EARTHQUAKE SAFETY IN UTAH

A Progress Report on Activities for the Period July 1994 - June 1996

UTAH SEISMIC SAFETY COMMISSION

Compiled by
F. Bruce Funk
for the Commission

November 1996

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EXECUTIVE SUMMARY

Part of the basic mission of the Utah Seismic Safety Commission (USSC) is to provide long-term oversight for reducing Utah's earthquake vulnerability and making Utah a safer place to live and work. This report documents activities to improve earthquake safety in the two years since creation of the USSC and presents the results of a survey sent statewide to over 650 individuals and entities in both the public and private sectors.

The results of the questionnaire indicate that heartening progress in the general areas of earthquake awareness, preparedness, and response-related actions is taking place throughout the state. In general, decision-makers in Utah are emphasizing earthquake awareness and education and are making good progress in advancing preparedness and response capabilities, but they are not as readily funding high-cost construction needs such as retrofitting of buildings.

The statewide emphasis on training of Community Emergency Response Teams (CERT) has met with great success. Likewise, activity has increased in upgrading emergency management capabilities including communications to improve earthquake response capabilities.

The majority of the effort directed at improving the seismic safety of buildings and infrastructure is in preventing construction of substandard buildings. Many government entities commented that ensuring compliance with seismic requirements of the Uniform Building Code was an integral part of their plans review and inspection process. Some city/county offices and emergency/essential services buildings have been replaced by seismically sound facilities. Many of the state's school districts have also identified substandard structures; most of the structures being replaced are within the greater Salt Lake City metropolitan area.

Basic geoscience information is being advanced principally by the universities using both public and private funding. Projects have been initiated to understand the Wasatch fault system and the probable effects of a major earthquake on the population. Earthquake monitoring is also being accomplished, although on a much smaller scale than is required for comprehensive planning, warning, and engineering. Salt Lake, Tooele, Davis, Utah, and Weber Counties specifically mentioned completion of loss-estimation efforts in their jurisdictions. Significant time and resources have also been dedicated to upgrading bridges in the state's highway system and implementing high seismic standards in the reconstruction of I-15.

The remaining challenge for Utah is for lawmakers and administrators at all levels of government to mitigate the predicted losses through defensive actions. The successes noted above requiring funding have mostly come as a result of industry, school district, or local government initiatives. Some defensive actions, however, are inherently costly and will require greater state leadership.

INTRODUCTION

The earthquake threat in Utah is real. In a March 1996 article in the *Journal of Geophysical Research,* James McCalpin and Stuart Nishenko estimate that the probability of a major earthquake along the Wasatch fault alone may be 13 percent in 50 years and 25 percent in 100 years and that the probability for an earthquake on the Salt Lake City segment of the Wasatch fault may be as high as 57 percent in 100 years. Direct losses from such an earthquake may exceed $12 billion. At an earthquake conference held one year after the Northridge, California earthquake, the California Office of Emergency Services estimated that a $5 billion investment in mitigation would have significantly reduced the $25 billion direct loss caused by the

earthquake, indicating that loss-reduction measures pay off in the long run.

This report is a summary of earthquake-safety measures initiated and/or advanced in the first two years of the existence of the Utah Seismic Safety Commission (USSC). It briefly assesses the status of implementing the USSC's 1995 document, *A Strategic Plan for Earthquake Safety in Utah*. The main focus is on the activities of state and local government, industry, businesses, school districts, and hospitals during the past two years that address earthquake safety.

The first section of this report summarizes the USSC's creation, mission, activities, and initiatives up to June 30, 1996. The second section summarizes the results from a survey of 684 state and local government agencies, professional societies, businesses, hospitals, school districts, emergency planners, counties, cities, and the media in April and July 1996. That questionnaire (appendix A) consisted of five basic questions relating to the five objectives in the *Strategic Plan*. It was designed to maximize the response rate while allowing an accurate measure of overall progress statewide in seismic matters.

USSC ACTIVITIES

Mission

The USSC was created by the 1994 Legislature (appendix B) following the January 17, 1994 Northridge, California earthquake which occurred near the beginning of the legislative session. With the ultimate goal of making Utah a safer place to live, the mission of the USSC, as for its predecessor, the Utah Earthquake Advisory Board (UEAB), 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. Assisted by the USSC's standing committees, a legislative charge to produce a strategic plan for consideration by the 1995 Utah Legislature was completed with the publication in January 1995 of *A Strategic Plan for Earthquake Safety in Utah*.

The USSC was given nominal funding ($4500) to finance operating costs, but lacks staff funding. Its structure is similar to its predecessor organizations, but membership is augmented by representation from the Utah Senate and House of Representatives. Its members and standing committees are listed in appendix C.

Strategic earthquake-safety planning in Utah has proceeded under a statewide vision contained in the Governor's planning agenda. That agenda's cornerstone is a set of overall policy goals known as the **"Five Key Objectives."** Those objectives are:

- Providing a world-class education.
- Creating quality jobs and business climate.
- Improving government.
- Enhancing the quality of life for all Utahns.
- Fostering self-reliance.

Consistent with these objectives, the USSC was given the charge to:

- Review earthquake-related hazards and risks in Utah.
- Prepare recommendations to identify and mitigate these hazards and risks.
- Prioritize recommendations for adoption as policy or loss-reduction strategies.
- Act as a source of information for earthquake safety and promote earthquake loss-reduction measures.
- Update the strategic planning document and other supporting studies or reports.

Additionally, the USSC has adopted the following 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 in the future.
- 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.

Major Accomplishments

Development of a Strategic Plan

A draft of *A Strategic Plan for Earthquake Safety in Utah* was presented to the Utah Legislature in October 1994 at a meeting of the State and Local Affairs Interim Committee. The final report was printed in January 1995 and distributed to legislators, local governments, and others.

With the publication of the *Strategic Plan*, the state formalized its efforts to reduce losses in future earthquakes. The plan consists of the five objectives and 33 strategies in appendix D. These strategies represent a long-term "road-map" of efforts aimed at saving lives, preventing injuries, protecting property, and reducing the social and economic disruption from earthquakes. The USSC is confident that the plan's objectives and strategies remain valid and should continue to serve as a focus for seismic safety-related projects in the future.

Following development of the *Strategic Plan* and in preparation for the 1996 legislative session, the commission narrowed its list of 33 strategies down to three high priorities (see USSC Priorities section) and met with the Governor and the director of his Office of Planning and Budget to present these priorities. Subsequent presentations were also made to the state legislature in House and Senate caucuses. Of the three priorities, Governor Leavitt included a one-time, $200,000 funding request for the strong-motion program in his 1996-7 budget. However, the 1996 Legislature did not appropriate the requested funds, nor did it pass any bills or provide funding for any other of the USSC's recommended actions.

Seminars and Briefings

The USSC co-sponsored the two day *Wasatch Front Seismic Risk Regional Seminar* organized by the Earthquake Engineering Research Institute in November 1994. This regional seminar brought forth the latest technical information on earthquakes in Utah and generated much media coverage of the earthquake threat.

The January 1996 meeting of the USSC was a forum for presentation of the latest data on earthquake probabilities on the Wasatch fault. Dr. Stuart Nishenko of Natural Disaster Research, Inc. (formerly at U.S. Geological Survey) presented the results of work he has undertaken with Dr. James McCalpin, GEOHAZ Consultants (formerly at Utah State University Department of Geology). They used data from recent trenches on the Wasatch fault to calculate new earthquake probabilities for various Wasatch fault segments. A press conference was held after the meeting.

SUMMARY OF PROGRESS IN IMPROVING EARTHQUAKE SAFETY

To measure progress in achieving the goals set forth in the *Strategic Plan*, the USSC conducted a survey by mailing a questionnaire. Twenty-seven percent of the questionnaires (184 responses) were returned from the 684

mailed. Over half were in response to a second mailing to selected addressees along the most earthquake-prone area of Utah's urban corridor. Figure 1 depicts the overall responses according to the objective number (appendix D) found in the *Strategic Plan*. The quantity listed in figure 1 "Positive Responses" is the number of respondents that indicated progress under any strategy for the objective. If the respondent indicated progress in more than one strategy, more than one positive response is reflected in the graph. Therefore, the numbers are the total of all positive responses for every strategy under each objective. Similarly, the "No Progress Responses" represents expressions of 'no progress' or blank entries on response forms indicating no progress in any strategy in that objective.

