

Introduction:

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My comments center on one central point of view: that being USGS as a key partner to CUSEC in addressing both the understanding of the earthquake hazard and its associated risks.

Background:

Geologists, seismologists, engineers, and economists believe that catastrophic earthquakes -- earthquakes whose effects are so severe that they will cause unacceptable levels of damage to buildings and infrastructure, economic loss, mortality, morbidity, and adversely affect the environment, production facilities, economic markets, and distribution systems -- are inevitable in the central United States (CUS).

On the basis of what has happened with past earthquakes in the CUS and throughout the world in similar hazard and built environments, along with preliminary loss modeling, it is well known that a catastrophic earthquake can leave an indelible mark for many years on individuals, businesses, communities, infrastructure, insurers, and the nation. Catastrophic earthquakes can adversely affect the environment, and overwhelm production facilities, distribution systems, and economic markets, jeopardizing the financial stability of businesses, insurers, communities, and the nation. Estimates of the economic losses from a catastrophic earthquake occurring today in the CUS are in the range of \$60-100 billion (based on FEMA’s loss estimation software, HAZUS-MH). The physical effects of such an earthquake would damage, destroy, and disrupt the normal functions of government, schools, hospitals, essential and critical facilities, and business; disrupt local and regional infrastructure; leave tens of thousands dead, injured, homeless, and jobless; divert tourism; reduce the tax base; use up community resources planned for health care, education, and other social programs; and deplete insurance and financial resources.

With little or no warning, an earthquake will strike the CUS, causing major physical, social and economic disruption in an area far greater than any we have seen in similar earthquakes in other areas of the country. The CUS is home to over forty four million people, with approximately 12 million at immediate risk, utilizing some of the nation’s oldest infrastructure, most of which was not designed with earthquakes in mind. Add to this the fact that a large percentage of the population lives in rural communities scattered over a large geographical area with fewer resources at their disposal to prepare for or recover from an earthquake, and it is easy to see why this region is so vulnerable.

While most people associate the CUS with the great earthquakes of 1811-12 - which produced four temblors near magnitude 8 and thousands of aftershocks, few realize the CUS is the most seismically active area east of the Rocky Mountains, experiencing between 150 to 200 earthquakes a year. Earthquakes of estimated magnitude 6.4, 6.8 and 5.5 also occurred in 1843, 1895 and 1968 respectively. The 1968 earthquake, a 5.5 in southern Illinois, caused damage in three states and was felt in 23 states.

Ironically the last two damaging earthquakes in the CUS did not occur on the New Madrid Seismic Zone which has the greatest amount of scientific focus, and funding support but rather on the less studied and less understood Wabash Valley Seismic Zone. In 2002, Evansville, Indiana experienced a magnitude 4.6 earthquake which toppled chimneys and caused other minor damages. And the most recent event, a M 5.2 in which damage occurred in a three state area and was felt in over 19 states took place on April 18, 2008. What is known about the Wabash Valley seismic zone is it is capable of producing a M7 event. Specifics of how this seismic zone functions and how it may or may not be linked to New Madrid have not been studied in any detail.

The potential losses from future earthquakes of magnitude 6 or greater in the CUS are expected to be significant due to 1) the high population scattered over a large area making difficult to respond; 2) the large number of structures that are not designed and constructed to withstand the effects of earthquakes; 3) the widely distributed unconsolidated sediment, which is poor foundation material; 4) an aging infrastructure and 5) the large area that would be affected by damaging ground motion (about 20 times larger than the area impacted by a California earthquake of comparable size - see attachment 2).

Post-earthquake conditions will vary from state to state, and the following areas will most likely be impacted: Critical Facilities, Businesses, Transportation, Communication, Oil and Natural Gas Pipelines, and Housing.

Partnership Approach:

NEHRP cannot be about the Federal government fixing a problem, it will never happen. The earthquake threat is complex and multifaceted. Only through the combined strengths of the many organizations and agencies which work within NEHRP can the advances be made in the understanding of, preparedness for, and risk reduction from earthquakes in the US. This is particularly true for the CUS, which, unlike other more notably known areas of the US that have a long established earthquake program, has only in the last 25 to 30 years had a focused effort to understand the seismic hazard and its associated risk.

In the late 1970's, at about the same time as the creation of NEHRP, the scientific understanding of the earthquake hazard in the CUS was beginning to emerge. It was becoming clear that the seismic hazard here was unique from both a geological and seismological basis. Response planning in the CUS typically didn't address earthquakes, and if it did, it was based on the more traditional way of planning dealing with a small area of impact and usually limited to one or two local jurisdictions. An earthquake that would impact multiple states over a very large geographical area was an alarming new finding.

