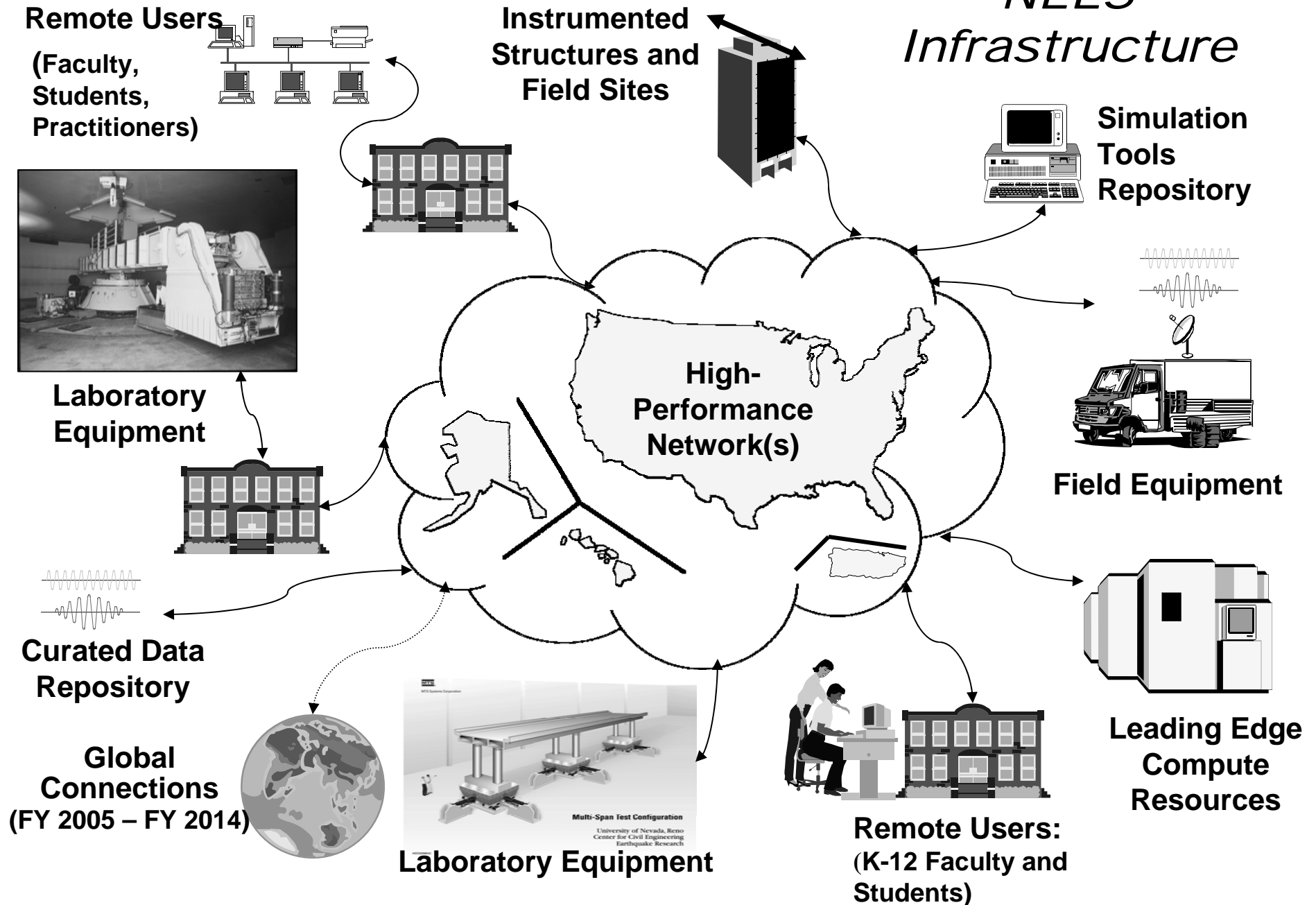


# What the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) Is

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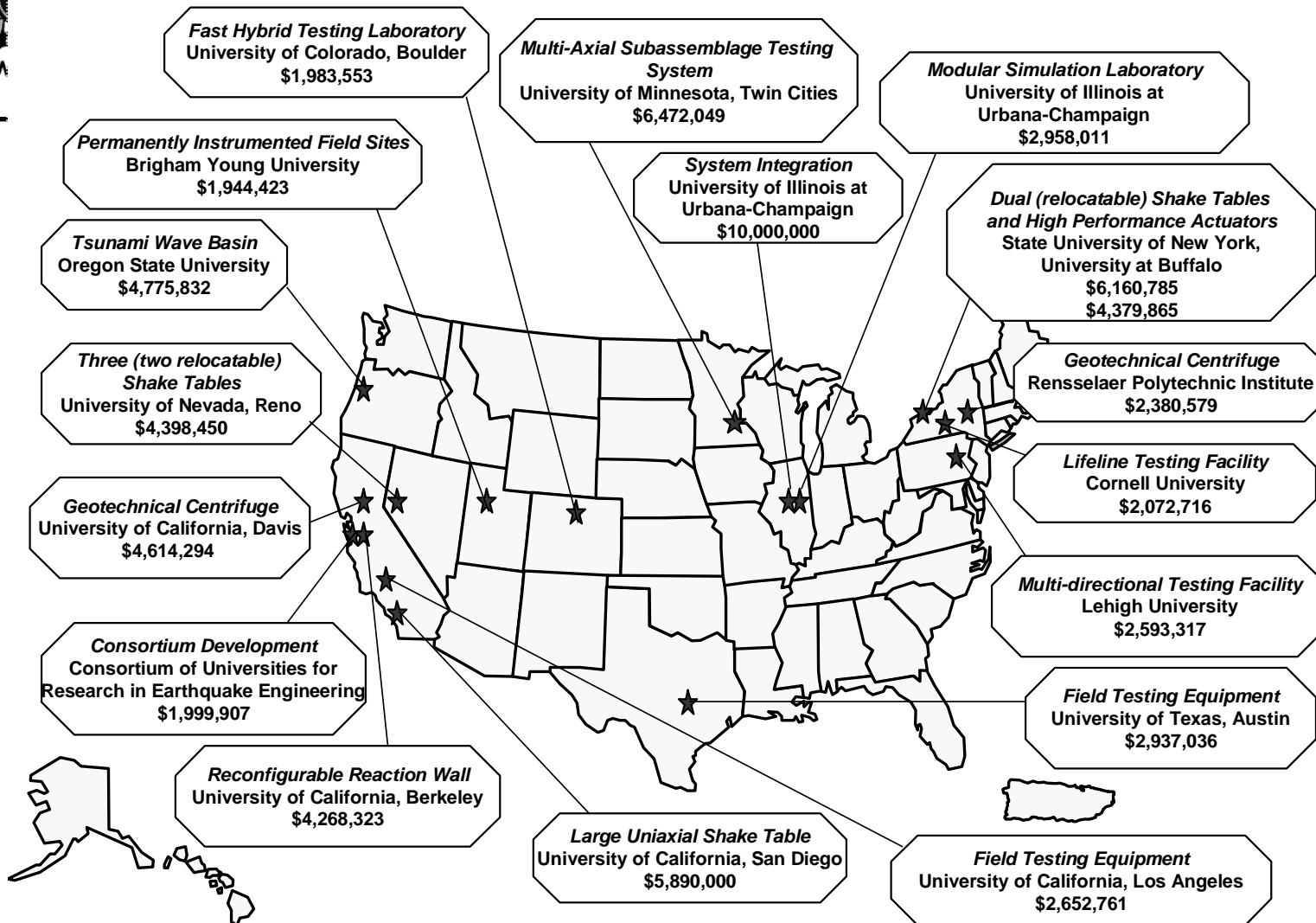
- An unprecedented, world-class shared infrastructure earthquake engineering research and education
- Interconnectivity of resources that is the heart of NEES
- A new *modus operandi* for research/development/tech transfer/ deployment
- New and unencumbered pathways to engage all in earthquake engineering research and education
  - Educators, students, practitioners, general public...
  - Telepresence, curated data repository, simulation tools...
  - Information exchanges/collaborations
- Platform for application and technology development

# *NEES Infrastructure*





## NEES Award Portfolio





# NEES Earthquake Engineering Testing Equipment and Facilities

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- Equipment Categories
  - Shake tables
  - Centrifuges
  - Tsunami/wave tank
  - Large-scale laboratory experimentation systems
  - Field Installations
- NEES Funding:
  - Equipment Investment total \$69.5 million
  - Network investment total \$10.3 million
  - NEES Consortium funded at \$2.0 million
  - NEES Maintenance of \$200 million FY05-14
  - NEESR Research funding at \$100 million FY05-14