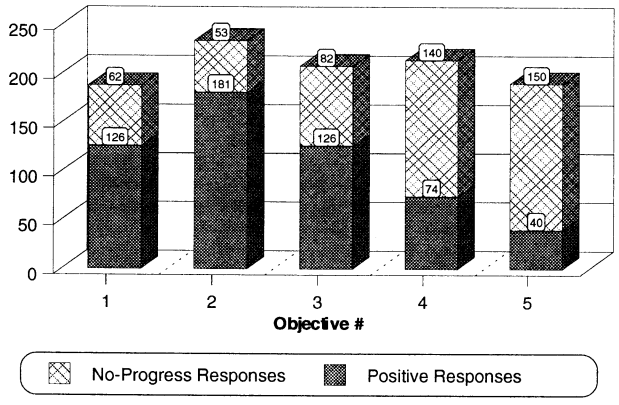


Figure 1. *USSC questionnaire response.*

The questionnaire was not designed to support statistical analysis or extrapolation to the total population, but rather to identify significant progress that has been made statewide since the USSC's inception. Three additional aspects of the results as shown in figure 1 should be noted:

- More than one objective was often addressed on questionnaires as well as more than one strategy under each objective.
- Even though the number of responses for objectives 1 and 3 are close, for example, there are only three strategies under objective 1 as opposed to 13 under objective 3.
- The number of responses indirectly reflects the number of people or groups responsible for an objective or strategy. For example, by their nature, more organizations are involved in objective 1 than objective 4, and the number of positive responses reflects this.

Respondents had a listing of all objectives and strategies, but did not necessarily have a full copy of the *Strategic Plan* as they formulated answers, and thus could not be expected to respond in full detail to each strategy. A list of contributors to this report and respondents to the questionnaire is in appendix E.

The following sections contain a summary of progress in each of the objectives, followed by a strategy-by-strategy listing of selected responses and other activities noted by USSC members and staff. Figures within the discussion of each objective depict the number of responses to each of the strategies.

Objective 1: Increase Earthquake Awareness and Education

Increasing earthquake awareness and education is a common priority among all categories of survey responders and is clearly a successful activity. Awareness training comes in the form of videos, classroom lectures, various training and mock disaster drills, employee-centered instruction, and newspaper/TV/radio presentations. Training is conducted routinely by many emergency planners, city officials, hospital administrators, and experts in education. Information is being disseminated to industry, government, religious, and education leaders and they are passing it on to others in their respective domains. Several city-level officials are conducting citizen training and are making earthquake-related materials available for check-out.

A significant effort to inform school

children and school administrators about earthquake safety is exemplified by the efforts of the Utah Parent Teacher Association (PTA). It distributed printed material to all school districts and conducted two statewide surveys concerning earthquake preparedness. The geology departments at the

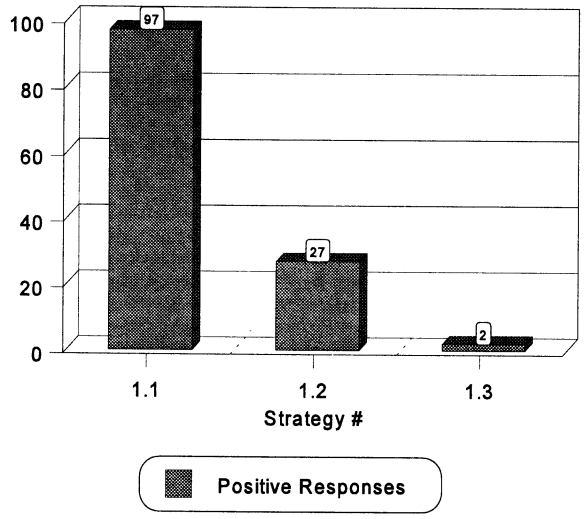


Figure 2. *Objective 1 strategies.*

University of Utah and Brigham Young University have steadily advanced the level of understanding of Utah's earthquake hazards. Eleven districts specifically mentioned that earthquake training is important in their curriculum although most of that emphasis was at the elementary school level.

Although the Utah Geological Survey (UGS) and Salt Lake County have produced maps which cities and counties can use for simplifying disclosure of hazards, only Salt Lake County requires disclosure; no respondent mentioned any effort to disclose geologic hazards in real estate transactions.

Strategy 1.1: Inform citizens about earthquake hazards and risks.

- Utah's Division of Comprehensive Emergency Management's (CEM) Earthquake Preparedness Program's (EPP) presentations to over 9400 students, teachers, school staff, and school administrators; provision of information to over 1900 people from business, local government, and the general public; and distribution of more than 70,000 full-colored brochures containing preparedness and mitigation information.

- The University of Utah Seismograph Stations' (UUSS) development of a public-service activity called "Earthquake Education Services" designed to provide Utah's K-12 educators with earthquake-related resources for teaching; provision of local earthquake information via the Internet to the general public; operation of an earthquake information center that conducts tours of facilities; and development of a traveling exhibit, World Wide Web information, and annotated educational slide sets that inform users about earthquakes in general and the personal experiences of Utahns with earthquakes in the past.

- The Utah Geological Survey's preparation of public information brochures and participation in workshops to help home buyers, real estate agents, and the general public understand earthquake hazards.

- Provision of information by the Utah PTA Emergency Preparedness Committee to PTA organizations statewide that included information gathered during a visit to the Northridge earthquake site, production and distribution of 1000 audio tapes, and distribution of an earthquake training video for schools.

- Publication of research papers by UUSS seismologists and the geology departments of the University of Utah and Brigham Young University, and the UGS on Utah's earthquake threat.

- Education of employees by many industry and hospital administrators on emergency

procedures in the workplace -- most notably the Utah Transit Authority, Mountain Fuel Supply Company, Thiokol, National Semiconductor, Unisys, Salt Lake City Airport Authority, and Intermountain Health Care.

- Distribution of 15,000 Disaster Information Calendars by Tooele County.

- Institution of a campus-wide emergency preparedness program by Brigham Young University to include employee training and student orientation to the earthquake threat.

- Extensive use of various earthquake training videos and other materials by counties, cities, schools, and government agencies.

- Salt Lake City School District's ensuring that each school has an emergency plan.

- Active dissemination of geoscience data by Sevier, Provo, and Granite School Districts.

- Support by TV stations and the major newspapers for regular programming and articles on preparedness and the local earthquake threat.

- UGS publication of the *Fault Line Forum* for the "earthquake community."

- State Division of Risk Management's focus on the seismic condition of Utah's schools and training of state agencies on the importance of having an emergency plan.

- Sunset City's sponsorship of an annual emergency preparedness fair.

- Provo City's meetings with business leaders to address earthquake vulnerability and its community education program.

- Salt Lake City/County's co-sponsorship of the annual "It's Our Fault" earthquake preparedness week.

- Formulating/drilling of disaster reaction plans by hospitals.

Strategy 1.2: Incorporate earthquake education in school curricula.

- Development of earthquake teaching materials for the elementary science core curriculum by a team of Utah elementary teachers and geologists.

- Receipt of a grant by the UUSS and CEM that 1) promotes *Earthquakes in the Utah Science Core Curriculum; part II*, 2) continues the curriculum program developed for the elementary level, thereby facilitating its development and implementation for the secondary level, and 3) adapts the FEMA/AGU (American Geophysical Union) curriculum *Seismic Sleuths* for use in secondary classrooms.

- CEM's EPP and the UUSS co-sponsorship of several "How-To" workshops for schools and teachers across the state with over 280 participants in attendance and teaching of the FEMA school curriculum course "Tremor Troop" to Wasatch Front teachers.

- College of Eastern Utah's earthquake preparedness outreach program for grades 3-9.

- Cache County's earthquake awareness programs for middle school audiences.

- Attendance by Morgan County emergency/school district personnel of FEMA training in Maryland.

Strategy 1.3: Disclose geologic hazards in real estate transactions.

- The UGS has provided hazard maps for

cities and counties to use in disclosing hazards.

- Salt Lake County's Natural Hazards Ordinance requires "disclosure documents" to be completed prior to development in areas of potential natural hazard.

