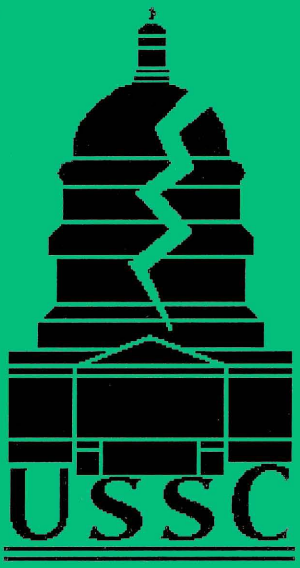
EARTHQUAKE SAFETY IN UTAH



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UTAH SEISMIC SAFETY COMMISSION

for the Period July 1, 1996, to December 31, 1999

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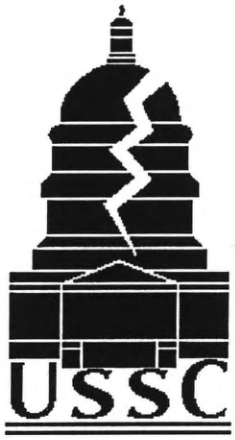

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For the Commission and its Staff

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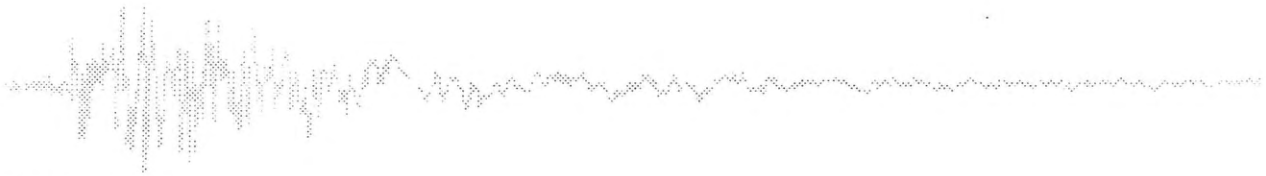

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Executive Summary

Since the implementation of a Strategic Plan in 1995 and the adoption of guiding principles, the Utah Seismic Safety Commission (USSC) has aggressively moved toward fulfilling its ultimate goal: making Utah a safer place to live. This report documents the many and varied activities related to this goal, either initiated, planned and executed, influenced, or engaged in by the USSC and its Standing Committees during the 42-month period ending on December 31, 1999. Activities prior to July 1, 1996, are documented in a progress report issued by the USSC in November 1996.

This report also details the results of a survey on earthquake awareness issues. The survey, which supplements an earlier survey summarized in the 1996 progress report, was sent to counties, cities, and organizations throughout the state. The latest survey was intended to clearly delineate the implementation of earthquake-related regulations, enforcement activities, reviews, educational practices, and mitigation efforts in Utah by private and governmental entities, and to rank those entities according to the priorities each placed on its individual commitment to earthquake safety. Generally speaking, the survey shows that the larger the entity, public or private, the higher the priority given to the concept of seismic safety. The survey also shows specifically and clearly where more effort on the part of the USSC is needed.

The USSC maintains Standing Committees to assist in the performance of its duties. Through these Standing Committees, the USSC achieved several accomplishments:

The Awareness and Education Standing Committee planned and hosted three conferences on earthquake awareness. The Schools Subcommittee conducted a survey *(appendix A)* of the state's school districts as part of the Prepared Schools Project, an effort to assist schools in achieving the highest levels of disaster preparedness. Schools that comply with the mandates of the project earn incentives on casualty insurance premiums through the Utah Division of Risk Management.

Because of overlapping areas of responsibility and activities, the Emergency Management Standing Committee merged at the end of the 1999 fiscal year with the Awareness and Education Standing Committee. Prior to that, Emergency Management, with the involvement of the Division of Comprehensive Emergency Management (CEM), began coordinating Hazards United States (HAZUS) training for communities and organizations throughout Utah and continues training Community Emergency Response Teams (CERT).

The Engineering and Architecture Standing Committee, supported by the Structural Engineers Association of Utah (SEAU), supported adoption of effective building codes and stricter enforcement of existing codes.

The Geoscience Standing Committee, supported by the Utah Geological Survey (UGS), assessed local government needs for geoscience information and promoted the purchase and installation of real-time earthquake-monitoring and strong-motion instrumentation.

The Lifelines and Infrastructure Standing Committee is in the process of compiling a comprehensive inventory of statewide lifelines for use by emergency managers. This committee is also beginning the task of addressing the issue of collocation of utilities, a nearly universal practice by planners and engineers that tends to magnify the damage caused to lifelines during earthquakes.

Because the USSC is an advisory organization, it depends mainly upon CEM, the UGS, and the University of Utah Seismic Stations (UUSS), to carry out its initiatives. In addition to lending staff support to the USSC, CEM works closely with the Federal Emergency Management Administration (FEMA) in the areas of earthquake preparedness, mitigation, and recovery; the UGS conducts seismic hazards studies with funding from the National Earthquake Hazards Reduction Program (NEHRP); and the UUSS is developing pilot programs in real-time earthquake instrumentation in Salt Lake City with the help of a grant from the U. S. Department of the Interior.

The State of Utah, thanks to the efforts and quality leadership of private and public organi-

zations, continues to make enormous strides in its goal to insure the continued well-being of its people and places in the event of natural disasters. Awareness of the state's unique earthquake hazard has never been higher, but the sobering fact is that each year without a major seismic event is merely one more year down the road to the inevitable. Preparation is the only salvation.

Introduction

Any discussion of earthquake hazards in Utah necessarily involves an excursion into the abstract; although Utah has experienced several moderate earthquakes in its history, there has not been a major event along the Wasatch Front in modern times. With the help of the HAZUS database, however, there are real numbers to help actualize the on-going conjecture. HAZUS data, which is rapidly being refined, indicates that a magnitude (M_c) 7.0 earthquake along the Wasatch Front would have a nearly $9 billion impact on the state's economy in terms of damage, homelessness, wages and income loss, injuries, and death. Estimates are that such an event would kill anywhere from several hundred to several thousand people, disrupt lifelines, destroy hospitals and schools, and paralyze the population center of the state — and that is in the context of today's knowledge — and today's behavior. Earthquakes in other seismically active areas of the state also pose an increasingly significant threat as populations grow and development progresses.

