Fault Line Forum
Volume 11, Number 1-2 • 1995

A Strategic Plan for Earthquake Safety in Utah

by Janine L. Jarva
Utah Geological Survey

In the previous issue of the *Fault Line Forum* (v. 10, no. 4, p. 1-3), we indicated that we would use several issues to highlight individual strategies contained in *A Strategic Plan for Earthquake Safety in Utah*. The *Plan's* 33 strategies are grouped under five key objectives. We began by focusing on the strategies of the first key objective, to increase earthquake awareness and education. In this issue, we reprint the strategies contained in the second key objective, to improve emergency response and recovery.

Anyone interested in obtaining a copy of *A Strategic Plan for Earthquake Safety in Utah* can contact Janine Jarva, Utah Geological Survey, 2363 South Foothill Drive, Salt Lake City, UT 84109-1491, (801) 467-7970, fax (801) 467-4070, e-mail address: nrdomain.nrugs.jjarva@email.state.ut.us, or Judy Watanabe, Utah Division of Comprehensive Emergency Management, 1110 State Office Building, Salt Lake City, UT 84114, (801) 538-3400, fax (801) 538-3770.

. . . strategies to improve emergency response and recovery.

STRATEGY: Establish community emergency response teams (CERTs) statewide.

Output: Trained volunteer community emergency response teams exist statewide.

Outcome: Reduce life, property, and environmental loss by providing more immediate response in a disaster.

Background

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

Implementation

Four steps are required: (1) orient elected officials, policy makers, police, and fire and emergency management personnel in the use of volunteers in disaster response; (2) identify citizen groups and volunteer organizations; (3) distribute information and hold workshops through local public safety organizations and community service groups; and (4) continue to provide technical assistance and recertification to CERTs wishing to provide community-based relief. The steps would be accomplished under the direction of local Emergency Program Managers, with assistance of fire and rescue agencies to train volunteer community emergency response teams and team leaders.

Responsible Agencies

Utah Division of Comprehensive Emergency Management (CEM)
Local Emergency Program Managers
Fire and medical agencies
Community groups of all types

Resources Needed

Funding needed to provide CERT instructors to train local volunteers groups, to provide CERT safety equipment and basic supplies, and to manage and track statewide CERT teams and resources: approximately $100 per volunteer. Local governments within Salt Lake County began pilot training programs in 1994. Trainers currently volunteer their time free-of-charge. CEM would like to provide CERT training to 30 Utah communities with populations of 100,000 or less, annually. It would take about 15 years to offer training to most communities statewide. If training for two classes of 25 volunteers each are run in each of 30 communities, annual cost would be approximately $150,000.

STRATEGY: Develop effective exercise and training programs for hospitals.

OUTPUT: All hospital staff are trained for earthquake emergency response including implementing a standardized triage system.

OUTCOME: Hospitals are prepared for earthquake response.

Background

Past exercises have revealed inadequacies in response-related operations. Hospitals need to ensure their facilities are operational after an earthquake. This would require training and exercising hospital response plans, as well as interaction between hospitals and coordination with local emergency management officials. Hospitals need to routinely schedule exercises individually and in conjunction with other hospitals and local officials. All hospitals should exercise using a standardized triage system with universal triage tags. This system would save time, lessen confusion, and, most importantly, save lives. A universal triage system would be critical in mutual medical aid situations where emergency room staff are working in hospitals other than their own.

Implementation

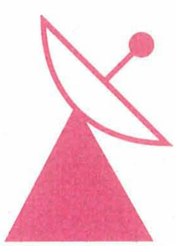
There are six elements to preparing Utah hospitals for an earthquake emergency: (1) accurately identify each hospital's capabilities and seismic vulnerability; (2) enhance communication for air traffic at each hospital; (3) train hospital staff on ARES/RACES (amateur radio operators emergency systems) capabilities; (4) provide training as part of the hospital's policies; (5) establish continuing education goals; and (6) standardize hospital triage systems and encourage comprehensive seismic safety education programs for hospital personnel. Exercises to test hospital emergency response plans should be held periodically.

Responsible Agencies

Utah Division of Comprehensive Emergency Management (CEM)
Utah Hospital Association
Utah Department of Health
Local emergency management officials
Local governments
Local fire and police departments

Resources Needed

CEM's Exercise Program specializes in writing and conducting exercises. Developing and conducting a hospital-specific earthquake-scenario exercise centered around a standardized triage system would cost approximately $50,000.



OUTPUT: Develop a communication system that will allow for the use of new technologies and provide the capability of expansion during peak disaster use.

OUTCOME: Emergency response capability will be enhanced because the new communication system will allow for the interoperability of agencies to meet the requirements of multi-agency response.

Background

Public safety and local governmental agencies in Utah currently operate radio systems in the VHF 150 and UHF 450 frequency band. The availability of additional frequencies in these two bands for system expansion is very limited. With the advancement of technology comes the responsibility to develop a system that will allow for the use of this new technology. We must ensure that the system allows for the interoperability of agencies to meet the requirements of multi-agency response. Most agree that radio coverage, combined with inadequate channel allocations, are the biggest problems in meeting the objectives of protection of life and property.

During emergency situations, history continues to repeat itself with the inability of agencies to communicate with each other in an effective manner.

Implementation

A new communication network that will support both voice and data applications and accommodate current and future requirements needs to be developed. The system should support city, county, state, and federal agencies. All government agencies that are users or will have future communication needs will be requested to evaluate their present capabilities and their future communication requirements.

Responsible Agencies

Utah Division of Information Technology Services
Utah Department of Public Safety
ARES/RACES (amateur radio operators organizations)
Local governments
State agencies

Resources Needed

An 800 MHz system is currently being evaluated for future communication needs for the state, including emergency response. Preliminary estimates indicate the initial phase of conversion from the present system will cost up to $10 million.

STRATEGY: Enhance the integrated emergency management system statewide.

OUTPUT: An integrated emergency management system at all levels of government and the private sector to protect life, health, property, and the environment.

OUTCOME: All jurisdictions and agencies can more fully utilize their resources to respond to any type of a disaster, including earthquakes.

Background

As Utah's population, infrastructure, and economy continue to grow, it becomes an increasing challenge for all agencies to inventory and utilize their resources. City, county, and state governments have designated Emergency Coordinators to prepare and conduct mitigation, preparedness, response, and recovery operations. These Coordinators are also responsible for exercising and evaluating their plans. Emergency planning and operation evaluation is an ongoing process. This should lead to a higher level of response proficiency.

Implementation

Encourage a full-time Emergency Coordinator for each state agency. Increase training in Integrated Emergency Management concepts. Continue to exercise emergency plans.

Responsible Agencies

Utah Division of Comprehensive Emergency Management
State Emergency Response Teams (SERT)
County emergency management offices

Resources Needed

Funding for 1 FTE Emergency Coordinator in each of the 25 largest state agencies would cost approximately $48,500 per coordinator, or an approximate annual cost of $1,212,500.

Utah Seismic Safety Commission Meets with Governor

by Janine L. Jarva
Utah Geological Survey

The USSC met with Utah Governor Michael O. Leavitt on August 18, 1995 to present its *Strategic Plan for Earthquake Safety in Utah.* Recognizing that the Governor is uniquely positioned to take the long-term view and articulate to citizens and state agencies that the earthquake problem is serious and requires responsible action, the USSC requested that he set an example and take the lead on many of its highest-priority actions. The USSC wants to be able to say, "Utah should prepare for earthquakes and the state is willing to help." USSC Chairman T. Leslie Youd, Utah state Senator Craig A. Peterson, Utah state Representative Peter C. Knudson, Walter Arabasz (Director of the University of Utah Seismograph Stations), William Juszcak (Utah Division of Facilities Construction and Management), and Suzanne Winters (Governor's Science Advisor) represented the Commission at the presentation. We will report on the outcome of this meeting in the next issue of the *Fault Line Forum.*

Utah Seismic Safety Commission News

by Janine L. Jarva
Utah Geological Survey

"Now that A Strategic Plan for Earthquake Safety is completed, where do we go from here?"

The responsibility is not government's alone. All members of Utah society must accept responsibility and take actions necessary to reduce the risk from earthquake hazards.

