

**National Earthquake Hazards Reduction Program  
Advisory Committee on Earthquake Hazards Reduction  
University of Memphis  
Memphis, Tennessee  
November 9–10, 2010**

**Meeting Summary**

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**Advisory Committee Members:**

Chris Poland, Chair	Degenkolb Engineers
Walter Arabasz*	University of Utah
James Beavers	University of Tennessee
Jonathan Bray	University of California, Berkeley
Richard Eisner	Fritz Institute
James Harris	J. R. Harris and Company
John Hooper	Magnusson Klemencic Associates
Michael Lindell	Texas A&M University
Jack Moehle	University of California, Berkeley
Thomas O'Rourke	Cornell University
Susan Tubbesing	Earthquake Engineering Research Institute
Anne vonWeller	Chief Building Official, Murray City, Utah
Yumei Wang	Oregon Department of Geology and Mineral Industries
Brent Woodworth	Global Crisis Services, Inc.
Mark Zoback	Stanford University (SESAC ex-officio liaison)

\*not in attendance

**NEHRP ICC Member-Agency Representatives and NIST Support:**

Shyam Sunder	NIST, Engineering Laboratory Director, ACEHR Designated Federal Official
Jack Hayes	NIST, NEHRP Director
Edward Laatsch	FEMA
Joy Pauschke	NSF
David Applegate	USGS
Tina Faecke	NIST, NEHRP Secretariat
Michelle Harman	NIST, NEHRP Secretariat
John Filson	USGS, NEHRP Secretariat
Brian Garrett	BRI Consulting Group

**Guests:**

Bob Amato	Kentucky Energy and Environment Cabinet
Robert Bauer	Illinois State Geological Survey
Oliver Boyd	USGS
Jim Cobb	Kentucky Geological Survey

Anisa Como	Mid-America Earthquake Center
Art Frankel	USGS
Greg Hempen	URS Corporation
Stephen Horton	Center for Earthquake Research and Information
Richard Howe	Structural/Seismic Risk Consultant
David Johnston	Arkansas Geological Survey
Joseph Koester	U.S. Army Corps of Engineers
Chuck Langston	Center for Earthquake Research and Information
Natasha McCallister	USGS
Steve McDuffie	U.S. Department of Energy
Nathan Moran	Center for Earthquake Research and Information
Alisa Nave	Central United States Earthquake Consortium
Bob Paullus	Barter & Associates
Shahram Pezeshk	University of Memphis
Gary Patterson	Center for Earthquake Research and Information
Phyllis Steckel	EQ Insight LLC
Joe Tomasello	The Reaves Firm
Zhenming Wang	Kentucky Geological Survey
Jim Wilkinson	Central United States Earthquake Consortium
Rob Williams	USGS
Mitch Withers	Center for Earthquake Research and Information
Phil Yen	Federal Highway Administration

## Summary of Discussions

### I. Opening Remarks and Overall Program Reporting

#### I. A. Review Meeting Goals and Agenda

Chris Poland, chair of the Advisory Committee on Earthquake Hazards Reduction (ACEHR), welcomed attendees to the meeting, reviewed ACEHR's duties as specified in its charter, and summarized the meeting agenda. Noting that several scheduled speakers were from federal agencies that, although not participants in the National Earthquake Hazards Reduction Program (NEHRP), are nevertheless involved in important related earthquake risk reduction activities, Poland stated that ACEHR recognizes these agencies' involvement and has encouraged their collaboration with NEHRP. Poland asked all ACEHR members and guests in attendance to introduce themselves.

#### I. B. Welcome and Opening Remarks

Shyam Sunder welcomed the attendees on behalf of Patrick Gallagher, director of the National Institute of Standards and Technology (NIST) and chair of the NEHRP Interagency Coordinating Committee (ICC). Sunder reported that NIST is currently recruiting candidates for the position of deputy director of NEHRP. In addition, NIST recently hired Eric Letvin as director of the agency's Disaster and Failure Studies Program. Letvin will work with NEHRP Director Jack Hayes as well as with the yet-to-be-hired leader of NIST's National Windstorm Impact Reduction Program research and development efforts.

Sunder noted the important role that ACEHR plays in advising the ICC and the agencies participating in NEHRP. The agencies look to ACEHR for an independent, expert, consensus voice on issues important to NEHRP. Sunder welcomed the participation of the invited speakers and other guests, but cautioned that the focus of the meeting was on communication among ACEHR members and that a period of time had been set aside on the agenda for comments from the public.

### **I. C. Meeting Logistics**

Jack Hayes welcomed the participation of Jack Moehle as the newest member of ACEHR. Hayes also reviewed the meal arrangements that had been made for committee members and pointed out some of the materials included in the meeting notebooks provided to all members.

## **II. Mid-America Earthquake Hazards and Current Building Codes**

### **II. A. Overview of the University of Memphis Center for Earthquake Research and Information (CERI)**

CERI Director Chuck Langston welcomed ACEHR to the University of Memphis and presented an overview of CERI. He described the center's roles as a state agency, as part of the university, and as part of the Advanced National Seismic System (ANSS). He also spoke about CERI's facilities, personnel, partners, and funding, as well as about some of the events planned for the New Madrid Bicentennial (the 200th anniversary of the great New Madrid earthquakes of 1811 and 1812). Copies of the presentation slides that Langston displayed were included in the meeting notebooks provided to committee members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

An ACEHR member asked about the seismic network monitored by CERI for the central region of ANSS, specifically what network facilities are located in St. Louis. Langston referred the question to a CERI staff member in attendance, who reported that the network includes eight urban strong motion stations in St. Louis that are operated by St. Louis University.

### **II. B. Overview of the Central United States Earthquake Consortium (CUSEC)**

CUSEC Executive Director Jim Wilkinson presented an overview of the consortium. He described the organization's partnership approach and its organizational links to FEMA's headquarters and regional earthquake mitigation staff and to the emergency management agencies and earthquake programs within the consortium's member states. He discussed CUSEC's goals relating to public awareness, mitigation, multi-state response and recovery planning, and the application of research, and described some of the consortium's related projects and activities. He also commented on the low level of earthquake mitigation prevailing in the region and some of the challenges involved in addressing that issue. Copies of the presentation slides that Wilkinson displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

A committee member asked about the availability of information on the costs and benefits of earthquake mitigation, which could be used to incentivize mitigation in the region. Wilkinson responded that the information now available is dated and that new studies are needed based on a consensus approach.

In response to a question about the seismic risk modeling being used for planning in the region, Wilkinson explained how a consensus approach was used to develop and select a risk modeling methodology for the states in the New Madrid Seismic Zone (NMSZ). The modeling was performed by the Mid-America Earthquake (MAE) Center using FEMA's HAZUS loss-estimation software. Wilkinson anticipates that the data generated through this modeling effort could be used for the next 5 to 10 years.

A member inquired about how well states in the region are supporting their earthquake program managers in terms of program staffing and funding. Wilkinson replied that it is challenging for the programs to obtain sufficient funding from their state governments. He praised FEMA for reestablishing a funding mechanism dedicated to state earthquake programs, but noted that the new program so far has less funding to distribute than did its predecessor.