Earthquakes can't be prevented, but behavior can be modified to mitigate the impact of such events. As victims in earthquake-ravaged regions in Turkey, China, Taiwan, Japan, and the United States have recently verified, preparedness pays dividends. The USSC aggressively pursues its Strategic Plan *(appendix B)* to improve earthquake safety in Utah, and this Progress Report describes the USSC's activities and accomplishments during the period of July 1, 1996, to December 31, 1999. It also examines how counties, communities, and businesses in Utah view their level of awareness of earthquake safety and the priority they place on earthquake safety, given their seismic risk, and offers an assessment for future initiatives, priorities, and activities.

The first part summarizes the activities and accomplishments of the USSC Standing Committees. The second part is a detailed breakdown of a survey *(appendix C)* sent to 52 of the state's largest employers, all 29 counties, and 112 first-, second-, and third-class cities. The survey creates an earthquake-safety profile of those entities. The third part is a proposal of the USSC's future needs, activities, and plans for further improving earthquake safety in Utah.

The USSC Mission, Objectives, and Guiding Principles

The Utah Seismic Safety Commission (USSC) was created by the 1994 Legislature *(appendix D)* and modified by the 2000 Legislature *(appendix E)* with the ultimate goal of making Utah a safer place to live.

The mission of the USSC is to function as a medium for state and local governments, the private sector, and the public to advance earthquake-related issues by developing, researching, and recommending seismic policies and approaches aimed at reducing Utah's earthquake hazards and managing Utah's earthquake risk.

The USSC will accomplish this mission through the objectives of reviewing earthquake-related hazards and risks in Utah, preparing recommendations to identify and mitigate these hazards and risks, prioritizing recommendations for adoption as policy or loss-reduction strategies, acting as a source of information for earthquake safety and earthquake loss-reduction measures, and updating the strategic planning document and other supporting studies or reports.

In addition, the USSC will abide by these statements as guiding principles:
There is a real and serious danger of both life-threatening and damaging earthquakes in Utah in our lifetime. We as individuals and collectively can take significant actions to reduce the loss of life, property damage, and long-term economic impact of an earthquake. Implementing an earthquake-safety plan for Utah is a long-term process. Strategies to safeguard lives and property from earthquakes must be sensitive to financial and regulatory burdens. Many actions can be taken now, without great expense, that will make Utah safer tomorrow.

The Standing Committees

The Strategic Plan *(appendix B)*, published in January 1995, served as a call to action for the hazards awareness community in Utah and created a list of strategies to implement. This section of the Progress Report will examine each USSC Standing Committee and relate its efforts to transform that call to action into meaningful activities and accomplishments.

The Awareness and Education Standing Committee (AESC)

focused its efforts on businesses and schools. It sponsored and hosted three earthquake awareness conferences, surveyed public and private schools around the state to determine their level of awareness and preparedness, and began implementing the Prepared Schools Program.

At the first conference, "Earthquakes in Utah: Will Your Business Survive?" the committee made the Strategic Plan an integral part of the curriculum. The conference attracted more than 200 participants to the State Office Building and presented Utah business people with the hard facts and the sobering realities of earthquake vulnerabilities.

The conference featured a scenario presentation and panel discussion on what would happen if a M_c 6.7 earthquake struck Salt Lake City. Representatives from county government, emergency response agencies, insurance and financial institutions, engineering and construction industries, and public utilities discussed possible ways the earthquake would affect them the day of the event as well as one week, one month, and one year later. The conference-goers were left with an encouraging message: preparation saves lives, jobs, and businesses.

Breakout sessions focused on mitigation, emergency response, business recovery, and workplace and home preparedness. Attendees viewed video footage of earthquake damage resulting from the 1994 Northridge, California, event; heard detailed information on building construction for earthquake safety; received tips on how large and small companies address earthquake problems; and picked up tips on making their homes earthquake safe.

The conference concluded with a presentation of the USSC Strategic Plan and the reminder that the initiative for improving earthquake safety usually comes from private groups and local governments.

As part of the conference, Lt. Governor Olene Walker presented the first USSC Earthquake Safety in Utah Awards, one certificate for outstanding contributions and three certificates of excellence. The *Salt Lake Tribune* and its Science Writer, Lee Siegel, received the first award. The citation noted that the morning daily reported on earthquake-related activities in Utah and made an important contribution to increasing awareness and promoting earthquake safety among Utah's citizens, businesses, and decision-makers. Siegel spearheaded the reporting of earthquake issues, and his editors featured those reports and other earthquake-related articles prominently and supported earthquake safety.

Strategies addressed by the Awareness and Education Standing Committee

- *1.1 — Inform citizens about earthquake hazards and risks*
- *1.2 — Incorporate earthquake education in school curricula*
- *3.3 — Improve the post-earthquake operational status of essential service buildings*
- *3.6 — Improve safety and operation ability of older public school buildings*
- *5.1 — Update estimates of direct losses to be expected from earthquakes*
- *5.2 — Evaluate the indirect losses associated with earthquakes*

The first Certificate of Excellence was awarded to Brigham Young University for its comprehensive campus-wide and community-wide earthquake safety efforts, including (1) providing earthquake awareness and preparedness information to all students and staff, (2) providing CERT training for 118 employees, (3) developing an emergency communications system and comprehensive disaster-response plan, (4) maintaining 72-hour food and water supplies for all students, and (5) creating an on-going seismic upgrade plan for existing facilities.

The second Certificate went to the Salt Lake City School District for its pioneering efforts and initiative in upgrading older schools and improving earthquake safety. The district was the first in Utah to commission a district-wide evaluation of its buildings. Based on those findings, the district implemented a plan to retrofit and replace the schools that need upgrading.

