



Volume 17, Number 2 - 2001

Improved Earthquake Safety for the Wasatch Front

USSC Releases “Earthquake Safety in Utah: Activity and Accomplishment Progress Report” to Utah Legislature

By: Fault Line Forum Staff

“Earthquake Safety in Utah: A Progressive Report on the Activities and Accomplishments of the Utah Seismic Safety Commission from July 1996 to June 2000” was made available to the 2001 state legislature in April 2001. The report outlines the activities and accomplishments of the USSC in the area of earthquake safety. It also identifies plans for future initiatives, priorities, and activities for the Commission, based partially on results of a survey on earthquake awareness issues. The survey was sent to counties, cities, and major employers throughout the State of Utah.

Since 1995, when the Commission created *A Strategic Plan for Earthquake Safety in Utah*, 27 of its 35 strategic objectives have either been successfully met or are being addressed in an ongoing way—thanks to the efforts of many, including more than 35 individuals who actively serve on the USSC’s five standing committees.

Here are five of the notable activities and accomplishments of the Commission during the report period that was organized under nineteen topical issues and actions:

- **Seismic Safety in School Construction**— Commission consensus-building with school districts resulted in the adoption of new regulations by the State Board of Education that require all new school construction and major additions to under go seismic quality control reviews.
- **Interstate 15 & 80 Bridge Reconstruction**— Four members from the Commission’s Geoscience Committee, serving on the I-15 Corridor Seismic Advisory Committee, persuaded UDOT to use design standards for I-15 bridges that were higher than those it conventionally uses.
- **Seismic Strengthening of Existing Buildings**— The Commission has been actively advocating seismic upgrading of un-reinforced masonry buildings when their lives are extended and enforcement of existing statewide ordinance on roof anchors and parapet bracing.
- **Involving Business and Institutions in Seismic Safety Planning**— Three conferences were conducted to motivate businesses and institutions to include earthquake safety in their contingency planning and to help business survive and recover from earthquakes.

“75% of all organizations surveyed had some form of policies and procedures in place for disasters.”

see Progress Report page 3

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Utah Region Earthquake Activity

By Susan J. Nava
with significant contributions from
Jeff Fotheringham and Lorraine Nelms

During the three-month period January 1 through March 31, 2000, the University of Utah Seismograph Stations located 470 earthquakes within the Utah region. The total includes two earthquakes in the magnitude-4 range, five earthquakes in the magnitude-3 range, and 51 earthquakes in the magnitude-2 range. Earthquakes that have magnitudes of 3.0 or larger are described below. There were two earthquakes reported felt during the report period. (Note: All times indicated below are local time, which was Mountain Standard Time during the report period.) Additional information on earthquakes within the Utah region is available from the University of Utah Seismograph Stations at either <http://quake.utah.edu>, nava@seis.utah.edu

Significant Main Shocks and Clusters of Earthquakes

Southwestern Utah: A cluster of 22 earthquakes ($1.3 \leq M \leq 3.3$) occurred from March 3 through 8, about four miles SW of Aurora (~10 miles NE of Richfield). From March 23 through 24, a separate cluster of 29 shocks occurred about six miles W of Kanosh (~20 miles W of Richfield). Significant earthquakes include: M_L 3.3 March 8 8:25 a.m. 4 miles SW of Aurora. Felt in Aurora, Richfield, and Venice. And M_L 3.1 March 23 6:04 p.m. 5 miles S of Kanosh.