In its quarterly meetings on April 20, 1995 and July 11, 1995, the USSC began to address the question, "Now that *A Strategic Plan for Earthquake Safety in Utah* is completed, where do we go from here?" The Commission approved an action plan put forward by Commissioner Lee Allison, detailing specific suggestions as to how the USSC can accomplish its mission. The proposal states, in part,

"The USSC recognizes that its charge from the state legislature is a continuing mission to effect long-term change and improvement in earthquake mitigation, preparedness, and response in all aspects of society. The responsibility is not government's alone. All members of Utah society must accept responsibility and take the actions necessary to reduce the risks from earthquake hazards. The USSC will use reports, hearings, and workshops to focus attention on implementing the *Strategic Plan* by all levels of government and by the private sector. The USSC will work as a facilitator to pull the separate parts together, coordinate individual actions, and assist the primary agencies in every possible way. The USSC will implement the *Strategic Plan* by supporting, encouraging, coordinating, and convincing the state operating agencies, local jurisdictions, businesses, and citizens to carry out the initiatives within their areas of responsibility."

Two specific actions that the USSC is currently considering are to sponsor an earthquake conference and to produce an annual review of mitigation and preparedness accomplishments and progress throughout Utah. A third action, to establish standing committees with specific charters, is already being undertaken by the Commission, as detailed below.

To encourage broader community involvement and input, a proposal to establish standing committees of the USSC was endorsed by the full Commission. The purpose of these standing committees will be to provide continuing guidance to the USSC on ways to carry out its mission and revise and implement the *Strategic Plan*. The missions of the standing committees are:

- **Engineering and Architecture**: ensure appropriate earthquake-resistant design and construction of buildings and other engineered structures, James S. Bailey, Acting Chair, (801) 328-0278.
- **Earth Sciences**: ensure adequate earthquake hazard assessment and monitoring, Walter J. Arabasz, Acting Chair, (801) 581-6274.
- **Emergency Planning**: ensure development and implementation of policies and procedures for state, local government, and private entities to adequately respond to an earthquake, Lorayne M. Frank, Acting Chair, (801) 538-3770.
- **Earthquake Awareness**: encourage citizens, businesses, and government to improve earthquake safety and preparedness through education, public information, and increased awareness, M. Lee Allison, Acting Chair, (801) 467-7970.
- **Intergovernmental Relations**: gain broad-based support for governmental action on the *Strategic Plan*, Suzanne Winters, Acting Chair, (801) 538-1038.

Acting committee chairs listed above have been appointed by the USSC from its membership. Acting chairs will assemble committee members to be confirmed by the USSC. Members of the committees must have experience in the committee's area of concern and have an interest in furthering the goals of the USSC. Committee members will serve two years and can be reappointed. Once established, each committee will elect a chair, who will serve one year and can be re-elected. There is no limit on the size of committees. The USSC may dissolve any committee at any time and create new committees as the need arises. Anyone interested in serving on a standing committee should contact the acting chair.

Carl Eriksson, Inspections Services Manager for Salt Lake County Development Services, attended a conference in Los Angeles sponsored by the California Office of Emergency Services, on the lessons learned one year after the Northridge earthquake of January 17, 1994. The USSC invited him to share his insights at its April 20 meeting. His prepared remarks are reproduced below:

My name is Carl Eriksson. I am the chief building official for Salt Lake County. I am also a licensed structural engineer and I have been involved with seismic issues in the state of Utah, working with the Utah Geological Survey and the Seismograph Station staff, for the past 11 years. Recently, I had the opportunity of attending a conference in Los Angeles regarding the

Northridge earthquake, which occurred on January 17, 1994. I was privileged to visit many of the damage sites, speak with many people there, and receive formal reports on what worked and what didn't. I am here today to report some of my findings regarding these issues. My intention in reporting these findings is not necessarily to endorse or sanction any particular action taken by California regarding earthquake preparedness and response, but rather to make you aware of some of the possibilities. The actions taken or being proposed in California fall into three different categories:

A. Laws that require seismically dangerous structures to be retrofitted.

B. Laws that create incentives to correct seismically dangerous structures.

C. Actions that provide assistance to local jurisdictions to deal with earthquakes.

The first category, requiring seismically dangerous structures to be retrofitted, was first established by the City of Long Beach in 1959, as a result of serious failures of parapets and unreinforced masonry buildings (URM's) in the 1933 Long Beach earthquake. Many other cities have followed suit and the State of California, acting on a recommendation of the California Seismic Safety Commission, passed SB 547 in 1986, requiring every jurisdiction to identify all URM's within their boundaries and to develop programs to mitigate these hazards. An example of a local law that has recently been adopted is found in San Diego. Effective January 1, 1994, their URM retrofitting ordinance requires owners of about 700 buildings (mostly built before 1939) to brace parapet walls and install floor-to-wall ties within five years of notification. Remodeling and repair can trigger additional steps. If an owner spends more than 50 percent of the building's value on retrofitting and repair during any five-year period, it must tie roof diaphragms to walls, or, in multistory buildings, tie floor diaphragms to walls. Spending 100 percent of the building's value requires a complete seismic retrofit within 10 years, as does converting more than 33 percent of the space to a higher occupancy use. The City of Los Angeles has an even stricter URM ordinance which went into effect in 1981. Retrofitting costs there have averaged $8 to $12 per square foot.

The possibility of such ordinances being adopted has historically been opposed by property owners, historic preservationists, and low income community representatives who fear the effort to increase earthquake safety could have negative consequences of large-scale urban redevelopment, or of devaluing their existing properties in which they may have large investments.

Such "unfunded mandates" as those adopted in California, impose heavy burdens on local jurisdictions; many California jurisdictions have simply not complied with the timetables for identifying URM's and developing mitigation programs. These laws, if enacted, might be more effective if combined with incentives which will diminish or offset the costs both to local jurisdictions and to building owners.

On January 1, 1993, a statewide law went into effect in Utah, requiring that all commercial buildings built before 1975 be evaluated for seismic hazards and that recommendations to correct the hazards be provided by the evaluating engineer. The law has been relatively ineffective, however, because the triggering mechanism is "when said building is undergoing reroofing, or alteration of or repair to" parapets, etc.

The second category, incentives to mitigate seismic hazards, would seem to respond to these problems. Among the possibilities are the following:

Point-of-Sale Incentives:

1. Require that any existing commercial or multi-family (more than two) residential building that is sold be inspected for earthquake hazards and that any hazards identified through the inspection be ameliorated by appropriate repairs. The inspection on commercial buildings would be limited to: parapets, cornices, tanks, towers, signs, statuary, and similar appendages that present falling hazards; inadequately connected roof and floor diaphragms in URM's; water heater tiedowns; and suspended ceilings and lights which historically have represented substantial losses in earthquakes, even in modern buildings.

2. Require that any existing one- or two-family dwelling that is sold be inspected for earthquake hazards and require that any hazards so identified be corrected. The inspection on such dwellings would be limited to chimneys and unreinforced masonry, foundation anchors, water heater tiedowns, and obvious structural problems.

3. Require that any building located in an area of surface-fault rupture or high liquefaction shall have notice given to any buyer, of the hazard associated with its location.

4. Provide tax incentives to building owners who voluntarily conduct seismic upgrades of their buildings, whether residential or commercial.

Insurance-Related Incentives:

5. Require all homes in Seismic Zone 3 for which new mortgages are issued, to purchase insurance from a state-operated insurance

> ***"On January 1, 1993, a statewide law went into effect in Utah, requiring that all commercial buildings built before 1975 be evaluated for seismic hazards and that recommendations to correct the hazards be provided by the evaluating engineer. The law has been relatively ineffective, however. . . "***

> **"... sends a message to each municipality that not only is the state asking you to prepare for an earthquake, they are also willing to help you with that preparation."**

fund to cover the first $5,000 to $10,000 (or 10 percent) of losses in an earthquake. It would be purchased at a price of about $1 per year per $1000 valuation of the dwelling. The money would be placed in a fund that would be used to assist homeowners after a major earthquake. In addition, this money could be used with item 2, above, by allowing the cost of corrections made in item 2 (not to exceed $5,000) to be added onto the loaned amount and insured by the state with these premiums.

6. *Limit financial aid to property owners who fail to obtain earthquake insurance, or distribute the available aid to property owners in a manner that significantly favors those who obtain earthquake insurance.*

Finally, the third category, assistance to local jurisdictions, sends a message to each municipality that not only is the state asking you to prepare for an earthquake, they are also willing to help you with that preparation. Here are two possible ways the state could help:

1. *Provide a state law that will allow the state CEM office to allocate engineers/inspectors to assist cities and counties in performing inspections. Currently, a number of jurisdictions have already established agreements with various engineers to work for them in an emergency; while this foresight on the part of these cities is commendable, it may result in very valuable resources being allocated where they are least needed. There needs to be a central clearinghouse to be sure that resources are appropriately distributed. This same state law could address the issues of immunity or protection for the volunteer engineers and inspectors and provide for methods of identification, reporting and record keeping, remuneration, etc.*
2. *The state could provide to local jurisdictions, sample ordinances that would address each of the areas of concern that come up, such as: waiving or deferral of permit fees, preservation of historic structures, emergency declaration ordinances, etc. Additionally, sample emergency response plans could be prepared for use by cities and counties. I have obtained a copy of the Los Angeles City emergency plan, which is impressive and most useful in helping to formulate our own plan. Many hours have been spent by our staff members in preparing a plan that is still only rudimentary when compared to the LA city plan.*

All the suggestions and ideas presented here deal with existing building inventory. The new codes and new code enforcement procedures that have been implemented over the past two years, will in large measure minimize the problems associated with new construction.