The third Certificate went to Hyde Park City for involving its community in disaster planning, providing CERT instruction, held mock disaster exercises, replaced or relocated city offices and water-system components to safer structures and locations, and included seismic hazards in its master plan and zoning ordinances.

The AESC followed up a year later with another successful conference, "Earthquakes: Mean Business." The emphasis for this conference was on business survivability issues, and the 1994 Northridge, California, earthquake served as a research model for a team of researchers who interviewed business owners one and two years after the event. Business representatives discussed the components of a recovery plan, including the ability to:

- Respond to the new market dynamic by changing strategy and tactics, while being realistic in assessing capabilities and options. If a new location is called for, for instance, do it without delay and get the word out; do not simply wait for customers to return.
- Maintain adequate cash reserves and insurance to cover potential damage.
- Know the terms of the lease and the responsibilities contained in it.
- Prepare for recovery delays; it takes time to restore infrastructure and community services.
- Take the extra steps needed to protect business records, both paper and electronic copy.

The message to businesses was clear: think about more than just bricks and mortar. For businesses to survive an earthquake, structural mitigation efforts must be met with management mitigation techniques.

The 1997 symposium also offered breakout sessions on the "employee lifeguard" program for remaining in business in spite of an earthquake, legal liability and insurance issues for employers, business and home preparedness measures, emergency response training, and workplace preparedness and survival techniques. More than 150 business leaders and government officials from the Wasatch Front attended.

Two organizations were recognized for their mitigation efforts. The USSC gave its Award for Outstanding Contributions to Earthquake Safety in Utah to Mountain Fuel Supply Company for its efforts to provide awareness and safety information to all its employees and customers. Mountain Fuel conducts company-wide earthquake response exercises, is involved in a long-term program to upgrade its lines and facilities to improve earthquake resistance, and exceeds building code requirements in its new facilities.

The Utah Department of Transportation received the Certificate of Excellence for implementing a state-of-the-art seismic design of the Interstate 15 reconstruction project. The criteria exceed code requirements and will help ensure survival of this critical roadway even in the event of the strongest groung shaking expected.

In 1998, the AESC joined with the ACP in sponsoring a symposium on preparing businesses and communities for surviving an earthquake. Presentations included breakout sessions on "How to Plan: The ABCs of Business Resumption Planning," "Plan Validation: Testing Your Plan in Small-Group Table-Top Demonstrations," and "All Hazards Preparation: A Broad-Scope Workshop on

All Manner of Perils that can Affect Your Community." This conference attracted about 175 risk managers, contingency planners, and emergency preparedness officials from throughout the state.

Also in 1998, the AESC, through its Schools Subcommittee, undertook a survey *(appendix A)* of public and private schools in Utah. The survey was mailed in April 1998 to 731 public school and 102 private school principals. Of that total, 365 public schools (49.9 percent) and 25 private schools (24.5 percent) responded. The purpose of the survey was to learn what has already been done in schools to prepare for emergencies and in what areas help is needed to become better prepared. During the course of the survey, the AESC's School Subcommittee succeeded in gaining Governor Mike Leavitt's endorsement on a proclamation designating April as "Earthquake/Disaster Preparedness Month," which enhanced public awareness of earthquake safety issues.

The responses to the survey indicated that the majority of Utah school principals, both public and private, have an interest in being well prepared for emergencies. Most (94 percent public, 76 percent private) have written plans and all responding schools hold at least one fire drill annually; most (83 percent public, 76 percent private) hold earthquake drills at least once a year, and fewer still (50 percent public, 38 percent private) hold drills for other emergencies at least once a year. Even fewer (48.2 percent public, 40 percent private) have ever evaluated their plans, although most (87.4 percent public, 72 percent private) review it at least once every one-to-three years.

When asked specifically about earthquake risk, the respondents produced fewer positive responses. While most schools identified some or all of the nonstructural hazards, such as furnishings that could fall (77 percent public, 92 percent private), far fewer have in place a plan to mitigate these same hazards (59 percent public, 64 percent private). Many of the responding principals did not know whether their buildings had been inspected by structural engineers for earthquake resistance (64 percent public, 48 percent private).

Public schools usually have Parent-Teacher Associations that are active in safety issues (76 percent), and about half of all responding schools recognized that they could use some help in becoming better prepared. Most wanted help with writing emergency plans (52.5 percent public, 50 percent private) and receiving grade-level specific activity packets (57.2 percent public, 75 percent private). Fewer than half wanted how-to workshops on writing plans, conducting drills and exercises, educating school communities, and identifying and mitigating non-structural hazards (43.1 percent public, 41.6 percent private); or CERT training (45 percent public, 37.5 percent private).

A major concern of the survey was with the preparedness of schools that did not reply. Were they statistically similar to the respondents, or did they choose not to participate in the survey because they had very little — or no — interest in earthquake preparedness issues?

The AESC is now using the schools survey to develop a "Prepared Schools Project," a plan to encourage and aid all schools to become better prepared for emergencies in general and earthquake hazards in particular. The project takes schools incrementally through several levels of preparedness, helping them reach the highest standard of readiness. The tangible payoff for completing the program is insurance premium incentives offered by the Utah Division of Risk Management.

The first step is a "Certificate for Effective Drills and Safe Surroundings," which requires schools to complete four simple tasks: (1) conduct a school-wide earthquake/disaster drill, (2) have the school safety committee evaluate the drill, (3) conduct a school-wide hazard hunt, and (4) conduct the required number of fire drills during the school year. To assist with these tasks, the AESC provided all schools with a binder of activities, curriculum materials, a disaster video, maps, and posters. Once they earn that certificate, schools will then need to demonstrate competency in five areas in order to receive the insurance incentives: (1) awareness and education, (2) reducing risks before the event, (3) emergency response, (4) longer-

term emergency response, and (5) recovery.