Ed Laatsch, who was representing FEMA at the meeting, responded to a question about whether states are currently required to match all or part of the funds that FEMA annually awards to state earthquake programs. He noted that since NEHRP is still operating under its 2004 congressional reauthorization, state matching is currently not required. The new reauthorization under consideration in Congress contains a 50% state matching requirement, but allows for exceptions due to economic hardship. Should that requirement be enacted, Laatsch indicated that FEMA would probably grant exceptions for the next year or two because of the recession.

A member asked whether state earthquake programs in the region are receiving funding from the U.S. Department of Homeland Security (DHS), apart from that being awarded by FEMA. Wilkinson indicated that, although state programs do work with other DHS components, those components have not been a significant source of funding for the earthquake programs.

Wilkinson asked Robert Bauer of the Illinois State Geological Survey to speak to the committee briefly about the recent earthquake-related activities of the Association of CUSEC State Geologists. Bauer said that association members have been providing seismic hazard mapping assistance for CUSEC and FEMA in connection with FEMA's ongoing New Madrid catastrophic planning project. They have also been involved in state earthquake response planning efforts, in planning for post-earthquake clearinghouses, and in the activities of the CUSEC State Transportation Task Force.

## **II. C. Earthquake Hazard Assessment for Mid-America (Kentucky Geological Survey)**

Jim Cobb, Kentucky state geologist and director of the Kentucky Geological Survey, spoke to the committee about assessing the earthquake hazard in the NMSZ. The thrust of his remarks was that the seismic design maps promulgated for the Central United States in the NEHRP Recommended Seismic Provisions documents, and the U.S. Geological Survey (USGS) National Seismic Hazard Maps on which the design maps are based, have for years overstated the

earthquake hazard present in the NMSZ. He described how this characterization of the earthquake hazard has impeded economic development in Kentucky, referencing a letter sent to NEHRP by the Paducah-Area Community Reuse Organization, and urged that the NEHRP design maps be modified to correct this inaccurate characterization. Copies of the presentation slides that Cobb displayed, and the letter that he referenced, were included in the meeting notebooks provided to ACEHR members and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

In response to GPS data presented by Cobb showing that crustal deformation is much less in the intraplate NMSZ than in California's plate-boundary region, an ACEHR member cautioned that deformation may not accurately reflect the seismic strain present in intraplate areas. Another member asked whether there are statistics showing how economic development has been impeded over the past decade in NMSZ localities due to the seismic hazard assessments. Cobb responded that letters citing adverse economic impacts have been sent to NEHRP. A member asked whether there have been any econometric studies of these impacts, and Cobb answered none had been carried out. Cobb said that he did not know the answer to a follow-up question about whether the high hazard assessment has impeded mitigation in the region (i.e., whether the hazard is perceived to be so high that mitigation is regarded as futile).

A member commented that the hazard level shown in the NEHRP design maps does not appear to be as high or overstated as Cobb has found in the USGS seismic hazard maps. Economic development officials have told Cobb, however, that corporations often make decisions about where to locate new facilities based on the first information they see, which is typically the USGS seismic hazard maps. Cobb stated that he does not question the science behind the USGS maps, noting that the Kentucky Geological Survey uses similar inputs for its hazard maps. He does, however, think that the way that USGS has chosen to display its hazard-assessment output does not convey a reasonable characterization of the hazard in the NMSZ.

## **II. D. Earthquake Hazard Assessment for Mid-America (U.S. Geological Survey)**

USGS Seismologist Art Frankel spoke to the committee about the evidence and processes used by USGS in developing the national seismic hazard maps, in particular the portions of those maps covering the NMSZ. He summarized evidence showing the NMSZ to be a repeating, large-magnitude source of seismic activity, and described the open, consensus-building approach followed in interpreting and characterizing this evidence. He stated that more research is needed to understand the recent GPS findings that have fueled the controversy over the seismic hazard level, noting that those data are still subject to multiple interpretations and are outweighed, in the consensus view of experts convened by USGS, by the 4,000 years of geologic and historic evidence of repeated large earthquakes in the region. He emphasized that while USGS makes the seismic hazard maps, the NEHRP design maps are developed by engineers in the Building Seismic Safety Council using the USGS hazard maps. Copies of the presentation slides that Frankel displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

A committee member asked whether USGS has examined the potential impact of the seismic hazard on lifelines in the region. Frankel said no, reiterating that USGS is only involved in assessing the earthquake hazard, not the risks associated with the hazard. Asked to describe in

more detail the process involved in developing the national seismic hazard maps, Frankel noted that the process is repeated every 5 to 6 years and that it always includes open, regional workshops, including one for the central and eastern states.

A member observed that the level of seismic hazard that designs are required to protect against is related to the size of the earthquake return period, and that society must decide what return period is most appropriate to use based on perceptions of risk and prevailing beliefs about what is prudent. Others observed that the issue of return periods and their associated hazard curves is being resolved by the new, risk-targeted approach that has been adopted for creating the NEHRP design maps. The maps included in the latest (2009) edition of the NEHRP Recommended Seismic Provisions were created using this new approach, and these maps are being incorporated into the ASCE 7-10 standard and the next (2012) edition of the *International Building Code* (IBC).

## **II. E. Mid-America Earthquake Scenario**

Anisa Como, from the MAE Center at the University of Illinois, presented an overview of the methodology used and findings produced in the MAE Center's Phase II earthquake impact modeling study. This project examined the impact that NMSZ earthquakes could have in the Central United States, and was one of the most comprehensive and rigorous earthquake impact studies ever undertaken. The best available input data were analyzed using FEMA's HAZUS loss-estimation software and other state-of-the-art tools. The modeling was based on a hypothetical, magnitude 7.7 rupture involving all three segments of the NMSZ. It produced a range of detailed estimates on likely damage to general buildings, essential facilities, transportation and utility systems, and other critical infrastructure, as well as on casualties, debris generation, and economic losses. Copies of the presentation slides that Como displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

An ACEHR member asked whether the study has included any analyses of the investments in mitigation that would be required to significantly reduce the expected losses. Como explained that the primary modeling tool used in the study, HAZUS, does not have the capability to perform such analyses. The MAEViz software tool, which was used for some of the modeling related to transportation and utilities, does have this capability. The MAE Center has used MAEViz to perform such analyses, but because this work has been done primarily for private companies, Como did not include the resulting data in her presentation.

Another member asked about what outreach has been done to disseminate the findings of the study. Como explained that this multiyear study was conducted in conjunction with FEMA's ongoing New Madrid catastrophic planning project, and that the MAE Center has disseminated study findings through the state and regional planning workshops that FEMA has convened for that project. Como was asked whether the MAE Center has considered redoing the modeling using a magnitude 7.2 earthquake scenario in place of the worst-case, magnitude 7.7 quake. She responded that the magnitude 7.7 event was selected because FEMA needed the worst-case scenario for the catastrophic planning project.