Our legislature has performed commendably in creating the Utah Seismic Safety Commission and they are to be complimented for their efforts. Likewise, I offer my praise to this commission for your efforts to bring about a consciousness of the earthquake threat in Utah and to take effective steps in preparing us for such an event.

Thank you for the opportunity to speak to you.

References and Selected Bibliography

1. "San Diego Implements Its Masonry Ordinance," Engineering New-Record (ENR), July 4, 1994, p. 11.

2. <u>An Action Plan for Reducing Earthquake Hazards in Existing Buildings</u>, FEMA Publication 90, 1985.

3. "Retroactive Earthquake Regulations in Long Beach," Buildings Standards Magazine, October, 1984, p. 21.

4. L.A. City Earthquake Safety Ordinance, Division 88 - Earthquake Hazard Reduction in Existing Buildings, Los Angeles Building Code, 1985 edition.

5. <u>A Guide to Reducing Losses from Future Earthquakes in Utah, Consensus Document</u>, Fifth Annual Workshop on Earthquake Hazards and Risk Along the Wasatch Front, Utah, Walter J. Arabasz, July, 1989.

6. 1994 Northridge Earthquake After-Action Report, draft copy, not published, K. Robert Ayers, May 13, 1994.

Some of the points brought out by Carl in the discussion following his prepared remarks included:

- In Salt Lake County, the location of homes in fault-rupture or liquefaction zones, is disclosed by the county recorder so that buyers are notified prior to sale.
- Salt Lake County emergency responders are well prepared for search and rescue, but little planning has been done for recovery and rebuilding.
- Emergency-response plans are being set up and many Salt Lake County inspectors/employees have 72-hour kits in their offices.
- New buildings in the county are seismically better, but the triggering mechanism for retrofitting existing URM buildings probably needs to be changed.
- Enforcement of seismic provisions of the Uniform Building Code is improving, but problems still exist in smaller jurisdictions; education and training of inspectors are needed for further improvement.
- Structural plan checks are not well done by all jurisdictions in Salt Lake County at this time; many cities must contract for plan-checking

services.
- Salt Lake County has completed a reconnaissance inventory of seismic resistance in buildings in the county and determined that 20-30 percent of the buildings are sufficiently suspect to merit more detailed investigation.

Other observations that arose in the discussion following Carl's presentation were:
- California has a large resource base for response and recovery, but Utah does not.
- California regulates many earthquake-related aspects of development, but Utah "dances around any form of regulation."
- California's position that "not only is the state asking you to prepare for an earthquake, they are also willing to help you with that preparation" is not the case in Utah and the Legislative and Executive branches of government show little inclination in this direction.
- We need a thorough building inventory to determine the extent of Utah's problem.
- We need to inventory city and county preparedness plans and capabilities and provide state help in developing emergency-response plans.
- It is timely for the USSC to summarize loss-reduction activities in the state to set examples and encourage others to action.
- We need to look at legal issues of emergency response (liabilities, licensing, inter-state cooperatives) now, before the disaster strikes.

Carl's thought-provoking observations served to reinforce the USSC's resolve to ask the Governor to commit the state to setting an example in reducing losses and providing leadership in implementing the *Strategic Plan*.

Large Earthquakes on the Salt Lake City Segment of the Wasatch Fault Zone - - Summary of New Information from the South Fork Dry Creek Site, Salt Lake County, Utah

by Bill D. Black, William R. Lund, and Bea H. Mayes
Utah Geological Survey

[The full article will be published in Utah Geological Association Publication 24, *Environmental and Engineering Geology of the Wasatch Front Region*. -Ed.]

ABSTRACT

The Wasatch fault zone (WFZ) is one of the longest and most active normal-slip faults in the world. The fault trends through the densely populated Salt Lake City metropolitan area, and is a potential source for large earthquakes that pose a significant seismic hazard. Previous paleoseismic studies at two sites (Little Cottonwood Canyon and South Fork Dry Creek) on the Salt Lake City (SLC) segment of the WFZ showed that at least three large-magnitude surface-faulting earthquakes occurred in Holocene time (past 10,000 years), including two earthquakes in the past 6,000 years. Timing for these earthquakes suggested the average recurrence interval of surface faulting on the SLC segment was 4,000 ± 1,000 years. However, not all of the fault scarps at either site could be trenched. A subsequent study at Dry Gulch discovered a previously unrecognized surface-faulting earthquake on an untrenched scarp at the nearby South Fork Dry Creek (SFDC) site, which reduced the average recurrence interval to 2,400 ± 500 years in the past 10,000 years and 2,150 ± 400 years in the past 6,000 years.

To develop a comprehensive Holocene chronology of surface-faulting earthquakes on the SLC segment, the Utah Geological Survey reoccupied the SFDC site to complete the investigation started there in 1985. We excavated five new trenches across fault scarps at this site. When combined with the 1985 study, all fault scarps at SFDC are now trenched. Radiocarbon age analyses of buried soils and organic-rich sediment in two trenches on different scarps show that a previously unrecognized surface-faulting earthquake occurred about 3,950 years ago. These new data, combined with evidence from the previous studies, show that four surface-faulting earthquakes (rather than three) occurred on the SLC segment in the past 6,000 years: (1) a most recent event shortly after 1,100-1,550 years ago, (2) a second event shortly after 2,100-2,800 years ago, (3) a third event shortly after 3,500-4,500 years ago, and (4) a fourth event shortly after 4,950-5,750 years ago. The new earthquake reduces the average recurrence of surface faulting on the SLC segment in the past 6,000 years from 2,150 ± 400 years to 1,350 ± 200 years.

The new earthquake reduces the average recurrence of surface faulting on the SLC segment in the past 6,000 years from 2,150 ± 400 years to 1,350 ± 200 years.

Summary of the "February 3, 1995, M_L 5.2 Seismic Event in the Trona Mining District of Southwestern Wyoming"

by James C. Pechmann, University of Utah
William R. Walter, Lawrence Livermore National Laboratory
Susan J. Nava, University of Utah
& Walter J. Arabasz, University of Utah

[The full article is published in Seismological Research Letters, v. 66, no. 3, May 1995, p. 25-34. -Ed.]

The largest known mining-related seismic event in U.S. history took place on February 3, 1995, in southwestern Wyoming. This event was associated with the collapse of an unoccupied 1 x 2 kilometer section of a 0.5-kilometer-deep trona mine operated by Solvay Minerals. Roof caving and methane gas release endangered 55 miners in adjacent parts of the mine, injured ten of them, and led to one fatality.

Two lines of evidence indicate that the dominant source of the seismic energy release in the M_L 5.2 seismic event was the mine collapse itself rather than slip on a fault: (1) long-period (20 to 40 second) regional waveforms from this event can be modeled better with an implosional source than with any fault-slip source and (2) leveling data provided by Solvay Minerals show an average surface subsidence of -0.6 meter over the collapse, which is large enough to account for the seismic moment and radiated seismic energy that we have estimated for the event. An additional, but less definitive piece of supporting evidence is that all of the clear P-wave first motions from the event are dilatational. Although we cannot rule out the possibility that a small, nearby tectonic earthquake could have triggered the mine collapse, we see no evidence for this scenario in the seismic data we have examined to date.

U.S. Geological Survey NEHRP External Grants Program Eliminated by the House

The U.S. House of Representatives voted to eliminate the $8 million National Earthquake Hazard Reduction Program external grants program from the Department of the Interior's budget in July. The external grants program provided research funds for scientists conducting earthquake-hazard research at state and local government levels and academic institutions. The program strengthened partnerships between federal and state and local investigators and funded much critical research that could not be performed internally by the USGS. It also provided support to regional seismic networks for research using network data.

Scientific findings funded by the external program were demonstrated to save lives and dollars in the Northridge earthquake. The elimination of the program is proposed as a means of reducing the USGS budget while preserving its core programs. The Senate will now consider the cut following this House action.

—Modified from the WSSPC (Western States Seismic Policy Council) - 95 Summer Newsletter, July 1995.

New York City Adopts Seismic Provisions

The first seismic building code for the city of New York was unanimously passed by the city council, and on February 21, 1995 was signed into law by Mayor Rudolph Guiliani. Passage of the code was a result of an effort that was initiated by a committee of engineers, city officials, and industry and business representatives over 10 years ago when New York City was reclassified from seismic risk zone 1 to 2A (on a scale of 4).