One of the obstacles to the program, according to school administrators, is accomplishing those tasks without detracting from budgeted time for instruction and activities. An example of how schools can make earthquake safety part of the learning curriculum was demonstrated in 1999 by Pleasant Grove High School (PGHS) in Utah County. Administrators used the existing Schools-to-Careers Program at PGHS to stage an earthquake preparedness drill that involved the entire 1,500-person student body, which was able to work with professionals from the local hospital and fire department, police and sheriff's agencies, ambulance companies, local government, newspapers, and radio stations.

As an added bonus, students in the Health Education Academy Program gained experience in triage efforts and first aid, while students in the Drama Department used their make-up skills to insure the "injured" students looked realistic. Everybody had a role to play, and the school even used the drill to have the school district evaluate the building itself, which was constructed in 1959

PGHS has an evacuation plan in place, and the exercise tested it as well as showing school officials how their plan interfaced with plans of local hospitals, city and county governments, and police agencies. The drill tested evacuation and transportation capabilities by using ambulance companies, school buses, and even Utah Army National Guard paramedic vehicles.

By using a concept known as "job shadowing," administrators were able to keep everybody interested. Students were followed health-care providers, police officers, reporters, emergency medical technicians, and fire department personnel as they did their jobs in a stressful setting. The drill involved surrounding communities and, as a part of the curriculum, it can be refined and reused every year.

Since 1997, the AESC has also been involved, at least peripherally, in displaying "Earthquakes in the Intermountain West," a traveling exhibit of photographs, text, and graphics about earthquakes in Utah and the surrounding region. The exhibit was developed by Earthquake Education Services in the University of Utah Seismograph Stations (UUSS) with funding from the National Earthquake Hazards Reduction Program (NEHRP) through the U.S. Geological Survey (USGS). The target audience is the general public and school communities. The 8-foot by 19-foot free-standing display has been placed in libraries, government buildings, small museums, and earth-sciences conventions.

THE EMERGENCY MANAGEMENT STANDING COMMITTEE (EMSC) used the CEM staff to focus its efforts on HAZUS software training and CERT education. Both

STRATEGIES ADDRESSED BY THE EMERGENCY MANAGEMENT STANDING COMMITTEE

- *1.1 — Inform citizens about earthquake hazards and risks*
- *1.2 — Incorporate earthquake education in school curricula*
- *1.3 — Disclose geologic hazards in real estate transactions*
- *2.1 — Establish community emergency response teams statewide*
- *2.4 — Enhance the integrated emergency management system statewide*
- *3.3 — Improve the post-earthquake operational status of essential service buildings*
- *3.15 — Mitigate nonstructural hazards in private buildings*
- *5.1 — Update estimates of direct losses to be expected from earthquakes*
- *5.2 — Evaluate the indirect losses associated with earthquakes*

initiatives are central to the plan of ensuring that all segments of the state's population will be able to face the emergencies inherent in the aftermath of an earthquake. HAZUS does this by identifying community vulnerabilities; CERT, by giving its initiates the experience and expertise necessary to respond to community needs. EMSC members were also involved with the AESC in planning and hosting the three earthquake awareness conferences.

In 1997, CEM began implementing HAZUS, a Geographic Information System (GIS) program that recognizes earthquake hazards and assesses risks for communities. With its roots in an Applied Technology Council (ATC) pilot project funded by the Federal Emergency Management Agency (FEMA), HAZUS uses a GIS-based software program to map and display demographic information about individual communities, given the size and location of a hypothetical earthquake. HAZUS can estimate the amount of ground shaking, the number of casualties and buildings damaged, the impact on transportation systems, the extent of disruption to utilities, the number of people displaced from their homes, and the estimated cost of repairing projected damage and other effects.

HAZUS projections can be used before an earthquake to:

- develop earthquake-hazards mitigation strategies as countermeasures to potential losses and disruption,
- develop preparedness or contingency plans, and
- anticipate the nature and scope of response and recovery efforts.

After an event, HAZUS information can be used to:

- project immediate economic impact for state and federal resource allocation and support,
- activate immediate emergency recovery efforts, and
- formulate long-term reconstruction plans.

CEM is now in the process of gathering more information about Utah, to include site-specific details about geology, building inventory, utilities, transportation systems, and engineering and geotechnical data. Such information will allow CEM to increase the accuracy of the HAZUS estimates and the ability to customize those estimates to the specific conditions of individual communities. To that end, CEM is working with the University of Utah to collect data on building stocks that do not appear on county assessor's records. Some of the structures that may not now appear include schools, colleges and universities, hospitals, state buildings, city and county buildings, and churches. An oversight committee, comprised of representatives from the Salt Lake County Planning Division, FEMA, CEM, and UGS, to provide direction and coordination with the university. Funding for the effort will come from FEMA and CEM program funds.

In addition, CEM staff in 1999 created a HAZUS Data Users Group (HDUG) to help build up and facilitate the use of the database. HDUG receives training in the use of HAZUS, develops a clearinghouse and associated security for the database, takes on the responsibility of updating information with the HAZUS model, and uses HAZUS analysis to encourage actions aimed at reducing future earthquake damage. At its first meeting, the HDUG saw a demonstration of HAZUS, learned where the databases are stored and how to contribute to them, and received encouragement to enlist support of other potential users and organizations. In the future, the HDUG plans to:

- provide basic and advanced HAZUS training;
- execute a Memorandum of Understanding with Salt Lake County, which has agreed to act as the clearinghouse for the data, provide users with password access so they can contribute and retrieve information, and create a firewall to protect proprietary information;
- update default data, to include allocating funds for staffing and other expenses; and
- motivate agencies and organizations to reduce future earthquake damage.

Potential HAZUS users include representatives from:

- city and county agencies such as building inspectors, emergency management teams, planning offices, public works, utilities, and water and sewer districts;
- state agencies such as Public Safety, State Lands, UGS, Automated Geographic Reference Center, Transportation, and USSC;
- federal agencies such as the USGS, Army Corps of Engineers, and Bureau of Reclamation;
- local colleges and universities;
- the private sector such as utilities, cable television providers, oil and gas refineries and pipeline companies, and other large employers; and
- other organizations, both secular and religious.

