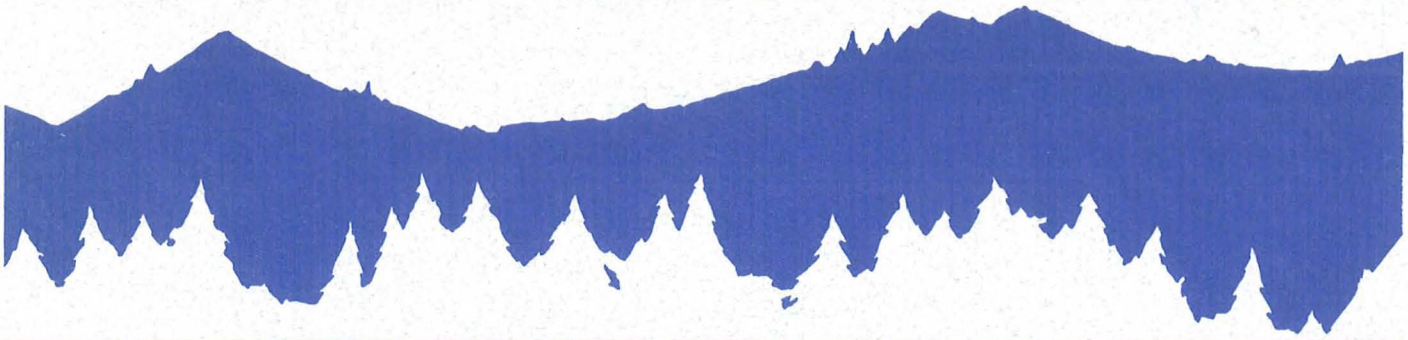
WASATCH FRONT FORUM



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EARTHQUAKE HAZARDS PROGRAM

1993

FAULT LINE FORUM TO REPLACE *WASATCH FRONT FORUM*

This will be the last issue of the *Wasatch Front Forum (WFF)* as you have come to know it. The Utah Earthquake Advisory Board (UEAB) has formally adopted the *WFF* as its official newsletter and renamed it the *Fault Line Forum*. The *WFF* began in early 1984 as a vehicle for timely dissemination and exchange of information about the Wasatch Front National Earthquake Hazards Reduction Program (NEHRP). Wendy Hassibe, U.S. Geological Survey, was the editor through 1986. In 1987, the emphasis of the Wasatch Front NEHRP shifted from scientific research to implementation activities aimed at reducing earthquake risk. The *WFF* broadened its scope to emphasize translation and transfer of scientific and technical information to non-technical users and to facilitate the use of research results to reduce losses. The *WFF's* audience expanded to include architects, engineers, planners, emergency managers, public officials, and policy-makers at all levels of government. We have extended coverage from the Wasatch Front to the entire state and include activities in other western states and at the national level when appropriate.

We believe the *WFF* has a continuing role to play in disseminating timely earthquake "news" in Utah. The *WFF* will continue to inform readers of scientific research but will make an increasing effort to communicate work aimed at hazard reduction such as new zoning ordinances, seismic retrofits, public-awareness campaigns, and earthquake exercises. We will follow the progress of earthquake initiatives considered by the Utah Legislature. We will particularly focus on the UEAB's activities and evolution, especially the development of the "Utah At Risk" strategic planning document. So, beginning with the next issue, due out in March, 1994, the old *WFF* will have a new name and a new look, to reflect its new affiliation with the UEAB, its evolving purpose, and its expanded statewide coverage.

IN MEMORIAM - WILLIAM J. KOCKELMAN, 1932-1993

We regret to inform readers of the passing of William J. Kockelman, U.S. Geological Survey (USGS), on September 4, 1993. Bill was co-editor of the *WFF* representing the USGS from 1988 to the time of his death, and was an integral part of the USGS National Earthquake Hazards Reduction Program (NEHRP) in Utah. You may recall his seven-part series in volumes 6 to 8 of the *WFF* regarding "translation and transfer" of earth-science information to users. He excerpted the series from his paper "Reducing earthquake hazards in Utah: the crucial connection between researchers and practitioners," now available in USGS Professional Paper 1519.

Bill was a planner for the USGS in Menlo Park, California, and was a principal motivating force who encouraged and provided guidance to scientists to more effectively work with users to achieve their mutual goal of hazard reduction. He served unselfishly on many technical and professional committees, including the California Seismic Safety Commission. He edited, contributed to, or wrote 18 books and more than 100 published reports, articles, and book reviews. He was a sought-after speaker and contributor at Utah's earthquake conferences from 1983-1989, and had continued his involvement as an advisor and mentor when the concentrated USGS NEHRP involvement ended in 1989. He was one of the principal reasons for the success of the new and innovative "Implementation" element first attempted in the Utah NEHRP.

We at the *WFF* and the citizens of Utah owe Bill a debt of gratitude for his insightful work with us to promote public safety through the effective use of earth-science information. The earth-science and planning professions have lost an able leader and the earthquake community has lost an effective champion of the hazard-reduction cause. He played a very unique and essential role, and will be sorely missed by us all.

Earthquake Activity in the Utah Region

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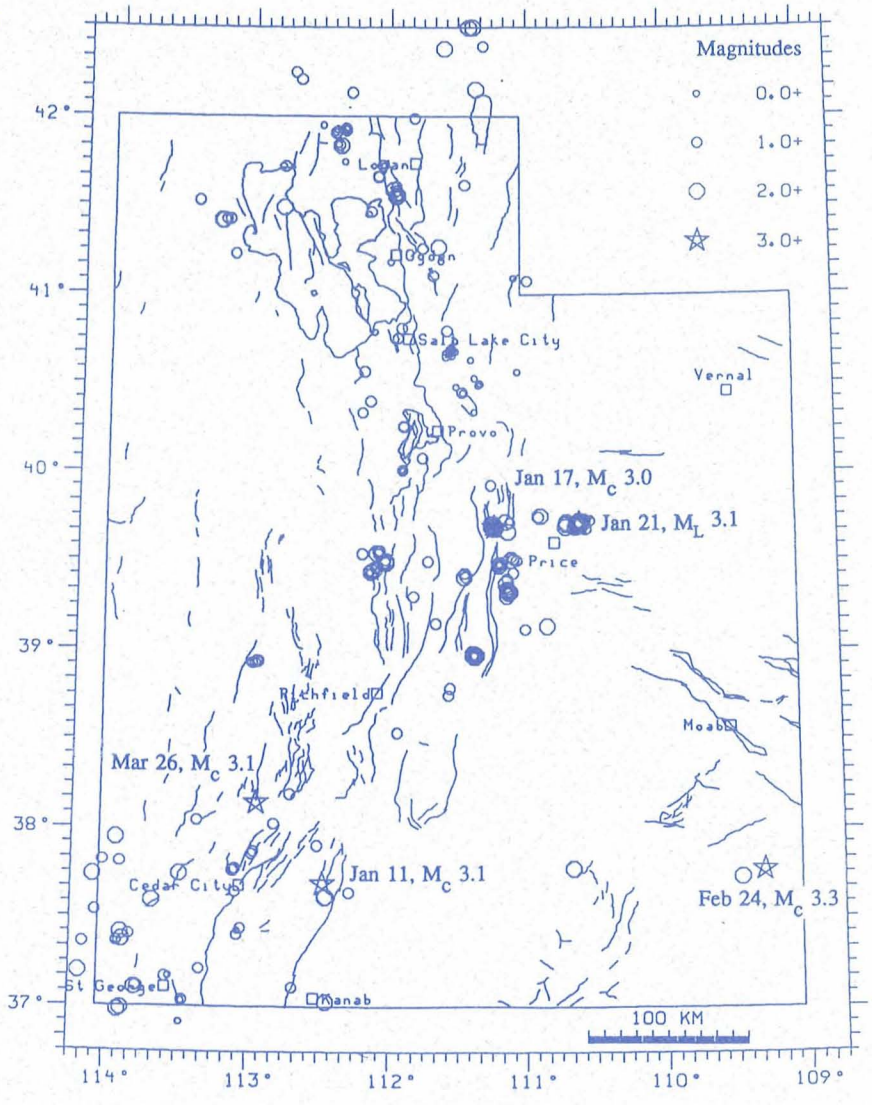
January 1 - March 31, 1993