New York City's building code is based on the seismic-design provisions of the Uniform Building Code (UBC) with some city-specific modifications, such as those for site factors and building separation. Seismic-design requirements will apply to new construction, excluding one- and two-family dwellings. Other changes include requiring more ductile steel beam-to-column connections, additional concrete shear walls and steel reinforcement of masonry, and more secure anchorage of precast panels. The soils-factor range has been increased because of lessons learned from the 1989 Loma Prieta earthquake. The resulting recommendations were submitted to the New York City Commissioner of Buildings in April 1991, and will take effect in February 1996.

For a copy of the new seismic provisions, contact Rick Chandler, P.E., Brooklyn Borough Deputy Superintendent, Department of Buildings, (718) 802-3677, fax (718) 802-3674.

—Reprinted from NCEER Bulletin, v. 9, no. 2, p. 17.

Earthquake Education Services, University of Utah Seismograph Stations

by Deedee O'Brien, University of Utah

The University of Utah Seismograph Stations initiated "Earthquake Education Services" (EES) as a public service in September 1994. The goal of EES is to help provide Utah school teachers (K-12) with earthquake-related educational materials, training, and ongoing support to foster earthquake education in Utah's schools. The mission of EES is supported by the "Partnership for Earthquake Education Resources," an informal partnership among the U of U's College of Mines and Earth Sciences, the Department of Geography, the Seismograph Stations, the Utah Division of Comprehensive Emergency Management, the Utah Geological Survey, and the Utah Chapter of the American Red Cross. Deedee O'Brien is the Coordinator of EES, which has the following projects underway:

- "Earthquakes in the Science-Core Curriculum" is funded by the Federal Emergency Management Agency (FEMA) as a state-level prototype project to implement earthquake education by meeting state-specific needs. The project focuses on the new Elementary State Science Core Curriculum which provides an opportunity for earthquake instruction in the 3rd and 5th grades. The FEMA funding pays a team of teachers to work with geologists to develop instructional materials (lesson-plan activities, hands-on materials, AV resources such as slides, posters, etc.) and training that will then be made available to 3rd- and 5th-grade teachers statewide. The 3rd grade curriculum was field tested by 20 teachers in May 1995. In June, the 3rd grade project team provided these curriculum materials and instruction to 40 teachers in state-funded "train-the-trainer" workshops. The 5th grade field test workshop is scheduled for August 1995. The project team geologists, Sandra Eldredge from the Utah Geological Survey and Dr. Paula Wilson from the University of Utah's College of Mines and Earth Sciences, made this project possible.
- "Personalizing the Earthquake Threat in the Intermountain Region" is a U.S. Geological Survey-National Earthquake Hazards Reduction Program funded project to develop educational materials for the general public. Photographs and personal accounts of local earthquakes, as recorded in newspapers and diaries, will be used to prepare the following products: scripted slide-sets, a book of selected photos and personal accounts, plans for using the collected material in a traveling museum exhibit, and a World-Wide-Web archive of collected information on the Internet. Information from seventy earthquakes (magnitude 5 and larger in the Utah region and magnitude 5.5 and larger in other Intermountain Seismic Belt states) will be compiled for this project.
- "Earthquake Shaking Challenges" is an exhibit prototype being developed with funding from the Utah Science Center for its travelling exhibit project "Leonardo on Wheels." A group of shaking table stations will allow the visitor to explore the variables that affect building response to ground shaking. The visitor will be challenged to design buildings that meet the architectural demands of visual appeal and functionality and the engineering demands of earthquake resistance (bracing, shear walls, damping, etc.).

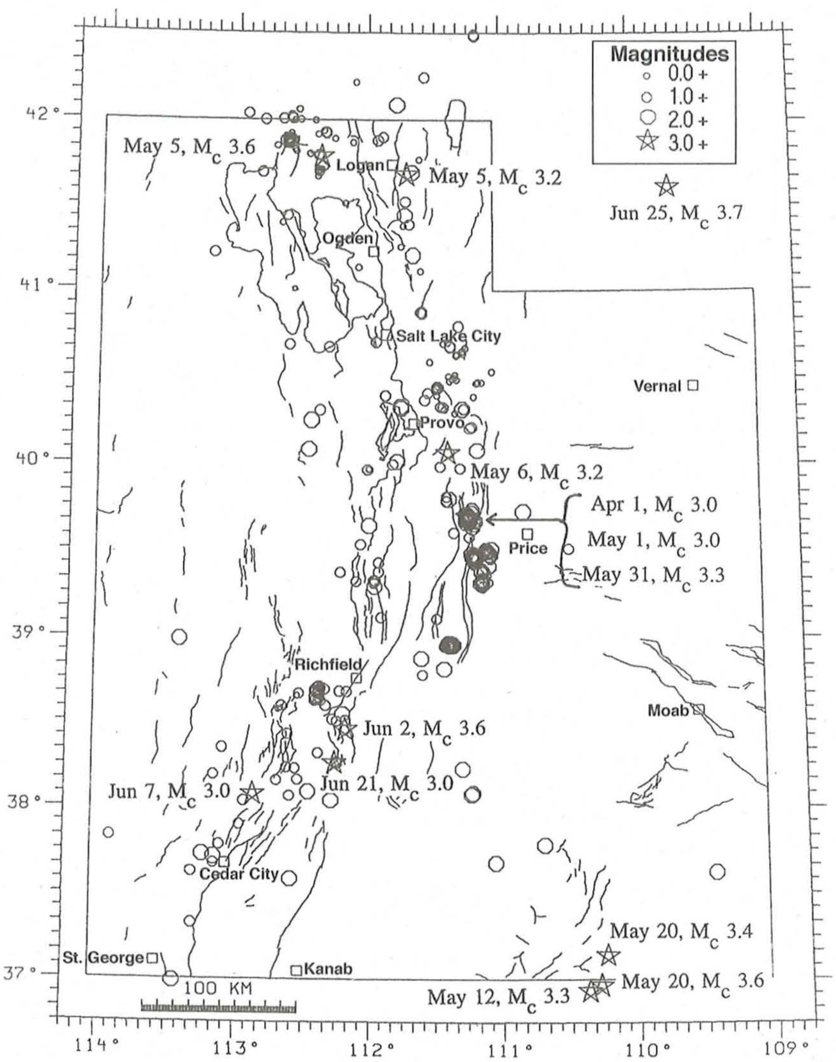
Family Preparedness Booklet Available from EQPCE in English, Chinese, Filipino, Spanish and Vietnamese

The Earthquake Preparedness Center of Expertise (EQPCE), part of the U.S. Army Corps of Engineers, South Pacific Division, publishes a 32-page family preparedness booklet that is now available in five languages: English, Chinese, Filipino, Spanish, and Vietnamese. This booklet provides information on how to prepare individual households for earthquakes. It gives advice on what to do before, during, and immediately after a quake, as well as during the ensuing recovery period. It gives basic guidance on assessing the structural integrity of foundations, cripple walls, and chimneys, and offers suggestions on securing nonstructural items. The booklet guides the reader through the steps needed to develop an evacuation and post-disaster reunion plan for a family and lists emergency supplies that should be kept on hand. Editions will soon be made available in Russian, Korean, Japanese, and French.

Single copies of the booklet are available free-of-charge by contacting Richard Cook, U.S. Army Corps of Engineers, EQPCE, Attn: CESPD-CO-EQ, 211 Main Street, Room 302, San Francisco, CA 94105-1905, (415) 744-2807, fax (415) 744-2774. Specify the language that you are interested in.

—Reprinted from press release submitted by the Earthquake Preparedness Center of Expertise

Earthquake Activity in the Utah Region



by Susan J. Nava
University of Utah Seismograph Stations
Department of Geology and Geophysics
Salt Lake City, UT 84112-1183
(801) 581-6274

April 1 - June 30, 1994

During the period April 1 through June 30, 1994, the University of Utah Seismograph Stations located 521 earthquakes within the Utah region. The total includes 13 earthquakes in the magnitude 3 range and 244 in the magnitude 2 range. Earthquakes which have magnitudes of 3.0 or larger are plotted as stars and specifically labeled on the epicenter map. There was only one earthquake reported felt during the report period. Magnitude is either local magnitude, M_L, or coda magnitude, M_C. All times indicated are Mountain Standard Time.

