

Summary Minutes

Nevada Earthquake Safety Council

7 May 2008

The Nevada Earthquake Safety Council (NESC) met from 9:30 a.m. to 3:00 p.m. at the Clark County Building Department's Russell/Cameron Office, (4701 W. Russell Road) in Las Vegas. These and previous minutes are posted on the Web site for the committee (<http://www.nbmg.unr.edu/nhmpe/nesc.htm>).

Jim Werle chaired the meeting. Individuals attending the meeting are members of the Council:

John Anderson*, Nevada Seismological Laboratory
 Elizabeth Ashby, Nevada Division of Emergency Management
 Peggy Ayala, URS Corporation, Las Vegas
 Scott Ball*, Engineering Geologist, MWH Americas, Inc., Las Vegas
 Alan Bennett*, City of Reno
 Mike Blakely*, Blakely, Johnson, and Ghusn,
 Ian Buckle*, University of Nevada, Reno – Center for Civil Engineering Earthquake Research
 Wayne Carlson*, Nevada Public Agency Insurance Pool
 Matt Clark, Optim Seismic Data Solutions, Las Vegas
 Craig dePolo, Nevada Bureau of Mines and Geology, who held the proxy for Greg Flanigan*, Farmers Insurance
 Terri Garside, Nevada Bureau of Mines and Geology
 Jenelle Hopkins*, Clark County School District, Las Vegas
 Werner Hellmer, Clark County Department of Development Services, Building Department, who held the proxy for Ron Lynn*, Clark County Department of Development Services
 David Kennard, FEMA Region IX (Oakland, California)
 John Louie, Nevada Seismological Laboratory
 Rick Martin, Nevada Division of Emergency Management
 Greg Moss*, The Moss Group
 Glade Myler, Office of the Attorney General, representing Nevada Division of Emergency Management
 Jim O'Donnell*, Geophysical Contractor, Las Vegas
 Jon Price*, Nevada Bureau of Mines and Geology
 Jim Reagan*, Sierra Pacific Power Company
 Burt Slemmons, University of Nevada, Reno (retired), consultant in Las Vegas
 Ken Smith, Nevada Seismological Laboratory
 Wanda Taylor*, UNLV Department of Geoscience
 Ying Tian, UNLV
 Jim Walker, Nevada Department of Transportation
 Jim Werle*, Converse Consultants
 Lloyd West, Optim Seismic Data Solutions, Las Vegas

* indicates member of the Board of Directors.

A quorum of directors (the necessary 11) was present.

Board Members unable to attend or send a proxy included:

Bernie Anderson*, Nevada Assembly
 Steve Koenig*, Bellagio Resorts
 Warren Hardy*, Nevada State Senator

Marge Gunn Nutman*, Nevada Association of Counties & Lincoln County Office of Emergency Management
 Ryan Turner*, American Red Cross

A quorum of directors (the necessary 11) was present.

The minutes of the 6 February 2008 meeting were unanimously approved.

Education and Awareness Committee

Jenelle Hopkins reported for Diane dePolo. Diane and others with the Nevada Seismological Laboratory (NSL) and Nevada Bureau of Mines and Geology (NBMG) continue to help plan the Vigilant Guard '08 exercise, which will be held June 12-20. Six Nevada counties and three California counties are participating. Washoe County will have rubble piles in Reno and Incline Village and focus on recovery. The Division of Emergency Management (DEM) is hosting a Vigilant Guard '08 – FEMA Region IX Leadership tabletop exercise on Friday, 9 May 2008.

In April, a delegation from Turkmenistan visited the Washoe County Emergency Operations Center (EOC); Washoe County School District; the EOC, NSL, and shake tables in the College of Engineering at the University of Nevada Reno (UNR); and local police and fire agencies as part of a collaboration between the Nevada National Guard and the country of Turkmenistan. The delegation will return to Nevada for the Vigilant Guard '08 exercise.

Jenelle and Diane asked for volunteers to help with the NESC booth for the City of Reno Safety Expo (Tuesday, June 24th) and the Silver State Governor's Safety Conference (Wednesday, June 25th, through Friday, June 27th), from 9 or 10 a.m. until 5 or 6 p.m. each day. The expos will be held in the west parking lot across from Circus Circus in Reno. Given the recent earthquakes in the Reno area, we anticipate that the NESC booth will see lots of traffic. If you can help, please contact Diane at diane@seismo.unr.edu or 784-4976.

From the education and awareness point of view, NSL and NBMG have been quite busy for the last two months. NSL has fielded hundreds of phone calls from concerned citizens, who have wanted to know what to do, who relate their experiences, or who want to know what will happen next. NSL and NBMG staff have given numerous interviews to local, regional, and national media, and the Governor has been briefed on the earthquake activity. NBMG and NSL have distributed thousands of booklets on "Living with Earthquakes in Nevada" (NBMG Special Publication 27, published with FEMA's financial assistance in 2000) to citizens of Elko County, including those in Wells.

Several town-hall meetings were held with residents of the Mogul-Somersett subdivisions on the northwest side of Reno. Following the two magnitude 4+ earthquakes on April 24th in that area, hundreds of free booklets were left for the public at fire houses and libraries in northwest Reno. These were picked up and used by the residents, some of whom were therefore better prepared for the magnitude 4.7 earthquake that struck at 11:40 p.m. on April 25th. Working with FEMA and the Reno Gazette-Journal, NBMG slightly updated and electronically reformatted the "Living with Earthquakes in Nevada" booklet, adding pictures and information from the February 21st Wells earthquake, and approximately 75,000 copies were distributed as an insert in the Sunday, May 4th, edition of the newspaper. The Nevada Appeal, the newspaper serving Carson City, is also interested in running this booklet as a newspaper supplement.