Objective 2: Improve Emergency Response and Recovery

Figure 3 reflects significant advancement in implementation of the CERT concept and improvements in the overall emergency management system in the state. Most areas along Utah's urban corridor have instituted CERT programs or are developing them. Of the hospitals that replied to the survey (appendix E), only three mentioned that they had CERT-qualified employees (PHC Regional Medical Center, Salt Lake Regional Medical Center, and the Beaver Valley Hospital). Half of all cities responding to the survey reported active implementation of CERT programs while several more have plans to institute the program by fall 1996.

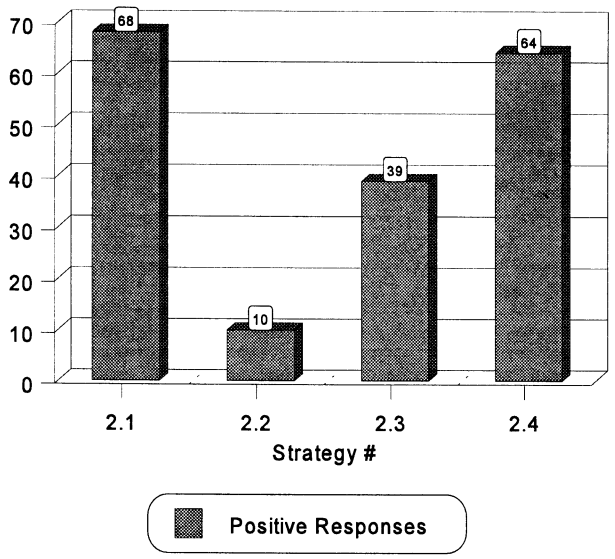


Figure 3. *Objective 2 strategies.*

Most of the cities reported regular exercising of their emergency plans. Twelve cities reported significant upgrades of their communications capabilities. Many school districts responding conduct earthquake drills.

Strategy 2.1: Establish Community Emergency Response Teams (CERT) statewide.

- In cooperation with FEMA, CEM's development of a CERT training video and "Train-the-Trainer Program" to enable communities to train their own personnel and citizens.

- Utah Transit Authority's training of CERT teams at its five operating divisions (Weber County, Orem, and three in Salt Lake County).

- Training of 50 CERT team members by Franklin Quest Company.

- Harmon's, Inc. ensuring that there is one trained CERT team in each of its eight supermarkets.

- CERT training in Davis (most cities), Weber, Tooele, Morgan, and Box Elder Counties.

- Utah County's CERT program for the deaf.

- Cache County's training of 200 citizens in the past year in the CERT program.

- Establishment at Brigham Young University of a CERT program for the university which has trained 118 employees in the last year.

- Davis County School District's training of 55 employees in the last year on the way to a goal of having 6 CERT members at each elementary and 12 at each secondary school.

- West Jordan's institution of a CERT

program designed to train all of its citizens who have interest, beginning with its organized Neighborhood Watch groups.

- Graduation of 250 from Sandy City's CERT training program; 120 from Spanish Fork's program.

- Salt Lake City's program of having a CERT team in each city-owned building.

Strategy 2.2: Develop effective exercise and training programs for hospitals.

- Conducting of disaster drills to test reaction to an earthquake-related emergency by 18 of the 22 healthcare facilities.

- Conducting by Ogden Regional Medical Center, Brigham City Community Hospital, and Bear River Valley Hospital of reaction drills in conjunction with community and/or county-wide disaster exercises.

Strategy 2.3: Enhance communication capabilities for emergency responders.

- Installation by the Utah Transit Authority of a backup mobile repeater radio system.

- Upgrading of disaster communications capabilities by Thiokol, National Semiconductor Corporation, and Mountain Fuel Supply.

- Purchase of emergency communication equipment for every division and office in the Department of Environmental Quality.

- Chemical Stockpile Emergency Preparedness Program (CSEPP) upgrade of the Tooele County communications system.

- Juab County's upgrading of all communications at its public safety building, complete with backup power.

- Upgrading of disaster hospital communications by Columbia Mountain View Hospital and Intermountain Healthcare (IHC) Hospitals of Utah County.

- Purchase of all necessary communications equipment by Brigham Young University to coordinate emergency response efforts with city, county, hospital, and its own employees.

- Cache and Provo City School Districts' providing radio systems for their schools in case of power failure.

Strategy 2.4: Enhance the integrated emergency management system statewide.

- The UUSS's development of an automated "Rapid Earthquake Alert" system to provide emergency responders with up-to-date earthquake information to maximize the efficient use of manpower and other resources.

- Thiokol's relocation of its Emergency Operations Center (EOC) into a new, more earthquake-resistant facility with emergency power and upgraded communications.

- Development by Thiokol, Utah Power, and MATRIXX Marketing of disaster recovery plans.

- Establishment of a mobile command post and EOC by the Salt Lake City Airport Authority.

- Kennecott Corporation's development of an emergency response plan that includes a notification procedure and communication center.

- Establishment of an EOC by the Bureau of Reclamation and incorporation of an EOC into the state's new Natural Resources building in Salt Lake City.

- Mountain Fuel's table-top and bi-annual full-scale exercises emphasizing earthquake reaction procedures.

- Table-top and full-scale drills by the Department of Corrections addressing prisoner control and relocation and the purchase by the department of the necessary equipment to extract people who are victims of structural collapses.

- Development of mobile command centers by Davis, Utah, and Kane Counties.

- Establishment by Brigham Young University of both EOC and alternate EOC locations; provision by the university to meet all essential needs of its student population for the first 72 hours following a disaster.

- Mandating by the State Board of Education that a Emergency Preparedness Week be held in every school prior to October 31 of each school year.

- Integration of Cache, South Summit, Sevier, Iron, and Washington School Districts' emergency capabilities with local city and county agencies.

- Conducting of an annual mass casualty exercise by Provo City with the Utah Valley Regional Medical Center.

Objective 3: Improve the Seismic Safety of Buildings and Infrastructure

This objective introduces the area of funding commitments addressed as a concern earlier in this report. Accordingly, figure 4 reflects the fact that the more funding required to make a difference in a particular strategy area, the less activity there has been. Twenty-one school districts replied with positive comments for this objective. Six hospitals (one-third of total hospitals/medical centers responding) and three school districts mentioned that new construction and/or retrofitting of older buildings meets current Uniform Building Code (UBC) minimum requirements (seismic zone 3). Although many entities stressed that new construction is "to current seismic code," specific "plans-review" procedures were not mentioned by the same number of contributors as a comparison of responses to strategies 3.1 and 3.4 reveals. Similarly, very few responders to the survey mentioned any kind of active program for bracing parapets and installing roof anchors in the reroofing of their buildings. Strategies 3.9 and 3.10 (seismic safety of residences and mobile homes) were not addressed in any questionnaire responses.

Responses from private businesses and corporations revealed that they are mounting their own efforts to retrofit older buildings and construct newer ones to current seismic standards. Especially noteworthy was

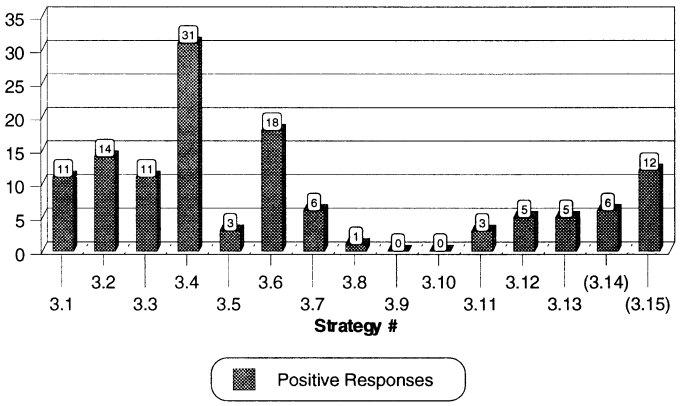


Figure 4. *Objective 3 strategies.*

Mountain Fuel Supply Company's construction of and relocation of critical company operations functions to a new seismic zone 4 essential facilities building in Salt Lake City. Geneva Steel is similarly designing new buildings to seismic zone 4 standards. Other efforts

involving private buildings were not originally provided for in the list of strategies in the *Strategic Plan*. To capture that significant input, new strategies 3.14 and 3.15 were added for the purposes of this report only.