A member asked whether the study has examined the impacts that could result from a series of several major earthquakes occurring over a period of months, similar to what happened in 1811 and 1812. Como said that because HAZUS was unable to model multiple events, this was not incorporated into the study. Another member asked whether different times of day were considered for the scenario earthquake. Como said that three different times were considered in the first phase of the study, and that 2:00 a.m. was selected because that was when the modeling indicated that damage and casualties would be the worst. In response to a question about why high casualties were expected in several areas far outside the worst-hit area, such as in southern Mississippi and Indianapolis, Como explained that a number of modeling variables, such as building heights and population density, could account for those findings.

## **II. F. ACEHR Discussion of Mid-America Earthquake Hazard Issues**

The committee began with a discussion related to the MAE Center's Mid-America earthquake scenario study. A member wondered about the extent to which these kinds of earthquake findings are being or could be integrated into regional multihazard impact assessments. Noting that the details of loss findings can be important for planning, a member suggested that the methodologies used for loss-estimation studies should be vetted through the same sort of consensus-building process as USGS uses for the national seismic hazard maps. Several members commented on the size of the losses found in the MAE Center study, some thinking them unexpectedly high and others too low, given the prevalence of problem buildings in the region.

Committee members then discussed their overall impressions of the earthquake hazard in the region and how it is being assessed. One observed that there is no evidence that seismic strain release is going to differ in the future from what it has been in the past. Consequently, during the next few thousand years, the region is going to continue to be an area where large earthquakes occur. Others commented on the need for studies that can support response and recovery planning for a sequence or cluster of multiple earthquakes, since that has been the pattern of seismic activity in the past.

There was broad participation among committee members in exploring how ACEHR or NEHRP should respond to the concerns expressed by Jim Cobb about the adverse economic impacts of the prevailing seismic hazard assessment. It was suggested that perhaps NEHRP could help to establish a dialogue aimed at addressing these concerns. There were questions about the nature of the problem—whether it had to do with the scientific assessment or how that assessment is being presented or perceived, and whether earthquake hazard perceptions really are influential in determining where corporations decide to locate new facilities. Members observed that if such perceptions were strongly influential, California would not have the industry it has today. Questions also were raised about whether and by how much the perceived overstatement of the hazard is incrementally affecting building designs, construction costs, and mitigation efforts in the region.

There was general agreement that if ACEHR and NEHRP could help establish a more coherent message about seismic hazards in the NMSZ, confusion could be reduced amongst the public, which is of particular importance as the New Madrid Bicentennial approaches. A member

suggested that ACEHR could begin by developing its own consensus on the scientific assessment of the hazard, including how the available GPS findings should be characterized.

## **II. G. Memphis Area Building Codes—Introduction**

Bob Paullus, of Barter and Associates in Memphis, contextualized the controversy over the level of seismic hazard in the NMSZ, and summarized the current status of building codes in Memphis, in Tennessee, and in surrounding states. He noted that the controversy has persisted over the past 30 years in Memphis, which is the largest metropolitan area on the southern end of the NMSZ. Area builders, engineers, and building owners commonly believe that the incremental costs of seismic-resistant design and construction provide nothing in return since there are no living memories of large earthquakes in the area. Knowledge of NEHRP's new risk-targeted design maps has not yet disseminated through the local design community, and the current IBC design maps are commonly perceived to require designing for a once-in-2,500-year event.

Arkansas and Kentucky currently have statewide building codes based on IBC 2006, while Illinois and Missouri have not adopted statewide codes. Tennessee recently adopted IBC 2006 statewide, but exempted Memphis (Shelby County), where the code is currently based on IBC 2003 with an amendment (Appendix L) adopted in 2007. The amendment allows engineers to use, as an alternative to the design maps in IBC 2003, an earlier NEHRP map that uses 10% probability of exceedance in 50 years. However, the state recently notified Memphis and Shelby County that if they do not update their code to IBC 2006, they will lose their exemption from the statewide code requirement. As a stopgap measure, Memphis now plans to stay with IBC 2003 but eliminate the Appendix L amendment and replace the reference to ASCE 7-05 with a reference to ASCE 7-10. Over the coming year, the city plans to review IBC 2009 with an eye toward adopting it in place of IBC 2003. Paullus noted that the Insurance Services Office (ISO) recently dropped its rating for Memphis by 5 points, which has increased local property insurance premiums, because the prevailing building code is currently out of date.

## **II. H. Memphis Area Building Codes—Perspectives (Tomasello)**

Joe Tomasello, senior manager of engineering for The Reaves Firm in Memphis, provided his perspective on the controversy over the level of seismic hazard in Memphis. His arguments were substantially in agreement with those expressed earlier by Jim Cobb. He believes that the USGS national seismic hazard maps overstate the hazard in the Memphis area, and that the design maps in IBC 2003 and IBC 2006 require a level of seismic protection (against an event expected to occur once every 2,500 years) that is comparable to that enforced in California and excessive for Memphis. He contended that seismic design in the Memphis area should be based on hazard maps showing peak acceleration with 10% probability of exceedance in 50 years (a return period of 500 rather than 2,500 years). He stated that use of the 2% probability of exceedance in 50 years as required by IBC 2003 adds substantially to the cost of new buildings, from 10%–15% for residential and commercial structures to as much as 35% for buildings designed for industrial use. Copies of the presentation slides that Tomasello displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).



A member commented that, because there have been multiple swarms of earthquakes that have included magnitude 7 or greater events over the last few thousand years in the Central United States, and because these swarms have recurred after several hundred years rather than several thousand years, he does not feel that the prevailing seismic hazard assessment is hyping the threat. Instead, it is pointing to events that have and will occur and are prudent to prepare for. Tomasello responded that in characterizing the threat and establishing associated design standards, it is reasonable to consider the perspective of building owners who have to allocate limited construction resources among multiple potential threats, and who have to consider the comparative likelihood that each hazard will impact the building over its useful life of 50–100 years.

### **II. I. Memphis Area Building Codes—Perspectives (Howe)**

Richard Howe, a structural engineering and seismic risk consultant in Memphis, presented his perspective on seismic hazard assessment and building codes in the Memphis area. He argued that because building codes are concerned with public safety, their development and adoption are (and should be) the province of quasi-democratic processes involving consensus building among experts and decision making by government officials. The development of seismic code provisions encompasses assessing the seismic hazard, developing engineering standards that can mitigate the hazard, deciding what code provisions will ensure an appropriate level of public safety, and adopting those provisions.