Research Committee

Craig dePolo noted that items involving the Research Committee will come up later on the agenda.

Policy Recommendation Committee

Wayne Carlson provided a status report on NESC efforts regarding unreinforced masonry (URM) buildings. As reported during the previous NESC meeting, in an effort to determine whether there is a cost-effective way to acquire an inventory of commercial buildings throughout Nevada, various data sources were contacted, including:

1. Nevada Public Agency Insurance Pool records for rural public agencies
2. The Insurance Services Office, an insurance company-funded organization that inspects buildings for fire rating purposes
3. Nevada county assessors to determine information collected in their inspection files
4. Marshall & Swift, a property appraisal and assessor software company.

Responses have been slow and/or incomplete from these sources, except the assessors. URMs that exist throughout Nevada are not identified as such from preliminary information obtained from some of the sources contacted. However, it may be possible to use a combination of factors in order to identify possible URMs upon actual inspection, such as year built and whether it is a masonry building of any type based upon the coding systems used.

In February 2008, a test run was made by a computer firm that supports many county assessors for property tax purposes. Specific potential URM identification factors and year-built dates were searched to determine whether an electronic inventory is feasible on a broader basis. The results proved positive and may be sufficient for gathering data from this source and from other assessors who utilize different systems. Mike Blakely assisted Wayne with definitions of URMs for the purpose of setting up the database. A year-built date of 1961 will be used in the definition of potential URMs. Once the database parameters are agreed upon, a survey can be initiated.

In March 2008, the Nevada Public Agency Insurance Pool agreed to provide matching funds for a FEMA grant that will enable furtherance of the URM data-gathering effort. Elizabeth Ashby has identified Fernley flood/canal breach disaster-mitigation funds of approximately \$33,000 from FEMA, and the matching funds will be approximately \$11,000.

Wayne also reported on recovery funding for the 21 February 2008 Wells earthquake. Fortunately, the City of Wells, Elko County, and the Elko County School District all carry earthquake insurance (thanks largely to the efforts of the Public Agency Insurance Pool). The Public Agency Insurance Pool is working with the City of Wells to determine whether uninsured losses can be covered by the State or, if reconsidered for a Presidential Declaration of Disaster, by FEMA.

Rick Martin and Dave Kennard noted that a Presidential Declaration of Disaster was not requested for Wells. FEMA and DEM were in the community together during the initial damage assessment. Wayne noted that FEMA's initial estimate of uninsured losses from the earthquake was \$788,000. However, the City of Wells has since estimated uninsured losses at \$1,500,000, and other jurisdictions (Elko County School District, Elko County, and the Wells Rural Electric Company) have estimated additional uninsured losses. Among FEMA's criteria for a Presidential Declaration are requirements that losses exceed certain capitation thresholds, currently \$1.24 per State resident and \$3.11 per County resident. The Wells event did not meet the State threshold, although it did meet the County threshold.

Wells City Hall, an unreinforced masonry building built in the 1920s, did receive some damage. The City has stopped non-life-safety repairs, because some of the repairs themselves were damaged by aftershocks.

Part of the Wells High School has been reopened, and the auditorium is being repaired for use during this year's graduation.

Wayne raised an important question regarding earthquake insurance: What is an earthquake for the purpose of insurance and emergency recovery? The insurance companies consider what happens within 168 hours (7 days) as part of the main event. If damage occurs from an aftershock that occurs after the 168-hour period, the insurance companies would consider that damage as occurring from a second event, and a separate deductible would apply. Many policies have deductibles that are at a level of 10% of the value of the home and its contents. It is possible that a building could be progressively damaged by aftershocks or earthquakes clustered as a sequence or series in time such that there is more than seven days between damaging events. This is important for the Public Agency Insurance Pool, because it bears liability for the first \$250,000 in damage from an earthquake, and if the damage is spread out over multiple events, the Pool is at risk of having to cover this amount multiple times.

Dave Kennard noted that FEMA handles the duration of its incidents on a case-by-case basis; he gave an example of a fire that was followed by a debris-flow, which was worsened by the fire's burning vegetation that normally helps to prevent debris flows.

The series of earthquakes near Fallon in 1954 and beyond serve as an example of the importance of this issue for Nevada. Fallon experienced the following (dates and times in Greenwich Mean Time, which is eight hours ahead of Pacific Standard Time or seven hours ahead of Pacific Daylight Savings Time):

7 July 1954, 11:13	Magnitude 6.6
7 July 1954, 11:18	Magnitude 5.5
7 July 1954, 11:49	Magnitude 5.7
7 July 1954, 22:07	Magnitude 6.0
24 August, 1954 05:51	Magnitude 6.8 to 7.0
31 August 1954, 22:20	Magnitude 5.8
1 September 1954, 05:18	Magnitude 5.5
16 December 1954, 11:07	Magnitude 7.2 to 7.3
16 December 1954, 11:11	Magnitude 6.8 to 7.1
16 December 1954, 14:16	Magnitude 5.8
21 November 1955	Magnitude 5.5
23 March 1959	Magnitude 6.3

Although some of these earthquakes occurred on separate faults, they all affected the City of Fallon.