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

- Salt Lake County's consideration of liquefaction in its plans review process.
- Review of plans for seismic considerations prior to raising new structures by Orem, Heber City, Sandy, Mapleton, and Bountiful.
- Coordination between the Federal Highway Administration and the Utah Department of Transportation to ensure local seismic design criteria are being met in federally funded projects.

Strategy 3.2: Enforce the state amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when reroofing their buildings.

- Upgrading of roof diaphragms to current code compliance as buildings are reroofed or renovated by Granite, Sevier, Weber, and Jordan School Districts.
- Upgrading of five of Harmon's eight supermarket stores to meet parapet/roof anchor code.
- Addition of lateral bracing and roof diaphragm slabs to Concourse 'B' at the Salt Lake City Airport.

Strategy 3.3: Improve the post-earthquake operational status of essential service buildings.

- Mountain Fuel's construction of a seismic zone 4 essential facilities building in Salt Lake City.
- Spanish Fork City's replacement of its fire, police, and ambulance buildings.
- Salt Lake City's retrofitting of all fire stations.
- Collocating of the Juab County Emergency services with the sheriff's office in a seismically sound facility.

Strategy 3.4: Reduce structural hazards of government-owned buildings.

- Centerville City's exceeding of seismic standards in its seismic zone 4 construction of a new city hall and a community center.
- Hill Air Force Base's completion of analysis and prioritization of a 20-year retrofit program of all buildings on the base.
- Remodeling of a commercial structure by Weber County to seismic code standards for consolidation/movement of county offices from sub-seismic-standard buildings.
- Hyde Park City's $650,000 replacement of its city building with one built to seismic code.
- West Jordan's replacement of its city office building with one built to seismic code.

Strategy 3.5: Mitigate nonstructural hazards in government-owned and leased buildings.

- Installation of a seismic safety valve on its gas main by the State Tax Commission.
- Provo City's purchase of property on which to park police vehicles rather than parking them under the city building.

- The State Division of Risk Management's provision of a premium credit incentive to all covered agencies, school districts, and higher education institutions to install an automatic gas shut-off valve and fire protection system in new and existing buildings.

Strategy 3.6: Improve safety and operational ability of older public school buildings.

- Use by the State Division of Risk Management of a policy of valuation change to determine insurance premiums/claim limits as an incentive for building upgrades.

- Significant replacement of buildings either completed or in progress in Salt Lake City, Morgan, Tooele, Beaver, Murray City, Grand, Provo, and Jordan School Districts.

- Seismic upgrade of 33 Granite School District buildings or portions thereof in the past several years, adding shear walls during major interior remodeling projects.

- Jordan School District's on-going efforts to address seismic deficiencies identified in a 1990 vulnerability assessment. One high school, one middle school, and two elementary schools have been replaced; three other elementary schools have been renovated to UBC seismic zone 3 standards.

- Replacement/retrofitting of all high schools by the Salt Lake City School District.

Strategy 3.7: Improve safety and operational ability of older hospital buildings.

- Seismic bracing of the fire sprinkler system in the Olympus View Psychiatric Hospital.

- Bracing nonstructural items such as filing cabinets in the Sanpete Valley Hospital.
- Secondary bracing of three multi-level buildings at the Veterans Affairs Medical Center.

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

- Replacement/retrofitting of 13 buildings at Brigham Young University.

Strategy 3.9: Improve the seismic safety of older homes.

- No responses.

Strategy 3.10: Improve safety of mobile homes.

- No responses.

Strategy 3.11: Prevent loss of historic buildings.

- Seismic upgrade of Governor's mansion.

- Strengthening of American Fork and Provo tabernacles by the LDS Church.

- Seismic strengthening of the Cathedral of the Madeline.

- Seismic evaluation of the State Capitol.

Strategy 3.12: Improve lifeline survivability in the event of an earthquake.

- Establishment of backup utilities at most prison facilities by the Department of Corrections to address water, power, and heating needs.

- Addition of seismic shut-off valves for natural gas main lines to the Tooele Army Depot (TAD) and Thiokol; installation of seismic relays on power lines to some buildings at the TAD.

- Completion of a vulnerability study of its

lifelines by Provo City.

Strategy 3.13: Improve earthquake performance of water and waste-water systems.

- Identification by Tooele County of three city water tanks for seismic retrofit.
- Provo City construction of a new seismically sound centrifuge building at its water reclamation plant.
- Hyde Park City's $2.3 million upgrade of its water system and relocation of the water tank.
- Seismic retrofit plans being designed for numerous water-supply dams throughout the state in response to Utah's 1990 Dam Safety act.

New Strategy (3.14): Reduce structural hazards in older private buildings by retrofitting to current seismic building requirements.

- Completion by CEntry Constructors and Engineers of a seismic hazard assessment of two petroleum refineries and addition of anchor bolts to hazardous materials storage tanks.
- Utah Power upgrade of its Salt Lake City plant to UBC standards.
- Installation of seismic flooring at critical locations by MATRIXX Marketing.

New Strategy (3.15): Mitigate nonstructural hazards in private buildings.

- Anchoring facilities equipment at Litton Guidance and Control Systems, National Semiconductor, Associated Foods, Thiokol, and MATRIXX Marketing.

Objective 4: Improve Essential Geoscience Information

The geology and engineering departments at Utah universities and the Utah Geological Survey have been active in preparation of technical papers and supervision of graduate students on seismic hazard mapping, earthquake monitoring, and Global Positioning System (GPS) surveys. Research relevant to this objective includes:

- The effect of deep sediments underlying the Salt Lake Valley on amplifying earthquake ground shaking.
- Differences in aftershock sequences in the Utah region, compared to typical sequences in California.
- The physical origin of stresses responsible for deformation along Utah's main seismic belt.
- Evidence for local precursory decreases in the rates of occurrence of "background" earthquakes before some, but not all, moderate-sized earthquakes in Utah.
- How the Wasatch fault may interact with neighboring faults to advance or retard seismic slip.
- Information from the surface ruptures of ancient "paleo" earthquakes for estimating the characteristics of future large earthquakes on Utah's active faults.
- Hazard implications of prehistoric liquefaction-induced landslides.
- Patterns of coal mining-induced earthquakes in the Wasatch Plateau-Book Cliffs coal mining districts and constraint on the seismic hazard these induced earthquakes pose.

Sixteen of the cities responding to the questionnaire reported local initiatives and improvements in essential geoscience information. The response rate for strategies 4.5-4.10 is relatively low as indicated in figure 5 below partially because of the cost involved in implementing them.

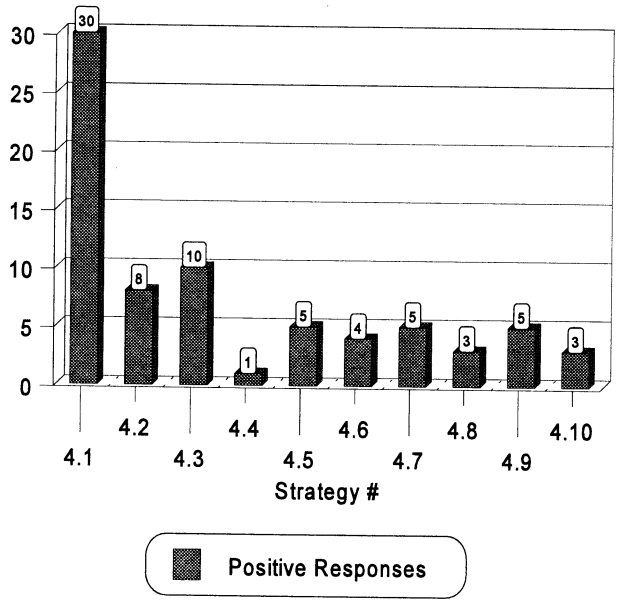


Figure 5. *Objective 4 strategies.*

Strategy 4.1: Reduce earthquake losses by mapping and identifying geologic hazards.