Howe traced the latest national model code development process, from the 2008 USGS seismic hazard maps and 2009 NEHRP Recommended Seismic Provisions to ASCE 7-10 and IBC 2012. He argued that, instead of questioning the hazard assessments and design guidelines that emerge from this cyclical, quasi-democratic process, the community should focus on defining, measuring, and learning how to optimize the incremental costs of the new code provisions. He discussed how the incremental costs associated with seismic-resistant design and construction (the seismic cost premium) can be defined, how to evaluate and build local consensus on how large those cost premiums should be, and how developers, engineers, and builders can optimize the premiums in their building projects. If this “enlightened” approach to optimizing costs is used, Howe contended that the seismic cost premium for typical building construction should be no more than 1% of the total project construction contract cost. Copies of the presentation slides that Howe displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

### **II. J. Observations from 2010 Darfield, New Zealand Earthquake**

USGS Geophysicist Oliver Boyd described the setting, characteristics, and impacts of the magnitude 7.1 earthquake that occurred in New Zealand on September 4, 2010. He summarized and presented images of the damage incurred due to ground shaking, liquefaction, and ancillary events. In response to a question about construction standards in New Zealand, Boyd said that his impression was that the building codes in force there are comparable to U.S. model building codes. Copies of the presentation slides that Boyd displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

An ACEHR member who, like Boyd, traveled to New Zealand following the quake, shared several of his observations. He noted that industrial storage racks performed poorly in the earthquake. Racks collapsed en masse in two major food storage centers serving the Christchurch area (a city of 375,000 located about 40 kilometers [km] from the epicenter). Two weeks after the event a large landslide blocked a rail line and highway, which hampered the replenishment of food stocks in Christchurch. Relatively few fires erupted in the quake's aftermath (only eight in Christchurch), perhaps because electricity tripped out and natural gas is not used much there. About 5% of Christchurch was impacted by liquefaction, which primarily occurred along watercourses. The city has about 1,600 km of water and sewer lines, and out of those, about 40 km of water lines and 70 km of sewer lines need to be replaced due to damage incurred in the earthquake. The shallow water table is making repairs very expensive and has compounded the damage initially caused by the quake.

## **II. K. ACEHR Member Discussion, Questions, and Identification of Issues Facing Earthquake Risk Mitigation in Mid-America**

Poland asked the committee whether the presentations on Memphis building codes indicate that something different needs to be done in regard to NEHRP and IBC seismic provisions. A member responded that something different has been done—the new risk-targeted design guidance adopted in the 2009 NEHRP Recommended Seismic Provisions and ASCE 7-10, and that will be promulgated through IBC 2012, should resolve much of the codes controversy in the NMSZ. That the controversy has not yet diminished, and that the USGS seismic hazard maps are apparently being misinterpreted in the region, indicates that NEHRP needs to do a better job of disseminating information about the hazard maps and the new design provisions.

A member commented on the fact that losses from the 2010 Darfield, New Zealand earthquake were so much lower than those that have been projected for a large NMSZ event. She observed that there are substantial differences between the residential building stocks in the two regions, and that consequently, a different impact should be expected were a New Zealand-type earthquake to occur in the NMSZ.

A member remarked that while considerable research in the physical sciences and earthquake engineering has gone into the development of the hazard maps and seismic code provisions, little research has been conducted on the economic impacts of this guidance. He suggested that surveys and econometric studies can and should be conducted on the impact that this guidance has on employer movement into and out of at-risk areas and on the prices of residential, commercial, and industrial buildings. Another member noted that good data on the costs of seismic-resistant design and construction have not been generated since the 1970s or 1980s.

An observer pointed to Tomasello's contention that in this region, seismic design can be based on a 10% rather than a 2% probability of exceedance in 50 years. What ACEHR thinks about such design differences and the tradeoffs they entail is very important. A member observed that no one seems to be objecting to the approach that USGS has applied in developing the seismic hazard assessment for the region. What is unclear, and needs to be explained, is how that hazard characterization was translated into the design guidance contained in the current IBC provisions. In addition, more education needs to be provided about the new risk-targeted design approach coming in IBC 2012.

It was noted that in New Zealand, the code uses 10% in 50 years for residential structures and 5% and 2% for other categories of structures. This illustrates, as does the controversy in Memphis, that this issue has not been uniformly settled, and that there remains room for fresh approaches on how to characterize appropriate seismic design thresholds.

A member stated that the upcoming New Madrid Bicentennial events will focus attention on the earthquake hazard in the Central United States, and that people will be looking for information. This could provide a platform for the dissemination of extreme positions. It would be beneficial for NEHRP to develop a policy on the earthquake threat facing the region and make that available to the public during the bicentennial. If this is not done, the information vacuum could be filled by extreme viewpoints. Discussion followed about whether this policy statement should be prepared by ACEHR or by the NEHRP agencies with feedback from ACEHR. One member advised that the message needs to be proactive, and should be issued by an entity, like ACEHR, that the public will perceive as independent and authoritative. An observer cautioned that, while NEHRP plays an important role in supporting the development of design guidance, it is NEHRP's partners in the private sector that establish design standards and promulgate model code provisions. A member countered that it is within the purview of NEHRP and ACEHR to ensure that seismic design guidance and the hazard assessment that underlies it is accurately understood and correctly interpreted.

Regarding the content of a NEHRP policy message, a member advised that rather than focusing on arcane details about the likelihood or frequency of worst-case events, the message should emphasize what everyone can agree on. And that is that the region is likely to experience repeated earthquakes of at least moderate size and that, unless building codes and other measures are strengthened to more effectively mitigate the risks posed by these events, a tremendous amount of damage is likely to result. Other members agreed that in addition to building codes, retrofitting and preparedness, response, and recovery planning are also important. A member noted that in the 1990s, New Zealand successfully implemented lifeline retrofit efforts by conducting a major study involving all major lifeline stakeholders. The discussion concluded with an acknowledgement that controversy does exist in the region and that the New Madrid Bicentennial offers an opportunity to provide information that will help quell, rather than further stoke, this controversy.

### **III. NEHRP and Non-NEHRP Agency Activities Related to Earthquake Safety in Mid-America**

#### **III. A. DOE Earthquake Research and Implementation Activities**

Steve McDuffie, a seismic engineer in the Office of the Chief of Nuclear Safety at the U.S. Department of Energy (DOE), presented an overview of the department's activities related to earthquake risk reduction. He said that after taking a leadership role in the 1990s in seismic hazard characterization and design, the department's involvement declined. In recent years, DOE's Chief of Nuclear Safety (CNS) has been working to again strengthen the department's performance in natural phenomena hazard mitigation. In 2007 the CNS established the Seismic Lessons-Learned Panel, which meets every 6–8 months to provide recommendations for DOE.

The CNS and DOE's Office of Nuclear Energy have partnered with the Electric Power Research Institute and the U.S. Nuclear Regulatory Commission to support the Central and Eastern United States Seismic Source Characterization (CEUS-SSC) for Nuclear Facilities Project, and these same partners, along with USGS, are supporting the Next Generation Attenuation Relationships for Central and Eastern North America (NGA-East) project. DOE sites are required to review their natural phenomena hazard assessments every 10 years, and consequently there are several site-specific probabilistic seismic hazard analyses under way or upcoming. Copies of the presentation slides that McDuffie displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

A member asked about DOE's plans for reconciling its 1020-series standards with national consensus standards. McDuffie explained that while the 1020 seismic standards will remain in effect for existing facilities, DOE plans for new seismic design work at its facilities to be governed by ASCE 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*. There was also some discussion about how DOE's seismic hazard assessment work relates to that of USGS. McDuffie said that for the Central and Eastern United States, DOE will be using the findings coming out of the CEUS-SSC project. Art Frankel of USGS commented that his agency is communicating with, although not collaborating in, the CEUS-SSC project, and will decide how much of the CEUS-SSC findings to use in the next update of the national seismic hazard maps. He noted that the same is true for the NGA-East project and its findings.

