STRATEGIC PLAN FOR

EARTHQUAKE SAFETY

IN MISSOURI

2007

Progress in Preparing

Missouri Seismic Safety Commission

December, 2007

Missouri Seismic Safety Commission

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NOTE: * Indicates someone who was serving on the Commission when Objectives were approved in March 2007 who is no longer on the Commission at the time of publication.

COVER:

Participants on a 2004 field trip to St. Louis view part of the Missouri Department of Transportation's seismic retrofit project at the Poplar Street Bridge complex. (Photo courtesy of Jim Wilkinson, Central United States Earthquake Consortium)

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The Commission wishes to thank representatives from several state agencies who contributed information and/or a technical review or portions of this document. They include the Division of Geology and Land Survey, MO Department of Natural Resources; MO State Highway Patrol, MO Department of Transportation; and MO Department of Mental Health.

Accessible for review at http://sema.dps.mo.gov/EQ.htm

Additional copies are available from State Emergency Management Agency, P.O. Box 116, Jefferson City, MO 65102

Historical Roster - Missouri Seismic Safety Commission

NAME	*PROFESSION*	*COMMISSION SEAT*	*SERVED*
Marie Collins	Metropolitan Sewer District	Public Utilities	1995-2001
William L. Durbin	URS Woodward Clyde	Soils Engineering	1995-2002
Marilyn H. Roberts	State Farm Insurance	Insurance	1995-2001
Patricia A. Killoren	Mayor- Crestwood, MO	Local Government	1995-1996
Thomas Schwetye	Schwetye Architects	Architecture	1995-2003
Charlsie Floyd	American Red Cross	ARC Representative	1995
Greg Hempen	U.S.Army Corps of Engineers	Planning	1995-current
Ernest H. “Bud” Hunt	Editor- Dunklin Daily Democrat	Business	1995-1998
Phyllis Steckel	EQE-Theiss/EQE/ABS	Geology	1995-2004
Carol Tharp	Platte County Emergency Mgt.	Emergency Management	1995-1998
Sen. Irene Treppler	Sponsor – Missouri Senate	State Senator	1995-1997
Rep. Larry Thomason	Sponsor – Missouri Gen. Assembly	State Representative	1995-1998
Robert E. Palmer	Asst. Fire Chief – Mehlville FPD	Fire Protection	1995-1998
Susan E. Clowe	American Red Cross	ARC Representative	1995-1998
Jennifer Marino	Cities Utilities-Springfield	Mechanical Engineering	1995-1998
John C. Theiss	Thiess Engineering/EQE	Structural Engineering	1995-1998
Kennard Whitfield	Mayor- City of Rock Hill, Mo	Local Government	1997-2004
Robert Herrmann	Professor – St. Louis University	Seismology	1995-current
Dr. Phillip Gould	Professor – Washington Univ.	Electrical Engineering	1995-current
Majorie Schramm	Mayor, Kirkwood, Missouri	Local Government	1996
Senator Jerome T. Howard	Missouri Senate	State Senator	1997-2000
Susan Green	Capitol Area Red Cross, Cole County Emergency Mgt.	ARC Representative, Emergency Management	1999-2007
Thomas Roeseler	Bank of America	Business	1999-2007
Mark Hasheider	Asst. Fire Chief – Cape Girardeau, Missouri	Fire Protection	1999-current
Pamela J. Nunn	Jefferson County Emer. Mgt.	Emergency Management	1999
Ted Pruess	Larson Engineering –St. Louis	Structural Engineering	1999-2007
Rep. Denny Meredith	Missouri General Assembly	State Representative	2000-2003
Pam Schroeder	See Pamela J. Nunn	Emergency Management	2000-2002
Michelle Ray Smith	Avanti Engineering/Belle Engineering – St. Louis	Mechanical Engineering	2001-2004
Michael J. Marx	Ameren UE	Public Utilities	2002-current
Diane L. Priest	Shelter Insurance	Insurance	2003-2004
Meg McLaughlin	American Red Cross	ARC Representative	2003-2004
Scott M. Olsen	URS Griener/Woodward Clyde	Soils Engineering	2003-2004

NAME	PROFESSION	COMMISSION SEAT	SERVED
Steve Hermann	Fox Architects	Architecture	2004
Donald Landon	American Red Cross	ARC Representative	2006-current
Jeffery Garnatz	Shelter Insurance	Insurance	2006-current
David Rogers	Rolla School of Mines	Geology	2006-current
C. "Drew" Juden	Sikeston Dept. of Public Safety	Local Government	2006-current
Daniel Abbott	Corrigan Company	Mechanical Engineering, Architecture	2006-2007
Kenneth Berry	URS Corporation	Soils Engineering	2006-current
Rep. Otto Bean	Missouri General Assembly	State Representative	2006
Sen. Rob Mayer	Missouri General Assembly	State Senator	2006-current
Rep. Billy Pat Wright	Missouri General Assembly	State Representative	2006-current
Melvin C. DeClue	MELDEC Group	Business	2007-current
Jim Palmer	Kansas City Power & Light	Structural Engineering	2007-current
Jack Lakenan	Perry County Emer. Mgt.	Emergency Management	2007-current

FOREWORD

Past earthquakes have caused great damage in the central region of the United States, including Missouri and other states. While the State of Missouri is still vulnerable to earthquake loss, the risk of damage can be greatly reduced or managed to the benefit of all. This *Strategic Plan for Earthquake Safety in Missouri* develops tangible, practical recommendations and procedures to prepare Missouri for future earthquakes as well as other hazards (natural and man-made) at the same time. Elements of the plan have been developed to be useful, cost-effective, and significant for all Missouri citizens and businesses.

This document is an on-going product of a 1993 legislative mandate. At that time, the State of Missouri enacted Senate Bill No. 142, which created the responsibilities of the **M**issouri **S**eismic **S**afety **C**ommission, The MSSC, through its committees, assembled the original draft of this plan in October 1996. Considerable planning, interpretation of the enacting legislation, general advice from the State Emergency Management Agency, and participation by state agencies and counsel from knowledgeable, interested individuals were involved in creating the original document. Comments from reviewers were evaluated and incorporated into the plan. MSSC incorporated material from federal, state and local programs, documents and activities, as well as its own deliberations, in shaping its original strategies and fashioning them to meet the needs of the State of Missouri.

And yet, since 1996 so much of our world has changed. Now, more than ever before, we are dependent on instant communication to make decisions having profound impact on others' lives. Advances in science and engineering have increased our knowledge of the world around us and have devised methods by which we might better protect ourselves from the forces of nature. There is increased political and public sensitivity to the natural and man-made disaster threats to our lives and communities while our awareness of contemporary man-made threats seemingly expands with each daily news report. With this enhanced awareness has come a marked increase in people's expectations regarding emergency preparedness and response. At the same time, preparedness, response, and recovery resources are over-extended as never before and "threat fatigue" is a tangible risk of information overload. Our population is maturing – the number of retirement communities is ever-expanding. Our infrastructure assets have increased as well, along with the general public's reliance on them. Unfortunately, too, we have witnessed the enormity of potential response needs that can arise when disasters do occur and with those needs, the overwhelming pressure and demands on those charged with effective response. Finally, we are a global family. We have seen the damaging impacts that disasters hundreds or thousands of miles distant can have on local, regional and national economies.

Without question, much has been done within the state of Missouri over the last 10 years to better prepare her citizens to cope with the effects of an earthquake or other disaster. Even so, there is much more yet to be done. This updated strategy recognizes the successes we have enjoyed but acknowledges the challenges that lie ahead and, even more importantly, outlines a framework to address these challenges in a responsible, proactive manner.

The MSSC, state agencies, local governments, residents and individual businesses may use this plan to begin the large task ahead. This plan will not only aid in projecting goals, but will also evolve as initiatives are taken and new information expands the potential for responding to earthquakes and other disasters. Priorities have been established but may be revised in the future. The MSSC will attempt to focus these priorities and urge Missouri's stakeholders to pursue these goals within the State's capabilities.

The lessons learned from past U.S. earthquakes have demonstrated the significant burden placed on surviving families, businesses, utilities and state agencies. The great New Madrid earthquakes of 1811-1812, the largest U.S. events in terms of area of major damage, force us to recognize the threat to our region. Preparation now, following the Strategic Plan, will yield significant reductions in fatalities, casualties, damaged structures, business failures, and state infrastructure losses from earthquakes. These same actions will also reduce the impact of other natural hazards

The Members of the Missouri Seismic Safety Commission

The earthquake threat to Missouri cannot be ignored!

Last Changed: March 9, 2007

EXECUTIVE SUMMARY

Introduction

The mission of the Missouri Seismic Safety Commission (MSSC) is to review Missouri's current preparedness for major earthquakes and to make recommendations to mitigate their impact.

The State of Missouri has taken important steps to prepare for and to reduce the effects of this natural disaster. Missouri has recently developed and exercised their "Catastrophic Event" Plan. Along with those efforts a template was developed for local jurisdictions to assist them with developing their plans. To increase efficiency in response efforts Missouri is developing software called the Missouri Emergency Information System (MERIS) which will help facilitate joint response efforts throughout the state.

Although these achievements are good first steps, more work needs to be done. The key issues identified by the MSSC are as follows:

1. The earthquake threat to Missouri is real. Addressing the problems now will yield significant long-term benefits.

2. The reduction of earthquake risk in Missouri requires the combined efforts of individuals, businesses, industry, professional and volunteer organizations and all levels of government.

3. Many of the strategies identified in this report for reducing earthquake risk can be implemented through proactive, voluntary community participations. Others will require legislation or significant funding.

Summary of Objectives

The earthquake problem is multifaceted. This is acknowledged in the legislation establishing this Commission which requires the participation of many different disciplines such as earth science, engineering, planning and emergency response, as well as levels of government. Thus, a plan to address the earthquake problem in Missouri is necessarily detailed. The objectives of this strategy are:

Objective 1: Increase Earthquake Awareness and Education

Knowledge is a crucial component of the program to minimize risk to our citizens and their property

Objective 2: Reduce Earthquake Hazard Through Mitigation

Casualties and economic losses can only be avoided by taking positive steps to ensure that structures and systems survive earthquake shaking with minimal damage

Objective 3: Improve Emergency Response

Response efforts need to be well coordinated, fast and efficient to reduce injury, additional loss of life, and further property destruction

Objective 4: Improve Recovery

A well-designed recovery process helps people resume their normal lives, by reducing the emotional and economic impact of the disaster over the long term

Objective 5: Assess Earthquake Hazards.

Readiness for an earthquake requires basic knowledge about expected earthquake locations and the effects of local site conditions on shaking, as well as rapid notification of their occurrence

Implementation

This report contains 35 strategies to meet these five objectives. The strategies, actions and results are presented together at the beginning of each objective of this report, followed by detailed discussion of individual strategies. The MSCC will endeavor to make significant progress on these objectives during the next twelve months.

MISSOURI'S EARTHQUAKE THREAT

Earthquakes can cause death, injury, major economic loss and social disruption. Recent examples of this include the 1994 Northridge, California and 2006 Java, Indonesia earthquakes. Missouri has already experienced earthquakes much greater than either the Northridge or Java events. During the winter of 1811-1812 three earthquakes estimated to have been magnitude 7.5 or greater were centered in southeast Missouri. Thousands of aftershocks continued for years. While estimates of the recurrence intervals of the large 1811-1812 earthquakes are about 500 - 1000 years, smaller, but still destructive, earthquakes are even more likely. The recurrence interval for a magnitude 6 earthquake is about 90 years. The last such earthquake was in 1895 near Charleston, Missouri.

Earthquakes in Missouri

A sequence of powerful earthquakes struck the mid-Mississippi Valley in the winter of 1811-1812. No fewer than 18 of these events were felt on the Atlantic seaboard, which implies that their magnitudes were greater than 6 - 6.5. The main shocks on December 16, 1811, January 23, 1812 and February 7, 1812 had magnitudes greater than 7.5, making them some of the largest earthquakes known in the continental United States. Since then, large earthquakes have continued to occur: significant earthquakes, each about magnitude 6, occurred in 1843 near Marked Tree, Arkansas, and on October 31, 1895 near Charleston, Missouri.

Earthquakes affecting the region are not restricted to the Bootheel. The magnitude 5.5 earthquake, November 9, 1968 in southeastern Illinois caused minor damage in St. Louis. Other earthquakes have occurred throughout southeastern parts of Missouri. The figure on the cover of this report shows the distribution of historic known earthquakes in the region. Active research projects on the nature of the earthquake problem are being sponsored through the National Earthquake Hazards Reduction Program (NEHRP). These investigations have documented large earthquakes prior to 1811-1812, thus reinforcing concern for the future. Other efforts generated updated probabilistic hazard maps that show the degree of the earthquake threat in southeastern Missouri and the St. Louis area.

Earthquake Hazards

The most important direct earthquake hazard is ground shaking. Ground shaking affects structures close to the earthquake epicenter but can also affect those at great distances. Certain types of buildings may be damaged by earthquakes at a significant distance from the epicenter. This places most of southeastern Missouri, as well as the St. Louis metropolitan area, at risk. Un-reinforced masonry structures, tall structures without adequate lateral resistance, and poorly-maintained structures are specifically susceptible to large earthquakes. Owners of these structures should be aware of their potential for seismic damage.

Indirect hazards may also occur at great distances from large earthquakes. Liquefaction, landslides and life-line disruptions will most affect areas closest to the epicenter, but may occur at significant distances. The impact on the general public, small- to medium-size businesses, life-line services, and the infrastructure may be radically lessened if precautions are undertaken at multiple levels.

The flat-lying, southeastern (Bootheel) section of Missouri is most susceptible to earthquakes because it overlies the New Madrid fault zone. It is the epicentral area of the 1811-1812 earthquakes and seismic activity continues there. It also has the highest risk because its subsurface conditions -- loose sediments and a high water table -- tend to amplify earthquake ground shaking. The immediate vicinity of the Ozarks is also at risk from earthquakes in the New Madrid fault zone. Like the Bootheel, subsurface conditions of the Mississippi and Missouri River valleys tend to amplify earthquake ground shaking. As a result, these areas, including much of metropolitan St. Louis, are also at high risk from earthquakes. Earthquake hazards in the western part of the state also exist because of the historical earthquakes in eastern Kansas and Nebraska. No area of Missouri is immune from the danger of earthquakes. Minor, but potentially damaging, earthquakes can occur anywhere in the state.

