S. Hrg. 110–454

THE NEW MADRID SEISMIC ZONE: WHOSE FAULT IS IT ANYWAY?

HEARING

BEFORE THE

AD HOC SUBCOMMITTEE ON STATE, LOCAL AND PRIVATE SECTOR PREPAREDNESS AND INTEGRATION

OF THE

COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

DECEMBER 4, 2007

Available via http://www.gpoaccess.gov/congress/index.html

Printed for the use of the Committee on Homeland Security and Governmental Affairs

U.S. GOVERNMENT PRINTING OFFICE

40–505 PDF WASHINGTON : 2008

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2104 Mail: Stop IDCC, Washington, DC 20402–0001

COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS

JOSEPH I. LIEBERMAN, Connecticut, *Chairman*

CARL LEVIN, Michigan
DANIEL K. AKAKA, Hawaii
THOMAS R. CARPER, Delaware
MARK L. PRYOR, Arkansas
MARY L. LANDRIEU, Louisiana
BARACK OBAMA, Illinois
CLAIRE MCCASKILL, Missouri
JON TESTER, Montana

SUSAN M. COLLINS, Maine
TED STEVENS, Alaska
GEORGE V. VOINOVICH, Ohio
NORM COLEMAN, Minnesota
TOM COBURN, Oklahoma
PETE V. DOMENICI, New Mexico
JOHN WARNER, Virginia
JOHN E. SUNUNU, New Hampshire

MICHAEL L. ALEXANDER, *Staff Director*
BRANDON L. MILHORN, *Minority Staff Director and Chief Counsel*
TRINA DRIESSNACK TYRER, *Chief Clerk*

AD HOC SUBCOMMITTEE ON STATE, LOCAL, AND PRIVATE SECTOR PREPAREDNESS AND INTEGRATION

MARK L. PRYOR, Arkansas, *Chairman*

DANIEL K. AKAKA, Hawaii
MARY L. LANDRIEU, Louisiana
BARACK OBAMA, Illinois
CLAIRE MCCASKILL, Missouri
JON TESTER, Montana

JOHN E. SUNUNU, New Hampshire
GEORGE V. VOINOVICH, Ohio
NORM COLEMAN, Minnesota
PETE V. DOMENICI, New Mexico
JOHN WARNER, Virginia

KRISTIN SHARP, *Staff Director*
MICHAEL MCBRIDE, *Minority Staff Director*
AMANDA FOX, *Chief Clerk*

CONTENTS

Opening statements: Page
Senator Pryor 1

WITNESSES

TUESDAY, DECEMBER 4, 2007

Glenn M. Cannon, Assistant Administrator for Disaster Operations Directorate, Federal Emergency Management Agency, U.S. Department of Homeland Security 3
John R. Hayes, Jr., Director, National Earthquake Hazards Reduction Program, National Institute of Standards and Technology, U.S. Department of Commerce 5
David Applegate, Senior Science Advisor for Earthquakes and Geological Hazards, U.S. Geological Survey 7
David Maxwell, Director, Arkansas Department of Emergency Management and Vice Chair, Central United States Earthquake Consortium 15
Callen Hays, Crisis Management Coordinator, Memphis Light, Gas, and Water 17

ALPHABETICAL LIST OF WITNESSES

Applegate, David:
Testimony 7
Prepared statement 44
Cannon Glenn M.:
Testimony 3
Prepared statement 25
Hayes, John R., Jr.:
Testimony 5
Prepared statement with an attachment 35
Hays, Callen:
Testimony 17
Prepared statement 59
Maxwell, David:
Testimony 15
Prepared statement 51

APPENDIX

Background 63
Charts submitted by Mr. Cannon 65
"Concepts of Planning and Response to a Missouri Catastrophic Event (Earthquake) (Missouri State Emergency Operations Plan Annex Y)" submitted by Mr. Cannon 67
"Missouri Local Workshop Registration List" submitted by John Campbell, Acting Operations Branch Chief of The Missouri Emergency Management Director's Advisory Committee 86
Questions and Responses submitted for the Record from:
Mr. Cannon 94
Mr. Applegate 99
Mr. Hayes 100

THE NEW MADRID SEISMIC ZONE: WHOSE FAULT IS IT ANYWAY?

TUESDAY, DECEMBER 4, 2007

U.S. SENATE,
AD HOC SUBCOMMITTEE ON STATE, LOCAL, AND
PRIVATE SECTOR PREPAREDNESS AND INTEGRATION,
OF THE COMMITTEE ON HOMELAND SECURITY
AND GOVERNMENTAL AFFAIRS,
Washington, DC.

The Subcommittee met, pursuant to notice, at 2:40 p.m., in Room SD–342, Dirksen Senate Office Building, Hon. David Pryor, Chairman of the Subcommittee, presiding.

Present: Senator Pryor.

OPENING STATEMENT OF SENATOR PRYOR

Senator PRYOR. We will get underway here. I think we are all set up here now with our visuals. I want to thank the panel for being here and I apologize for being 5 or 10 minutes late; they called a vote on us right at 2:30 and I had to get over to the Capitol to vote.

Some of the Senators on the Subcommittee may be coming in later. We have a Commerce Committee markup and some action on the floor and some other things, so its a busy day. What I will do is I will leave the record open for a few weeks to allow Senators to ask questions. Panelists, if you could get us your responses back as quickly as possible, we would appreciate it.

Let me go ahead and welcome everyone here. I want to thank all of you for being here today for this hearing before the Ad Hoc Committee on State, Local, and Private Sector Preparedness and Integration. We are calling this hearing "The New Madrid Seismic Zone: Whose Fault is it Anyway?" a little bit of a play on words. I know you earthquake researchers get tired of that play on words, but we couldn't resist. We are talking about a very serious subject today, one that touches my State very directly, as you can see from the map, and that is the New Madrid fault line.

I want to welcome Dave Maxwell and thank him for being here. He is in the back of the room. He is on our next panel, but he is from my home State of Arkansas and we will give him the proper introduction in a few moments.

As most people who follow earthquakes in this country and understand the history of earthquakes in this country, in 1811 and 1812, a series of three very large earthquakes struck the New Madrid region. The earthquakes measured between 7.0 and 8.0 on the Richter scale. The earthquakes were so powerful that they changed

the course of the Mississippi River and the Mississippi River actually flowed backwards for some time. The tremors from the earthquakes could be felt as far away as 1,000 miles. In fact, there are recorded stories of church bells ringing in Boston because the ground was shaking in Boston, Massachusetts.

Today, we know a lot more about earthquakes than we did back in 1811 and 1812 and we can see the New Madrid quake zone and the fault line; it affects seven States: Arkansas, Mississippi, Tennessee, Missouri, Kentucky, Illinois, and Indiana. Science tells us that if there is a major earthquake on that fault line, that it could be worse than the earthquake that we could see in Southern California at some point that gets a lot more publicity and has a lot more notoriety, by the way, but this earthquake here is a very serious threat to the United States. Imagine every bridge along the Mississippi River on those maps going away, or imagine the levees breaking along not just the Mississippi River, but all the river systems there that are impacted here, you can look at locks and dams breaking, you can look at levees, which almost surely some of them would surely disintegrate or at least be greatly damaged with a major earthquake, it doesn't take long to understand how serious this challenge and this threat is.

Scientists estimate that, depending on how severe the earthquake might be, it may cost upwards of $500 billion to this country, and if you look at Hurricane Katrina, as terrible as it was, and we all know about the tragedy in Hurricane Katrina, that has cost the government $130 billion so far. So this one could far outscale the cost and the difficulty, the challenges that it would present this country.

Since 1812, we have escaped a catastrophe in the region, but the threat is real and I think it is essential that we assess the hazard, develop accurate response plans, and educate the public about the safety precautions that we all can take.

Today, we will hear from several Federal agencies about their role in preparing for and responding to an earthquake in the New Madrid Seismic Zone. All the agencies represented—FEMA, NIST, USGS—play an important role in research, mitigation, and response.

On the second panel, we will hear about the work being done at the regional and State level. Finally, we will discuss preparation efforts that critical infrastructure owners and operators in the region are taking.

Because there is so much we don't know about the earthquake hazard in this region and because the area has not suffered a major earthquake for almost 200 years, it is critical to bring attention to this topic. I hope we can work together to develop and maintain open lines of communication between all levels of government and our critical infrastructure and private sector partners.

And one more note before we go to our first panel. I know that a few years ago, FEMA did an analysis and looked at the biggest challenges that the country may face in natural disasters and they decided to do two major exercises in the middle part of the country. One was Hurricane Pam, which simulated a large hurricane. This was a couple of years before Hurricane Katrina. And the second one they never did, but they were supposed to. FEMA was sup-

posed to do a major exercise on the New Madrid earthquake. So it is my hope that, at some point, we put that back on the calendar. I know there is discussion for putting a major planning exercise together for 2011, which I think would be the 200 anniversary of the last earthquake. But anyway, I hope that we will consider making that a major and very regional effort.

So with that, what I want to do is introduce the panel. Our first witness will be Glenn Cannon, Assistant Administrator for the Disaster Operations Directorate at FEMA. Mr. Cannon is responsible for coordinating the development and execution of interagency plans for response operations in Presidential disaster and emergency declarations. He has an extensive background in public safety administration and has served in many leadership roles in the City of Pittsburgh.

The second witness will be Jack Hayes, Director of the National Earthquake Hazards Reduction Program at the National Institute of Standards and Technology. Mr. Hayes is responsible for overall program management, coordination, and technical leadership and facilitation of implementation of earthquake risk mitigation measures. Prior to joining the National Institute of Standards and Technology (NIST), Mr. Hayes was a leader of seismic and structural engineering research at the U.S. Army Research and Development Centers Construction Engineering Research Laboratory.

And our third witness on this panel is Dr. David Applegate, Senior Science Advisor for Earthquakes and Geological Hazards at the U.S. Geological Survey. Dr. Applegate is responsible for coordination of geologic hazards activities across the U.S. Geological Survey. He also chairs the National Science and Technology Council's Interagency Subcommittee on Disaster Reduction and is an adjunct faculty member of the University of Utah's Department of Geology and Geophysics.

So, Mr. Cannon, please proceed.

TESTIMONY OF GLENN M. CANNON,[1] ASSISTANT ADMINISTRATOR FOR DISASTER OPERATIONS DIRECTORATE, FEDERAL EMERGENCY MANAGEMENT AGENCY, U.S. DEPARTMENT OF HOMELAND SECURITY

Mr. CANNON. Thank you, Chairman Pryor, and thank you for the opportunity to discuss FEMA's Catastrophic Disaster Response Planning Initiative for a potential earthquake along the New Madrid Seismic Zone.

Successfully responding to the anticipated effects of a catastrophic disaster is one of the greatest challenges Federal, State, and local governments face. Recognizing this, FEMA has implemented a Catastrophic Disaster Response Planning Initiative designed to enhance disaster response planning activities by focusing attention on disasters that could immediately overwhelm existing local capabilities.

Working with our partners at every level of government, we are identifying high-risk areas, developing loss estimates, assessing response capabilities and the accompanying shortfalls, and developing comprehensive planning strategies to address these shortfalls

[1] The prepared statement of Mr. Cannon appears in the Appendix on page 25.

and enhance capabilities. This initiative also involves participation by the private sector, voluntary organizations, non-governmental organizations, academia, and members of the critical infrastructure sections. We are collaborating on a number of functional response topics with a focus on particularly high-risk regions, which are laid out in greater detail in my written testimony.

But today's hearing is focused on our efforts to improve overall capabilities to respond to and recover from a catastrophic New Madrid Seismic Zone earthquake. Our activities include identifying issues that cannot be resolved based on current capabilities and proposing recommended courses of action for decisionmakers.

Our New Madrid Planning Initiative focuses on a no-notice major earthquake in the central portion of the United States. Working with our partners, we have conducted risk assessments that show the wide-ranging impact an earthquake in this region would have. Estimates of total building loss alone exceeded $70 billion. Approximately 44 million people live in the New Madrid Seismic Zone area, with 12 million in the highest-risk areas. An earthquake would have a major impact on the economy, transportation, lifelines, and other factors of everyday life across this region and the entire country. Estimating losses is essential to decisionmaking at all levels of government. It provides a basis for developing mitigation, emergency preparedness, and response and recovery plans, policies, and capabilities.

We are working from the grassroots level up to carry out all aspects of planning for a New Madrid event. This includes using a scenario-driven plan development process with area-specific workshops in both urban and rural areas. The workshops bring together local, State, and Federal response operators with emergency planners and other subject matter experts to develop catastrophic response plans based on real world modeling. The resulting hazard-specific annexes will supplement existing base plans for response and recovery.

To date, local workshops and planning activities have been conducted in Arkansas, Indiana, Missouri, Illinois, Kentucky, and Tennessee, and workshops are scheduled in Mississippi and Alabama for early next year. Several States are also involved as potential host States to accept those evacuating areas hit by such a catastrophic earthquake. These States provided significant evacuee support following Hurricane Katrina. Being located in and near the New Madrid Seismic Zone, they would likely be called upon to assist evacuees.

As you can imagine, there are many operational, logistical, and victim assistance activities that we will all need to respond to in any catastrophic event. I am proud of the coordinated and integrated activities that we are taking to be prepared for responding to a major event. The New Madrid Seismic Zone Initiative offers significant benefits, such as greater cross-disciplinary and inter-disciplinary involvement in the planning, including examining economic stabilization and post-disaster redevelopment issues. In fact, the lessons learned from this initiative will be exported to other catastrophic planning venues across the Nation.

Administrator David Paulison noted recently that FEMA's mission is based upon the founding principles of this great Nation:

Protecting life, liberty, and the pursuit of happiness. The Founding Fathers banded together to create this Nation. In a similar fashion, we are banded together with our many partners to provide effective emergency management. None of us can or should try to do it alone. Working together, we can make sure that during the next catastrophic event, we have an integrated response system where all participants at all levels of government, the private sector, and non-governmental organizations understand their roles and responsibilities prior to the event occurring.

Together, we can also educate the public on their role during disasters. Government, even perfectly synchronized, cannot provide the entire response. All of our citizens need to participate in the emergency management process and take responsibility for their personal preparedness. A catastrophic disaster, whether in the New Madrid Seismic Zone, along our Gulf Coast, or anywhere in the country, will impact all of us. As such we must all work together to be prepared.

This concludes my testimony and I will be pleased to answer any questions. Thank you.

Senator PRYOR. Thank you. Mr. Hayes.

TESTIMONY OF JOHN R. HAYES, JR.,[1] DIRECTOR, NATIONAL EARTHQUAKE HAZARDS REDUCTION PROGRAM, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, U.S. DEPARTMENT OF COMMERCE

Mr. HAYES. Chairman Pryor, I thank you and the Members of the Subcommittee for conducting today's hearing. I appreciate the opportunity to be here before you to present a brief overview of the National Earthquake Hazards Reduction Program (NEHRP), and the role that the National Institute of Standards and Technology (NIST), plays in this partnership. NEHRP was established in 1977 to provide technical assistance for pre-earthquake mitigation activities by State and local governments, industry, and the private sector.

As background, I note that earthquakes strike without warning. In the past 200 years, very large magnitude earthquakes have occurred in Alaska, California, South Carolina, and the New Madrid region. There is evidence that such earthquakes have occurred in the more distant past in the Pacific Northwest, Utah, and other areas. A 2006 National Research Council report noted that 75 million people and half of our Nation's buildings, worth $8.6 trillion in 2003 dollars, are located in areas of the United States that are prone to damaging earthquakes.

The United States has been fortunate not to have experienced recent severely damaging earthquakes, but considering our significant urbanization and societal interconnectivity, the consequences of earthquakes include significant injury and loss of life in addition to potentially severe economic and national security consequences. Experts consistently estimate that a "big one" that strikes a major U.S. urban area may cause over $100 billion in losses.

[1] The prepared statement of Mr. Hayes with an attachment appears in the Appendix on page 35.

Most recently reauthorized in 2004, NEHRP is responsible for three main areas: Improving the understanding of earthquakes and their effects through interdisciplinary research; developing effective measures for earthquake hazards reduction; and promoting the adoption of earthquake hazards reduction measures. The 2004 reauthorization also directed NEHRP to develop, operate, and maintain the Advanced National Seismic System, the George E. Brown, Jr. Network for Earthquake Engineering Simulation, and the Global Seismographic Network.

Congress has indicated it intends for NEHRP to provide better earthquake preparedness for the Nation through interagency coordination and cooperation with the following program agency responsibilities. The National Science Foundation (NSF) supports a broad range of basic research that is integrated with educating students at all levels, as well as professional and public outreach. NSF has supported three National Earthquake Engineering Research Centers, one of which, the Mid-America Earthquake Center, is headquartered at the University of Illinois at Urbana-Champaign.

NIST is responsible for performing problem-focused R&D to improve earthquake-resistant building codes, standards, tools, and practices. In the recent reauthorization, Congress directed NIST to assume the program lead agency role.

The U.S. Geological Survey conducts and supports earth science investigations, produces seismic hazards assessments, monitors earthquake activity, and coordinates post-earthquake reconnaissance.

The Federal Emergency Management Agency (FEMA) translates research results into cost-effective State and local loss reduction measures. To do that, FEMA provides technical guidance and information about building codes and practices, supports public-private partnerships, provides estimates of potential losses, and supports public awareness education. In partial fulfillment of these responsibilities in the mid-continent region, FEMA supports the Central U.S. Earthquake Consortium. Consistent with the statutory responsibilities, FEMA leads NEHRP in working closely with the National Model Building Code organizations through the Building Seismic Safety Council to ensure that cost-effective earthquake construction techniques are incorporated in the Nation's building codes.

The four program agencies are jointly developing plans for earthquake engineering research and outreach efforts that support this process.

The 2004 NEHRP reauthorization directed several key new program developments. It directed the formation of an Interagency Coordinating Committee (ICC), that is composed of the directors of the four program agencies as well as the directors of the Office of Science and Technology Policy and the Office of Management and Budget. The ICC released its first annual report to the Congress on NEHRP in early 2007 and recently approved the outline for a new NEHRP strategic plan that is now under development. The plan will include several key areas of needed program emphasis that were endorsed by the ICC in 2006.

The reauthorization also directed the formation of an Advisory Committee on Earthquake Hazard Reduction that advises the ICC

chairperson on program technical direction. The committee was formed in early 2007 and has now met twice. At its most recent meeting in October, the committee provided detailed feedback for improving and refining the strategic plan that is now under development.

As I mentioned earlier, NIST is responsible for performing applied engineering research that links fundamental science and engineering knowledge with its practical application for cost-effective design and construction of earthquake-resistant structures. Until fiscal year 2007, funding had not existed to support this responsibility. In fiscal year 2007, the Congress appropriated $800,000 of new monies that allowed NIST to initiate this NEHRP research. The President's fiscal year 2008 budget request added another $4.75 million for NIST earthquake research that would enable NIST to undertake a substantial program of coordinated in-house and extramural research.

In conclusion, NEHRP focuses on pre-earthquake mitigation activities and has no direct operational responsibilities for post-earthquake response and recovery. However, NEHRP resources do support those activities, providing critical information to address this national hazard.

Thank you very much, sir, for your attention, and I will be happy to answer any questions you might have.

Senator PRYOR. Thank you. Dr. Applegate.

TESTIMONY OF DAVID APPLEGATE,[1] SENIOR SCIENCE ADVISOR FOR EARTHQUAKES AND GEOLOGICAL HAZARDS, U.S. GEOLOGICAL SURVEY

Mr. APPLEGATE. Thank you, Mr. Chairman, for holding this hearing on a very important topic. From today's perspective, the three magnitude 7.5 to 8.0 earthquakes that struck the Mississippi Valley back in the winter of 1811 and 1812 seem quite distant, but infrequent events nevertheless represent very real risks, and if those earthquakes were to recur today, significant damage to buildings, transportation, and critical infrastructure would occur in at least eight States.

At the U.S. Geological Survey (USGS), we strive to deliver the information and tools that emergency managers, public officials, and citizens need to prevent natural hazards from becoming disasters. In collaboration with our partners in the National Earthquake Hazards Reduction Program plus State and local governments and universities, the USGS carries out our responsibilities under the Stafford Act to provide warnings and notifications on earthquakes and other geologic events as well as additional NEHRP roles to assess earthquake hazards, support targeted research, and help build public awareness.

Now, why are there earthquakes in the Central United States? Although the large majority of earthquakes occur along the edges of the brittle tectonic plates that make up the earth's outer skin, earthquakes do occur far from present-day plate boundaries as the stresses from those boundary zones are translated into the more stable interiors, as in the case in the Central and Eastern United

[1] The prepared statement of Mr. Applegate appears in the Appendix on page 44.

States. Such earthquakes are less frequent than in California or Alaska, but an earthquake in the mid-continent affects a much larger area than the same size earthquake in California, and that is reflected in both of the diagrams up here,[1] the one on the dais showing comparison of a damaging earthquake, the Northridge earthquake in 1994, with the Marked Tree event in 1895, so that is sort of a moderate-size quake, and the one over here to my left, comparing the 1811 New Madrid events to the 1906 earthquake that destroyed the San Francisco area. You can see that the damage zones and the zones in which it was felt are much broader, and that is because in the Central United States, the crust is older and it is colder and it translates the energy from seismic waves much more efficiently. In the Mississippi Valley, in particular, you also have amplification of that shaking because of the very thick sediment, so that communities there are more intensely affected.

Now, geologic research shows that similar sequences of major earthquakes to those in 1811 and 1812 have happened at least twice before, in about 1450 A.D. and 900 A.D. We estimate that there is a 7 to 10 percent chance of an earthquake the size of those in 1811 and 1812 striking the region in the next 50 years. However, the occurrence of even a moderate-sized earthquake like the 1895 event close to urban centers like Memphis could be locally devastating. And the chances of a magnitude 6.0 earthquake occurring in this region in the next 50 years is 25 to 40 percent.

Now, turning to response, knowing where shaking is most intense immediately after an earthquake can save lives by providing emergency responders with the situational awareness that they need to concentrate their efforts where they matter most. For that reason, USGS has been building the Advanced National Seismic System (ANSS) to modernize the Nation's seismic monitoring infrastructure and provide the most rapid information we can about strong shaking. Through ANSS, the USGS sends rapid reports of potentially damaging earthquakes to over 100,000 users, including the Departments of Defense, Homeland Security, State and local emergency managers, the news media, and the public.

USGS monitors earthquakes in the Central United States in cooperation with the University of Memphis, St. Louis University, and the University of Kentucky.

Now, within 5 minutes after a potentially damaging earthquake in the Central United States, notifications are sent to local, State, and Federal officials with the epicenter and preliminary magnitude. Within 20 minutes, an initial shake map is released, and that is shown here.[2] It is on the left. This is a scenario shake map that was used for the recent SONS exercise for an 1811-type New Madrid event, with the strongest shaking shown in red. That is available in about 20 minutes, and then the products are refined as more data arrive, helping to prioritize response.

Now, 3 months ago, USGS began delivering a new product known as PAGER, the Prompt Assessment of Global Earthquakes for Response, which provides rapid estimates of population exposure to shaking, giving emergency responders and aid agencies a

[1] The charts referred to appears in the Appendix on page 65.
[2] The chart referred to appears in the Appendix on page 65.

quick estimate of the extent of the likely response required, and that is what is shown on the right.

In addition to shaking that would cause significant damage to today's buildings and lifelines, the 1811 and 1812 earthquakes also caused landslides along the bluffs from Mississippi to Kentucky. A type of ground failure called liquefaction caused soils to flow and may make roadways in the Mississippi Valley, such as I–55, impassable. It also can disrupt agriculture and cause levee failures.

The citizens of this region need to be aware of the likely consequences of earthquakes. Through the Central United States Earthquake Consortium, testifying in the next panel, the USGS and FEMA partner with State emergency management agencies and geological surveys to provide information that they can use in their planning efforts and to educate the public.

Mr. Chairman, while earthquakes are inevitable, their consequences to our building environment are not and there is much we can do as a Nation to improve our resilience to these and other natural hazards. This concludes my remarks. I will be pleased to answer any questions.

Senator PRYOR. Thank you, Dr. Applegate.

Let me start with you, if I may, just to follow up on some of your testimony. You did a good job of summarizing them during your opening statement, I'd like to clarify the geological differences between an earthquake in the New Madrid area versus one in California. Tell us the geological reasons why you could see a more widespread area of damage.

Mr. APPLEGATE. Sure. Well, there are a couple of geologic factors involved. One of those is that out in the West, where we have got an active plate boundary, the crust is much more broken up. You have a much younger crust, a warmer crust. The energy from earthquake waves doesn't get transferred as far. For example, in that 1906 earthquake, it was felt about as far away as Nevada, but that was it. So all the energy was concentrated in a small area.

In contrast, in the Central United States or the Eastern United States, this is very old crust. This has been part of the continent for a long time and it is older, it is colder, and so basically, just like ringing a bell, the waves are going to travel very efficiently through this medium. And so the same kind of waves are going to travel over a much broader area.

And in the case of the Mississippi Valley itself, then you have a second factor which leads to damage and that is that you have this very thick accumulation of sediments—whenever you have a pile of sediment like that, it is just going to shake a lot harder than, say, a hard rock site. And so those two factors, I think, lead to increased shaking.

Senator PRYOR. Do you call that liquefaction?

Mr. APPLEGATE. Well, then at the surface, those are exactly the kind of sediments, when if mixed with water, when they are shaken, they lose all their strength and then you get the liquefaction, absolutely.

Senator PRYOR. And so if you have the phenomenon of liquefaction on the surface, what does that mean for buildings and infrastructure?

Mr. APPLEGATE. Well, it means that the ground has lost all its strength, and so it is essentially, it is turned into a slurry and so that can be a major challenge for buildings, for lifelines, and it is certainly one of the aspects in the catastrophic planning scenario that is being looked at in terms of the range of damages that could be experienced.

Senator PRYOR. And how long does that liquefaction, or liquefied state, remain on the surface? Is it over once the shaking stops, or does it remain there?

Mr. APPLEGATE. Well, it partly depends on how much of the groundwater basically gets squired out. So there are areas where you are going to get uplift. There are other areas where you are going to get substance. The whole ground surface is going to drop. In those areas, you may get flooding. For example, in certain agricultural areas, you could get flooding that would last for months. In other areas, it is going to be over relatively quick, but you are going to be dealing with a lot of ground rupturing and that sort of thing.

Senator PRYOR. Is there any practical rule of thumb on when you can start rebuilding after you have a major earthquake like that?

Mr. APPLEGATE. That is where the New Madrid earthquake poses an extra challenge compared to the kinds of earthquakes that we tend to see in other parts of the country. This sequence of large events that happened over a 2-month period in 1811, when we look back at the geologic record, it appears that there are similar sequences, so that may be sort of the characteristic way that the stress is relieved, which means that does need to be factored into the rebuilding, that you could have not just sort of week-after shocks, but you could have another major event in a month, and that certainly is critical in terms of how you make your decisions about rebuilding.

Senator PRYOR. Are those aftershocks predictable?

Mr. APPLEGATE. Earthquake prediction remains a huge challenge, and in some ways, we look at earthquakes and we have gotten pretty good at saying where earthquakes occur. The challenge is knowing when a big earthquake is going to occur. So our hazard maps are all about saying where—that is an example of where earthquakes are going to occur. But from a prediction standpoint, it may be that the earthquakes themselves don't actually know how large they are going to grow until the rupture has initiated. So a lot of folks have been trying, but have not yet succeeded.

Senator PRYOR. Geologically, in the New Madrid area, are you seeing signs that pressure is building or things are happening under the surface? Can you make an accurate prediction? You gave some statistics during your opening statement about a certain percentage chance over so many years. Could you run through those again?

Mr. APPLEGATE. Sure. The kind of forecasts that I was referring to are based on the same data that go into our National Seismic Hazard maps, and that then in turn is what gets built into building codes. And so we do that prediction or forecast over a 50-year period, which is sort of the life span of a typical building. The estimate based on the recurrence history of these previous large events and moderate-size events are for about a 7 to 10 percent chance

over the next 50 years for a magnitude 7.0-plus event, but in the area of 25 to 40 percent for another one in the magnitude 6.0 range, sort of similar to that 1895 event that you have there. So again, those projections are about where earthquakes are going to occur and then can be fed into building codes that can make buildings stronger.