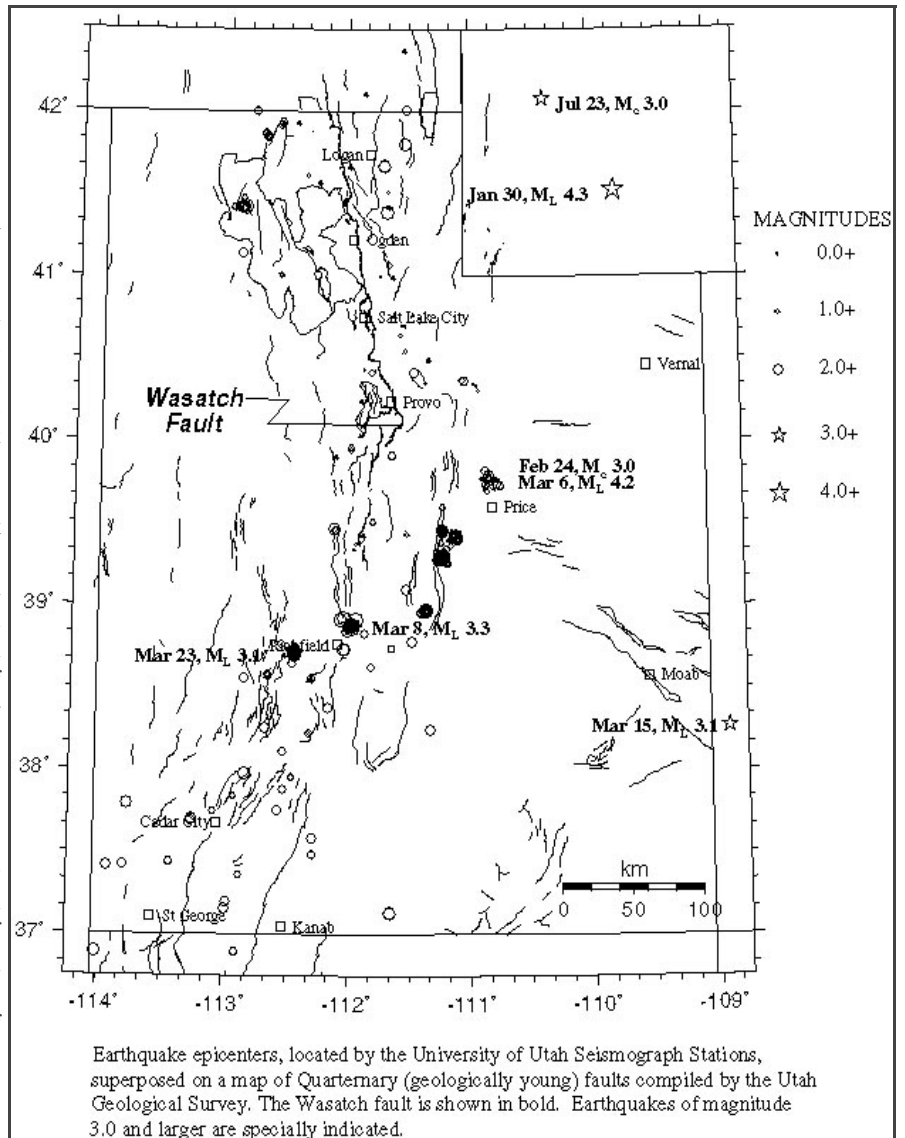
Northern Utah Earthquakes: A cluster of 12 earthquakes ($0.8 \leq M \leq 2.7$), located about 14 miles NNW of Lakeside (~50 miles W of Ogden), occurred from January 16 through 25 and from March 15 through 17. This sequence of events is a continuation of earthquake activity that began during the previous year.

Southern Utah/Colorado Area: Significant shock include: M_L 3.1 March 15 5:14 a.m. 12 miles SW of Uravan, Colorado.

Southwestern Wyoming: Significant shocks include: M_L 3.2 January 8 3:43 p.m. 16 miles SSW of La Barge, Wyoming and M_L 4.3 January 30 7:46 a.m. 16 miles WSW of Green River, Wyoming.

Eastern Wasatch Plateau-Book Cliffs Area near Price (coal-mining related): Significant shocks include: M_C 3.0 February 24 9:02 p.m. 6 miles N of Helper and M_L 4.2 March 6 7:16 p.m. 5 miles N of Helper. Felt in Helper and Price.

A total of 293 seismic events (magnitude 0.5 to 4.2) interpreted to be mining-related were located in this region during the period. On March 6, 2000, a magnitude 4.2 earthquake occurred at the Willow Creek coal mine, located about 5 miles north of Helper. This shock is the largest mining-related seismic event to occur in the Wasatch Plateau-Book Cliffs since regional earthquake monitoring began in 1962. This event triggered several rock falls in the area and a number of roof falls in the Willow Creek mine. Detailed seismological information about this event can be found in *Arabasz, W.J. and Pechmann, J.C. (2001): Seismic Characterization of Coal-Mining Seismicity in Utah for CTBT Monitoring, Final Report, LLNL Research Agreement No. B344836* available from either the University of Utah Seismograph Stations or Lawrence Livermore National Laboratory.