HAZUS has the potential to raise awareness and serve as a catalyst for change. It can identify hazards and vulnerabilities so communities can focus on solutions. HAZUS helps organizations explore options to prepare for and reduce the effects of earthquakes, and it can be sued to compare benefits to costs on projects to ensure that dollars are spent wisely. Eventually, HAZUS can add modules that can reflect other hazards, such as wind, flood, wildfire, and landslides. Ultimately, HAZUS can reduce Utah's vulnerabilities to natural hazards.

The second of CEM's major initiatives has been CERT training, which is necessary to provide citizens with the basic skills to handle their own needs and to respond to the needs of their communities in the event of a disaster. CEM sponsors the program, trains the trainers, and encourages local jurisdictions and organizations to incorporate CERT training in their own disaster preparedness activities.

The course consists of 21 hours of training in:

- preparedness, to include introduction to disasters, impact of disasters on infrastructure, hazards posed by buildings and nonstructural items, and the role of CERTs in disaster response;
- fire suppression, to include identifying and reducing potential fire hazards, basic fire suppression strategies, firefighting resources, and firefighting techniques;
- medical training, to include treatment strategies for life-threatening conditions and principles of triage, head-to-toe assessments, treatment for head wounds, fractures, sprains, burns, and other injuries;
- light search-and-rescue, to include priorities and resources, techniques for assessment and searching, removing victims, and rescuer safety; and
- psychology and team organization, to include post-disaster emotional environments, the Incident Command System, CERT strategies, tactics, and documentation.

The class ends with a course review and a disaster simulation exercise. CEM oversees the program and ensures that the guidelines for instruction and training are followed. By bringing together private and public sector elements in CERT training effort, and ensuring that they work together with city, county, and corporate emergency planners, CEM promotes effective communication among, and enhances the relationships of, emergency management systems statewide.

At the Commission's July 1999 quarterly meeting, the EMSC and the AESC reported that they would combine their efforts on three initiatives:

- make data on geologic hazards more accessible to policy- and decision-makers in Utah,
- work to acquire a "shake van" to provide education and awareness opportunities for schools and businesses statewide, and
- explore ways to use lobbyists from private companies to advance the Commission's agenda in the State Legislature.

One of the premier issues identified by the two committees the creation of legislation that would mandate complete disclosure of geologic hazards to potential buyers of real estate. Utah does not now have such a requirement, and the two committees will work with representatives and lobbyists from the real estate, construction, and insurance industries to make full disclosure a reality.

A tangible benefit of close cooperation among emergency managers and increased awareness and education of hazards issues was the awarding in 1999 of FEMA funding of up to $300,000 to Salt Lake City for *Project Impact: Building a Disaster-Resistant Community.* The grant will be used to sustain the city's cooperative initiatives in the long term by continuously engaging and leveraging the resources of the city's *Project Impact* partners.

The project is a nationwide effort aimed at protecting families, businesses, and communities by reducing the effects of disasters. FEMA, in awarding the grant, recognized Salt Lake City's strong infrastructure and the willingness of representatives from the public and private sectors to work together to mitigate hazards, both natural and human-caused. Project Impact will be managed by Salt Lake City Emergency Management in cooperation with CEM and FEMA. Committees representing a cross section of involved members will be created to facilitate the coordination and accountability of projects and the creation of future endeavors.

THE ENGINEERING AND ARCHITECTURE STANDING COMMITTEE (EASC) worked closely with the Structural Engineers Association of Utah (SEAU) to formulate strategies for improving the seismic safety of buildings and infrastructures, improve building-code enforcement statewide, and strengthening building codes generally.

The following initiatives were undertaken:

- Former Commission Chair Les Youd and EASC committee member Bill Juszcak, Project Coordinator of the Utah Division of Facilities Construction and Management (DFCM), met with the Utah State Building Board in September 1996. They discussed the Commission's request that $10.5 million per year be added to the DFCM budget to inventory the seismic vulnerability of state buildings and begin to retrofit the ones most vulnerable.
- The DFCM reported on the earthquake vulnerability of the State Capitol to a legislative management committee preparing for the 1997 Legislature. DFCM estimated that the cost of evaluating the structure would be $3 million, and that retrofitting needed to prevent collapse during an earthquake would be about $100 million.
- UASC members wrote a white paper on building-code enforcement and plan review in Utah. Currently, Utah does not license plans examiners, only building inspectors. This deficiency

STRATEGIES ADDRESSED BY THE ENGINEERING AND ARCHITECTURE STANDING COMMITTEE

3.1 — Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements

3.4 — Reduce structural hazards of government-owned buildings

3.6 — Improve safety and operational ability of older public school buildings

3.8 — Improve safety of older high-occupancy buildings (250 persons or more) to be structurally competent to withstand moderate-to-large earthquakes

3.14 — Reduce structural hazards in older private buildings by retrofitting to current seismic buildings

4.4 — Ensure design professionals and building officials are kept current on relevant geoscience information

contributes to the lax code enforcement regarding seismic issues. The committee presented the document to the Utah Advisory Council on Intergovernmental Relations (UACIR), and the Commission adopted the white paper as its official position on the matter. The document was used as the basis for legislation that would have required state licensing of building-plans examiners. The bill failed to pass the Legislature, so the UASC changed tactics and drafted rules changes to present to the Uniform Building Code Commission (UBCC). That body could recommend that the state's Division of Professional Licensing (DOPL) adopt the changes and incorporate them into the State Inspector Licensing Law.