Increased education, concern and subsequent action can reduce the potential effects of earthquakes, and this can be done in conjunction with preparations for other natural hazards. A program that recognizes the risk of flooding, landslides and other dangers and which incorporates earthquake issues, will be the most beneficial to our citizens. Individuals and all levels of government have roles in reducing earthquake hazards. Individuals can reduce their own vulnerability by taking some simple and inexpensive actions within their own households. Local government can take action to lower the threat, through the proper use of poor sites, assuring that vital or important structures (police, fire and school buildings) resist hazards, and developing infrastructure in a way that decreases risk. State agencies and the legislature can assist the other levels of action and provide incentives for minimizing hazards.

Last Changed 04/01/07

Objective 1: Increase Earthquake Awareness and Education.

Knowledge is a crucial component of the program to minimize risk to our citizens.

Strategy	Initiative	Result
1.1 Promote awareness of earthquakes and earthquake risk in Missouri among the general public.	Deliver information about earthquakes and earthquake risk in Missouri to the general public thru our MSSC website. This information would also be available for use by businesses, and other local and state officials	The general public needs to be appraised of the general earthquake safety risk so they will become better equipped to prepare for, survive and recover from future earthquakes in Missouri.
1.2 Promote awareness of earthquakes and earthquake risk in Missouri among key professionals in critical fields.	Encourage, endorse, support, and help develop building codes that consider realistic seismic loads and incorporate seismic detailing, and enlisting the help of key professionals in leading the overall effort to adopt the latest IBC Code, and its successor versions.	Key professionals in critical fields, such as civil engineering, insurance companies, lending institutions, building inspection and safety officials, construction trades, and building code organizations to be aware of how to mitigate the deleterious effects and impacts of earthquake damage, using cost effective measures that have been employed elsewhere to good effect.
1.3 Promote awareness of earthquakes and earthquake risk in Missouri among K-12 students in cooperation with officials from the state Department of Elementary and Secondary Education (DESE).	Work with DESE to make educational materials readily available to all Missouri K-12 teachers and students, the general public, and the news media, so these groups can become educated about earthquake risk and disaster preparedness. Focus on downloadable "how to" graphics, which are relevant to individual homeowners and businesses.	Future generations of Missourians will be better equipped to prepare for, survive, and recover from future earthquakes. This will prepare them not only for earthquakes, but other natural disasters that portend similar problems, such as tornadoes, loss of electrical power, loss of transportation mobility, emergency communications options, calling for assistance, etc.

Last Changed: March 9, 2007

Missouri Seismic Safety Commission - Strategy 1.1

STRATEGY:

Promote awareness of earthquakes and earthquake risk in Missouri among the general public.

ACTION:

Deliver information about earthquakes and earthquake risk in Missouri to the general public through our MSSC website. This information would also be available for use by businesses, as well as local and state officials.

RESULT:

The general public needs to be appraised of the general earthquake safety risk so they will become better equipped to prepare for, survive, and recover from future earthquakes in Missouri.

Background

Each year, much more information is becoming available on earthquakes and the earthquake risk in Missouri. Much of this is emanating from ongoing research being funded by the Federal Emergency Management Agency (FEMA); the State Emergency Management Agency (SEMA); the U.S. Geological Survey (USGS); the Division of Geology and Land Survey (DGLS); the American Red Cross; and other state, federal, and private sources.

This printed information has been available to the general public for years, but is not easily accessed on the Internet by lay people through common search engines. The Commission will continue to support increasing awareness of earthquakes and earthquake risk to the general public through such programs as Earthquake Awareness Week, which coincides with the anniversary of the February 7, 1812 New Madrid earthquake. We anticipate a good deal of attention will be focused on earthquake awareness in the Midwest during the upcoming bicentennial of the 1811-1812 New Madrid sequence. We will continue to sponsor permanent and mobile exhibits, public speakers, earthquake drills, and other activities which have been held in the past, with varying degrees of success.

Implementation

The MSSC feels that the most potent mechanism to reach the general public is through a well-maintained website that posts handouts designed with colorful graphics for easy viewing and downloading by students, teachers, and the general public. Results could be improved by using different and more appealing handouts, which have been developed by a variety of agencies in other states, such as Alaska, Washington, Oregon, and California. The Commission hopes to provide electronic access to many of these materials through ‘hot links’ on the MSSC website, which would allow end users the ability to peruse earthquake safety fliers and informational materials posted by other public agencies.

Many of these materials are focused on cost-effective life safety mitigation measures, such as simple tie-downs and seismic restrainers which are easily implemented by occupants or homeowners, with sufficient guidance from the handouts. These materials would also be available to the broadcast and print media and be referenced in any press release from SEMA. Rapport with media professionals should be established and maintained. Earthquake awareness needs to be marketed to the general public; it needs to shift gears from a passive to an active approach commensurate with where much of the general population is turning to for technical information (the Internet).

The Commission will continue to encourage permanent displays in museums throughout the state on earthquakes in general, past earthquakes in Missouri, earthquake risk in Missouri, real-time seismographs, earthquake safety, earthquake preparedness, and current earthquake research topics.

The Commission will also:
Sponsor hot links to posted lectures on earthquake risk and safety issues approved by the Commission and SEMA, and offer technically qualified and entertaining public speakers to speakers' bureaus and radio industry resources [databases from which speakers for talk-radio interviews are found] throughout the State.

Develop and maintain an Internet Home Page on earthquakes and earthquake risk in Missouri. Update the home page as needed, at least monthly. Include a calendar of earthquake-related professional development training, short courses, continuing education, and workshops.

Develop and/or endorse "envelope stuffers" for utilities to include in their billing envelopes. "Envelope stuffers" outline earthquake safety, risk factors and earthquake history in Missouri. The Public Service Commission (PSC) could help in developing and distributing these envelopes.

Solicit support from key public and private organizations. Utilities, corporations, local service organizations, professional organizations, government agencies, and others can help to develop a network for information dissemination.

Create public service announcements which outline earthquake safety, risk factors and earthquake history in Missouri for the broadcast media.

Develop mobile displays for shopping malls, fairs, libraries, public buildings, special events, and airports that outline earth-quake safety, risk factors and earthquake history in Missouri.

Encourage public and commercial television stations to broadcast earthquake-related Programs.

Sponsor annual Earthquake Awareness Week (the week in which February 7 falls each year). Target envelope stuffers, public service announcements, public speeches, radio interviews, mobile displays, school earthquake drills, and poster contests to peak in this week. The overall message should state that this is the week to review, reevaluate, and rotate emergency supplies, such as changing batteries, rotating stored water and food supplies, adding diapers if there is a new baby in the household, and including new medications.

Issue regular and special press releases to appropriate news media points of contacts. Topics could include each full meeting of the Missouri Seismic Safety Commission, approaching anniversaries of significant historical earthquakes, announcements of significant technical discoveries or insights into earthquakes and earthquake risk in Missouri and planned earthquake drills.

Have press releases prepared in advance to take advantage of a "window of opportunity," such as a larger high-visibility earthquake worldwide, a moderate earthquake in the Midwest or another natural disaster in Missouri.

Responsible Agencies:
Department of Public Safety
State Emergency Management Agency, Department of Public Safety (SEMA/DPS)
Division of Geology & Land Survey, Department of Natural Resources (DGLS/DNR)
American Red Cross
U. S. Geological Survey (USGS)
Federal Emergency Management Agency (FEMA)

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 1.2

STRATEGY:

Promote awareness of earthquakes and earthquake risk in Missouri among key professionals in critical fields.

ACTION:

Encourage, endorse, support, and help develop building codes that consider realistic seismic loads and incorporate seismic detailing; and enlisting the help of key professionals in leading the overall effort to adopt the latest International Building Code (IBC) and its successor versions.

RESULT:

Key professionals in critical fields- such as civil engineering, insurance companies, financial institutions, building inspection and safety officials, construction trades, and building code organizations- will be aware of how to mitigate the deleterious effects and impacts of earthquake damage, using cost effective measures that have been employed elsewhere to good effect.

Background
Courses and workshops developed by FEMA have been presented to engineers, hospital administrators, architects, and others periodically. Most of these have been in the area of structures and design.

Implementation
There are many ways to approach key professionals in critical fields. A general list follows:

Sponsor, support, and encourage professional development of engineers, architects, and other design professionals through short courses, continuing education, and workshops. Enlist help of professional organizations and others.

Sponsor, support and encourage professional development of builders, general contractors, and other construction professionals through short courses, continuing education, and workshops. Enlist cooperation of trade unions, public and private trade and technical schools, University of Missouri Extension, and others.

Sponsor, support and encourage professional development of owners and operators of large facilities and buildings through short courses, continuing education, and workshops. Enlist cooperation of metro and state-wide safety councils, Building Owners & Managers Association (BOMA), St. Louis Construction Consumers Council, University Extension, and others.

Sponsor, support, and encourage professional development of owners, operators, and key users of large engineered systems (i.e., executive and strategic managers and directors) through short courses, continuing education, and workshops. Participants include personnel with utilities, transit districts, railroads, airports, pipelines, mines, river transporters, dam owners, hazardous waste handlers, underground space, etc. Enlist cooperation of professional associations and other organizations.

Sponsor, support and encourage professional development of owners, operators, and key users of electronic systems (i.e., executive and strategic management and directors) through short courses, continuing education, and workshops. Participants include data managers and processors, and those in telecommunications networks, banks and financial institutions, Internet service providers, broadcast stations, etc. Enlist cooperation of professional associations and other organizations.

Sponsor, support and encourage professional development of media professionals through short courses, continuing education, and workshops. Participants include reporters, news and assignment editors, and others at newspapers and television and radio stations. Enlist cooperation of professional associations and other organizations.

Sponsor, support and encourage professional development of government officials through short courses, continuing education, and workshops. Participants include city, county, and state elected and appointed officials; school board members; industrial developers; planning and zoning officials; public-body risk managers; emergency preparedness officers; etc. Enlist cooperation of Missouri Association of Counties (MAC), Missouri Intergovernmental Risk Management Association (MIRMA), Missouri Municipal League (MML), and others.

Points of Contact:
State Board of Education; Department of Elementary and Secondary Education
Division of Career Education; Department of Elementary and Secondary Education
Division of Workforce Development; Department of Economic Development
Board for Architects, Professional Engineers, Professional Land Surveyors and Landscape Architects; Division of Professional Registration; Department of Insurance, Financial Institutions, and Professional Registration
Board of Geologist Registration; Division of Professional Registration; Department of Insurance, Financial Institutions, and Professional Registration
Board of Occupational Therapy; Division of Professional Registration; Department of Insurance, Financial Institutions, and Professional Registration
Board of Respiratory Care; Division of Professional Registration; Department of Insurance, Financial Institutions, and Professional Registration
Missouri Real Estate Appraisers Commission; Division of Professional Registration; Department of Insurance, Financial Institutions, and Professional Registration
Missouri Real Estate Commission; Division of Professional Registration; Department of Insurance, Financial Institutions, and Professional Registration
University of Missouri Extension
American Society of Civil Engineers (ASCE)
American Institute of Architects (AIA)
American Institute of Professional Geologists
American Public Works Association (APWA)

Association of Engineering Geologists
Associated General Contractors
Associated Industries of Missouri
Association of Missouri Electric Cooperatives
Building Owners & Managers Association (BOMA)
Earthquake Engineering Research Institute (EERI) - New Madrid Chapter
Consulting Engineers of Missouri (CECMo)
Missouri Alliance for Historic Preservation
Missouri Apartment Association
Missouri Association for Community Action
Missouri Association of Councils of Government
Missouri Association of Counties
Missouri Association of Homes for the Aging
Missouri Association of Private Career Schools
Missouri Bankers Association
Missouri Broadcasters Association
Missouri Chapter of American College & Emergency Physicians
Missouri Child Care Association
Missouri Community College Association
Missouri Cooperative Extension Service
Missouri Emergency Medical Services Association
Missouri Hospital Association
Missouri Hotel & Motel Association
Missouri LP Gas Association
Missouri League of Nursing Home Administrators
Missouri Municipal League
Missouri Safety Council
Missouri Society of Professional Engineers
Missouri State Council of Carpenters
Missouri Vocational Association
St. Louis Construction Consumers Council
SAVE Coalition

Responsible Agencies:
State Emergency Management Agency, Department of Public Safety (SEMA/DPS)

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 1.3

STRATEGY:

Increase awareness of earthquakes and earthquake risk in Missouri among K-12 students.

ACTION:

Teach all Missouri K-12 students about earthquakes and earthquake risk, from both an earth science and a public safety perspective.\

RESULT:

Future generations of Missourians will be better equipped to prepare for, survive, and recover from future earthquakes. This will prepare them for their futures, whether they remain in Missouri, move to California, vacation in Alaska or Hawaii, or do business in Japan.

Background
Kindergarten through 12th-grade students may be the most receptive to learning about earthquakes and earthquake risk. Many earthquake/ earthquake risk resources are available, both in hardcopy and in electronic form via the Internet. Excellent materials are available from FEMA and others sources.

Implementation
Some ways to increase awareness of earthquakes and earthquake risk among K-12 students follow. Sponsor, support and encourage use of study units on earthquakes, earthquake risk, earthquake safety, and related topics. Use modules already available from FEMA and other sources. Incorporate study of earth science, natural and human history, math, geography, physics, computer science, individual research, and other subjects in an age-appropriate manner.

Sponsor, support and encourage enthusiastic earthquake drills and safety exercises in each public and private K-12 school in Missouri.

Sponsor, support and encourage earthquake safety poster contests in grades K-6. Displays of local entries will be posted in schools, libraries, public buildings, etc. Local winners will compete statewide; final winners will be used in televised public service announcements for following years' Earthquake Awareness Week.

Responsible Agencies:
Division of School Improvement; Department of Elementary and Secondary Education
Missouri Association of Teaching Christian Homes, Inc.
Families for Home Education, Inc.
Association of Missouri private schools

Last Changed March 9, 2007

Objective 2: Reduce Earthquake Hazard Through Mitigation.

Casualties and economic losses can only be avoided by taking positive steps to ensure that structures and systems survive earthquake shaking with minimal damage.

Strategy	Action	Result
2.1 Promote the adoption and enforcement of technically sound and economically feasible codes, standards and procedures for the design and construction of new structures and additions to existing structures.	Design buildings to resist earthquakes and encourage local government to adopt a building code for seismic design as required by Chapter 319 of the Revised Statutes of Missouri.	Overall damage to structures from future earthquakes will be reduced if the latest codes, standards and procedures are adopted and implemented.
2.2 Identify existing essential facilities and schools especially susceptible to earthquake damage. Consider both structural & non-structural damage. Encourage the development of methods to reduce such damage.	Develop a plan for increasing the seismic resistance of essential facilities and schools in a cost-effective manner. Encourage universities and professional societies to provide educational opportunities to design professionals in the methodology of seismic rehabilitation of structures.	Seismic retrofitting of existing essential facilities and schools will allow these facilities to be available for post-earthquake recovery.
2.3 Review Missouri dam safety criteria relative to potential earthquake hazards.	Evaluate present rules with respect to the current knowledge base and, if needed, recommend changes to design and construction procedures. Use these rules to assess the seismic safety of the design of new dams and the evaluation of existing dams.	Dams in Missouri will be more resistant to earthquake hazards. Public safety will be enhanced.
2.4 Encourage the continuation of the program to evaluate existing bridges for seismic risk.	Assess, retrofit, and/or replace seismically deficient bridges.	Reduce the risk of collapse or severe damage to highway bridges. Vital transportation routes will be maintained after a large earthquake. Bridges which are at risk will be retrofitted or replaced in a timely manner.