During January 1 through March 31, 1993, the University of Utah Seismograph Stations located 367 earthquakes within the Utah region. The total includes five earthquakes in the magnitude 3 range and 177 in the magnitude 2 range. Earthquakes with magnitude 3.0 or larger are plotted as stars and specifically labeled on the epicenter map. There were two earthquakes reported felt during the report period. Magnitude indicated here is either local magnitude, M_L, or coda magnitude, M_C. All times indicated below are local time, which was 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 0.9 to 3.3) make up 51% of the shocks that occurred in the Utah region during the report period. These clusters are located: (a) 10 miles NE of Price, (b) 25 miles WNW of Price, (c) 20 miles WSW of Price, (d) 25 miles SW of Price, and (e) 35 miles NE of Richfield.

M_C 3.0	January 17	12:26 p.m.	Part of cluster (b)
M_L 3.1	January 21	2:01 a.m.	Part of cluster (a) Felt in Helper and in Soldier Creek Mine

• Northern Utah: A cluster of 17 earthquakes occurred WNW of Garland (approximately 30 miles NW of Logan). The shocks occurred primarily in mid-January and in late-March, and ranged in magnitude from 0.6 to 2.3.

Thirteen shocks occurred under the Wellsville Mountains, northeast of Brigham City, (approximately 30 miles NW of Logan). The earthquakes occurred sporadically throughout the report period.

A cluster of 14 earthquakes occurred primarily in March, three to five miles NW of Park City (20 miles ESE of Salt Lake City). The majority of these shocks had magnitudes less than 1.0.

• Central Utah: In early February and mid-March, a cluster of 17 earthquakes occurred SW of Levan (50 miles N of Richfield). The largest shock in this cluster was magnitude 2.8.

M_C 1.8	February 26	3:36 a.m.	3 miles NW of Payson Felt in Springville

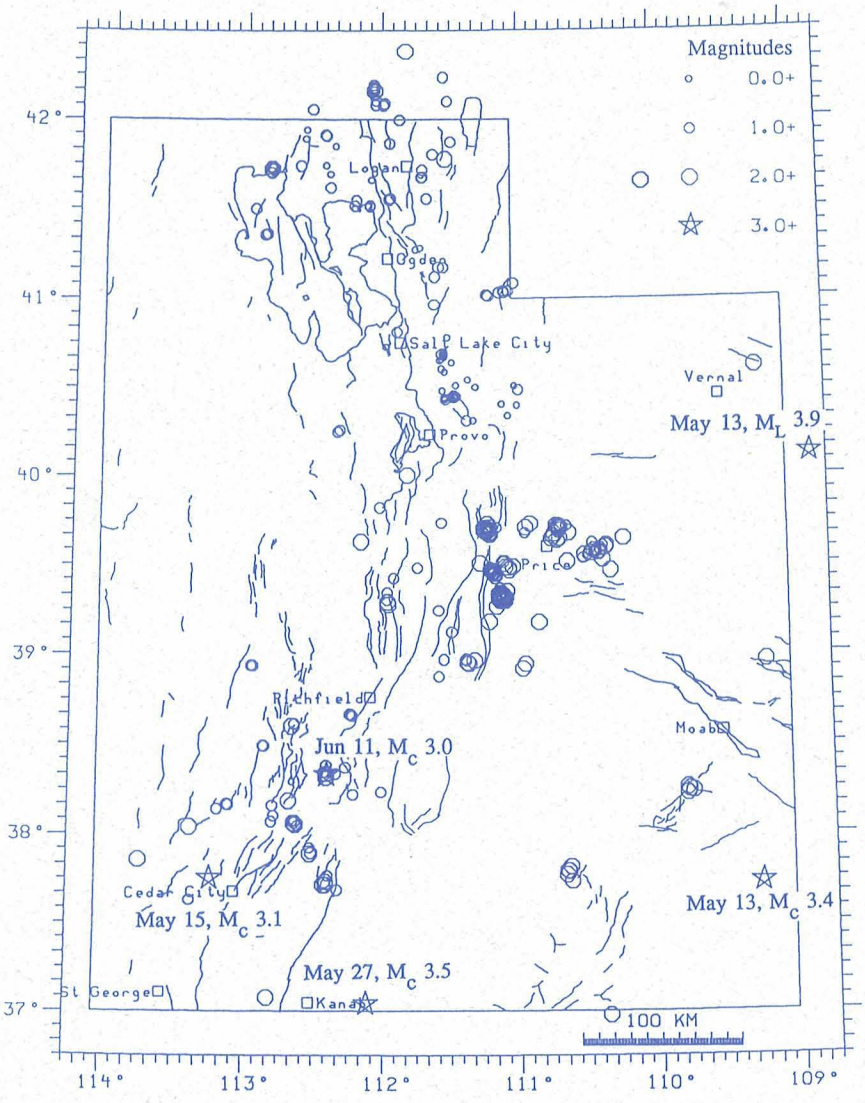
• Significant earthquakes in Southern Utah:

M_C 3.1	January 11	8:34 p.m.	10 miles S of Panguitch
M_C 3.3	February 24	1:11 p.m.	7 miles SSE of Monticello
M_C 3.1	March 26	9:49 a.m.	5 miles S of Minersville

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

April 1 - June 30, 1993

During April 1 through June 30, 1993, the University of Utah Seismograph Stations located 405 earthquakes within the Utah region. The total includes five earthquakes in the magnitude 3 range and 186 in the magnitude 2 range. Earthquakes with magnitudes of 3.0 or larger are plotted as stars and specifically labeled on the epicenter map. There was one earthquake reported felt during the report period. Magnitude indicated here is either local magnitude, M_L, or coda magnitude, M_C. All times indicated below are local time, which was Mountain Standard Time from April 1-3, and Mountain Daylight Time during the remainder of the report period.



Significant main shocks and clusters of earthquakes

• Eastern Wasatch Plateau-Book Cliffs area near Price (coal-mining related): Five clusters of seismic events (magnitude 1.1 to 2.9) make up 49% of the shocks that occurred in the Utah region during the report period. These clusters are located: (a) 20 miles E of Price, (b) five miles NE of Price, (c) 25 miles WNW of Price, (d) 25 miles SW of Price, and (e) 30 miles SSW of Price.

• Northern Utah: A cluster of ten earthquakes occurred primarily in April and May, 5 miles WNW of Dayton, Idaho (30 miles NNW of Logan). The largest was a magnitude 2.5 shock.