A member asked McDuffie about his perception of the potential synergy that could result from greater cooperation between DOE and NEHRP. He indicated that increased communication could be synergistic and that he is willing to help bring that about. He suggested that the major difference between the two entities is that DOE is focused exclusively on high-hazard facilities, while NEHRP is not as concerned with those. A member countered that NEHRP is concerned about the seismic safety of all of the built environment.

### **III. B. USACE Earthquake Research and Implementation Activities**

Joseph Koester, geotechnical and materials community of practice lead for the U.S. Army Corps of Engineers (USACE), presented an overview of USACE's involvement in earthquake risk reduction activities. That involvement primarily concerns dams and levees in seismically active areas, including the seismic hazards that they face, their probable and demonstrated seismic performance, and how they can be designed, constructed, or modified so as to ensure appropriate levels of performance. He reported that most of USACE's current guidance documents related to seismic design, construction, and evaluation are either new or under revision. He also described some of the major laboratory equipment that USACE has available for seismic testing. He noted that while USACE used to have an earthquake research and development budget of \$2 million per year (during 1998–2001), it currently has no funding allocated for this purpose. Copies of the presentation slides that Koester displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

Several members asked about the use of USACE's centrifuge and shake table equipment for seismic testing projects. Koester responded that these facilities are open to all and do coordinate with similar sites maintained by other agencies; however, recently the USACE facilities have not been used very much for seismic projects.

### **III. C. FHWA Earthquake Research and Implementation Activities**

Phil Yen, the seismic hazard mitigation program manager at the Federal Highway Administration (FHWA) Office of Infrastructure, Research and Development, presented an overview of FHWA's earthquake-related research efforts. These efforts have largely focused on bridges because many of the Nation's bridges are more than 50 years old. Yen summarized the origins and key provisions of current seismic design criteria for bridges, and described FHWA's Riska due to Earthquake Damage to Roadway Systems (REDARS) 2 seismic risk analysis tool for highway systems, the agency's seismic retrofitting guidance for bridges, and its recent advanced research efforts conducted through MCEER and the University of Nevada, Reno. Part of the MCEER work involves the development of common design principles and methodologies that can be used across all natural hazards that affect bridges. Copies of the presentation slides that Yen displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

A member asked about the current status of the REDARS seismic risk analysis system. Yen answered that it is still in use as a loss-estimation tool, enabling transportation officials to determine which bridges are most likely to sustain serious damage in earthquakes. In response to a question about the size of FHWA's earthquake research budget, Yen indicated that, although it varies somewhat from year to year depending on the number and stage of current projects, it averages about \$3–\$4 million per year. The federal Highway Trust Fund is the source of this funding.

A member asked Yen to explain more about how the current seismic performance criteria for bridges came to be adopted by the American Association of State Highway and Transportation Officials (AASHTO) in 2007. Yen said that in 2002, AASHTO rejected proposed design criteria based on a 3% probability of exceedance in 75 years (2,500-year return interval). While some states were prepared to accept those criteria, others, including states in the NMSZ, rejected them because they would impact too many bridges and be too complicated to implement. After several years of further study under the National Cooperative Highway Research Program, compromise criteria were proposed and accepted. Current criteria call for normal bridges to be designed to the life safety performance objective considering a seismic hazard with a 7% probability of exceedance in 75 years (1,000-year return period). Bridge owners (states) can establish higher performance objectives for bridges that they consider important (e.g., the Golden Gate Bridge in California). Asked whether consideration is being given to raising the performance objective for normal bridges from life safety to operational, Yen answered that until states are prepared to accept the higher costs involved (as much as 15% to 20% of overall project costs), this is not likely to happen.

### **III. D. USGS NEHRP Mid-America Activities**

Rob Williams of the USGS Geologic Hazards Team described the agency's involvement in the New Madrid Bicentennial activities, which officially kick off in St. Louis in February 2011 and

extend through the National Earthquake Conference in Memphis in May 2012. USGS involvement includes the development of new urban hazard maps for Evansville, IN, and the eastern half of the St. Louis metropolitan area; participation in FEMA's May 2011 National Level Exercise; and the preparation of earthquake simulation data, animated ground motion videos based on the simulations, and other USGS information products. Williams also reviewed recent USGS internal and external seismic research initiatives focused on the Central United States, and discussed the progress that is being made and the work yet to be done in understanding the seismicity of this region. Copies of the presentation slides that Williams displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

In connection with USGS participation in the New Madrid Bicentennial, a member asked about what information the agency will be providing about aftershocks. Williams stated that USGS has and will be communicating that if an event like those in 1811 and 1812 were to occur again, it is expected that it would be accompanied by a vast set of aftershocks, including magnitude 6, 5, and 4 earthquakes.

### **III. E. FEMA NEHRP Mid-America Activities**

Ed Laatsch, chief of FEMA's Building Science Branch (located within the Risk Reduction Division of FEMA's Federal Insurance and Mitigation Administration), presented an overview of FEMA's current and upcoming NEHRP-related activities in the Central United States. He reviewed FEMA's involvement in the New Madrid Bicentennial events, including the efforts of FEMA's National Level Exercise work groups, the training being conducted through the National Earthquake Technical Assistance Program, FEMA's support for the Central United States Earthquake Consortium (which, in turn, is organizing the bicentennial kick-off event and the Great Central U.S. ShakeOut), FEMA's participation in a weeklong preparedness and mitigation outreach road trip leading up to the kick off, and the agency's work with the Applied Technology Council in developing videos and other mitigation outreach materials for the bicentennial.

Laatsch also described the impact of FEMA's Earthquake State Assistance Program in the region; FEMA's new FY 2011 contracting vehicles for outreach, awareness, and training activities; and the role of mitigation before and after earthquakes. Copies of the presentation slides that Laatsch displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

Laatsch and Jim Wilkinson responded to a member's inquiry about planning for multi-jurisdictional resource allocation in the New Madrid catastrophic planning initiative. They indicated that how limited resources are to be allocated among the states and FEMA regional offices involved is a major focus of this planning. A member asked about what happened to FEMA's lifelines mitigation programming. Laatsch responded that FEMA was forced to eliminate those efforts due to funding shortages. He noted that there have been continual requests for renewed lifelines funding within FEMA, but that these efforts have been unsuccessful due to the prevailing budgetary constraints. Another member commented that states have appreciated the restoration of the Earthquake State Assistance Program.

### **III. F. NIST NEHRP Mid-America Activities**

NEHRP Director Jack Hayes described two new NIST research and development projects focused on the seismic performance of buildings in the Central and Eastern United States. One project, being conducted by NIST staff in cooperation with a committee of the American Institute of Steel Construction, is studying interrelationships between design requirements for wind and earthquake loading. Over the next 2 years, this pilot study will focus on archetypical structural-steel moment and braced frames in seismically active areas where strength requirements may be controlled by wind. The premise is that it may be possible to reduce seismic detailing requirements in such contexts.