John Anderson stated that the seismological community could provide a rigorous determination of whether multiple earthquakes are physically connected within a swarm such as this, potentially leading to a rigorous definition of "an earthquake" that would not be tied to an arbitrary time window.

Strategic Planning Committee

ACTION ITEM: Jim Reagan will produce a draft of the 2007 NESC annual report for adoption at the August meeting. Terri Garside will place adoption of this report on the agenda for that meeting.

Nominating Committee

Jim Werle welcomed Scott Ball to the board of directors for NESC, filling the position for Geosciences, Southern Nevada. Jim noted that Glade Myler has contacted Jeff Maples, Southwest Gas in Carson City, to ask if he is willing to serve as a NESC Board member in the position of a representative from Business and Industry in Northern Nevada. We are awaiting approval from the company.

Ad-Hoc Committee on Department of Homeland Security

Jim Reagan reported that there is no news regarding changes or opportunities within the Department of Homeland Security.

Ad-Hoc Committee on Anchoring of Propane Tanks

The NESC unanimously approved a motion to send the following letter to the Nevada Board for the Regulation of Liquefied Petroleum Gas.

“Nevada Board for the Regulation of Liquefied Petroleum Gas
P.O. Box 338
Carson City, NV 89702

Dear Sir or Madam:

On behalf of the Nevada Earthquake Safety Council, I would like to voice concern regarding the requirements for anchorage of horizontal LPG storage tanks. We have reviewed the requirements set forth in NRS 590, NAC 590, and NFPA 58 (2004); it appears as though there are no requirements for such tanks to be restrained in order to resist movement caused by ground motion. We have included several FEMA documents that identify the importance of protecting LPG tanks from damage during earthquakes. There are a variety of possible methods that can be implemented to secure such tanks that do not impart undue stress upon the tank’s mounts or shell. We would welcome the possibility of meeting with you in order to discuss our concerns.

Thank you.

Sincerely,

Chair, NESC”

ACTION ITEM: Terri Garside will prepare the letter to the Nevada Board for the Regulation of Liquefied Petroleum Gas for Ron Lynn’s signature.

Werner Hellmer noted that small tanks may not need to be anchored, although larger tanks may need anchoring. This letter will help open a dialog on this issue. Craig dePolo noted that most tanks performed well (with unbroken flexible connections) after the Wells earthquake. He has had conversations with Wells Propane, which did a good job of responding to that earthquake. One large tank moved and leaked during the earthquake, but this tank was not secured; it had been set on snow and rolled during the earthquake.

John Anderson offered that NSL scientists, who have been studying accelerations and velocities needed to topple precarious rocks, could use their understanding of that phenomenon to address needs for anchoring of propane tanks.

Mike Blakely noted, from a structural engineering perspective, that propane tanks are similar to water heaters and ought to be anchored.

Dave Kennard stated that FEMA would perhaps be able to pay for mitigation of tanks (at a 3 to 1 ratio of federal to non-federal funds). This would help lessen the cost for homeowners, businesses, and government agencies. FEMA funds would need to pass through a State or local government agency. He noted that the same would apply for efforts to retrofit unidentified URMs. That is, a local or State

governmental agency could get FEMA funds for a program of assisting private landowners and businesses, either through the pre-disaster hazard mitigation program, or using post-disaster mitigation funds for which the State is eligible.

Division of Emergency Management Report

Rick Martin and Elizabeth Ashby reported that the DEM Recovery and Mitigation Section is working on five Presidential Declarations of Disaster (including the Fernley canal breach as the latest). The total is about \$8 million in FEMA assistance.

DEM sent a damage assessment team to Wells earthquake. There was only about \$790,000 in damage to public infrastructure and buildings; this was not enough to meet the threshold that FEMA sets for public assistance, given the population of Nevada. Very few people applied for Small Business Administration loans. DEM is working with FEMA and the Nevada Public Agency Insurance Pool on re-evaluating the damage and need for a Presidential Declaration.

Glade Myler noted that funding for certain NESC activities could be covered with Homeland Security funds.

ACTION ITEM: Jon Price will contact Kamala Carmazzi to investigate the possibility of getting a representative from the Nevada Earthquake Safety Council on the State's Homeland Security Grants Working Group.

Glade reported that he organized a tri-state tabletop exercise to work on legal issues after a disaster. The exercise focused on pandemic disease but also dealt with earthquakes and other disasters was held in April; it involved legal staff from Nevada, Utah, and Idaho. Another legal exercise will be held next year in Idaho. FEMA is working on a training course on legal issues.

Rick Martin noted that DEM is waiting to hear from the Department of Homeland Security/FEMA on funding for NESC-approved projects that could be covered with federal fiscal year-end funds.

Dave Kennard offered FEMA's assistance in offering one or more training classes on non-structural retrofits for hospitals.

ACTION ITEM: Terri Garside will work with FEMA on scheduling a training class on non-structural retrofits for hospitals.

Report on Seismicity Since 7 February 2008

John Anderson reported that the Nevada Seismological Laboratory (NSL) has been quite busy during the last quarter. Much information about the Wells earthquake (magnitude 6.0 on 21 February 2008), the Mogul earthquake swarm (starting with a felt earthquake on 28 February 2008, progressing to a magnitude 4.7 on 24 April, and still ongoing), and other earthquakes in Nevada (a swarm near Alamo and various magnitude 3 and larger earthquakes in other parts of the state) is documented on the NSL website (www.seismo.unr.edu).