2.5 Minimize the risk of hazardous material spills and the resulting contamination that may be caused by an earthquake.	Assess the potential for hazardous material spills using current seismic hazard maps and implement ways to minimize that risk.	Reduce the risk to the public and the environment resulting from hazardous material spills caused by an earthquake.
2.6 Encourage identification of critical lifeline vulnerability interdependencies.	Identify lifeline interdependencies in earthquake-prone areas where the hazard of ground failure is high and where vulnerable structures support interdependent lifelines; develop a mitigation plan for each lifeline. Encourage equipment improvement, facility redundancy and relocation, and pre-event response and recovery agreements.	During an earthquake emergency, damage to one lifeline will not cripple an adjacent lifeline when the recognized hazard is anticipated and accommodated.
2.7 Promote land use planning for new critical facilities and schools.	Encourage local governments to adopt land-use planning and ordinances. Use these regulations to locate critical facilities and school sites based on current hazard maps.	Loss of life will be reduced and the operational status of critical facilities will be maintained by considering land-use and building factors relative to earthquakes and other natural hazards.
2.8 Encourage financial and insurance institutions to provide incentives for hazard mitigation.	Support educational efforts to aid the public in understanding their role in mitigating damage, the nature of catastrophe insurance, the role of deductibles, and threats to solvency. Support educational, regulatory and legislative efforts aiding the availability and affordability of insurance.	There will be a financially sound catastrophic insurance business, public acceptance of need to carry earthquake insurance with substantial deductibles, and public support of commercial and residential earthquake-resistant building design.

2.9 Encourage the education of design professionals and code officials in the latest seismic design practices.	Seismic design should be a part of the engineering and architecture curricula at state universities and colleges and included in the testing required for licensing engineers. Promote continuing education for architects and engineers. Promote continuing education of seismic design requirements for code officials.	Design professionals and code officials with knowledge of current seismic design methodologies will lead to safer structures.

Missouri Seismic Safety Commission - Strategy 2.1

STRATEGY:

Promote the adoption and enforcement of technically sound and economically feasible codes, standards and procedures for the design and construction of new structures and additions to existing structures.

ACTION:

Design buildings to resist earthquakes and encourage local government to adopt a building code for seismic design as required by Chapter 319 of the Revised Statutes of Missouri.

RESULT:

Overall damage to structures from future earthquakes will be reduced if the latest codes, standards and procedures are adopted and implemented.

Background

Life safety protection of the public can be improved by statutes requiring seismic design, by policies adopted by government agencies and private industry, or, in the case of buildings, by the adoption of the latest model building codes. The cost of designing and constructing new structures to conform to current codes is usually small, when compared to the overall construction cost.

Legislation

Chapter 319 to 319.200, Earthquakes - Seismic Building and Construction Ordinances, of the Revised Statutes of Missouri contains seismic design requirements. Beginning January 1, 1991 each city, town, village or county in Missouri which can be expected to experience an intensity of ground shaking equivalent to a Modified Mercalli Intensity of VII or greater from an earthquake along the New Madrid Fault with a potential magnitude of 7.6 on the Richter Scale, shall adopt an ordinance or order requiring that new construction and additions to existing buildings and structures comply with the standards for seismic design and construction of the UBC or BOCA Codes [1]. Seismic design criteria for additions apply only to structural components constituting the alteration and shall not be applied to require reconstruction or fortification of existing structures proposed to be altered.

Most small municipalities and rural counties do not have the resources to properly review plans and specifications to assure compliance with a building code. Consideration could be given to having the Division of Design and Construction in Jefferson City assume this responsibility for jurisdictions that do not have the resources.

[1] The UBC and BOCA Codes have been succeeded by the International Building Codes (IBC)."

Implementation
Revise Section 319.200 of the Missouri Statutes "Earthquakes - Seismic Building and Construction Ordinances," to reflect the current building codes and the current seismic hazard maps. The revised statute should recognize that Third Class Counties are prohibited from adopting building codes. The threshold for adopting seismic design requirements should be based on United States Geological Survey ground motion parameters, not the Modified Mercalli Scale. Encourage local governments to comply with these seismic design provisions. Identify resources to assure that the code provisions are enforced.
Encourage all engineering and architectural schools in Missouri to include seismic design in their curricula and the respective registration boards to include seismic design on licensing exams. Encourage professional societies to provide appropriate continuing education courses on earthquake resistant design.

Responsible Agencies:
Missouri Legislature
Local Government
Registration Board

Missouri Seismic Safety Commission - Strategy 2.2

STRATEGY:

Identify existing essential facilities and schools especially susceptible to earthquake damage. Consider both structural & non-structural damage. Encourage the development of methods to reduce such damage.

ACTION:

Develop a plan for increasing the seismic resistance of essential facilities and schools in a cost-effective manner. Encourage universities and professional societies to provide educational opportunities to design professionals in the methodology of seismic rehabilitation of structures.

RESULT:

Seismic retrofitting of existing essential facilities will allow these facilities to be available for post-earthquake recovery.

Background

Many hospitals, schools, police and fire facilities, jails and court houses were built prior to building code requirements for seismic design. In these facilities, there is a high likelihood that normal functions will cease after even a moderate earthquake. Those buildings, and the people who occupy them, will be in need more than ever for post-earthquake recovery.

Non-structural damage usually occurs at lower earthquake levels than does structural damage. Mitigation of non-structural hazards in essential facilities is the first line of defense in keeping critical services available for post-earthquake recovery. Non-structural retrofit can also be a cost-effective prevention strategy when budgets are limited. In California, hospitals have ceased operations after earthquakes because of non-structural damage, even though the structural system was essentially undamaged.

The costs of retrofitting existing structural systems in order to make them more earthquake resistant are often high. In many cases retrofitting may not be economically feasible. While it may not be politically feasible to mandate retrofitting of all susceptible facilities, owners should be encouraged to do so when possible.

The magnitude of this task is illustrated by inventories in the St. Louis area. A tabulation of structures in the area critical to post-earthquake recovery included 15 at airports, 42 at ambulance stations, 160 at fire stations, 33 at hospitals and 97 at police stations.

Implementation

Development of a strategy for retrofitting existing structures warrants careful study. For example, mandating retrofitting of older facilities could result in the abandonment of many such facilities because economics might not justify the expenditure. On the other hand, incentives such as tax and insurance reductions may be attractive inducements. The appropriate organization to develop an effective strategy should be identified.

The first priority should be given to retrofitting critical facilities that will be essential for post-earthquake recovery. Hospitals, fire stations, police stations and other critical facilities should be encouraged to assess the vulnerability of their structures and develop a plan for retrofitting them. FEMA has developed guidelines for the evaluation and retrofitting of existing structures. An inventory of critical buildings should be undertaken in eastern Missouri, especially in southeastern Missouri. A comprehensive plan for evaluating these structures should be developed, starting with rapid visual screening methods and progressing through detailed studies of deficient buildings. These studies should be undertaken by design professionals with knowledge of existing building construction, regional construction practices, and structural analysis.

Elementary and secondary schools, colleges and universities should be encouraged to assess their vulnerability and to retrofit seriously deficient structures. The assessment of seismic vulnerability should also take into account soil conditions.

Each critical facility should be required to submit a "report of vulnerability" to its governing authority. This report would assess the most vulnerable elements of their structures, i.e., those which when damaged would render their facilities unusable or unable to carry out their essential functions. With this information, a prioritized plan can be developed with cost estimates and a schedule for upgrading. The seismic upgrading requirements for critical facilities should be used by building owners in their capital improvement plans. Tax and insurance incentives should also be considered to encourage retrofitting of essential facilities. The governing authorities for these facilities could then monitor the progress of implementation and assess appropriate awards or sanctions, i.e. certification, funding, etc.

Architects, engineers and building officials should be trained in the methods for cost-effective seismic upgrades of existing buildings.

Responsible Agencies
Department of Public Safety; Division of Fire Safety; State Fire Marshal
Joint Commission of Hospital Certification
Department of Insurance, Financial Institutions, and Professional Registration
Department of Health and Senior Services (DHSS)
Department of Elementary and Secondary Education (DESE)
Department of Higher Education (DHE)
Public Service Commission
Office of Administration, Division of Facilities Management, Design and Construction
Department of Corrections
Local government

Missouri Seismic Safety Commission - Strategy 2.3

STRATEGY:

Review Missouri dam safety criteria relative to potential earthquake hazards.

ACTION:

Evaluate present rules with respect to the current knowledge base and, if needed, recommend changes to design and construction procedures. Use these rules to assess the seismic safety of the design of new dams and the evaluation of existing dams.

RESULT:

Dams in Missouri will be more resistant to earthquake hazards. Public safety will be enhanced.

Background

The State of Missouri has developed a sound program for dam safety including existing dams, construction of new dams, and maintenance of dams. Potential earthquake shaking effects are applied to the construction of new dams and to other dams if there appear to be demonstrable safety hazards as outlined by State statutes.

Implementation

The review should be accomplished by a panel of specialists. This panel should include persons who are very familiar with the Missouri Statute that addresses dam safety and the spirit of that statute, such as a representative of the Dam and Reservoir Safety Council and a program staff member. Other panelists should be included: a seismologist having knowledge of earthquake activities and potential effects in the Midwest; and a geotechnical engineer with a background in the seismic effects on dam foundations. Seismic provisions of the rules will apply to new dams.

Responsible Agencies:
Department of Natural Resources;
Division of Geology and Land Survey (DGLS/DNR)
Department of Public Safety; State Emergency Management Agency (DPS/SEMA)

Missouri Seismic Safety Commission - Strategy 2.4

STRATEGY:

Encourage the continuation of the program to evaluate existing bridges for seismic risk.

ACTION:

Assess, retrofit, and/or replace seismically deficient bridges.

RESULT:

Reduce the risk of collapse or severe damage to highway bridges. Vital transportation routes will be maintained after a large earthquake. Bridges which are at risk will be retrofitted or replaced in a timely manner.

Background

The Missouri Department of Transportation (MoDOT) performed an initial assessment of bridge earthquake vulnerability in Missouri in 1990. The task force identified priority routes in the high risk areas in the southeastern part of the state. Approximately 633 bridges were identified. The Task Force recommended that a program be established to retrofit these bridges and that the legislature fund this work separately from the normal highway program. MoDOT is actively proceeding with this bridge-strengthening program as funding becomes available.

Implementation

The legislature is encouraged to continue funding this program for retrofitting high risk bridges. Federal funding should be pursued whenever possible.

Responsible Agencies:
Missouri Department of Transportation (MoDOT)

Missouri Seismic Safety Commission - Strategy 2.5

STRATEGY:

Minimize the risk of hazardous material spills and the resulting contamination that may be caused by an earthquake.

ACTION:

Assess the potential for hazardous material spills using current seismic hazard maps and implement ways to minimize that risk.

RESULT:

Reduce the risk to the public and the environment resulting from hazardous material spills caused by an earthquake.

Background

Hazardous materials are routinely shipped throughout Missouri by train, truck, pipeline and barge. Serious environmental threats have been generated by transportation accidents involving hazardous materials. Many companies located in eastern Missouri store and manufacture hazardous materials. These facilities should be designed and/or retrofitted to make them more earthquake resistant. Hazardous materials can also be a deterrent to post-earthquake inspection of buildings because of the risk of exposure to volunteers inspecting buildings after an earthquake.

40 CFR 112 requires facilities storing or using petroleum in regulated quantities from above-ground tanks to implement a Spill Prevention Control and Countermeasure Plan to control the release of such materials.

The Oil Pollution Act of 1990 requires facilities posing a substantial threat of releasing oil to a waterway to have a contingency plan for responding to releases.

The Emergency Planning and Community Right-to-Know Act requires facilities storing or using regulated quantities of hazardous materials to report those materials and their maximum quantities to both local and State authorities.

Section 112 of the Clean Air Act requires facilities storing or using regulated hazardous materials in certain quantities to develop Risk Management Plans including Emergency Response Plans and to provide that information to State and local governments.

The implementation and enforcement of these programs will greatly aid in meeting the objectives of this strategy. However, the level of funding may not be adequate to meet the objectives within an appropriate time frame.

Implementation
The Missouri Hazardous Waste Law (10 CSR 23-6) requires that an applicant for a hazardous waste management facility permit to design and construct the facility to withstand stresses from earthquake loading or certify that the existing facility is able to withstand stresses from an earthquake. Existing facilities may use the seismic standard specified in the UBC or BOCA codes as a basis for certification. The certification must be completed by a qualified independent professional engineer registered in Missouri.

The Missouri Department of Natural Resources (DNR) should assess whether the risks of hazardous materials spills are adequately managed in Missouri. DNR should also ascertain if hazardous waste management facilities are designed and operated in a manner that minimizes earthquake risks. Procedures should be in place to minimize the risks of exposure to hazardous materials by emergency response personnel, including volunteer inspectors who respond to an earthquake.

DNR should verify all SPCC Plans and other laws regulating the manufacture, transport, storage, use and disposal of hazardous materials. This may require an increase in funding for the agency to fulfill its responsibility for earthquake hazards.

Responsible Agencies:
Department of Natural Resources (DNR); Division of Environmental Quality
Department of Natural Resources (DNR); Division of Energy
Department of Natural Resources (DNR); Division of Geology and Land Survey
Department of Public Safety; Division of Fire Safety; State Fire Marshal
Public Service Commission

Missouri Seismic Safety Commission - Strategy 2.6

STRATEGY:

Encourage identification of critical lifeline vulnerability interdependencies.

ACTION:

Identify lifeline interdependencies in earthquake-prone areas where the hazard of ground failure is high and where vulnerable structures support interdependent lifelines; develop a mitigation plan for each lifeline. Encourage equipment improvement, facility redundancy and relocation, and pre-event response and recovery agreements.

RESULT:

During an earthquake emergency, damage to one lifeline will not cripple an adjacent lifeline when the recognized hazard is anticipated and accommodated.