The other project is a cost-benefit analysis of codes and standards for earthquake-resistant construction in selected regions of the United States. The first phase of this study is focused on Mid-America. Up to eight archetypical low- and mid-rise commercial and residential buildings will be designed (the selected buildings will include at least one “essential” building and may reflect actual buildings recently constructed in the region) under three separate levels of seismic criteria: no seismic design criteria, criteria currently in use in the region, and criteria from the 2009 NEHRP Recommended Seismic Provisions and ASCE 7-10. Site conditions will be representative of those found in the region. Detailed construction costs will be estimated and compared across the three design levels for each building. This phase of the study, to be completed in 2–3 years, is being conducted for NIST by the NEHRP Consultants Joint Venture. Copies of the presentation slides that Hayes displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

There was considerable discussion about the cost-benefit project. Participants noted that this study is unlike past efforts to develop nationally applicable designs and costs; rather, it will focus on developing data that accurately represent construction costs in the region, for building designs that are prevalent in the region. In response to an inquiry about what other regions may be examined in subsequent phases of the project, Hayes indicated that potential candidates include areas in South Carolina and Utah. Hayes agreed that this study is more cost analysis than cost-benefit analysis; it will not attempt to quantify benefits in terms of casualties or damage avoided, but rather will express benefits as the levels of protection assumed to be afforded to buildings and occupants by the levels of design criteria under study. A member noted that it will be important to retain the data from this project so that follow-on studies may be able to explore benefits further. There was general agreement that this study is needed and that it can contribute significantly to resolving persistent cost issues relating to seismic design in the Central United States and other regions.

### **IV. General Discussion of Issues and Recommendations for Addressing Earthquake Safety in Mid-America**

The committee brainstormed potential content for a written statement that could be issued by ACEHR in support of the New Madrid Bicentennial. Suggestions discussed included encouraging greater collaboration among NEHRP agencies in the formulation of their bicentennial communications; proactively addressing seismic risk (based on a less-than-worst-case seismic hazard) and seismic design needs in the region; discussing what has been and

should be learned about the socioeconomic impacts of seismic hazard characterizations; educating engineers and building owners about the design guidance that is forthcoming under ASCE 7-10 and IBC 2012, and its implications for the persistent wrangling over the level of seismic design that is appropriate in Mid-America; showing sensitivity to the concerns of those enmeshed in this wrangling; and supporting local building officials in their efforts to update seismic building codes in the region. Several members cautioned that there are multiple audiences to be considered, including the design and construction community, emergency managers, and the public.

Jack Hayes noted that FEMA, NIST, and USGS met with area design professionals last year and have since begun work on a joint white paper about seismic hazards and risks in the region and their implications for seismic design. David Applegate added that for the bicentennial, USGS plans to issue a new edition of the “Putting Down Roots in Earthquake Country” publication designed for residents of the Central United States.

There was considerable discussion about the agencies’ joint white paper and whether it would serve the need for a statement from NEHRP for the bicentennial. Hayes noted that the agencies were planning to issue the paper in the form of a peer-reviewed journal article (perhaps published in *Spectra*). There was concern about this being able to be completed in time for the kick off of the bicentennial in February, and whether the statement needs to be branded as coming from NEHRP or ACEHR. An observer noted that if the white paper is issued by NEHRP, a public comment period would be required and the statement would first need to be reviewed and approved by the NEHRP ICC (presumably at its next meeting in January).

There was general agreement that any statement needs to be available in time to distribute to the kick-off speakers and to regional elected officials in conjunction with the kick off. It was also agreed that the statement should comprise two to three pages of text that addresses earthquake hazards, response, mitigation, and enforcement in the region. Hayes noted that the white paper does not address response and recovery and that adding such content would extend the time required for interagency review of the statement. It was suggested that perhaps the agencies’ white paper or a statement abstracted from it could be accompanied by an ACEHR statement that addresses response and recovery.

## **V. General NEHRP Issues, Program Status Reports and Plans, and ACEHR 2011 Report Planning**

### **V. A. NEHRP Office Report on Current Status and Budgets**

NEHRP Director Jack Hayes summarized recent developments related to the management and coordination of NEHRP activities by the program office at NIST. He updated the committee on the status of the NEHRP reauthorization legislation awaiting action in the U.S. Senate, on the status and size of the program budgets requested by NEHRP’s participating agencies for FY 2011, on ACEHR membership changes, on NEHRP’s annual reports for Congress, on personnel developments in the program office, on the National Research Council’s delay in completing the new 20-year U.S. Earthquake Implementation Roadmap, and on the development of the online NEHRP Clearinghouse. Hayes also described the ongoing efforts to reengage the Interagency Committee on Seismic Safety in Construction and the U.S. Japan Cooperative Program in



Natural Resources Panel on Wind and Seismic Effects. He also reiterated that NIST has hired a director for its Disaster and Failure Studies Program, and that NIST plans for this individual to speak to ACEHR at its next meeting. Copies of the presentation slides that Hayes displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

A member asked whether the workshop that NIST sponsored on what can be learned from the February 2010 Chile earthquake focused on lifelines or other areas in addition to structures. Hayes said that the workshop, and the research projects that it spawned, have focused on the implications of that event for U.S. model building codes. This is the area in which NIST felt that it could make the greatest impact on behalf of the U.S. taxpayers who fund NIST's limited earthquake research and development budget. Chile uses building codes that are comparable to U.S. model codes, and consequently, the February earthquake was in effect a real-world test of those codes, and issues related to reinforced concrete construction stood out among the reconnaissance findings.

Hayes was also questioned about NEHRP's progress in planning future earthquake risk reduction research related to lifelines. He said that it now appears that NEHRP should be able to sponsor a lifelines planning workshop in 2012. A workshop on the coordination of post-earthquake reconnaissance is being planned for 2011 in response to the expected shift of that responsibility from USGS to NIST, and the program cannot afford more than one workshop in a single year. A member also asked about progress in getting non-NEHRP agencies involved in coordinating, collaborating, and sharing with NEHRP. Hayes said that he had spoken with Phil Yen and other FHWA representatives about further cooperation with that agency, and is pursuing contacts with the Nuclear Regulatory Commission. In addition, David Applegate, who represents USGS on the NEHRP Program Coordination Working Group and chairs the Subcommittee on Disaster Reduction (SDR) for the President's National Science and Technology Council, has briefed the SDR on NEHRP's desire to engage with other agencies concerned with earthquake risk reduction.