- Completion by the UGS of geologic-hazard maps for Heber Valley, Tooele Valley, Springdale, Moab-Spanish Valley, and Castle Valley (Grand County).
- Completion by CEM's EPP and the UGS of the first three county maps (Salt Lake, Davis, and Weber) entitled "Selected Critical Facilities and Geologic Hazards" that show locations of hospitals, schools, and dams in relation to the location of liquefaction-potential zones, fault lines, and landslides.
- Use of Geographic Information Systems (GIS) (which include earthquake-hazards map data) by Provo, Orem, Layton, and Parowan cities; and by Weber County.
- Salt Lake County Planning Division's mapping of locations of fault, liquefaction, and geotechnical subsurface investigations.
- Completion by the Davis County Sheriff's Office of research on the hazard of the Farmington landslide.
- Utah Power's requirement of a geotechnical study that includes a liquefaction potential analysis for all of its new buildings.
- Kennecott's completion of a state-of-the-art hazard assessment of the northern Oquirrh mountain region.

Strategy 4.2: Perform geologic hazards investigations for critical public facilities.

- Integration of geologic-hazard information into the VA Medical Center building improvements.

Strategy 4.3: Make land use compatible, through local government ordinances, with known hazards.

- Strict enforcement of existing zoning ordinances by many cities and counties.

Strategy 4.4: Ensure design professionals and building officials are kept current on relevant geoscience information.

- Press release and presentation of latest earthquake probabilities to the USSC.
- Presentations by the UGS to the Construction Specification Institute and the Utah League of Cities and Towns

Strategy 4.5: Determine appropriate seismic criteria and procedures for evaluating performance of existing dams.

- UUSS's publication of the results of a study that guides the determination of an "Operating Basis Earthquake" (OBE) design parameter required as part of a seismic-hazard analysis of any new dam built in the state.

- Completion of geologic mapping of 125 Utah dams by the Utah Division of Water Rights; some required trenching data while others only required fault activity analysis.

- Determination of Maximum Credible (MCE) and Operating Basis (OBE) earthquakes for all long-term storage/high hazard dams by the state's Division of Water Rights.

- Continued evaluation of all of its dams by the U.S. Bureau of Reclamation; recent modification of Steinacker and Pineview Dams and on-going modification of Scofield Dam.

- Kennecott's study of the east Great Salt Lake fault in advance of its tailings modernization project and earthquake risk evaluation of various company facilities.

Strategy 4.6: Reduce earthquake-induced liquefaction risk to highway structures.

- The Utah Department of Transportation's (UDOT) empaneling of a Seismic Advisory Committee to help ensure appropriate liquefaction designs associated with the rebuilding of I-15.

- UDOT funding for liquefaction evaluation of bridges statewide.

Strategy 4.7: Determine appropriate seismic design coefficients for highway bridges.

- Completion of a seismic hazard analysis by UDOT and review by the Seismic Advisory Committee to specify seismic design parameters for the reconstruction of I-15 in the Salt Lake Valley.

Strategy 4.8: Develop incrementally a strong-motion program.

- The UUSS development of a program for a near-real-time strong-motion monitoring network along the Wasatch Front for rapid post-earthquake alert.

- UUSS installation of an accelerograph at the Jordanelle Dam site in September 1995 with funding from the U.S. Bureau of Reclamation.

- Deployment of seven accelerographs by the UGS under the Utah Strong-Motion Instrumentation Program (USMIP) in early 1996.

Strategy 4.9: Develop a statewide, real-time earthquake monitoring system.

- Sustainment of the seismograph monitoring program in the state by a budget increase for the UUSS from the Utah Legislature in 1994, which also facilitated 1) establishing three new monitoring stations in southwestern Utah, 2) a satellite link to the U.S. National Seismograph Network, and 3) studies of mining-induced seismicity in the major coal-mining districts of Carbon and Emery Counties.

- Development and testing of a UUSS system that remotely interrogates central-recording computers for updating earthquake information and determines and broadcasts via pager the location and size of significant earthquakes within minutes of occurrence.

- Soldier Creek and Jordanelle Dams' strong-motion instruments.

- Kennecott's seismic monitoring instruments in the Oquirrh Mountains.

Strategy 4.10: Monitor faults using Global Positioning System (GPS) measurements.

- GPS Surveys during the summers of 1994 and 1995 along the Wasatch fault by the Department of Geology and Geophysics at the University of Utah.

Objective 5: Assess Earthquake Risk

Any structural improvements mentioned in the foregoing objectives that included an assessment of earthquake risk should be considered to be positive contributions to this objective as well. With regard to the additional comments listed below, thorough risk assessments of *direct* losses from earthquakes should include assessment of *indirect* losses as well. But the latter are often precluded by funding shortages and/or lack of time and expertise. Only those questionnaires that specifically mentioned indirect loss assessments are reflected in figure 6. Similarly,

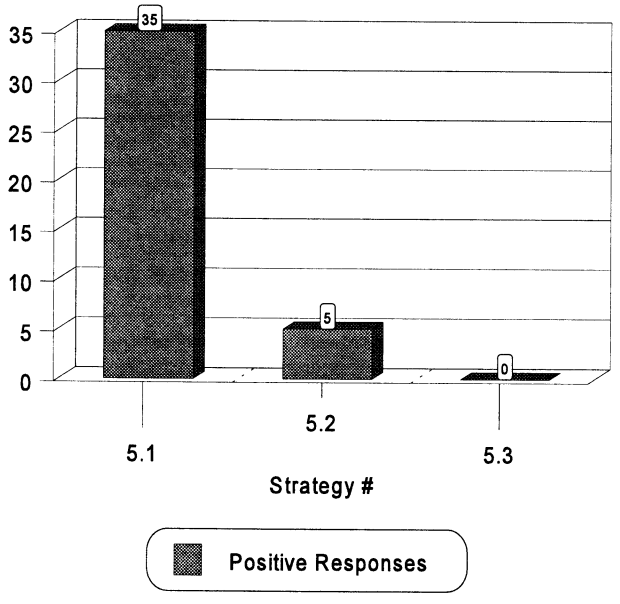


Figure 6. *Objective 5 strategies.*

specific reference to lifelines was not made on the questionnaire; actual progress in this area (strategy 5.3) may not have been reflected as a result. Few hospitals in the state mentioned that risk assessments had been performed during the past two years. Only four of those responding reported any activity at all. This does not preclude the possibility, however, that assessments were completed prior to 1994.

Strategy 5.1: Update estimates of direct losses expectable from earthquakes and Strategy 5.2: Evaluate the indirect losses associated with earthquakes (combined).

- Tooele Army Depot's quantitative risk assessment of its Chemical Disposal Facility.
- CEM's EPP's receipt of training for the new FEMA risk assessment program called "HAZUS" that provides the analytical capabilities to give any jurisdiction a reasonable idea of losses after an earthquake when used in conjunction with various local data bases.
- Completion of a report by the Applied Technology Council (ATC-36) updating their comprehensive loss estimation methodology and applying it to Salt Lake County for a large-magnitude earthquake on the Wasatch fault.
- Tooele County's hazard and vulnerability analysis of Tooele and Rush Valleys.
- The state's Division of Risk Management requirement that all covered entities appoint a Risk Control Committee to identify, prioritize, and mitigate problems relative to safety, to include seismic risk.
- Mountain Fuel's ongoing evaluation of seismic risk as a part of the design process for new pipelines.
- Completion by Weber and Tooele Counties of studies that include indirect damage assessments.

Strategy 5.3: Conduct lifeline collocation vulnerability studies.

- No responses.

USSC PRIORITIES

Although further progress with each of the strategies as noted above is encouraged by the USSC, the three priority strategies presented to the governor and the 1996 Legislature listed below will continue to be stressed. The emphasis remains on increasing awareness and reducing vulnerability as top priorities. *Although these high-priority actions may seem expensive, the even greater costs incurred by a large earthquake must be considered when assessing their benefits.*

1) Improve earthquake resistance of state-owned buildings (strategy 3.4). Many older state-owned buildings are likely to be severely damaged and cause significant death and injury in a moderate-to-large earthquake. The state needs to evaluate its building inventory and implement a long-term plan to improve the seismic resistance of its hazardous buildings. (Cost: $10.5 million/year for 25 years)

2) Measure strong earthquake ground shaking (strategies 4.8 and 4.9). There is a lack of Utah-specific data for local earthquake engineering and no means to rapidly assess and deliver strong-ground-shaking information to guide response and recovery efforts. We need appropriate instrumentation for measuring strong earthquake ground shaking in urban areas that will:

- Characterize strong ground shaking for engineering evaluation and design.
- Determine the influence of local soils, topography, and geology on ground shaking.
- Rapidly determine the severity and extent of damaging ground shaking for emergency response and recovery.