Seismicity is up across the State. Excluding earthquakes near Wells and Mogul, the activity in other parts of the State is up about 40% since February 21st. In contrast, at the NESC meeting three months ago (see minutes of the 7 February 2008 meeting), John stated that 2007 was near a record low for earthquakes in terms of numbers of magnitude 3 or greater earthquakes (36 earthquakes of $M \geq 3$ in 2007; only two years had fewer, 1977 and 2005, each with 31). There were only 3 earthquakes of magnitude 4 or greater in Nevada in 2007. The 2007 numbers have already been exceeded in 2008.

NSL has established wireless telemetry with a direct communication to DEM in Carson City.

NSL has been consistent in sending a message of earthquake preparedness. We can't predict earthquakes. People should be prepared.

John stressed the importance of real-time seismic monitoring (with real-time telemetry versus retrieving data from remote instruments hours or days after an earthquake). One of the potential products is automatic HAZUS (loss-estimation modeling) using ShakeMaps created from real-time monitoring.

The Wells earthquake was not well instrumented by the Advanced National Seismic System of the U.S. Geological Survey (USGS) because of remoteness and low historical seismicity. Thanks to instruments installed for the National Science Foundation's EarthScope program, NSL was able to locate the earthquake more accurately than the USGS location, which was off by approximately 12 kilometers.

The Wells earthquake appears to have occurred on a fault that has not been recognized as having been active during the Quaternary Period (the last 1.8 million years). The fault apparently did not break to the surface. Directivity (the direction that the earthquake rupture appears to have progressed from its hypocenter) appears to have been to the south, towards Wells, and to the east, down-dip from the hypocenter, although ongoing work will better constrain what actually happened.

To measure aftershocks, NSL, the USGS, and the University of Utah installed 24 portable seismic stations, and NSL installed microwave telemetry. The Wells Rural Electric Company provided tremendous support with a snow-cat vehicle that NSL used while installing the stations.

The Mogul-Somerset swarm (approximately 7 miles west of downtown Reno) has been fairly well instrumented with seismometers and a few GPS stations. The largest event was a magnitude 4.7 on April 24 at 11:40 p.m. local time. It was preceded by a magnitude 4.1 at 3:47 p.m. and a magnitude 4.2 at 3:55 p.m.. The earthquakes all appear to be right-lateral strike-slip displacements on northwest striking faults.

John noted that there is a 2% probability that a given earthquake is a foreshock of an earthquake with a magnitude 1.0 unit higher within the next 10 days, and that there is a 5% probability that a given earthquake is a foreshock of an earthquake with a magnitude 0.5 unit higher within the next ten days.

The pattern of small earthquakes (with a relatively quiet period preceding a magnitude 3 or larger earthquake) characterized the swarm from February 28 to April 15. After that date, the rate of earthquakes accelerated until April 24, when the rate of earthquakes accelerated even more. The earthquake activity has dropped since April 24, but the swarm is still a vigorous sequence.

Geodetic data related to the Mogul earthquake are intriguing and provocative. One particular station has moved east, either in response to the earthquakes or reflecting a deeper process that is driving the earthquakes themselves. Careful real-time GPS measurements may be quite useful in understanding and forecasting earthquakes.

It appears that over time, since February 28th, earthquakes in the Mogul sequence have gotten deeper, with a median depth progressing from about 2 km early to 4.5 km more recently. With time, the earthquakes have spread out from Mogul, in both northwest and southeast directions. The overall length of the northwest-striking zone of earthquakes was approximately 4 km in the latest data that was available to be presented.

John noted that the design acceleration for Reno in the International Building Code (2% chance of exceedence in 50 years is 0.64 g (0.64 times the acceleration due to gravity). Preliminary analysis by

NSL indicates that comparable or greater accelerations may have been measured at Mogul. The peak values and accelerograms will be posted on the Nevada Seismological Laboratory web site (www.seismo.unr.edu) once they have been carefully checked. The fact that the earthquake was shallow, albeit relatively small in magnitude, helps to explain large accelerations, if they are confirmed.

John summarized by stating that the Wells earthquake was probably one of the best-recorded normal-faulting earthquakes ever, and the Mogul swarm will probably be the best-studied earthquake swarm ever, thanks in large part to the professionalism of the scientists involved.

In answer to questions, John noted that shaking at Mogul from the M4.7 event at first seemed to last for 20 seconds or more at his house, but in hindsight some of that motion was from a magnitude 3.3 foreshock 11 seconds beforehand. The direct P- and S-waves on the strong motion records, which caused the strongest shaking, only lasted about 3 seconds, but shaking detectable by people in the area, including the foreshock and the subsequent coda, did last about 20 seconds. On the basis of throwing items from shelves and moving heavy furniture, the earthquake was strong enough to put it in at least the Intensity VI category on the modified Mercalli Intensity scale. At least two houses in Mogul experienced loss of decorative stone facades suggestive of Intensity VII on the Modified Mercalli Intensity scale. At least two houses had failure of the attachment of corners of the garage to the foundation, and deformed frames of the garages, which might be indicative of Intensity VIII. When John filled out "Did You Feel It?" on the USGS web site, it gave an estimated intensity of VIII.