- The committee proposed that a seismic review be performed by the structural engineering member of the value-engineering review team at the 30 percent and 90 percent completion points in the design process of new schools. With the support of school district administrators, this design quality control can be accomplished without legislation through administrative rulemaking by the Utah State Office of Education.
- Upon the recommendation of the SEAU, the committee moved to form an ad hoc group of concerned citizens to examine the need for regulations requiring the seismic retrofitting of certain classes of existing buildings in Utah. The SEAU board approved a draft resolution supporting this type of regulation and further (1) recommended that certain "triggers" (age and type of structure, occupancy or use change, additions or alterations, and reroofing) be established that would require the seismic upgrade of certain buildings; (2) suggested using as guidelines for the statewide code such documents as the Uniform Code for Building Conservation (UCBC), International Building code, FEMA guidelines, and experience from other cities (notably Portland, Oregon, and San Francisco, California); (3) recommended using either a seismic force level of 75 percent of the 1994 Uniform Building Code (UBC) seismic zone forces in conjunction with the 1994 UBC or UCBC requirements, or an acceleration indicated by the national seismic hazards maps showing 10 percent probability of exceedance in 50 years in conjunction with FEMA Publication 273, or both; and (4) recommended using state and property tax breaks and reduced insurance rates as incentives to make seismic upgrading attractive to owners.

The Geoscience Standing Committee (GSC) agenda is reflected in some investigational and educational priorities of the UUSS, CEM, and the Applied Section and Geologic Extension Service of the UGS, so the relevant work done by those agencies fulfills objectives of the USSC's Strategic Plan. Other organizations involved in furthering the initiatives of the Commission include the Utah Department of Transportation (UDOT), Utah State University (USU), and Brigham Young University (BYU).

In 1999, the GSC and UGS established the Guidelines Advisory Committee (GAC) to advise on local government needs for geoscience information and training to reduce risks from earthquakes and other geologic hazards. The GAC determined what products and services would be needed, who should provide them, and what resources might be required, and also addressed possible roles of local government insurers (Utah Risk Management Mutual Agency [URMMA] and Utah Local Governments Trust [ULGT]) in encouraging risk reduction.

The local government groups identified as having specific needs for geoscience information are:

- planners, who work directly with developers, landowners, and geotechnical consultants in regulating land use;
- building officials, who perform field inspections of sites, and in some rural jurisdictions, perform all of the duties of city/county engineers and planners; and

- elected officials and administrators, who must be informed of the dangers to citizens in their jurisdictions posed by geologic hazards to help them implement appropriate risk-reduction measures.

The GAC identified the products and services needed by each of those groups, the likely preparers of the information, possible sources of funding, and steps needed for implementation.

Planners use geoscience information to prepare, adopt, and enforce ordinances and prepare master plans that reduce losses from geologic hazards. Planners should understand hazards and be able to inform developers and landowners of studies required prior to approval of subdivisions or other land uses. The earth-science information products most valuable to planners, listed in order of priority, are:

- Special-study-area maps showing where geologic hazards may exist. These maps are chiefly for use in ordinances to indicate where special studies are required and possibly for disclosure in real-estate transactions. They would be prepared by the UGS, county geologists, or private consulting geologists. The UGS and local governments would share funding while consultants would be eligible for direct funding. In order to provide this product, the preparers would complete new maps and update existing maps, and conduct workshops in the use of geologic-hazards maps in ordinances and for disclosure.
- Non-technical brochure(s) explaining hazards and risk-reduction measures that planners can hand out to developers and homeowners; training for planners to better understand geologic hazards and risk reduction; compilations of individual packets of information specific to a city or county. The preparers would be the UGS, county geologists, and UUSS's Earthquake Education Services. No outside funding has been identified; possible contributions could come from cities and counties for specific information packets. The new brochures would cover all geologic hazards, and the preparers would more widely distribute those already available and provide workshops and training for planners to increase understanding of geologic hazards and risk-reduction measures.
- A brochure explaining the process of using geologic-hazards information and maps, ordinances, and disclosure to reduce risks and losses. Preparers would be the UGS and county geologists. There has been no outside funding identified.

Strategies Addressed by the Geoscience Standing Committee

2.4 — Enhance the integrated emergency management system statewide

3.12 — Improve lifeline survivability in the event of an earthquake

4.1 — Reduce earthquake losses by mapping and identifying geologic hazards

4.2 — Perform geologic hazards investigations for critical public facilities

4.3 — Make land use compatible, through local government ordinances, with known hazards

4.4 — Ensure design professionals and building officials are kept current on relevant geoscience information

4.5 — Determine appropriate seismic criteria and procedures for evaluating performance of existing dams

4.8 — Develop incrementally a strong-motion program

4.9 — Develop a statewide, real-time earthquake monitoring system

4.10 — Monitor faults using Global Positioning System (GPS) measurements

Preparers would produce the brochure and distribute and train users, perhaps through the American Planning Association (APA), Utah League of Cities and Towns (ULCT), Utah Association of Counties (UAC), and URMMA.

Building officials must be able to recognize evidence for hazards in the landscape and in excavations. They must be familiar with seismic and grading requirements in the UBC. The Utah Chapter of the International Conference of Building Officials (ICBO) could present workshops and field training at its annual meetings, and the URMMA could host workshops and hold field trips for building officials in UBC requirements and field hazard recognition with help from the UGS and county geologists. Funding could come from the UBC Commission (Division of Occupational and Professional Licensing) education fund.

Elected officials and administrators need succinct, straightforward information on geologic hazards and the role that local government can play in reducing risk and liability. Workshops are impractical because elected officials often change every two years; information products most valuable to this group, listed in order of priority, are:

- A brochure discussing geologic-hazards liabilities and Utah case law affecting cities and counties, and ways to promote safety and reduce liability. The preparers would be city/county attorneys, other legal council, or law-school students/faculty. Funding sources have not been identified, but the need could be met by encouraging and facilitating research by City/ County attorneys or as a research project for law-school students/faculty.
- Analysis of costs and benefits of geologic-hazards risk reduction. The preparers would be the UGS, CEM, or HDUG. Funding sources have not been identified, but HAZUS can produce loss estimates for earthquakes, as well as for all hazards; it can also compile historical losses, estimate costs of risk reduction, and compare actual and projected losses to risk-reduction costs to determine benefits.