Background

In many locations, various lifelines, including pipelines, rail, highway, electric, and communications, are located within close proximity of each other, either in defined corridors or at crossings. Seismic damage to one lifeline may easily impact adjacent lifelines. An example would be an interstate pipeline crossing. The failure of a single lifeline may be repaired within a reasonable time, but the failure of two (or more) adjoining lifelines could pose complex repair problems. Significant delays may result from the complexity of repairs, slowing the operational return of vital public services essential to public health and safety.

Implementation

Undertake studies to identify all critical co-location sites within earthquake-prone areas. Establish a task force of public and private lifeline operators to estimate the potential impacts from damage to adjacent lifelines on their systems.

Responsible Agencies:

Department of Public Safety; State Emergency Management Agency (SEMA)
Department of Transportation (MoDOT)
Department of Natural Resources; Division of Geology and Land Survey (DGLS)
Public Service Commission
Municipal and private utilities, railroads, and pipeline operators

Missouri Seismic Safety Commission - Strategy 2.7

STRATEGY:

Promote land use planning for new critical facilities and schools.

ACTION:

Encourage local governments to adopt land-use planning and ordinances. Use these regulations to locate critical facilities and school sites based on current hazard maps.

RESULT:

Loss of life will be reduced and the operational status of critical facilities will be maintained by considering land-use and building factors relative to earthquakes and other natural hazards.

Background
Site factors such as soil types, soil profiles, depth to rock, topography, and depth of ground water have a significant impact on the ground shaking a facility will experience. Site factors can greatly amplify the ground shaking transmitted through the bedrock. There is presently little regulation by local jurisdictions on the location of new critical facilities and schools. Site factors are generally considered to be just another design parameter for the design professionals.

Facilities that are properly located and constructed, relative to site conditions, will have less earthquake-induced damage or be subject to fewer other collateral seismic hazards, such as landslides and subsidence. These structures will be more readily available for post-earthquake recovery, and injuries and loss of life within such structures will be reduced and, perhaps, avoided entirely. New facilities located on favorable site conditions will also cost less to construct.

Implementation
Because new facilities can be constructed in safer locations, local government stakeholders should choose to locate new structures wisely. The State should cooperate with and provide technical support and other assistance to municipal and county governments as they develop policies and ordinances based on current hazard maps. State legislation could include incentives for local governments to develop zoning and other land-use planning procedures for reducing vulnerability of critical care facilities and schools to natural hazards.

Responsible Agencies:
Municipal (including service districts) and county government
Department of Public Safety; State Emergency Management Agency (SEMA)
Department of Natural Resources; Division of Geology and Land Survey (DGLS)

Missouri Seismic Safety Commission - Strategy 2.8

STRATEGY:

Encourage financial and insurance institutions to provide incentives for hazard mitigation.

ACTION:

Support educational efforts to aid the public in understanding their role in mitigating damage, the nature of catastrophe insurance, the role of deductibles, and threats to solvency. Support educational, regulatory and legislative efforts aiding the availability and affordability of insurance.

RESULT:

There will be a financially sound catastrophic insurance business, public acceptance of need to carry earthquake insurance with substantial deductibles, and public support of commercial and residential earthquake-resistant building design.

Background

A.M. Best, the independent insurance rating service, has in recent years lowered the financial ratings of numerous major insurers, declaring a need for them to reduce exposure to natural disasters. There is presently a trend in the insurance sector for minimizing the exposure to earthquake damage claims by excluding coverage on certain classes of buildings, i.e. unreinforced masonry and older buildings, raising premiums on vulnerable facilities, and raising deductibles for seismic damage on facilities where coverage is available.

There is a general lack of public understanding of the role of premiums, stated coverages, and deductibles in the providing of catastrophe insurance. Even regulators may wish to participate in further education on these issues. Commercial and residential owners may wish to participate in lowering their risk by undertaking efforts to mitigate possible damage.

It is possible that Federal legislative proposals may emerge to promote solvency in the insurance sector in the event of a catastrophe. These ideas and proposals should be considered in the light of state experience and needs, and should be supported if they further the goal of a solvent industry.

Implementation

The financial and insurance sectors could provide incentives for both the seismic design of new facilities and the seismic strengthening of existing facilities. These incentives would encourage seismic design of facilities in areas without established building codes, and provide financial incentives for the strengthening of existing facilities. These financial incentives for retrofit could make the difference between a positive or negative cost-benefit analysis.

Financial and insurance institutions should be invited to participate in both legislative and regulatory efforts to encourage seismic design of new facilities and the strengthening of existing facilities. This approach to managing risk could minimize the need for restrictive coverages, high deductibles, and high rates.

A working group should be established to determine Missouri's needs for revision of the catastrophic insurance system. The members of the group should include the insurance industry, state regulators, professional engineers, architects, and commercial and residential property owners. This group would bring together all stakeholders for the discussion of owners' risk-reduction responsibilities, insurer solvency, and availability of catastrophic insurance. Consider Federal legislative remedies as they develop. Support state legislative efforts related to mitigation. Seek regulatory support for properly rated catastrophic coverage with adequate deductibles.

Responsible Agencies:
Department of Insurance, Financial Institutions, and Professional Registration
Department of Natural Resources, Division of Geology and Land Survey

Missouri Seismic Safety Commission - Strategy 2.9

STRATEGY:

Encourage the education of design professionals and code officials in the latest seismic design practices.

ACTION:

Seismic design should be a part of the engineering and architecture curricula at state universities and colleges and included in the testing required for licensing engineers. Promote continuing education for architects and engineers. Promote continuing education of seismic design requirements for code officials.

RESULT:

Design professionals and code officials with knowledge of current seismic design methodologies will lead to safer structures.

Background
Seismic design and seismic strengthening will only happen if the design professionals and code officials are both aware of the issues and remain current with respect to the state of knowledge.

Implementation
Missouri has implemented a continuing education requirement for both architects and professional engineers. This requirement does not stipulate the content of the continuing education. The continuing education concept should be enhanced to require some units on design for natural hazards. Continuing education for code officials should also cover design for natural hazards, and should focus on underlying design concepts and how to review plans and specifications for compliance. Professional societies and institutions of higher education should play a key role in this continuing education process.

Building codes should be written to have their intent clearly stated. The present cycle of new building codes every three years is counterproductive, with both design professionals and code officials struggling to stay current. Longer code cycles are encouraged to stabilize design.

Responsible Agencies:
Department of Insurance, Financial Institutions, and Professional Registration;
Division of Professional Registration; Board of Architects, Professional Engineers, Professional Land Surveyors and Landscape Architects
Department of Insurance, Financial Institutions, and Professional Registration;
Division of Professional Registration; Board of Geologist Registration
Professional organizations of engineers, architects, and geologists

Objective 3: Improve Emergency Response

Response efforts need to be well coordinated, fast and efficient to reduce injury, additional loss of life, and further property destruction.

Strategy	Action	Result
3.1 Review the earthquake response component of the statewide integrated emergency management system.	Develop an integrated emergency management system at all levels of government and the private sector to protect life, health, property and the environment following an earthquake event.	Improved emergency response through more effective utilization of resources and personnel.
3.2 Promote Community Emergency Response Teams (CERTs) statewide.	Train volunteer Community Emergency Response Teams statewide.	Reduction of life, property and environmental loss by providing more immediate response in a disaster.
3.3 Support the formation, training and funding of Urban Search and Rescue Teams within the State of Missouri.	Train and organize specialty teams designed for intense search and rescue to augment local fire departments during major emergencies.	Reduction of loss of life by mobilizing and deploying Urban Search and Rescue task forces with a significant capability for disaster response.
3.4 Promote development of emergency response plans at the state and local levels utilizing the Incident Command System.	Develop comprehensive emergency response plans at state and local levels and test plans through exercises with first responders.	Reduction of life, property and environmental losses by providing training and education for all first responders in a natural disaster.
3.5 Promote the selection and training of qualified local emergency response directors and their personnel.	Establish minimum job qualifications for local emergency response directors and develop programs for these directors and their personnel.	Emergency response managers and personnel are trained and prepared to respond to an earthquake or other natural disaster.

3.6 Evaluate mass care exercise and training programs for local emergency management and volunteer agencies who respond to disasters.	Evaluate and promote coordination of current multi-agency training and exercise programs under conditions expected after earthquakes, specifically between local emergency management and voluntary agencies. Promote identification of agency mass care roles and responsibilities in the event of a major disaster.	Local emergency management and voluntary agencies will know their mass care roles and responsibilities in a disaster and will coordinate responses.
3.7 Expand and promote training in disaster mortuary and identify potential temporary mortuary sites in major population centers.	Continue recruitment and training of the Missouri Funeral Directors Disaster Response Team (MFDADRT) and for mortuary personnel to be trained as Disaster Mortuary Coordinators for Mortuary Services. Support pre-disaster identification of temporary mortuary sites which can be accessed immediately in major population centers and/or in each of MFDA districts.	Trained personnel will be available to establish the means and methods for the most reasonable and proper care and handling of the dead in multi-fatality earthquake disaster situations, and in the event of mass casualties. Potential use areas such as mortuaries, cemeteries and National Guard Armories are pre-identified in major population centers to be used as temporary morgue sites.
3.8 Enhance communication capability and coordination for emergency response between state and local governments and private groups.	Develop viable alternative means of communications between state and local government entities and volunteer organizations.	Emergency responders will have viable alternative means of communication in order to coordinate response during an earthquake emergency.
3.9 Enhance ability of emergency response personnel, materials and equipment to reach affected areas.	Identify and upgrade key transportation routes (roads, air, rail and water) to areas with a high risk of damage in the event of a major earthquake.	Reduction of life, property and environmental losses and enhancement of the recovery process.
3.10 Promote mutual aid agreements between political subdivisions at local and state levels.	Support and encourage the establishment of mutual aid agreements.	Mutual aid agreements will be established at the local and state levels.

3.11 Promote development of effective, coordinated response plans for utilities.	Assess and mitigate earthquake risks and damage to utilities.	Utility lifelines will continue to function or can be rapidly repaired after an earthquake.
3.12 Develop the capability to respond to multiple hazardous materials incidents.	Determine the potential for hazardous material incidents following an earthquake and develop the necessary emergency response capability.	Improved response to and recovery from hazardous material release after earthquakes.

Last Changed 03/09/07

Missouri Seismic Safety Commission - Strategy 3.1

STRATEGY:

Review the earthquake response component of the statewide-integrated emergency management system.

ACTION:

Develop an integrated emergency management system at all levels of government and the private sector to protect life, health, property and the environment following an earthquake event.

RESULT:

Improved emergency response through more effective utilization of resources and personnel.

Background

The concept of an integrated emergency management system focuses on the development of individual emergency response plans by state and local government agencies and public and private organizations in which the interrelation, coordination and cooperation of the various entities are considered. Unlike other natural disasters, such as floods or tornadoes, a major earthquake will occur without warning and the damage to structures, bridges and utilities will be much more widespread and severe.

One tool which can be utilized to enhance the emergency management system is a comprehensive database of resources (both public and private) throughout the state that could be called upon in an emergency. The State Emergency Management Agency has developed such a database; however, many local government agencies do not currently have access, due to computer equipment limitations.

Implementation

Promote the concept of an integrated emergency management system to local emergency response coordinators, government agencies and public and private entities through seminars. Place special emphasis on response planning for earthquake events, to ensure that responders and critical facilities are functional after such an event.

Support the establishment of a statewide computer network for emergency response and the acquisition of computer equipment by local emergency response coordinators to enable access to the network.

Responsible Agencies:
Local, municipal and county governments
State Emergency Management Agency (SEMA)
Volunteer and professional organizations
Private industry

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.2

STRATEGY:

Promote Community Emergency Response Teams (CERTs) statewide.

ACTION:

Train volunteer Community Emergency Response Teams statewide.

RESULT:

Reduction of life, property and environmental loss by providing more immediate response in a disaster.

Background
In the immediate aftermath (first 72 hours) of an earthquake, standard emergency services will not be available. Research has shown that most rescue and emergency services are provided by untrained volunteers spontaneously functioning in damaged neighborhoods. This initiative would provide very basic training for interested people in fire safety, light rescue, disaster medical operations, hazard inspection, and other services. Grouped together within each community, as a part of neighborhood groups, church groups or professional organizations, these volunteers would be in place to act independently and spontaneously in the event of a disaster. They would be known and trusted by the people they would be helping. These volunteers will respond in their neighborhoods first, then go to staging areas to assist their local government's disaster efforts.

Implementation
Four steps are required:

Instruct elected officials, policy makers, police, fire and emergency management personnel on the use of volunteers in disaster response

Identify citizen groups and volunteer organizations

Distribute information and hold workshops through local public safety organizations and community service groups

Continue to provide technical assistance and recertification to CERTs wishing to provide community-based relief

These steps would be accomplished under the direction of local Emergency Program Managers, with assistance from fire and rescue agencies in training volunteer Community Emergency Response Teams and team leaders.

Responsible Agencies:
State Emergency Management Agency (SEMA)
Local Emergency Program Managers
Fire and medical agencies
Community groups of all types

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.3

STRATEGY:

Support the formation, training and funding of Urban Search and Rescue Teams within the State of Missouri.

ACTION:

Train and organize specialty teams designed for intense search and rescue to augment local fire departments during major emergencies.

RESULT:

Reduction of loss of life by mobilizing and deploying Urban Search and Rescue task forces with a significant capability for disaster response.

Background
Urban Search and Rescue is a plan of action for responding to disasters and for addressing the consequences of incidents or emergency situations when specialized personnel are needed for search and rescue.

The plan is applicable to natural disasters such as earthquakes, tornadoes, floods, dam failures and/or terrorist activities. As part of its disaster planning, mitigation and response function, the State Emergency Management Agency has implemented a plan to develop an Urban Search and Rescue capability within the State of Missouri. This concept, entitled Missouri based-US&R (Missouri Urban Search and Rescue), calls for the development of a tiered response system to catastrophic events which require urban search and rescue.

Implementation
The Boone County Fire Protection District has coordinated and implemented the development of an Urban Search and Rescue Task Force. This US&R Task Force operates under the State Emergency Management Agency (SEMA) in a similar capacity to those established in California and several other states. Through a memorandum of agreement with the State Emergency Management Agency, the Boone County Fire Protection District serves as a resource for personnel, management, training and a portion of the equipment cache.

The task force will be deployed throughout Missouri by the State Emergency Management Agency. Requests for out-of-state responses would be made by FEMA to the State Emergency Management Agency in Jefferson City. The director of SEMA would then obtain the governor's consent to deploy the task force, the cost of which would be covered by FEMA.