In early April and late May, a series of six earthquakes from 1.1 to 2.1 magnitude occurred near the northern arm of the Great Salt Lake 35 miles W of Tremonton (50 miles W of Logan). This region was the site of Utah's only historical surface-faulting earthquake, a magnitude 6.6 shock that occurred on March 12, 1934.

In April and May, seven small earthquakes (magnitude 1.1 to 1.7) occurred near the Utah-Wyoming border, 15-20 miles NE of Coalville (40 miles NE of Salt Lake City).

Throughout the report period, a series of earthquakes occurred five miles S of Midway (15 miles NE of Provo), in the general vicinity of Deer Creek Reservoir. The shocks ranged in magnitude from 0.4 to 1.7.

• Significant earthquakes in the Eastern Utah region:

M_L 3.9	May 13	10:13 a.m.	12 miles SE of Dinosaur, CO

• Southern Utah: Several small swarms of earthquakes occurred in southern Utah during the report period. In early April, five shocks (magnitude 1.2 to 2.7) occurred five miles SE of Panguitch (35 miles E of Cedar City). On June 16, a brief flurry of seven earthquakes (magnitude 1.4 to 2.7) occurred 15 miles SSE of Beaver (30 miles NE of Cedar City). In mid-June, nine shocks (magnitude 1.4 to 3.0) occurred 15 miles NE of Beaver (30 miles SW of Richfield). Significant earthquakes:

M_C 3.4	May 13	2:50 p.m.	10 miles SSE of Monticello
M_C 3.1	May 15	9:30 p.m.	11 miles WNW of Cedar City Felt in Cedar City
M_C 3.5	May 27	12:21 p.m.	23 miles E of Kanab
M_C 3.0	June 11	6:07 a.m.	13 miles NW of Circleville

UTAH RECEIVES 1994 NEHRP GRANTS

The U.S. Geological Survey recently announced proposals selected for funding in 1994 under the National Earthquake Hazards Reduction Program and Utah is well represented in the chosen projects. The following summaries are excerpted from proposal abstracts.

"Detailed assessment of the liquefaction susceptibility of thinly bedded sediments," $35,000, 12 months, Loren Anderson and Jeffrey R. Keaton, principal investigators.

The N value from the Standard Penetration Test (SPT) is routinely used by geotechnical engineers to evaluate the liquefaction susceptibility of sand and silty sand deposits. Investigations by Utah State University of several sites in the lake bed deposits along the Wasatch Front in Utah strongly suggest that this method (called the Seed method) cannot be directly applied to sand deposits with thinly interbedded clay seams. Examination of trenches that were made at sites with low SPT N values (indicating high liquefaction susceptibility) clearly show no evidence of liquefaction even though there is geologic evidence that strongly suggests the occurrence of at least three seismic events that would have produced sufficient ground shaking to induce liquefaction. The proposed study will conduct a detailed investigation of sand deposits with thinly interbedded clay seams that were known to liquefy or not liquefy during strong ground shaking. The research is urgently needed because the Seed method is currently being used to make liquefaction evaluations in these lake bed deposits.

"Seismic source evaluation of the Salt Lake City segment of the Wasatch fault zone, central Wasatch Front, Utah," $27,680, 12 months, William R. Lund, principal investigator.

The Utah Geological Survey will reoccupy one of the earlier trench sites (the South Fork Dry Creek site) and complete the paleoseismic investigation started there in 1985 to establish the history of Holocene surface faulting at a single location on the Salt Lake City segment. By combining the results of this investigation with those obtained in 1985, it should be possible to construct a more complete chronology of surface-rupturing earthquakes for the segment from at least the middle Holocene (past 6,000 years). Until that chronology is established with confidence, questions will remain regarding the seismic history of Utah's most populous fault segment and the adequacy of hazard and risk assessments currently used to prepare for future large earthquakes.

"Hazard potential, failure type, and timing of liquefaction-induced landsliding in the Farmington Siding landslide complex, Wasatch Front, Utah," $19,134, 12 months, Mike Lowe, principal investigator.

The Utah Geological Survey (UGS) will conduct a detailed geologic investigation of the liquefaction-induced Farmington Siding landslide complex near Farmington, Davis County, Utah. A recent NEHRP-funded study by the UGS confirmed that recurrent movement has taken place on the Farmington Siding landslide complex. However, the timing of landslide events and failure mechanism (flow failure versus failure by lateral spreading) have not yet been clearly determined. These factors must be understood in order to evaluate hazard potential. Local governments are more likely to avoid development on these features and adjacent areas, or look for an area-wide mitigation strategy to reduce the risk, if they understand the hazard potential. In addition to helping reduce the loss of life and property in the Farmington area as a result of earthquakes, methods developed may prove useful for evaluating similar problems on other landslides along the Wasatch Front and elsewhere.

"Effective dissemination of NEHRP research results in Utah--connecting researchers and practitioners," $15,850, 12 months, Janine L. Jarva and Gary E. Christenson, principal investigators.

The Utah Geological Survey has continued an active program to translate scientific research results into products useful

to a diverse community of end-users, and to forge strong partnerships between the research community (universities, the private sector, and state and federal agencies) and those who ultimately use the information to implement hazard-reduction policies (local governments, engineers, architects, planners, and emergency preparedness planners and responders). In this project, we will develop and apply new geographic information systems (GIS) methods to consolidate the recently completed Quaternary tectonics map and tabular database [see related article, this issue] and to expand and update two other ongoing projects, the Geologic Hazards Bibliography of Utah and the *Wasatch Front Forum*, to more effectively disseminate earthquake-hazards information.

1993 NEHRP-FUNDED RESEARCH IN UTAH

The following three reports present results-to-date of 1993 NEHRP-funded research in Utah and are excerpted from Summaries of Technical Reports, volume XXXV, USGS Open-File Report, in press.

"Earthquake-potential evaluation of the Oquirrh fault zone, central Wasatch Front, Utah," William R. Lund, Susan S. Olig, and Bill D. Black, principal investigators.

The Utah Geological Survey is studying the Oquirrh fault to determine the earthquake hazard it presents to western Utah and the nearby Salt Lake City metropolitan area. Results show that the fault is active and has generated repeated large-magnitude (7+) earthquakes in the past 26,000 years. The repeat time for these events is between 12,600 and 21,900 years. The most recent surface-rupturing earthquake occurred between 4,300 and 7,700 years ago. Vertical displacement during that event was 2 to 3 meters and the length of surface rupture was 10 kilometers. Besides ground rupture, an event of this size would produce strong ground shaking, liquefaction, and landslides.

"Surficial geologic mapping of the Nephi segment, Wasatch fault zone, Utah," W.E. Mulvey and K.M. Harty, principal investigators.

The Utah Geological Survey is mapping the surficial geology along the Nephi segment (Payson to Nephi) of the Wasatch fault, the southernmost of the five most active central segments of the Wasatch fault zone. The map will provide information on faulting on the segment, and serve as a base for the Utah engineering- and environmental-geologic community and local governments to derive surface-fault-rupture and other geologic-hazards maps. The final publication will be a 1:50,000-scale colored map, in a format consistent with USGS maps of other segments of the Wasatch fault.

"Preparation of public-information products from NEHRP research results, Wasatch Front, Utah," Sandra N. Eldredge, principal investigator.