## **V. B. USGS Report on Current Activities and Implementation of ACEHR Recommendations**

David Applegate, senior science advisor for earthquake and geologic hazards at USGS, addressed the committee about the recent activities and accomplishments of the USGS Earthquake Hazards Program (this program serves as the USGS component of NEHRP). He summarized the work of the USGS/USAID Earthquake Disaster Assistance Team in Haiti and USGS involvement in post-earthquake work in Chile. He spoke about USGS support for the successful 2010 Great California ShakeOut, how USGS is using the American Reinvestment and Recovery Act funding that it allocated to the earthquake program, the upcoming work planned for the agency's multi-hazards demonstration project, USGS involvement in FEMA's New Madrid Bicentennial National Level Exercise, recent USGS support for the U.S./Japan Earthquake Research Panel, the newly enhanced version of the USGS PAGER (Prompt Assessment of Global Earthquakes for Response) tool, and the new USGS online applications that help engineers use data from the national seismic hazard mapping project for earthquake-resistant design. Copies of the presentation slides that Applegate displayed were included in the

meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

A member asked about whether earthquake early warning, which is one of the topics being pursued through the USGS Southern California Multi-Hazards Demonstration Project, requires different equipment than that required for seismic monitoring. Applegate explained that it requires densification of the California Integrated Seismic Network. Other members inquired about progress in obtaining ground motion data from Chile for the February 2010 earthquake, and Applegate responded that USGS continues to work on locating and arranging access to these data.

### **V. C. FEMA Report on Current Activities and Implementation of ACEHR Recommendations**

Ed Laatsch, chief of FEMA's Building Science Branch, presented an overview of FEMA's recent and ongoing activities and accomplishments related to earthquake risk reduction. He described FEMA's recent pilot project with the State of Utah, under which local engineers volunteered to use FEMA's rapid visual screening (RVS) methodology to assess the seismic vulnerability of a sample of the public schools located along Utah's Wasatch Front. The engineers also pilot-tested FEMA's Rapid Observation of Vulnerability and Estimation of Risk (ROVER) tool, which enables digital collection of RVS data via smartphones or other handheld devices.

Laatsch also described some of FEMA's new earthquake-related publications and training resources, and the agency's participation in the most recent Code Change Hearings and Final Action Hearings convened by the International Code Council for the next editions of the IBC, *International Residential Code*, and *International Existing Building Code*. He updated ACEHR on FEMA's State Earthquake Assistance Program, the ongoing QuakeSmart initiative, and FEMA's NEHRP-related priorities for FY 2011. He also identified the personnel who carry out FEMA's NEHRP activities; they include some, but not all, of the staff in the Building Science Branch at FEMA headquarters (the branch also has other, non-NEHRP responsibilities), as well as regional earthquake program managers assigned to FEMA's regional offices (these individuals often have other duties in addition to their earthquake work). Copies of the presentation slides that Laatsch displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

A member asked for further information about FEMA's QuakeSmart partnership with ServiceMaster. Laatsch explained that FEMA has been talking with the firm about providing earthquake mitigation training for ServiceMaster employees, which they could apply in their homes as well as in company facilities. Another member requested that at the next ACEHR meeting, Laatsch describe how FEMA's NEHRP work in the Building Science Branch fits within and relates to other earthquake-relevant components of FEMA and DHS. In response to another inquiry, Laatsch encouraged committee members with suggestions about FEMA's NEHRP-related priorities to bring those ideas to him so that he can evaluate how they might fit within the agency's statutory responsibilities under NEHRP.

#### **V. D. NIST Report on Current Activities, Including Status of In-House and Extramural Research Projects, and Implementation of ACEHR Recommendations**

Jack Hayes presented an overview of recent developments in NIST's Earthquake Risk Mitigation Research and Development (ERM R&D) Program. Hayes described how the ERM R&D program, which is one of three programs within the NIST Engineering Laboratory's Disaster-Resilient Structures and Communities Strategic Goal area, has been guided by the ATC-57 report and will be guided by the new roadmap for U.S. seismic risk mitigation implementation activities that is being prepared by the National Research Council. He described the in-house and extramural resources that NIST has acquired to conduct ERM R&D, and explained how specific research topics have been identified through staff participation in key committees and reconnaissance efforts and reviews of research-planning documents.

Hayes updated the committee on the objectives and status of nearly 20 ERM R&D projects that are currently in progress, either in-house at NIST or externally through the NEHRP Consultants Joint Venture. He also described the earthquake-related grants issued by NIST under the American Reinvestment and Recovery Act. Copies of the presentation slides that Hayes displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

A member commented that NIST has done an amazing job in building internal and external research programs that are producing useful information. Shyam Sunder, director of the Engineering Laboratory at NIST and the ACEHR Designated Federal Official, noted that this year the U.S. Department of Commerce has selected Hayes to receive its Silver Medal Award.

#### **V. E. NSF Report on Current Activities and Implementation of ACEHR Recommendations**

Joy Pauschke, program director for George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) Operations and Research at the National Science Foundation (NSF), briefed the committee on recent NEHRP- and earthquake-related activities at NSF. She described NSF's support for post-earthquake research related to the January 2010 Haiti earthquake, funded through the agency's ongoing, "standing" awards and its RAPID award mechanism. This and potential future research related to the Haiti event were discussed in an April 2010 NSF webcast and at a recent workshop funded by NSF. The agency is also funding a 5-year project to develop the Continuously Operating Caribbean GPS Observational Network (COCONet), and helped fund the March 2010 Workshop on Rebuilding for Resilience: How Science and Engineering Can Inform Haiti's Reconstruction.

Pauschke also described the research funded following the February 2010 Chile earthquake through NSF's standing and RAPID awards, and the August 2010 NSF-funded workshop held to discuss this and potential future research related to this event. Recent accomplishments at the Southern California Earthquake Center (SCEC), which is jointly supported by NSF and USGS, were highlighted by Pauschke. These included the center's simulation of a magnitude 8.0 rupture on the southern San Andreas fault, which modeled wave propagation throughout the region.

Pauschke reported on recent, NSF-funded upgrades of specific NEES laboratory equipment and the NEES cyber-infrastructure, as well as on the 2010 NEES Research Experience for Undergraduates program, research conducted in NEES facilities, and reports from NEES-sponsored workshops. She also described the two studies under way, conducted by the National Academy of Sciences and the Science and Technology Policy Institute, that will help shape NSF's support for earthquake engineering research infrastructure after 2014 (when NSF's support for NEES is scheduled to end). NSF expects to announce its plans for NEES support in the fall of 2012. Copies of the presentation slides that Pauschke displayed were included in the meeting notebooks provided to ACEHR members, and are available on the NEHRP website at [www.nehrp.gov/committees/nov\\_2010.htm](http://www.nehrp.gov/committees/nov_2010.htm).

Members had several questions related to the two studies on future support for research infrastructure. Pauschke explained that the studies are focusing on grand challenges because those are the types of projects that are large enough to need (and justify continuing support for) a nationwide network of testing laboratories and associated cyber-infrastructure. The requirements of future grand challenge projects will shape what sort of network NSF is willing to support. This does not mean, however, that the post-2014 network can be used only for grand challenges; it simply means that because grand-challenge projects are the largest or most complex projects foreseen, the facilities they require should shape the maximum capabilities of any future network. A member asked why, given this renewed focus on grand challenges, the NEES research program stopped funding grand-challenge projects. Pauschke responded that grand-challenge funding was discontinued because ACEHR had recommended more NSF support for curiosity-based awards. A member countered that ACEHR had intended for additional curiosity-based support to supplement, rather than supplant, NSF's support for grand challenges.