Among the capabilities of each US&R Task Force are:

Physical search and rescue operations in damaged/collapsed structures

Emergency medical care to disaster response personnel

Emergency medical care to the injured

Reconnaissance to assess damages and needs and to provide feedback to local, state and Federal officials

Assessment/shut off of utilities to houses and buildings

Hazardous materials surveys/evaluations

Structural/hazard evaluations of government/municipal buildings needed for immediate occupancy to support disaster relief operations

Stabilizing damaged structures, including shoring and cribbing of damaged buildings

The ultimate goal for the State of Missouri would be to have three (3) such teams, the first within the central part of the state, the second within the eastern part and the third in the western area. All teams would support and back-up each other if necessary.

Please Note: Missouri Rescue One is a federally funded Urban Search and Rescue Team based in Columbia, Missouri. Although a Federal asset, MoRescueOne can be used a response organization in a catastrophic earthquake along the New Madrid Fault. The Missouri Seismic Safety Commission would still like to have two additional US&R Task Forces within the State (the eastern force and the western force).

Responsible Agencies:
Federal Emergency Management Agency (FEMA)
State Emergency Management Agency (SEMA)
Department of Public Safety (DPS)
Fire and Medical Agencies

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.4

STRATEGY:

Promote development of emergency response plans at the sate and local levels utilizing the Incident Command System.

ACTION:

Develop comprehensive emergency response plans at state and local levels and test plans through exercises with first responders.

RESULT:

Reduction of life, property and environmental losses by providing training and education for all first responders in a natural disaster.

Background
With the exception of some large city fire and law enforcement departments, few officers or medical personnel will ever respond to a sufficient number of disasters to gain the experience needed for handling large scale emergencies. Most emergency service personnel are duly trained in basic rescue, aerial operations, and emergency medical care where up to ten patients may be involved. This is especially true of volunteer first responders.

Implementation
Often the need for a plan is perceived only after a major problem or event occurs. One of the goals is to make all emergency service personnel aware of the need for comprehensive planning and proper training before a disaster occurs. The ability to plan organize, command, and coordinate activities during a major disaster must be developed before the problem occurs.

All agencies should develop a disaster plan and be thoroughly knowledgeable about the plan. First responders must have fundamental knowledge of disasters and the ability to think and act quickly and decisively. Field exercises should be held to test the plan in order to disclose any and all weaknesses, so that changes can be made. All agencies must be thoroughly familiar with the Incident Command System.

Responsible Agencies:
State Emergency Management Agency (SEMA)
Department of Public Safety (DPS)
Local Emergency Program Managers
Fire, Law Enforcement and Medical Agencies

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.5

STRATEGY:

Promote the selection and training of qualified local emergency response directors and their personnel.

ACTION:

Establish minimum job qualifications for local emergency response directors and develop programs for these directors and their personnel.

RESULT:

Emergency response managers and personnel are trained and prepared to respond to an earthquake or other natural disaster.

Background
The ability of local emergency response agencies to be effective, following a disaster, is directly related to the qualifications of those responsible for coordinating response efforts as well as training the emergency response personnel. In the State of Missouri there is currently no standardized job description for the position of local emergency response coordinator, nor minimum training requirements for emergency response agency personnel. In some instances, the emergency response coordinator serves voluntarily, with no compensation, or is a part-time employee with other full-time responsibilities. Other coordinators are full-time employees, who devote their work time to disaster mitigation, response and recovery planning and training of local emergency response personnel.

Training of emergency response personnel, including disaster simulation exercises, will enhance the capabilities of these personnel and allow for testing and improving the local emergency response plan. Not all local jurisdictions in Missouri participate in SEMA sponsored training exercises annually. This training ranges from a "table top" exercise to a full simulation of a disaster event.

Implementation
Develop a standardized job description and support funding for a full-time qualified local Emergency Response Coordinator as defined by Chapter 44.090 of the Revised Missouri Statutes.

Promote training exercises for all local emergency response agency personnel.

Responsible Agencies:
State Emergency Management Agency (SEMA)
State and Local Government
Local fire, police, EMS and Public Works Agencies
Private and Public Groups

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.6

STRATEGY:

Evaluate mass care exercise and training programs for local emergency management and volunteer agencies who respond to disasters.

ACTION:

Evaluate and promote coordination of current multi-agency training and exercise programs under conditions expected after earthquakes, specifically between local emergency management and volunteer agencies. Promote identification of agency mass care roles and responsibilities in the event of a major disaster.

RESULT:

Local emergency management and volunteer agencies will know their mass care roles and responsibilities in a disaster and will coordinate responses.

Background
At the local level, when a disaster occurs, emergency management and various voluntary agencies like the American Red Cross and the Salvation Army are sometimes unclear about their joint mass care roles and responsibilities, especially regarding congregate shelters. In addition there seems to be a lack of knowledge regarding resources. There are not enough shelters or shelter staff currently available. A report by the California Seismic Safety Commission states that this was a major concern during California's recent earthquakes. Also, there was not a clear understanding regarding responsibility for shelter site selection or for staffing and operation of shelters.

In Missouri, this would not be a concern at the state level, but it could be of concern at the local level, especially in the smaller communities.

Implementation
SEMA, in conjunction with local emergency management and voluntary agencies at the state and local levels, evaluates multi-agency exercise and training programs in the area of mass care to ensure that agencies know their roles and responsibilities during an earthquake or major disaster relief operations.

Responsible Agencies:
State Emergency Management Agency (SEMA)
Department of Social Services (DSS)
Local Emergency Managers
American Red Cross
Salvation Army

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.7

STRATEGY:

Expand and promote training in disaster mortuary and identify potential temporary mortuary sites in major population centers.

ACTION:

Continue recruitment and training of the Missouri Funeral Directors Disaster Response Team (MFDADRT) and mortuary personnel to be trained as Disaster Mortuary Coordinators for Mortuary Services. Support pre-disaster identification of temporary mortuary sites which can be accessed immediately in major population centers and/or in each of MFDA districts.

RESULT:

Trained personnel will be available to establish the means and methods for the most reasonable and proper care and handling of the dead in multi-death, earthquake disaster situations, and in the event of mass casualties. Potential use areas such as mortuaries, cemeteries and National Guard Armories are pre- identified in major population centers to be used as temporary morgue sites.

Background
Appendix 2 to Annex T of the State of Missouri Emergency Operations Plan outlines the Special Mortuary Service SOP, New Madrid Earthquake, and Appendix 3 relates to Temporary Morgue Sites SOP. The Missouri Funeral Directors Association (MFDA) has an Emergency Preparedness Committee which meets quarterly. Training is conducted three times a year for members and non-members of the association. Members of the Missouri Funeral Directors Association also receive training through the State Emergency Management Agency and through the Federal Emergency Management Agency. They participate in exercises and drills.

MFDA indicated that currently the pre-identified mortuary sites are those generic sites mentioned above. The state may wish to consider pre-identification of the temporary sites in each of the MFDA districts as well as the major population centers.

Implementation
Encourage continued training of state and local mortuary qualified disaster coordinators, trained disaster responders and other funeral service personnel through the Missouri Funeral Directors Association, SEMA, and FEMA. Pre-identify temporary sites in major population centers and in each of the MFDA districts.

Responsible Agencies:
State Emergency Management Agency (SEMA)
Missouri Funeral Directors Association
Department of Health and Senior Services (DHSS)
Missouri State Highway Patrol (MSHP)
Missouri National Guard
Local Coroners/Medical Examiners

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.8

STRATEGY:

Enhance communication capability and coordination for emergency response between state and local governments and private groups.

ACTION:

Develop viable alternative means of communications between state and local governmental entities and volunteer organizations.

RESULT:

Emergency responders will have viable alternative means of communication in order to coordinate response during an earthquake emergency.

Background

A key issue in implementing a coordinated emergency response effort is determining the magnitude and severity of the damage, as well as the type and scope of aid required. Past experience during emergency response coordination at state and local emergency operations centers has proven that cellular and commercial phone systems are effective communication tools. However, following a major earthquake, there is great potential that these means of communications may be interrupted. It is therefore imperative that alternative means of communications are available.

Currently the State has four alternative avenues of communication within damaged areas. These are the Missouri State Highway Patrol (MSHP), the Missouri State Water Patrol (MSWP), the Missouri Department of Transportation (MoDOT), and ham radio operators. In addition, the Division of Fire Safety has state-wide mutual aid frequencies available for fire departments. These frequencies are strictly for mutual aid responses, however.

The Missouri State Highway Patrol has about 1,000 vehicles with radio communication and 14 aircraft. Within two hours of a major earthquake in the Bootheel area, over 200 patrol persons can be in the affected area, assuming major transportation routes are open. The ability of the Patrol to utilize its radio communications, however, may be affected by damaged relay towers. Satellite communications equipment has been added to each MSHP Troop Headquarters, as well as to the four out-state Area Coordinators the State Emergency Management Agency (SEMA) has in Cape Girardeau, Kansas City, St. Louis and Springfield. SEMA also has satellite communications at its Jefferson City Headquarters, as do several local emergency management officials in southeast Missouri. SEMA also has portable satellite/cellular phone systems which personnel can take into the field during a disaster response situation.

The satellite equipment operates on systems provided by Mobile Satellite Ventures and GlobalStar and is independent of the public switched telephone network. These units operate on two networks within the state – the Highway Patrol's and SEMA's. The units can be switched to work on either network. Also, the RSOCs are in the process of identifying the responsible local communications answering point in each county of their respective regions. These answering points, as described in the communication annex mentioned above, will be responsible for monitoring the MTAC and VTAC/UTAC interoperability channels on a routine basis. During a significant event, they will be responsible for making reports upstream to SEMA via the regional communications net control center.

The State Emergency Management Agency has a database of volunteer ham operators who can communicate with the State Emergency Operations Center. These volunteers can be a valuable asset; however, these individuals may have other immediate personal concerns (injured family, friends and property), so that utilization of this source of communication may not be available immediately following an earthquake.

In addition, the State Emergency Management Agency has explored the possibility of installing its own satellite communications network. The cost of installing such a network is estimated to be about $200,000. Local government and emergency response agencies operate on their own radio frequencies. The ability of these various agencies to communicate is of great importance following a disaster.

Implementation
Local emergency response agencies should identify all radio frequencies used by local government agencies, fire departments, EMS providers, volunteer agencies and other entities which could play a role in emergency response. This information should be incorporated in the state and local emergency response plans and the ability of the local emergency response agency to communicate with these other entities evaluated.

Emergency training exercises should be conducted to test the communications capabilities of local agencies. Further consideration should be given to installing a Statewide Satellite Communications Network with the equipment housed in earthquake resistant structures where necessary.

Responsible Agencies:
Missouri State Highway Patrol (MSHP)
State Emergency Management Agency (SEMA)
Local Emergency Management Officials
Local Political Subdivisions
Local fire, police, EMS, and Public Works Agencies
Private and Public Groups

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.9

STRATEGY:

Enhance ability of emergency response personnel, materials and equipment to reach affected areas.

ACTION:

Identify and upgrade key transportation routes (roads, air, rail and water) to areas with a high risk of damage in the event of a major earthquake.

RESULT:

Reduction of life, property and environmental losses and enhancement of the recovery process.

Background

In the event of an earthquake or other natural disaster, access to the affected areas will be by highway, rail, air and water. Failure of roadways and bridges, railroad lines and bridges, airport runways and air traffic control systems, and waterway ports could severely hamper both the response and recovery process.

The Missouri Department of Highways and Transportation has compiled a "Risk Report of Structures" in which some 633 bridges have been identified for retrofitting. A retrofitting schedule has been developed based on whether the structure is along a main transportation route or a service road within an area. To date, 16 bridges have been retrofitted. The estimated cost of retrofitting the remaining bridges is about $70 million. Two bridges of major concern are the Poplar Street Bridge in the City of St. Louis and the Caruthersville Bridge. Both bridges serve as a critical link to the areas they serve.

Several major railroad lines traverse through Missouri. Although rail lines within the areas of major damage would in all likelihood be severely damaged and inoperable, the rail system could be used to transport large quantities of emergency goods to staging areas. In addition, goods being carried on trains that have been derailed or stopped due to damaged tracks could be utilized. However, Federal Law prohibits seizure of railroad goods and services by State government, even in the event of a declared state emergency. Only the President of the United States or the Department of Defense has the right of seizure. Historically, however, the rail industry has voluntarily offered its services in the event of a natural disaster.

The Missouri and Mississippi Rivers are other sources of transportation for the state. Barges are used to transport goods and materials. The leading ports are St. Louis, Cape Girardeau, Caruthersville, New Madrid and Hannibal. If any of these ports are deemed operable following an earthquake, they would be useful in transporting emergency goods into affected areas.

There are 354 airports and 80 heliports in the State of Missouri. Fifteen airports are in the St. Louis area. Air transportation would be a quick and efficient way to import emergency personnel and some materials into a disaster region, provided that the airports and control towers survive. The State Emergency Management Agency (SEMA) has recommended that a study be done on airports and control towers to determine seismic vulnerability. From this information retrofits could be made to improve reliability after an earthquake event.

Implementation

Highways:

Identify key emergency routes into areas of potential significant damage in the event of an earthquake and review current bridge retrofitting schedule.

Continue and increase funding, if possible, for the retrofitting of key roadways and bridges.

Review and test the current post-earthquake damage assessment plan for highways and bridges.

Railroads:

Identify rail lines which could be utilized to transport goods and personnel.

Conduct a vulnerability study of these rail lines and develop a staging plan.

Initiate discussions with railroad owners regarding utilization of both rail lines and goods after an earthquake. Formal agreements should be entered into if feasible.

Waterways:

Identify key ports and determine if retrofitting can be done to improve survival.

Coordinate a plan with the Corps of Engineers, Port Authority, Missouri State Water Patrol, and the Coast Guard to determine port availability and accessibility following an earthquake.

Discuss with barge transportation companies the use of their services to transport emergency goods.

Airports:

Conduct a study of the seismic vulnerability of airports and heliports in Missouri.

Identify the airports that would be most useful and implement retrofit improvements.

Responsible Agencies:
State Emergency Management Agency (SEMA)
Bridge and Highway Safety Divisions; Department of Transportation (MoDOT)
Aviation, Railroad and Waterways Sections; Multimodal Division; Department of Transportation (MoDOT)
U. S. Army Corps of Engineers
Missouri State Water Patrol (MSWP)
Port Authority
U. S. Coast Guard
Federal Aviation Administration (FAA)

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.10

STRATEGY:

Promote mutual aid agreements between political subdivisions at local and state levels.

ACTION

Support and encourage the establishment of mutual aid agreements.

RESULT:

Mutual aid agreements will be established at the local and state levels.

Background
Chapter 44.090 of the Revised Missouri Statutes allows local political subdivisions to enter into mutual aid agreements for emergency aid with other public and private agencies within and outside the state, provided such agreement is approved by the governor. Such mutual aid agreements allow for the sharing of resources and personnel in the event of an emergency.