The Utah Geological Survey will publish public-information products including: (1) a homebuyer's guide to earthquake hazards, (2) a full-color brochure describing and illustrating the Wasatch fault, Utah's most active fault, (3) a pamphlet "translating" information on the ground-shaking hazard in Utah, and (4) a series of page-size liquefaction-potential maps for Wasatch Front counties. In addition, NEHRP-funded liquefaction-potential maps and reports that are unpublished and not widely available, will be published as contract reports. All publications will provide needed information on earthquake hazards to the public, realtors, planners, and public officials.

QUATERNARY TECTONICS MAP NOW AVAILABLE

The Utah Geological Survey has just published Bulletin 127, "Quaternary Tectonics of Utah" by Suzanne Hecker. The report is the result of a multi-year effort to compile in a single reference all information available on potential earthquake-generating (Quaternary-age) tectonic features (faults, folds, and other deformation) in Utah. The report includes a 1:500,000-scale map showing tectonic features thought to be active in the past 1.6 million years. Features are color-coded to show the time of

last movement, which is an indication of their relative activity. Index maps are provided to relate features on the map to an extensive table of information giving recurrence intervals, slip rates, ages of prehistoric earthquakes, and other pertinent information on each tectonic feature.

Also included in the report is a 1:500,000-scale map of Quaternary volcanic features (flows and vents), similarly color-coded to show time of eruption. This map shows the relationship between tectonic features and volcanic eruptions, and depicts areas of most recent volcanism and presumably where it is most likely to recur.

The report is a technical reference for use chiefly by geologists and engineers in evaluating earthquake hazards. It indicates that the most active faults are concentrated in north-central Utah along the Wasatch Front; the Wasatch fault is the most active in the state. However, many less active but potentially dangerous faults and other tectonic features capable of generating large earthquakes are present elsewhere in the state, particularly along the urbanized corridor following I-15 from the Wasatch Front south to St. George. The most recent volcanism is confined chiefly to southwestern Utah; the youngest flows are only about 600 years old.

We believe this report will have broad application, and hope it will stimulate research and contribute to more accurate assessments of earthquake hazards in Utah. The report sells for $16.00 ($17.00 including tax for Utah residents, add $2.50 for postage and handling if ordering by mail). A digital version of the maps is available through the State Geographic Information Database from the Utah Automated Geographic Reference Center, 4130 State Office Building, Salt Lake City, Utah 84114, (801) 538-3163.

ATC AND USGS SPONSOR REGIONAL SEMINARS ON NEW DEVELOPMENTS IN EARTHQUAKE GROUND MOTION ESTIMATION [BUT WHERE'S SALT LAKE CITY? - ED.]

In early 1994 the Applied Technology Council (ATC) and the U.S. Geological Survey (USGS) will conduct a series of five seminars throughout the United States to provide a comprehensive overview of recent USGS developments in earthquake ground-motion estimation and the implications for engineering design practice. The seminars are for practicing structural and geotechnical engineers and are part of the ongoing ATC-35 Project to "Transfer U.S. Geological Survey Research Results into Engineering Design Practice."

The locations and dates of the five regional seminars are:

Los Angeles	January 26
San Francisco	January 27
Seattle	February 2
New York City	February 9
Memphis	February 10

Each seminar will provide comprehensive but practical region-specific state-of-the-art information on earthquake potential and the characteristics of expected ground shaking, with a special emphasis on issues relevant to the design ground motions. Seminar topics include: (1) regional earthquake risk (focused on the region in which the seminar is conducted), (2) strong-ground motion estimation (new techniques for estimating ground motions as a function of earthquake source, travel path, and site parameters, with emphasis on problems specific to the particular region), and (3) implications of new knowledge and new developments for engineering practice (specifically applicable to geotechnical engineering and structural engineering).

The pre-registration fee, which includes lunch and the seminar proceedings (issued at the start of each seminar), is $80 ($64 for ATC subscribers). The on-site registration fee is $90. For registration information please contact the Applied Technology Council, 555 Twin Dolphin Dr., Suite 550, Redwood City, CA 94065, phone 415-595-1542, fax 415-593-2320.

-Reprinted (minus editorial comment) from EERI Newsletter, v. 27, no. 12, December, 1993.

UTAH'S SEISMIC SETTING AND DAM SAFETY: A GIS PERSPECTIVE

by Joe Borgione
Utah Division of Water Rights, Dam Safety Section

Excerpted from a paper presented at the Southwest ARC/INFO Users Group Meeting
October 1993, Jackson Hole, Wyoming

INTRODUCTION

Dam safety in the state of Utah is regulated through the Department of Natural Resources, Division of Water Rights, Dam Safety Section. Earthquakes represent a significant problem to dam safety. As with any engineered structure, dams can sustain considerable damage from an earthquake (USCOLD, 1992). The September 2, 1992, 5.8 Richter magnitude earthquake in the southwest corner of Utah is the most recent, prominent event in the state (Black and Christenson, 1993); at least two dams impounding water at the time of the event were the cause of concern (Borgione, in preparation).

To better monitor dam performance during earthquakes, an ARC/INFO-based analysis program was developed to identify dams which, in the event of an earthquake, should be inspected. The program, written in Arc Macro Language (AML), searches the dam database and identifies dams to be inspected based on their proximity to the epicenter and the magnitude of the earthquake. A second seismic/dam safety analysis displays the spatial relationship between dam sites, Uniform Building Code (UBC) seismic zones, and known fault systems.

ANALYSES

The QUAKES AML

Within the Dam Safety Section, a post-earthquake-dam-inspection policy recently was updated and automated using ARC/INFO. This policy and subsequent computer application allows engineers to determine what dams, if any, need to be inspected for damage following an earthquake. Prior to computerization, staff members would draw a circle around an epicenter with a radius based on earthquake magnitude. Any dams within the circle would then be inspected. This concept is the basis of the QUAKES AML. [More information on the QUAKES AML is given in *WFF*, 1992, v. 8, no. 3, p. 11.]

Table 1 shows the distances used to calculate search radii. The radii represent a relationship between earthquake magnitude and associated ground acceleration. For example, within the magnitude range of 5.6 to 6.0, ground accelerations of about 0.1 g or greater are expected to a radius of 25 miles. Curves developed for this table were derived by the Dam Safety Section and are based on Leps and Jensen (1984). Using the 0.1 g acceleration as a target allows a conservative estimate accommodating dams for which structural and/or foundation integrity is unknown.

A secondary search radius of 1.5 times the primary radius is also calculated. This ensures that dams just outside the primary radius or others that may be subject to ground acceleration deformation within a reasonable distance are included.

QUAKES has been executed a number of times. The program came on line after the September 2, 1992 St. George earthquake, and was used to identify all dams that should have been inspected following that event. A few dams were discovered that had been overlooked for inspection. Shortly after its implementation, with a small earthquake in northwest Utah, the program determined that no dam sites were located within the small search radii. In June, 1993, the Federal Emergency Management Agency (FEMA) sponsored "Response 93" [see *WFF*, 1992, v. 8, no. 4, p. 12-16], a mock disaster using a magnitude 7.5 event within the Salt Lake Valley. With such a location and size, 271 dam sites appear in the primary radius; another 172 dams appear in the secondary search.

Seismic-Zone Analysis

A key element in the execution of the QUAKES application is accurate data with respect to magnitude and location of a given event. These data are currently provided by the University of Utah Seismograph Stations, which monitors all seismic activity through a statewide network.