#### **V. F. Continued Discussion of Issues and Recommendations for Addressing Earthquake Safety in Mid-America**

ACEHR Chair Chris Poland led a continuation of the committee's discussion begun earlier (see section IV above) about the purpose, content, and authorship of a statement that could be issued by NEHRP or ACEHR in support of the New Madrid Bicentennial. Poland suggested that NEHRP develop a statement, 2–3 pages in length, by the end of the year, which could be reviewed and edited by ACEHR via conference call in early January, then given to the ICC for their review and approval. Shyam Sunder pointed out that if the statement is authored by the NEHRP agencies, it would have to be approved by the ICC first, then made available for public comment (including comments from ACEHR). He noted that ICC approval may be able to be expedited by circulating an electronic copy to the agency heads for their individual review and approval.

Poland reiterated that the statement is intended to convey the position of NEHRP on what should be done in Mid-America, and that it should distinguish between and address both seismic design and planning for preparedness and response. Jim Wilkinson suggested that perhaps the statement could be folded into the Presidential proclamation that will be issued for the bicentennial. Several members commented on the audiences to which the statement could or should apply, and there seemed to be general agreement that, while individual parts of the statement may be more relevant to particular audiences, the statement as a whole should address the entire population of the region.

Poland displayed a list of the topics that committee members had earlier suggested be addressed in the statement. The committee reviewed, discussed, and made modifications to these topics. One observer commented that while some of the suggested content seemed appropriate for the public, some appeared directed at NEHRP and what it should be doing in the region.

### **V. G. Public Input Period**

A period of up to 30 minutes was made available during which guests could address the committee. Due to the number of individuals who had registered to make comments, each speaker was limited to 3 minutes.

Greg Hempen, a geophysicist working in the St. Louis office of the URS Corporation, observed that people in the region have been confused by conflicting scientific hypotheses about the seismic hazard. He said that it is important that any statement issued by NEHRP reach members of the banking and insurance communities as well as building designers and developers. He noted that three states in the New Madrid region do not have statewide building codes, which could be addressed in the statement. He recommended that federal experts participate in public meetings held for the bicentennial. He also recommended that some of the EarthScope monitoring stations that are migrating through the region be made permanent.

Rob Williams of USGS observed that in his latest research paper, Seth Stein suggests that while the faults responsible for the 1811–1812 earthquakes may be shutting down, they may have loaded nearby structures. Consequently, Williams believes that Stein would agree that there is seismic hazard present in the Central United States, and that it would therefore be possible for NEHRP to develop a consensus statement on the hazard. Williams noted the importance of completing the urban seismic hazard planning projects in the region, and of encouraging other federal agencies to cooperate in the bicentennial. He also said that NIST's cost-benefit analysis of seismic design should be very helpful for the region. This latter comment was echoed by Oliver Boyd of USGS, who stated that the analysis should be extremely beneficial for efforts to upgrade building codes in the Memphis area.

Phyllis Steckel of EQ Insight LLC told the committee that there are people in the region who would be willing and able to help the committee develop the planned statement in support of the bicentennial. She noted that the 2011 Earthquakes Mean Business seminar in St. Louis will be the 18<sup>th</sup> such meeting held annually. The continuing popularity of these sessions evidences area employers' interest in earthquake preparedness and seismic risk reduction.

Shahram Pezeshk, chair of the Department of Civil Engineering at the University of Memphis, thanked the committee for coming to the region. He noted the significance of both Memphis and Charleston (SC) in regard to seismic risks in the Central and Eastern United States. He emphasized that there is not a lack of knowledge in the Memphis area about the seismic hazard and seismic design.

Bob Paullus, of Barter and Associates in Memphis, also thanked the committee for holding this meeting in Memphis. He believes that the discussions will facilitate greater understanding among seismic design stakeholders in the area.

## V. H. Future ACEHR Meeting and 2010 Report Planning

Before adjourning the meeting, Chris Poland led a final committee discussion about the statement in support of the bicentennial, and about the next face-to-face ACEHR meeting. In regard to the statement, he suggested that ACEHR prepare a draft, review it via conference call in late December, and then ask the ICC to review it and consider it for release as a statement from NEHRP in support of the bicentennial. A member asked whether the entire draft would be intended for public consumption; Poland indicated that it would include a statement for the public as well as recommendations for NEHRP.

Poland again displayed the topics that the committee had developed for the statement in earlier discussions, and asked for volunteers to help with the writing for each topic. The table below lists each topic and the names of the committee members who volunteered to help write about it. Poland asked that drafts be sent to him for compilation, by December 1 if possible. The committee agreed to hold a conference call to review the statement on December 21 at 1:00 p.m. eastern time.

### ACEHR Recommendations for Inclusion in the Bicentennial Statement

Topic	ACEHR Members
1. Encourage collaboration/exchange of information	Woodworth
2. Advise NEHRP agencies to be proactive and speak with a unified voice—reach out to public officials, decision makers, and the public	Moehle, Poland
3. Need statement of risk with broad scientific and engineering professional acceptance	Arabasz, Bray, Wang
4. Recommend ASCE 7-10 design-level earthquake hazard	Beavers, Harris, Hooper
5. Emergency response plans (public and other planners) should address the likely and worse case	Eisner, Tubbesing
6. Support local officials trying to adopt the provisions (2009 IBC with ASCE 7, 2010 edition for EQ design)	Beavers, vonWeller
7. Show sensitivity to concerns expressed and outline important steps forward	O'Rourke, Wang
8. Sell owners/engineers on enforcement, including special inspections	vonWeller, Woodworth

Poland noted that the committee normally meets in person in February or March to work on its annual report to the ICC. Since the next report will be abbreviated and will need to be submitted by May 1, 2011, Poland suggested that it may be best to meet in mid-to-late March. He asked the committee for suggestions on what, other than the annual report, should be included in the agenda for that meeting. Members' suggestions included the following: a presentation from the director of NIST's Disaster and Failure Studies Program; an update on the NEHRP reauthorization legislation; a presentation from FEMA on how its NEHRP work in the Building Science Branch fits within and relates to other earthquake-relevant components of FEMA and DHS, and on how the Earthquake State Assistance Program is going; information about how ASCE 7-10 fits into the model code development process; and an update on progress in

developing ANSS (although it was pointed out that this is overseen by the Scientific Earthquake Studies Advisory Committee).

There was also some discussion about whether and which non-NEHRP agencies should be invited to the meeting. It was agreed that while some of the most relevant agencies had spoken to the committee already at this meeting, some agencies remain that would be beneficial to hear from.

Members also had a few suggestions regarding the content of the committee's next annual report. One noted that the report could clarify that ACEHR did not intend for its recommendation about increased support for curiosity-based research at NSF to cause the agency to end its funding for grand challenges. Another observed that the trends and developments section may need to incorporate developments flowing from the 2010 earthquakes in Chile and Haiti.