URMMA and ULGT provide insurance coverage to their local government members. URMMA in particular promotes risk reduction by providing training and assigning ratings to local government members based on their risk-reduction efforts. URMMA could further help local governments manage risks from geologic hazards by including geologic hazards in their training workshops and risk ratings. The URMMA Executive Committee oversees risk ratings and would need to approve any proposed changes or additions to the rating system to include geologic hazards. Other groups highlighted by URMMA that need geoscience information to help encourage risk reduction include the ULCT, UAC, local Councils of Governments (county commissions and mayors in each county), URMMA itself, and ULGT. This information should include examples of risks taken and losses incurred by local governments from geologic hazards.

A need exists for geoscience information in a form designed for local government officials to use in promoting risk-reduction measures. Planners need maps depicting geologic-hazard special-study areas and information explaining hazards and the risk-reduction process. Building officials need training in UBC requirements and field hazard identification. Elected officials and administrators need information on local government liability and responsibility to protect public safety with respect to geologic hazards, and the costs and benefits of risk reduction. Partnerships with various professional (APA, ICBO) and local government (ULCT, UAC, URMMA, ULGT) groups can greatly facilitate risk reduction.

Completion of these geoscience-information products and services becomes the responsibility of the designated preparers, as facilitated by the USSC GC and UGS. Because completion depends on factors outside the GAC's control, no time tables or schedules can be set for completing products or performing services.

In light of those needs, there have been several publications and technical studies

produced by the UGS since July 1996, as well as new scientific and technical investigations involving the Applied Section of the UGS and funded at least in part by NEHRP:

NON-TECHNICAL PUBLICATIONS

- *The Wasatch Fault* (PI-40), a brochure that explains hazards the fault poses and gives examples of good and bad land uses in the fault zone, summarizes how often earthquakes occur on the fault, and discusses the potential for future activity. Several full-color photographs show what the fault is, where it is located, and how to recognize it.
- An earthquake hazards map of Utah County, showing critical facilities such as schools, hospital, and dams, and locates liquefaction and surface-rupture hazards and landslides.
- *The Homebuyers Guide to Earthquake Hazards in Utah* (PI-38), a general-information pamphlet that discusses real estate concerns.
- *Earthquakes & Utah* (PI-48), a brief summary of seismic events that have affected Utah from Brigham City to St. George.

TECHNICAL STUDIES

- Surficial geologic map of the Nephi segment of the Wasatch Fault zone, eastern Juab County.
- Surficial geologic map of the West Cache fault zone and nearby faults, Box Elder and Cache counties.
- *Paleoseismology of Utah, Volume 6:* The Oquirrh fault zone, Tooele County, Utah: surficial geology and paleoseismicity.
- *Paleoseismology of Utah, Volume 7:* Paleoseismic investigation on the Salt Lake City segment of the Wasatch fault zone at the South Fork Dry Creek and Dry Gulch sites, Salt Lake County, Utah.
- *Paleoseismology of Utah, Volume 8:* Paleoseismic investigation at Rock Canyon, Provo segment, Wasatch fault zone, Utah County, Utah.
- *Proceedings Volume,* Basin and Range Province Seismic-Hazards Summit.

SCIENTIFIC AND TECHNICAL ACTIVITIES

- A paleoseismic study of the West Cache fault zone (WCFZ), Cache Valley, Utah, which is between Logan and Brigham City, Utah's tenth and 16th largest cities, respectively. The UGS will excavate and log four trenches to evaluate earthquake potential of the WCFZ and associated faults. The results will provide a complete chronology of surface-rupturing earthquakes for Cache Valley and the norther part of the populous Wasatch Front, and that information will permit accurate estimates of seismic hazard and risk.
- Seismic hazard mapping of Cache Valley using geographic information system (GIS) technology. The results will help establish a customized protocol for mapping seismic hazards in the unique geologic environments of north-central Utah and will result in the production of seismic-hazard maps in a rapidly developing area near the northern Wasatch Front. These hazard maps will add substantially to the information available to planners and public officials, who will use the maps to reduce the impact of seismic hazards on future development and manage post-earthquake response and recovery efforts.
- A seismic hazard study of the Hurricane fault in southwestern Utah, which extends 250 kilometers from Cedar City, Utah, to Peach Springs, Arizona. The results of the investigation will be used to characterize the frequency of surface rupture and segmented behavior of the Hurricane fault, and will greatly improve understanding of seismic hazards in the region at a time when this information can be incorporated into design standards and building practices for on-going development.
- Development of a quaternary fault database of the seismically active Intermountain seismic belt, which is a zone of historical seismicity extending from northern Arizona to central Montana. Results of the study will provide a convenient reference for earthquake sources in Utah and add to

code requirements and safer buildings. Earthquake records from the array of detectors can also be used by engineers and seismologists for various investigations including structura-response studies, analyses of basin effects, ground-motion attentuation, comparison of ground acceleration date with intensities, and source studies. The on-going project is funded by the USGS through the NSMP, and is being conducted in close cooperation with UGS and UUSS.

Besides historical data, real-time earthquake information systems provide rapid information to crisis managers — such as public safety officials and operators of utilities, hospitals, dams, and other critical facilities and lifelines — who make the decisions for response and recovery in the event of an earthquake. Many of the benefits from this timely decision-making can be measured in dollars; rapid estimates of damage, losses, and populaiton impacts based on real-time ground-shaking information has become important to meet requirements for a formal Presidential Declaration of disaster. This information can also directly expedite federal recovery assistance to individuals and communities.

But the system has valuable historical application as well. Real-time earthquake information systems offer a practical framework for unifying earthquake data, information, and knowledge in a way that the overlapping needs of emergency management, engineering, and science can be served most cost-effectively. Recordings of strong ground shaking contribute to safe, cost-effective seismic design and the ability to quantify the forces to which a specific damaged structure — or locale — was subjected. There are enormous financial consequences attached to either under-designing or over-designing for earthquakes.