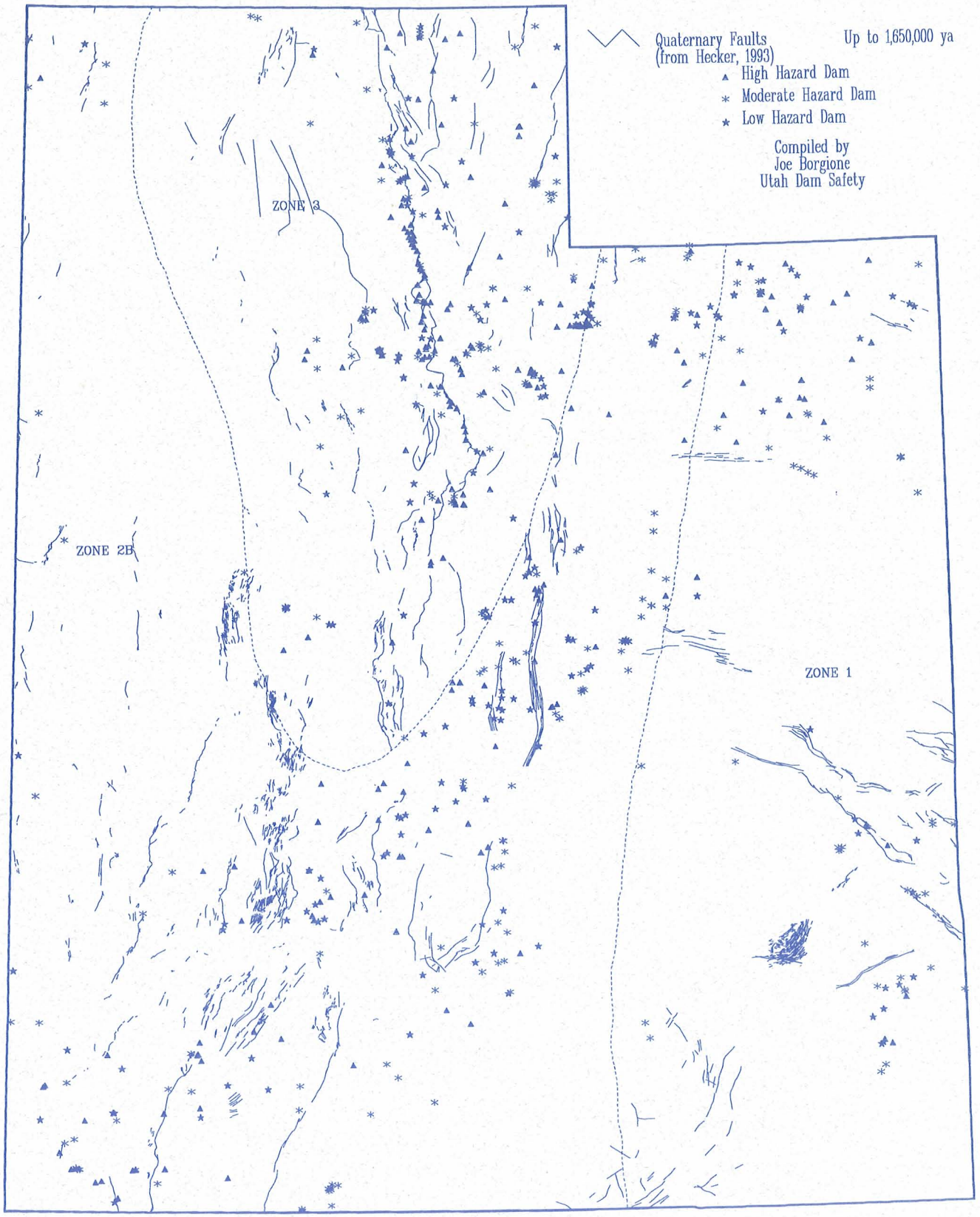


Figure 1. Dams, UBC seismic zones, and Quaternary faults in Utah.

Table 1. Relationship between earthquake magnitude and search-radius distance.

Richter Magnitude	Search Radius (mi)
4.0 to 4.5	10
4.6 to 5.0	12
5.1 to 5.5	18
5.6 to 6.0	25
6.1 to 6.5	38
6.6 to 7.0	55
7.1 and greater	75

Budgetary constraints may necessitate limiting the network to the immediate Wasatch Front area, a region generally associated with Uniform Building Code (UBC) seismic zone 3. Utah is divided into three UBC seismic zones, 1, 2b, and 3, which reflect the seismicity of the particular region; 1 is the lowest and 3 is the highest with respect to seismic hazard. An analysis using ARC/INFO defines which dams would fall into zones 1 and 2b, outside the area of coverage if the network is limited (figure 1). Quaternary faults from Hecker (1993) are also shown in figure 1.

Hazard ratings for dams in figure 1 are based on downstream risk (Utah Division of Water Rights, 1991). High-hazard dams are those which, in the event of failure, are expected to cause extensive property damage and threaten human life. A moderate-hazard dam failure is expected to cause extensive property loss, but is much less likely to threaten human life. Finally, a low-hazard dam failure is expected to result in property loss sustained only by the dam owner. Hazard ratings do not in any way reflect the integrity of the dam. Table 2 shows the numbers and designated hazard ratings of dams in UBC zones 1 and 2b, with respect to all the dams in the ARC/INFO database.

The numbers in table 2 include dams which were designed primarily to function as flood-control structures. Such dams typically impound water for relatively brief periods of time, after cloudburst events or during periods of high spring runoff. Many of them are assigned the high-hazard rating, but probabilities of these reservoirs being full during a significant seismic event are remote. To more accurately represent the dam safety/seismic analysis, table 3 includes only dams designed primarily as water-storage (WS) facilities which store water for extended periods of time.

Clearly, UBC zones 1 and 2b envelop a much larger area of Utah and a greater number of dams than does UBC zone 3. The results shown in table 3 indicate that the majority of dams, especially high- and moderate-hazard water-storage structures, are located in regions susceptible to seismic activity. Of the 353 water-storage dams in seismic zones 1 and 2b, 70 percent are in zone 2b where many of the state's larger historical earthquakes have occurred. Accurate epicenter information from the UUSS network in these areas is vital for dam safety.

CONCLUSIONS

The QUAKES program provides a valuable analytical tool for dam safety. Although program design specifically focuses on dams and earthquakes, the concept can be adapted to a wide range of applications. Like most programs that produce a hardcopy output, QUAKES is periodically reviewed and updated. One upcoming modification will be to include output of latitude/longitude data of dams on the list. During the Response 93 exercise, Civil Air Patrol pilots requested these data be included to aid in developing a flight plan for reconnaissance missions.

One limitation of the application is that it is a computer program; in the event of a major earthquake in the Salt Lake area where the computer facilities are located, the likelihood of accessing the

Table 2. Dams in UBC seismic zones 1 and 2b in Utah.

Total Dams in ARC/INFO Database	677	
Dams in Zones 1 & 2b	392	58%
Total High-Hazard Dams	227	
High-Hazard Dams in Zones 1 & 2b	99	44%
Total Moderate-Hazard Dams	197	
Moderate-Hazard Dams in Zones 1 & 2b	122	62%
Total Low-Hazard Dams	242	
Low-Hazard Dams in Zones 1 & 2b	165	68%
(11 Dams are not hazard-rated)		

Table 3. Water-storage (WS) dams in UBC seismic zones 1 and 2b in Utah.