(Cost: $200,000/year on-going)

3) Improve earthquake awareness and education (strategy 1.1). This priority supplements existing programs and targets groups having an impact on loss reduction with:

- Materials to include in Utah science core curricula.
- An awareness campaign for the general public.
- Earthquake-focused workshops for schools, business, industry, professional groups, and local governments.
- Utah-specific earthquake literature.
- A Utah Earthquake Resources Guide.

(Cost: $155,000 first year; $95,000/year on-going)

CONCLUSIONS AND PERSPECTIVE

Significantly improving earthquake safety is a long-term, but cost-effective process that requires vigilance and a strong commitment to public safety and well-being. This report documents that many businesses, individuals, school districts, state agencies, and local governments are taking the earthquake threat seriously and are making progress in improving earthquake safety on many fronts. Most of their work relates to improving awareness and preparedness, and generally involves lower-cost strategies. The higher-cost engineering, architecture, and lifelines/infrastructure strategies are not being pursued as actively, although some organizations are leading the way. We have a sufficient geoscience understanding of earthquake hazards to pursue loss reduction, although some critical information and resources are still lacking, particularly with regards to instrumentation. Risk assessments, which are the basis for determining the cost-effectiveness of various strategies, are becoming more common but are not routinely performed.

Most initiatives to improve earthquake safety in Utah are being implemented by individuals, local governments, and the private sector. Some projects are being initiated through state leadership and

funding, such as seismic upgrading of I-15 during the pending reconstruction, but much more state-level effort is needed to meet the objectives of the *Strategic Plan.* The USSC will continue to support earthquake safety measures on all fronts including the state level, but will emphasize work with local government and private industry where interest is high. We are pleased with the level of action being taken, particularly in view of the lack of regular "reminder" earthquakes to help keep awareness levels high.

ACKNOWLEDGMENTS

We thank the many individuals who responded to the questionnaires. Their initiative and dedication is responsible for the success of the earthquake safety program in Utah. Gary E. Christenson of the Utah Geological Survey and Bob Carey of the Division of Comprehensive Emergency Management (both are members of USSC standing committees) reviewed drafts of the report, lending critical guidance pertaining to both content and format. Brenda Edwards of CEM reviewed a draft of the report and provided support with mailings of the questionnaires and preparation of this report.

APPENDIX A
QUESTIONNAIRE

The Utah Seismic Safety Commission (USSC) is gathering information on Utah's progress in improving earthquake safety during the time period of 7/1/94 thru 6/30/96. The information will be published in the USSC annual report in which you will be acknowledged as a contributor. Please fill out the following questionnaire and return by July 12, 1996. Please make copies and distribute them to those that you believe would provide us with additional information.

Name_____ Telephone_____

Organization_____ FAX number_____

Address_____

PLEASE DESCRIBE ACTIVITY UNDER APPROPRIATE CATEGORY BELOW.

1. Increase Earthquake Awareness and Education
   For Example: Agency/business meeting held to address actions/needs in an earthquake; School district put earthquake science/awareness in the school curriculum.

2. Improve Emergency Response and Recovery
   For Example: Community emergency response team (CERT) formed and trained; An inventory of communications equipment made to upgrade the capabilities in an earthquake; Hospital planned an exercise training program for earthquake response preparedness.

3. Improve the Seismic Safety of Buildings and Infrastructure
   For Example: A parapet was braced and roof anchors installed in a downtown business; Government building assessed for structural damage in the event of an earthquake.

4. Improve Essential Geoscience Information
   For Example: Mapping of urban earthquake-prone areas began; seismic study completed; Geologic-hazard ordinance adopted.

5. Assess Earthquake Risk
   For Example: updates of estimates of direct losses expectable from an earthquake began; Indirect losses associated with an earthquake identified.

Please include any additional comments or suggestions. Use the back of sheet if needed.

APPENDIX B
Legislative Creation of the Utah Seismic Safety Commission

UTAH SEISMIC SAFETY COMMISSION
1994
GENERAL SESSION

Enrolled Copy
H. B. No. 358

By Kim R. Burningham
Nancy S. Lyon
Afton B. Bradshaw

AN ACT RELATING TO STATE AFFAIRS IN GENERAL; CREATING A UTAH SEISMIC SAFETY COMMISSION; DEFINING MEMBERSHIP; PROVIDING DUTIES AND RESPONSIBILITIES; PROVIDING A SUNSET DATE; AND PROVIDING AN EFFECTIVE DATE.

THIS ACT AFFECTS SECTIONS OF UTAH CODE ANNOTATED 1953 AS FOLLOWS:

AMENDS:

63-55-263, AS LAST AMENDED BY CHAPTERS 13, 66, 212, AND 234, LAWS OF UTAH 1993

ENACTS:

63C-2-1, UTAH CODE ANNOTATED 1953
63C-2-Z, UTAH CODE ANNOTATED 1953
63C-2-3, UTAH CODE ANNOTATED 1953
63C-2-4, UTAH CODE ANNOTATED 1953

Be it enacted by the Legislature of the state of Utah:

Section 1. Section 63-55-263, Utah Code Annotated 1953, as last amended by Chapters 13, 66, 212, and 234, Laws of Utah 1993, is amended to read:

63-55-263. **Repeal dates, Title 63, 63A, and 63C.**

(1) Sections 63A-4-204 and 63A-4-205, authorizing the Risk Management Fund to provide coverage to non-state entities, are repealed July 1, 1996.

(2) The Board of Parks and Recreation, created in Sections 63-11-12 and 63-34-3, is repealed July 1, 1997.

(3) Title 63, Chapter 25, Commission on Criminal and Juvenile Justice, is repealed July 1, 2002.

(4) The Resource Development Coordinating Committee, created in Section 63-28a-2, is

repealed July 1, 1994.

(5) (a) The Department of Natural Resources, created in Section 63-34-3, is repealed July 1, 1999.

(b) The Board of Water Resources, created in Sections 63-34-3 and 73-10-1.5, is repealed July 1, 2001.

(c) The Board of State Lands and Forestry, created in Sections 63-34-3 and 65A-1-2, is repealed July 1, 1999.

(d) The Board of Oil, Gas and Mining, created in Sections 40-6-4 and 63-34-3, is repealed July 1, 2003.

(e) The Board of Parks and Recreation, created in Sections 63-11-12 and 63-34-3, is repealed July 1, 1997.

(f) The Wildlife Board, created in Sections 23-14-2 and 63-34-3, is repealed July 1, 1999.

(g) The Board of Big Game Control, created in Sections 23-14-5 and 63-34-3, is repealed July 1, 1999.

(h) The Riverway Enhancement Advisory Council, created in Section 63-34-3, is repealed July 1, 1999.

H. B. No. 358

(i) The Great Salt Lake Advisory Council, created in Sections 63-34-3 and 65A-10-5, is repealed July 1, 1999.

(j) The Board of the Utah Geological Survey, created in Sections 63-34-3 and 63-73-2, is repealed July 1, 1999.

(k) The Water Development Coordinating Council, created in Sections 63-34-3 and 73-10c-3, is repealed July 1, 2001.

(l) The Division of Water Rights, created in Sections 63-34-3 and 73-2-1.1, is repealed July 1, 2001.

(m) The Division of Water Resources, created in Sections 63-34-3 and 73-10-18, is repealed July 1, 2001.

(n) The Division of Parks and Recreation, created in Section 63-34-3, is repealed July 1, 1997.

(o) The Division of Oil, Gas and Mining, created in Sections 63-34-3 and 40-6-15, is repealed July 1, 2003.

(p) The Division of Geological Survey, created in Section 63-34-3 and Title 63, Chapter 73, is repealed July 1, 1999.

(6) (a) The Office of Internal Audit, created in Section 63-49-7, is repealed July 1, 2001.

(b) The Office of Comptroller, created in Section 63-49-7, is repealed July 1, 2001.