Report on the Wells Earthquake

Craig dePolo reported some of his experiences and observations from the Wells earthquake and the Mogul swarm. The earthquake occurred early on Thursday morning. Late that morning, Jon Price conveyed results of a HAZUS loss-estimation simulation run by the Nevada Bureau of Mines and Geology (NBMG) staff to Frank Siracusa, head of DEM. Initial reports of damage had already been coming to DEM, NSL, and NBMG through telephone calls, radio, and TV reports. A team of geologists from the Utah Geological Survey went to the area later that day to look for evidence of surface ruptures or other earthquake effects. NBMG earthquake geologist Craig dePolo joined the DEM damage assessment team, which arrived in Wells the following morning. Because snow covered the ground, and because the earthquake was too small to expect significant surface ruptures (typically these occur with earthquakes of magnitude 6.5 or greater), NBMG did not establish a physical, scientific and technical clearinghouse. In a larger event, such a clearinghouse would be a place near the epicenter (with power and Internet connections) for scientists and engineers to share observations and make plans for additional observations to be collected the next day. The clearinghouse would also assist the Division of Emergency Management with its or the local government's EOC. At NBMG's request, the Utah Geological Survey initiated a virtual clearinghouse on the Web to accept observations, including photographs, coming from scientists and others. Within a few days, NBMG assumed control of the virtual clearinghouse, which is still functioning at <http://www.nbmgs.unr.edu/> as an archive of technical information and observations.

NBMG plans to publish a report on the Wells earthquake, in which the geological setting; seismic, geologic, and geodetic observations; damage and social impacts; and response and recovery aspects of the earthquake will be documented. A chapter on lessons learned will also be included. Coauthors will include colleagues from NSL, DEM, USGS, University of Utah, and other organizations that contributed to investigating the earthquake. NBMG has requested funding from the USGS to help cover the expenses of preparing this report.

Although the earthquake did not cause a rupture or fault scarp at the surface, there were surface effects that were measured with geodetic techniques. Data from interferometric synthetic aperture radar (InSAR) are consistent with the seismic observations, which imply that the main shock occurred on a northeast-striking, southeast-dipping normal fault. The area southeast of where the fault projects to the surface (the hanging

wall of the fault), dropped in surface elevation by as much as approximately 13 centimeters. The other side of the fault (the footwall), to the northwest, apparently did not change in elevation (at the centimeter-resolution of the InSAR imagery).

Craig showed slides of damage from the Wells earthquake. Several buildings collapsed. Most damage occurred to URMs. Approximately 60 chimneys were damaged. Non-structural damage was widespread in the City of Wells. A compelling photograph that Craig was given showed a large, heavy television set that had fallen off the wall into a crib. Fortunately, the three-week old child that had been in the crib, visiting with its mother, had gone to Oregon the day before. Otherwise, the child may well have been a casualty of the earthquake.

Power stayed on during the Wells earthquake. One water line broke during the main shock, and another broke during an aftershock. The town of Wendover-West Wendover helped repair the lines a couple of weeks later.

Local emergency responders and individuals were on their own for about 40 minutes, and they handled the event well. Professionals and the general public knew what to do. People had familiarity with one another, and the command structure and response personnel were experienced. A leaking liquid propane tank was handled by Wells Propane quickly and without injuries. There were communication incompatibilities in the first 24 hours; cell phones were saturated with too many calls. They used their third and last option for an EOC location. Fire and county sheriff personnel initially inspected buildings; 7 were red tagged, 52 were yellow tagged, and approximately 400 were green tagged. Four teams of inspectors, each pairing a structural engineer with a building inspector, spent about one month following up with detailed inspections.

Two homes were lost. Approximately one dozen manufactured homes needed to be reset on their foundations. Within two weeks, essentially all the businesses were operational, and most were back in operation the day after the earthquake. Saturday fix-up days worked quite well; an interfaith council helped to coordinate supplies, volunteers, and task orders for repairing damage to individual buildings. About \$200,000 in private donations came into Wells to help with the recovery efforts. The community spirit was tremendous. The mayor and city manager of Wells handled the recovery efforts quite well. Individuals were the largest asset.

Craig noted that there were many lessons used as well as lessons learned from the Wells earthquake. It was a limited incident. Thanks to Wayne Carlson and the Nevada Public Agency Insurance Pool, the city and school district were covered with earthquake insurance. The event could have been much worse, had the earthquake been at a different time of day (when people were at work in the URMs, or when they were not at home to turn off gas or put out the one fire that started during the earthquake). It would also have been worse had the earthquake been larger (and had the shaking lasted a few more seconds). Wells was in a lower probability part of the State in terms of earthquake hazards than either Las Vegas or Reno, but the earthquake nonetheless happened.

Three groups of American Red Cross volunteers helped. One of the challenges for volunteers is matching the needs of the local population to the resources that the volunteers bring with them. The needs were met well in Wells; if anything, the community had more donated relief supplies than were needed.

Early recovery was important. Wells recovered quickly in large part because of a pioneer approach – a pioneering spirit, courage, and wisdom – and modern-day savvy. Craig suggested that FEMA consider a rural disaster fund to assist in such early recovery.

Wayne Carlson noted that his office sent a crisis-intervention team to help lower the stress of the 12 members of staff of the City of Wells.

Report from the National Earthquake Conference, April 22-26, 2008 in Seattle, Washington

Jon Price, Terri Garside, Craig dePolo, and Dave Kennard reported on the conference. During the conference, FEMA released its new report, *FEMA 366*, “HAZUS-MH Estimated Annualized Earthquake Losses for the United States.” This report, which is available on line at <http://www.fema.gov/library/viewRecord.do?id=3265>, estimated that the average annual loss from earthquakes in Nevada would be \$78 million (placing Nevada seventh among the 50 states in this measure of earthquake risk), of which \$33 million per year would be for the Las Vegas metropolitan area and \$29 million per year would be for the Reno metropolitan area (placing these areas 18th and 23rd, respectively, among the 43 metropolitan areas at most risk to earthquakes).