Missouri is currently only one of three states which has a statewide Fire and Rescue Mutual Aid Agreement in place. This agreement allows fire and rescue units to respond to emergency events outside their jurisdictional areas, at the request of the local jurisdiction.

The State of Missouri is also currently exploring the feasibility of entering into mutual aid agreements with adjacent states and the Missouri National Guard is actively pursuing the development of such agreements with adjacent states.

In addition, St. Louis County has passed Ordinance No. 15,175 which allows for mutual aid agreements with political subdivisions in both Missouri and Illinois. As of January, 1995 only 13 of the 90 plus municipalities in St. Louis County have entered into such an agreement with the St. Louis County government.

Implementation
Promote mutual aid agreements between local political subdivisions by conducting informational seminars for elected officials and government agencies.

Actively pursue mutual aid agreements with adjacent states.

Responsible Agencies:
State Emergency Management Agency (SEMA)
Local Political Subdivisions

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.11

STRATEGY:

Promote development of effective, coordinated response plans for utilities.

ACTION:

Assess and mitigate earthquake risks and damage to utilities.

RESULT:

Utility lifelines will continue to function or can be rapidly repaired after an earthquake.

Background

Critical elements of the infrastructure of many utilities are vulnerable to damage during earthquakes. There is potential for damage to electrical substations, transformers and transmission lines; the rupture or collapse of water, gas and sanitary sewer pipelines; damage to water and wastewater treatment facilities; as well as telephone switchgear and transmission lines. Cellular communication towers could collapse or become misaligned and thus inoperable. Disruption of water and wastewater service could pose a health risk, as could the loss of electrical or gas service should the earthquake occur during either the winter or summer months. Loss of telecommunications could hamper the response process and the rupture of gas lines and mains could result in fires.

Electric and gas service to eastern Missouri is primarily provided by Union Electric, Laclede Gas and the Rural Electric Cooperatives. Water and sewer service is generally provided by local private or government-owned utilities. Southwestern Bell is currently the primary telecommunications carrier in this area; however, several cellular telephone service providers have also established their presence.

Development of an emergency response plan by utilities under the jurisdiction of the Public Service Commission is currently voluntary and cannot be mandated due to the Hancock Amendment. Emergency response plans for government-owned utilities, such as municipally-owned natural gas systems, are part of the overall local government Emergency Response Plans.

Within the St. Louis area, there exists a voluntary Disaster Response Council which is composed of representatives of the local utilities. The purpose of this Council is to promote a coordinated effort in the response and recovery following an earthquake or other natural disaster.

Mutual aid agreements have been established by several utility providers with providers outside the area of potential earthquake damage.

Implementation
Utilities should be encouraged to perform vulnerability studies of their facilities.

The development of an emergency response plan by each utility under the jurisdiction of the Public Service Commission should be promoted. These response plans should be coordinated with the local and state emergency response plan, tested and updated annually.

Mutual aid agreements and voluntary coordination of emergency response efforts should be promoted.

Responsible Agencies:
State Emergency Management Agency (SEMA)
Public Service Commission (PSC)
Division of Environmental Quality; Department of Natural Resources (DNR)
Division of Energy; Department of Natural Resources (DNR)
Local government agencies and utilities

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 3.12

STRATEGY:

Develop the capability to respond to multiple hazardous materials incidents.

ACTION:

Determine the potential for hazardous material incidents following an earthquake and develop the necessary emergency response capability.

RESULT:

Improved response to and recovery from hazardous material release after earthquakes.

Background
The Title III: Superfund Amendments and Reauthorization Act (SARA) program could be utilized to aid in the identification of facilities storing hazardous materials. Under the program, facilities report annually the hazardous materials stored for the past year (Tier II Reports). These reports are filed with the Local Emergency Planning Committee (LEPC), the Division of Fire Safety (Missouri Emergency Response Commission), and the local fire departments. The LEPCs are formed by the county but sometimes several counties will form one LEPC. The LEPCs would be a good source for identifying facilities; however not all LEPCs have a computer database of the Tier II Reports. The State Emergency Management Agency (SEMA) is working towards putting computers with emergency response software in every LEPC office and forming a state-wide network. This is a very important step in the identification process.

Since the potential number of hazardous material releases after an earthquake is expected to be large. The Missouri Department of Natural Resources (DNR) will be overwhelmed with reported incidents. DNR has six regional offices along with the central office which would work together in disaster recovery. Three full-time hazardous materials people are needed at each regional office.

Fire departments would also be very involved in dealing with hazardous material releases. The LEPCs would work together with the local fire departments to conduct training and emergency exercises to deal with hazardous material releases. Funding is needed for the Division of Fire Safety to provide on-going training on hazardous materials and equipment.

Implementation
Use an electronic data base to identify and track potential sources of hazardous material release following earthquakes, and provide the resources and training needed to respond to likely hazardous material incidents.

Local Emergency Planning Committees will need computers and software for collecting and managing data on the locations, nature and uses of hazardous materials. Local fire departments will need equipment and training to respond appropriately to multiple hazardous material incidents. The Missouri Department of Natural Resources needs additional hazardous material staff to coordinate data management and training.

Responsible Agencies:
Missouri Emergency Response Commission (MERC)
State Emergency Management Agency (SEMA)
Department of Natural Resources (DNR)
Division of Fire Safety (DFS)
Local Fire Departments
Local Emergency Planning Committees

Last Changed March 9, 2007

Objective 4: Improve Recovery

A well-designed recovery process helps people resume their normal lives, by reducing the emotional and economic impact of the disaster over the long term.

Strategy	Action	Result
4.1 Promote the designation of earthquake resistant short- and long-term shelters.	Identify suitable, earthquake resistant short- and long-term shelters and coordinate agreements for their use.	Earthquake resistant short- and long-term sheltering facilities will be available following a major disaster.
4.2 Promote the development of contingency plans for the location, design and construction of long-term temporary housing.	Plan for the construction of long-term temporary housing.	Long-term temporary housing will be available for victims displaced by a major earthquake.
4.3 Promote funding and training of post earthquake building inspection volunteers.	Continue to train volunteers throughout the State of Missouri to make rapid visual examinations of buildings through the SAVE Coalition.	By using a system already in place for training, certifying and mobilizing volunteers, structures that are safe for occupancy can be rapidly identified after an earthquake or other disaster. This will permit housing and jobs to be quickly restored.
4.4 Enhance the ability of individuals, businesses, and government agencies to recover from an earthquake disaster.	Enable entrepreneurs and small and large businesses to recover from an earthquake and to access assistance at all levels in a timely manner so that economic recovery progresses.	The adverse economic impact of an earthquake will be reduced in the affected area.
4.5 Enhance emergency management and coordination following NIMS guidelines.	Support the implementation of a coordinated emergency management system to provide rapid and systematic response following a seismic event.	Emergency response capability will be enhanced by coordinated responses to local requests for assistance in the immediate post earthquake phase of events.
4.6 Support identification of facilities and methods for disposal of uncontaminated debris and hazardous materials as the result of an earthquake.	Prepare a plan for disposal of hazardous materials, contaminated and uncontaminated debris.	Coordination will result in improved and efficient, coordinated disposal of hazardous materials and uncontaminated debris.

4.7 Support crisis counseling to individuals after an earthquake.	Encourage the development of a network of trained counselors who will respond to and provide counseling.	Residents, particularly children, will be able to understand and cope with the emotional trauma following an earthquake.
4.8 Enhance ability to provide crisis counseling to individuals in affected areas.	Coordinate the disaster mental health response when a disaster occurs	Residents, particularly children, will be able to understand and cope with the emotional impact following an earthquake.

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 4.1

STRATEGY:

Promote the designation of earthquake-resistant short- and long-term shelters.

ACTION:

Identify suitable, earthquake resistant short- and long-term shelters and coordinate agreements for their use.

RESULT:

Earthquake resistant short- and long-term sheltering facilities will be available following a major disaster.

Background
Disaster plans frequently identify buildings and facilities such as schools, churches, community centers, etc., as care and shelter centers. These are suitable for the short-term use (one to two weeks), but are almost never available on a long-term basis (up to two months). In most cases, the facilities are not earthquake resistant. Even with the best of planning and preparation and, with the combined resources of government, the Red Cross, and other voluntary agencies, it will be difficult to identify enough of those facilities. The use of the computer-program loss estimation tool called HAZUS (which stands for “Hazard- United States) provides emergency planners with a way to calculate what effect an earthquake would have on their jurisdiction fir a variety of factors, including providing an estimate of the number of people who would need sheltering.

Implementation
Mass care sheltering needs following an earthquake must be addressed by disaster preparedness and planning. Both short- and long-term shelters must be identified and designated prior to an earthquake. Structures should be assessed to determine their vulnerability to a seismic event. Agreements should be entered into for the use of these facilities to consider special needs populations.

Responsible Agencies:
State Emergency Management Agency (SEMA)
Missouri Housing Development Commission
Department of Social Services (DSS)
Department of Economic Development (DED)
American Red Cross
Salvation Army

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 4.2

STRATEGY:

Promote the development of contingency plans for the location, design and construction of long-term temporary housing.

ACTION:

Plan for the construction of long-term temporary housing.

RESULT:

Long-term temporary housing will be available for victims displaced by a major earthquake.

Background
In the event of a major earthquake, the American Red Cross, Disaster Services, estimates that over 725,000 Missourians will require temporary housing, with over 465,000 of these individuals located in the metropolitan St. Louis area.

An estimated 154,700 of the victims will initially seek housing in public shelters (schools, churches, tents, etc.) run by volunteer organizations. However, these facilities generally operate for a period of only 60 to 90 days. After this time, individuals who are unable to return to their homes due to significant damage may require long-term temporary housing. It is critical to the well-being of these victims that this housing be quickly identified so that they can begin rebuilding their lives.

The local emergency management agency should develop a contingency plan for providing housing prior to the disaster, so that adequate housing can be constructed rapidly when needed.

Implementation
The first step in developing a long-term temporary housing plan is to establish a committee consisting of local emergency management personnel and planning and zoning representatives, as well as individuals from the engineering and construction communities.

This committee should be responsible for evaluating existing rentals in the area to identify existing facilities which may survive and be habitable following a major earthquake Identifying property which could be utilized to construct long-term temporary housing, taking into consideration road access and the availability of utilities evaluating a variety of prefabricated housing products on the market to identify those which would be best suited for use in the affected areas and developing a plan for the closure and dismantling of long-term housing areas to ensure that this "temporary" housing does not become "permanent".

Responsible Agencies:
Local Emergency Management Agency
Local Governments
Volunteer Organizations
Planning and Zoning Personnel
Engineering and Construction Community
Federal Department of Housing and Urban Development (HUD)
American Red Cross
State Emergency Management Agency (SEMA)
Federal Emergency Management Agency (FEMA)

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 4.3

STRATEGY:

Promote funding and training of post-earthquake building inspection volunteers.

ACTION:

Continue to train volunteers throughout the State of Missouri to make rapid visual examinations of buildings through the SAVE Coalition.

RESULT:

By using a system already in place for training, certifying and mobilizing volunteers, structures that are safe for occupancy can be rapidly identified after an earthquake or other disaster. This will permit housing and jobs to be quickly restored.

Background
In 1991, the State Emergency Management Agency (SEMA) and the leadership of engineering and architectural professional societies began to develop a program for post earthquake volunteer inspectors. A coalition, called Structural Assessment and Visual Evaluation (SAVE), was formed to handle this task by the Missouri Society of Professional Engineers (MSPE), the Missouri Chapters of the American Society of Civil Engineers (ASCE) and the Consulting Engineers of Missouri (CECMo). Since its formation other professional organizations, such as American Institute of Architects/Missouri, New Madrid Chapter of the Earthquake Engineering Research Institute (EERI), Structural Engineers Association of Kansas and Missouri (SEAKM), and the Missouri Seismic Safety Commission (MSSC) have added their support.

When a disaster requiring SAVE Coalition volunteers occurs, local authorities will contact SEMA and request support. An estimate is made of the number of required volunteers and SEMA contacts the SAVE Coalition State and Regional Coordinators. In the event of a large disaster, it is anticipated that volunteers will be mobilized from outside the affected area because the local volunteers may be required to care for their families or their own structures or businesses. If a disaster occurs which requires volunteers, those volunteers are indemnified from professional liability.

Implementation
The ability of the Coalition to assist local building inspectors in evaluating structures is directly related to the availability of qualified, trained volunteers. Continued, and increased, funding is needed to promote the program and train volunteers, including refresher courses.

Volunteers from outside the areas of greatest potential damage are especially important, since individuals within these areas may have other immediate personal concerns. Continued planning is also needed for mobilizing and housing volunteers from outside the affected area.

Responsible Agencies:
Local governments
State Emergency Management Agency (SEMA)
Professional Organizations referenced above

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 4.4

STRATEGY:

Enhance the ability of individuals, businesses and government agencies to recover from an earthquake disaster.

ACTION:

Enable entrepreneurs and small and large businesses to recover from an earthquake and to access assistance at all levels in a timely manner so that economic recovery progresses.

RESULT:

The adverse economic impact of an earthquake will be reduced in the affected area.

Background
Depending on the severity of the event, delayed economic recovery of the affected area could be as disastrous as the property losses. In addition, with most of the jobs in the private sector being created by small businesses (some reports indicate up to 80 percent), access to Federal and State programs become vitally important to these small business owners. The consensus is that the larger, national and international companies doing business in the affected area of an event will have staff personnel who are familiar with ways to tap into emergency funding programs.

Many businesses, particularly in rural parts of the state, provide essential support services that will be needed as part of public efforts to assist areas recovering from an earthquake.

Implementation
Develop informational packets and practical guidelines on the small business application procedures, and business planning for disaster response and recovery; distribute this information through public awareness and education programs and extension services. Recommend to the Federal government that a streamlined approach be used for loan applications during the post-disaster period.

Responsible Agencies:
Federal Emergency Management Agency (FEMA)
State Emergency Management Agency (SEMA)
Small Business Administration
Division of Workforce Development; Department of Economic Development (DED)

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 4.5

STRATEGY:

Enhance emergency management and coordination following National Integrated Management System (NIMS) guidelines.

ACTION:

Support the implementation of a coordinated emergency management system to provide rapid and systematic response following a seismic event.

RESULT:

Emergency response capability will be enhanced by coordinated responses to local requests for assistance in the immediate post-earthquake phase of events.