Because of these factors, the USSC began working with the Department of Interior to include Salt Lake City in a proposed real-time earthquake instrumentation pilot program. The effort bore fruit in late 1999 with the announcement that the UUSS will be receiving seed money during fiscal year 2000 under a cooperative project with the USGS to implement the system in the Ogden-Salt Lake City-Provo urban corridor and the 2002 Olympic venues. Larger-scale federal funding may become available in fiscal year 2001 if the U.S. Congress approves pending initiatives for an Advanced National Seismic System, with emphasis on urban areas of high seismic risk.

The pilot project will include:

- the installation of new strong-motion instruments at about 20 sites with continuous digital telemetry, which would be the first stage of a proposed 500-station network along the Wasatch Front;
- the capability for automated broadcasts of the location and size of a potentially disruptive earthquake within a few minutes of its occurrence; and
- a prototype capability to generate automated computer maps (called *ShakeMaps*) within several minutes of any significant earthquake in the study area, showing the geographic distribution and severity of ground shaking.

The Intergovernmental Relations Standing Committee (IRSC) has never been impaneled, but given the nature of what remains to be accomplished, the IRSC will need to be activated and quickly become a committed player.

The Lifelines and Infrastructure Standing Committee (LISC) began creating a GIS-based inventory of all the important lifelines in Utah with a primary focus on the Wasatch Front area and to include transportation routes and utility corridors. The committee is also studying the issue of co-location of utilities, a situation that tends to magnify damage to lifelines during earthquakes.

As part of that process, the LISC agreed to validate the work done by the Lifelines Committee of the American Society of Civil Engineers (ASCE). The group conducted a survey of Utah's approximately 300 water-system groups and 150 sewer-system groups regarding their knowledge of

code requirements and safer buildings. Earthquake records from the array of detectors can also be used by engineers and seismologists for various investigations including structura-response studies, analyses of basin effects, ground-motion attentuation, comparison of ground acceleration date with intensities, and source studies. The on-going project is funded by the USGS through the NSMP, and is being conducted in close cooperation with UGS and UUSS.

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As part of that process, the LISC agreed to validate the work done by the Lifelines Committee of the American Society of Civil Engineers (ASCE). The group conducted a survey of Utah's approximately 300 water-system groups and 150 sewer-system groups regarding their knowledge of

earthquake vulnerability. From that information, the ASCE identified the need for basic education and developed a presentation to show those groups how to evaluate their own systems. The USSC volunteered to fund further presentations and update the information used in it using the newest data gathered in Utah.

In addition, the Commission has been supporting the work of UDOT in its investigation of seismic safety standards for Utah's bridges and freeway interchanges. UDOT has estimated that a M_c 7 event in the Salt Lake Valley would cause $170 million in damage to Interstate 80 just between State Street and Parley's Canyon, but that retrofitting would reduce that loss to about $17 million. UDOT is also incorporating the latest seismic safety features in its reconstruction of the Interstate 15 corridor through the Salt Lake Valley.

USU is also conducting research on old structures that will be torn down during the reconstruction process. These old bridges and overpasses have become experimental devices that structural engineers use to determine if various shaking techniques can tell if a bridge has structural damage. The ability to use the condemned bridges gives the researchers information they can compare to results from national laboratories on the behavior of steel girders — information that cannot be adequately tested in any other environment. The information obtained allows engineers to cost-effectively ensure bridge safety without over-building a structure.

A research team from BYU is also investigating the earthquake resistance of steel pillars used on the I-15 project. Using a form of seismic testing known as static and statnamic loading, the researchers can discover how the pillars hold up under the presumed pressures of an earthquake.

Strategies Addressed by the Lifelines and Infrastructure Standing Committee

3.12 — Improve lifeline survivability in the event of an earthquake

3.13 — Improve earthquake performance of water and waste-water systems

4.6 — Reduce earthquake-induced liquefaction risk to highway structures

4.7 — Determine appropriate seismic design coefficients for highway bridges

5.3 — Conduct lifeline co-location vulnerability studies

Priorities for the Future

With the publication of the Strategic Plan, the Commission is in the process of accomplishing, or has successfully implemented, 26 of its 35 sub-categories, or nearly 75 percent. The nine remaining strategies require specific legislation, commitment from enforcement agencies, or both.

The real estate disclosure strategy (1.3) can be accomplished only with the support of the real estate industry, the construction trades, and insurance companies. The Commission has begun work on gaining those endorsements, and hopes to be ready to present proposed legislation in the very near future.

Strategies 2.2 and 3.7 (hospitals) need the active participation and commitment of all the state's hospitals, for-profit and not-for-profit alike. Hospitals occupy a unique position in any seismic mitigation scheme, since they must remain operational in order to deal with casualties; no one else can fill that role. If hospitals cannot survive, casualties will be compounded.

With the implementation of *Project Impact* in Salt Lake County, communication capabilities for emergency responders (2.3) will have to be enhanced. The communities and agencies directly involved have to effect this vital strategy; the Commission, through the influence of its members, can only offer advice and counsel.

The remaining five strategies (3.2, 3.5, 3.9, 3.10, and 3.11) are essentially enforcement issues that will require aggressive educational opportunities for building officials, the commitment and involvement of communities and zoning agencies, and perhaps stronger legislation. Again, through the influence of its members, the Commission will be an advocate for significant improvement in these areas.

Moderating the effects of an earthquake is a tremendously complex task because an earthquake is totally unpredictable, both in size and occurrence. The effort begins with awareness, but is sustained with education, training, scientific investigation, and preparation. The Commission exists to coordinate those initiatives, keep them in focus, and advance them at every opportunity.

Priorities for the Future

1.3 — Disclose geologic hazards in real estate transactions

2.2 — Develop effective exercise and training programs for hospitals

2.3 — Enhance communication capabilities for emergency responders

3.2 — Enforce the state amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when re-roofing

3.5 — Mitigate nonstructural hazards in government-owned buildings

3.7 — Improve safety and operational ability of older hospital buildings

3.9 — Improve the seismic safety of older homes

3.10 — Improve safety of mobile homes

3.11 — Prevent loss of historic buildings

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