A Draft Strategic Plan for the National Earthquake Hazards Reduction Program (NEHRP) for fiscal years 2008 to 2012, is available on line at <http://nehrp.gov/plans/publiccomment.htm>. Jack Hayes, who directs NEHRP through the National Institute of Standards and Technology, encouraged comments from the public on this plan. The website mentioned above includes the process for submitting comments, which are due by Friday, May 9.

Shortly before the conference, the United States Geological Survey (USGS), in conjunction with the California Geological Survey and the Southern California Earthquake Center, released the “Uniform California Earthquake Rupture Forecast, Version 2,” which is available on line at <http://pubs.er.usgs.gov/usgspubs/ofr/ofr20071437>. The study, described as “a sophisticated integration of scientific fact and expert opinion,” integrated information from geodesy, geology, seismology, and paleoseismology to estimate the probabilities of earthquakes occurring in the next 30 years throughout California. Overall, the study concludes that there is more than a 99% probability of one or more earthquakes of magnitude 6.7 or greater in California within the next 30 years. The study further identified the southern portion of the San Andreas fault as the California fault with the highest probability of generating at least one magnitude 6.7 or larger earthquake (59% in the next 30 years), and the Hayward-Rogers Creek fault in the eastern San Francisco Bay area as the most likely source of such an earthquake in northern California (31% in the next 30 years).

A number of federal, state, and local agencies and universities are working together to plan a major earthquake exercise, “the Great Southern California ShakeOut” on November 13-16, 2008. Information is available at www.ShakeOut.org. Dave Kennard noted that if one or two representatives from NESC would like to attend this exercise as observers, he can help arrange an invitation.

Jim Reagan noted that the southern California exercise is part of a larger “Golden Guardian” exercise. A northern California component of that exercise will be a landslide-induced seiche at Lake Tahoe. NSL is involved in planning that exercise, which will be held on November 6, 2008.

Also shortly before the conference, the USGS released the 2008 version of the National Seismic Hazard Maps, which are available on line at <http://earthquake.usgs.gov/research/hazmaps/>. These maps feed into the NEHRP provisions that are incorporated into the International Building Code by the International Code Council, and, ultimately, are considered for adoption by local jurisdictions. Quoting information supplied to NESC by the USGS at the time of the release,

“For some areas such as western Oregon and Washington, the new maps contain higher estimates for how hard the ground will shake compared to earlier versions of the maps released in 1996 and 2002.

But for most of the United States, the ground shaking estimates are lower. This revision incorporates new seismic, geologic and geodetic information on earthquake rates and the manner in which the energy released in earthquakes dies off with distance from the rupture.

National-scale maps of earthquake shaking hazards provide information essential to creating and updating the seismic design provisions of building codes used in the United States. The timing of the National Seismic Hazard Map release is tied to the schedule for revising model building codes that are developed by international code committees and then considered by state and local governments for adoption. Cities and counties rely on seismic design provisions in building codes to ensure that structures such as buildings, bridges, highways and utilities are earthquake resistant.

"The hazard maps released today incorporate more than a century of seismic monitoring and decades of research," said USGS Director Mark Myers. "These maps help policymakers and engineers make all of our structures — from our homes to our hospitals to the utilities that run beneath our feet — better able to withstand the earthquakes of tomorrow."

The National Seismic Hazard Maps consist of a series of maps and databases describing ground shaking at many points across the country and have many applications. They are used by insurance companies to set insurance rates for properties in various areas of the country, by civil engineers to estimate the stability and landslide potential of hillsides, by the U.S. Environmental Protection Agency to set construction standards that ensure the safety of waste-disposal facilities, and by the Federal Emergency Management Agency to plan the allocation of assistance funds for earthquake education and preparedness.

The geologic and geophysical data-collection, research and modeling results that underpin the maps have been generated by USGS scientists as well as their colleagues in academia, state government, and the private sector funded by external grants from the USGS Earthquake Hazards Program and other sources. The new maps represent the best available science as determined by the USGS based on an extensive information gathering and review process involving state and university experts nationwide.

Last week the USGS and its partners released a new earthquake rupture forecast for California, the first ever such forecast done statewide. That forecast focused on the likelihood of earthquakes happening on specific faults. The National Seismic Hazard Maps take the information about those faults and calculate the intensity of shaking that a given location could potentially experience over a 50-year period. These shaking estimates combine the effects from all possible earthquakes, both nearby and distant.

The changes in earthquake ground shaking estimates are due principally to the incorporation of new models on the strength of earthquake shaking near faults, and the manner in which shaking decreases with distance. The increased hazard in western Washington and Oregon is due to new ground-motion models for the offshore Cascadia subduction zone. Because of new models, ground motion estimates in the Central and Eastern United States are about 10 – 25 percent lower. Ground motion estimates in most of California, Utah, Nevada, Arizona, Idaho and western Montana are as much as 30 percent lower for shaking that affects taller multi-story buildings. For those same areas, ground motion estimates remain nearly the same for shaking that affects structures of one or a few stories. Because these maps are done at a national scale, they do not take into account local soil conditions and the depth of sedimentary basins, which can significantly amplify shaking relative to bedrock. As a result, site-specific factors are applied in the building codes to determine the seismic design needed for individual structures.