Geologic Hazards of Utah Conference Held in April 2001

The Utah Section of the Association of Engineering Geologists and the Utah Geotechnical Group American Society of Civil Engineers, along with the Utah Geological Survey, Utah Seismic Safety Commission, and Utah Geological Association, co-sponsored a 2-day conference on Geologic Hazards of Utah in April 2001. David Simon (AEG) and John Wallace (ASCE) were the conference chairs. The objective was to inform practicing engineers and geologists of the latest data and techniques in hazards assessment.

The conference highlighted recent advances in earthquake and landslide hazard analysis as well as looked at dam and avalanche hazards. Total attendance over the 2 days was about 180, consisting of geologists, engineers, seismologists, planners, and students.

Earthquakes were the topic of the conference's first day and included new earthquake ground-shaking maps for the Salt Lake Valley and Utah. Also covered were the latest in liquefaction hazard evaluation, results of recent Utah fault studies, and discussion of building codes and site response.

Topics on the second day included geologic and engineering methods of landslide and debris-flow hazard evaluation, Wasatch Front landslides of 1998, rock-fall and avalanche hazard assessment. The final speaker gave the planning perspective and outlined what planner's need in geologic-hazards reports. Each day concluded with the speakers participating in panel discussion with the audience.

A CD with PowerPoint presentation text and illustrations of the Geologic Hazards of Utah Conference is available from John Wallace, john@igesinc.com for \$10.00. Hard copies of talk abstracts are available for \$12.00 from IGES as well.

Progress Report cont.

- **Prepared Schools**— Using a survey of emergency preparedness sent to all schools, public and private, a program to guide schools toward better preparedness has been developed. Implementation of the project is moving forward with the first step of a yearly program call "Prepared Schools for Effective Drills and Safe Surroundings." This program encourages schools to survey their surroundings for earthquake hazards and conduct at least one school-wide earthquake drill yearly.

To obtain a copy of the full report, or view survey results, email a request to: Amisha Lester at CEM: alester@dps.state.ut.us

Earthquake Ground Shaking Microzonation Maps of the Salt Lake City Metro Area

Editor's note: The following article is taken from an abstract paper by Ivan Wong with additional information contributed by Walter Silva, Susan Olig, Patricia Thomas, Douglas Wright, Francis Ashland, Nick Gregor, James Pechmann, Mark Dober, Gary Christenson, and Robyn Gerth.

The Salt Lake City metropolitan area is one of the most seismically hazardous urban areas in the interior of the western United States due to its location within the Intermountain Seismic Belt and its position adjacent to the seismically active Wasatch fault.

In order to raise the awareness of the general public and to help mitigate earthquake hazards in the Salt Lake City metropolitan area, a series of deterministic earthquake scenario and probabilistic microzonation maps have been developed. The nine maps depict surficial ground shaking and thus incorporate the site response effects of shallow unconsolidated sediments. These GIS-based maps display color-contoured ground motion values in terms of peak horizontal acceleration and horizontal spectral accelerations at 0.2 and 1.0 sec periods.

"The resulting hazard maps dramatically show the frequency-dependent amplification of unconsolidated sediments in the Salt Lake Valley"

The probabilistic maps are for the two return periods of building code relevance, 500 and 2,500 years. The scenario maps are for a moment magnitude 7.0 earthquake on the Wasatch fault's Salt Lake City segment.

In the probabilistic seismic hazard analysis, a total of 35 faults were characterized in terms of their probability of activity, geometry, rupture behavior (including segmentation), maximum earthquake magnitude, recurrence model, and recurrence rates. Background earthquakes were also included in the hazard analysis through the use of an areal source zone and Gaussian smoothing of the historical seismicity.