Significant Main Shocks and Clusters of Earthquakes

• **Eastern Wasatch Plateau-Book Cliffs area near Price** (coal-mining related): five clusters of seismic events (magnitude 1.0 to 3.3) make up 50% of the shocks that occurred in the Utah region during the report period. These clusters are located: (a) 25 miles WNW of Price, (b) 20 miles WSW of Price, (c) 25 miles WSW of Price, (d) 30 miles SW of Price, and (e) 55 miles SW of Price. Significant earthquakes include:

M_C 3.0	April 1	10:45 p.m.	11 miles NE of Fairview
M_C 3.0	May 1	2:47 a.m.	10 miles NE of Fairview
M_C 3.3	May 31	6:48 p.m.	11 miles NE of Fairview

• **Northern Utah:** a cluster of 36 earthquakes (M ≤ 2.7) occurred 25 miles W of Garland (40 miles WNW of Logan). Most of the earthquakes in this series occured during May and June. A separate cluster of 14 earthquakes (M≤ 3.6) occurred 10 miles WSW of Tremonton (30 miles W of Logan), during May. Both of these clusters of earthquakes are a continuation of seismic activity from the preceding report period (January-March 1994). Significant shocks include:

M_C 3.2	May 5	12:04 p.m.	6 miles E of Providence
M_C 3.6	May 5	7:37 p.m.	11 miles W of Garland

• **Central Utah:**

M_C 3.2	May 6	4:42 p.m.	11 miles ESE of Mapleton

• **Southern Utah:** a series of 25 earthquakes occurred 9 miles WNW of Sevier (20 miles SW of Richfield). The shocks ranged in magnitude from 0.9 to 2.4. The majority of the earthquakes in this sequence occurred on May 21st and 22nd. A cluster of three earthquakes occurred along the Utah-Arizona border (120-125 miles E of Kanab) in a remote area located near Lake Powell. Significant earthquakes include:

M_C 3.3	May 12	1:47 p.m.	16 miles NW of Kayenta, AZ
M_C 3.4	May 20	11:10 p.m.	29 miles N of Kayenta, AZ
M_C 3.6	May 20	3:16 p.m.	17 miles NNW of Kayenta, AZ
M_C 3.6	June 2	10:25 p.m.	10 miles SE of Sevier; felt in Monroe

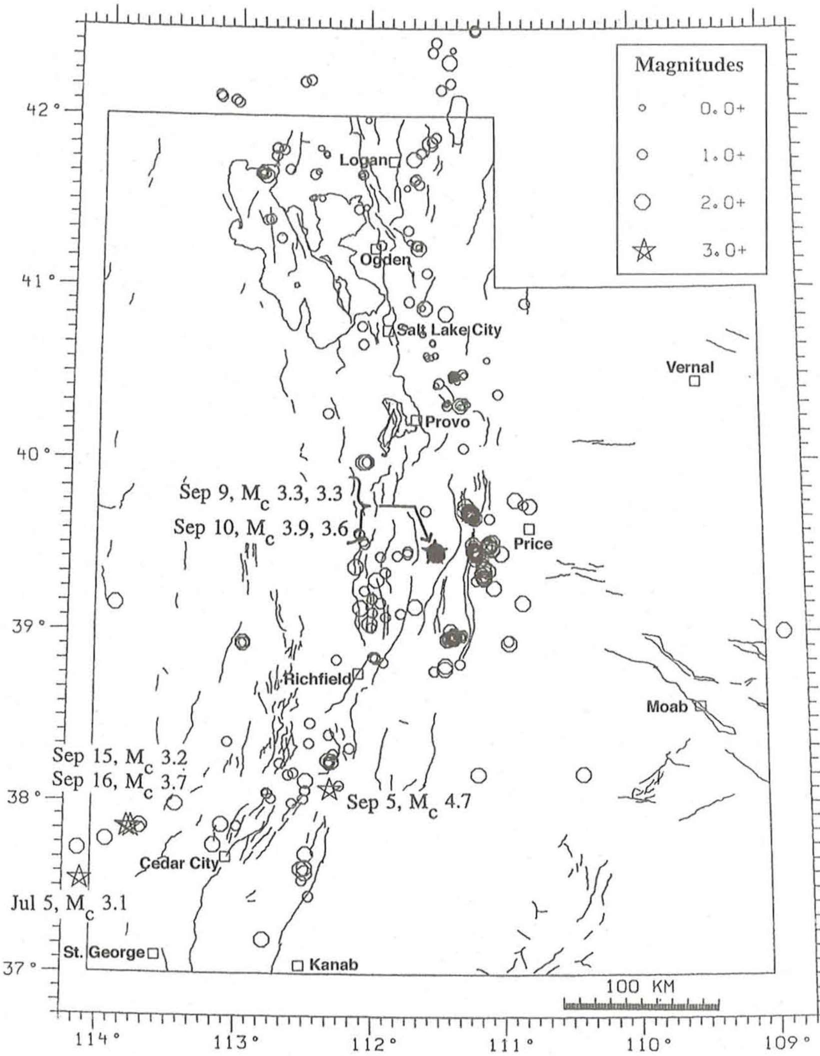
M_C 3.0	June 7	6:51 p.m.	10 miles SSE of Minersville
M_C 3.0	June 21	3:17 p.m.	6 miles N of Circleville

• **Southwestern Wyoming:** a seismic event occurred in a region of active Trona mining on June 25th. This shock may have been mining induced or related to a mine collapse. For more information about seismic events in this area, the reader is referred to the "The February 3, 1995, M_L 5.1 Seismic Event in the Trona Mining District of Southwestern Wyoming" by J.C. Pechmann and others, *Seismological Research Letters,* v. 66, no. 3, 1995.

M_C 3.7	June 25	4:07 p.m.	13 miles WNW of Green River, WY

July 1 - September 30, 1994

During the period July 1 through September 30, 1994, the University of Utah Seismograph Stations located 499 earthquakes within the Utah region. The total includes one earthquake in the magnitude 4 range, seven in the magnitude 3 range, and 220 in the magnitude 2 range. Earthquakes which have magnitudes of 3.0 or larger are plotted as stars and specifically labeled on the epicenter map. There were four earthquakes reported felt during the report period. Magnitude is either local magnitude, M_L, or coda magnitude, M_C. All times indicated are Mountain Standard Time.



Significant Main Shocks and Clusters of Earthquakes

• **Eastern Wasatch Plateau-Book Cliffs area near Price** (coal-mining related): five clusters of seismic events (magnitude 1.2 to 2.9) make up 34% of the shocks that occurred in the Utah region during the report period. These clusters are located: (a) 25 miles WNW of Price, (b) 20 miles WSW of Price, (c) 25 miles WSW of Price, (d) 30 miles SW of Price, and (e) 55 miles SW of Price.

• **Northern Utah:** A cluster of eight earthquakes (M≤ 2.2) occurred 30 miles N of Lakeside (50 miles W of Logan) along the north shore of the Great Salt Lake. A swarm of 25 earthquakes occurred 3 miles ESE of Heber (30 miles SE of Salt Lake City), primarily during the month of August. The shocks ranged in magnitude from 0.3 to 2.0.

• **Central Utah:** A swarm of 111 earthquakes (M≤ 3.9) occurred 1 mile S of Spring City. All of the shocks occurred between September 8 and 16. Significant shocks include:

M_C 3.3	Sept. 9	2.06 p.m.	2 miles SSW of Spring City; felt in Sanpete County
M_C 3.3	Sept. 9	2.13 p.m.	2 miles SSW of Spring City; felt in Sanpete County
M_C 3.9	Sept. 10	12:33 a.m.	2 miles SSW of Spring City; felt in Sanpete County
M_C 3.6	Sept. 10	3:23 a.m.	1 miles SSW of Spring City

• **Southern Utah:** A cluster of seven earthquakes (M≤ 2.2) occurred 5 miles NNW of Circleville (40 miles SSW of Richfield). Significant earthquakes include:

M_C 3.1	July 5	3:30 a.m.	22 miles WSW of Enterprise
M_C 4.7	Sept. 5	9:48 p.m.	7 miles S of Circleville; felt in Circleville, Kingston, Junction
M_C 3.2	Sept. 15	5 :18 a.m.	19 miles NNW of Enterprise
M_C 3.7	Sept. 16	10:03 a.m.	20 miles NNW of Enterprise

Additional information on earthquakes within the Utah region is available from the University of Utah Seismograph Stations.