Senator PRYOR. And do you know anything about the building codes? Are people following those building codes out there?

Mr. APPLEGATE. Well, that is part of the handoff we have in NEHRP.

Senator PRYOR. I understand.

Mr. APPLEGATE. We prepare the maps and we work with FEMA to get those provisions built into model codes and then that is part of their NEHRP activity—is the actual looking at the adoptions. We certainly try to do what we can in conjunction in terms of building public awareness, but that is certainly a challenge.

Senator PRYOR. All right. Mr. Hayes, during your testimony you referred to FEMA, NIST, NSF, and USGS. We have a lot of Federal agencies involved here. Could you give us the one-minute description of the role each plays when it comes to earthquake planning and response? Could you give us a very brief summary on that?

Mr. HAYES. Well, within NEHRP, sir, there is not a very extensive role that NEHRP plays in planning and response. The statute has NEHRP focusing on pre-disaster mitigation efforts. Within the legislation, essentially FEMA is levied with the responsibility for exercising the National Response Plan when an event occurs and work that USGS, our partners at USGS provide, as Mr. Applegate has described for you, provide information that is used in the response activities following an earthquake. NIST and NSF are responsible for providing research results that can then be worked by FEMA into the National Model Building Code process. But we don't actually play an active role other than what FEMA does and in what USGS does indirectly in the response activities following an earthquake.

Senator PRYOR. Mr. Hayes, is it your impression that information is flowing among the agencies as it should be, or can we improve there?

Mr. HAYES. I think that the information is flowing very well. We have a very good working partnership, and I suppose you would expect me to say that anyway, but I really mean it. I have been asked that question before and it starts with developing personal relationships with the other people and the other agencies. I consider this young man here to be a real good friend and we work together very closely, and he gets so many e-mails and phone calls from me that he doesn't sometimes want to open the next one. But I think we are working together very well.

And I think at the higher levels of the agencies, the creation of the Interagency Coordinating Committee, which is comprised of the agency directors——

Senator PRYOR. I am sorry, go ahead.

Mr. HAYES. No problem. I think that the creation of the Interagency Coordinating Committee, which was required by the 2004 reauthorization, has improved the communication process among

the agencies even more because the agency directors or their representatives are meeting periodically and are in a room face-to-face to discuss the issues that are before the people at the working level in those agencies. So I think it is very good, actually.

Senator PRYOR. Good. Mr. Cannon, let me turn to you, if I may. There is a mystery here on the Subcommittee and it has to do with the Federal Contingency Plan Report. Apparently the staff asked FEMA for that last month, last week, and even yesterday, and we have been given assurances that it exists, but FEMA has failed to provide it to the Committee. Do you know anything about that?

Mr. CANNON. What I can speak to is the fact that there is an Interim Contingency Plan——

Senator PRYOR. Right.

Mr. CANNON [continuing]. Which we developed early on in the process of the New Madrid Seismic Zone effort so that at FEMA and at the Federal level, we would have a coordinated approach to a no-notice event. It is just a draft. It is an interim. It is not a final document. But it is my understanding that this Friday, FEMA staff will be coming over and we are actually going to have a chance to go through and look at the event. But it has not been released because it is not ready yet to be released.

Senator PRYOR. When will it be ready for release?

Mr. CANNON. Well, it is not the planning product, it is just what we would do in the event of something occurring tomorrow or next week. So it won't be complete until the end of all the workshops and all—because it is continually refined. As we do each State and we complete each State, then we add more details to it.

But it began as a very generic, normal no-notice response template. Just as we have a notice template for hurricanes, we have a no-notice template that we are using for New Madrid. But it is the same no-notice template that we would essentially use if we had a terrorist event next week, as well. The primary difference between notice and no-notice is how much time you have to prepare to respond, and there are certain things that have to occur in every one of those events. So specifically, this one we did for New Madrid, but it is an ongoing process. So I wish I could tell you it would be done in a month or a year, but that is really not the case. It will transition into the final document for New Madrid when all the workshops are completed.

Senator PRYOR. Do you think it will be more than a year?

Mr. CANNON. I do think it will be more than a year, we have only two more States to do some workshops in in the first quarter of 2008, so hopefully by mid-year, we might be able to share something that we could put out publicly. But again, it is an interim dynamic document. It is not meant to be a finished document at any point in time.

Senator PRYOR. But as I understand what you said a minute ago, you are going to make it available to our staffs on Friday of this week?

Mr. CANNON. Yes, sir, in its present form, as it exists today. And each week you look at it, it is a snapshot of where we are at that moment in time because it constantly changes as we gather more information from the planning process.

Senator PRYOR. OK. There has been, as I said, a mystery for this document. I think previously we were given assurances that we could see it and have access to it and that just never has happened. Apparently as recently as this week, someone from your office brought over a stack of documents and a note saying the report was in there, but it wasn't. So if you are going to make it available this week, that would be very helpful and we will follow up accordingly.

Mr. CANNON. Yes, sir. Friday, I understand, there will be a review of it with your staffs.

Senator PRYOR. Great. Let me ask this, Mr. Cannon, if I can. As I understand it, you have a tentative plan to do a major exercise relating to the New Madrid fault zone sometime in 2011, is that right?

Mr. CANNON. Yes, sir. That is the date for the final completed plan and exercise.

Senator PRYOR. Do you know whether that is going to be a TOPOFF exercise?

Mr. CANNON. No, I don't. Right now, we are building it as just our final exercise for New Madrid. I don't know if the next TOPOFF would include that or not.

Senator PRYOR. OK. And who makes that decision?

Mr. CANNON. That decision is really done by Preparedness, which is now part of FEMA. It returned last April. I can certainly inquire for you if that could be considered as part of the TOPOFF scenario.

Senator PRYOR. Yes, I think that would be great because my experience with TOPOFF exercises is you just allocate more resources and more focus. If you look at the maps here, you can see how this could be a very catastrophic event for the United States. My sense is you ought to give it strong consideration for a TOPOFF——

Mr. CANNON. I should also add, sir, that in 2009 and 2010, we are also scheduled for regional exercises within—there are four FEMA regions that cover those eight States and so we have planned on smaller exercises within those regions building up to the final large exercise. And the other piece is that a portion of it was exercised in this year's Coast Guard-EPA Spills of National Significance on the Mississippi.

Senator PRYOR. OK. And let me ask you if you know about building codes. Are you familiar with how builders, etc., home builders and commercial builders, are doing in terms of complying with building codes and doing that type of prep work in anticipation of an earthquake?

Mr. CANNON. I believe that through FEMA's Mitigation Directorate, we have developed model codes for this area, and I understand——

Senator PRYOR. Are they being followed?

Mr. CANNON. Well, I understand that some have been adopted at the local level. We will get back with you to report if there are any at the State level, but in my reading, I didn't come across that. I only came across that there were local governments that have adopted some codes.

Senator PRYOR. OK. Let me ask you, Mr. Cannon, while I have you, about the effect a major earthquake would have on interstate commerce. Has FEMA worked through scenarios about what would

happen if the Mississippi River closed down and if bridges collapsed across the river? Do you have contingency plans?

Mr. CANNON. Yes, sir. It is all part of the planning process, and this is a geographically-based, scenario-driven planning process that goes from the ground up. What we wanted to do was to make sure that everyone involved—the initial first responders, the local governments that would have to be involved, their State Governments, all are part of this process so that, one, they get to know each other before the event occurs, and two, they know what the expectations are of each other.

So we are looking at this area from our level, at FEMA's level, as supporting all those local incident commanders and first responders as part of the National Incident Command System and Unified Command, but also our planning in how do we support this if the roadways are gone, river traffic may not be there, airfields may be disrupted. How are we going to get the resources in there to support that? And that is all part of our contingency planning that we are doing for New Madrid. That will all be included, but basically, we need to surround this and come in from all sides.

Senator PRYOR. The other thing there in that part of the country, it just happens there is a lot of rail infrastructure there, and also pipelines with natural gas and oil run through that area, so an earthquake could be very disruptive. You could have a major chemical spill either in the Mississippi River or somewhere in that region—or many places in that region, in fact. So again, this could be a major catastrophic event.

Mr. Cannon, do you know a lot about the insurance industry? I know after Hurricane Katrina, there were some very serious problems with the insurance industry about wind damage versus water damage. I know that there is such a thing as earthquake insurance. Does FEMA or your office get into when that should be recommended and what happens if people don't carry that?

Mr. CANNON. No, sir, not my office. We do operations, disaster operation response, but I believe we could get you some information from Mitigation that would provide what you are asking for.

Senator PRYOR. That would be great. One of my concerns there is after Hurricane Katrina, the wind damage——

Mr. CANNON. Yes.

Senator PRYOR [continuing]. Versus the water damage, and you can have that same type of scenario with an earthquake, because it may be the earthquake causes a fire and the house burns down.

Mr. CANNON. Yes, sir.

Senator PRYOR. It could be a mud slide or a flood when a levee breaks or whatever the situation is. It may not be the earthquake itself. We talked in the Commerce Committee, of which I am a member, about an all-hazards-approach. I know that is out of your bailiwick, but I hope that the government and the insurance industry are talking, so I would encourage FEMA to reach out and work with Congress and work with the insurance industry on that.

Mr. CANNON. Yes, sir. We will get back to you with that.

Senator PRYOR. You guys did a great job in your opening statements and you covered some of these questions previously. Why don't I go ahead and close this panel and I will ask the second panel to come up, but again remind this panel before you leave

that some of our Members aren't here today and we may have some follow-up questions. I want to thank this panel for being here and appreciate your expertise and your looking at the New Madrid situation. Thank you very much.

Mr. HAYES. Thank you.

Mr. APPLEGATE. Thank you.

Mr. CANNON. Thank you, sir.

Senator PRYOR. With that, I will call the second panel up here, and as they are getting squared away and the two panels are switching places, let me go ahead and introduce our second panel of witnesses.

The first witness will be David Maxwell. He is Director of the Arkansas Department of Emergency Management. As Director, Mr. Maxwell chairs the Arkansas Homeland Security Advisory Group and serves on several emergency management committees and councils for the State of Arkansas. At the national level, he is Vice Chair of the Central United States Earthquake Consortium (CUSEC), and participates as a State member of the National Emergency Management Association.

The second witness we have will be Callen Hays, Crisis Management Coordinator for Memphis Light, Gas, and Water. Mr. Hays served as the project manager for the construction of the Memphis Light, Gas, and Water's new emergency operations center, which opened last June. He also served as the project manager for the hazard mitigation study that was commissioned by Memphis Light, Gas, and Water in 2006. Mr. Hays is a licensed professional engineer for the State of Tennessee and has worked with his company for 13 years.

So with that, Mr. Maxwell, go ahead.

TESTIMONY OF DAVID MAXWELL,[1] DIRECTOR, ARKANSAS DEPARTMENT OF EMERGENCY MANAGEMENT AND VICE CHAIR, CENTRAL UNITED STATES EARTHQUAKE CONSORTIUM

Mr. MAXWELL. Thank you, Chairman Pryor, Senator Sununu, and other Members of the Subcommittee. I appreciate the opportunity to appear before you today. As stated, I am David Maxwell, Director of the Arkansas Department of Emergency Management (ADEM), as well as the current Vice Chair of the Central United States Earthquake Consortium (CUSEC).

ADEM's role in planning for an earthquake along the New Madrid Seismic Zone falls into two areas. The first and primary area of focus is to establish and implement an earthquake preparedness program to ensure the safety and well-being of the citizens of Arkansas from the risks associated with earthquakes within the State, and second to address those aspects outside the State which would certainly have a direct effect on Arkansas.

We take an all-hazards approach when planning and perform a gap analysis for specific hazards where needed. This requires the full cooperation of all other State and local government agencies, departments, and personnel.

[1] The prepared statement of Mr. Maxwell appears in the Appendix on page 51.

CUSEC serves as a coordinating hub for the region, performing the critical role of coordinating multi-State efforts of the Central Region. While each individual State is the primary implementor of emergency management functions, CUSEC's role is largely facilitative in uniting and coordinating actions of the eight States in the New Madrid Seismic Zone—Alabama, Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri, and Tennessee.

In 1997, Congress enacted the Earthquake Hazards Reduction Act in recognition of the fact that earthquakes pose the greatest potential threat of any single event natural hazard confronting the Nation. It directed the President to establish and maintain an effective Earthquake Hazards Reduction Program. In doing this, Congress created the National Earthquake Hazards Reduction Program, which gives the responsibility to the Federal Government to provide direction, coordination, research, and other support efforts aimed at earthquake hazard mitigation and preparedness. The Federal Emergency Management Agency, the U.S. Geological Survey, the National Science Foundation, and the National Institute of Standards and Technology were assigned specific roles.

While national attention focused on the high-risk areas such as California, the late Dr. Otto Nuttli of St. Louis University was pioneering research on the dangers of earthquakes in the Central United States. His research provided the conclusive evidence that prompted the creation of CUSEC in 1983. FEMA, in full cooperation with the States most at risk from a New Madrid seismic event, laid the groundwork for the formulation of CUSEC that year. This partnership was built around four goal areas: Public outreach and education, multi-State planning, mitigation, and application of research to address the hazard and associated risk. The primary mission is the reduction of deaths, injuries, property damage, and economic losses resulting from earthquakes in the Central United States. Authority for CUSEC is vested in the Board of Directors, which is composed of the Directors of Emergency Management for the eight member States.

As Director of ADEM, I oversee every aspect of emergency management for the State of Arkansas. This includes the planning, mitigation, response and recovery efforts for an earthquake. My written remarks today deal specifically with what could happen should a catastrophic earthquake occur in the area.

There is always work to be done in preparedness. While I cannot show you where preparedness works, I can show you where it was not used. We exercise and plan according to current research and upgrade it constantly to keep up with new developments. There will always be a need to practice coordination between local, State, and Federal organizations involved. A challenge will always be the lack of warning that an earthquake presents.

Arkansas, as well as the other CUSEC member States, are constantly improving their catastrophic plans to address issues that will arise when an earthquake strikes. The biggest challenge we have is selling the need for preparedness on earthquakes. Because we do not live in a State where earthquakes are a regular occurrence, the thought tends to be that they will not happen. While we all know that earthquakes cannot be prevented, certainly we can

minimize casualties and damages by being prepared. I cannot overemphasize the importance of awareness and self-preparation.

Thank you so much for your kind attention. It has been my honor to be with you today and I will be happy to attempt to answer any questions.

Senator PRYOR. Thank you. It is great to see you again, Mr. Hays.

TESTIMONY OF CALLEN HAYS,[1] CRISIS MANAGEMENT COORDINATOR, MEMPHIS LIGHT, GAS, AND WATER

Mr. HAYS. Let me begin with a quick apology. I am currently battling some laryngitis issues, so I know my voice will come and go during my statement. Just bear with me.

Memphis Light, Gas, and Water since 1989 has spent $16 million to upgrade our water production facilities. We have been awarded almost $4 million in FEMA grants to retrofit four out of eight water pumping facilities and nearly 60 water production wells. Given the past success of these efforts, MLG&W felt there were other mitigation opportunities for our gas and electric systems. Determining the most effective spending of money relative to size and mitigation is a question not many utilities have the personnel and the expertise to handle.

In early 2006, we budgeted for and contracted an all-hazard mitigation study to R.W. Howe and Associates. This study would recommend where each network is most vulnerable to various natural hazards and where the most effective spending of retrofit dollars reside and the best opportunities to apply for Federal funding.

No one can predict the exact amount of damage or cost of an event like this. The majority of damage taking the longest amount of time to restore would be the water treatment plants that have yet to be seismically mitigated, underground pipelines on gas and water distribution systems, and unanchored transformers at electric substations. There is no economically feasible way to mitigate underground pipelines. Strengthening the above-ground collection, control, and distribution points of all three networks will reduce the down-time. It will be a lengthy restoration process for customers. It certainly will take months, not weeks, to restore.

Widespread outages of all three systems varying in restoration time will occur. The outage time will be based on many factors that are difficult to quantify: A customer's location relative to the system failure; condition of overpasses and bridges that may prevent easy access of materials, equipment, and mutual aid labor forces from arriving in the region; the ability of MLG&W's remote monitoring system to remain intact; and the amount of down time of our wholesale suppliers of electricity and gas. If TVA's transmission system is down or there are several breaks along the natural gas pipelines of our suppliers, then the rigidity and strength of our system will be inconsequential.

MLG&W's restoration priorities are to preserve life safety first and foremost, which means reestablishing services to hospitals, water pumping stations, and sewer treatment plants are the highest priority.

[1] The prepared statement of Mr. Hays appears in the Appendix on page 59.

There are other ways that we are preparing ourselves for this seismic event. We have been replacing our cast iron gas distribution system in the inner city of Memphis. Cast iron gas pipe is more subject to failure with sudden ground motion than polyethylene pipe, which is much more flexible. Since 1991, MLG&W has spent $48 million to replace 206 miles of cast iron gas pipe. MLG&W recognizes and is adopting the National Incident Management System and the Incident Command Structure into its emergency response protocol. We require all members of our crisis response teams to be both NIMS and ICS trained and certified.

MLG&W bought a new business building back in 2003 that was seismically retrofitted for immediate occupancy and operability following a magnitude 7.0 earthquake. We placed all critical telecommunications, computer network servers, and a new emergency operations center in this building. The increased awareness of the constant work that has to be done for business continuity and disaster recovery planning for MLG&W operations has justified the process of creating an area department focused on crisis management.

MLG&W works hard to integrate itself with other local, State, and Federal Governments, as well as private sector partners, to discuss ways of improving this area's emergency management readiness. We have upper management employees that serve on several local business continuity and disaster recovery planning committee boards.

We have made efforts to educate the community on how it can be more self-reliant following a catastrophic event. Partnering with our local PBS station, we broadcast a show called "Memphis Energized." On one of these shows, we teach our customers how to shut off their gas and water services in case of an emergency, how to strap gas-fired hot water heaters to house framework, and to have a personal emergency plan ready. Our local EMA office teaches Community Emergency Response Team classes, or CERT classes, to help residents learn how to endure a long-term emergency event. The public needs to understand after a large earthquake it can and will be months, not days, before many utility services are restored and they need to be educated on how they can be ready.

There are a couple areas where improvements can be made to help utilities in this area prepare for an earthquake. The Federal mitigation money available to support seismic retrofits for public utility infrastructure is an annual pre-disaster mitigation program. For 2008, the program only had $100 million available nationwide, of which perhaps 10 percent was allocated to utility projects. Given the criticality of utilities to life preservation and economic well-being of this region and the Nation, more funding earmarked for seismic utility retrofit work, as well as giving some priority to our utilities located in the New Madrid, is needed. MLG&W had the resources to fund a comprehensive hazard mitigation study. Many rural and small utility companies cannot afford this type of analysis. Funding for these types of studies to help guide smaller utilities on their mitigation strategies would be helpful.

Enhancing public education concerning residential emergency preparedness is needed. MLG&W voluntarily began mitigating its utility systems back in 1999. Many utilities and energy suppliers

may not be taking this threat as seriously. Utility distributors are dependent on wholesale suppliers of electricity and gas. The government needs to ensure that both public and private wholesale suppliers of electricity and gas in the New Madrid Seismic Zone area have considered this threat and are taking steps to mitigate their own systems.

This concludes my testimony. Thanks.

Senator PRYOR. Let me, if I may, start with you, Mr. Maxwell. You probably heard me quiz the FEMA witness earlier about this contingency plan. He said it was a draft, it is not ready yet, it may be a year or more before it is completed. But from your standpoint, given the position you hold in the State, have you been contacted to give any input into that report?

Mr. MAXWELL. Well, if I understood Mr. Cannon's remark, they are basing a lot of the State input on the workshops that we are conducting that FEMA is funding. So they are getting State input through those workshops.

Senator PRYOR. OK. Have you seen a draft of the report at all?

Mr. MAXWELL. No.

Senator PRYOR. OK. And also let me ask you about a story that came out recently that the White House, OMB, may propose in fiscal year 2009, to eliminate Emergency Management Performance Grants (EMPG), from the budget in the 2009 fiscal year. While I understand that nothing has been finalized and this news report is based on a leak and it is a very tentative proposal, I would like to get your thoughts on that, about how the State of Arkansas and other States use EMPG grants and what would happen if we lost access to that funding source.

Mr. MAXWELL. Well, the EMPG grants go to fund part of our agency and to a large degree funds the local emergency managers in every county. We share a portion of that grant with our local officials to help fund the salaries of the local emergency managers. So the short answer to it all is if you want to do away with the emergency management system in this Nation, you do away with that grant.

Senator PRYOR. Yes. And you may not know right off the top of your head, but do you know how much Arkansas has received from that grant annually?

Mr. MAXWELL. Off the top of my head, I believe it was around $3 million this year.

Senator PRYOR. OK. And I assume that other States get a rough——

Mr. MAXWELL. Equivalent——

Senator PRYOR [continuing]. Amount of that based on population and——

Mr. MAXWELL. It is based on population——

Senator PRYOR. Yes.

Mr. MAXWELL. We get about one percent of what is allocated nationwide.

Senator PRYOR. So it would be a considerable detriment to State and local emergency management efforts?

Mr. MAXWELL. Yes, sir. That is putting it mildly.

Senator PRYOR. OK. Mr. Hays, I know your voice is not holding up so well today, but let me ask a few questions. We are talking

about grants. You mentioned that you have received some grants to retrofit and otherwise strengthen some of your facilities. How has that gone, and when you do that, do you report back to the Federal Government on what you are doing and how that is going? Give us a sense of what that has been like.

Mr. HAYS. The reporting structure back, I am not really familiar with that, but I do know that the $4 million total that I mentioned earlier is spread out over four different grants that we were awarded through FEMA and all those grants were relative to our water production facilities, things like bracing aerators, filtration systems, pump buildings, some of our water treatment plants. The theory is you can't keep underground pipelines from breaking apart when an earthquake like this happens, but if you can keep an above-ground water treatment plant that takes years to build, then the amount of time it takes to band-aid your pipelines, to get them so the water is flowing through again, quickly and help the restoration process. So we focused on our grants doing water treatment.

Senator PRYOR. Great. And as part of this effort, it sounds like Memphis Light, Gas, and Water has gone through a risk assessment study to understand where the weak links are in the system, so to speak, and I am sure Memphis Light, Gas, and Water has tried to predict the results of a serious earthquake. Give us a sense of what you think might happen in Memphis if there was a serious earthquake like is depicted on some of these maps.[1]

Mr. HAYS. We partner with the Mid-America Earthquake, share that information with them and they have given us some estimates from their models that show, I think, $56 billion in economic loss for the State of Tennessee with majority of losses in the Memphis and Shelby County region and $15 billion of that is directly related to utility infrastructure costs. How real those numbers are computer generated based on data and uncertainty about exactly where the ground is going to liquefy and the amount of ground shaking relative to where you have critical infrastructure is unknown. But it is going to take an extremely long amount of time to repair especially an underground infrastructure, pipelines. And as you mentioned earlier, there are also three major natural gas suppliers that go through Shelby County and that continues on to the north, Texas Gas, Trunkline, and ANR.

Senator PRYOR. Yes.

Mr. HAYS. So that needs to be considered, as well.

Senator PRYOR. Right. And what about your staffing, because it seems to me if you have a catastrophic event like this, you will by necessity be short-handed because a lot of your people will be out in the metro area when this happens, and will not be able to come in to you. Do you have contingency plans for that on how you are going to try to handle the staffing needs and to try to restore those services as quickly as possible?

Mr. HAYS. We have crisis teams already established, an electric crisis team, gas crisis team, and a water crisis team, and each person on each of those teams have back-up personnel and each with their responsibilities. It is going to be difficult to know who is going to be able to be available for work and even their back-ups. Every-

[1] The charts referred to appears in the Appendix on page 65.

one will certainly understand the first day or two will be spent with most people taking care of their families and making their own personal life secure. It is almost like, as you know, hope for the best, having everything backed up and hope they can make it.

Senator PRYOR. As someone told me one time, hope for the best, but plan for the worst.

Mr. HAYS. Correct.

Senator PRYOR. You heard me talk with the FEMA witness a few minutes ago about a large-scale exercise where you have all levels of government working together—Federal, State, local. Get the private sector involved, volunteer organizations, health providers, etc., first responders, all that, everybody doing a large-scale simulation or a big exercise. Have you all done something like that and did it, or would it benefit you to do that?

Mr. HAYS. We have. We participated in the SONS 2007 exercise this past June that was based on a large-scale magnitude earthquake and we corresponded with our local EMA office participating in that drill.

Senator PRYOR. And was that beneficial to you?

Mr. HAYS. It was. The key weakness that is brought up time and again is communications. That will be a difficult task to overcome logistically as one's land lines are cut and cell phone towers fall or networks are overwhelmed. Using other means of communications will be difficult.

Senator PRYOR. Right. Mr. Maxwell, let me turn to you, if I can. We talked about CUSEC earlier. You are involved with that group and I think that is great. And as a member of that group plus what you do in Arkansas, what sort of guidance are you getting from the Federal Government in your planning and response effort? Are they working with you on a regional level or just on the State level, or tell us how that is going.

Mr. MAXWELL. We have a little of both, actually. We are, in these series of workshops that we are doing that are funded by FEMA, we did three in the State of Arkansas. We did three local workshops to enable a lot of local responders and local officials to be involved to really start to identify the gaps that are out there that we need to respond to. Then we had a State-wide workshop to take the information gleaned from the local workshops and pull it together to see what the State could do. We are hoping that we can prevail upon FEMA to release the funds that we did not spend on those workshops to go back out to the local governments and do a series of tabletops to really solidify a lot of the information that came out in the larger workshops.

Senator PRYOR. And how helpful are the tabletops? You just did one last month?

Mr. MAXWELL. Yes, sir. Actually, we have done two within a month. Governor Beebe, as you know, is very interested in all of this and he has pulled his cabinet together, or certain segments of the cabinet together to do tabletop exercises. We have done one on terrorism. The last one we did was on earthquakes, which was extremely beneficial for us. After that tabletop, the governor instructed me to, within the next couple of weeks, which we have done, to run the same scenario again but with the deputy directors of the agencies, not just with the directors, to ensure that we don't

have major fall-off if the directors aren't available. So we are looking at that continuity of operations aspect.

Senator PRYOR. Now, when you are doing these tabletops, I know that is mostly in Arkansas, but when you look at the red zone here, clearly at a minimum in all these maps, you get Arkansas, Missouri, and Tennessee, and in other maps you get a lot bigger red zone in that. Do you work with Missouri, Tennessee, your counterparts there?

Mr. MAXWELL. Yes, sir. As a matter of fact, I leave here today and will be attending a CUSEC Board of Directors meeting with my counterparts in all of those States to discuss issues and make sure that we are coordinating our efforts.

Senator PRYOR. Is the State of Arkansas, as well as these other States, coordinating with States that may be out on the rim, like Oklahoma, Texas, Louisiana, etc., that hopefully won't be as adversely impacted as us toward the center will be and to establish mutual aid agreements with them? Have we gone that far?

Mr. MAXWELL. Yes, sir. One of the things that we are working on very hard and one of the lessons that we learned from Hurricane Katrina, actually, was that we do have to have those plans in place to shelter a large number of people from our State. And so we have had discussions with Oklahoma, Texas, other States in the FEMA Region 6 so that in the event—we have a Memorandum of Understanding in writing with Louisiana that goes two ways. If there is a hurricane, we will accept their evacuees, and if there is an earthquake, they will accept ours.

Senator PRYOR. Great. Mr. Maxwell, in your testimony, you said something I thought was insightful. You said the biggest challenge is, "selling the need for preparedness on earthquakes," especially in our part of the country, because we just don't have a lot of experience with that. I mean, we talk about something that happened in 1811 or 1895. There are just not a whole lot of people around who went through that before.