For both the scenario earthquake and the probabilistic analysis, ground motions on rock were calculated using a combination of state-of-the-art empirical attenuation relationships, which were generally applicable to extensional tectonic regimes, and a stochastic numerical modeling approach. Because of Salt Lake City's location in an alluvial basin, site response effects on ground motions can be significant.

U.S. Geological Survey Holds Meeting on National Seismic Hazard Maps

As part of its periodic revision of the National Seismic Hazard Maps (NSHMs), the U.S. Geological Survey (USGS) holds a series of regional meetings to solicit comments from local scientists and engineers. The NSHMs are the national standard for assessing earthquake ground-shaking hazards, and are used in the new International Building Code. The USGS held a meeting in Salt Lake City in March 2001 for the Intermountain West region, consisting of Utah, Nevada, Montana, Idaho, Wyoming, Arizona, New Mexico and Colorado. The meeting was in preparation for the next National Seismic Hazard Map revision, which is scheduled for completion in December 2001.

In its periodic revisions, the U.S. Geologic Survey looks at new data on attenuation relations, methods of map compilation, and seismic-source parameters, including fault recurrence intervals, slip rates, and maximum magnitudes. Geologists presented results of their recent fault studies, including new long-recurrence records for the Salt Lake City segment of the Wasatch fault, and thoughts regarding use of the fault data to prepare the maps.

"Understanding just what the GPS rates tell with regard to earthquake occurrence is more difficult here."

Seismologists and engineers discussed new attenuation relations, site response, and other issues of importance in probabilistic seismic hazard assessments. Some principal issues relevant to Utah that were brought up and will be considered further by the USGS include:

- Use of new normal-faulting attenuation relations, mostly developed for the Yucca Mountain project in Nevada, which indicate normal-faulting earthquakes generate less ground motion than other earthquakes.
- A more detailed analysis of uncertainties. Maps presently show only mean hazard, but an expanded logic tree could be used for a more detailed uncertainty analysis.
- Changing weights in logic trees of characteristic vs. Gutenberg-Richter earthquake recurrence models.
- Considering multi-segment ruptures on the Wasatch fault.
- Considering clustering, long vs. short recurrence records, and time-dependent models for fault sources.

The USGS specifically called for more fault slip-rate, recurrence, and displacement data from fault trenches, and the establishment of regional working groups to provide consensus fault parameters.

Local speakers at the workshop included R.B. Smith, Wu-Lung Chang, and J.C. Pechmann from the

University of Utah and Ron Harris from Brigham Young University.

Following the NSHM meeting, Wayne Thatcher of the USGS conducted a workshop on the use of Global Positioning System (GPS) satellite data in seismic hazard mapping, with particular emphasis on the Basin and Range province.

In some plate boundary areas such as California and the Pacific Northwest, geodetic strain rates measured using GPS are generally similar to geologic slip rates, and have been used in seismic hazard maps. However, in the Basin and Range, geodetic (GPS) rates are generally higher than geologic slip rates. Therefore, understanding just what the GPS rates tell with regard to earthquake occurrence is more difficult here, and general agreement on the appropriate use of GPS rates in seismic hazard maps in the Basin and Range has not yet been reached.

Earthquake and Hazard Awareness Campaign a Success in Utah

By: Bob Carey

The Utah Seismic Safety Commission assisted local emergency management jurisdictions in a statewide public awareness campaign of earthquake and other natural disasters. The campaign was in conjunction with the signing of the proclamation by Governor Michael O. Leavitt, declaring April 2001 as "Earthquake and Disaster Preparedness Month."

Several cities and counties throughout Utah conducted preparedness activities during the month. The most notable efforts were those of Salt Lake City, Salt Lake County and Weber County. The Salt Lake jurisdictions held a Preparedness Fair at the Utah State Fair Park on April 28. The major organizing efforts for the fair were carried out by Ryan Pietramali of the Salt Lake City Emergency Management Office and their organizing committee. The fair featured vendor booths, a blood drive, Community Emergency Response Team (CERT) activities, command vehicles from local jurisdictions, Salt Lake City fire trucks, bomb squad demonstrations by Salt Lake County, search dogs, and the Air Med helicopter.