Perspectives on Earthquakes in Rural Areas

> ***. . . the focus of the National Earthquake Hazard Reduction Program has been on large urban areas with a high risk of loss potential. However, the last ten years have seen earthquakes largely affecting rural areas rather than cities. . .***
>
> ***In each case, early reports significantly under-estimated the extent of damage and the economic impact. . .***

The Bureau of Disaster Services of the State of Idaho has published the proceedings of an October 1993 conference, *Perspectives on Earthquakes in Rural Areas*. The workshop was jointly sponsored by the Federal Emergency Management Agency and the U.S. Geological Survey. Among the topics covered were the effects of earthquakes on rural industries, agriculture, water systems, schools and small-town businesses. Examples were drawn from the Borah Peak, Loma Prieta, Landers/Big Bear, Cape Mendocino, Scotts Mills, and Klamath Falls earthquakes. You may request a single copy, free-of-charge, from Stephen Weiser, Earthquake Program Coordinator, Idaho Bureau of Disaster Services, 650 West State Street, Boise, ID 83720-3650, (208) 334-3460, fax (208) 334-2322.

The Preface of this report is reprinted below:

FEMA, the Federal Emergency Management Agency, is concerned with catastrophic disasters—disasters that affect many people or large areas or cause large dollar losses. Understandably, this translates into concerns for urban disasters. Similarly, the focus of the National Earthquake Hazard Reduction Program (NEHRP) has been on large urban areas with a high risk of loss potential.

However, the last ten years have seen earthquakes largely affecting rural areas rather than cites: Borah Peak (1983) damaged towns in Idaho, Loma Prieta (1989) was particularly damaging to the small communities south of San Francisco, Landers/Big Bear (1992) affected southern California desert towns, Cape Mendocino (1992) struck northern California forest communities, and Scotts Mills (1993) and Klamath Falls (1993) affected communities in Oregon. In each case, early reports significantly under-estimated the extent of damage and the economic impact, and, after the initial attention, public interest was directed elsewhere as the media returned home to deal with the issues of the urban settings they come from.

The concept of rural is something not well defined, since for most government agencies it means "non-metropolitan." Workshop participants represented a diversity of rural areas: the area surrounding Spokane, coastal Washington, southwestern Oregon, the northern coast of California, inland southern California, Nevada, western Montana, and southern and central Idaho. Neither was any particular economic activity dominant: logging, farming, ranching, dairies, mining, aquaculture were all represented. People in these areas, however, do not necessarily have the same expectations of emergency services; since many live more than 45 minutes form a major medical center, they do not expect mobile critical care facilities. Nor do they expect virtually instantaneous firefighting response. They perceive themselves as more self-reliant, more independent, more neighborly than urban populations.

Given sparser settlement, one conclusion is that damage is harder to spot by the "windshield surveys" that FEMA depends on for evaluations. It may also be different, so that "experienced" disaster personnel may not be noticing or responding to actual damage.

Another conclusion is that rural people believe the propaganda: people in Watsonville, for instance, because of media coverage of damage in the Bay area, assumed that they were less affected than that city, and consequently did not ask for help. They were, of course, actually in the epicentral region themselves.

A third conclusion is that rural areas are at double risk. Not only need they be prepared for earthquakes affecting them, they need to be prepared for earthquakes affecting the urban areas that support them with critical services. Both will be competing for the same resources in a catastrophe.

On the other hand, earthquakes in the rural areas of the West (away form the very active coastal plate boundaries) tend to have long recurrence intervals. No responsible scientist can commit to a large event within the next 30 years—only something big sometime. This vagueness makes implementing seismic safety programs challenging, since people are skeptical about the risk. The message continues to be: earthquakes may by unpredictable, but their consequences are not. Rural buildings are hazardous, especially old brick schools and public buildings. Building codes are important to make sure that new buildings are strong. Retrofits to older buildings are not cost-effective. Knowing about how old buildings behave helps us to know what to do so that we can preserve life and property.

Most of the activities that participants in the workshop identified are the same as for cities, but focus on local, microcommunity involvement. The challenge is to convey not doom but preparedness. Individual responsibility is an important concept in rural areas, and programs must take this into account. We cannot force people to prepare, but reasonable people-if apprised of a reasonable danger-will prepare themselves.

Meetings and Conferences

• October 17-19, 1995, **Fifth International Conference on Seismic Zonation**, Nice, France. The conference, sponsored jointly by the Earthquake Engineering Research Institute and the French Association of Earthquake Engineering, will focus on identifying useful applications of seismiczonation techniques that have led to realistic loss estimations and/or refined mitigation efforts related to the built environment, land use, and emergency preparedness. The program will include multidisciplinary discussions of how seismic zonation has been used as a tool in mitigation efforts in major seismic regions throughout the world. For further information, contact EERI at 499 14th Street, Suite 320, Oakland, CA 94612-1934, (510) 451-0905, fax (510) 451-5411.

• October 17-19, 1995, **Eighth Annual Emergency Preparedness Conference**, Vancouver, British Columbia. The purpose of this conference is to raise the level of emergency preparedness by promoting awareness; providing information, tools, and solutions to problems; sharing experiences; showcasing technologies; and creating networking opportunities. For more information, contact the Emergency Preparedness Conference, Marie Rogan, Conference Registrar, BC Rehab, 700 West 57th Avenue, Vancouver, BC, Canada, V6P 1S1, (604) 321-3231, fax (604) 321-7833.

• October 23-24, 1995, **Association of Contingency Planners 1995 Annual Symposium**, Los Angeles, California. ACP is a nonprofit, volunteer organization dedicated to educating businesses and the public on the importance of contingency planning and disaster preparedness. The symposium will focus on emergency planning for both corporations and individuals. For information, contact John Bogner, Sony Pictures, Inc., 10202 West Washington Boulevard, Suite 3106, Culver City, CA 90232, (310) 280-5646, fax (310) 280-6808.

• October 25-26, 1995, **International Conference on High Technology Buildings**, Sao Paulo, Brazil. Sponsored by the Council on Tall Buildings and Urban Habitat, the objective of the conference is to disseminate new knowledge and advances in technology that are being applied the world over in new buildings and urban-development projects, from concept through design and construction. For more information, contact the CTBUH at Lehigh University, (610) 758-3515, fax (610) 758-4522.

• October 27-28, 1995, **California Universities for Research in Earthquake Engineering Symposium** in honor of George Housner, Pasadena, California. For half a century, Professor George Housner has been one of the country's leaders in the field of earthquake engineering. In the first of a series of symposia to showcase the lifelong accomplishments of individuals contributing to the understanding of earthquakes, CUREe will honor the career of Professor Housner. Co-sponsored by the California Institute of Technology, the symposium will bring together scientists and engineers from around the country and overseas who will discuss the progress made in various areas pioneered by Professor Housner, including structural engineering, ground motion, public policy, and education. The symposium presentations will also include thoughts on future developments. For more information, contact CUREe, 1301 South 46th Street, Richmond, CA 94804, (510) 231-9557, fax (510) 231-5664.

• October 30-November 1, 1995, **1995 International Conference on Structural Stability and Design**, Sydney, Australia. For more information, contact ICSSD-95 Conference Secretariat, c/o Australian Institute of Steel Construction, P.O. Box 6366, North Sydney, NSW, Australia 2059, 61-2-929-666, fax 61-2-955-5406.

• November 6-9, 1995, **Geological Society of America Annual Meeting "Bridging the Gulf"**, New Orleans, Louisiana. For general information contact the GSA Meetings Department, (800) 472-1988 or (303) 447-2020, ext. 141.

• November 14-19, 1995, **First International Conference on Earthquake Geotechnical Engineering**, Tokyo, Japan. Sponsored by the Japanese Society of Soil Mechanics and Foundation Engineering and the Earthquake Geotechnical Engineering Committee of the International Society for Soil Mechanics and Foundation Engineering, themes include dynamic soil behavior, dynamic response of ground, liquefaction and associated phenomenon, seismic failure of embankments and slopes, and reports on recent earthquakes. For more information, contact Dr. Ilko Towhata, Department of Civil Engineering, University of Tokyo, Hongo, Bunkyo-ku, Tokyo 113, Japan, phone 81-3-3812-2111, ext. 6121, fax 81-3-3818-5692.

• December 10-13, 1995, **National Seismic Conference on Bridges and Highways**, San Diego, California. Co-sponsored by the Federal Highway Administration and the California Department of Transportation, the conference objective is to provide a forum for the exchange of information on current practice and research for seismic design and retrofit of new and existing bridges. The conference will focus on national problems and solutions which are of interest to bridge, geotechnical, and highway engineers in all seismic-hazard zones. For more information, contact Barbara Murdock, Tonya, Inc., (202) 289-8100.

• January 5-9, 1996, **Big Cities World Conference on Natural Disaster Mitigation**, Cairo, Egypt. Sponsored by Cairo University and the International Commission on Earthquake Prognostics, the conference will encompass topics in earthquake prognostics, volcanic disasters, tropical storm and cyclone disasters, flash floods, and flood-plain disasters. Earthquake-related topics include: damage scenarios and protection of big cities, experimental earthquake simulation, seismic strengthening and upgrading of existing buildings, passive and active control, seismic safety of non-engineered rural dwellings, and health-care facilities in areas of high earthquake risk. For further information, contact Dr. Amany Asfour, 14 Syria Street, Mohandeseen, Guiza, Egypt, (202) 701482, fax (202) 3444429.