(c) The Office of Planning and Programming, created in Section 63-49-7, is repealed July 1, 2001.

(d) The Office of Community Relations, created in Section 63-49-7, is repealed July 1, 2001.

(e) The Maintenance Division, created in Section 63-49-8, is repealed July 1, 1995.

(f) The Construction Division, created in Section 63-49-8, is repealed July 1, 1997.

(g) The Preconstruction Division, created in Section 63-49-8, is repealed July 1, 1997.

(h) The Safety Division, created in Section 63-49-8, is repealed July 1, 1999.

(i) The Right-of-way Division, created in Section 63-49-8, is repealed July 1, 1995.

(j) The Aeronautical Operations Division and Aeronautical Committee, created in Sections Z-1-12 and 63-49-8, are repealed July 1, 1995.

(k) District management offices, created in Section 63-49-9, are repealed July 1, 2001.

(l) The Transportation Commission, created in Section 63-49-10, is repealed July 1, 1995.

(7) The Utah Constitutional Revision Study Commission, created in Section 63-54-1, is repealed July 1, 1998.

(8) The Crime Victims' Reparations Board, created in Section 63-63-4, is repealed July 1, 1997.

(9) The Utah Seismic Safety Commission, created in Section 63C-2-1, is repealed July 1, 2004.

Section 2. Section 63C-2-1, Utah Code Annotated 1953, is enacted to read:

63C-2-1. **Creation of commission -- Membership -- Appointment --Vacancies.**

(1) There is created the Utah Seismic Safety Commission consisting of 13 members, designated as follows:

(a) the commissioner of the Department of Public Safety:

(b) the director of the Division of Comprehensive Emergency Management:

(c) the director of the Utah Geological Survey:

(d) the director of the University of Utah Seismograph Stations:

(e) the executive director of the Utah League of Cities and Towns or his designee:

(f) a representative from the Structural Engineers Association of Utah biannually selected by the membership:

(g) the director of the Division of Facilities and Construction Management or his designee:

(h) the executive director of the Department of Transportation or his designee:

(i] the State Planning Coordinator or his designee:

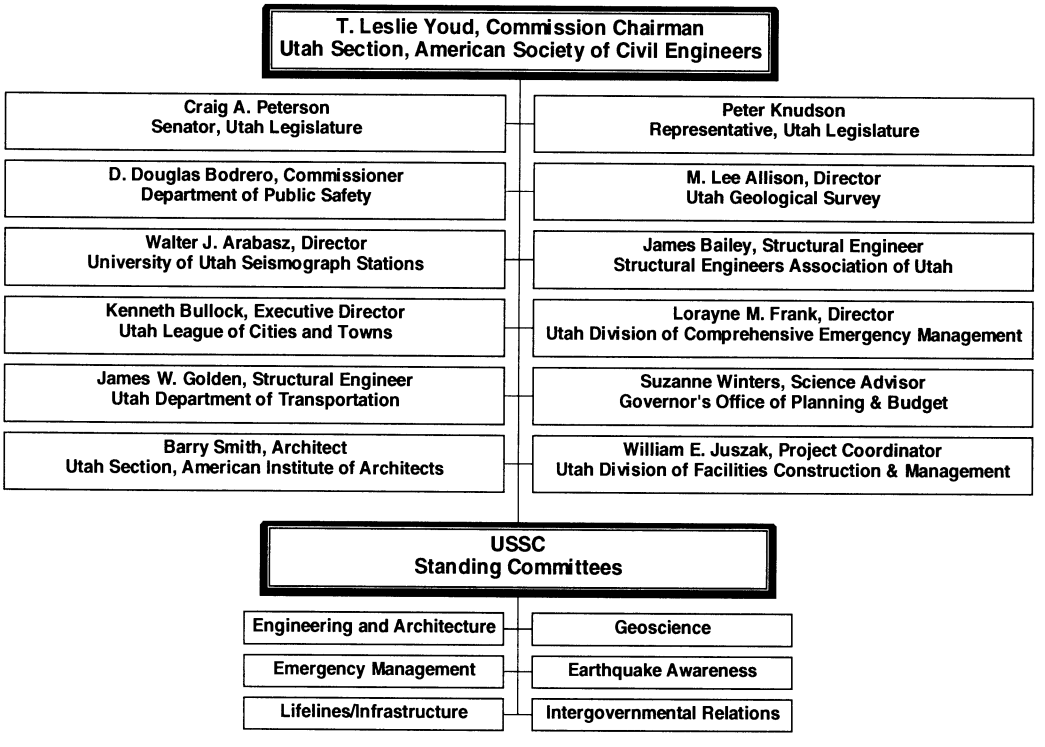
(i) a representative from the American Institute of Architects, Utah Section, biannually selected by the membership:

(k) a representative from the American Society of Civil Engineers, Utah Section, biannually selected by the membership:

(l) a member of the House of Representatives appointed biannually By the speaker of the House: and

(m) a member of the Senate appointed biannually by the president of the Senate.
(2) The commission shall annually select one of its members to serve as chair of the commission.
(3) Vacancies occurring on the commission shall be filled by the appointing authority for the position for the balance of the unexpired term.
Section 3. Section 63C-2-2, Utah Code Annotated 1953, is enacted to read:
63C-2-2. **Meetings -- Duties -- Committees.**
(1) The commission shall meet at the call of the chair. but not less than once each quarter.
(2) The commission shall:
(a) review earthquake-related hazards and risks to the state of Utah and its inhabitants:
(b) prepare recommendations to identify and mitigate these hazards and risks:
(c) prioritize recommendations and present them to state and local government or other appropriate entities for adoption as policy or loss reduction strategies:
(d) act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures:
(e) prepare a strategic seismic planning document to be presented to the State and Local Interim Committee before the 1995 annual general session of the Legislature: and
(f) periodically update the planning document and monitor progress toward achieving the goal of loss reduction.
(3) The commission may divide into or create subcommittees as it determines necessary to carry out its duties under this section.
Section 4. Section 63C-2-3, Utah Code Annotated 1953, is enacted to read:
63C-2-3. **Compensation of Members -- Per diem.**
(1) Members of the commission who are employees of a state or local governmental entity shall serve without pay or compensation for their services but may receive per diem and travel expenses in accordance with Division of Finance rules.
(2) Members of the commission who are not employees of a state or local governmental entity shall receive per diem and travel expenses in accordance with Division of Finance rules.
Section 5. Section 63C-2-4, Utah Code Annotated 1953, is enacted to read:
63C-2-4. **Staffing.**
Staff support to the commission shall be provided By the Division of Comprehensive Emergency Management and the Utah Geological Survey.
Section 6. **Effective Date.**
This act takes effect on July 1, 1994.

APPENDIX C
USSC Members and Standing Committees



THE STANDING COMMITTEES OF THE USSC

Engineering and Architecture - Earle Eppich, Chairperson (Reaveley Engineers & Associates)

James S. Bailey	Structural Engineer, Allen & Bailey Engineers
Thair Blackburn	Blackburn Architects
Parry Brown	Reaveley Engineers & Associates, Inc.
William Dunn	Dunn Associates, Inc.
Carl Eriksson	Inspections Services Manager, Salt Lake County Development Services
Max A. Gregersen	CEntry Contractors & Engineers, Inc.
William E. Juszcak	Project Coordinator, Utah Division of Facilities Construction and Management
Barry Smith	Hart Fisher & Associates

Geoscience - Walter J. Arabasz, Acting Chairperson (Director, University of Utah Seismograph Stations)

Jon E. Bischoff	Materials & Research, Preconstruction Division, Utah Department of Transportation
Ronald L. Bruhn	Professor, Department of Geology & Geophysics, University of Utah
Gary E. Christenson	Manager, Applied Geology, Utah Geological Survey
Marvin W. Halling	Assistant Professor, Department of Civil & Environmental Engineering, Utah State University
Jeffrey R. Keaton	Senior Engineering Geologist & Vice President, AGRA E&E, Inc.
William R. Lund	Senior Scientist, Applied Geology, Utah Geological Survey
James C. Pechmann	Research Associate Professor, Department of Geology & Geophysics, University of Utah
Kyle M. Rollins	Assistant Professor, Department of Civil Engineering, Brigham Young University
T. Leslie Youd	Department of Civil Engineering, Brigham Young University