Preparedness activities in Weber County were also held on April 28 at the Weber County Fair Grounds and headed by Lance Peterson, Weber County Emergency Coordinator. The Weber County activities mirrored those in Salt Lake and were highlighted with the arrival of the Life Flight emergency helicopter.

All organizers felt the statewide concept for the preparedness month was a good idea and are looking forward to activities next year.

Microzonation cont.

To include these effects, five generalized site response units were defined from litho-logic characteristics and shear-wave velocities. Based on a suite of in situ shear-wave profiles and dynamic material properties for each unit, amplification factors were calculated as a function of input rock motion and thickness of each site response unit.

These amplification factors, which could be less than 1.0, signifying deamplification, were multiplied with the input rock motions to arrive at the surficial ground motions.

The resulting hazard maps dramatically show the frequency-dependent amplification of unconsolidated sediments in the Salt Lake Valley. The pattern of both amplification and deamplification in the map area is clearly a function of the distribution and thickness of the surficial geologic units. Hanging wall effects and to a lesser extent, rupture directivity along the Wasatch fault are also quite evident on the hazard maps. Peak horizontal accelerations for the scenario earthquake range up to and exceed 1.0 g. For the 500- and 2,500-year return period maps, the maximum peak accelerations are 0.5 and 1.1 g, respectively.

These maps are not intended to replace site-specific studies for engineering design. Rather, these maps hopefully will be used by government agencies; the engineering, urban planning, and emergency preparedness and response communities; and the general public as part of an overall program to reduce earthquake hazards and losses in Utah.

Governor Leavitt Proclaims April 2001 Earthquake and Disaster Preparedness Month

By: Fault Line Forum Staff



On March 13, 2001, supporting the efforts of the Utah Seismic Safety Commission, Governor Michael O. Leavitt signed a proclamation declaring April 2001 "Earthquake and Disaster Preparedness Month." The signing was attended by (from left to right): Geoscience Standing Committee Chair Gary Christenson, the Commission's Chair, Walter Arabasz, Governor Michael O. Leavitt, Commissioner Vanna Hunter, and Awareness and Education Standing Committee Chair Bob Carey.



Utah Seismic Safety Commission Quarterly Meeting in Ogden

By: Bob Carey



The Utah Seismic Safety Commission held its April meeting in the Weber County Commission Chambers. Barry Welliver, Chair of the Engineering and Architecture Standing Committee, reported to the group about the Commission's presentation to the Legislature's Government Operations Interim Committee. The presentation was on the new progress report that the Commission had recently completed for the Legislature. Representative Don Bush, a member of the Interim Committee, stated that Barry presented the report well and the Committee was appreciative of the Commission's efforts.

Bob Carey, Chair of the Awareness and Education Standing Committee, reported on the proclamation signing by Governor Michael O. Leavitt and the activities during April 2001 as "Earthquake and Disaster Preparedness Month." The highlighted activities included a state-wide earthquake drill for schools and preparedness fairs in Salt Lake and Weber Counties. The Commission also provided printed materials for city and county emergency managers.

Lance Peterson, Weber County Emergency Management Program Manager moderated a series of presentations of emergency and mitigation activities in Weber County. Gary Christenson, Utah Geological Survey, gave a slide presentation about the earthquake threat in Northern Utah. Lance Peterson talked about rapid damage assessment procedures and planning. Cathy Diehl, Coordinator, Ogden City Emergency Management, spoke about the Ogden City Emergency Plan and its implementation. The Weber County Building Department Building Inspector Rial Storey talked about the County's "Post-earthquake Safety Evaluation of Buildings" program. Kent Kofford, Bureau of Reclamation engineer, took the group through the earthquake-retrofitting at Pineview Dam. Brent White with ARW Engineers gave a presentation on the history of Ogden's Parapet Ordinance.

The meeting closed with a slide presentation of Ogden earthquake-retrofitted buildings by Wayne Glover with Ogden City Building Services.

Seventh U.S. National Conference on Earthquake Engineering

The Seventh National Conference on Earthquake Engineering will provide an opportunity for both researchers and practitioners to share the latest knowledge and techniques for understanding and mitigating the effects of earthquakes.