• March 5-8, 1996, **International Conference and Exposition on Natural Disaster Reduction '96**, Washington, D.C. Sponsored by the American Society of Civil Engineers, the objective of this conference is to discuss the role of engineers, scientists, and others, in preventing, mitigating, preparing for, and recovering from the effects of natural disasters on the built and natural environments, with consideration for socio-economic, political, public health, and institutional interfaces. Organized under the auspices of the United Nations International Decade for Natural Disaster Reduction, it will attract a diverse population from around the world. Papers are solicited in any of the following topic areas: hazard identification (identification, mapping, forecasting and warning, geographic information systems, geodetic position systems, deterministic versus probabilistic approaches, dissemination, case studies); vulnerability assessment (performance of structures and lifelines, analytical and experimental procedures, deterministic versus probabilistic approaches); risk management (codes, insurance, incentives and disincentives, regulatory standards, public policies); mitigation (new construction, repair and retrofit, structural and non-structural measures, analytical and experimental results, public policies); education (technology transfer, public awareness, formal education, continuing education); institutional issues (regulatory, legislative, codes and standards); and response and recovery (evacuation, response, recovery, retrofit, reconstruction). Abstract submittal deadline is September 15, 1995. To submit an abstract or for more information, contact George L. De Feis, NDR '96, Conferences and Conventions Department, ASCE, 345 East 47th Street, New York, NY 10017, (800) 548-2723, fax (212) 705-7975.

• March 11-13, 1996, **International Conference on Retrofitting Structures**, New York, New York. Sponsored by the Department of

Civil Engineering and Engineering Mechanics, Columbia University, the National Science Foundation, and the National Center for Earthquake Engineering Research, this meeting will give experts in structural retrofitting the opportunity to share their professional experience. Practicing engineers, as well as university researchers and government representatives, will critically analyze current practice and define future research to improve retrofitting of structures of all kinds. For information, contact Raimondo Betti, Columbia University, 610 S.W. Mudd Building, New York, NY 10027, (212) 854-3143, fax (212) 854-6267.

• March 14-19, 1996, **Response of Concrete Bridges in Recent Earthquakes**, Denver, Colorado. Sponsored by the American Concrete Institute Committee 341, Earthquake-Resistant Concrete Bridges, this is a technical session that will be held during the ACI spring convention. Presentations on findings based on field investigation, testing, and/or analysis of concrete bridge response during recent earthquakes, and the effect of these earthquakes on bridge seismic retrofit and design are planned. For further information, contact Dr. M. Saiid Saiidi, Civil Engineering Department (258), University of Nevada, Reno, NV 89557, (702) 784-4839, fax (702) 784-4466.

• March 16-21, 1996, **1996 National Disaster Medical System (NDMS) Annual Conference**, San Diego, California. This conference will bring together emergency response professionals from all over the United States and several foreign nations. For additional information, contact NDMS, 5600 Fishers Lane, Room 4-81, Rockville, MD 20857, (800) 872-6367, ext. 444.

Recent Publications

Anagnos, T., Rojahn, C., and Kiremidjian, A.S., 1995, NCEER-ATC joint study on fragility of buildings: National Center for Earthquake Engineering Research Technical Report 95-0003, 116 p. Available for $15.00 from NCEER Publications, State University of New York at Buffalo, Red Jacket Quadrangle, Box 610025, Buffalo, NY 14261-0025, (716) 645-3391, fax (716) 645-3399.

Bennett, R.A., Reilinger, R.E., Rodi, William, Yingping, Li, Toksoz, M.N., and Hudnut, Ken, 1995, Coseismic fault slip associated with the 1992 M_W 6.1 Joshua Tree, California, earthquake—implications for the Joshua Tree-Landers earthquake sequence: Journal of Geophysical Research, v. 100, no. B4, p. 6443-6462.

Berke, P.R., and French, S.P., 1994, The influence of state planning mandates on local planning quality: Hazard Reduction and Recovery Center No. 110A, 15 p. Available for $3.00 from the Hazard Reduction and Recovery Center, College of Architecture, Texas A&M University, College Station, TX 77843-3137, (409) 845-7813, fax (409) 845-4491.

Borcherdt, R.D., 1994, Estimates of site-dependent response spectra for design (methodology and justification): Earthquake Spectra, v. 10, no. 4, p. 617-653.

Bruhn, R.L., and Schultz, R.A., 1994, Geometry and slip distribution in normal fault systems: implications for surface faulting and earthquake nucleation [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 677.

Buckle, I.G., 1995, Report from the Hanshin-Awaji earthquake—overview of performance of highway bridges: NCEER Bulletin, v. 9, no. 2, p. 1-6.

Bufe, C.G., Varnes, D.J., and Nishenko, S.P., 1994, Long-term seismicity patterns and pre-earthquake failure processes [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 434.

Burby, R.J., Berke, P.R., Dalton, Linda, DeGrove, John, French, S.P., Kaiser, Edward, May, Peter, and Roenigk, Dale, 1993, Is state-mandated planning effective?: Hazard Reduction and Recovery Center No. 109A, 9 p. Available for $3.00 from the Hazard Reduction and Recovery Center, College of Architecture, Texas A&M University, College Station, TX 77843-3137, (409) 845-7813, fax (409) 845-4491.

Chung, R.M., editor, 1995, Hokkaido-Nansei-Oki earthquake and tsunami of July 12, 1993, reconnaissance report: Earthquake Spectra, Supplement A to v. 11, Publication 95-01, 166 p.

Costantino, Carl, 1995, Report from the Hanshin-Awaji earthquake—overview of geotechnical observations: NCEER Bulletin, v. 9, no. 2, p. 7-10.

Cowie, P.A., Main, I.G., and Knipe, R., 1995, Looking for patterns in fault populations: EOS, Transactions of the American Geophysical Union, v. 76, no. 12, p. 125.

Davis, C.H., 1994, Preliminary results of ongoing regional structural analysis of deformation banding as a guide to strain and paleostresses in the Colorado Plateau region of southern Utah [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 685.

dePolo, C.M., and Anderson, J.G., 1994, Fault slip rates and associated horizontal deformation in the Great Basin, U.S.A. [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 685.

Dewey, J.W., Reagor, B.G., Dengler, L., and Moley, K., 1995, Intensity distribution and isoseismal maps for the Northridge, California, earthquake of January 17, 1994: U.S. Geological Survey Open-File Report 95-92, 35 p.

Eaton, G.P., 1995, Transforming the U.S. Geological Survey-an invited comment: Natural Hazards Observer, v. 19, no. 4, p. 1-2.

Eberhard, M.O., and Meigs, B.E., 1995, Earthquake-resisting system selection statistics for reinforced concrete buildings: Earthquake Spectra, v. 11, no. 1, p. 19-36.

Eidinger, John, 1995, Lifelines suffered in Kobe quake: EERI (Earthquake Engineering Research Institute) Newsletter, v. 29, no. 5, p. 8-9.

Etkin, David, 1995, Toward a comprehensive assessment of North American natural hazards-an invited comment: Natural Hazards Observer, v. 19, no. 5, p. 1-2.

Federal Emergency Management Agency, 1995, Preserving resources through earthquake mitigation—National Earthquake Hazards Reduction Program fiscal years 1993-1994 report to Congress: Federal Emergency Management Agency, 170 p. Available free from FEMA, Publications Distribution Facility, 8231 Stayton Drive, Jessup, MD 20794, (800) 480-2520, (202) 646-3484, fax (301) 497-6378.

Gomberg, J., 1994, Dynamic strains and the triggering of earthquakes [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 438.

Hays, W.W., 1995, Understanding Kobe: Natural Hazards Observer, v. 19, no. 4, p. 8.

Huang, M.J., and Shakal, A.F., 1995, CSMIP strong-motion instrumentation and records from the I10/215 interchange bridge near San Bernardino: Earthquake Spectra, v. 11, no. 2, p. 193-215.

Igarashi, R., Saeki, S., Takahata, N., Sumikawa, K., Tasaka, S., Sasaki, Y., Takahashi, M., and Sano, Y., 1995, Ground-water radon anomaly before the Kobe earthquake in Japan: Science, v. 269, no. 5220, p. 60-61.

Jackson, D.D., 1994, Testing earthquake prediction methods [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 453.