So my question is how do you educate the public? Is it Public Service Announcements? Is it through the public schools? What can the Federal Government do to better bring public awareness to the real danger of an earthquake in our State and this region?

Mr. MAXWELL. Well, I think the answer to that is yes to all of the above. Really, we need to do Public Service Announcements. We do town hall meetings where we go out and try to educate the general public. We are going to try some new things. With all of my gray hair, you can tell I am not really up on a lot of the newer technology, but we have staff that are exploring how to use You Tube and other things that the younger generation automatically uses to put educational messages out. We are going to try anything that we possibly can that might work.

A couple of years back, I was sitting in a meeting talking about earthquakes and somebody that was very involved in preparedness leaned over to me and said, "You know, we ought to put out messages that people need to be prepared." We do that all the time, and so obviously our message isn't being heard. So our problem is finding a way to get that message out where it will be heard. It is not working, the traditional means, so we will try any avenue.

Senator PRYOR. Well, I think it is human nature for people to naturally want to filter out and not pay a lot of attention to the earthquake threat because they don't feel that sense of urgency or it is not real to them, but I tell you, if you go down to New Orleans and you see the devastation they have gone through, it makes you appreciate the destructive power of Mother Nature. Anything we can do on the Federal level to help educate people and provide the resources to do what you need to do to get the word out to the public, we need to try to do it. Probably with Memphis, you guys might put bill inserts in periodically and things like that. We just need to continue to raise awareness. Even though that first message usually doesn't work, after people are exposed to that message a number of times, hopefully, it will start sinking in.

Listen, that is all the questions I had. Again, we are going to have some Senators who could not be here today who may submit questions for the record. I just want to thank our two panels for all that they do and the panelists. I notice that Dr. Applegate stayed. We appreciate that, and the staff from the previous panel stayed. We really appreciate that, your staying to listen.

I just want to tell you that this is something that is very real. There is a very real danger. We don't know how imminent it is. That is one of the things that is very elusive here. But we know that at some point, if it does happen, it could be a major catastrophic event and we need to do all we can to be prepared for it.

So again, I want to thank you all for coming here. I know some of you traveled a great distance to be here and I appreciate that.

The last thing I was going to say is we are going to leave the record open for 2 weeks and allow Senators to submit their questions in writing. So if you all get some questions in writing, we would appreciate a rapid turn-around.

With that, I want to thank all the Subcommittee staff and all the Senators and their staffs for doing this and certainly all the witnesses and the media for being here. Thank you very much.

The hearing is adjourned.

[Whereupon, at 3:57 p.m., the Subcommittee was adjourned.]

APPENDIX

Statement for the Record

Glenn M. Cannon
Assistant Administrator
Disaster Operations Directorate
Federal Emergency Management Agency
Department of Homeland Security

Before the

United States Senate

Committee on
Homeland Security and Governmental Affairs
Subcommittee on State, Local, and Private Sector Preparedness and Integration

December 4, 2007

Chairman Pryor, Ranking Member Sununu, and Members of the Subcommittee, I am Glenn Cannon, the Assistant Administrator for Disaster Operations at the U.S. Department of Homeland Security's (DHS) Federal Emergency Management Agency (FEMA). Thank you for this opportunity to discuss FEMA's Catastrophic Disaster Response Planning Initiative for a potential earthquake along the New Madrid seismic fault zone, which is a 150-mile long, 50-mile wide earthquake fault covering four FEMA regions and eight states--Alabama, Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri, and Tennessee. The fault extends southward from Cairo, Illinois through New Madrid and Caruthersville, Missouri, down though Blytheville, Arkansas to Marked Tree, Arkansas. It extends into Kentucky near Fulton and into Tennessee near Reelfoot Lake, and extends southeast to Dyersburg, Tennessee.

Successfully responding to the anticipated effects of a catastrophic disaster is one of the greatest challenges Federal, State, and local governments face. Historic and recent events, such as Hurricane Katrina, demonstrate that a catastrophic disaster can impact the United States at any time. Using funding appropriated for catastrophic planning in Fiscal Year 2006 and 2007, FEMA implemented a Catastrophic Disaster Response Planning Initiative (Initiative) that is designed to ensure that FEMA and its Federal, Tribal, State, and local partners plan and prepare to effect an appropriate, timely, and efficient response to a catastrophic disaster.

This Initiative will significantly enhance Federal disaster response planning activities by focusing on catastrophic disasters: those disasters that by definition will immediately overwhelm the existing disaster response capabilities of Tribal, local and State governments. In cooperation with State and local governments, this initiative will identify high risk areas, develop loss estimates for such incidents, assess and inventory current disaster response capabilities, anticipate response shortfalls, and develop comprehensive planning strategies for addressing such shortfalls and enhancing capabilities. Products developed by the Initiative will include incident-specific response plans for pre-selected geographic regions, based upon loss estimating models and capability inventories of affected Tribal, local, State, and Federal responders.

FEMA's Initiative is focused on integrated emergency preparedness which is an evolving core competency of FEMA. It is based on principles from the National Incident Management System (NIMS) and the National Response Plan (NRP). [The latter is under revision as the new National Response Framework (NRF).] The Initiative will help further the development of the National Preparedness System by developing detailed, site-specific, geographically-based, and operationally-focused Federal, State, local, tribal, and private sector plans; will improve overall prevention, protection, response and recovery capabilities at all levels of government; and bolster Tribal, State and local planning activities.

FEMA's Disaster Operations Directorate, Disaster Assistance Directorate, Mitigation Directorate, and National Preparedness Directorate are collaborating closely on this important Initiative. The Disaster Operations Directorate is continuing its venue-specific catastrophic planning and disaster readiness initiatives. The Mitigation Directorate's risk modeling and earthquake mitigation programs provide invaluable guidance. The Disaster Assistance Directorate is planning for capability enhancements in the areas of evacuation/mass migration, congregate sheltering, housing, debris management, and other recovery operations. And, the National Preparedness Directorate will apply lessons learned to the preparedness assistance programs it is responsible for administering.

This Initiative applies a collaborative planning approach that involves all levels of government, the private sector, voluntary organizations, non-governmental organizations, academia, and

members of the critical infrastructure sectors to address specific functional response planning in multiple, critical disaster response categories such as: search and rescue, communications, command and control, temporary medical care, special needs, debris, schools, evacuation, sheltering, mass care, pets, temporary housing, transportation, staging and distribution of critical resources, access control, reentry, power, water, and ice distribution, volunteer and donations management, critical incident stress management, hazardous materials, temporary emergency protective local ordinances and State statutes, and public information and dissemination. FEMA has coordinated closely with its State and local partners to facilitate the identification of the highest risk areas, develop important loss estimates, assess response capabilities and gaps, and develop comprehensive strategies to enhance capabilities at all levels of government. Initiative objectives include:

- Improving overall capabilities to respond to and recover from a catastrophic New Madrid Seismic Zone (NMSZ) earthquake and related hazards;
- Developing integrated Federal, State, local, and private sector plans and operational coordination;
- Incorporating lessons from the Hurricane Katrina response, Southeast Louisiana Catastrophic Hurricane Planning, and previous earthquake planning and responses;
- Identifying issues that cannot be resolved based on current capabilities; and
- Proposing recommended courses of action for decision makers.

The Initiative includes four geographically-specific venues that provide cross-planning opportunities: Southeast Louisiana, Florida, California and the NMSZ.

DISASTER OPERATIONS DIRECTORATE: Venue Specific Catastrophic Disaster Response Planning

New Madrid Seismic Zone (NMSZ) Planning

The NMSZ Catastrophic Disaster Response Planning Initiative was selected as a venue to address one of the 15 National Planning Scenarios, "natural disasters-major earthquake" as identified in the National Preparedness Guidelines dated September 2007. The NMSZ Catastrophic Disaster Response Planning Initiative focuses on a "no-notice" major earthquake along the NMSZ. The NMSZ Initiative uses a bottoms-up, grass-roots planning approach with broad stakeholder participation that will help ensure comprehensive plan development, plan enhancements, and a sustainable planning process.

Initiative Participants

Through engaged partnership, FEMA is coordinating with and taking advantage of a broad base of public, private, and academic expertise to develop meaningful catastrophic disaster response plans for the NMSZ.

Key participants include:

- Central United States Earthquake Consortium (CUSEC) and the eight member States;
- Federal Departments and Agencies including the Department of Transportation, the Department of the Interior's U. S. Geological Survey (USGS), Environmental Protection Agency, Department of Health and Human Services, Department of Defense (US Army Corps of Engineers, NORTHCOM, and 5th Army);
- The National Earthquake Hazards Reduction Program (NEHRP) partnership of four Federal agencies: FEMA, the National Institutes of Science and Technology (NIST), the USGS, and the National Science Foundation (NSF);
- DHS: U.S. Coast Guard, National Infrastructure Simulation and Analysis Center (NISAC);

- Local governments in the eight impacted States;
- Business, industry, and voluntary organizations within the eight State NMSZ area;
- Mid-America Earthquake Center (MAEC) at the University of Illinois at Urbana-Champaign;
- Department of Energy's Sandia National Laboratory;
- George Washington University Center for Crisis Disaster and Risk Management;
- US Chamber of Commerce; and
- American Petroleum Institute.

Risk Assessment: Consequences of a NMSZ Earthquake

In the winter of 1811-1812, the central Mississippi River Valley near New Madrid, Missouri was struck by some of the most powerful earthquakes in U.S. history. Other major earthquakes occurred in 1843 and 1895. Today, this region of the central United States has more earthquakes than any other part of the Nation east of the Rockies. The consequences of an earthquake in the NMSZ, similar to those that occurred in 1811-1812 and 1895, would have a significant and wide-ranging impact on the Nation's economy. CUSEC, MAEC, USGS, and FEMA have completed preliminary modeling of the potential impacts of an earthquake in the NMSZ. Estimates of total building loss alone in the area from one earthquake today exceed $70 billion. Approximately 44 million people live in the eight State area, with 12 million in the highest risk areas. Commodities (crude oil and natural gas) which flow via pipeline, rail, highway, and barge through the impacted area would likely be disrupted for a significant period of time and the infrastructure for alternative modes of transportation would likely be damaged as well. Interstate commerce could be bisected at the Mississippi River. Alternative modes of transportation and commerce, even if available, would be resource constrained. Major fiber optic cable routes and the power grid could be disrupted. Economic sectors impacted would include fuel (oil) for the upper Midwest; coal supplies for generation plants in the Southeast and Midwest; food exports; and critical transportation facilities (e.g. Memphis, Tennessee FEDEX Super Hub). Transportation systems would be destroyed or disabled, and the ability to bring in emergency services personnel and supplies from outside the area could be very limited.

Hazards U.S. - Multi-Hazard (HAZUS-MH): Methodology for Estimating Loss

Estimating losses is essential to decision making at all levels of government; it provides a basis for developing mitigation plans and policies, emergency preparedness, and response and recovery planning. FEMA's Mitigation Directorate directed the development of the HAZUS-MH program to estimate potential losses from earthquakes, hurricane winds, and floods. HAZUS-MH uses state-of-the-art Geographic Information Systems (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of earthquakes, hurricane winds, and floods on populations. HAZUS-MH is used to identify vulnerabilities and develop mitigation strategies in the New Madrid region. The MAEC uses HAZUS-MH, in combination with state-of-the-art earthquake science funded through the National Science Foundation, and other tools, to develop the earthquake loss scenarios. The USGS provides ground motion data that is based on a potential repeat of the 1811-12 New Madrid earthquakes. NISAC assesses potential seismic impacts to the Nation's critical infrastructure and economy. FEMA conducts HAZUS-MH user workshops and distributes workshop results to various groups. HAZUS-MH products are used to support disaster activities and are available through the Homeland Security Information Network (HSIN) web portal for information sharing, work product tracking, and guidance development.

Response Initiative Planning Workshops

In March 2007, FEMA kicked off the NMSZ Initiative with the four impacted FEMA Regions, eight States, and CUSEC. FEMA's Regional Interagency Steering Committee (RISC) meetings are used to help coordinate the project with partner Federal Departments and Agencies and the States. FEMA also created an Interagency/Intergovernmental Steering Committee to help ensure coordination and synchronization of planning activities. Additional Federal catastrophic disaster planning efforts with the States have been integrated into this Initiative, and FEMA is providing contractor and planning support to the States, regions, and CUSEC.

The NMSZ Initiative uses unique, scenario-driven, plan development processes carried out through a series of multi-level, functional, and area-specific workshops, including city/geographic area workshops in both urban and rural areas. To guide the development of hazard-specific annexes for the involved States and regions, the workshops bring together local, State, and Federal response operators with emergency planners and other subject matter experts to develop catastrophic response plans based on real-world modeling. Representatives from the entire spectrum of the emergency management community are involved in plan development, which ensures maximum ownership and effectiveness of the plans they may ultimately have to implement. Workshop participants collaborate on development of the plans as if they were responding to an actual incident. This scenario-driven planning concept intersperses planning with exercise phases to test and refine the plans and results in operational and functional plans that are ready for immediate use. The resulting hazard-specific annexes will supplement existing base plans for response and recovery.

Several key products already produced in the NMSZ Initiative include the following:

- ***Capabilities Assessment Summary:*** Overview and summary of the capabilities and shortfalls of the eight NMSZ States, based on detailed assessments for each State.

- ***Federal Interim Contingency Plan:*** Plan developed at the beginning of the NMSZ project to provide interim guidance and structure for a Federal response to a NMSZ earthquake in case one occurs before the project is completed. This Plan will eventually evolve into a more comprehensive, integrated Federal, State, and local plan.

- ***NMSZ Scenarios:*** State-specific "worst case" earthquake scenarios developed to support planning workshops. MAEC developed a report that laid the groundwork for the scenarios.

- ***State and Local Planning Templates:*** Templates to provide the framework for the State and local jurisdictions to develop their specific NMSZ Catastrophic Earthquake Response Plans, either as stand-alone plans or as annexes to existing plans. A template has been completed for Arkansas local jurisdictions and draft templates have been developed for Illinois, Indiana, Kentucky, Mississippi, and Missouri local jurisdictions.

- ***U.S. Chamber of Commerce Workshop & Report:*** A workshop, based on a catastrophic NMSZ earthquake scenario, conducted in June 2007 as a joint effort between the U.S. Chamber of Commerce and FEMA in coordination with the DHS Private Sector Office. The Workshop drew more than 100 participants from the private sector (including Microsoft,

Wal-Mart, Verizon, United Parcel Service, Home Depot, Office Depot, General Electric, and Anheuser-Busch) and voluntary agencies. The Chamber has requested additional opportunities to coordinate with FEMA on the NMSZ Initiative.

- ***Workshop Execution Plans:*** Plans to guide the conduct of each State's Workshop.
- ***Strategic Plan for Execution:*** Plan for carrying out the overall NMSZ Catastrophic Planning Initiative supported by a Joint Project Development Plan.

To date, local workshops and planning activities have been conducted in Arkansas, Indiana, Missouri, Illinois, Kentucky, and Tennessee. Workshops are scheduled in the remaining States next year. These efforts continue today. Regional and final integration workshops are tentatively scheduled for mid-2008. Moving into FY 2009-2010, the NMSZ Initiative will continue with scenario-based training and exercises of the plans. A major command exercise of the NMSZ plans is tentatively scheduled for FY 2011 as the culminating event to coincide with the 200th Anniversary of 1811 New Madrid Earthquake.

In summary, the NMSZ Initiative will ultimately produce a number of highly beneficial products, including:
• A comprehensive catastrophic earthquake planning plan for the central U.S.;
• State, as well as local and regional, NMSZ Catastrophic Earthquake Response Annexes;
• Federal Regional NMSZ Catastrophic Earthquake Response Annexes;
• An overall national plan for a NMSZ earthquake scenario that integrates all of the plans into a single system that can be applied in principle to similar efforts in other States; and
• A plan maintenance schedule and materials for training and exercises of the individual plan annexes and the overall national plan

DISASTER ASSISTANCE DIRECTORATE: Recovery Catastrophic Planning

As the component of FEMA that oversees the delivery and implementation of recovery programs that facilitate the recovery of individuals and State and local governments in the immediate aftermath of a Presidentially-declared disaster, FEMA's Disaster Assistance Directorate's contribution to the Catastrophic Planning Initiative includes evacuation/mass migration, congregate sheltering, housing, debris management, and other recovery operations.

The Robert T. Stafford Disaster Relief and Emergency Assistance Act authorizes the President to issue emergency or major disaster declarations in advance of, or following a natural or terrorist disaster. In October 2006, Congress authorized the Post-Katrina Emergency Management Reform Act, outlining new recovery assistance requirements in the areas of mass care, evacuation support, housing, and human services. FEMA looks at these requirements as enhancements to existing underlying authorities, and recognizes that while some of these solutions may work in one disaster scenario, such as a New Madrid event, in other cases, the needs of the community and the resource and coordination capabilities of State, local, and Federal partners will also contribute to the overall successful implementation of these initiatives.

Evacuation Support Planning
In situations where the State or local government has advance warning of a hazard or disaster event, evacuating the affected population and supporting the displaced disaster victims is of paramount importance. FEMA's Evacuee Support Planning initiative focuses on developing strategies and guidelines for support of mass evacuations and displaced disaster victims through development of planning guidance and a Host-State Evacuee Support Plan template. These planning efforts will enhance operational effectiveness to provide recovery assistance to individuals and households, as well as public assistance to State and local governments in the event of an extraordinary or catastrophic disaster. To ensure the guidance and template realistically address State concerns and operational perspectives, the template will be created and refined from host-State evacuee support plans developed in select States. The host-State evacuee support plans are developed through workshops that employ realistic catastrophic scenarios and consequence estimates which drive discussion and planning, and ultimately the creation of functional, integrated evacuee support plans. The project integrates concurrent catastrophic planning efforts in the New Madrid Seismic Zone (NMSZ) and south Florida. The States which are participating in this project – Arkansas, Georgia, Tennessee, Oklahoma, and Texas – provided significant evacuee support following Hurricane Katrina. As well as being located north of the gulf coast States, they are located in and near the NMSZ and would likely be called upon to assist evacuees in the event of a NMSZ earthquake disaster.

Mass Sheltering and Housing Assistance Recovery Strategy
A catastrophic incident may well result in a self-directed or organized large-scale evacuation, resulting in large displaced populations.

Traditionally, mass care operations are provided by non-profit and local voluntary organizations, such as the American Red Cross, Salvation Army, etc. Our voluntary partners play a critical role in helping applicants find temporary shelter and distributing disaster commodities to meet emergency needs, which are often urgent and magnified. In an effort to improve shelter management and accountability, FEMA and the American Red Cross developed the National Shelter System (NSS). The NSS is a web-based data system that supports shelter management, reporting, and facility identification activities. The system is intended for use by all agencies that provide shelter services during disasters to ensure a comprehensive understanding of the shelter populations and available shelter capacity. In addition, the system provides visibility on large shelter populations and positions FEMA to deliver targeted registration assistance to disaster victims.

Once residents have been evacuated, meeting their immediate emergency needs becomes the next challenge. In July 2006, FEMA announced a Mass Sheltering and Housing Assistance Recovery Strategy which provided guidance and protocols for providing sheltering and housing assistance. While this strategy focuses on assistance associated with large hurricane evacuations, the procedures and underlying processes also may apply to no-notice events, such as major earthquakes. Key elements of the strategy are advance identification of Congregate and Transitional Shelters to provide short-term lodging and Temporary Housing facilities for an extended period of time. Contained within the strategy is a Shelter Registration Protocol which will allow FEMA field personnel to proactively register evacuees at designated congregate shelter locations and organized evacuee reception sites, including those out-of-State. FEMA also

has a Transitional Sheltering Protocol, which may be implemented when large numbers of evacuees are being housed in congregate shelters and will not be able to return to their homes for an extended period of time. In addition to the sheltering protocol, FEMA has an initiative to offer Evacuee Return Transportation, which can be used if FEMA, in support of the affected State, coordinates the out-of-State evacuation of State residents, and the evacuees are able to return to and occupy their homes within a short period of time, FEMA will organize a reverse, mass relocation effort. If evacuees are not able to return to their homes for an extended period of time, eligible evacuees may be reimbursed for independent transportation expenses to return to their homes.

National Emergency Family Registry Locator System and National Child Locator Center
In a large-scale evacuation, families may become unwillingly separated due to urgency of the evacuation, loss of communication systems, and/or the method and type of evacuation assistance made available. To assist displaced disaster victims reconnect with family members and locate missing children, FEMA has established the National Emergency Family Registry Locator System and the National Emergency Child Locator Center. Families and friends will be able to call an 800 number or go to the internet to send or receive messages for selected friends or family members including those in medical facilities. The National Center for Missing and Exploited Children and FEMA have partnered to facilitate the search and the reunification of missing children due to a disaster or evacuation. A Memorandum of Understanding was signed in 2006 by FEMA, the Department of Justice, the National Center for Missing and Exploited Children, and the American Red Cross to further develop and implement methods for quickly identifying and reunifying missing and separated children and family members following a disaster.

Donation Network
In catastrophic incidents, State and local officials may find it difficult to identify, manage, and match donated offers of products, services, and volunteers that pour into disaster stricken areas. FEMA and other components within the Department of Homeland Security worked collaboratively to develop a secure, web-based Aidmatrix network that connects Federal and State/Local Governments, the Private Sector and the Voluntary Sector to incoming donations of donated goods and volunteers. The network provides real-time visibility of donations and enables donors to view the specific needs of voluntary agencies, so that donations can be targeted as appropriate. It also provides real-time visibility into relief warehouse inventory levels, assisting local and State officials to make more informed decisions regarding the donations distribution.

National Disaster Housing Strategy (NDHS)
One of the greatest challenges presented by the scope and scale of catastrophic disasters is the ability to house displaced evacuees. While FEMA facilitated the means for hundreds of thousands of evacuees to quickly secure interim accommodations, and transition those individuals and families into longer-term, and more stable, housing solutions, it was a process filled with difficult decisions and lessons learned.

To further enhance housing capabilities, FEMA has engaged Federal, Tribal, State, and local partners to develop a National Disaster Housing Strategy (NDHS). The purpose of the NDHS is

to convey national guidance, operating principles, and a vision for public (Federal, State, tribal, local), private, and non-profit cooperation in providing disaster housing assistance. It defines the roles, programs, authorities, and responsibilities of all entities, detailing shared responsibilities and emphasizing the cooperative efforts required to provide disaster housing assistance. The NDHS further outlines the most efficient and cost-effective options for meeting disaster housing needs. The NDHS is in the final development stages.

Joint Housing Solutions Group (JHSG)

In 2006, FEMA also launched a Joint Housing Solutions Group (JHSG) charged with identifying viable alternatives to FEMA travel trailers and manufactured homes, and recommending improvements for conducting disaster housing operations. The Joint Housing Solutions Group has developed housing evaluation criteria, a Housing Assessment Tool, and screened, tested and rated more than 100 alternative housing providers and their products ranging from panelized, manufactured, and modular homes to shipping container prototypes. In October 2007, the JHSG released a one year report to identify the milestones of the JHSG Steering Committee. The next step is to pilot test select housing units in order to gauge field performance. We feel this effort is paramount in our ability to offer alternatives to traditional disaster housing modes.

Debris Removal

Following a large-scale disaster, debris removal is a complex operation that requires significant resources and capable officials to manage and accomplish the work. The debris generated can be of such large quantities and varied forms that it stretches, and sometimes exceeds, the limits of a community's capability to effectively and efficiently respond. Debris may be in the form of downed trees, destroyed personal property to include home contents and automobiles, hazardous waste, construction and demolition material, or even boats and vessels that obstruct waterways. Environmental considerations, damage to historic buildings, debris on private property, and demolition of private residences and other facilities are just a few of the issues that further complicate an already challenging task. Creating and executing a plan to remove and dispose of these materials with respect to the myriad of considerations that must be taken into account is a daunting task that requires coordination with numerous governmental entities at all levels of government and, most importantly, with the citizenry of the community.

In most circumstances, debris operations are the responsibility of Tribal, State and local governments. Typically, FEMA is not directly involved and does not contract for or complete any of the debris removal work. In most disasters, FEMA's role is one of providing technical assistance and grant funding through the Public Assistance Program to reimburse the Tribal, State and local governments. While FEMA does not directly manage Tribal, State and local debris operations, it does take an active role in providing technical assistance and oversight and has issued a strategic framework for providing debris removal assistance in support of a Presidentially declared emergency or major disaster. To assist State and local governments identify available debris removal contractors, FEMA created a web-based Debris Removal Contractor Registry. State and local governments, tribal authorities and other eligible Public Assistance applicants such as private nonprofit organizations can use the database registry to find contractors who can do the debris removal work they need. Information is provided and maintained by contractors and their representatives, and allows contractors to describe the equipment and staff they have available. The Federal effort may also include the provision

Direct Federal Assistance, usually in the form of US Army Corps of Engineers (USACE) support. This assistance is designed to address situations where the level of debris is catastrophic in scale, or where the capabilities of the State and/or local government to effectively manage such operations are overwhelmed. Finally, FEMA encourages, and assists States with planning for, coordinating, and managing debris removal operations. FEMA works with States to encourage the use of pre-event contracts and/or arrangements with local or regional debris removal contractors, to assure the immediate availability of coordinated debris removal support following a disaster.

Conclusion

The NMSZ Initiative offers significant benefits including extensive cross-disciplinary and inter-disciplinary participation. Our planning process is helping to broaden the scope of existing planning to include economic stabilization and post-disaster redevelopment and is fostering the development of more integrated and cohesive plans that can address all hazards. The lessons learned from the NMSZ Initiative will be exported to other catastrophic planning venues across the Nation. This concludes my testimony, and I am pleased to answer your questions.

TESTIMONY OF

DR. JOHN R. HAYES, JR.

DIRECTOR

NATIONAL EARTHQUAKE HAZARDS REDUCTION PROGRAM

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

U.S. DEPARTMENT OF COMMERCE

BEFORE THE

UNITED STATES SENATE

COMMITTEE ON HOMELAND SECURITY AND GOVERNMENT AFFAIRS

AD HOC SUBCOMMITTEE ON STATE, LOCAL, AND PRIVATE SECTOR PREPAREDNESS AND INTEGRATION

HEARING ON

"THE NEW MADRID SEISMIC ZONE: WHOSE FAULT IS IT ANYWAY?"

DECEMBER 4, 2007

INTRODUCTION

Chairman Pryor, Ranking Member Sununu and Members of the Subcommittee, thank you for conducting this hearing on the impact that a major earthquake in the New Madrid seismic zone would have on the Nation and what can be done to prepare for and mitigate those impacts. The New Madrid seismic zone covers parts of eight states: Illinois, Missouri, Arkansas, Kentucky, Tennessee, Indiana, Alabama and Louisiana. I appreciate the opportunity to appear before you today, to discuss both the overall coordination activity of the National Earthquake Hazards Reduction Program (NEHRP) and the research program that supports NEHRP at the National Institute of Standards and Technology (NIST). NEHRP addresses the earthquake threat for the entire Nation and of course, the New Madrid region is one of the areas of potential major seismic activity. As you know, NEHRP is an interagency effort involving the National Science Foundation (NSF), the Department of Homeland Security's Federal Emergency Management Agency (FEMA), the U.S. Geological Survey, and the National Institute of Standards and Technology (NIST). I shall break my presentation into three broad areas – an overview of NEHRP, a summary of recent NEHRP coordination activities, and, finally, a brief description of the role that NIST plays in NEHRP.

It is important to set the stage for this brief discussion by mentioning that:

- Earthquakes strike without warning – there is no "getting out of the way" or the opportunity to pre-positioning emergency relief supplies as can be done with hurricanes.

- Damaging earthquakes have struck in many places around the U.S. - within the past 200 years, very large magnitude, potentially damaging earthquakes have occurred in Alaska, California, South Carolina, and the New Madrid region. There is paleoseismic evidence that such earthquakes have occurred in the more distant past in the Pacific Northwest, Utah, and other areas. A 2006 report from the National Research Council[1] noted that 75 million people and 50 percent of the total number of buildings that have been constructed in the U.S., worth $8.6 trillion in 2003 dollars, are located in areas of the U.S. that are prone to damaging earthquakes.