Emergency Management - Pat Lewis, Chairperson (Divisional Claims Superintendent, State Farm Insurance Company)

Roger Anderson	Assistant Director, Davis County Emergency Services
Jane Z. Zhang	Emergency Preparedness Coordinator, Utah Office of Education

Robert D. Carey	Earthquake Program Manager, Utah Division of Comprehensive Emergency Management
Andy Glad	Assistant Chief, Sandy City Fire Department
Deborah H. Kim	Emergency Services and Trauma Coordinator, University of Utah Medical Center
Karen Mayne	Staff Adjutant/Coordinator, Provo City Police Department
Bob Nielson	Supervisor of Security Services, Mountain Fuel Supply Company
Paul Wanlass	Technical Assistant, Salt Lake County Water Conservancy District

Awareness and Education - M. Lee Allison, Acting Chairperson (Director, Utah Geological Survey)

Pat Iannone	Director, Utah Association of Realtors
Gary Madsen	Professor, Department of Sociology, Utah State University
Deedee O'Brien	Outreach Coordinator, College of Mines & Earth Sciences, University of Utah
Kathy Ochsenbein	Science Department Head, Roy Junior High School
Ed O'Sullivan	Quake Pro
Patrick Reese	Emergency Response Officer, The Church of Jesus Christ of Latter-day Saints
Alan D. Rindlisbacher	Director of National Development, Division of Business and Economic Development, Utah Department of Community and Economic Development
Michael W. Stever	Emergency Program Manager, Salt Lake City Department of Management Services
Chris Kramer	Public Information Officer, Division of Comprehensive Emergency Management
Joni Whitear	Fire Claims Superintendant, State Farm Insurance Companies
Judy Johnson	Agency Field Executive, State Farm Insurance Companies

Intergovernmental Relations

(Not yet empaneled)

Lifelines/Infrastructure

(Not yet empaneled)

APPENDIX D
STRATEGIC PLAN'S OBJECTIVES AND STRATEGIES

Objective 1: Increase earthquake awareness and education

Strategies
- 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.

Objective 2: Improve emergency response and recovery

Strategies
- 2.1 Establish Community Emergency Response Teams (CERTs) statewide.
- 2.2 Develop effective exercise and training programs for hospitals.
- 2.3 Enhance communication capabilities for emergency responders.
- 2.4 Enhance the integrated emergency management system statewide.

Objective 3: Improve the seismic safety of buildings and infrastructure

Strategies
- 3.1 Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.
- 3.2 Enforce the state amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when reroofing their buildings.
- 3.3 Improve the post-earthquake operational status of essential service buildings.
- 3.4 Reduce structural hazards of government-owned buildings.
- 3.5 Mitigate nonstructural hazards in government-owned and -leased buildings.
- 3.6 Improve safety of older public school buildings.
- 3.7 Improve safety and operational ability of older hospital buildings.
- 3.8 Improve safety of older high-occupancy buildings (250 persons or more) to be structurally competent to withstand moderate to large earthquakes.
- 3.9 Improve the seismic safety of older homes.
- 3.10 Improve safety of mobile homes.
- 3.11 Prevent loss of historic buildings.
- 3.12 Improve lifeline survivability in the event of an earthquake.
- 3.13 Improve earthquake performance of water and waste-water systems.

Objective 4: Improve essential geoscience information

Strategies
- 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.
- 4.6 Reduce earthquake-induced liquefaction risk to highway structures.
- 4.7 Determine appropriate seismic design coefficients for highway bridges.
- 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.

Objective 5: Assess earthquake risk

Strategies
- 5.1 Update estimates of direct losses expectable from earthquakes.
- 5.2 Evaluate the indirect losses associated with earthquakes.
- 5.3 Conduct lifeline collocation vulnerability studies.

Appendix E
List of Responders to Questionnaire

The following contributors responded to the questionnaire in appendix A. The USSC thanks these organizations, agencies, industry leaders, and administrators for their time and dedication to the cause of reducing the earthquake threat in Utah and for responding to the questionnaire.

CITIES AND TOWNS

Alpine
Alta
Bountiful
Brigham City
Centerville
Charleston
Clearfield
Clinton
Coalville
Ephraim
Fillmore
Fruit Heights
Harrisville
Heber City
Hinckley Town
Hyde Park
Kanab
La Verkin
Layton
Mapleton
Mt. Pleasant
Murray
North Logan
North Ogden
Ogden
Orem
Parowan
Provo
Richfield
Richmond
Riverton
Salina
Salt Lake
Sandy
Santa Clara
Santaquin
South Weber
South Jordan
Spanish Fork
Spring City
Springville
Sunset City
Syracuse City
West Valley
West Jordan
West Point
Willard
Woodland Hills

COUNTIES

Box Elder
Cache
Davis
Duchesne
Garfield
Juab
Kane
Morgan
Salt Lake
Sanpete
Sevier
Tooele
Utah
Washington
Weber

PROFESSIONAL ORGANIZATION

Association for Women Geoscientists

STATE AND FEDERAL GOVERNMENT

Central Utah Water Conservancy District
Department of Corrections
Department of Human Services
Department of Transportation
Department of Natural Resources
Department of Commerce
Department of Environmental Quality
Department of Public Safety
Division of Business and Economic Development
Division of Comprehensive Emergency Management
Division of Risk Management
Division of Facilities Construction and Management
Federal Highway Administration
Hill Air Force Base
Internal Revenue Service
State Fire Marshall
State Office of Education
Tooele Army Depot
U.S. Bureau of Reclamation
U.S. Geological Survey
U.S. Small Business Administration
Utah Highway Patrol
Utah Geological Survey
Utah Division of Water Rights
Utah State Tax Commission

SCHOOL DISTRICTS

Beaver
Cache
Daggett
Davis
Duchesne
Grand
Granite
Iron
Jordan
Judge Memorial
Kane
Logan City
Millard
Morgan
Murray
North Summit
North Sanpete
Piute
Provo
Salt Lake
Sevier
South Summit
Tintic
Tooele
Washington
Weber

INSTITUTIONS OF HIGHER EDUCATION

Brigham Young University (Department of Geology, Emergency Preparedness Office)
College of Eastern Utah (Prehistoric Museum)
Salt Lake Community College
University of Utah (Seismograph Stations, Meteorology Department, Department of Geology and Geophysics)
Utah State University (Department of Geology)

BUSINESSES, INDUSTRY, PUBLIC UTILITIES

Alliant Techsystems
Albertson's, Inc.
Associated Food Stores
Becton Dickinson & Co.
Calder - Kankainen
CEntry Constructors and Engineers
Consulting Engineer Council
Curtis Engineers, Inc.
DMJM
E.A. Miller Inc.
First Security Corporation
Franklin Quest Co.
Harmon City, Inc.
Heath Engineering Co.
Karren & Associates
Kennecott Corporation
Larsen and Malmquist, Inc.
Litton Guidance & Control Systems
Matrixx Marketing
Mervyn's Utah Distribution Center
Moroni Feed Company
Mountain Fuel Supply Co.
National Semiconductor Corporation
Pacific Power/Utah Power
Parsons - Brinkerhoff
Perpetual Storage, Inc.
R C Willey Home Furnishings
State Farm Insurance Companies
Thiokol Corporation
UNISYS Corporation
Utah Transit Authority
Utah PTA

HEALTH CARE FACILITIES

Alta View Hospital
American Fork Hospital
Bear River Valley Hospital
Beaver Valley Hospital
Brigham City Community Hospital
Castleview Hospital
Columbia St. Mark's Hospital
Columbia Mountain View Hospital
Davis Hospital and Medical Center
Dept. of Veteran Affairs Medical Center
Fillmore Community Medical Center
Garfield Memorial Hospital
Gunnison Valley Hospital
IHC Hospitals of Utah County
Lakeview Hospital
Milford Valley Healthcare Services
Ogden Regional Medical Center
Olympus View Hospital
PHC Regional Medical Center
Primary Children's Hospital
Salt Lake Regional Medical Center
Sanpete Valley Hospital

MEDIA

KTVX-TV Channel 4
KUED-TV Channel 7
The Salt Lake Tribune