Organized by the Earthquake Engineering Research Institute, this quadrennial conference will bring together professionals from the broad range of disciplines committed to reducing the impact of earthquakes on the build and natural environment.

The technical program will consist of keynote lectures, technical sessions, a students' poster session, and several focused discussion sessions on special topics of national and local interest.

The conference will include several focused group discussion sessions on various special topics:

- Using NYC and Boston seismic building code provisions: Lessons Learned.
- Earthquake engineering research-An incubator for multi-hazard mitigation?
- Advanced technologies for earthquake risk mitigation.
- Advanced technologies for response and recovery.
- Earthquake-resistant design as partial protection against terrorism?
- Reports from recent devastating urban earthquakes.
- Loss estimates for major urban areas-case studies and world developments.

Each session will be lead by a panel of up to five members. Panel members will be responsible for preparing a five-page outline paper in a format that allows presentation prior to the discussion and encourages active participation of attendees. The papers will appear in the Proceedings.

The conference will be July 21-25, 2002 in Boston, Massachusetts at the Park Plaza Hotel. For more information, visit the website www.eeri.org, or call (510) 451-0905.

Scott Behunin: New USSC Commissioner and Director of Comprehensive Emergency Management



Mr. Behunin joins the staff at CEM after 22 years in law enforcement at the Department of Natural Resources. He most recently served as that department's director for law enforcement and as a captain responsible for training, emergency management planning, policy, administration and investigations.

Behunin was born in Alabama and grew up in California. He received a bachelor's degree from Utah State University and is working toward his Masters of Public Administration at the University of Utah. He and his wife Tamra have three daughters.

In the Next Issue of the Fault Line Forum



**The Utah Seismic Safety Commission
will Receive a New Chairperson:
Walter Arabasz is Stepping Down.**

**Utah Seismic Findings: A Math
Formula for Lateral Soil Movement**



Letter from the Editor:

I would like to take this time to invite any reader to submit letters or feedback on the *Fault Line Forum*. If you have any suggestions on the publication, or contributions for future articles, feel free to submit them to bspratt@dps.state.ut.us. It is important for contribution on relevant topics and to allow for a forum where readers can express their opinion.

Thank you, Byron Spratt, Editor.



Calendar of Events

JULY

24-27

Seismic Risk in Caribbean Region
Santiago, Dominican Republic
Info: codia.santiago@codotel.net.do

AUGUST

1-4

Earthquake Engineering Applications in
Geotechnical Engineering
Dearborn, MI
Info: tkagawa@ce.eng.wayne.edu

7-10

International Tsunami Symposium
Seattle, WA
Info: www.pmel.noaa.gov/its2001

12-17

SMiRT Conference
Washington DC
Info: www.engr.ncsu.edu/SMIRT_16

16-19

Int'l Conference on Engineering Materials
San Jose, CA
Info: mcmullin@email.sjsu.edu

27-30

Disaster Recovery for Sustainability
Boulder, CO
Info: jacque.Monday@colorado.edu

29-31

IABSE Conference on Wooden Structures
Lahti, Finland
Info: www.iabse.ethz.ch

SEPTEMBER

4-6

ERES
Malaga, Spain
Info: www.wessex.ac.uk/conferences/2001

8-12

National Emergency Management Association
NEMA Annual Conference.
Big Sky, MT
Info: www.nemaweb.org

OCTOBER

2-5

Association of Engineering Geologists
Annual Conference
St. Louis, MO
Info: jkeaton@agraus.com

3-5

Modeling and Simulation in Civil Engineering
Paris, France
Info: www.enpc.fr/caquot

7-10

10th Int'l Conference on Soil Dynamics and
Earthquake Engineering SDEE
Philadelphia, PA
Info: www.drexel.edu/sdee2001

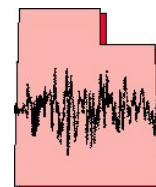
21-24

Western States Seismic Policy Council
23rd Annual Conference
Sacramento, CA
Info: www.wsspc.org

2002

July 21-25

Seventh U.S. National Conference on
Earthquake Engineering
Boston, MA
Info: reinhorn@buffalo.edu, www.eeri.org



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