- The U.S. has been relatively fortunate in recent years not to have had hugely damaging earthquakes. But, considering the significant changes to the "built environment" (buildings and other infrastructure), higher population densities, and much higher societal interconnectivity, the consequences of earthquakes such as those that are known to have occurred in the past and are projected by experts to happen again could lead to a catastrophic disaster; beyond the obvious potential for injury and loss of life, the economic and national security consequences are huge. In the New Madrid region, for example, the relatively brief economic impacts of the 1993 Mississippi River floods on cross-river rail and highway transportation give but a minor glimpse of what could happen in long-term earthquake-induced losses of multiple major bridges or fuel pipelines. Experts consistently estimate that a "big one" that strikes a major U.S. urban area may cause over $100 billion in losses.

[1] *Improved Seismic Monitoring, Improved Decision-Making: Assessing the Value of Reduced Uncertainty*, National Research Council, 2006.

NEHRP provides technical assistance for pre-earthquake mitigation activities by State and local governments, industry, and the private sector. NERHP -- as opposed to several of the NEHRP agencies -- has no operational responsibilities for planning and responding to earthquakes, but in the aftermath of an earthquake, NEHRP resources provide notifications and assessments. Following is a brief discussion of the statutory basis for NEHRP.

AN OVERVIEW OF NEHRP

Created in 1977 and most recently reauthorized in 2004 (P.L. 108-360), NEHRP is national in scope. As delineated in the reauthorization, the three overarching NEHRP program activities are to:

- Improve the understanding of earthquakes and their effects on communities, buildings, structures, and lifelines, through interdisciplinary research that involves engineering, natural sciences, and social and economic sciences;

- Develop effective measures for earthquake hazards reduction; and,

- Promote the adoption of earthquake hazards reduction measures by federal, state, and local governments, national standards and model (building) code organizations, architects and engineers, building owners, and others with a role in planning and constructing buildings, structures, and lifelines.

The 2004 reauthorization delineated a fourth program activity that effectively supports the first three activities: develop, operate, and maintain an Advanced National Seismic System (ANSS); the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES); and the Global Seismographic Network (GSN).

By statute, there are four NEHRP agencies: FEMA, NSF, NIST, and the USGS. Through the series of reauthorizations of NEHRP since 1977, the Congress has clearly indicated that NEHRP will provide better earthquake preparedness for the Nation through the synergies gained by interagency coordination and cooperation than would be accomplished by the agencies if they worked separately. The directors of the agencies share this belief and are striving to provide continuous improvement in the agencies' cooperative efforts.

The NEHRP agency leaders' commitment to the program's vision is reflected in NEHRP's Mission Statement:

> *To work in multi-disciplinary interagency partnerships with end users to create an earthquake-resilient Nation by developing and implementing risk reduction knowledge, tools, and practices that enhance public safety, economic strength, and national security.*

In accomplishing the statutory program activities, the four agencies have the following general responsibilities:

• Federal Emergency Management Agency works to translate research and development results into cost-effective loss reduction measures at State and local government levels, develops risk reduction tools and measures, prepares technical guidance for new and existing buildings and lifelines, prepares and disseminates information about building codes and practices, supports public-private partnerships to improve disaster resilience, helps decision makers by providing estimates of potential losses, and develops and supports public education that increases public awareness. Through cooperative agreements, FEMA's Mitigation Directorate supports the Central United States Earthquake Consortium (CUSEC), which is headquartered in Memphis, and other regional consortia around the U.S. CUSEC augments individual State capabilities by facilitating interstate (regional) coordination and information sharing, implementing risk reduction activities, gathering and disseminating earthquake-related information, developing private sector partnerships that support mitigation activities, and facilitating delivery of professional training. FEMA's Disaster Operations Directorate is presenting information at this hearing on its non-NEHRP activities in the New Madrid region, including ongoing development of extensive catastrophic earthquake planning exercise scenarios for localities throughout the New Madrid region.

• The National Institute of Standards and Technology performs problem-focused research and development to improve building codes and standards for new and existing buildings and lifelines, advances seismic-resistant construction practices, develops measurement and prediction tools supporting construction performance standards, and evaluates advanced technologies for improved and cost effective earthquake resistant construction. In the recent reauthorization, Congress directed NIST to assume the NEHRP Program Lead Agency role.

• National Science Foundation supports a broad range of basic research covering geoscience, engineering, economic and social science aspects and impacts of earthquakes through projects conducted by individual researchers, research teams, university-based centers and consortia, and non-profit organizations. NSF-funded research investigates the causes and dynamics of earthquakes, plate tectonics, and crustal deformation; the seismic performance of geotechnical, structural, nonstructural, and lifeline systems; and the social, behavioral, and economic aspects of earthquake hazard mitigation. NSF also supports the collection and distribution of seismographic data through an award to the Incorporated Research Institutions for Seismology and the operation of advanced earthquake engineering research experimental facilities and cyberinfrastructure through an award to NEES Consortium, Inc. NSF-funded projects support the education of new scientists and engineers, integration of research and education, and outreach to professionals and the general public. During 1997 – 2007, NSF supported three earthquake engineering research centers. One of these three centers, the Mid-America Earthquake Center, headquartered at the University of Illinois at Urbana-Champaign, includes member institutions throughout the New Madrid region. The Mid-America Earthquake Center has provided seminars to public officials, government agencies, school boards, business communities, and students of all ages on the earthquake hazard in Mid-America and on the state-of-the-art technologies developed by the Center for addressing this hazard.

• The U.S. Geological Survey conducts and supports basic and applied earth science investigations, produces national and regional seismic hazards assessments, performs ground

shaking studies, monitors earthquake activity in the U.S. and abroad, works with stakeholders to facilitate knowledge transfer, and coordinates post-earthquake reconnaissance.

Figure 1 on page 8 of this testimony provides a graphic representation of the NEHRP agencies' interactions in accomplishing the program mission.

With respect to this hearing, two additional points are very important in providing an overview of NEHRP.

First, as indicated by the statutory program activities, the NEHRP role is almost entirely one of technical support for pre-earthquake mitigation measures and post-earthquake notifications and assessments. Largely through roles that are specified in the Stafford Act (P.L. 93-288) and the National Response Plan, both FEMA and USGS are involved in operational planning and post-earthquake response activities. The NEHRP reauthorization requires FEMA to develop, coordinate, and execute the National Response Plan following earthquakes, but that legislation otherwise does not address operational planning and response issues. Both FEMA and USGS are providing their perspectives on these responsibilities in their presentations.

Second, NEHRP addresses the earthquake threat for the entire Nation. The New Madrid region is certainly one of the prime focus areas and is of major concern. Significant earthquake activity that occurred there slightly less than 200 years ago produced widespread damage that would be much worse today because of the significantly increased development and urbanization in the area. Paleoseismic research indicates that such earthquakes do recur there, if infrequently.

These earthquake-related research activities include the USGS earthquake activity mapping efforts covering the entire nation as well as NSF research in geosciences, engineering, and social and economic sciences that study seismic issues throughout the United States including the New Madird region. FEMA works directly with organizations involved in drafting national model building codes to provide recommended earthquake-resistant design provisions for buildings and other structures. These recommendations are used to develop the earthquake-resistant design provisions for national model building codes that are adopted in whole or in part by all 50 States.

RECENT NEHRP COORDINATION ACTIVITIES

In addition to outlining program activities and individual agency responsibilities, the recent NEHRP reauthorization directed several key new program developments.

The reauthorization directed the formation of an Interagency Coordinating Committee (ICC) and an Advisory Committee for Earthquake Hazards Reduction (ACEHR).

The ICC, which is composed of the directors of the four program agencies, as well as the directors of the Office of Science and Technology Policy and the Office of Management and Budget, has met five times since its formation in April 2006. The ICC released its first annual report to the Congress on NEHRP accomplishments and budgets in early 2007. The ICC has also approved the outline for a new NEHRP Strategic Plan that is now under development. The reauthorization requires annual program reports, as well as the new plan. The plan will endorse

several key areas of needed program emphasis that were determined by the ICC through a number of internal analyses in 2006, including:

- Development of performance-based seismic engineering (PBSE) tools;
- Development and promoting implementation of cost-effective retrofit measures for existing buildings;
- Fielding of the entire planned Advanced National Seismic System;
- Development and promotion of earthquake scenarios;
- Development of a post-earthquake information management system for use by both researchers and practitioners;
- Renewed emphasis on mitigation grants to States and localities;
- Support for applied research linking basic research with field application; and
- Increased application of the social sciences in earthquake mitigation activities.

The ACEHR exists to advise the ICC Chairperson (the NIST Director) on the technical direction of the program. Following a rigorous nomination process, the ACEHR was formed in early 2007 and has now met twice. The national earthquake professional community responded enthusiastically to calls for ACEHR nominations, making the member selection process very challenging (over 85 nominations were received for 15 committee seats), but one that resulted in a balanced and diverse group of experts in key earthquake-related professional fields, from state and local governments, academia, and the private sector. At its most recent meeting in October 2007, the ACEHR was briefed on the ICC-approved Strategic Plan outline and provided detailed feedback that is being used to improve and refine the plan.

The ICC expects to complete the new Strategic Plan in early to mid-2008, following a period of public comment. The ICC will also release the second annual report. The 2004 reauthorization further directs the development of a Management Plan that implements the Strategic Plan, as well as a coordinated interagency budget. The Management Plan will be developed following the release of the Strategic Plan, and the ICC recently approved an interagency budget coordination process that will be implemented with the development of the 2010 agency budgets. The process respects the roles of the separate Congressional appropriations committees that have jurisdiction over the budgets of the four agencies.

In its new role as Lead Agency for the Program, NIST was directed to plan and coordinate the program, including leading activities to ensure that the program includes all steps needed to promote implementation of earthquake hazard reduction measures, supporting the development and commercial application of performance-based seismic engineering (PBSE) tools, requesting assistance from other Federal agencies as needed, and developing comprehensive plans for earthquake engineering research.

To support its lead agency role, NIST established in early 2006 the NEHRP Program Office, or Secretariat, within its Building and Fire Research Laboratory (BFRL). The Secretariat addresses

program planning and coordination activities and has created a web site, www.nehrp.gov, to provide a communication conduit to earthquake professionals and the public.

Over the past twenty years, NEHRP, principally through the efforts of FEMA, has developed a well-integrated process for working with the national model building code organizations through the Washington-based Building Seismic Safety Council (BSSC) to ensure efficient implementation of earthquake-resistant construction techniques. FEMA has begun working with the earthquake professional community to develop a first generation of PBSE guidelines, based on knowledge that is available today, and the four NEHRP agencies are working together with the earthquake professional community to develop a plan for research and further development of PBSE. NIST, NSF, and USGS are all actively engaged in developing plans for needed earthquake engineering research.

THE RESEARCH ROLE OF NIST WITHIN NEHRP

Two of the four NEHRP agencies, NIST and NSF, have research as their primary NEHRP missions. NSF is responsible for sponsoring most of the basic, or fundamental, engineering research that is performed at academic institutions around the U.S. (both NSF and USGS support geoscience research). NIST is responsible for performing applied, or problem-focused, engineering research. Engineers in the private sector describe the applied research work as "bridging a knowledge gap" that has existed between fundamental science and engineering knowledge (products of the NSF-sponsored research) and its practical application for cost-effective design and construction of earthquake-resistant structures (via supporting implementation of new or improved practices, standards, and building codes, which is primarily a FEMA responsibility). This research is consistent with the NIST BFRL mission of promoting U.S. innovation and competitiveness by anticipating and meeting the measurement science, standards, and technology needs of the U.S. building and fire safety industries in ways that enhance economic security and improve the quality of life. Fulfilling this mission involves creating critical solution-enabling tools (metrics, models, and knowledge) and promoting performance-based standards that are used by the U.S. building and fire safety industries.

Until Fiscal Year 2007 (FY07), funding had not existed to support the stated NIST NEHRP research role. In FY07, Congress appropriated $800,000 of new monies in the NIST budget that allowed NIST to initiate NEHRP research. In the FY08 budget request, the President added another $4.75M for NIST NEHRP research. With the requested FY08 budget increase, NIST would be in a position to undertake a substantial program of coordinated in-house and extramural NEHRP research.

CONCLUSION

This testimony provided a brief overview of NEHRP, and NIST's role in NEHRP. NEHRP provides technical assistance for pre-earthquake mitigation activities by State and local governments, industry, and the private sector, around the U.S. Those activities take on many forms, including basic and applied research, seismological data gathering and synthesis, transfer of knowledge regarding earthquake hazards and cost-effective building practices, support for

national model building code development, and education that extends from K-12 to the collegiate level, to earthquake practitioners, and to the public-at-large.

While NEHRP is national in scope, issues related to the New Madrid region are certainly very significant to the program. As stated in the USGS testimony, there is much that remains to be learned about the earthquake hazard in the heartland, but what we know highlights many needs for greater preparedness and mitigation. We in NEHRP fully intend to continue our efforts to increase the disaster resilience of all areas, including Mid-America.

It has been my pleasure to provide this brief overview of NEHRP. Thank you very much for your attention. I will be happy to answer any questions you may have.

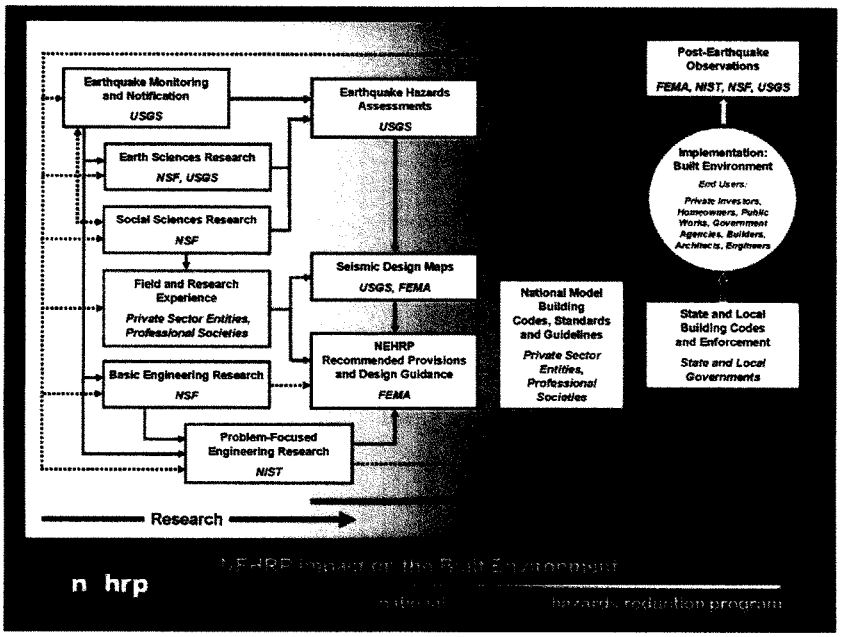


Figure 1 NEHRP Activities that Impact the Built Environment.

STATEMENT OF
DR. DAVID APPLEGATE
U.S. GEOLOGICAL SURVEY
U.S. DEPARTMENT OF THE INTERIOR
BEFORE THE
COMMITTEE ON HOMELAND SECURITY AND GOVERNMENT AFFAIRS
AD HOC SUBCOMMITTEE ON STATE, LOCAL, AND PRIVATE SECTOR
PREPAREDNESS AND INTEGRATION
UNITED STATES SENATE
DECEMBER 4, 2007

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to testify at this hearing on the impacts that a major earthquake in the New Madrid seismic zone would have on the Nation and what can be done to prepare for and mitigate those impacts. My testimony will focus on the role of the USGS and our coordination with other Federal agencies, particularly FEMA; will address differences between the New Madrid seismic zone and other active faults around the country; and will provide an overview of USGS work in monitoring and notification of seismic activity.

From today's perspective, the three large earthquakes that struck the lower Mississippi Valley in the winter of 1811 and 1812 seem quite distant in time – but infrequent events nevertheless represent very real risks. If the New Madrid earthquakes of 1811-1812 were to recur today, significant damage to buildings, transportation, and critical infrastructure would occur in at least eight states, resulting in loss of life and economic disruption. While earthquakes are inevitable, their consequences on our built environment are not, and there is much that we can do as a Nation to improve our resilience to these and other natural hazards.

At the U.S. Geological Survey (USGS), we strive to deliver the information and tools that emergency managers, public officials and citizens need to prevent natural hazards from becoming disasters. The USGS has the lead Federal responsibility under the Stafford Act (P.L. 93-288) to provide notification – including forecasts and warnings where possible – for earthquakes, volcanoes and landslides. The USGS is a partner in the congressionally established National Earthquake Hazards Reduction Program (NEHRP) along with the Federal Emergency Management Agency (FEMA), the National Institute of Standards and Technology (the lead agency), and the National Science Foundation (NSF). In collaboration with these Federal partners plus state and local governments and universities, USGS reports on earthquake size, location, and shaking intensity; develops regional and national hazard assessment maps and related products; supports targeted research to improve these products; and builds public awareness of earthquake hazards. Along with our NEHRP partners, USGS is committed to translating research results into actions that can reduce earthquake losses.

Why Are There Earthquakes in the Central United States?

Most earthquakes occur where the brittle plates that form the Earth's crust and uppermost mantle interact, either pressing together, pulling apart, or sliding by one another. Such is the case with California's San Andreas Fault, where the plate that underlies the Pacific Ocean is sliding past the North American plate, and with the subduction zones off the Pacific Northwest and Alaska, where plate collision is forcing oceanic crust to slide beneath North America, generating giant earthquakes and active volcanic chains.

But earthquakes also occur far from present-day tectonic plate boundaries as the stresses from those plate interactions are translated into the more stable interiors. Such intraplate earthquakes in the central and eastern United States are less frequent than earthquakes in California or Alaska, but the hazard they pose is by some measures equally significant. The older, colder crust in the central and eastern United States allows earthquake waves to travel much farther and thereby affect much larger areas than earthquakes of comparable size in the west. That is the case with the New Madrid seismic zone, which stretches from just west of Memphis, Tennessee, up into southern Illinois. Another geologic factor increasing the hazard from New Madrid earthquakes is that earthquake waves tend to be amplified by the soft soils of the Mississippi Valley, adding to the intensity of shaking experienced by communities there.

All these factors came into play during a two-month period in 1811 and 1812 when three earthquakes with moment magnitudes estimated at between 7.5 and 8.0 had a profound effect on the region and were felt as far away as the eastern seaboard. Thousands of aftershocks followed and continued for decades. Although few people lived in the region at the time, the effects on the landscape remain clear nearly two centuries later. These effects include sand blows, formed when strong shaking from a large earthquake caused wet, loose sand deposits to lose cohesion and – acting like a liquid – erupt onto the ground surface through overlying silt and clay layers. Studies of such sand blows show that similar sequences of major earthquakes have happened at least twice before, in about 1450 A.D. and 900 A.D.

Based on geologic research on the paleoseismic record of past earthquakes, the USGS estimates that there is a 7 to 10 percent chance of a New Madrid earthquake the size of those in 1811-12 occurring in the next 50 years. However, the occurrence of even a moderate-sized earthquake located in close proximity to urban centers such as Memphis or St. Louis could be locally devastating. The last magnitude-6 earthquake struck near Charleston, Missouri, in 1895. The chance of such an earthquake occurring in the New Madrid region in the next 50 years is 25 to 40 percent.

These probabilities are derived from the USGS National Seismic Hazard Maps, which are developed from geologic information about faults, evidence of prehistoric earthquakes, instrumental and historical earthquake catalogs generated by seismic monitoring, and ground deformation measurements. The National Seismic Hazard Maps are used to estimate probabilities of large earthquakes and the ground shaking to be expected if those earthquakes occur.

An important facet of the NEHRP partnership is the cooperation between the USGS and FEMA to incorporate these seismic hazard maps into model building codes. These USGS maps are the basis for seismic design maps in the International Building Code and the International

Residential Code, which have been adopted in almost all states. The newest version of these maps has recently been delivered to the Building Seismic Safety Council for incorporation into the next generation of model building codes. Seismic hazard maps are also used in the design of bridges, dams, and other critical facilities; for loss estimation studies; and to set premiums for earthquake insurance.

The USGS has recently begun developing higher-resolution maps and other products that focus on the most vulnerable urban areas. In the central and eastern United States, these include Memphis, St. Louis, and Evansville, Indiana, which is in the Wabash Valley seismic zone along the southern border of Illinois and Indiana. Such maps require detailed mapping of surficial geology and knowledge of sub-surface geology in order to incorporate the local effects into estimates of shaking. They are useful for prioritizing retrofitting of unreinforced masonry buildings, initial seismic design of structures, and urban planning. Urban hazard mapping in the central United States involves a number of state and university partners including St. Louis University, the Illinois State Geological Survey, the Missouri Department of Natural Resources, the Kentucky Geological Survey, the University of Missouri at Rolla, the University of Memphis, and the Indiana Geological Survey.

Delivering Rapid Information for Emergency Response

Just as knowing where earthquakes occur can lead to building codes that save lives through a more resilient built environment, knowing where shaking is most intense immediately after an earthquake also can save lives by providing emergency responders with the situational awareness they need to concentrate their efforts where they matter most.

For that reason, the USGS and our partners have been building the Advanced National Seismic System (ANSS) to modernize the Nation's seismic monitoring infrastructure and provide, within minutes, information about strong shaking and probable damage. The ANSS consists of a national backbone network, regional networks, a 24/7-staffed National Earthquake Information Center, and ground- and structure-based instruments concentrated in high-hazard urban areas. Currently about 15 percent deployed, the ANSS has already greatly improved information available for emergency responders, engineering performance studies, and long-term earthquake hazard assessments.

The USGS provides rapid reports of potentially damaging earthquakes to the National Command Center; the White House; the Departments of Defense, Homeland Security (including FEMA), Transportation, Energy, and the Interior; State and local emergency managers; numerous public and private infrastructure management centers (for example railroads and pipelines); the news media, and the public. These earthquake notifications are delivered as e-mails and text messages to over 100,000 users. A suite of information products are available through the USGS Earthquake Hazards Program website, which receives an average of two million hits per day. For undersea earthquakes, USGS also provides near-real-time seismic data to the National Oceanic and Atmospheric Administration tsunami warning centers, supporting their monitoring and notification mission.

In the central United States, earthquake monitoring is accomplished cooperatively by the USGS, the Center for Earthquake Research and Information at the University of Memphis, St. Louis University, and the University of Kentucky. The ANSS Mid-America Region includes the New Madrid and Wabash Valley seismic zones, as well as ANSS urban strong-motion monitoring targets of Memphis, St. Louis, and Evansville. There currently are 200 real-time seismic stations in the central United States., only 70 of which meet modern standards. Over 500 seismic stations are planned for the central United States. These regional networks process approximately 200 earthquakes for the New Madrid seismic zone annually. The ANSS Mid-America Region also encompasses the East Tennessee and South Carolina seismic zones that pose a threat to Alabama, Georgia, South Carolina, North Carolina, Virginia, West Virginia, Kentucky, and Tennessee. In these areas, roughly 40 stations are processed in real-time to provide information on about 70 earthquakes annually.

Within five minutes after a potentially damaging earthquake in the central United States, notifications are sent to local, state, and Federal emergency management officials and others with the epicenter and preliminary magnitude of the earthquake. Within 20 minutes, an initial ShakeMap is released showing areas of expected higher ground shaking for use in emergency response, utilities, business recovery, and public awareness. Within 60 minutes after the earthquake, seismograms have been analyzed to determine the geometry of the fault, and an improved ShakeMap is released. With ANSS only partially deployed, these ShakeMaps are primarily model-based rather than data-based, due to the sparse and heterogeneous station coverage in the region. As additional sensors are installed, these maps will improve in resolution and accuracy.

Three months ago, the USGS began delivering a new product, known as Prompt Assessment of Global Earthquakes for Response (PAGER), which provides rapid estimates of population exposure to shaking in the same timeframe as ShakeMap. The PAGER system overlays the estimated shaking intensity with a global population database to estimate population impact. This gives emergency responders and aid agencies a rapid estimate of the extent of the likely response required. Such information is particularly valuable in cases where communications may be down. Domestically, PAGER complements the rapid loss estimates that are generated using FEMA's HAZUS software in conjunction with USGS ShakeMaps.

Using Scenarios to Better Understand What is at Risk

The actions we as a society take before hazardous events strike are even more important than how we respond in the aftermath of a natural disaster. In addition to the geologic factors that raise the hazard from intraplate earthquakes, an important reason why central U.S. earthquakes can be particularly devastating is that the impacted communities are less prepared than their west coast counterparts. Most of the buildings and infrastructure were built without consideration of seismic shaking, in large part because it has been so long since the last damaging earthquakes in the region. In the New Madrid seismic zone, the challenge to strengthen or replace the many vulnerable structures is compounded by the large numbers of jurisdictions that would be affected by a large earthquake.

Scenarios are a tool that can help make such hazards more real by detailing the likely consequences of a repeat New Madrid earthquake sequence on today's society, where the hundreds of settlers in 1811-12 have been replaced by millions of residents in cities, towns, and farms across the region as well as a complicated, interconnected infrastructure that serves not only the local population but the Nation as a whole. The information in a scenario can be used to reduce the vulnerability of lifelines, retrofit critical structures, improve monitoring systems, plan emergency response, and educate our citizens.

Scenarios are being used by FEMA and others to carry out more realistic preparedness exercises. This year's Spills of National Significance (SONS) exercise, which used a New Madrid earthquake scenario developed by the USGS and partners as its trigger for testing spill response, and FEMA's upcoming catastrophic planning exercise based on a New Madrid earthquake, should improve preparedness in the region.

The impacts of an earthquake of magnitude of 7.5 or greater in the New Madrid seismic zone are daunting, starting with significant structural damage to buildings in Arkansas, Mississippi, Alabama, Tennessee, Kentucky, Indiana, Illinois, and Missouri. Lifelines crossing the region, including highways, bridges, and oil and gas pipelines leading to the northeastern United States., would be severely damaged, particularly in the Mississippi Valley. If the earthquakes were to occur when the Ohio and Mississippi Rivers were high, loss of levees would be likely, along with flooding of low-lying communities. The City of Memphis, with over one million people in its metropolitan area, would be the most affected urban center. Memphis has an aging infrastructure, and many of its large buildings, including unreinforced schools and fire and police stations, are particularly fragile when subjected to severe ground shaking. Very few buildings were built using modern building codes that have some provision for seismic-resistant design.

Earthquake hazards involve more than just seismic shaking. The 1811 and 1812 earthquakes caused landslides along the bluffs from Mississippi to Kentucky. Today a repeat event could be expected to produce similar effects in downtown Memphis. At least one highway and one railroad bridge crossing the Mississippi River are unlikely to survive a major New Madrid earthquake, and many old overpasses would likely collapse. A significant hazard in the New Madrid region is a type of ground failure called liquefaction, which in 1811 and 1812 affected a region from south of Memphis to St. Louis. Liquefaction causes soil to flow and form deep cracks that may make roadways in the Mississippi Valley of Arkansas and Missouri (such as I-55) impassible. Liquefaction can cause flooding of fields and roads with water, sand, and mud, disrupting agriculture for an extended period of time. Liquefaction and failure of levees and riverbanks could make the Mississippi River unnavigable for many weeks. Although Memphis is likely to be the focus of major damage in the region, St. Louis, Little Rock and many small and medium-sized cities would also sustain damage.

One characteristic of New Madrid earthquakes is particularly noteworthy. Geologic evidence suggests that the sequence of three large earthquakes in a two-month period in 1811 and 1812 is characteristic of the region. This means that during recovery efforts, subsequent earthquakes as strong as the first shock, rather than just weaker aftershocks, must be considered when deciding where to feed and shelter people and when to start rebuilding.

Much more detailed scenarios are being developed for the forthcoming catastrophic planning exercise being undertaken by FEMA in conjunction with the Mid-America Earthquake Center headquartered at the University of Illinois at Urbana-Champaign as well as by the Earthquake Engineering Research Institute (EERI). This scenario will be similar to the one that EERI produced for a major earthquake striking Seattle.