Background
Response to disaster has always been focused on the local emergency management level. When local resources are committed to response, the State has the responsibility to assist the local responders to overcome shortfalls. When State resources are fully committed or estimated to be exhausted, requests are made to the Federal government to alleviate the State's shortfall, as well as that of the local government units. One method to increase the likelihood of rapid response and recovery is to anticipate suspected shortfalls and plan to obtain these resources from other States or the Federal government. *Communication* is essential in coordinating rapid response between the various levels of government.

Implementation
The State of Missouri needs to work closely with the Federal Emergency Management Agency at regional and national levels to coordinate policies and plans that will allow rapid deployment of Federal and other States' resources. Planning efforts at the FEMA regional level should be encouraged with pre-designated deployments of essential personnel to work with the State in the earliest stages of the disaster. Additional planning efforts on the essential Emergency Support Functions (ESFs) of the National Response Plan (NRP) between Federal and State representatives should be continued under the FEMA Region VII Regional Interagency Steering Committee program. This will allow the FEMA representatives to meet with their state counterparts and familiarize the Federal representatives with the operational procedures within the State. In turn, this will provide for FEMA sponsored resources to supplement (not supplant) existing State resources and allocations.

Other important facets of emergency management are interstate compacts that are currently being passed between various states under the aegis of the Emergency Management Assistance Compact (EMAC). EMAC will allow recipient states to interchange and accept resources from states outside the affected areas of the earthquake. Resources will be requested from donor states as required by the states in need. The States not affected by the disaster should be familiar with the concept of operations used by the requesting states in order to streamline the request process to avoid confusion and duplication of requests. These discussions can be carried out through the Regional Interagency Steering Committee (RISC) program as well as through coordination with CUSEC and its constituent members.

Furthermore, local government units need to have input into this process through local emergency operations and recovery plans. The local government units are the ones facing the brunt of emergency operations. They need to examine their shortfalls for response (and recovery), prioritize requests for assistance, and avoid making duplicate requests. Input from the local government units may be gathered in several ways: through an Area Coordinator system, from the annual SEMA/MEPA Conference and through the State's emergency exercise program.

Responsible Agencies:
State Emergency Management Agency (SEMA) - Planning Section
Federal Emergency Management Agency (FEMA)
Other Federal Agencies
Central United States Earthquake Consortium (CUSEC)
Local governments (particularly Emergency Management)
State agencies (with emergency response and recovery functions)

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 4.6

STRATEGY:

Support identification of facilities and methods for disposal of uncontaminated debris and hazardous materials as the result of an earthquake.

ACTION:

Prepare a plan for disposal of hazardous materials, contaminated and uncontaminated debris.

RESULT:

Coordination will result in improved and efficient, coordinated disposal of hazardous materials and uncontaminated debris.

Background
Following an earthquake, large quantities of debris, both contaminated and uncontaminated, will need to be removed from disaster sites for disposal. The volume of material will possibly be more than local landfills or approved hazardous disposal facilities can handle in an efficient, timely manner.

Implementation
Develop debris disposal plans that address the potential for large volumes of expected uncontaminated and non-hazardous debris and the special handling and disposal for contaminated and hazardous debris.

Responsible Agencies:
Local Emergency Planning Committees
Missouri Emergency Response Commission (MERC)
State Emergency Management Agency (SEMA)
Missouri Department of Natural Resources (DNR)
Division of Fire Safety (DFS)
Local Fire Departments
Environmental Protection Agency

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 4.7

STRATEGY:

Support crisis counseling to individuals after an earthquake.

ACTION:

Encourage the development of a network of trained counselors who will respond to and provide counseling.

RESULT:

Residents, particularly children, will be able to understand and cope with the emotional trauma following an earthquake.

Background
As the lead agency responsible for planning and coordinating disaster mental health response with public and private agencies, DMH has developed an All-Hazards Emergency Operations Plan located at http://www.dmh.mo.gov/diroffice/disaster/disaster.htm on the DMH website. The plan is consistent with federal guidance and was developed to provide specific operational guidance in activating disaster mental health services as one of many components included in Annex K, Health and Medical of the SEOP for which the Department of Health and Senior Services is the lead.

The Department of Mental Health coordinates the state mental health response when a disaster or terrorism event occurs through the local community mental health centers and Voluntary Organizations Active in Disaster. The Department also has the responsibility to apply for the FEMA Crisis Counseling Immediate Services Grant (ISG) and/or Regular Services Grant (RSG) when there is a Federal declaration for individual assistance. The State Emergency Management Agency serves as the GAO in the ISG while DMH serves as the GAO in an RSG. DMH also provides psychological first aid training throughout the state for health care providers, schools, and first responders.

Implementation
DMH will continue to work with community agencies to coordinate the mental health response and to provide training in psychological first aid.

Responsible Agencies:
State Emergency Management Agency
Department of Mental Health
Department of Health and Senior Services

Revision: June 13, 2007

Missouri Seismic Safety Commission - Strategy 4.8

STRATEGY:

Enhance ability to provide crisis counseling to individuals in affected areas.

ACTION:

Coordinate the disaster mental health response when a disaster occurs

RESULT:

Residents, particularly children, will be able to understand and cope with the emotional impact following an earthquake.

Background
As the lead agency responsible for planning and coordinating disaster mental health response with public and private agencies, DMH has developed an All-Hazards Emergency Operations Plan located at http://www.dmh.mo.gov/diroffice/disaster/disaster.htm on the DMH website. The plan is consistent with federal guidance and was developed to provide specific operational guidance in activating disaster mental health services as one of many components included in Annex K, Health and Medical of the SEOP for which the Department of Health and Senior Services is the lead.

The Department of Mental Health coordinates the state mental health response when a disaster or terrorism event occurs through the local community mental health centers and Voluntary Organizations Active in Disaster. The Department also has the responsibility to apply for the FEMA Crisis Counseling Immediate Services Grant (ISG) and/or Regular Services Grant (RSG) when there is a Federal declaration for individual assistance. The State Emergency Management Agency serves as the GAO in the ISG while DMH serves as the GAO in an RSG. DMH also provides psychological first aid training throughout the state for health care providers, schools, and first responders.

Implementation
DMH will continue to work with community agencies to coordinate the mental health response and to provide training in psychological first aid.

Responsible Agencies:
State Emergency Management Agency
Department of Mental Health
Department of Health and Senior Services

Revision: June 13, 2007

Objective 5: Assess Earthquake Hazards

Readiness for an earthquake requires basic knowledge about expected earthquake locations and the effects of local site conditions on shaking, as well as rapid notification of their occurrence.

Strategy	Action	Result
5.1 Map and identify natural geologic hazards. Support of additional state and federal funding is needed.	Complete earthquake hazard maps of counties subject to damage by earthquake shaking. Support the St. Louis Area Earthquake Hazard Mapping program.	Hazard mapping will provide a single, uniform source to identify Missouri's geologic hazards. Mapping furnishes several products: planning material for response and recovery, input to HAZUS, and data for engineering assessments.
5.2 Support the continuing development of generalized soil profile parameters for ground-shaking analyses. Develop data exchange standards.	Recommend generalized soil profiles for ground-motion hazards analyses. Note the proper range of soil and rock parameters for the region.	Analytical modeling of ground shaking through generalized soil profiles permits improved assessment of Missouri's property hazards and risk appraisal, when combined with local hazard maps.
5.3 Support the current geoscience response team that identifies and evaluates post-earthquake effects. Support preparatory DGLS training.	Investigate landform changes promptly following the causative earthquake. Conduct geoscience teams' investigations concurrent with engineering and response teams. The geoscience material will be basic input for future hazards from aftershocks and/or later damaging earthquakes.	Areas affected by earthquake induced landform changes will be identified to assist recovery efforts and to evaluate post-earthquake land use risks.
5.4 Support earthquake-hazard studies.	Varied scientific, professional and governmental agencies are committed to assessing the earthquake threats to Missouri, for example the New Madrid Earthquake Scenario by late 2011.	The New Madrid Earthquake Scenario will provide realistic hazard data and direct engineering/scientific information to user communities of eastern and southeastern Missouri.

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 5.1

STRATEGY:

Map and identify natural geologic hazards. Support of additional state and federal funding is needed.

ACTION:

Complete earthquake hazard maps of counties subject to damage by earthquake shaking. Support the St. Louis Area Earthquake Hazard Mapping program.

RESULT:

Hazard mapping will provide a single, uniform source to identify Missouri's geologic hazards. Mapping furnishes several products: planning material for response and recovery, input to HAZUS, data for engineering assessments.

Background

Regional scale and generalized earthquake hazards maps have been completed for much of southeastern Missouri. These maps use limited geologic map data to classify potential earthquake damage caused by shaking or liquefaction. The most recent regional map covers an area from Sikeston to Caruthersville (1999) at a scale of 1:100,000. Larger scale maps at 1:24,000 scale maps have also been prepared for the Cape Girardeau (2001) and for the Poplar Bluff (2004) 7.5-minute quadrangles by the Division of Geology and Land Survey (DGLS). The purpose of these maps is to inform the general population and various (business, emergency and government) communities of potential earthquake impacts and hazards. These maps are not intended to be used for site-specific analysis of an individual location, but have more detail for general use than previous maps, and classify earthquake hazard potential using the 1997 National Earthquake Hazard Reduction Program (NEHRP) site-soil classification system.

A regional hazard mapping project has been initiated (2003) for the St. Louis Metropolitan region. The project is known as the St. Louis Area Earthquake Hazard Mapping (SLAEHM) Project and is a joint effort involving the United States Geological Survey (USGS), the DGLS, the Illinois Geological Survey, University of Missouri-Rolla Natural Hazards Mitigation Institute, St. Louis University, and has a number of private and public cooperators. The goal of the mapping project is to identify potential earthquake hazards in twenty-two 7.5-minute 1:24000 scale quadrangles in St. Louis, St. Louis City, northern Jefferson and southern St. Charles counties, and a number of quadrangles. Hazard mapping is a multiphase process that begins with surficial material geologic maps that incorporate engineering soils data, and culminates in maps that shows areas that have soils likely to liquefy or amplify ground motion during an earthquake. In the St. Louis, Missouri region detailed surficial material maps are not completed. A number of quadrangles in the Illinois portion of the metropolitan region have already been mapped by the Illinois Geological Survey. An engineering soils database has been compiled from a fraction of the publicly available boring records for hazard mapping in the Missouri portion of the St. Louis Metropolitan region, as part of the SLAEHMP hazard mapping project.

Classification of earthen materials to identify shaking susceptibility should utilize the 1997 NEHRP site soil classification system, as a means to address local effects of earthquake shaking and other seismic hazards. This site soil classification (differing substantially from agricultural soil classification) considers the physical or engineering characteristics of any unconsolidated natural material in the classification. The NEHRP 1997 system is used with the 2003 International Building Code (IBC 2003) to address seismic design criteria related to site soil characteristics. A number of Missouri municipalities have adopted the IBC 2003 codes including seismic design criteria, but lack the resources to compile engineering soils data for planning purposes or hazard evaluation. Hazard map data that incorporates site soil classification analysis is already needed by these communities to evaluate seismic design needs for existing or new construction.

Legislation established by the Missouri General Assembly and individual legislators' interest has given much encouragement to earthquake investigations. Mapping efforts have been supported in part by FEMA/SEMA and the NEHRP in coordination with CUSEC. However, data and mapping costs remain as a significant issue if earthquake hazard mapping will progress to meet urban area needs in a timely fashion and with sufficient detail.

Private and government infrastructure losses occur due to natural geologic hazards. Geologic hazards can be identified and mapped for the benefit of communities in advance of the earthquake. Local governments, when informed of risk-based losses, are in a position to guide land use in a manner compatible with the geologic hazards. Flooding and landslides are frequent reminders of losses from imprudent land use. Earthquakes present the greatest loss potential to life, injury and economic welfare in the state. Potential destruction can be reduced by prudent land use. Costs associated with identifying and making known geologic-hazard areas are repaid many times over in reduced financial and personal injury losses to a community. Hazard mapping identifies the best sites for new structures, aids in evaluating of existing buildings, and allows assessment of development programs for other land uses.

With the natural hazard information provided, property developers, land owners, and local governments are able to assess the best use of property. Many potential hazards, if recognized, require minimum precautions to avoid later property damage and life risk. Without such information, serious property damage and other risk conditions will develop that otherwise could have been avoided.

Hazard maps would enable local and state governments to better guide land use and would contribute to long term cost reductions to the government, as well as to the private sector.

Incentives could be offered to local governments for encouraging hazard recognition.

Implementation
Completed maps have been widely requested and distributed by the thousands.

Completion dates for maps at 1:100,000 scale to include all of eastern and southeastern Missouri extend beyond the year 2010. While two 1:24,000 scale maps have been produced, there is a great need to produce additional 1:24,000 scale maps for urban areas or smaller Missouri communities. These detailed maps are needed for accurate application of building codes, which have been adopted by a number of municipalities in Missouri. Additional funding is needed for realistic completion dates.

Legislation or reward-based State policy should encourage local governments to adopt geologic-hazard ordinances. Local governments need technical assistance, ordinances and enforcement model programs for their use. Legislation is necessary to require geologic hazard mapping for those types of facilities that affect the general public and to enable local governments and others to require such maps when deemed appropriate locally.

Responsible Agencies:
Division of Geology and Land Survey, Department of Natural Resources (DGLS-DNR)
County Governments
State Emergency Management Agency, Department of Public Safety (SEMA-DPS)

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 5.2

STRATEGY:

Support the continuing development of generalized soil profile parameters for ground-shaking analyses. Develop data exchange standards.

ACTION:

Recommend generalized soil profiles for ground-motion hazards analyses. Note the proper range of soil and rock parameters for the region.

RESULT:

Analytical modeling of ground shaking through generalized soil profiles permits improved assessment of Missouri's property hazards and risk appraisal, when combined with local hazard maps.

Background

Earthquake hazard maps with geologic emphasis, including one for the greater St. Louis area (1995) at a scale of 1:100,000, focus on broad scale geologic properties that indicate hazard, e.g., likelihood for liquefaction and or landslide. Hazard assessment requires knowledge of how local geological properties affect expected ground motions. This can be done by defining generic soil property profiles in the state and using them in computer models to predict local effects. One site soil classification system has been developed through the National Earthquake Hazard Reduction Program (NEHRP) and is the basis for seismic design building codes in a number of Missouri municipalities.

> (The NEHRP 1997 site soil classification system has been implemented as part of the 2003 International Building Code to address seismic design criteria related to site soil characteristics. The site soil classification and guidance procedures are described in the two publications below.
>
> FEMA (1998a). 1997 Edition: NEHRP Recommended Provisions for Seismic Regulation for New Buildings, Part 1 - *Provisions*. Published by the Federal Emergency Management Agency (FEMA), as FEMA # 302, Washington DC
>
> FEMA (1998b). 1997 Edition: NEHRP Recommended Provisions for Seismic Regulation for New Buildings, Part 2 - *Commentary*. Published by the Federal Emergency Management Agency (FEMA), as FEMA # 303, Washington DC)

Because a standardized site soil classification exists as part of recent model building codes, this action helps local officials evaluate seismic design criteria associated with existing or new structures. Further, the proper modeling of soils better refines risk models, such as HAZUS.