Armed with this new understanding of seismic hazard, the scientific community, which included the USGS, shared their findings with the emergency management community including the Federal Emergency Management Agency (FEMA) and the states that would be impacted by a New Madrid event. Based on the consensus of the scientific community that the New Madrid Seismic Zone posed a real threat to the CUS, FEMA and those states took steps to address the risks posed by this hazard.

With funding support provided by the FEMA, the Central United States Earthquake Consortium (CUSEC) was established in 1983. Authority for CUSEC is vested in the Board of Directors, which is composed of the Directors of the State Emergency Management agencies in each Member State. CUSEC Member States include the eight states most affected by the earthquake threat in the CUS: Alabama, Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri, and Tennessee. CUSEC, a 501(c)(3) organization, is a working example of how individuals, businesses, communities, insurers, professionals, and local, state, and Federal governments can effectively work in partnership to address a common problem.

CUSEC also includes nine Associate Member States: Georgia, Iowa, Louisiana, Nebraska, North Carolina, South Carolina, Ohio, Oklahoma and Virginia - which serve a vital role in supporting the impacted states from a damaging earthquake in the CUSEC region. – (See attachment 1)

Soon after the formation of CUSEC, it became clear to the CUSEC Board of Directors that in order to address the risk, it needed products such as hazard maps, accurate scenarios and other scientifically based information, while also needing to understand the changing science behind the hazard, i.e. probabilities. CUSEC, being a small organization, looked to the individual state geological surveys for help. What resulted was the formation of an Association of CUSEC State Geologists, which is comprised of the 8 Member State Geological Surveys. The Association looked to the USGS as its federal partner to help them achieve the task outlined by the CUSEC Board of Directors. This partnership exemplifies the benefits that can be gained by a true federal/state collaboration.

Like many federal agencies, the USGS provides a needed measure of financial support to the states, but it goes beyond that in that there is a true working relationship that exists for the betterment of both the Association and USGS. Each brings a strength to the collaboration that collectively works in a way that isn't always seen between federal and state levels of government. This relationship has, on more than one occasion, been referred to as a model approach worth duplicating in other areas.

The success of the Association's affiliation with USGS is representative of CUSEC's overall approach to addressing the earthquake hazard. Working with a variety of agencies and organizations, CUSEC works to develop and implement programs to address the hazard and its associated risk through its four organizational goals which were derived from the established NEHRP legislation of 1977 which are:

- To raise the level of public awareness and education of the earthquake hazard
- To promote the adoption of mitigation programs, tools and techniques to reduce the vulnerability of the central United States to earthquakes
- To foster multi-state planning for response to and recovery from a damaging earthquake in the central United States
- To promote the application of research and lessons learned to improve the level of preparedness for earthquakes

CUSEC accomplishes its four primary goals with the help of its network of governmental and non-governmental partners in reaching its mission "... the reduction of deaths, injuries, property damage and economic losses resulting from earthquakes in the Central United States." By working closely with the USGS both directly and through the Association of CUSEC State Geologists activities which address the needs of the partnership are jointly developed and implemented.

The USGS and FEMA, as NEHRP agencies go, are unique in that of the four agencies that comprise NEHRP they serve a broad and diverse audience from the very technical to the most basic. The approach both agencies take in carrying out their NEHRP mandates shows their willingness to go beyond the "mandate" and ensure that a true collaboration exist with those they support at the state and local level.

This collaboration has yielded products such as maps, studies, general awareness information (i.e., a historical hazard poster, brochures), public forums (town hall meetings, training, etc.), contributed to scenario development for earthquake planning, exercise support and policy decisions, committee involvement, and in general, greater appreciation and understanding for differing points of views and mandates.

The strength of the CUSEC partnership is its ability to work through issues which may exist between its partners, and even between CUSEC and its partners, while continuing to keep a common focus.

Areas of concern from a central U.S. perspective:

In the CUS, a major concern of emergency managers is critical facilities, 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.

Schools are a special problem. Because many are constructed of unreinforced masonry, one federal study estimated that in a magnitude 7.6 earthquake (daytime earthquake with school in session), up to 25 percent of all casualties may be children (FEMA, Six Cities V). Since schools are traditionally used as shelters following a disaster, the loss of these structures will limit the availability of shelter space in communities throughout the Central U.S.

The CUS. also serves as a major transportation and communication corridor. Communications facilities, such as radio and microwave towers and telephone trunk lines, are fragile, principally because their structural integrity depends on stable ground.