Building Public Awareness

The citizens of this region will bear the brunt of a future New Madrid earthquake. They need to be educated on the likely consequences of earthquakes, how to recognize a safe building, the importance of retrofitting and how to respond safely. In particular, there is a need to educate people on how to better secure the contents of their homes and workplaces. Damage to contents caused $12 billion of the $40 billion in losses in the 1994 Northridge earthquake that struck southern California.

Through the Central U.S. Earthquake Consortium, the USGS and FEMA are working with state emergency management agencies, departments of transportation, and geological surveys to provide information that they can use in their planning and public education efforts. Activities include developing shaking scenarios for state and local exercises, sponsoring field trips for state and local officials and the business community, and holding local earthquake town hall meetings and other public forums throughout the region. Additional efforts include participating in earthquake awareness week activities, maintaining a Public Earthquake Resource Center at the USGS office at the University of Memphis Center for Earthquake Research and Information, and preparing and distributing educational and informational materials.

Scientific Questions Remain

An integrated picture of what will happen in a future New Madrid seismic zone earthquake -- from rupture on the fault to shaking and damage of buildings and infrastructure -- requires research on all aspects of the earthquake process. Such research may include: mapping the near-surface geology in the urban region; determining the location and geometry of all hazardous faults; measuring the seismic wave speed across the range of near-surface materials; and deploying ANSS sensors in the ground to quantify the way earthquake waves travel in the region and in key engineered structures to better predict how they will respond to severe shaking. These results would provide a more complete picture of where mitigation would do the most good and would better support emergency response. Scientific analysis reduces uncertainty, and further engineering evaluation will help reveal the actual level of vulnerability in our built environment and help prioritize retrofitting. A few of the research questions that the USGS and its NEHRP partners are pursuing include:

- What is the full extent of the New Madrid seismic zone? We are searching for additional geologic evidence, using seismic and geophysical exploration methods to identify active fault systems.
- Are there other areas in mid-America besides the New Madrid zone that can produce large earthquakes? How often do they occur? We know that the Wabash Valley seismic zone has magnitude 6.5 or greater earthquakes with about a 4,000-year recurrence. The

search continues for geological and geophysical evidence that can reduce uncertainty with regard to the timing of prehistoric earthquakes and active fault systems.

- Can we identify areas of high hazard using GPS measurements of ground deformation? In contrast to plate boundaries like California's San Andreas fault, where the rate of major earthquakes is predictable based on measured deformation, large earthquakes in the New Madrid region seem to happen much more frequently than predicted from GPS measurements of ground deformation. The USGS and NSF are supporting research and monitoring activities to better constrain these ground-deformation rates and better understand the process that leads to earthquake rupture in this intraplate setting.
- What level of ground shaking can we expect from future large earthquakes? Data from an expanded ANSS will improve ShakeMap and urban hazard maps. Additional work is needed to measure and map the properties of soils that amplify ground shaking.
- What information is most needed by local officials to promote and prioritize mitigation actions, and by emergency managers to best respond when an earthquake strikes?

Conclusion

While there is still much that we do not know about the earthquake hazard in the heartland, we could significantly improve the resilience of our society and economy through greater preparedness and targeted mitigation. In the future, earthquake monitoring and long-term data and information collection activities will continue to be crucial for decisionmakers seeking to ensure public safety.

Mr. Chairman, this concludes my remarks. I will be pleased to answer any questions you may have.

Statement of

David Maxwell

Director

Arkansas Department of Emergency Management

And

Vice Chair

Central United States Earthquake Consortium

Before the

Ad Hoc Subcommittee on State, Local and Private Sector Preparedness and Integration

Committee on Homeland Security

United States Senate

Hearing on "The New Madrid Seismic Zone: Whose Fault is it Anyway?"

December 4, 2007

Washington, DC

Thank you Chairman Pryor, Senator Sununu and other members of the subcommittee. I appreciate the opportunity to appear before you today. I am David Maxwell, Director of the Arkansas Department of Emergency Management (ADEM) as well as the current Vice Chair for the Central United States Earthquake Consortium (CUSEC). ADEM's role in planning for an earthquake along the New Madrid seismic zone falls in two areas. The first and primary area of focus is to establish and implement an earthquake preparedness program to ensure the safety and wellbeing of the citizens of Arkansas from the risk associated with earthquakes within the state, and secondly to address those aspects outside the state which would certainly have a direct effect on Arkansas. We take an all hazards approach when planning and perform a gap analysis for specific hazards where needed. This requires the full cooperation of all other state and local government agencies, departments and personnel. CUSEC serves as the "coordinating hub" for the region, performing the critical role of coordinating multi-state efforts of the central region. While each individual state is the primary implementer of emergency management functions, CUSEC's role is largely facilitative in uniting and coordinating actions of the eight states in the New Madrid Seismic Zone (NMSZ) Alabama, Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri and Tennessee.

In 1977 Congress enacted the Earthquake Hazards Reduction Act in recognition of the fact that earthquakes pose the greatest potential threat of any single-event natural hazard confronting the nation. It directed the President to "establish and maintain an effective earthquake hazards reduction program." In doing this, Congress created the National Earthquake Hazards Reduction Program which gives the responsibility to the federal government to provide direction, coordination, research and other support to efforts aimed at earthquake hazard mitigation and preparedness. The Federal Emergency Management Agency (FEMA), the United States Geological Survey (USGS), the National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST) were assigned specific roles. While national attention focused on high-risk areas such as California, the late Dr. Otto Nuttli of St. Louis University was pioneering research on the danger of earthquakes in the central United States. His research provided the conclusive evidence that prompted the creation of CUSEC in 1983. FEMA in full cooperation with the states most at risk from a NM seismic event laid the ground work for the formation of the CUSEC in 1983. This partnership was built around four goal areas: public outreach and education, multi-state planning, mitigation and application of research to address the hazard and associated risk... The primary mission is "...the reduction of deaths, injuries, property damage and economic losses resulting from earthquakes in the central United States." Authority for CUSEC is vested in the Board of Directors, which is composed of the directors of emergency management for the eight member states.

As a member of the Governor's cabinet through my work with ADEM, we are heavily engaged in planning both preparation and response for both natural and man-made disasters within the state. We have held two table top exercises with Governor's staff, cabinet members and department heads, preparing for events that would follow a catastrophic earthquake along New Madrid. The last such exercise was held as recently as November 9th.

Being the Director at ADEM, I oversee every aspect of emergency management for the state of Arkansas. This includes the planning, mitigation, response and recovery efforts for an earthquake.

As part of our planning for worst case scenario, we have expanded our planning effort to 34 counties instead of the original 24. We conducted scenario driven earthquake workshops over the summer focusing on what is expected to happen should a 7.7 magnitude earthquake occur. According to U.S. Geological Survey, this is the most appropriate "characteristic" earthquake scenario. Here are just a few of the things that may happen:

The central U.S. serves as a major transportation corridor and it would be highly probable that transportation through the region would almost surely come to an abrupt stop. Coupled with this the major oil and petroleum pipelines crossing the region as well as the potential losses to the electrical grid that controls large areas of the central and eastern U.S. makes this not only a local/state problem but a national one as well.. . Unlike other areas which have experienced damaging seismic events the residents of the central U.S. are unprepared emotionally to face the devastating effects brought on by a seismic event.

Loss estimates using HAZUS-MH

- 34 County Study Region
- Approx 25,000 Sq. Miles
- 1.3 Million People
- 550,000 Buildings
- 540 Schools
- 48 Hospitals
- 2,800 Bridges
- 1,350 Rail Segments
- 75 Ports
- 125 Airport Facilities
- $32 Billion in Transportation
- $20 Billion in Utility System

- 120,000 buildings at least moderately damaged
- 20% of inventory
- 50,000 buildings beyond repair
- 25% of manufactured housing at least extensive damage
- 270 Bridges completely damaged
- 65% of hospital beds unavailable
- 50 schools w/complete damage
- 35% w/out Water
- 25% w/out Electric

An earthquake in the New Madrid seismic zone could strike seven or more states, causing major physical, social, and economic disruption to a region that is home to forty million people. Of the 44 million, approximately 12 million are at immediate risk. Memphis and Saint Louis make up the two largest cities in the region with approximately 1 million respectively. The remaining 8-9 million people at risk fall in the rural areas scattered between Memphis and Saint Louis. The potential losses from future earthquakes of magnitude 5.5 or greater in the New Madrid seismic zone are expected to be significant, for at least three reasons: 1) the central US has a high percentage of structures not designed and constructed to withstand the effects of earthquakes; 2) the region is characterized by poorly consolidated sedimentary rocks, which are poor foundation material; and 3) a New Madrid quake would impact a multi-state region (about 10 times larger than the area impacted by a California earthquake of comparable size).

The consequences from a major New Madrid earthquake would be substantial, estimated from $60 to $100 billion for one of three projected events, or a total of $150 to $200 billion in losses. The destruction to the transportation system would make up a significant portion of those losses.

- Direct loss of life due to collapse or structural failure of the lifeline.
- Indirect loss of life due to an inability to respond to secondary catastrophes, such as fires, and/or provide emergency medical aid.
    - Delayed recovery operations.
    - Release of hazardous products (e.g., losses from tank cars derailed by track failure, gas leaks from ruptured utility lines) and environmental impacts.
    - Direct loss of property and utility service (e.g., the collapse of a bridge carrying utilities).
    - Losses due to interruption of access (e.g., export losses due to port damage).
    - Disruption of economic activity across the region and nation as well as in the community directly affected.

However, there are other earthquake related hazards that can affect transportation systems. These hazards are: (1) faulting, which results in rupture of the earth's surface; (2) ground failures, which can result in liquefaction, slope instability, and subsidence; and (3) induced physical damages, such as flooding, dam or levee failures, landslides, fires and hazardous materials releases.

Liquefaction could be an enormous problem in a large earthquake. Buildings and infrastructures such as roads, bridges, power lines, gas lines, water lines, telephone lines, etc. could all be damaged by the moving land. This could cause difficulty during rescue or recovery efforts following an earthquake. Many of these infrastructures will be needed but many will take a long time to repair.

Community Vulnerability

Communities in the Central U.S. - both large and small - are vulnerable to even moderate sized earthquakes (magnitude 5.5 and greater). One of the principal reasons is that the older downtown areas are largely constructed of un-reinforced masonry structures, which are among the most vulnerable structures from the effects of ground shaking. This is especially true in rural communities where un-reinforced masonry constructed buildings make up a greater percentage of structures.

A central question is what will happen to the population in a damaging earthquake? There is no simple answer. The number of casualties will depend on several factors: time of day of the earthquake, location and depth of the epicenter, and magnitude, duration of the quake, and the magnitude of aftershocks.

A major concern of emergency managers is critical facilities, or, those buildings and systems that are critical to effective response and recovery operations. These include law enforcement, fire, emergency operations centers, hospitals and other medical care facilities, and schools.

Given the large number of dams and the extensive network of reservoirs and levees along the region's river systems, significant flooding from earthquake induced breaks in dams and levees should be expected at high water periods. Roads and bridges would also be damaged, compounding response and recovery efforts.

Highway Transportation
The major components of the highway transportation system are pavements, bridges, overpasses, viaducts or elevated expressways, tunnels, embankments, slopes, avalanche and rock shelters, retaining walls, and maintenance facilities. Roadways and bridges are of primary concern, since their loss of function will have the greatest impact on the ability to move people and equipment after the earthquake.

Roadways will sustain damages in a New Madrid earthquake, primarily from surface displacements, liquefaction, slope instability and earthquake induced flooding from broken levees during high water events. Pavements will crack in a damaging New Madrid earthquake, principally due to ground failure (such as liquefaction). Critical links in the interstate system, including Interstate 55 and Interstate 40, would in all likelihood be closed due to failures to approaches to bridges, and damage to the pavement itself.

Hazardous Materials Spills
Hazardous materials are a by-product of the economy of the Central U.S. As a major transportation corridor, tremendous volumes of hazardous materials pass through this region by rail, highway, and river. Oil and natural gas pipelines also crisscross near or through the New Madrid seismic zone, transporting 4 million barrels per day of crude oil, petroleum products and natural gas. As metropolitan areas in the Central U.S. continue to grow, more and more people live and work near industrial and commercial facilities that process or store hazardous materials. Hazardous materials releases and spills are a major earthquake induced hazard, one that will have a regional impact. The transportation system that we depend on to move hazardous materials products is clearly vulnerable to earthquakes.

Vulnerability of Inland Waterways and Ports
An earthquake in the New Madrid seismic zone would have two direct impacts on the inland waterways system: first, it could seriously impede the navigability of the rivers and canals; and secondly, an earthquake could cause serious damages to port facilities.

In essence, inland waterways, which are counted on to provide an economical source of transportation for the movement of bulk goods across the region, can suddenly become dysfunctional as a result of an earthquake. Furthermore, alternative modes of transportation for bulk goods – notably railroad – would also be rendered inoperable for extended periods of time.

Air Transportation
It was not until 1990 that federal owned or funded buildings including airport facilities – had to be designed for earthquakes. However, even if an airport is designed and constructed to conform with building codes which require seismic design, that design represents only minimum standards to provide for life safety. This translates into the following conclusion: terminals and control towers will suffer damage during an earthquake.

Liquid Fuel and Transport
Airplanes need fuel, and this fuel is typically stored in above ground storage tanks and is transported through underground pipelines to airplane gate areas. The immediate problem is the threat of fire and explosion as a result of rupture to the tanks and underground pipelines. For the most part, building codes do not address the seismic design of liquid fuel storage tanks or underground pipelines.

Business Vulnerability
At least two categories of businesses will be impacted by an earthquake: first, the large retail chains that tend to be located in local or regional shopping centers; and second, the locally owned businesses that often operate with limited capital, typically in a building that is rented or leased. For the first category, a damaging earthquake may mean the temporary closing of a few outlets; for the second category - the independent merchant - an earthquake can spell disaster: loss of building, loss of inventory, loss of utility services, and loss of market share, which in many cases, can lead up to complete loss of business.

Earthquakes in the central or eastern United States affect much larger areas than earthquakes of similar magnitude in the western United States. For example, the San Francisco, California, earthquake of 1906 (magnitude 7.8) was felt 350 miles away in the middle of Nevada, whereas the New Madrid earthquake of December 1811 (magnitude 8.0) rang church bells in Boston, Massachusetts, 1,000 miles away. Differences in geology east and west of the Rocky Mountains cause this strong contrast.

Sources:
Central U.S. Earthquake Consortium (CUSEC) Publications:
- EARTHQUAKE VULNERABILITY OF TRANSPORTATION SYSTEMS IN THE CENTRAL UNITED STATES

REDUCING THE RISK: EARTHQUAKES IN THE CENTRAL UNITED STATES

Arkansas continues to make significant investments in our preparedness and response capabilities as well as all of the CUSEC states. Earlier I referred to a series of earthquake workshops which were held with local governments in the state, in cooperation with FEMA, CUSEC, USGS, Mid-America Earthquake Center, Innovative Emergency Management Incorporated (IEM) and Arkansas Geological Survey to enhance the state's preparedness. They focused on direction and control, communications, damage assessment, first responder issues, medical and mass care, transportation and evacuation, debris management, congregate shelter, reception areas and infrastructure recovery CUSEC coordinated similar workshops with all eight New Madrid states. The state of Arkansas has also conducted several other events:

- NMSZ Hazard/Threat Assessment Workshop – May 20, 2007 (Workshops are now considered exercise activities per HSEEP doctrine)

- Operation Poseidon NMSZ Functional Exercise – June 19, 2007

- EPA/USCG/FEMA Sponsored Spills of National Significance (SONS) 2007 Full Scale Exercise – June20-21, 2007

- Senior Executive Officials New Madrid Earthquake Tabletop Exercise (Governor's Office and Cabinet) – November 9, 2007

- Deputy Director's New Madrid Earthquake Tabletop Exercise (Lieutenant Governor's Office and State Agency deputies) – November 27, 2007

The following list of participants is comprehensive to the exercise activities listed above:

Federal Participants:

DHS / FEMA	US Air Force
EPA	US Navy
US Geologic Survey	US Marine Corps
US Coast Guard	USA Corps of Engineers
US Army	Health and Human Services

Certainly I want to mention the work between the state survey and ADEM and USGS in support of the SONS exercise and cat planning. It's a strong link between CUSEC the states and NEHRP.

State Participants:

Governor's Office	AR Insurance Dept
AR Dept of Emergency Management	AR Dept of Finance & Administration
AR Department of Health	AR State Police
AR Department of Human Services	AR National Guard
AR Geologic Survey	AR Dept of Environmental Quality
AR Dept of Information Services	AR State Crime Lab
AR Highway & Transportation Dept	AR Wing, Civil Air Patrol
AR Department of Corrections	Radio Amateur Civil Emergency Services
AR Banking Department	American Radio Relay League (AR Section)

Local Participants (multi-disciplinary and multi-agency representation):
34 Earthquake Counties, cities in those counties and first responders of those counties.

Non-Governmental Organization/Private Sector
American Red Cross
Wal-Mart

In 2007, exercise activities occurred several weeks to several months apart. The State of Arkansas Draft Multi-Year Training and Exercise Plan has tentatively identified the following dates for execution of the New Madrid Earthquake Exercise Series:

1st Quarter 2008 – High Impact County TTX Series
April 2008 – State Response Functional Exercise
October 2008 – State/Local Response TTX
1st Quarter 2009 – State/Local Response Full Scale Exercise

2nd Quarter 2009 – State/Local Response Workshop
3rd Quarter 2009 – State/Local Response TTX
4th Quarter 2009 – State/Local Response Functional Exercise

Along with our exercises we have preparedness efforts that focus on education and outreach. We meet with local school districts and practice earthquake drills along with holding town meeting to address specific concerns of individual communities. We piloted a 'Sister County' concept and aligned the 24 eastern counties that are forecasted to experience a catastrophic earthquake with a sister county. The primary purpose is to respond quickly once the event has occurred with a NIMS structured Rapid Needs Assessment Team. In May of 2006 we positioned an earthquake planner in eastern Arkansas to focus specifically on county Emergency Operations Plans. That person is there solely to coordinate with counties in that region and assist them with improving their plans. Disasters are local and ADEM is doing everything to ensure that citizens in our counties are prepared to the fullest extent.

There is always work to be done in preparedness. While I cannot show you where preparedness works, I can show you where it was not used. New studies are being published everyday. Therefore, we are never finished in the literal sense. We exercise and plan according to the current research and upgrade it constantly to keep up with new developments. There will always be a need to practice coordination between the local, state and federal organizations involved. A challenge will always be the lack of warning that an earthquake presents. Hurricane Katrina provided a warning to all states that we had not taken catastrophic planning far enough. Arkansas has no plans of underestimating the possible damage from a planning standpoint. We will continue to use worst-case scenarios as we develop our response plans. Arkansas as well as the other CUSEC member states are constantly improving their catastrophic plans to address issues that will arise when an earthquake strikes. The biggest challenge we have is selling the need for preparedness on earthquakes. Because we do not live in a state where earthquakes are a regular occurrence, the thought tends to be that they will not happen. Most citizens just assume that they will go on with life as usual and not relocate even if one does occur. And because a large portion of the affected state is rural we must prepare to handle logistics on site. We must be prepared to take care of the citizens of Arkansas wherever they are located.

While we all have read and heard numerous times that earthquakes cannot be prevented, certainly we can minimize casualties and damages by being prepared. I cannot overemphasize the importance of awareness/self-preparation. As we all know, a catastrophic earthquake will be unlike any other disaster the region has previously experienced. With a tornado for example, those affected can expect the arrival of many, many people rushing to help as quickly as they can get there. Sadly, however, we all know that would not be the case with an earthquake, which is why we cannot have too much awareness and preparation. We will continue to hold scenario based exercises and identify any gaps in our planning efforts. I strongly feel that a TOPOFF exercise involving all levels of government to focus on an earthquake along the New Madrid is extremely important. This week all of the CUSEC states are meeting to synchronize exercise activities. We are planning a Full Scale Exercise in 2011 on the 200 year anniversary of the catastrophic 1811-1812 earthquakes. The federal government (FEMA) is helping tremendously with funding the workshops mentioned but funding as yet to be secured to support the planned exercise.. I hope there will be funds made available to help the states fill in the identified gaps and not have the situation as with the Hurricane Pam exercise with Katrina following without the identified gaps or concerns being addressed. If we are ready and prepared, we can significantly minimize casualties and the effects of the earthquake.

Thank you so much for your kind attention. It has been my honor to be with you today.

STATEMENT OF Mr. Callen Hays

Crisis Management Coordinator

Memphis Light, Gas and Water

BEFORE THE AD HOC SUBCOMMITTEE ON STATE, LOCAL, AND PRIVATE SECTOR PREPAREDNESS AND INTEGRATION COMMITTEE ON HOMELAND SECURITY AND GOVERNMENT AFFAIRS

UNITED STATES SENATE

DECEMBER 4, 2007

Memphis Light Gas & Water is the municipal utility supplier of electricity and gas for all of Memphis/Shelby County and the supplier of water to the majority of it. MLGW recognizes that a large magnitude earthquake threat exists for all areas within the New Madrid Seismic Zone. For MLGW to be a responsible steward to our customers, we know we cannot ignore this potential risk, and must take steps to strengthen and harden our utility systems to lessen the extent of damage to our infrastructure should this event take place.

MLGW just completed an all-hazards mitigation study on all three of its utility networks. This was MLGW's second mitigation study. The first was conducted back in 1989 by Allan and Hoshall and started MLGW down the path of seismic mitigation efforts. MLGW's Water Engineering Department has spent a little over $16 million in various upgrades to our water production facilities. MLGW has been awarded a total of almost $4 million in FEMA grants to retrofit and strengthen four out of eight major water pumping facilities and nearly 60 water production wells. Given the past success of these efforts, MLGW felt that there certainly could be other opportunities for our gas and electric systems to improve their resiliency against an earthquake event. Determining the most effective spending of limited budget dollars relative to the seismic strengthening of electric, gas, and water system components is a question not many utilities have the personnel with the expertise to handle. In early 2006, MLGW budgeted for and contracted this Hazard Mitigation Study to R.W. Howe and Associates to analyze our systems. This report would recommend where each network is most vulnerable to various natural hazards. The report helped us focus on where the most effective spending of retrofit dollars would occur, and would

also identify where would be the best opportunities to seek federal funding to assist in this effort. This study helped MLGW submit its first electric-based pre-mitigation grant application to FEMA seeking $1.98 million (with MLGW contributing $660,000) to help seismically retrofitting fifteen existing high voltage (161 & 115 kV) substation transformers at eleven electric substations in Memphis.

The study focused primarily on the earthquake threat. Earthquakes, although very infrequent, pose the greatest system-wide risk for all three utilities – electric, gas, and water – with the highest potential for damages and long duration service outages for substantial numbers of customers. For some MLGW buildings, earthquakes also pose life safety risks to occupants. Many of the other natural hazards considered occur more frequently, but with much lower, often very limited localized impacts.

I am often asked to paint a picture of what a large earthquake would do to the utility infrastructure in the Memphis region, and the cost associated with such an event. No one can predict the exact amount of damage. I do believe that the majority of damage taking the longest amount of time to restore would be the water treatment plants that have yet to be seismically mitigated and underground pipelines on both the gas and water distribution systems. On the electric side, damage to unanchored transformers at substations and unanchored network system transformers would take a long time to repair/replace as well. There is no economically feasible way to mitigate underground pipelines. Strengthening the above-ground collection/control/distribution points of all three systems will greatly reduce the system operation downtime, although it will still be a lengthy restoration process for customers which certainly will take months, not weeks to restore. I cannot put a realistic price tag on the dollars associated with physical damages plus the loss associated with business interruption for the Memphis metropolitan region. I have seen numbers from the 1994 Northridge earthquake in California that showed $40 billion in damages plus another $5.6 billion in estimated business interruption losses. I certainly don't think anyone will be surprised if this region suffers the same level of total economic losses.

With relation to our recent hazard mitigation study, we did not ask for a total price tag to be estimated for losses. Instead, we focused on what parts of our system were most vulnerable to this type of event and how to best mitigate those weaknesses. For our customers, widespread outages of all three systems varying in restoration time will occur. The outage time will be based on many factors that are difficult to quantify: 1) a customer's physical location relative to MLGW's system failures, 2) condition of overpasses and bridges that may prevent easy access of materials, equipment, and mutual aid labor forces from arriving in the region quickly, 3) the ability of MLGW's remote monitoring of system operations to remain intact, and 4) the amount of downtime of our wholesale suppliers of electricity and gas--MLGW can work on fixing our systems, but if TVA's transmission system is down or if there are several breaks along the natural gas pipelines of our suppliers, then the rigidity and strength of our systems will be inconsequential if we have to wait for our suppliers to fix their systems.

Being consistent with all emergency response plans, MLGW's restoration priorities are to preserve life safety first and foremost. This means re-establishing services to hospitals, water pumping stations, and sewer treatment plants are the highest priority. After this is accomplished, MLGW would focus on the stabilization and functionality of all gas gate stations, gas regulator stations and a damage report for the functionality of each electric substation. MLGW's customer restoration philosophy is to make repairs on each system in a prioritized order that restores the greatest number of customers per repair. We are also working on the development of mutual aid agreements to bring in additional resources for assistance.

MLGW has taken many steps to try to ready itself for this possible seismic event. In addition to this recent hazard mitigation study and water production strengthening measures, MLGW has been actively replacing its aging cast iron gas distribution system in the downtown and midtown districts of Memphis since 1991. This project helps the earthquake mitigation process relative to gas service restoration in the older parts of Memphis. Cast Iron gas pipe is more subject to failure with sudden ground motion than polyethylene pipe, which is much more flexible. Also, the older cast iron system has inline control valves spaced very far apart, which would reduce MLGW's ability to sectionalize gas system breaks and repairs. From 1991 through 2006, MLGW has spent $48 million dollars to replace 206 miles of cast iron gas pipe. MLGW has recognized and is adopting the National Incident Management System (NIMS) and the Incident Command Structure (ICS) into its emergency response protocol. We require all members of our crisis response teams to be NIMS/ICS trained and certified. MLGW bought a new business building back in 2003 that was seismically retrofitted for immediate occupancy and operability following a magnitude 7.0 earthquake. We placed all critical telecommunications, computer network servers, and built a new emergency operations center in this building. The increased awareness of the constant work that has to be done for business continuity and disaster recovery planning for MLGW's operations has justified the process of creating an area department focused on Crisis Management.

MLGW works hard to integrate itself with other local, state, and federal governments, as well as private sector partners to discuss ways of improving this area's emergency response readiness. I work closely with the local EMA officials and have open communications with them about how to improve our emergency response measures. MLGW has upper management employees that serve on several local business continuity and disaster recovery planning committee boards such as: the Mid South Area of Contingency Planners (MSACP) http://www.msacp.org/, the Community And Regional Resilience Initiative (CARRI) http://resilientus.org/ , the Urban Area Security Initiative (UASI) http://www.staysafemidsouth.us/3.html, and the Local Emergency Planning Committee (LEPC) http://www.msclepc.org/, to list only a few, there are others. MLGW participates in drills meant to test our response readiness to various emergency events. We participated in the Spills of National Significance (SONS) 2007 exercise this past June along with the state of Tennessee's accompanying TNCAT 07 exercise that were both based on a large scale earthquake in this region. We coordinated communications through our local EMA department and practiced our response plans accordingly.