The professional community has powerful procedures for evaluating potential ground motion at a site. Such investigations are expensive for sitting, planning and preliminary design, because extensive site information resulting from borings, soil testing and geophysical investigation is required. On the other hand, development of generalized soil profiles would quantitatively assist in hazard assessment when combined with the geologic hazard mapping and expected ground motion overlays.

Implementation
Create generalized soil models for specific counties or hazard maps. Generalized soil profiles would allow design software to initially assess sites before the expense of the necessary field testing and structural design phase. The resulting initial guidance would clarify the economic considerations for planning, site selection and development. Generalized soil profiles could be augmented with site specific data to refine ground shaking parameters for evaluation of existing or future structures. Knowledge of local site conditions permits realistic assessment of damage potential of existing structures.

Several resources would be brought together to develop generalized soil models. The DGLS has the professional capability to define the generalized soil profiles. State agencies, consulting firms and professional societies possess soil and rock information and Federal agencies have data bases of soil and rock properties, including shear wave velocities. A programmatic approach to soil profiles should be developed for their use with either 1:100,000 or 1:24,000 scale hazard mapping.

Responsible Agencies:
State Emergency Management Agency, Department of Public Safety (SEMA-DPS)
Division of Geology and Land Survey, Department of Natural Resources (DGLSDNR)

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 5.3

STRATEGY:

Support the current geoscience response team that identifies and evaluates post-earthquake effects. Support preparatory DGLS training.

ACTION:

Investigate landform changes promptly following the causative earthquake. Conduct geoscience teams' investigations concurrent with engineering and response teams. The geoscience material will be basic input for future hazards from aftershocks and/or later damaging earthquakes.

RESULT:

Areas affected by earthquake-induced landform changes will be identified to assist recovery efforts and to evaluate post-earthquake land use risks.

Background

Earthquakes sometimes affect the earth's surface by uplifting, down warping, or tilting large areas; during some large earthquakes surface fault rupture occurs. Liquefaction (when surface materials behave as a liquid as a result of ground shaking) occurs during moderate to large earthquakes, and may affect large areas. Sand boils and sand fissures sometimes occur during moderate to large earthquakes. Landslides and/or lateral spreading may occur on slopes of as little as 1 to 2 degrees. A damaging earthquake will impact any built structure, including levees, roadways, transmission lines and towers and many natural landforms. Municipal and industrial facility operation would obviously be impacted by the land surface affects of a damaging earthquake.

During the 1811-1812 earthquake series, large areas in southeastern Missouri became flooded as a result of soil liquefaction and ground subsidence and the collapse of riverbanks. The earthquakes also caused a large number of landslides around the region and local surface tilting. Similar surface effects can be expected in areas prone to liquefaction or landslides especially the areas affected by the 1811-1812 earthquakes. Earthquake-induced land disturbance has the potential to affect water quality and quantity due to damage of water supply or treatment facilities. Strong ground motion or earthquake induced landslides could lead to groundwater or surface water contamination from damaged waste treatment or industrial sites. Subsidence and liquefaction would damage if not entirely collapse bootheel area drainage canals, impounding surface water and causing local flooding. Roadways in some areas will subside or flood due to local subsidence, hampering emergency recovery and relief operations.

There is high risk for changes to natural and man-made drainage systems due to wide-spread uplift, downward tilting and local settling in the lowlands of southeast Missouri, which includes the most likely epicentral areas for large earthquakes in the New Madrid Seismic Zone. This area is extremely flat lying, sometimes having less than one foot of relief over several miles. During the 1811-1812 series of earthquakes, uplift, down warping, and tilting of up to 10 feet or more occurred over hundreds of square miles Southeast Missouri, including all or parts of Dunklin, Pemiscot, New Madrid, Mississippi, Stoddard, Scott, Butler, Bollinger, and Cape Girardeau counties, is highly developed agriculturally and includes some of the most productive agricultural land in Missouri and the nation.

The economic significance of this manmade drainage network can not be overstated. Agricultural development has only been possible within the last century because of the construction of this series of man-made drainage systems. Prior to this, the area was often saturated to the point of having standing water at the surface. These man-made drainage systems, including some in northeast Arkansas, have been developed and administered by several private drainage districts. All have been "cooperatively engineered" --- that is, the channels and ditches have been designed and installed to most effectively drain excess water from the land and deliver it ultimately to the Mississippi and St. Francis Rivers. The channels cross drainage district borders as well as state boundaries.

On a smaller scale, there are hundreds of municipal water distribution and wastewater collection systems in southeast Missouri that may also be adversely affected by earthquake-induced uplift, down warp, or tilting.

Implementation

The geoscience response team would document all observable landform change and damage, such as landslides, liquefaction features, sand blows, fissures, water course changes and flooding, and other earthquake-induced effects. The report generated by the team will present essential information for emergency response and post-earthquake recovery work, and for short- and long-term preparedness and mitigation planning.

No training or team mobilization trial runs for a geoscience response team have been implemented in Missouri although the DGLS has developed an operational plan, including designated geologists, needed equipment, mobilization and other immediate-response activities. Lack of funding and scheduling has prevented training implementation. Sufficient numbers of people must be trained because not all team members will be available and because the smallest team size is three persons for safety reasons. While one team may suffice for a small event, several teams may be required for even a moderate earthquake. Funding and experienced USGS direct staff support are essential requirements for training. The teams should consist of geoscience, geotechnical, lifeline and highway professionals.

Clearinghouses allow access to, and sharing of data between, varied academic and governmental and professional organizations for diverse field studies. The CUSEC State Geologists are supportive of the establishment of Clearinghouses following an earthquake. This subject geoscience response investigation is a field study that does not limit, and may be coordinated with, a Clearinghouse.

Responsible Agencies:
Division of Geology and Land Survey, Department of Natural Resources (DGLSDNR)
U. S. Geological Survey (USGS)
Other State and Federal agencies

Last Changed March 9, 2007

Missouri Seismic Safety Commission - Strategy 5.4

STRATEGY:

Support earthquake-hazard studies.

ACTION:

Varied scientific, professional and governmental agencies are committed to assessing the earthquake threats to Missouri, for example the New Madrid Earthquake Scenario by late 2011.

RESULT:

The New Madrid Earthquake Scenario will provide realistic hazard data and direct engineering/scientific information to user communities of eastern and south-eastern Missouri.

Background
Broad earthquake-hazard studies, like the New Madrid Earthquake Scenario, are important to the Midwest. The scientific, engineering and response communities have approximately five years to complete a New Madrid Earthquake Scenario. We trust that these communities will be composed of members of private industry, academia, federal, state and local governments, utilities, and relief organizations. The New Madrid Chapter of the Earthquake Engineering Research Institute is organizing the scenario effort.

Implementation
The purpose of the scenario will be to demonstrate with recent research in quantitative studies, appendices of various input, and general narratives the scope of a New Madrid event. Depending upon the direction chosen and the participants involved, products of the scenario would be: hypothetical time-histories of New Madrid event for a few participating cities, towns and counties; impacts upon various structures including important response structures (police and fire houses, hospitals), residential construction, office and public buildings; transportation network failures; lifelines and utilities (electric, phone, sewer, water) consequences; public communication serviceability during and immediately after the earthquake; immediate responses issues (HAZUS runs); mid-term response needs; and, (long-term) recovery assessments.

There have been earthquake scenarios produced for the Hayward Fault in California and the Seattle, Washington area. Guidelines for scenarios have been published. These published reports will be used to their fullest. The scope of the New Madrid Earthquake Scenario will depend upon the participants involved, acceptance of desirable scenario products, and agreement to meet some timelines for those products. HAZUS software, for example, is dependent upon the quality of the time history information, the spatial change of site soil conditions above rock, and the structural inventory of the community. Thus, runs of HAZUS are dependent upon already having the site soil conditions and time histories, and, at least, general information on the structural inventory and some infrastructure and economic data.

The benefit of the completed scenario are: the application of the most recent research, the availability to the engineering community procedural computations, impacts to existing lifelines so that upgrades may be made, invigoration of the response community with sufficient data for productive assessment, and basic understanding for the general populace of the real earthquake threat. Engineers in the region would have information to improve their standards of practice for earthquake risk. Lifeline agencies, utilities and government offices could comprehend the likely results of a seismic event, and could work to resolve both short-term and permanent solutions. The response communities will have a model of the impacts affecting the region. The impacts may be compared to past west-coast events in severity and areal damage to obtain an understanding of the losses, resources for response, and sociological and built-environment needs of the damaged communities in recovery.

Responsible Agencies:
New Madrid Chapter of the Earthquake Engineering Research Institute
(While no agencies have as yet made formal commitments, the partnership of participating organizations is hoped to be broad and diverse.)

Last Changed March 9, 2007

Missouri Statutes Related to Earthquakes (as of 2007)

The purpose of this tabulation is to highlight progress that Missouri has made in addressing the earthquake problem through legislation.

Statute Number	Date Approved	Revised	Description
44.023	1991	2002	Earthquake and natural disaster volunteer program established, agency's duties--expenses—immunity from liability, exception
44.225	1993		Shall be known as the "Seismic Safety Commission Act".
44.227	1993	1995	Commission on seismic safety created
44.229	1993		Commission's powers
44.231	1993		Program to prepare state for responding to a major earthquake, Commission's duty to establish
44.233	1993		Duties of commission
44.235	1993		Review and advisory powers of commission
44.237		2007	Repealed; Senate Bill 613
70.837	1992		Emergencies--public safety agencies may provide aid to public safety agencies in state and bordering states
160.451	1990		Earthquake emergency system to be established for certain school districts
160.453	1990		Requirements for emergency system - public inspection of system authorized
160.455	1990		Distribution to each student certain materials on earthquake safety – duties of school district
160.457	1990		School districts may elect to adopt certain provisions of earthquake emergency program
256.155	1989	1992	Interstate earthquake emergency compact
256.010	1939	1961	State Geologist Appointment;
256.170	1990		Geologic Hazard Assessment
256.173	1990		Cities and counties to be furnished geologic hazard assessment
256.175	1990		Notice to cities and counties subject to earthquake to adopt
319.200	1990	1996	Seismic construction and Rennovation ordinances
319.207	1990		Noncompliance to affect eligibility for state aid, loans, grants
320.090	1990	1996	Mutual Aid Agreements
379.975	1992		Earthquake Insurance

379.978	1992		Written disaster plan, insurer to develop
380.261	1984	1989	Kinds of insurance company may make

Glossary

Acronyms

AIA-American Institute of Architects

ASCE-American Society of Civil Engineers

BOMA-Building Owners and Managers Association

Bootheel-Southeastern corner of the State of Missouri; so named because of its shape.

CECMo-Consulting Engineers Council of Missouri

CERT-Community Emergency Response Teams

CSR-Code of State Regulations (Missouri)

CUSEC-Central United States Earthquake Consortium

DGLS-Division of Geology and Land Survey

DNR-Department of Natural Resources

DPS-Department of Public Safety

EERI-Earthquake Engineering Research Institute

EMAC-Emergency Management Assistance Compact

ESFs-Emergency Support Functions (see FRP)

FEMA-Federal Emergency Management Agency

IBC- International Building Code

ISTEA - Intermodal Surface Transportation Efficiency Act

LEPC-Local Emergency Planning Commissions

LEPCs-Local Emergency Planning Commissions

MEPA-Missouri Emergency Preparedness Association

MFDA-Missouri Funeral Directors Association

MFDADRT-Missouri Funeral Directors Association Disaster Response Team

MIRMA-Missouri Intergovernmental Risk Management Association

MML-Missouri Municipal League

MoDOT-Missouri Department of Transportation

MSPE-Missouri Society of Professional Engineers

MSSC-Missouri Seismic Safety Commission

Mercalli-Qualitative effects of earthquake damage

NEHRP-National Earthquake Hazard Reduction Program

NRP- National Response Plan (formerly FRP, Federal Response Plan)

PSC- Public Service Commission

RISC-Regional Interagency Steering Committee (see FEMA)

SAVE-Structural Assessment and Visual Evaluation

SEMA-State Emergency Management Agency

US&R-Urban Search and Rescue

USGS-U. S. Geological Survey

USSC-Utah Seismic Safety Commission

Definitions

Epicenter - the point on the earth's surface vertically above the hypocenter (or focus), point in the crust where a seismic rupture begins.

Fault- a fracture along which the blocks of crust on either side have moved relative to one another parallel to the fracture.

Ground motion- the movement of the earth's surface from earthquakes or explosions. It is produced by waves that are generated by sudden slip on a fault or sudden pressure at the explosive source and travel through the earth and along its surface

Hazard- an act or phenomenon that has the potential to produce harm or other undesirable consequences to people or objects.

Hazardous structure - a structure whose condition creates an imminent danger of physical injury, harm or damage to people or objects within or nearby.

Liquefaction- the process by which water-saturated sediment temporarily loses strength and acts as a fluid. This effect can be caused by earthquake shaking.

Non-structural hazard - a condition or phenomenon in a structure that is unrelated to the structural system but which has the potential to produce harm or other negative consequences to people or objects within or nearby. Examples include non-load-bearing architectural elements and mechanical and electrical components of the building system.

Risk - the probability that the potential harm or negative consequences of a hazard will be realized. This is the combination of the underlying hazard and vulnerability.

Seismic zone- an area of seismicity probably sharing a common cause. Example: "The New Madrid Seismic Zone."

Structural hazard - a structural condition in a structure that has the potential to produce harm or other negative effects on people or objects within or nearby. This is due to the failure of the structure to withstand the vertical gravity loads or lateral seismic forces acting on the structure.

Vulnerability - susceptibility to injury, harm, damage or economic loss.

Last Changed 10/01/07

Missouri Sources of Information

Information on earthquake mitigation/preparedness/response

State Emergency Management Agency
Attn: Earthquake Program Manager
P. O. Box 116
Jefferson City, Missouri 65102-0116
573/526-9232
http://sema.dps.mo.gov/semapage.htm

Information on recent earthquake locations

Earthquake Center
Saint Louis University
3507 Laclede Avenue
St. Louis, Missouri 63103
314/977-2236
http://www.eas.slu.edu/Earthquake_Center/

Maps and hazard information

Department of Natural Resources
Division of Geology and Land Survey
P. O. Box 250
Rolla, Missouri 65401-0250
573/368-2100
http://www.dnr.mo.gov/geology/index.html

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