The map included the following regional changes:

- Several new faults were included or revised as a source of earthquake ground shaking in California, the Pacific Northwest and the Intermountain West.
- The Wasatch fault in Utah was modeled to include the possibility of a magnitude-7.4 earthquake, in addition to smaller earthquakes along the fault.
- The model for earthquakes along the New Madrid Seismic Zone in the Central United States includes a wider range of possible magnitudes and return periods between major earthquakes. The model was also adjusted to allow for sequences of earthquakes to occur in groups of three within a few years time, similar to what occurred in 1811 – 1812.
- Offshore faults were added as possible sources of earthquakes near Charleston, S.C.
- For the Cascadia Subduction Zone, more weight was given to a magnitude-9 earthquake that ruptures the length of the subduction zone, versus multiple smaller magnitude-8 earthquakes that fill the zone over the same 500-year time period.”

Intermountain West:

1. Some decrease (up to about 30%) in hazard estimates for ground shaking for 10 story buildings, because of the new attenuation relations; not much change for 2 story buildings.
2. USGS worked with the Utah Geological Survey, Nevada Bureau of Mines and Geology and Western States Seismic Policy Council, as well as universities (UNR and UU), and other state geological surveys in the region to better determine slip rates on faults, better characterize their geometry, and improve procedures to quantify the uncertainties in how often faults rupture their entire length versus how often they rupture in smaller earthquakes (characteristic versus Gutenberg-Richter)
3. We now consider the possibility that adjacent segments of the Wasatch fault could rupture together producing a larger M7.4 earthquake.”

The USGS has indicated to Jon Price that they probably will update the 2002 USGS Earthquake Probability Maps (available at <http://eqint.cr.usgs.gov/eqprob/2002/index.php>), but that because the changes from 2002 to 2008 in the NEHRP maps are largely the result of different attenuation relationships, these earthquake probability maps, which show the probability of a given size of earthquake occurring over a given period of time within a 50-kilometer radius of a given location, are not likely to change significantly. Interestingly, Jon noted that the 2002 maps indicate the following probabilities for a magnitude 6.0 earthquake occurring within 50 kilometers of the following Nevada communities within a 50-year timeframe:

Wells ~9%
 Las Vegas ~12%
 Reno ~67%
 Carson City ~70%.

Jon noted that although the probability for Wells is considerably less than that for the Reno-Carson City urban area, and even a bit less than for Las Vegas, such an earthquake did occur on 21 February 2008. A lesson to be learned from the Wells earthquake is that all of Nevada should be prepared for earthquakes.

To assist DEM in deciding what resources will be needed after an earthquake, including whether a Presidential Declaration of Disaster should be sought by the Governor, NBMG runs FEMA’s loss-estimation model, HAZUS-MH within an hour or two after the event. For the Wells earthquake, the HAZUS-MH computer simulation estimated \$2 million to \$3 million in economic loss. For a similar, magnitude 6.0 earthquake in an urban area, the loss would be considerably higher. For example, HAZUS-MH estimated \$400 million to \$1.5 billion in economic loss for a hypothetical magnitude 6.0 earthquake with an epicenter near Mogul; most of the damage would be in the Reno-Sparks urban area, not just Mogul.

Jon noted that he regards HAZUS as being accurate within an order of magnitude – a factor of ten. That is, a model number of 100 will, in reality, be somewhere between 10 and 1,000. In practice, when HAZUS has been applied to actual earthquakes in the United States, it has generally been correct within a factor of two. That is, a model number of 100, may, in reality, be somewhere between 50 and 200.

There are significant opportunities to reduce the risks from earthquakes, from such actions as adhering to the latest seismic provisions in the International Building Code to retrofitting buildings or removing people from harm's way in unreinforced masonry buildings, to taking measures to mitigate non-structural hazards (such as removing heavy objects that could fall during an earthquake and injure someone). If risk-reduction measures are taken, the actual losses could be considerably lower than those estimated by HAZUS.

Jon Price noted that the Western States Seismic Policy Council (WSSPC) adopted four policy recommendations during the National Earthquake Conference. These include:

- 08-1 Improving Tsunami Public Education, Mitigation, and Warning Procedures for Distant and Local Sources*
- 08-2 Active Fault Definition for the Basin and Range Province*
- 08-3 Real-Time Earthquake Monitoring Networks*
- 08-4 Identification and Mitigation of Unreinforced Masonry Structures*

Details can be found at <http://www.wsspc.org/>. The first three are restatements (with some modifications) of WSSPC policy recommendations that had been adopted previously. The fourth is new. The crux of that statement is: "Unreinforced masonry bearing wall structures represent one of the greatest life safety hazards and economic burdens to the public during a seismic event. WSSPC recommends that each state, province or territory adopt a program to identify the extent of risk that unreinforced masonry structures represent in their communities and develop recommendations what will effectively address the reduction of this hazard."

WSSPC expects to develop a new policy dealing with the importance of creating realistic earthquake scenarios to help with mitigation, planning, and training for emergency response and recovery.

The next WSSPC annual conference is being arranged. It will likely be in Salt Lake City, perhaps in conjunction with the annual meeting of the Earthquake Engineering Research Institute (during the week of February 9 to 14, 2009).