# **NEESR – the Earthquake Engineering Research Program with NEES**

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- **FOUR TIERED PLAN FOR RESEARCH**
  - **Unsolicited Proposals to Study Important Problems**
  - **Individual Investigator Proposals**
  - **Small Group Proposals**
  - **Grand Challenge Proposals**
    - » **Multiple Investigator teams – larger awards to study larger problems**
    - » **Utilizing multiple laboratories or institutions**
    - » **Systems level studies**
    - » **The NEES System being utilized**



# NEES AND E-DEFENSE

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- **E-Defense is a large experimental system in Japan**
- **NEES and E-Defense are complimentary**
- **NEES has a variety of experimental facilities that can test small to near full scale specimens**
- **E-Defense competes this experimental system by permitting full scale tests to be conducted.**
- **Japan-USA-EC global collaboration**



# **SOLICITED AND UNSOLICITED RESEARCH**

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- **SOLICITED RESEARCH**

- NSF solicits research on a specific topic(s)
- Almost all of these are multidisciplinary in nature
- Example is Multidisciplinary Research on Critical Infrastructure and Related Systems (MRCIRS)
  - » Required research teams with at least one social scientist working with at least one engineer
  - » Focus was upon disaster mitigation, preparedness, response and/or recovery
  - » Modeling and predicting cascading failure of critical infrastructure systems and the societal impacts of such failure.



# **SOLICITED AND UNSOLICITED RESEARCH**

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- **UNSOLICITED RESEARCH**

- The heart and soul of NSF research activity
- Topics are determined by the investigators
- Engineering Examples:
  - » Performance-based earthquake engineering models and design criteria
  - » Effects of spatial variation of ground motion on extended lifeline structure
  - » Nonstructural component response
  - » Soil-foundation-structure interaction and design
  - » Post-earthquake safety, repair, and loss estimation
  - » Improved prediction of soil liquefaction, subsidence, lateral spreading, slope stability and site amplification
  - » Tsunami-wave/structure interactions





# LEARNING FROM EARTHQUAKES

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- **EERI program that sends engineers, geotechnical scientists and social scientists to the site of earthquakes around the world to gather ephemeral data.**
- **NSF has supported the program for over 30 years.**
- **Investigators have been sent to every major earthquake that has occurred over these three decades to gather important data that would be lost with time.**
- **2004 Indian Ocean Tsunami**
  - **LFE sent seven teams to six different countries**
  - **Over 80 investigators participated in the research**
  - **Findings are distributed free of charge**



# **EARTHQUAKE ENGINEERING RESEARCH CENTERS**

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- **MULTIDISCIPLINARY CENTER FOR EARTHQUAKE ENGINEERING RESEARCH (MCEER) at SUNY at Buffalo**
- **MID-AMERICAN EARTHQUAKE (MAE) CENTER at The University of Illinois**
- **PACIFIC EARTHQUAKE ENGINEERING RESEARCH (PEER) CENTER at the University of California at Berkley**
  - All of the centers are multidisciplinary in nature
  - They have specialized foci
  - The centers currently are in their eighth year of funding with NSF support extending through the tenth year.



# **SOCIAL AND ECONOMIC STUDIES**

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- **NSF UNDERTAKES MOST OF THE SOCIAL SCIENCE STUDIES THAT ARE MANDATED BY NEHRP.**
- **EXAMPLES OF RESEARCH IN THIS AREA:**
  - Improvisation and resilience in emergency Management
  - Household and community adoption of structural and non-structural mitigation measures
  - Urban search and rescue
  - Social vulnerability analyses
  - Comparative measures of community preparedness
  - Development of an evacuation management decision support system



# **SOCIAL AND ECONOMIC STUDIES**

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- **EXAMPLES (CONT.)**
  - **Prevalence and preparedness for conjoint natural and technological disasters**
  - **Tools and techniques for the technological integration of multi-hazard post-incident assessment**
  - **Comparative indicators of hazard vulnerability in urban areas**
  - **The effects of new urban developments compared to conventional low density developments on natural hazard mitigation**
  - **Warnings for short-fuse disasters**
  - **Protecting the nation's critical infrastructure from natural, technological and deliberate disasters**



# **Thank You So Very Much!**

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