MLGW's efforts to educate the community on how it can be more self-reliant in an earthquake event are one of the most effective ways we can increase this area's resiliency against a catastrophic event such as this. We have partnered with our local PBS station, Library Channel, etc. to broadcast a show called "Memphis Energized". On one of the shows, MLGW gave a educational clip to teach our customers how to simply shut off their gas and water services to their homes in case of an emergency, how to strap down their gas-heated hot water heaters to the house framework, and to have a personal emergency plan ready for themselves. The training that our local EMA office has done in regards to teaching Community Emergency Response Team (CERT) classes help teach residents how to be more self reliant in emergency situations. The public needs to be aware that it can and will be months, not days, before many utility services are restored and they need to be educated on how they can be ready. MLGW helped the Central United States Earthquake Consortium (CUSEC) host an educational seminar for utilities back in 1995 called "Earthquake Preparedness for Electric Utility Systems". This workshop helped show other utilities how to take steps to strengthen their own systems. A success story that demonstrates the payoff for mitigation strategies occurred in the summer of 2003, when the Memphis area was hit with straight line winds in excess of 100 mph on July 22nd. We had installed backup emergency generators at many of our water treatment plants as part of our seismic mitigation plan. Because these generators were in place, these water stations remained operational throughout the event, although the electrical services surrounding the area had gone down.

There is still a lot of work to be done. Planning for damage assessment strategies on all three utility systems will be a logistical hardship. Damage assessment deployment and communications will be the biggest challenges in the planning process. Like larger utilities, MLGW relies on a system of checkpoints on all three systems to give real time operating statuses to a control room area. In the event of a large magnitude earthquake, these radio transmitting devices and this methodology for automatically receiving an electronic report of the damage suffered by the electric, gas, and water system will be somewhat disabled. Knowing where we need to send resources and supplies to fix our systems will take a considerable amount of time when we will have to rely on a manual effort of visually inspecting all three systems. Underground problems on gas and water pipelines will sometimes not be evident by aerial surveillance assistance.

I sincerely appreciate the attention the federal government is giving to this potential catastrophic event facing the central United States. I would like to mention a couple of areas where improvements can be made to help utilities in this area prepare for an earthquake. The only Federal mitigation money regularly available to support seismic retrofits for public utility infrastructure is the annual Pre-Disaster Mitigation program. For 2008, the program only has $100 million available nationwide, of which perhaps 10% may be allocated to utility projects. Given the criticality of utilities to life preservation and economic well being of this region and the nation, more funding earmarked for seismic utility retrofit work, as well as giving priority to all utilities located in the impacted areas of the New Madrid Seismic Zone is needed. MLGW has been fortunate to have the resources to fund the type of hazard mitigation study that we conducted. Many rural and smaller utility companies cannot afford this type of analysis. Funding for these types of studies to help guide the smaller utilities on their mitigation strategies could also be helpful. Enhancing public education concerning residential emergency preparedness is needed. Perhaps the type of CERT training that EMA offers to the public could be incorporated into the high school curriculum under health studies. Many groups, such as the Mid American Earthquake Group and others, are working towards coming up with predictive damage assessment models to help shape mitigation strategies. Many utilities (public and private) have been unwilling to share infrastructure data with groups such as this due to the fear of exposing themselves to terrorist activity. Perhaps the government can create a clearinghouse area for the collection and dissemination of sharing this type of information, thus relieving those data owners of any liability issues. MLGW voluntarily began mitigating its utility systems back in 1989. Many utilities and energy suppliers may not be taking the threat of the New Madrid earthquake event seriously. Energy distributors are dependent on other sources of supply for electricity and gas. The government needs to ensure that both public and private wholesale suppliers of electricity and gas in the New Madrid Zone area have considered this threat and are taking steps to mitigate the places in their systems that may need attention.

Thank you.

Callen Hays, P.E.
Crisis Management Coordinator, MLGW

Background

The highest earthquake risk in the United States, outside the West Coast, is along the New Madrid Seismic zone (NMSZ). This "active' fault runs through five states, including Arkansas, and averages more than 200 measured events per year. Every 18 months the fault releases a shock of magnitude 4.0 or more, and magnitudes of 5.0 or greater about once per decade, causing significant damage. Although damaging tremors are not as frequent as in California, they do occur and the destruction covers more than 20 times the area due to the underlying geology. Historical analysis of the activity of the NMSZ indicates a high probability of a devastating seismic event in the central United States in the near future. Despite the presence of this significant fault systems, the state of Arkansas does not have a network of seismic stations in place, thus the ability to educate the public on the dangers and steps needed for preparedness is lacking.

From the scientific research conducted in the central United States, it is clear that this area has experienced repeated earthquakes in the last few thousand years. There is also mounting evidence supporting a larger than 7 magnitude for some of these earthquakes. Due to the short duration of historic archiving of natural events in the central United States, indirect geologic evidence is the primary source of information for the earthquake risk mapping process. Given the lack of knowledge about the spatial characteristics of prehistoric earthquakes in areas beyond the current microseismicity zones, and given the uncertainty in recurrence period and magnitude, earthquake hazard mapping will continue to be a debatable issue and a fair subject of criticism.

In spite of the obvious need for more knowledge about the northern Mississippi embayment south and southwest extension of the currently active zone in Arkansas, this area remains one of the most poorly studied segments of the mid-continent seismic zone. Its prehistoric earthquake features have been (and still are) under scientific and technical analysis for more than ten years. The study conducted so far for this area, however, has remained "on the fringe" of the work conducted north and northeast of it. The loose fluvial sediment in this area is thicker than in the area to the north, complicating the hazard-assessment process. Another complication is the continuous change of the landscape due to river meandering, flooding, and more recently, heavy agricultural activity.

Arkansas Earthquake Center

The center is located at the campus of University of Arkansas at Little Rock was established in 1991. It was supported by the Federal Emergency Management Agency and the Arkansas Department of Emergency Management with an initial mission of public education and scientific research. Its purpose is to provide a comprehensive earthquake education and technology transfer program in the state of Arkansas and adjacent states. Its current objectives are (1) earthquake monitoring, (2) scientific research, and (3) risk assessment and mitigation planning.

Needed Actions

Earthquake Monitoring. The Arkansas Earthquake Center at the University of Arkansas at Little Rock (UALR) proposes the installation and operation of a number of advanced

seismic stations in areas where earthquake monitoring is lacking to and study and assess the earthquake risk in Arkansas. This network will form the **Arkansas Seismological Observatory** (ASO) that would provide statewide and regional monitoring. The ASO will be constructed to accomplish six essential objectives:

(1) Monitor the earthquake activity throughout the state,

(2) Assist in emergency planning and to provide early warning,

(3) Provide public education on earthquakes and earthquake hazards,

(4) Provide information useful for earthquake hazard mitigation,

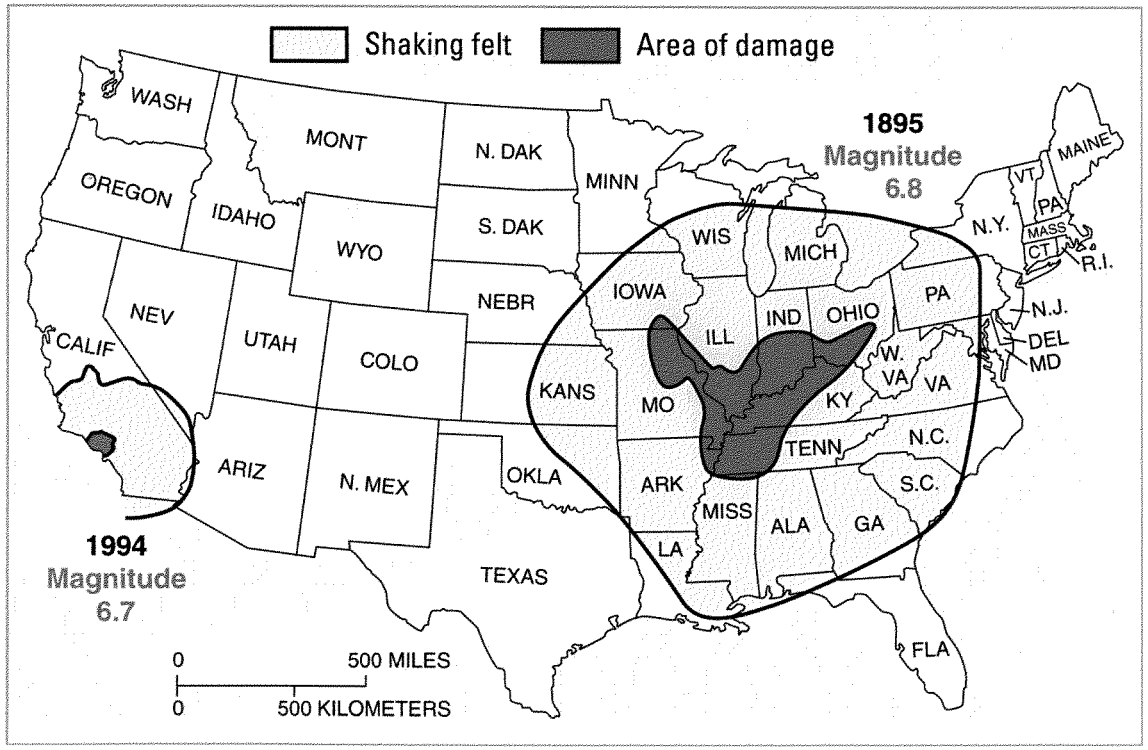
(5) Provide the scientific community with a wealth of information to study and hopefully understand the seismicity of Arkansas and its associated risk, and

(6) Provide real-time, immediate information on seismic activity to allow for rapid response to responsible government agencies such as the

Scientific Research. It is essential that the center maintains a comprehensive research program to expand out knowledge about the seismicity and its associated risk in the central United States. This knowledge will improve the mitigation planning and the needed actions to minimize the impact of major disasters.

New Madrid Seismic Zone Catastrophic Earthquake Planning Project

1994 California & 1895 NMSZ Earthquake Impact Comparison



New Madrid Seismic Zone Catastrophic Earthquake Response Planning Project
Workshop and Planner Locations

Workshop Participation

	Number of Workshops	Number of Attendees: Local	State	FEMA	Other Federal Agencies	Private Business	Non-Government Organization
Alabama	0	n/a	n/a	n/a	n/a	n/a	n/a
Arkansas	4	278	115	57	35	22	15
Illinois	1	0	30	0	5	0	2
Indiana	3	76	135	35	27	6	32
Kentucky	3	40	16	0	3	0	0
Mississippi	1	80	17	1	2	15	4
Missouri	2	144	78	13	4	10	13
Tennessee	1	65	82	17	9	5	5
Total	15	683	473	123	85	58	71

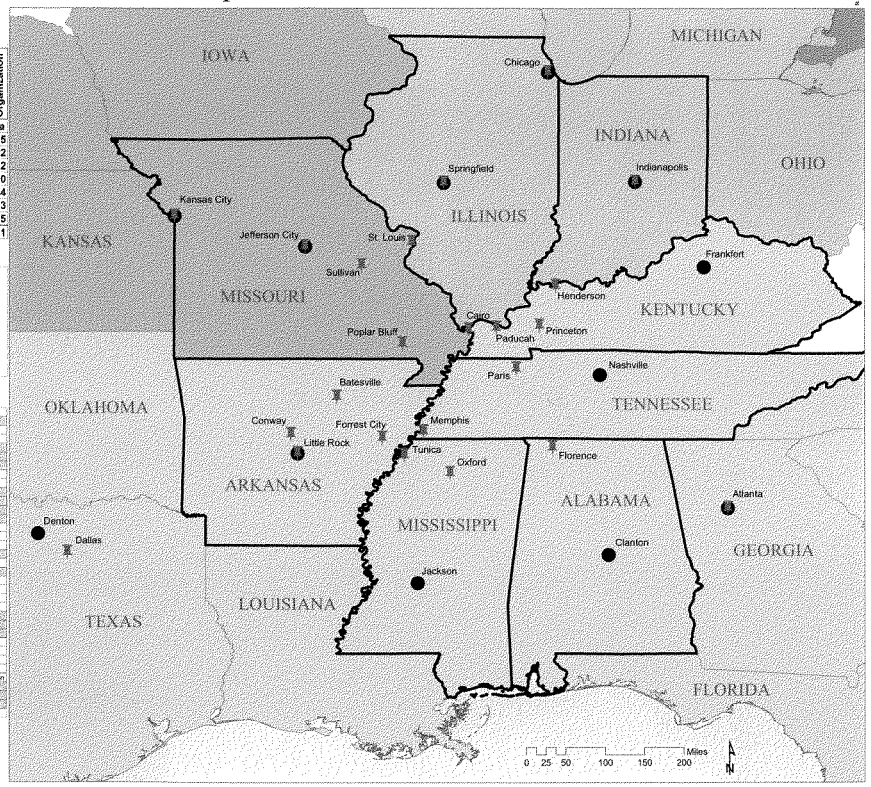
Legend

- Workshop Locations
- Planner Locations*
- NMSZ States
- FEMA Region IV
- FEMA Region V
- FEMA Region VI
- FEMA Region VII

*Project Management and Planners also located in Washington, DC

Workshop	Dates	City	Type
Arkansas	June 28-29, 2007	Batesville, AR	Local
Arkansas	July 10-11, 2007	Forrest City, AR	Local
Kentucky	July 31, 2007	Paducah, KY	Pre-Workshop
Kentucky	August 1, 2007	Princeton, KY	Pre-Workshop
Kentucky	August 2, 2007	Henderson, KY	Pre-Workshop
Arkansas	August 14-15, 2007	Conway, AR	Local
Arkansas	September 11-13, 2007	Little Rock, AR	State
Indiana	September 24-25, 2007	Indianapolis, IN	Topic
Missouri	October 11-12, 2007	Poplar Bluff, MO	Local
Missouri	October 15-16, 2007	Sullivan, MO	Local
Indiana	October 24-26, 2007	Indianapolis, IN	Topic
Indiana	October 30-31, 2007	Indianapolis, IN	Topic
Illinois	November 5-6, 2007	Springfield, IL	State
Mississippi	November 7-8, 2007	Tunica, MS	Topic
Tennessee	November 28-29, 2007	Buchanan, TN	State
Mississippi	December 12-13, 2007	Tunica, MS	Topic
Mississippi	January 16-17, 2008	Oxford, MS	Topic
Mississippi	February 12-14, 2008	Tunica, MS	State
Kentucky	March 11-14, 2008	Paducah, KY	State
Missouri	March 11-12, 2008	Jefferson City, MO	State
Tennessee	March 17-21, 2008	Memphis, TN	State
Alabama	March 24-28, 2008	Florence, AL	State
Indiana	TBD	Indianapolis, IN	Topic
Illinois	TBD	TBD	State
Illinois	TBD	TBD	State
Region IV	Spring-Summer 2008	Atlanta, GA	Region-States
Region V	Spring-Summer 2008	Chicago, IL	Region-States
Region VI	Spring-Summer 2008	Dallas, TX	Region-States
Region VII	Spring-Summer 2008	Kansas City, MO	Region-States
All 4 Regions	Summer 2008	TBD	Regional Integration
Cairo	Fall 2008	Cairo, IL	Geographic Area
Memphis	Fall 2008	Memphis, TN	Geographic Area
St. Louis	Fall 2008	St. Louis, MO	Geographic Area
Integration Workshop	Winter 2008-2009	TBD	Final Integration

NEW MADRID SEISMIC ZONE



Concepts of Planning and Response to a Missouri Catastrophic Event (Earthquake)
(Missouri State Emergency Operations Plan Annex Y)

The purpose of this outline is to provide operational concepts unique to catastrophic event planning and response, to meet the needs of local governments following a catastrophic event. It is intended to rapidly expand the response organization for a catastrophic event (most likely an earthquake) regardless of type i.e.: Natural Hazard or man made.

The earthquake-planning scenario used to develop the annex was based on the Federal Emergency Management Agency (FEMA) December 2005 Hazards United States (HAZUS) model-MH Earthquake Event Report, Magnitude 7.6 based in Southeast MO and was used to develop the loss estimation. The primary purpose of HAZUS is to provide a methodology and software application to develop loss estimations Although no loss estimation will prove completely accurate, it can provide potential damage patterns and the conceivable damage conclusions will provide guidelines for emergency response planning.

General Assumptions used to develop the plan were:

1. The Governor will declare a State of Emergency and request a Presidential Disaster Declaration.

2. The State of Missouri will immediately request support from the Federal Emergency Management Agency (FEMA).

3. FEMA will activate the National Response Plan.

4. The State Emergency Management Agency will activate the Emergency Management Assistance Compact (EMAC) and established mutual aid agreements will be honored to the extent possible.

5. The Governor will suspend operations in the affected and response tiers of the state as required allowing maximum utilization of resources in the initial response with the exception of those essential services identified in COOP/COG plans.

6. Damage to transportation, communication, power distribution systems, pipelines, chemical and fuel storage and other infrastructure systems will isolate communities creating virtual islands within the disaster areas. Damaged transportation routes may not be functional for many weeks or months. For at least 96 hours after an earthquake, affected local governments and individuals will attempt to meet their own emergency needs.

7. Local governments have the primary responsibility to prepare for and respond to incidents and disasters. As such, local jurisdictions must be prepared to manage initial emergency activities for at least the first 96 hours through internal capabilities and/or mutual aid agreements, regardless of the size and scope of the incident. State and federal government will make every effort to provide additional life safety support as quickly as possible;

however, State and federal resources may not be available in the early stages of an emergency.

8. Shelters identified for use during other natural disasters may not be available in the affecte area. Temporary sheltering in campers and tents may be determined to be the safest option until buildings and residences are inspected. Prudent and safe actions must be taken into consideration whether remaining in their residence or utilizing temporary shelters. Sheltering may take place outside the affected area.

9. A number of people will self evacuate the damaged area, if possible, while many others will stay for a variety of reasons including protecting property or caring for farm/companion animals. If evacuation is directed by local governments, state agencies will attempt to facilitate movement through the activation of the evacuation management team.

There were 13 appendixes developed to address unique concepts in a catastrophic event. Synopses of those appendixes are as follows:

Direction and Control (ESF #5 – Emergency Management)

The State of Missouri as normally organized will not be able to respond in the affected area and therefore will establish additional levels of command to ensure an adequate and organized response. In addition to the State Unified Command that will be formed at the State Emergency Operations Center (SEOC), two State Area Commands (SAC) will be established for the Affected Areas (Regions C and E). There is a possibility that if damage assessment shows necessity, a third SAC could be established north of the Missouri River for Region C.

In order to coordinate response resources and assets, the state will be divided into three tiers (regions). The affected tier (Regions C and E), The Initial Response Tier (Regions B,F,I,G), and the Support Tier (Regions H,A,D).

Expansion of Direction and Control will mobilize and de-mobilize following the six (6) phases to this operation and may occur simultaneously.

Alert / Assessment –
In order to enhance response operations, a number of "automatic triggers" have been identified.

1. At a verified 4.5 magnitude event or greater earthquake, all state departments and agencies will be placed in an alert status and begin verification as well as telephone alerts of personnel who staff the Unified Command or either Area Commands
2. At a verified 5.0 magnitude or greater earthquake, all state departments and agencies will be place in an alert status and begin verification as well as conduct telephone alerts of personnel who staff the Unified Command or either Area Commands and identify (4WD) transportation assets to support movement of personnel to the affected area and move personnel to Department reception locations for safety instructions and movement guidance from MODOT & SEMA.

3. At a verified 6.5 magnitude or greater earthquake, all state departments and agencies will be placed in an alert status and begin verification as well as conduct telephone alerts of personnel who staff the Unified Command or either Area Commands and identify (4WD) transportation assets to support movement of personnel to the affected area and move personnel to Department reception locations for safety instructions and movement guidance from MODOT & SEMA as well as will be prepared to move to staging areas or airports and wait for helicopter or small aircraft transport to their respective locations.

Mobilization

1. Initial response will come from the Initial Response Tier (Regions B,F,I,G) of the state.
2. It is the intent for resources in the support tier (Regions H, A, D) to remain in place unless otherwise directed by the plan to support replenishment of initial responding resources as the incident progresses.
3. Response and resources in the Affected Area (Regions C, E) will be applied to the immediate needs of the incident until the point at which they can return to near normal operations and begin response locally.
4. Mobilization of the State resources requires coordination with the State Unified Command to ensure safe routes and coordinated modes of transportation are available prior to departing to the affected area. It also requires that each department organize and account for personnel and resources in a reception area outside of the affected area prior to movement. In cases of staff mobilizing to support Area Commands departments may be directed to report to a reception area in Cole County or other locations announced at the onset of the disaster and then move to their area of responsibility as a team. Specifically if routes are not passable this would be required to coordinate movement by air (helicopter) to the command locations.

Staging

1. Staging areas have been established in the Initial Response and Affected tiers of the state for response and recovery resources. All State staging areas will be on state owned or leased property to ensure state control of those areas as well as to avoid conflict with local resources required to support local plans and efforts.
2. Staging areas are delineated into two categories, responder and victim and should not be co-located or combined at the same site; however they will be located in same cities or counties.
3. Departments are responsible for providing reasonable accommodations (food and lodging) for responders deployed for a minimum of 14 to 28 days. OA will assist with contracts for local hotels food service, property rental / lease and other services.
4. Local jurisdictions are responsible for identifying Points of Distribution (PODS); in the event that they are unable to occupy or staff those sites, the State will work with local jurisdictions and volunteer organizations to staff and begin the distribution process.

Response

At the onset of a catastrophic incident it will be necessary to rapidly expand the size and scope of State level operations focused on response. It will also be paramount that these operations are synchronized through the State Unified Command. The size and location of the subordinate area commands are predetermined in this plan but will (or may) be expanded or collapsed based on actual damage rather than assumptions or predictions used in this plan. Initially resources may be required to be "air lifted" into the affected area: therefore air bridging to available airfields may become the primary mode of transport to the affected area. If and when response by ground on ingress routes is available they will be utilized. The number one priority at the onset of a verified 4.5 magnitude or greater is that State government must take steps to assess and organiz a response capable of moving by ground but also able to change plans to movement by air.

Recovery

Recovery processes may be interrupted by subsequent aftershocks. In the event of aftershocks, the concept of operation will reset to assessment. The potential for response personnel to become victims exists and therefor additional resources may be required to respond to the subsequent damage. The aftershocks have the potentia to impact new areas within the New Madrid Seismic Zone.

Due to these subsequent aftershocks, response and recovery activities may occur simultaneously. Recovery efforts will be resource intensive and will last longer than any recovery historically known to the emergency management community. Local and State agencies will coordinate the return of citizens to the affected area when infrastructure has been safely restored which could take months and possibly multiple years.

De-Mobilization

Resources with unassigned missions in state staging areas will remain under the control of the state area command until release has been coordinated with the State Unified Command. Resources may be assigned from one state area command to another state area command depending on the duration of their deployment. When resources are no longer required in the statewide effort they will be released under the ICS demobilization process following the authority and process under which they were mobilized i.e.: State Fire Mutual Aid system, Law Enforcement Mutual Aid etc.

Communications (ESF #2- Communications)

The Missouri State Highway Patrol is the lead state agency for providing emergency communications from th affected area. Supporting agencies for this function are:

a. Missouri Department of Conservation
b. Missouri Department of Corrections
c. Missouri Department of Transportation
d. Missouri Department of Natural Resources
e. Missouri Department of Public Safety
f. Missouri Division of Fire Safety
g. Missouri State Water Patrol

h. Missouri National Guard
i. Civil Air Patrol
j. Radio Amateur Civil Emergency Services
k. Amateur Radio Emergency Service
l. Missouri Voluntary Organizations Active in Disaster
m. United States Army Military Affiliate Radio System

An Area Command will be established for Regions C and E. The Missouri State Highway Patrol will provide personnel to staff the communications unit leader positions in each of these command structures. A Regional Net Control Station (RNCS) will coordinate and support communication functions for their respective area commands, and a Local Net Control Station (LNCS) within their area of operation. Responder State Staging Areas will be established for incoming assets by discipline. Staging Area Managers will be assigned to each of these areas. Responding Units should have the address and initial contact frequency of their staging area prior to deployment.

Responding units will report by radio to the communications unit established by the Staging Area Manager. The initial report should contain:

a. The unit identifier
b. The unit discipline
c. The unit capability (heavy equipment, search and rescue, medical team, etc. etc.)
d. Communications capability

When the unit is assigned a mission, they will be given instructions to contact a LNCS or incident command upon arrival into the area of operation.

Law Enforcement (ESF #13 – Public Safety and Security)

Immediate operational response to a disaster situation is the responsibility of the local law enforcement in whose area the disaster occurs. However, due to the widespread regional nature of the event, local law enforcement capabilities will be severely limited.

State law enforcement support to local law enforcement after a large earthquake will require providing hundreds of law enforcement personnel from unaffected areas to the impacted area. An Area Command in Region E and in Region C will be activated for law enforcement response personnel. The Missouri State Highway Patrol will provide personnel to staff the Law Enforcement Operations Branch Chief, PIO, and Communications Unit Leader positions.

The Missouri State Highway Patrol will be supported in the task of providing emergency police services by the following agencies:

a. Missouri State Water Patrol
b. Division of Liquor Control
c. Division of Fire Safety
d. Missouri National Guard
e. Department of Conservation
f. Department of Corrections
g. Division of State Parks

Transportation (ESF #1 – Transportation)

Transportation into an impacted area will be challenging as a result of anticipated damage to roads and bridge due to an earthquake. Transporting heavy equipment and other resources will require unique transportation solutions. Many impacted areas will initially only be accessible by air. MoDOT has developed a comprehensive plan for an earthquake event. Upon declaration of an earthquake emergency by the governor and subsequent establishment and staffing of the State EOC and the MoDOT EOC, MoDOT's Chief Enginee will immediately mobilize all district forces and available field bridge inspection personnel for the purpose of assessing the condition of the highways and bridges on the State highway system. These reports will be forwarded to the SEOC for analysis and development of situational awareness.

Air Traffic will follow restrictions designated by the FAA. Upon verification of an earthquake event, SEMA will coordinate the request for Temporary Flight Restrictions (TFR) from the FAA to apply to air space from the 91st longitude east to the Mississippi River below 3500 ft AGL in accordance with Emergency Security Control of Air Space (ESCAT) Procedures. The TFR will help facilitate additional aerial damage assessment and aerial delivery of life-saving materials that will be conducted by MSHP, MDC, MoNG, MoDOT and CAI teams. Air Evacuation units (air ambulances) are considered response aircraft and will follow ESCAT procedures as outlined.

Railroad owners of any rail line are solely responsible for damage assessment and repair of all commercial rai lines in the state. There are approximately 4,400 miles of main track, 2,500 miles of yard track and about 7,000 public and private crossings in Missouri. At the present time 19 different railroads operate in the state of Missouri.

Ports and Waterways are the primary responsibility of the Missouri State Water Patrol and they will be responsible for monitoring the safety and security of ports and waterways along the Missouri and Mississippi rivers. It can be expected that this operation will take place in conjunction with the United States Coast Guard detachment based in St. Louis. Existing ferries operating in all affected areas will be utilized for transporting people and equipment to recovery projects and families separated by bridge closings.

Mass Care (ESF #6 – Mass Care, Housing, and Human Services)

The Missouri Department of Social Services (MDSS) is the agency with primary responsibility for mass care during a catastrophic event.

The two strategies for sheltering following a large earthquake are sheltering the population in the Affected Areas and sheltering the population evacuated from the Affected Areas.

In the Affected Areas : In the aftermath of a catastrophic event, there are several options for providing sheltering:

- The American Red Cross will operate designated shelters in the affected area if the shelters have not been damaged or destroyed. Normal locations are schools, universities (dormitories, gymnasiums), churches, and other buildings where the Red Cross has a written use agreement. If shelters are damaged by the event, building inspectors will have to inspect each shelter building before use, thereby denying immediat use of the shelter location.

- Loose groupings of individual shelters or group tents erected in the affected area but loosely organized into family or congregate areas. These temporary shelters provide minimum shelter but the affected population must rely on other locations for food, water, first aid, and information.

Outside the Affected Areas (evacuation):

- Red Cross will operate shelters outside of the affected area where the affected population can move to or be moved to in the event homes and infrastructure is destroyed. The intent is to employ resources located in the Support Tier of the state to accomplish this mission.

In all probability people will have to be sheltered in the Affected Area for the first 3 to 4 days until help coulc arrive. The following factors should be considered:

1. Seasonal weather conditions.
2. Those unable to return to their homes.
3. Type of evacuation order (mandatory or voluntary).
4. Injury or special needs population.
5. Sheltering capacity.
6. Keeping families together.