Total WS Dams in ARC/INFO Database	556	
WS Dams in Zones 1 & 2b	353	63%
Total High-Hazard WS Dams	156	
High-Hazard WS Dams in Zones 1 & 2b	83	53%
Total Moderate-Hazard WS Dams	174	
Moderate-Hazard WS Dams in Zones 1 & 2b	116	66%
Total Low-Hazard WS Dams	215	
Low-Hazard WS Dams in Zones 1 & 2b	150	70%

computer, much less having the electricity and network communications to run it, is low. Plans to deal with this problem include running the program as a simulator in advance of earthquake events and storing the output as hardcopy plots in safe locations, including various regional offices of the Division of Water Rights. Advance simulation of earthquakes having various magnitudes and epicenters around the state will improve initial response efforts after an event by providing emergency responders with enough information to include dam inspections in mission planning, even though computer facilities in Salt Lake City may be down.

The dam location/seismic zone analysis is relatively simple and exemplifies the utility of ARC/INFO. Graphic displays of various digital map databases, such as dam locations, seismic zones, and Quaternary faults, effectively depict exposure to hazards. Results of the analysis, both tabular and graphic, were included in a report to a special governmental task force investigating funding options for the seismic network.

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NSF SEEKS PROPOSALS ON PRECAST SEISMIC STRUCTURAL SYSTEMS

The Earthquake Hazard Mitigation Program (EHM) at the National Science Foundation (NSF) is encouraging submission of research proposals for the coordinated research program on Precast Seismic Structural Systems (PRESSS).

The general goals of the program are to develop new concepts, materials, construction technologies, and comprehensive rational design recommendations based on fundamental and basic research for safe and technically viable precast concrete construction in seismic zones.

In Phase I of PRESSS, proposals were funded in the areas of connection classification, development of analytical methods, and draft-design recommendations. Phase II is being implemented incrementally, and proposals have been funded primarily on experimental and analytical studies into the seismic performance of frame structures, and on further development of design recommendations.

The research areas which, among others, will be considered for possible support in the current phase (fiscal year 1994) are:

- innovative ductile connection systems involving advanced materials;
- Experimental and analytical studies in the seismic performance of panel systems with ductile connectors;
- utilization of differences in deformation characteristics between frame and panel components to reduce seismic response;
- development of simplified analytical procedures for seismic-response quantification of panel and panel/frame systems, based on dynamic inelastic time-history analyses; and
- development of innovative manufacturing and construction practices for precast systems in seismic zones.

The deadline for proposals is February 15, 1994. More details are available from PRESSS coordinator, Nigel Priestley, University of California at San Diego, 619-534-5951, fax 619-534-6373. General inquiries should be directed to S.C. Liu or M.P. Singh, Program Directors, Earthquake Hazard Mitigation Program, NSF, 4201 Wilson Blvd., Room 545, Arlington, VA 22230, 703-306-1361, e-mail: msingh@nsf.gov or sliu@nsf.gov.

-Reprinted from EERI Newsletter, v. 27, no. 12, December, 1993.

SELECTED SEISMIC REHABILITATION TECHNIQUES AND THEIR COSTS

The National Earthquake Hazards Reduction Program report entitled "Selected Seismic Rehabilitation Techniques and Their Costs," prepared by URS/John A. Blume & Associates, Engineers of San Francisco, California, is now available. The report was prepared under contract to the Federal Emergency Management Agency (FEMA).

The design examples in this publication illustrate the implementation of the seismic strengthening techniques described in "The NEHRP Handbook of Techniques for the Seismic Rehabilitation of Existing Buildings." The design examples include the retrofit of six buildings and three non-structural components. An additional example illustrates the design of a temporary pedestrian-protection canopy, a structure that might be required to permit the retrofit of the exterior of a building in an urban setting.

Individual copies can be obtained from Ugo Morelli of FEMA's Earthquake Programs Office, Room 625, 500 "C" Street S.W., Washington, D.C. 20472, (202) 646-2810, fax (202) 646-3104.

UTAH EARTHQUAKE ADVISORY BOARD NEWS

The Utah Earthquake Advisory Board (UEAB) has continued to develop the "Utah at Risk" document. At the most recent quarterly meeting, December 7, 1993, members of newly formed standing committees attended a general briefing on the evolution of the document and then broke into committee groups to review their objectives, develop mission statements, and consider initiatives. A new level of enthusiasm and commitment was evident throughout the meeting. Standing committees include:

ENGINEERING AND ARCHITECTURE COMMITTEE

Chairperson: *David Curtis, Past President, Utah Association of Structural Engineers

Carl Carpenter, Principal Engineer, Provo City Water Resources Department

Scott Ellis, Structural Engineer, Ellis & Associates

*Frank Fuller, Project Coordinator, Utah Division of Facilities, Construction and Management

*James Golden, Assistant Chief Structural Engineer, Structures Division, Utah Department of Transportation

Peter McDonough, Project Engineer, Mountain Fuel Supply Company

Barry Smith, Architect, Astel-Erickson

*Michael Stransky, Director, Western Mountain Region, American Institute of Architects

EARTH SCIENCES COMMITTEE

Chairperson: *Dr. Walter J. Arabasz, Research Professor and Director, University of Utah Seismograph Stations

*Dr. M. Lee Allison, State Geologist and Director, Utah Geological Survey

Dr. Jeffrey R. Keaton, Senior Engineering Geologist and Vice President, SHB AGRA, Inc.

William R. Lund, Senior Geologist and Deputy Director, Utah Geological Survey

Dr. James C. Pechmann, Research Associate Professor, Department of Geology and Geophysics, University of Utah

Dr. Kyle M. Rollins, Assistant Professor, Department of Civil Engineering, Brigham Young University

* Dr. T. Leslie Youd, Professor, Department of Civil Engineering, Brigham Young University

EMERGENCY PLANNING COMMITTEE

Chairperson: *Lorayne Frank, Director, Utah Division of Comprehensive Emergency Management

Roger Anderson, Assistant Director, Davis County Emergency Services

Roger Forsberg, Thiokol Corporation

LeGrand Jones, Loss Control Administrator, Utah Department of Transportation

Deborah H. Kim, Emergency Department, University of Utah Medical Center

Jeff Rylee, Director, Salt Lake City Emergency Services

EARTHQUAKE AWARENESS COMMITTEE

Chairperson: *Dr. M. Lee Allison, State Geologist and Director, Utah Geological Survey

Rex Curtis, Retired School Teacher

Steve Lutz, Director, Utah State Fire Academy

Dr. Gary Madsen, Professor, Department of Sociology, Utah State University

Hollie Muir, Disaster Education Coordinator, American Red Cross

DeeDee O'Brien, Outreach Coordinator, College of Mines and Earth Sciences, University of Utah

Patrick Reese, Emergency Response, Church of Jesus Christ of Latter Day Saints

Kay Sadler, Management Information Services Director, West Valley City

Kim Williams, CSEPP Public Information Officer, Utah Division of Comprehensive Emergency Management

INTERGOVERNMENTAL RELATIONS COMMITTEE

Chairperson: *John Harja, Senior Research Analyst, Governor's Office of Planning and Budget

*Ken Bullock, Executive Director, Utah League of Cities and Towns

(This committee is not yet finalized because John Harja only recently replaced Steven M. Klass [former Deputy State Planning Coordinator, Governors's Office of Planning and Budget] on the UEAB.)