The vulnerability of roads, bridges, airports, and rail lines in the CUS is well documented. Bridges and overpasses, in particular, are susceptible to ground shaking and soil liquefaction (quicksand effect), which means that access to and from disaster areas will be impeded.

The restoration of transportation routes is critical for two fundamental reasons: 1) the efficiency of disaster relief operations will be dependent on functionality of the routes; and 2) the pace of the economic recovery will be directly related to the ability to move goods and services across the region.

In essence, even a moderate earthquake would cause major disruption across the land. Barge traffic on the river, natural gas and crude oil pipelines, interstate highways, and power lines all provide essential services, the loss of which would have a significant, long-term impact on the entire central and eastern United States.

As a major transportation corridor, it would be highly probable that transportation through the region would almost surely come to an abrupt stop; with major oil, electrical and petroleum pipelines also intersecting this area states to the east would be severely impacted.

The consequences from a major New Madrid earthquake would be substantial, as stated previously estimates range from \$60 to \$100 billion. 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.

A recent report by the Sandia National Laboratories stated; “Direct damage to electric power infrastructure could cause a blackout affecting much of the entire Eastern Interconnection. The blackout would be short-lived (perhaps a week in duration) in the regions that are far enough from the earthquake center to experience only mild ground shaking. However, restoring the power grid in regions of highest ground-shaking intensity would take months.”

Central to the understanding of how an earthquake will affect the infrastructure is the work of the USGS and others within the NEHRP community. Their ability to provide critical information used in emergency response and risk reduction planning as well as day to day decisions at the state and local level will impact how the CUS responds to and recovers from a damaging earthquake. As stated previously, the understanding of the seismic hazard in the CUS is relatively new, due in large part to the infrequent aspect of the seismic hazard. The infrequency is both a blessing and a problem that creates challenges for everyone working within the earthquake program in the CUS. Awareness that there is a seismic threat is a constant challenge which affects funding levels, preparedness, and policy decisions.

Another way of viewing this is the level of funding to support seismic research in the CUS has been limited. This includes lack of funding for things such as dedicated research personnel to study areas like the Wabash Valley Seismic Zone and of course the New Madrid, purchase and installation of seismic instrumentation, which helps not only the scientific/engineering community understand what is happening, but provides emergency responders with critical information that will enhance life safety actions immediately following an earthquake.

Conclusion:

At present, consensus public policies based on social, technical, administrative, political, legal, and economic factors to cope with an inevitable earthquake are lacking in the CUS. This gap reflects the urgent need for a forum and a process for making decisions about plans, laws, and professional practices to reduce unacceptable risk to people, property, and infrastructure in the CUS.

While we all have read and heard numerous times that earthquakes cannot be prevented, certainly we can minimize casualties and damages by having a better understanding of

the seismic hazard and its associated risks. I cannot overemphasize how essential the USGS is in the understanding of, and planning for, a seismic event in the CUS.

The Department of Homeland Security/FEMA has listed an earthquake in the central US on its short list of disasters which are classified as "catastrophic" necessitating a separate response plan within the National Response Framework. This classification comes as no surprise to those who have struggled, including the USGS, to enlighten those in decision making positions to this reality. An earthquake in the CUS will be unlike any other disaster the region, and probably one of the most catastrophic the nation has ever experienced. CUSEC, its Member States, and many partners, are midway through a very intensive New Madrid catastrophic planning effort that will culminate with an exercise in 2011 on the 200 year anniversary of the catastrophic 1811-1812 earthquakes. The Federal Government, primarily FEMA and USGS, are helping tremendously through their leadership and support to make the planning and follow-on exercise a success.

But this is just part of an ongoing commitment that should include a complete assessment of the threat it represents to our homes, businesses, schools, hospitals, critical infrastructure, and communities, and invest in mitigation and preparedness, the two most cost-effective long-term public policies, while continuing to improve the capability for emergency response and recovery and reconstruction. Continued investments in mitigation, preparedness, emergency response, and recovery and reconstruction measures and regulations are urgently needed in the CUS

Only through continued collaboration of key partners like the USGS and FEMA and their willingness work beyond the federal boundaries, will CUSEC and its partnership approach to addressing the regional threat be successful in the "... the reduction of deaths, injuries, property damage and economic losses resulting from earthquakes in the Central United States." Failure of NEHRP or any one of its four member agencies to be actively engaged in the CUS and to understand the unique seismic situation that it represents will only add to the catastrophic consequences when the seismic event occurs.

My thanks to the Subcommittee on Energy and Mineral Resources in making the time to look at the NEHRP. It is a special honor for me to have the opportunity to share my thoughts with you concerning the USGS and their role in the earthquake program in the central U.S.

Background References

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