Animals and Pets

Issues regarding animals and pets will be managed to the extent possible in accordance with the Americar Red Cross policy and existing law. Animal owners have primary responsibility for the survival and well being of their animals. Owners should have an emergency response plan and readily accessible kits with provisions for their animal(s). Owners should take animals to designated veterinary hospitals, kennels, boarding facilities or alternative private animal care housing.

Service animals are specially trained animals used by a person with a disability to help with daily living and are allowed by law to accompany their owners anywhere.

The Missouri Department of Agriculture develops Standard Operating Guidelines (SOGs) for, but not limited to, beef cattle, dairy cattle, poultry, swine, equine, sheep, and small ruminants. These SOGs include natural disasters.

Owners of exotic animals are responsible for the containment, evacuation and care of their exotic animals

The United States Department of Agriculture will dispatch Veterinary Medical Assistance Teams (VMAT) to the state. VMATs provide treatment and aid to animals used in search and rescue efforts and animals hurt or endangered by catastrophic events such as earthquakes. They supplement the relief efforts already underway by local veterinarians and emergency aid providers.

Special Needs Population

DHSS is responsible for supporting local jurisdictions providing adequate services to the general population with special needs.

The special needs population includes individuals with physical, mental, sensory, cognitive, cultural, ethnic, socio-economic (including homeless), age, citizenship status, or any other circumstance creating barriers to understanding or the ability to act/react as requested of the general population during all phases of emergency management.

Department of Health and Senior Services (DHSS), Department of Social Services (DSS), and the Department of Mental Health (DMH) will coordinate operations to address the special needs population during an emergency including state and federal support to local subdivisions.

Health and Medical (ESF #8 – Public Health and Medical Services)

The Department of Health and Senior Services will make preparations to deal with large numbers of people in need of medical care with affected area hospitals unable to function normally. Executing response operations will depend on requirements imposed by the situation.

DHSS will coordinate movement of Health Resources and Services Administration (HRSA) funded support trailers and also coordinate the movement of MO 1-DMAT equipment and staff to the area.

DHSS will coordinate establishment of the Modular Emergency Medical System (MEMS) and select a location as close as possible to the affected area. DHSS Emergency Medical Services Unit will identify ambulance services that have MOUs in place with transportation companies to move patients to available facilities when requirements for patient care exceed area resources.

DHSS is responsible for the Licensed Emergency and Disaster Registry (LEAD-R). DHSS will review communications plans and availability of two way radios and satellite phones held by DHSS.

DHSS will coordinate with the Department of Mental Health to provide surge capacity crisis counseling to include emergency workers and plan to integrate volunteers from unaffected states and consider altered standards of care.

Logistics and Resource Management (ESF #7 – Resource Support)

Resource Management before, during and after this catastrophic disaster will involve seven primary tasks on a scale significantly greater than what is required for a normal disaster:

- Establishing Resource Management systems for identifying, describing, inventorying, requesting, controlling and documenting, delivering and tracking resources, and developing predetermined resource support packages and preexisting state resource contracts that will help cover anticipated shortfalls until full federal resources begin arriving.
- Activating the Resource Management Team members to work as an extended element of the SEOC Logistics Section to help perform the full Logistics Management function.
- Activating the Resource Management systems, predetermined resource support packages and preexisting resource support contracts.
- Dispatching resources during and subsequent to the initiation of the disaster.
- Coordinating at all levels to ensure the right resources reach the right destination at the right time.

- Coordinating with Donations Management to help make the most effective and efficient use of state provided resources.
- Deactivating or recalling resources during or after disaster.

Initial priority of support will be for:

- The operations of first responders such as fire suppression, law enforcement, ambulance, air ambulance, triage and life essential medical, and search and rescue.
- The re-establishment and functioning of essential local government services.
- The establishment of temporary staging areas in predetermined locations to provide initial operations and logistics support. Additional temporary staging areas may be established as the situation unfolds, circumstances allow, and resources become available.
- The establishment and provision of life-essential, critical supplies such as water, food and medicines, and other mass care requirements such as sheltering, sanitation, (heating and/or cooling/ice as necessary and possible).
- The establishment and provision of essential transportation assets to move to shelter or evacuate outside the disaster area to shelter those special needs populations, medical populations, lost children and/or populations otherwise without their own transportation.

State Staging Areas have been identified and will serve as temporary facilities at which commodities, equipment and personnel are received and pre-positioned for deployment. The State will stage supplies in accordance with known requirements. Responders outside the damage zone will deliver needed supplies by ground, air or water, as necessary.

Points of Distribution Sites (PODS) are temporary local facilities at which commodities are distributed directly to disaster victims. It is incumbent upon local jurisdictions to identify potential POD sites. PODS are operated by the local jurisdiction, however, it is recognized that local jurisdiction resources may be overwhelmed and operations will need to be augmented by the state.

Hazardous Materials (ESF # 10 – Oil and Hazardous Materials Response)

Immediately following a large earthquake, the Department of Natural Resources will head the Hazmat Operations Branch in the Area Commands that will be established for Region C and Region E. Immediate resource support for hazardous materials response will be provided by Missouri's 29 HSRT teams, through coordination with the Fire Marshal's Office and the Department of Natural Resources' private contractors. At the direction of the SEOC close coordination will be maintained between local, state and federal officials to establish priorities for hazardous materials response support.

Due to the potential of hazardous materials release, the Department of Natural Resources will deploy their Environmental Emergency Response Teams to the affected areas to assess the hazardous materials situation and provide technical assistance as soon as possible. In order to prioritize response efforts, an assessment will include the nature, amount, and locations of real or potential releases of hazardous materials, pathways to human and environment exposure, probable direction and time of travel of the materials, potential impact on human health, welfare, safety, and the environment.

Emergency Public Information (ESF #15 – External Affairs)

In the event of a 6.5 magnitude or greater earthquake impacting Missouri, all State Departments/agencies will automatically have their Communication Directors/Public Information Officers or duly appointed alternates report to the Joint Information Center at SEMA. The JIC Coordinator will establish work assignments and schedules.

The Governor's Office shall provide policy guidance for dissemination of all emergency public information and will designate the official State Spokesperson to brief the news media. The Department o: Public Safety's Public Information Officer (PIO) will coordinate with the Governor's Office on the initial release of all EPI during the crisis. The SEMA PIO will contact State Agency Public Information Officers before the Joint Information Center (JIC) is officially activated.

Dissemination of public information occurs via all media outlets: Internet, radio, television, newspapers, wire services, and emergency broadcast with coverage access.

Public Works (ESF #3 – Public Works and Engineering)

The Department of Natural Resources will coordinate with water and sewage treatment facilities in all matters concerning water supply and sewage treatment and disposal. The Department of Natural Resources Laboratory will conduct testing of drinking water and sewage treatment facilities.

Essential public infrastructure that would be needed (in order of priority) after a catastrophic event would include:

1. Life Safety
2. Access (ingress/egress)
3. Assessment of Mass Care Facilities
4. Energy Restoration
5. Drinking Water
6. Emergency Sanitation / waste water treatment
7. Debris removal
8. Pipeline Repair
9. Long-term restoration of water/waste water treatment
10. Long-term restoration of communications

Upon the request of the local jurisdiction, the Missouri Structural Assessment and Visual Evaluation (SAVE) Coalition will be activated by SEMA in accordance with RSMo Chapter 44.023 to conduct Post-Disaster damage assessments. SAVE Coalition inspectors' scope of responsibility is limited to the assessment of buildings and vertical structures. The evaluation of highways, roads and bridges, utilities, dams and other such structures will be conducted by MoDOT, local public works departments, utility owners, Department of Natural Resources, and the Army Corps of Engineers.

Working with local jurisdictions, SAVE volunteers will perform inspections and file follow-up reports:

1st Priority – Hospitals and emergency operations centers (police, fire stations, etc.)

2nd Priority – Other health care facilities
3rd Priority – Shelters for displaced persons
4th Priority – Commercial and industrial structures and multi-family residential structures over 3 stories
5th Priority – Single family residential structures and multi-family residential structures 3 stories or less

Evacuation (ESF #13 – Public Safety and Security)

This procedure establishes a consistent operational methodology for the State of Missouri and all political subdivisions therein to plan for and implement regional, multi-jurisdictional evacuations, regardless of the geographic area in which they occur. The availability of consistent state-wide procedures facilitates an adequate understanding on the part of all organizations and levels of government regarding their responsibilities during a regional evacuation, and establishes uniform operational techniques through which those responsibilities can be fulfilled. This procedure is adopted as an operational element of the Missouri Emergency Operations Plan, developed in accord with Code of State Regulations 11 CSR 10-11.010 and Chapter 44, Revised Statute of Missouri.

An Evacuation Management Team (EMT) within the Operations Section of the State EOC shall be established consisting of the following members:

- Department of Public Safety
- Public Information Officer
- State Emergency Management Agency
- Department of Natural Resources
- Missouri Department of Transportation
- Voluntary Organizations Active in Disaster
- Department of Social Services
- Department of Health and Senior Services
- Missouri State Highway Patrol

The Missouri Information and Analysis Center (MIAC) will coordinate with Damage Assessment Teams to determine what transportation infrastructure has been damaged and what evacuation routes are available.

EMT will recommend to State Unified Command whether ground evacuation is safely feasible. EMT will coordinate with local jurisdictions in setting up emergency rest areas along evacuation routes providing fuel, food, water, first aid, and sheltering information.

The staff of the State and County emergency operations centers will monitor hazardous situations as they develop. Regular conference calls will be held between the EMT, potentially affected county emergency operations centers and appropriate state and federal agencies as to the degree of threat to Missouri and the potential for escalation. In addition, the EMT will coordinate with the local emergency management agencies as to whether the hazard will require coordination and implementation of protective actions including evacuations across multiple jurisdictions. If so, EMT and potentially affected county emergency operations centers will begin implementation of the regional evacuation process.

Under circumstances involving evacuations of multiple regions, the Evacuation Management Team (EMT) may recommend to the Governor that a State directed evacuation is necessary. At the Governor's

direction, language will be included in the Governor's Executive Order identifying mandatory evacuation and directing a coordinated, regional response from the State Emergency Operations Center among all State and local response agencies. State direction of the evacuation may also occur when some or all of th following conditions are present:

- In support of regional evacuations, response operations including sheltering, traffic management, and emergency public information may be required in areas not threatened by th hazard;
- Multiple jurisdictions will utilize a limited number of regional evacuation routes necessitating central coordination and direction;
- The threat of aftershocks will necessitate evacuation of large numbers of people, requiring the coordination of emergency operations among two or more counties;
- The Governor has issued an Executive Order declaring a State of Emergency; and
- The Missouri Emergency Operations Plan has been duly activated.

(Note: this list is not exclusive; rather it is intended to provide guidance as to when State-directed evacuations may be necessary.)

The EMT and county emergency operations centers will monitor the progress of the regional evacuation and exchange information on an established time schedule to promote effective coordination by all involved jurisdictions. Through this procedure, the EMT and county emergency operations centers will coordinate the efficient deployment of resources when needed, utilization of available evacuee shelter capacity, and effectively address modifications to evacuation routes, if necessary.

Immediately upon the decision to implement a regional evacuation, all affected counties will communicat information to the EMT at regular intervals. Examples of such information regarding evacuations could include:

- The characteristics of the hazard and associated events
- The designated evacuation area, initiation times and resource mobilization status
- The progress of resource deployment
- The current status of regional evacuation routes
- The status of available public shelter and hotel/motel space by location
- Assessment of the need to terminate the evacuation prior to full completion
- Estimated time of evacuation completion

A regional evacuation will generate impacts outside areas immediately at risk and may necessitate the use of local resources in non-threatened counties to support the response. The Evacuation Management Team (EMT) will determine whether activation of response operations in designated host regions outside the immediate area of impact is necessary. If so, the EMT, in conjunction with the Governor's Executive Order, will direct the assistance of any or all local governments within Missouri, and request as needed adjacent state and county emergency management agencies, to support the regional evacuation as follows

- The EMT will designate, through a state mission, host regions to implement protective actions in support of evacuations in risk counties. All county emergency operations centers within designated host regions will activate and prepare to initiate host response plans.
- The EMT will coordinate traffic management issues with State and local law enforcement fron all counties within host and risk regions.

Damage Assessment / Incident Analysis (ESF #5 – Emergency Management)

Automatic response of all state agencies will occur at a verified m6.5 or greater seismic event. An immediate assessment of critical infrastructure is needed for response resources (roads, bridges, area command sites, staging area sites, communications systems, etc.)

The reports should contain, at the minimum, the following information:

- Location and nature of damage
- List of damages by category (roads, bridges, structures, communication facilities, etc.)
- Injuries, and fatalities
- Response capabilities of local jurisdictions

Once state area commands are established, the command will facilitate the collection of raw assessment data and forward that data to the SEOC for refinement and analysis.

Raw damage information is gathered and reported to the SEOC, where the Missouri National Guard (J2) Intelligence refines the data into information useful for effective management decisions.

E-Team is the preferred platform for damage assessment reporting. If E-Team is not available, the following platforms in order are: E-Mail, fax, or radio. The refined data will then be passed on to the Stat Unified Command staff and the State Area Commands to facilitate the creation of an Incident Action Plar (IAP).

Search and Rescue (ESF #9 – Search and Rescue)

No single organization has sufficient Search and Rescue resources to provide adequate Search and Rescu services. Therefore, Search and Rescue authorities will use all available resources, including federal, state local, private, and volunteer organizations.

Search and Rescue missions are prioritized according to the potential loss of human lives, critical facilities, equipment, or supplies.

An area command will be established in Regions C and E for search and rescue operations.

It is estimated for Region E that 100, 4 member, search teams with all terrain mobility will be required to conduct operations. It is assumed that local response capabilities will have searched approximately 1/3 of their geographic area within 12 hours following an earthquake event.
Upon verification of 6.5 magnitude or greater event, the Division of Fire Safety will activate its' Fire Mutual Aid system. The Search and Rescue Operations Branch Chief position will be manned initially by either an Incident Management Team (IMT), or other qualified personnel from the fire mutual aid system.

Responding personnel will be sent to a Region C or Region E staging area. It will be incumbent upon responding personnel to report to the staging area manager upon arrival. The staging area manager will report to search and rescue branch operations assets on scene, and mission capability status.

Due to the limited availability of technical rescue teams, and the probable widespread nature of the event, search and rescue will be divided into search missions and rescue missions.

Ground search teams will be comprised of four (4) personnel each. Optimal composition of these teams will be members having skills in basic first aid, operation of communications gear, map orientation, GPS operation, and navigation. Organizations that would be well served to man these teams are Community Emergency Response Teams (CERT), Civil Air Patrol (CAP), active military forces, and Volunteer Organizations Active in a Disaster (VOAD). The main mission for these teams will be structure searches and identification of rescue and evacuation missions.

Technical Rescue teams will be utilized for structure collapses and identified rescue operations.

The Civil Air Patrol will provide aerial assets to assist in search missions and identify possible rescue operations.

As damage assessment reports become available, search and rescue missions will be assigned as warranted.

Other Identified Items

In addition to Missouri's response actions, automatic requests for Federal Assets have been identified:

The initial request to FEMA Region VII will include

- Rapid Needs Assessment Team (RNA Team) with simultaneous ERT-A deployment to SEMA
- USDOT – Air Operations (helicopter)
- Disaster Mortuary Operational Response Team (DMORT) (2)
- Disaster Medical Assistance Team (DMAT) (4)
- Veterinary Medical Assistance Team (VMAT) (2)
- Urban Search and Rescue Team (USAR) (6)
- National Disaster Medical System (NDMS)
- National Communication System (NCS) Support
- GIS and Satellite support from United States Geological Service (USGS)
- Department of Defense (DOD) support for medical and Search Teams

Summary of State Agencies Roles and Responsibilities outlined in Annex Y (Catastrophic Event)

1. SEMA is the coordinating agency for catastrophic event operations for an earthquake. SEMA responsibilities include but are not limited to:

   a. Verification of the seismic event.
   b. Activate the SEOC. (Once activated, the SEOC is the coordinating point for all state response and recovery activities.)
   c. Prepare pre-scripted Executive Orders, Disaster Declaration Requests, and EMAC Requests.
   d. Serve as the collection point for damage assessment information.
   e. Address firewall issues between SEOC and agency EOCs.
   f. Activate Missouri Task Force 1 (MO-TF1).
   g. Coordinate with FEMA to activate additional US & R teams.
   h. Activate the Emergency Management Assistant Compact (EMAC) to request mutual aid.
   i. Develop and maintain Communications Asset Database for state agencies.
   j. Develop and maintain the Satellite Telephone Directory.
   k. Draft pre-scripted Executive Order that provides statewide law enforcement authority, as required.
   l. Coordinate the request for Temporary Flight Restrictions (TFR) from the FAA.
   m. Coordinate the provision of services, equipment, and supplies to support expedient operations associated with an earthquake disaster; for the approval and acquisition of equipment and supplies not available through normal purchasing channels and ordering time frames following an earthquake.
   n. Activate MO VOAD Partners.
   o. Provide Planning Section to each state area command
   p. Provide staffing for evacuation management team

2. All state departments/agencies will provide support for a catastrophic event. The following state departments/agencies will provide support.

   Agency responsibilities include:

   a. Missouri National Guard
      - Execute Cracked Earth Plan.
      - Personnel report immediately to Armories/Airfields.
      - Provide assets for the Joint Rapid Needs Assessment Flights.
      - Provide aerial support to assess the primary transportation routes and key airfields.
      - Support SEMA and the MIAC with damage assessment information.
      - Support MoDOT with repairing and opening major ingress/ egress routes and key airfields.
      - Establish geographic area commands in regions B, C, E, F, G, and I and provide liaison to MSHP Troop HQ, County and City Emergency Management Directors.
      - Establish a fixed wing and helibase hub in conjunction with MSHP, Department of Conservation, CAP, and FEMA Region VII.
      - Establish an airport as a forward fixed wing and helibase hub.

- Provide security for ingress/egress routes in support of MSHP.
- Provide light search and rescue teams in support of Fire Service/Local responders.
- Provide Law Enforcement augmentation in support of MSHP and Local Authorities.
- Provide air transport to move MO-TF1 to pre-identified locations.
- Provide staffing for evacuation management team

b. Missouri State Highway Patrol
- Primary agency for state law enforcement.
- Conduct assessment flight for the Governor and the Adjutant General.
- Conduct aerial assessment of pre-designated routes for bridge reconnaissance.
- Support local authorities with law enforcement functions.
- Provide Communication Unit to state area command.
- Provide PIO for each state area command Provide staffing for evacuation management team
- Coordinate the request for Temporary Flight Restrictions (TFR) with SEMA & FAA.

c. Department of Conservation
- Activate seismic flight operations plan (Cracked Earth)
- Law Enforcement Support
- Supply Heavy Equipment Assets
- Communications Network Support
- Fire Suppression Support
- Provide Logistics Section Chief to each state area command
- Provide Supply Unit Leader to each state area command
- Provide Ground Support Unit Leader to each state area command

d. Department of Corrections
- Transportation Support
- Mass Feeding Support

e. Department of Natural Resources
- Law Enforcement Support
- Hazmat Response Support
- Department of Natural Resources' Park Rangers will exercise a law enforcement role
- Dam Inspectors will coordinate with MoDOT for possible impact of collapsed dams near the primary routes to the damage zone.
- Will coordinate with water and sewage treatment facilities in all matters concerning water supply and sewage treatment and disposal
- Communications Director will staff the JIC at the SEOC.
- The Department of Natural Resources will test public drinking water and coordinate sample collection and transportation to the DNR ESP Lab, DHSS lab and/or private lab
- Provide HazMat branch chief for each state area command
- Division of State Parks will coordinate state parks use for evacuee / responder use with SEOC

f. Department of Transportation (MoDOT)
- Maintain the department's Comprehensive Incident Response Plan for an earthquake event.

- Conduct aerial and ground assessments of roads and bridges.
- Begin advanced preparations to ready personnel and equipment.
- Identification and repair of primary ingress/egress routes.
- Support law enforcement with traffic control.
- Deploy Post Incident Bridge Inspection Teams (PIBIT).
- Responsible for diverting all ground traffic from the west to routes north and south around the damage zone and across the Mississippi River.
- Assist with movement of trailers and other large medical support equipment if resources are available. If MoDOT resources are not available, MoDOT will coordinate with USDOT to obtain contract resources.
- Provide transportation branch chief to each state area command
- Provide staffing for evacuation management team
- Assist with movement of trailers and other large medical support equipment if resources are available. If MoDOT resources are not available, MoDOT will coordinate with USDOT to obtain contract resources.

g. Missouri State Water Patrol
- Provide law enforcement support.
- Monitoring the safety and security of ports and waterways along the Missouri and Mississippi Rivers.
- Route clearance teams with MoDOT and the MSHP
- Coordinate Dive Team operations

h. Civil Air Patrol
- Provide airborne radio relay
- Conduct aerial assessment of pre-designated routes.
- Assist with temporary flight restricted airspace coordination.
- Provide ground personnel to assist in search and rescue operations.

i. Missouri Division of Fire Safety
- Coordinate Fire Statewide Mutual Aid assistance.
- Coordinate with special strike teams (HSRT).
- The Division of Fire Safety Investigators will exercise a law enforcement support role.
- Provide Search and Rescue branch chief to each state area command.
- Activate Incident Management Teams (IMT)
- Provide staffing for evacuation management team

j. Office of Administration
- Address firewall issues between the SEOC and agency EOCs.
- Assist with staging area site selection and setup contracts with local hotels (if required).
- Provide IT staff to support each planning section of the state area commands.
- Provide Facilities Unit Leader to each state area command
- Provide Credentialing Unit Leader to each state area command
- Provide Food Unit Leader to each state area command

k. State University Campus Police Departments
- Provide law enforcement augmentation

l. Department of Social Services

- Primary responsibility for mass care during a catastrophic event.
- Communications Director will staff the JIC at the SEOC.
- Provide Mass Care Unit Leader to each state area command.
- Provide staffing for evacuation management team

m. Department of Health and Senior Services

- Make preparations to deal with large numbers of people in need of medical care with affected area hospitals unable to function normally.
- Coordinate movement of HRSA funded support trailers to the area.
- Coordinate movement of MO 1-DMAT equipment and staff to the area.
- Coordinate establishment of the Modular Emergency Medical System and select a location as close as possible to the affected area.
- Prepare the request for the Federal Medical Station.
- Identify ambulance services and transportation companies with MOUs in place to move patients.
- Identify long-term care and other non-traditional facilities that might be suitable to house ill patients.
- Prepare to activate the Licensed Emergency and Disaster Registry (LEAD-R).
- Review communications plans and availability of two-way radios and satellite phone held by DHSS.
- Review and revise, as necessary, the draft executive order recognizing licenses of out of-state health care providers and liability issues.
- Establish a statewide database to provide for screening of health care volunteers.
- Coordinate with Mental Health to provide surge capacity crisis counseling to include emergency workers.
- Plan to integrate volunteers from unaffected states and consider altered standards of care.
- Communications Director will staff the JIC at the SEOC.
- Provide EMS branch chief for each state area command.
- Provide Human Services Branch to each state area command.
- Provide staffing for evacuation management team

n. Department of Mental Health

- Mental Health facilities in the projected affected area should review ways of enhancing self sufficiency.
- Provide surge capacity crisis counseling to include emergency workers.
- Communications Director will staff the JIC at the SEOC.
- Provide staffing for evacuation management team

o. Department of Public Safety

- Director of Communications, for the Department of Public Safety will serve as the JIC staffing originator.
- Director of Communications will be the liaison between the Governor's Office and SEMA/JIC.
- Coordinate Homeland Security and MIAC activities
- MIAC provide intelligence analysis and damage assessment reporting
- Provide staffing for evacuation management team

p. Department of Economic Development

- Communications Director will staff the JIC at the SEOC.

q. Department of Insurance
- Communications Director will staff the JIC at the SEOC.

r. Department of Agriculture
- Communications Director will staff the JIC at the SEOC.

s. Department of Labor and Industrial Relations
- Communications Director will staff the JIC at the SEOC.

t. Department of Revenue
- Communications Director will staff the JIC at the SEOC.

u. Missouri Capitol Police
- Provide Law Enforcement Augmentation

v. Missouri Alcohol and Tobacco Control
- Provide Law Enforcement Augmentation

w. Missouri Emergency Response Commission
- Activate and coordinate HSRT deployment

x. Missouri Department of Higher Education
- Coordinate facility use for response/recovery efforts

y. Missouri Department of Elementary and Secondary Education
- Coordinate facility use for response/recovery efforts

z. Missouri Funeral Directors Association
- Conduct Mortuary Services

Missouri Local Workshop Registration List

Poplar Bluff Workshop

	Name	*Organization*
1	Ratcliff, Scot	1140th EN BN, MO Army National Guard
2	Garner, David	Advance Police Dept.
3	Ketelhut, Larry	American Red Cross
4	Davisson, Scot	American Red Cross
5	Probst, Billie	American Red Cross
6	Klueppel, Cheryl	American Red Cross Southeast MO Chapter
7	Ashby, John	AR State Bank Department
8	Tost, Teresa	Ava/Douglas County EMA
9	Sliger, Rick	BCEMA
10	Fredwell, Bob	BCFD
11	Jones, Larry	Board Of Municipal Utilities
12	MUNGLE, FLOYE	BOARD OF PUBLIC WORKS
13	Blagg, Richard	Board of Public Works
14	Burke, Barbara	Bootheel Counseling
15	Riddle, Jeff	Bootheel LEPC
16	Keys, Jr., Willard	Cape County Building & Grounds
17	McQuay, Don	Cape Girardeau County
18	Clifton, John	Cape Girardeau County
19	Dickerson, Ruth Ann	Cape Girardeau County Sheriff
20	Hasheider, Mark	Cape Girardeau Fire Dept.
21	Jones, Charlie	Caruthersville Fire Department
22	Riggs, Chris	Caruthersville Police Department
23	Wilkinson, Jim	Central US Earthquake Consortium
24	Calvert, Mike	Central US Earthquake Consortium
25	Young, Peggy	Central US Earthquake Consortium
26	Nave, Alisa	Central US Earthquake Consortium
27	Wilkins , David	City Light Gas & Water
28	Rapert, Denis	City of Charleston
29	Banes, Eddie	City of Fredericktown
30	Sullivan, Robert	City of Fredericktown
31	Wasson, Don	City of Fredericktown
32	O'Gara, Mike	City of Fredericktown
33	Barber, Joe	City of Fredericktown
34	Mallott, John	City of Kennett
35	Carter, Randy	City of Kennett Street Department
36	Wheeler, Roger	City of Kennett, MO
37	Grant , Danny	City of Malden
38	German, Winford	City of Malden
39	Hinson, Tommy	City of Malden
40	Rogers, Lloyd "Dewayne"	City of Malden
41	Kirkpatrick, WM	City of Piedmont
42	Roach, John	City of Puxico

Poplar Bluff Workshop

	Name	*Organization*
43	Hogue, Paul	CUSEC
44	Hester, Norm	CUSEC
45	Mazzocchio, Kimberly	Department of Social Services; Family Support Division
46	Woodsmall, Paula	Dept of Health & Senior Services
47	Rowe, Dave	Dexter Fire Dept.
48	Seymore, Don	Dexter Fire Dept.
49	Banken, Al	Dexter Fire Dept.
50	Haubold, Paul	Dexter Police Department
51	Barbour, J. Patrick	Dexter Police Department
52	Evers, Sue	DHS/FEMA Region VII
53	Winkler, Ann	DHSS
54	Bock, Richard	Divi. of Facilities Management, Design and Construction
55	Roark, Craig	DSS
56	Buchmeier, Nancy	DSS / Family Support Div
57	Kelley, Larry	Dunklin County
58	Kalkbrenner, James (Jim)	EMA
59	Fuchs, Eric	EMD Wayne County
60	Prance, John	Emergency Management
61	Knaup Jr., Richard	Emergency Management Agency
62	Deken, Darrell	Family Support Division
63	Miller, Roland	FAMILY SUPPORT DIVISION
64	Robertson, Rick	Family Support Division
65	Tate, Carl	Family Support Division
66	Blades, Sharon	FEMA
67	Sumners, Craig	FEMA
68	Pawlowski, Mike	FEMA HQ
69	Gregg, Chuck	FEMA Region 7
70	Kirk, Phil	FEMA Region VII
71	Smith, M. B.	fire dept
72	Edwards, Chuck	Fire Dept
73	Jefferson, Theresa	GWU
74	Marquez, Shannondor	IEM
75	Roze, Louanne	IEM
76	Hunter, Emily	IEM
77	Dargush, Andrea	IEM, Inc.
78	Coble, Rex	IEM, Inc.
79	Tuneberg, Sarah	IEM, Inc.
80	Bushnell, Jon L.	Innovative Emergency Management
81	Robertson, Stephen	Innovative Emergency Management
82	Reed, Greg	Innovative Emergency Management
83	Webb, Larry	Innovative Emergency Management
84	Morrill, Brian	Innovative Emergency Management
85	Stephens, Don	Innovative Emergency Management
86	Bartis, Melanie	Innovative Emergency Management
87	Mouser, Jason	Jackson Fire Rescue

Poplar Bluff Workshop

	Name	*Organization*
88	Horton, David	Kennett Fire Department/EMA
89	Tate, Barry	Kennett Police Department
90	Rogers, Jim	L-3 Communications
91	Cleveland, Lisa	Mid-America Earthquake Center
92	Harris, Danny	Mississippi County Emergency Management
93	Kinneman, Dale	Missouri Department of Transportation
94	Huskey, Lindell	Missouri Department of Transportation
95	Helpingstine, Michael	Missouri Department of Transportation
96	Lambert, Jeffrey	Missouri Department of Transportation
97	Ball, Cheryl	Missouri Department of Transportation
98	Compas, Craig	Missouri Department of Transportation
99	Hess, Edward	Missouri Department of Transportation
100	Bostic, Jackson	Missouri DNR
101	Bennett, Rick	Missouri DOT
102	May, Charles	Missouri SEMA
103	Toler, Terry	Missouri SEMA
104	Scrivner, Randy	Missouri State Emergency Management Agency
105	Leahy, Joseph	MO Army National Guard
106	Altman, Bill	MO Conservation Dept.
107	Francis, Rob	MO Division of Fire Service
108	Besemer, Steve	MO SEMA
109	Vitale, Jeffrey	Mo State Highway Patrol Troop E
110	Pulliam, Michael	Mo State Highway Patrol Troop E
111	Ridens, George	Mo State Highway Patrol Troop E
112	Robitsch, Todd	Mo State Highway Patrol Troop E
113	Lacy, Daniel	MODOT
114	Larkins, Daniel	Mt. Calvery Church
115	Coleman, Lyndell	Municipal Utilities
116	Hendricks, Doug	Municipal Utilities
117	McClarty, David	New Madrid County EMD/Lilbourn Fire Chief
118	Lathum, Jerry	New Madrid County Health Dept.
119	Russell, Keith	OA/FMDC
120	Dodson, Danny	Pemiscot County EMD
121	Sanders, Richard	Piedmont Police Dept.
122	Stucker, Ralph	poplar bluff fire dept.
123	Wallace, C.A.	Poplar Bluff Police Department
124	McClain, Michael	Poplar Bluff Police Department
125	Burton, Lindell	Scott County EMA
126	Nelson, John	Scott County Sheriff's Department
127	Walter, Rick	Scott County Sheriff's Department
128	Evans, Joel	Scott County Sheriff's Dept.
129	Bruce, Missy	Scott County Sheriff's Dept.
130	Wood , Shawn	Scott County Sheriff's Dept.
131	Kindred, Teresa	Scott County Sheriff's Dept.
132	Beardslee, Tom	Scott County Sheriff's Dept.