* Member, Utah Earthquake Advisory Board

In order to achieve broad involvement in a comprehensive, integrated, sustained effort to reduce earthquake hazards and risk in Utah, the input and participation of Utah's citizens and decisionmakers will be sought during the development of "Utah at Risk." To that end, the Earthquake Awareness Committee will formulate and promote an earthquake conference in 1994 to gather community input to the draft document.

The new affiliation of the *Wasatch Front Forum (WFF)* with the UEAB was also discussed at the meeting. As the official newslwtter of the UEAB, the *WFF* can bring greater visibility to and recognition of the UEAB among the citizens of Utah.

NEWS FROM COMPREHENSIVE EMERGENCY MANAGEMENT

Response '94

In June 1993, the largest full-scale earthquake exercise ever undertaken in the U.S. occurred in Utah [see *WFF*, 1992, v. 8, no. 4, p. 12-16]. Response '93 focused on the adequacy and feasibility of existing plans, procedures, and organizational structures which would be implemented in responding to a major earthquake disaster in Utah. The Utah Division of Comprehensive Emergency Management (CEM) and the Utah Association of Contingency Planners will co-sponsor a follow-up exercise to Response '93 called "Response '94 - Lessons Learned From '93." The disaster scenario will be a Richter magnitude 6.8 earthquake with an epicenter in the Salt Lake Valley. Response '94 will take place on March 31, 1994 at the Utah State Fairgrounds. It will be a one-day exercise involving the State Emergency Operations Center (EOC) and will include representatives from departments of state government, Wasatch Front county EOC's, city EOC representatives, and participants from business and industry. The exercise will emphasize coordinating and prioritizing requests for assistance from cities to counties and from counties to the state. During a disaster, affected counties will have to coordinate city requests for assistance and communicate them to the state. This exercise will provide all participants the opportunity to improve and strengthen these joint interactions in advance of a true disaster. If you would like further details about Response '94, contact Lance Peterson at CEM, 1-800-753-2858 or (801) 538-3745.

Recent Reorganization

CEM has recently undergone some organizational changes that affect their earthquake program, which resides in the Natural Hazards Section of the Operations and Field Coordination Bureau. John Rokich is the new manager of the Section but will also continue his responsibilities in disaster preparedness. Bob Carey is manager of the Earthquake Preparedness Information Center (EPICenter) and Judy Watanabe is the new Section planner who will assist all programs within the Section. Caryn Johnson remains the Natural Hazards Section intern and serves as staff to the Utah Earthquake Advisory Board.

1994 WESTERN STATES SEISMIC POLICY COUNCIL WHO ARE THEY AND WHAT DO THEY DO?

The 1994 Western States Seismic Policy Council (WSSPC) annual meeting will be held in Salt Lake City, probably in September. The 1993 annual meeting was in Jackson, Wyoming. It was highlighted by keynote speakers discussing the reorganization of the Federal Emergency Management Agency (Harvey Ryland, senior policy advisor to the Director of FEMA), the status of National Earthquake Hazards Reduction Program research (Dr. Rob Wesson, Chief, U.S. Geological Survey Office of Earthquakes, Volcanoes, and Engineering), and the application of new national seismic hazard maps (Dr. Ted Algermissen, U.S. Geological Survey). Representatives of the National Emergency Managers Association (Dr. Richard Andrews, California Office of Emergency Services) and Association of American State Geologists (Dr. Earl Bennett, Idaho State Geologist) discussed possible collaboration between these organizations and WSSPC.

WSSPC's mission is to provide a forum to advance earthquake hazard-reduction programs throughout the western states and to develop and recommend seismic policies and programs for the region through information exchange, research, and education. To do this, the following objectives have been identified:

1. Promote interstate cooperation.

2. Identify policy issues and develop strategies to enhance earthquake preparedness, mitigation, response, recovery, and related activities.

3. Provide advice and counsel to federal agencies on issues and research related to seismic safety.

4. Sponsor regional and subregional research projects and solicit funding as required.

5. Coordinate with other regional earthquake organizations to develop national earthquake policy positions.

6. Establish and sponsor training programs and activities.

7. Promote the interaction of the member states' Earthquake Preparedness Program and Geological Program representatives.

8. Raise the overall awareness at all levels, of earthquake hazards and methods to mitigate these hazards.

9. Serve as a resource for earthquake related materials, information, and activities.

10. Encourage government to support and fund scientific earthquake studies and earthquake preparedness activities that will reduce or eliminate deaths, injuries, and property damage that result from earthquakes.

WSSPC is currently composed of the following 15 states, U.S. territories, and Canadian provinces: Alaska, Arizona, British Columbia, California, Colorado, Guam, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Each state is requested to designate two voting delegates to WSSPC, one to represent the state emergency management earthquake program, and one to represent the state geological survey/geosciences earthquake program. At present, Fred May (Utah Division of Comprehensive Emergency Management) and Gary E. Christenson (Utah Geological Survey) are the delegates from Utah. Funding support for WSSPC activities is provided by the Federal Emergency Management Agency (FEMA).

WSSPC operates in much the same way as a volunteer organization; that is, most staff time and resources devoted to the operation of WSSPC are provided on an "as available" basis and WSSPC has no permanent staff. Leadership and direction for WSSPC is provided by a nine-person Executive Committee, including a Chairperson. The Executive Committee includes six voting delegates and three non-voting delegates. The six voting delegates are elected by WSSPC voting delegates annually and include three members representing emergency management and three members representing geosciences. The three non-voting delegates represent FEMA, USGS, and California . The Chairperson and Executive Committee may establish ad hoc subcommittees as needed and appoint members as appropriate. Fred May of Utah CEM is co-chairman with Reggie Yates (Arizona Division of Emergency Management), and is conference chairman for the 1994 Salt Lake City annual meeting.

Since its inception in 1979, WSSPC has focused primarily on the planning and conduct of the annual meeting and conference as a means to coordinate

and exchange information on earthquake-hazard reduction activities of the western states. To increase it's effectiveness, outreach capabilities, visibility, professionalism, and general membership, WSSPC initiated a strategic planning process in 1992 at the annual meeting at Incline Village, Nevada. The process resulted in a number of recommendations and actions, some to be taken immediately and others over the long-term. Specific initiatives proposed include:

1. Build program capability by establishing and staffing a permanent office.

2. Increase funding to support increased activity by establishing non-profit status, competing for grants, and possibly establishing membership fees.

3. Create training opportunities by conducting workshops and co-sponsoring events.

4. Encourage and incorporate subregional activities by groups of states within WSSPC.

5. Increase WSSPC visibility and enhance information exchange with a brochure, a newsletter, an electronic bulletin board, workshops, and an outreach program.

6. Increase involvement of state-agency directors in WSSPC policy and programs.

7. Support national mitigation strategy proposed by FEMA director James L. Witt.

WSSPC is at a crossroads, and hopes to become much more visible and active in the future. They will soon be looking for a permanent facility and staff for their new office, and will be requesting proposals from WSSPC states wishing to house them. We will publish updates on their activities in the *WFF*, and look forward to their annual meeting in Salt Lake City in September 1994. This will be an opportunity for Utah to showcase its earthquake program to the other western states.