Jones, N.P., Thorvaldsdottir, Solveig, Liu, Anqi, Narayan, Prakash,

and Warthen, Thomas, 1995, Evaluation of a loss estimation procedure based on data from the Loma Prieta earthquake: Earthquake Spectra, v. 11, no. 1, p. 37-61.

King, C.-Y., Koizumi, Naoji, and Kitagawa, Yuichi, 1995, Hydrogeochemical anomalies and the 1995 Kobe earthquake: Science, v. 269, no. 5220, p. 38-39.

King, S.A., and Kiremidjian, A.S., 1994, Regional seismic hazard and risk analysis through geographic information systems: Earthquake Engineering Center Report #111, 182 p. Available for $32.50 from the John A. Blume Earthquake Engineering Center, Department of Civil Engineering, Building 540, Stanford University, Stanford, CA 94305, (415) 723-3415, fax (415) 723-7514.

Lee, G.C., and Chang, K.C., editors, 1994, Proceedings of the international workshop on civil infrastructure systems—application of intelligent systems and advanced materials on bridge systems: National Center for Earthquake Engineering Research Technical Report 94-0019, 476 p. Available for $40.00 from NCEER Publications, University at Buffalo, Red Jacket Quadrangle, Box 610025, Buffalo, NY 14261-0025, (716) 645-3391, fax (716) 645-3399.

Lowry, A.R., and Smith, R.B., 1994, Elastic thickness and earthquake focal depth [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 445.

McNamara, R.J., 1995, Seismic damage control with passive energy devices—a case study: Earthquake Spectra, v. 11, no. 2, p. 217-232.

Malone, S.D., 1994, A review of seismic data access techniques over the Internet [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 429.

Martinez, L.J., Meertens, C.M., and Smith, R.B., 1994, GPS surveys of the Wasatch fault zone, Utah [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 179-180.

Michael, A.J., 1994, Public access to earthquake data from the U.S. Geological Survey's Branch of Seismology in Menlo Park, California [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 429-430.

Monastersky, Richard, 1995, Quiet hints preceded Kobe earthquake: Science News, v. 148, no. 3, p. 37.

Mustoe, N.B., and Benson, A.K., 1995, An integrated geophysical analysis of shallow faulting in the Wasatch fault zone near Provo and Springville, Utah County, Utah [abs.]: The Log Analyst, v. 36, no. 2, p. 54.

Naeim, Farzad, 1995, On seismic design implications of the 1994 Northridge earthquake records: Earthquake Spectra, v. 11, no. 1, p. 91-109.

Nathe, S.K., and Tubbesing, S.K., 1995, Kobe in the mind's eye: Natural Hazards Observer, v. 19, no. 4, p. 4-5.

National Center for Earthquake Engineering Research, 1995, NCEER response—a summary of earthquake reconnaissance efforts of the National Center for Earthquake Engineering Research: NCEER Bulletin, v. 9, no. 1, special supplement, 12 p.

National Information Service for Earthquake Engineering, 1995, Abstract journal in earthquake engineering: Earthquake Engineering Research Center, v. 24, no. 1 and 2. Available for $100.00 from NISEE, Earthquake Engineering Research Center, 1301 South 46th Street, Richmond, CA 94804-4698.

Nishenko, S.P., and Bufe, C.G., 1994, Testing the seismic cycle [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 453.

Olsen, K.B., and Schuster, G.T., 1994, Simulation of 3-D elastic wave propagation in the East Great Salt Lake (Weber) Basin [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 441.

O'Rourke, T.D., and Hamada, M., editors, 1994, Proceedings from the fifth U.S.-Japan workshop on earthquake resistant design of lifeline facilities and countermeasures against soil liquefaction: National Center for Earthquake Engineering Research Technical Report 94-0026, 782 p. Available for $40.00 from NCEER Publications, University at Buffalo, Red Jacket Quadrangle, Box 610025, Buffalo, NY 14261-0025, (716) 645-3391, fax (716) 645-3399.

Pechmann, J.C., Walter, W.R., Nava, S.J., and Arabasz, W.J., 1995, The February 3, 1995, M_L 5.1 seismic event in the Trona Mining District of southwestern Wyoming: Seismological Research Letters, v. 66, no. 3, p. 25-34.

Pekcan, Gokhan, Mander, J.B., and Chen, S.S., 1995, The seismic response of a 1:3 scale model R.C. structure with elastomeric spring dampers: Earthquake Spectra, v. 11, no. 2, p. 249-267.

Perkins, Jeanne, and Boatwright, John, 1995, The San Francisco Bay area—on shaky ground: Oakland, Association of Bay Area Governments. Report plus folio of 11 maps available for $13.00 plus $3.00 shipping and handling from ABAG, P.O. Box 2050, Oakland, CA 94604.

Rose, Adam, and Benavides, J., 1995, Interindustry models for analyzing the economic role of utility lifelines disrupted by earthquakes: NCEER Bulletin, v. 9, no. 1, p. 2-6.

Schramm, M.E., and Taylor, W.J., 1994, Fault segment boundary identification and kinematic analysis along the Hurricane fault in southwestern Utah [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 685.

Smith, R.B., Miller, D.S., and Meertens, C.M., 1994, Active tectonics of the Yellowstone hotspot imaged by earthquakes and GPS [abs.]: EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 65.

Somerville, Paul, 1995, Kobe earthquake—an urban disaster: EOS, Transactions of the American Geophysical Union, v. 76, no. 6, p. 49-51.

Sylves, R.T., 1995, Renewing FEMA—remaking emergency management: Boulder, Natural Hazards Research and Applications Information Center, Working Paper 93, 31 p. Available for $3 from NHRAIC, Institute of Behavioral Science #6, Campus Box 482, University of Colorado, Boulder, CO 80309-0482.

Thatcher, Wayne, 1995, Microplate versus continuum descriptions of active tectonic deformation: Journal of Geophysical Research, v. 100, no. B3, p. 3885-3894.

Thewalt, Christopher, Higashino, Masahiko, and Whittaker, Andrew, 1995, 1995 Hyogo-Ken Nanbu (Kobe) earthquake: EERC (Earthquake Engineering Research Center) News, v. 16, no. 2, p. 1,3.

Tsunogai, Urumu, and Wakita, Hiroshi, 1995, Precursory chemical changes in ground water—Kobe earthquake, Japan: Science, v. 269, no. 5220, p. 61-63.

Van Anne, Craig, and Scawthorn, Charles, editors, 1994, The Loma Prieta, California, earthquake of October 17, 1989—fire, police, transportation, and hazardous materials: U.S. Geological Survey Professional Paper 1553-C, 48 p.

Wakefield, Julie, 1994, Fault finding in Utah puts longstanding theories on the line: EOS, Transactions of the American Geophysical Union, v. 75, no. 40, p. 459-460.

Wakefield, Julie, 1995, 'Characteristic' earthquakes may not be so characteristic after all: EOS, Transactions of the American Geophysical Union, v. 76, no. 17, p. 169-170.

Wattenburg, W.H., McCallen, D.B., Murray, R.C., 1995, A modular steel freeway bridge—design concept and earthquake resistance: Science, v. 268, no. 5208, p. 279-81.

Wen, Y.K., 1995, Building reliability and code calibration: Earthquake Spectra, v. 11, no. 2, p. 269-296.

Whitman, R.V., 1995, Toward a strategic plan for the national earthquake risk reduction program: Earthquake Spectra, v. 11, no. 2, p. 299-317.

Williams, M.S., and Sexsmith, R.G., 1995, Seismic damage indices for concrete structures—a state-of-the-art review: Earthquake Spectra, v. 11, no. 2, p. 319-349.

The Fault Line Forum (formerly Wasatch Front Forum) is published quarterly by the Utah Geological Survey (UGS). It makes information available to the public which may be preliminary or unavailable in other published form, but is considered to be of value. It may not necessarily conform to UGS policy, technical review, or editorial standards. Information, contributions, questions, and suggestions concerning future issues may be sent to the Editor at the following address:

Janine L. Jarva, Editor
Utah Geological Survey
2363 South Foothill Drive
Salt Lake City, UT 84109-1491
(801) 467-7970, fax (801) 467-4070.
e-mail address:
nrdomain.nrugs.jjarva@email.state.ut.us

Publication supported by the U.S. Geological Survey (USGS), Department of the Interior, under USGS award number 1434-94-G-2486. The views and conclusions contained in this document are those of the authors, and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Table of Contents

Deadlines for Future Issues

v. 11, no. 4 ....October 31, 1995
v. 12, no. 1 ....January 31, 1996

Department of Natural Resources
Utah Geological Survey
2363 South Foothill Drive
Salt Lake City, UT 84109-1491
Address correction requested
Fault Line Forum

BULK RATE
U.S. POSTAGE PAID
S.L.C., UTAH
PERMIT NO. 4728