Poplar Bluff Workshop

	Name	*Organization*
133	Helton, Dennis	SEMA
134	Gliniecki, Dante	SEMA
135	Reynolds, Ronald	SEMA
136	Charrier, Jim	SEMA
137	Lehmen, AJ	SEMA
138	Bailey, Bob	SEMA
139	Jones, Sara	SEMA
140	Adams, Candace	SEMA
141	Winkler, Mark	SEMA
142	Carrender, Marilyn	SEMA
143	Burke, Maureen	SEMA
144	Martin, John	Sikeston Dept of Public Safety
145	Hailey, James	Sikeston DPS
146	Strait, Rick	Southeast Missouri Community Treatment Center
147	Schrum, Kevin	Southeast Missouri Community Treatment Center
148	Nicholls, Ryan	Springfield-Greene County OEM
149	Diemler, Timothy	State Emergency Management Agency
150	Heidbreder, Brenda	State Emergency Management Agency
151	Sloan, Steve	State Emergency Management Agency
152	Monroe, Marcus	State of MO / Dept of Social Services
153	Pleimling, Debbie	Stoddard Co. Public Health Center
154	Poff, Vicki	The Salvation
155	England, Don	Town of Oak Ridge
156	Weathers, Katherine	US Coast Guard

Sullivan Workshop

	Name	*Organization*
1	Gamble, Don	Air -Evac Lifeteam
2	Baldwin, Tom	Air -Evac Lifeteam
3	Wiedenhoffer, Michelle	AmerenUE, Souix Power Plant
4	Anderson, Mary	American Red Cross
5	Anzalone, Jono	American Red Cross - FEMA Region VII
6	Bates, Nancy	American Red Cross St. Louis Area Chapter
7	Friel, Melissa	American Red Cross-Capital Area Chapter
8	Melton, Marjorie	Board of Public Service
9	Calvert, Mike	Central US Earthquake Consortium
10	Wilkinson, Jim	Central US Earthquake Consortium
11	Jenne, Robert	City of Berkeley, MO
12	Mutert, Walter	City of Bridgeton
13	Burnley, W. Graham	City of Chesterfield
14	Thorp, Mark	City of Clayton
15	Arnoldy, Frank	City of Crestwood
16	Unser, Steve	City of Creve Coeur
17	Boyer, Chuck	City of Festus
18	Cook, Adam	City of Festus
19	Lewis, Tim	City of Festus
20	DeClue, Don	City of Festus
21	Clemens, Matt	City of Festus
22	Stoll, Stephen	City of Festus, MO
23	Wappelhorst, Jeff	City of Frontenac
24	Trout, Jack	City of Frontenac Fire Department
25	Walsh, Timothy	City of Manchester
26	DeShay, Dennis	City of Moline Acres
27	Hodges, Fred	City of Moline Acres
28	Crawford, Keith	City of Moline Acres
29	Rice, Ira	City of Moline Acres
30	Hopkins, Donald	City of Moscow Mills
31	Becker, Dian	City of Pacific
32	Welch, Happy	City of Pevely
33	Coffman, Doris	City of Potosi
34	Schatz, James	City of Sullivan
35	King, Dan	City of Sullivan
36	Thurmond, Joe	City of Sullivan
37	Cuneio, Larry	City of Sullivan
38	Falloon, Mark	City of Sullivan
39	Kranz, Patrick	City of Town and Country
40	Hotsenpiller, Lisa	City of Washington
41	Boehmer, Brian	City of Washington
42	Halmich, Bill	City of Washington
43	Thompson, Mike	City of Woodson Terrace
44	Jacquemin, Micah	City of Woodson Terrace
45	Juenger, Erin	Clayton Fire Department

Sullivan Workshop

Name	*Organization*
46 Avery, Kevin	Crestwood Police Department
47 Brumley, Jenny	CUSEC
48 Blake, Brian	CUSEC
49 Stockman, Chuck	De Soto Police Department
50 Polson, Karla	Dept Social Services /Family Support Division
51 Evers, Sue	DHS/FEMA Region VII
52 Roark, Craig	DSS
53 Allison, Sandy	Economic Development
54 Coots, Harold	Facilities Management
55 NINER, PAT	Family Support
56 Burns, Debbie	Family Support Div.
57 Blades, Sharon	FEMA
58 Sumners, Craig	FEMA
59 Pawlowski, Mike	FEMA HQ
60 Garrison, Alan	FEMA R7
61 Gregg, Chuck	FEMA Region 7
62 Kirk, Phil	FEMA Region VII
63 Boschert, Kevin	Florissant Police Department
64 Elliott, Steve	Franklin Co Sheriff
65 Schroeder, Ann	Franklin County
66 Dopp, Robert	Franklin County EMA / 911
67 Vestal, Sharon	FSD/Webster/Wright County
68 Zeitzmann, Larry	Glendale Fire Department
69 Jefferson, Theresa	GWU
70 Pigg, Christopher	Herculaneum Police
71 Rozek, Louanne	IEM
72 Hunter, Emily	IEM
73 Marquez, Shannon	IEM, Inc.
74 Dargush, Andrea	IEM, Inc.
75 Coble, Rex	IEM, Inc.
76 Webb, Larry	Innovative Emergency Management
77 Bushnell, Jon L.	Innovative Emergency Management
78 Bartis, Melanie	Innovative Emergency Management
79 Stephens, Don	Innovative Emergency Management
80 Morrill, Brian	Innovative Emergency Management
81 Robertson, Stephen	Innovative Emergency Management
82 Reed, Greg	Innovative Emergency Management
83 Nagel, Chris	Kirkwood Police Department
84 Rogers, Jim	L-3 Communications
85 Duffy, Daniel	Lakeshire MO Police Dept.
86 Carson, William	Maryland Heights Police Department
87 May, Charles	Missouri SEMA
88 Stonner, Susie	Missouri SEMA
89 Scrivner, Randy	Missouri State Emergency Management Agency
90 Moore, Sean	Missouri State Highway Patrol

Sullivan Workshop

	Name	*Organization*
91	Crase, Michael	Missouri State Highway Patrol
92	Marcee, Scott	Mo Baptist Hosptial - Sullivan EMS
93	Windle, Rodger	MO Div. of Fire Safety
94	Besemer, Steve	MO SEMA
95	Bragg, Michael	MoDOT
96	Schneider, Rick	MODOT
97	Campbell, Shaun	Moline Acres Police Department
98	Lathum, Jerry	New Madrid County Health Dept.
99	Russell, Keith	OA/FMDC
100	Neske, John	O'fallon Police Dept.
101	Jobe, Robin	Olivette Fire Department
102	Lakenan, Jack	Perry Co Emergency Management
103	Thomas, Terry	Pevely Police Dept.
104	Daugherty, Jerry	Portage Emergency Management Agency
105	Reynolds, Ronald	SEMA
106	Lohner, Derek	SEMA
107	Pasley, Jim	SEMA
108	Gliniecki, Dante	SEMA
109	Bernskoetter, Jim	SEMA
110	Helton, Dennis	SEMA
111	Koehler, Jamie	Southeast Missouri Chapter American Red Cross
112	Zerr, Rodney	St Charles County Sheriff's Department
113	Rhodes, Ernie	St. Charles Fire Department
114	Anthony, Robert	St. Charles Police Department
115	Wells, Alan	St. Francois County EMA
116	Bardot, Mike	St. Louis Co Dept. of Highways and Traffic
117	Penney, William	St. Louis County
118	Wittkoetter, Karen	St. Louis County
119	Heck, Gus	St. Louis County Dept of Highways and Traffic
120	Randazzo, Joseph	St. Louis County Emergency Management
121	Smiley, Michael	St. Louis County PD OEM
122	Dupuis, Paul	St. Louis County Police - OEM
123	Lord-Castillo, Brett	St. Louis County Police - OEM
124	Roach, William M.	St. Louis County Police Department
125	Diedrich, Mark	St. Louis County Police OEM
126	Walk, Ken	St. Louis Emergency Management Agency
127	Gray, Darla	St. Louis Police Department
128	Harris, Reggie L.	St. Louis Police Department
129	Gilliam, Edward	St. Peters Police Department
130	Diemler, Timothy	State Emergency Management Agency
131	Heidbreder, Brenda	State Emergency Management Agency
132	Campbell, John	State Emergency Mgt Agency
133	Monroe, Marcus	State of MO / Dept of Social Services
134	Eaton, Jim	Statewide Coordinator MFDEA
135	Armbruster, Art	Ste Genevieve Co. 911-EMA

Sullivan Workshop

	Name	*Organization*
136	Thoms, Christine	Sullivan Community Betterment Committee
137	White, Rich	Sullivan Fire Protection District
138	Halbert, Kevin	Sullivan Police Dept.
139	Poff, Vicki	The Salvation
140	Kitcher, Kyle	Union Police Department
141	Waggoner, Richard	US Army Corps of Engineers, OD-R
142	Lucas, John	Village of Caledonia
143	Vinyard, Robert	Village of Caledonia
144	Daniels, Michael	Warren County EMA
145	Karl, Edwin	Warren County EMA
146	Hahn, Ken	Washington Police Department

Question#:	1
Topic:	draft templates
Hearing:	The New Madrid Seismic Zone: Whose Fault is it Anyway?
Primary:	The Honorable Claire McCaskill
Committee:	HOMELAND SECURITY (SENATE)

Questions and Responses for the Record from Mr. Cannon

Question: You mentioned in your testimony before the subcommittee that you stated that FEMA had completed draft templates for the Federal Contingency Response Plans for the state of Missouri. I understand that this report has been provided to the committee staff but is unavailable for review by personal staff members. While I understand that this is only a draft plan and there is are still developing changes, it is also my responsibility as a member of this subcommittee and as a Senator from Missouri that I be fully aware of the direction of this plan before it is no longer subject to change. Missouri was the epicenter of the most recent seismic event on the New Madrid fault and has some of the most widely populated areas along the fault line, so there is much at stake if a plan is not properly developed. Therefore, I respectfully request that you provide a copy of just the draft plan for the state of Missouri.

Response:
FEMA has not completed "draft templates for the Federal Contingency Response Plans for the state of Missouri." Mr. Glenn M. Cannon testified that FEMA had completed a draft of a *Federal Interim Contingency Plan – Pre-decisional Draft: New Madrid Seismic Zone Catastrophic Earthquake Response Planning Project* (FICP). The draft FICP, provided to the committee on December 11, 2007, provides a broad plan that deals only with the Federal response to a NMSZ event. This Plan is a work in progress. As such, it does not, at this time, include anything about the plans of the State of Missouri, nor does it include any Federal plans that are specific to the State of Missouri. The FICP was developed to provide guidance in the unlikely event that a catastrophic NMSZ earthquake were to happen before the current project is completed. This Plan will evolve over time to include Federal plans that are more specific to each state in the NMSZ and to include integrated linkages to each state's NMSZ earthquake plans.

The pre-decisional draft of the FICP is still being reviewed in-house by FEMA. In December 2007 it was shared with the four FEMA regions involved with the NMSZ catastrophic planning. The Regional Administrators for these regions were requested to share the FICP with the States in their region. It will also be shared with FEMA's Federal partners for their review and comment and is scheduled to be revised and updated quarterly to include: (a) information and plans resulting from local-focused and state-focused workshops being held in each NMSZ state; and (b) response plans being

Question#:	1
Topic:	draft templates
Hearing:	The New Madrid Seismic Zone: Whose Fault is it Anyway?
Primary:	The Honorable Claire McCaskill
Committee:	HOMELAND SECURITY (SENATE)

developed by FEMA's federal partners.[1] As the NMSZ project progresses, the FICP will evolve into a detailed operations plan addressing Federal operations and describe processes to meet identified shortfalls in State and local capabilities for responding to a catastrophic NMSZ earthquake

Mr. Cannon also testified that following *local* planning workshops, held in Poplar Bluff on October 11-12, 2007 and in Sullivan on October 15-16, 2007, local planning templates would be developed. FEMA, its project team, and most importantly the Missouri State Emergency Management Agency (SEMA) are completing a report from these workshops that can serve as a guide for use by local emergency management agencies in Missouri to craft their local NMSZ earthquake response plans. When completed and approved by the Missouri SEMA for release, this report will be provided to the committee. The results of the local planning workshops will feed into the FICP and into a state-focused planning workshop scheduled for March 11-12, 2008 in Jefferson City, Missouri.

[1] FEMA's "Federal partners" include, among others, the agencies responsible for the 15 Emergency Support Functions (ESF) delineated in the National Response Plan and the National Response Framework.

Question#:	2
Topic:	workshops
Hearing:	The New Madrid Seismic Zone: Whose Fault is it Anyway?
Primary:	The Honorable Claire McCaskill
Committee:	HOMELAND SECURITY (SENATE)

Question: In addition, you also stated in your testimony that FEMA has completed the local workshops in Missouri. I would like copy of the date and location of each workshop held as well as a list of attendees.

Response:

Two "local" workshops have been completed in Missouri:

- October 11-12, 2007: Poplar Bluff, Missouri with 156 total participants
- October 15-16, 2007: Sullivan, Missouri with 146 total participants

Registration lists for each workshop are included (attachment 1). A Missouri "State" Catastrophic Earthquake Planning Workshop is scheduled for March 11-12, 2008, in Jefferson City, Missouri. Planning for this workshop is in progress.

Question#:	3
Topic:	I-55
Hearing:	The New Madrid Seismic Zone: Whose Fault is it Anyway?
Primary:	The Honorable Claire McCaskill
Committee:	HOMELAND SECURITY (SENATE)

Question: Mr. Applegate testified that one of the biggest problems we could face during a seismic event is ground liquefaction. He also mentioned that this could greatly impact I-55 which runs north and south along the Mississippi River in Missouri and is one the largest access roads to many cities between the Arkansas boarder and St. Louis. What is the response plan for evacuation and emergency response should critical portions of I-55 become impassible?

Response:

The Missouri State Emergency Management Agency (SEMA) has drafted its State Emergency Operations Plan (SEOP), dated October 2006. It is anticipated that additions and modifications to those portions of the plan that deal with evacuation and transportation, both for evacuation and response operations, will be made as a result of the current NMSZ project. The following sections of the SEOP provide guidance on evacuation and transportation:

SEOP, Annex "E" – Transportation (ESF # 1, Transportation), Section IV - Organization and Assignment of Responsibilities, Sub-section "A" – Organization, Paragraph 1states: "*The Missouri Department of Transportation (MoDOT) is responsible for all transportation systems and operations. MoDOT directs all activities to ensure the transportation systems are operable.*"

SEOP, Annex "G" – Evacuation (ESF # 1 – Transportation), Section IV – Organization and Assignment of Responsibilities, Sub-Section "A" – Organization, Paragraph 1 states: *"Public evacuation is the responsibility of local jurisdictions and in certain circumstances the Governor of the State of Missouri is responsible for issuing the executive order authorizing implementation of evacuation."*

SEOP, Annex "Y" – Catastrophic Event (Earthquake), Section IV – Organization and Assignment of Responsibilities, Sub-Section "A" – Organization, Paragraph 1 states: *"The organization for a catastrophic event such as an earthquake will be based on the SEOP Basic Plan, Section IV. All operations will be conducted under the National Incident Management System (NIMS)."*

SEOP, Annex "Y", Section III – Concept of Operations, Sub-Section "B" – Phases of Operation states:

"1. Alert/Assessment – Due to the potential for extraordinary and widespread damage, selected agencies and organizations will begin preliminary activity at pre-designated levels (Richter scale magnitude) of seismic activity as follows:

Question#:	3
Topic:	I-55
Hearing:	The New Madrid Seismic Zone: Whose Fault is it Anyway?
Primary:	The Honorable Claire McCaskill
Committee:	HOMELAND SECURITY (SENATE)

a. At a 4.5 magnitude or greater earthquake, the National Earthquake Information Center(U.S. Geological Survey), Golden, Colorado will notify SEMA of the seismic event. SEMA will go to a Classification 1 emergency status. Verifications will come from other sources such as St. Louis University or University of Memphis (see Appendix 18 to this Annex).

b. At a 5.0 magnitude MoDOT will conduct land based damage assessment of bridges and roadways in the impacted area.

c. At a 6.5 magnitude or greater all state departments/agencies identified in this plan will activate their plans and take respective actions for an earthquake response (i.e., aerial assessment of bridges and roads). See Attachment "A" to Appendix 1 of this Annex for diagram of the State Unified Command structure.

d. In addition to the damage assessment actions outlined in this Annex, other assessments will be conducted based on the situation. i.e. private industry, utilities, navigable waterways.

e. Damage assessment activities will be coordinated by SEMA as identified in Annex "D" of the SEOP, Damage Assessment and Incident Analysis."

More details are provided in SEOP Annex "Y" which is available from the Missouri State Emergency Management Agency. The State requires a non-disclosure agreement for release of copies. An overview of the SEOP Annex "Y" is included (attachment 2).

Prior to the March 2008 State-level Missouri workshop, the State and Federal partners will review the adequacy of existing plans and recommendations for improvement of evacuation and response operations. During that March workshop geo-specific aspects concerning I-55 and evacuation will be addressed in greater detail. FEMA is also working closely with its partners, especially the United States Geological Survey (USGS) and the Mid-America Earthquake Center (MAEC) to refine the models that predict impacts of a NMSZ earthquake on I-55 and other transportation routes.

Questions and Responses for the Record from Mr. Applegate

USGS Response to Senator McCaskill's Post Hearing Questions for the Record

Question: In your testimony before the subcommittee you mentioned that you had concerns about the ground liquefaction should a seismic event occur. Specifically, you referenced concerns over the impact this would have on I-55 which runs north and south in Missouri and is one of the largest access roads to many cities between the Arkansas border and St. Louis. Have you been able to identify the areas along I-55 that are most susceptible to liquefaction? If so, have those been communicated to FEMA for incorporation into the response plan? If not, can you please explain why this type of analysis has not been done?

Answer: FEMA is aware of the hazard and has incorporated it into their draft New Madrid earthquake contingency plan. Using USGS-funded regional geologic mapping, the state geological surveys that form the Association of Central U.S. Earthquake Consortium State Geologists provided the map used in the contingency plan, and it indeed shows very high susceptibility for the entire section of I-55 mentioned in the question. The areas most susceptible to liquefaction are those in the floodplain of the Mississippi and other rivers. Generally, this would be from just east of the bluffs of the river south of downtown Memphis, northward until just south of Cape Girardeau, Missouri. Although there are isolated areas along I-55 that may be somewhat less susceptible, those could be identified with site-specific studies that are the purview of consulting engineering firms.

Questions and Responses for the Record from Mr. Hayes

NIST RESPONSE TO
SENATOR MCCASKILL'S QUESTION FOR THE RECORD
SENATE HOMELAND SECURITY AND GOVERNMENT AFFAIRS COMMITTEE AD HOC SUBCOMMITTEE ON STATE, LOCAL & PRIVATE SECTOR PREPAREDNESS AND INTEGRATION
"THE NEW MADRID SEISMIC ZONE: WHOSE FAULT IS IT ANYWAY?"
DECEMBER 4, 2007

Question:

You testified about the process of establishing new building codes for areas that could be affected by a seismic event. I am curious to learn how these codes affect existing structures. Have you developed a set of standards to guide communities in dealing with structures that were built prior to the benefit of earthquake mitigation standards? If so, what are those standards and how are they being communicated to local communities?

Response:

The effects of building codes for new buildings on existing structures:
All 50 states have adopted, in total or in part, the *International Building Code* (IBC), a national model code published by the International Code Council (ICC). This model building code references national consensus standards developed by standards development organizations. The model code does not become a law or regulation unless it is adopted by a state or local jurisdiction. To ensure earthquake resistance is provided in new buildings, the IBC adopts by reference the *Minimum Design Loads for Buildings and Other Structures*, known as ASCE 7, which is a national consensus standard published by the Structural Engineering Institute of the American Society of Civil Engineers (ASCE). In recent years, ASCE 7 provisions have been drawn largely from the *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* that are produced by the Building Seismic Safety Council (BSSC), with support by FEMA through its NEHRP-related program. The *Recommended Provisions* document combines research advances with practitioner advances in knowledge and technology.

The IBC and ASCE 7 documents largely apply to the design and construction of **new** buildings. For **existing** buildings, the IBC and ASCE 7 contain limited provisions for additions, alterations, and changes in occupancy, either to accommodate significantly more occupants or upgrade to a more critical function. For these "triggering events" the IBC and ASCE 7 generally require designers to use new construction standards.

Codes, standards, and guidelines for earthquake resistance in existing buildings:
Issues related to aging effects, original construction standards, construction material quality, and workmanship all complicate efforts to ensure earthquake safety in older existing buildings. Recognizing this complexity, FEMA, through its NEHRP activities, undertook major initiatives in the 1980's and 1990's to develop guidelines for evaluating and rehabilitating existing buildings. FEMA worked with BSSC, the Applied Technology Council (ATC), and then ASCE to produce two definitive guidance documents addressing the rehabilitation of existing buildings. The first was produced in the form of guidelines in 1997, followed by the second in the form of a pre-standard in 2000. FEMA complemented those documents with a 1998 handbook covering seismic evaluation of existing buildings. Based on these FEMA documents, ASCE recently produced two national consensus standards: *Seismic Evaluation of Existing Buildings* (ASCE 31) and *Seismic Rehabilitation of Existing Buildings* (ASCE 41).

The new ASCE standards are nationally recognized consensus standards that can be referenced in building codes, but they are not in themselves building code documents. They address the complexities of evaluating and strengthening existing buildings far more comprehensively than the IBC or ASCE 7, in a manner that prudently minimizes the measures needed to strengthen structures to provide acceptable performance. For those building owners who are concerned about the earthquake resistance of their existing buildings, the ASCE standards are valuable tools. In areas of high seismic activity, they are being used widely on a voluntary basis.

While the ASCE standards for seismic design and analysis in existing buildings are available, they have not yet been adopted formally by many state and local jurisdictions. Therefore, they are not mandatory in these jurisdictions.

The ICC also produces the *International Existing Building Code* (IEBC). The 2006 edition of IEBC references ASCE 31 and the 2007/2008 IEBC supplement to the 2006 edition references ASCE 41. However, the IEBC has not yet been widely adopted by state and local jurisdictions.

Communication of standards for existing buildings to local communities:
During its development of the 1997 guidelines document, FEMA heavily engaged practitioners around the U.S. FEMA sponsored a series of three widely attended workshops that served to inform practitioners of the guidelines development and seek their inputs; one was conducted in St. Louis in 1993. Following the release of the guidelines document, FEMA sponsored a series of approximately 13 training seminars on its use around the U.S. Such seminars were conducted in Memphis and St. Louis. FEMA also produced a comprehensive case studies document in 1999 that showed architects and engineers real-world applications of the guidelines document. Now that ASCE has produced ASCE 31 and ASCE 41, it is beginning to conduct periodic training seminars around the country that cover their application.

Need for increased awareness, acceptance, and technical knowledge:
In any U.S. earthquake occurring over the next few decades, more older buildings designed without consideration for earthquake resistance will be affected than newer buildings built with earthquake-resistant technologies and practices. Those vulnerable older structures comprise 80 to 90 percent of the U.S. building stock. Some -- including the large numbers of unreinforced masonry buildings that are common in the New Madrid region -- are much more vulnerable than others. By some estimates, 10 to 20 percent of the buildings in a region affected by a major earthquake may collapse.

NEHRP leaders believe that gaining wider national awareness of and acceptance for improving earthquake resistance in the existing building stock is very important. NEHRP sponsored a September 2007 existing buildings workshop for leading earthquake professionals. The issue of increasing implementation nationwide was a major topic. Economic factors have been significant barriers to enacting mandatory standards for upgrading existing buildings. Workshop participants agreed that public and private incentives are imperative for encouraging the improvement of vulnerable buildings, given that most improvement efforts are and will remain voluntary. It is also important to continue promoting good design practices through training, education, and awareness efforts.

NEHRP leaders also believe it is very important to the nation that more research be conducted to better understand the expected behavior of older existing buildings in earthquakes and to devise cost-effective means of improving their behavior. Much of what is found in the current ASCE documents comes from the good "engineering judgment" of leading practitioners, not from earthquake or research experience. The 2007 workshop not only brought earthquake professionals together to explore the implementation issues, but it gathered information on the kinds of technical research that are needed to improve cost-effectiveness. More cost-effective technical solutions will foster more voluntary implementation efforts.

○