EARTHQUAKE SPECTRA THEME ISSUE

Passive Energy Dissipation

The August 1993 issue of *Earthquake Spectra,* the quarterly journal of Earthquake Engineering Research Institute (EERI), is devoted exclusively to the topic of energy-dissipation systems for improved earthquake performance of buildings. It is the third issue in a series of state-of-the-art reviews of a specific subject. The May 1990 issue of *Earthquake Spectra* focused on seismic isolation and the February 1992 journal addressed public-policy issues. In selecting papers for this third special issue, the Editorial Board tried to include all available dissipation systems, while consciously rejecting all papers which combine energy dissipation with base isolation.

The theoretical background and device testing have progressed to a state where energy-dissipation systems can be reliably designed and installed in existing and new buildings. Several papers in this issue describe projects that have successfully utilized energy-dissipation systems. Other papers provide background information on the performance of individual devices and systems from analytical and experimental studies.

We believe that this issue of *Earthquake Spectra* will be of interest to many. It should provide answers to questions on the feasibility, cost, practicality, theory, and application of energy-dissipation devices. We expect that energy-dissipation systems will be accepted by all code-enforcement agencies in the near future.

The theme issue of *Earthquake Spectra* is now available from EERI for $15. All orders must be accompanied by a check, or a VISA/MasterCard number. California residents add 8.25% sales tax; for surface shipping outside the USA, please add $2.50. For more information or to receive a free copy of the publications catalog, please contact EERI office at 499 14th Street, Suite 320, Oakland, CA 94612-1902, (510) 451-0905, fax (510) 451-5411.

MEETINGS AND CONFERENCES

April 5-7, 1994, **Annual Meeting of the Seismological Society of America**, Pasadena, California. Abstract deadline is January 18, 1994. Topics include original research in seismology, geophysics, and earthquake engineering. For further information, contact SSA Headquarters, 201 Plaza Professional Building, El Cerrito, CA 94530, (510) 525-5474, fax (510) 525-7204.

April 7-9, 1994, **EERI Annual Meeting**, Hilton Hotel, Pasadena, California. April 7 is the last day of the Seismological Society of America meeting being held at the same location. A concurrent program is being planned for that day. For information, contact the EERI Office, 499 14th Street, Suite 320, Oakland, CA 94612-1902.

April 18-21, 1994, **International Emergency Management and Engineering Conference, "Bridging the Gap Between Theory and Practice: Research and Applications,"** Miami, Florida. An interdisciplinary conference sponsored by The International Emergency Management and Engineering Society (TIEMES) to bring together users, planners, researchers, managers, technicians, response personnel, and other interested parties to learn, teach, present, share and exchange ideas and information about how, when, where, and why information management tools can be used to avoid, mitigate, and recover from disasters and other emergencies. The first two and one-half days of this four day conference will be devoted to technical sessions. The last day and a half of the conference will be dedicated to a ***Consultation on Information Management Technology for Emergency Preparedness*** (CIMTEP) which will bring together state and local government users of emergency preparedness automation (emergency managers, planners, and responders) with researchers and developers. This workshop will, first, inform end-users about the capabilities of existing technologies, and, second, give end users a forum to express needs and concerns that researchers and developers should address. Sessions for both new and experienced users are planned, and user input is solicited for these sessions. A discounted registration fee will be offered to state and local government emergency-preparedness personnel attending only the CIMTEP, to make participation possible for more end users. For information, contact Jim Sullivan at (214) 888-8804, fax (214) 270-3014, 2995 LBJ Freeway, Suite 200, Dallas, TX 75234.

May 4-6, 1994, **Geological Society of America Rocky Mountain Section Meeting**, Durango, Colorado. Submit abstracts to Jack A. Ellingson, Geology Department, Fort Lewis College, Durango, CO 81301, (303) 247-7244, by January 14, 1994. Meeting chairman, Douglas Brew, can be contacted at (303) 247-7254, fax (303) 247-7310, same address as above. For further conference information, contact Sue Beggs, GSA Meetings Manager, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301, (303) 447-2020.

May 13-14, 1994, **Third Conference on Tall Buildings in Seismic Regions**, Los Angeles, California. The conference is being organized by the Los Angeles Tall Building Structural Design Council and the Council on Tall Buildings and Urban Habitat. General session topics will include: Outstanding and Innovative Buildings; Development, Planning, Design, Engineering and Construction; Architectural Trends; Performance of Tall Buildings; Passive and Active Control for Intelligent Buildings; Innovative Structural Concepts; and Base Isolated Buildings. There are numerous specialty session topics as well, including case studies. For more information contact the Los Angeles Tall Buildings Structural Design Council; 800 Wilshire Blvd., Suite 510, Los Angeles, CA 90017; Attn: Lisa Dixon; 213-362-0707; fax 213-688-3018.

May 23-27, 1994, **World Conference on Natural Disaster Reduction**, held in Yokohama, Japan and sponsored by by the United Nations Department of Humanitarian Affairs, International Decade for Disaster Reduction. The results of the conference will contribute to the mid-term review of the Decade as required by the General Assembly. The aims of the conference are to: review IDNDR accomplishments at national, regional, and international levels; chart an action program for the future; exchange information on the implementation of IDNDR programs and policies; and increase awareness of the importance of the progress of disaster-reduction policies. Additional information can be obtained by contacting IDNDR Secretariat, United Nations, Palais des Nations, CH-1211 Geneva 10, Switzerland, telephone 41 22 798-6894, fax 41 22 733-8695.

July 10-14, 1994, **Fifth U.S. National Conference on Earthquake Engineering, "Earthquake Awareness and Mitigation Across the Nation,"** organized by the Earthquake Engineering Research Institute,

Marriott Downtown Hotel, Chicago, Illinois. The conference will provide an opportunity for both researchers and practitioners to share the latest knowledge and techniques for understanding and mitigating the effects of earthquakes. For further information, contact the Earthquake Engineering Research Institute, 499 14th Street, Suite 320, Oakland, CA 94612-1902, (510) 451-0905, fax (510) 451-5411.

July 15-16, 1994, Scientific meeting on **Monitoring and Assessment of Natural Hazards Using Space Technology**, Hamburg, Germany. Topics will include various techniques for monitoring natural hazards, assessment of damages due to natural hazards, prediction of natural hazards, and subsequent measures using airborn and space-born techniques. For more information, contact Ramesh P. Singh, Institute fur Weltraumwissenschaften (WE 4), Freie Universitat Berlin, Faveckstr. 69, 1000 Berlin 33, Germany, 49-30-838-66-66, fax 49-30-832-86-48.

October 2-7, 1994, **Association of Engineering Geologists Annual Meeting, "Engineering Geology: Past, Present and Future,"** held in Williamsburg, Virginia. Submit abstracts to Lanny Helms, Vice Chairman-Technical Program, c/o Target Environmental Services, 9180 Rumsey Road, Columbia, Maryland 21045, (410) 992-6622, fax (410) 992-0347, by May 2, 1994. For information, contact AEG, Suite 2D, 323 Boston Post Road, Sudbury, MA 01766, (508) 443-4639.

October 24-27, 1994, **Geological Society of America Annual Meeting, "Geology At the Leading Edge,"** Washington State Convention and Trade Center, Seattle, Washington. The theme will draw emphasis both to the geographical position of Seattle, situated on the leading edge of a convergent plate margin, and to the application of "leading edge" theoretical approaches to and technological advances in the elucidation of geological problems. Theme sessions and symposium proposals are sought in all aspects of Pacific Rim and convergent margin geology, with particular emphasis on the utilization of new technology. For information, call the GSA Meetings Department, (303) 447-2020.

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DEADLINES FOR FUTURE ISSUES

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