Craig noted that the San Francisco Planning and Urban Research Program, SPUR, a public-policy think tank, is making progress on explaining performance-based engineering to building owners and the public. With the leadership of Chris Poland, CEO of Degenkolb Engineers, SPUR is defining what San Francisco needs from its seismic mitigation policies to be a "resilient city." They are using new terms to describe the probabilities of ground motions from earthquakes occurring, such as "routine" for what occurs routinely; "expected" for what can be expected once in the lifetime of a structure, and "extreme" for more or less the worst-case scenario. SPUR is also defining resiliency in terms of performance goals, such as rebuilding within three years after a major earthquake and having all utilities operational within 3 to 30 days.

Terri Garside stated that she was impressed with the presentation by Dennis Mileti, Professor Emeritus in Sociology at the University of Colorado. He stressed the need for mitigation action before an earthquake. Terri also noted that NESAC has a seat on the WSSPC board; she held Ron Lynn's proxy at the WSSPC annual meeting. WSSPC will be establishing a Website that will link state seismic safety commissions, councils, and boards.

Report on the Geological Society of America Meeting in Las Vegas

Wanda Taylor reported on the joint meeting of the Rocky Mountain and Cordilleran Sections of the Geological Society of America (www.geosociety.org) on March 19-21 on the UNLV campus. There were 735 total registrants, 309 of whom were students. The diversity of sessions led to the success of the meeting. There were 23 half-day oral sessions and 12 half-day poster sessions with approximately 400 presentations and 11 field trips (with a field guide published by the Geological Society of America). The meeting included a one-day Seismic Hazards Summit of the Southern Nevada Region, which focused on results from recent work and needs for additional research in the region. The improvement in knowledge about earthquake hazards in southern Nevada since the last such summit (in 1996) was remarkable. Wanda thanked NESC for its help in sponsoring the summit.

Adoption of Draft Letter to the Nevada Board of Professional Engineers & Land Surveyors on the Accuracy of Fault Locations in the USGS Quaternary Fault and Fold Database

NESC board members unanimously approved a motion to send the following letter to the Nevada Board of Professional Engineers & Land Surveyors.

“The Nevada Earthquake Safety Council has witnessed misuse of the United States Geological Survey’s (USGS) online fault and fold database (<http://earthquake.usgs.gov/regional/qfaults/>), in which consultants plot the database on Google Earth maps at large and inappropriate scales. The result is usually misplotting of the fault trace, because errors in making the map are magnified. The dataset was never intended to be used this way, and this practice exceeds limits that are stated in the online explanation.

To understand the problem, consider that most of the ground surface does not have faults. So it is likely that the location where a misplotted trace is placed will not have a fault if explored. Consequently, known faults are not being explored and are erroneously dismissed because of the negative field results from misplaced locations. A report on a misplaced fault may be adopted by adjacent projects, spreading the impact.

The metadata with the USGS dataset states, “Their [the mapped faults’] accuracy is no more than 450 ft (140 m), or the width of the fault trace at about 15 miles.” Google Earth viewed at about 15 miles altitude is equivalent to a scale of about 1:100,000, the compilation scale of the project. Some input data were initially compiled at a scale of 1:250,000 and transferred to 1:100,000 for this project, so additional limits might be applied. For now, **the problem would be largely solved if users of the USGS data set complied with the stated limitations of the data.** This data set does not replace the need to conduct a site-specific review for earthquake faults to insure proper planning and design.

Nevada has more mapped Quaternary faults than any other state in the Union, and a wise approach to this hazard, avoiding unnecessary building across faults, will benefit not only occupants and individual property owners but the State as a whole, because we will avoid large amounts of fault-displacement damage from earthquakes.

Recommended guidelines for fault studies in Nevada have been endorsed by the Nevada Earthquake Safety Council and the Nevada chapters of the Association of Environmental and Engineering Geologists, and are available online (<http://www.nbmng.unr.edu/nesc/guidelines.htm>). We are currently considering an update to address this issue of plotting faults at inappropriate scales. In the meantime, we encourage you to alert engineers under your jurisdiction to comply with the limitations of the USGS data set and recognize that plotted faults may be mislocated by more than 450 feet.

Thank you,

Chair, NESC”

John Anderson suggested that NESC also send a copy of this letter to the USGS, encouraging that they make the scale issue more prominent on their Web site.

ACTION ITEM: Terri Garside will prepare the letter to the Nevada Board of Professional Engineers & Land Surveyors on the accuracy of fault locations in the USGS Quaternary Fault and Fold Database for Ron Lynn’s signature. Jon Price will send a copy of the letter to the USGS earthquakes program, requesting that the disclaimer be more prominent.

Old Business

Jim Werle reviewed action items from the previous meeting. John Louie noted that Ron Lynn helped encourage the City of Henderson to join the effort of earthquake-hazard parcel mapping using shear-wave velocities.

Whereas most action items had been duly handled, the following two remain:

Jim Reagan will produce a draft of the 2007 NESC annual report for adoption at the May meeting. Terri Garside will place adoption of this report on the agenda for that meeting.

Craig dePolo will invite representatives from the USGS, Sandia, and DOE and their contractors to a NESC meeting to discuss the implications of earthquake hazards at Yucca Mountain for possible licensing of a nuclear waste repository.

New Business

ATC-20 Classes and other FEMA-Sponsored Training Classes

FEMA, NSL, and NBMG are sponsoring two training classes on *Post-Earthquake Safety Evaluation of Buildings* (ATC-20 classes), one on June 3rd in Reno and one on June 4th in Las Vegas. These courses are designed for building inspectors and structural engineers who inspect buildings shortly after an earthquake and tag them as unsafe and not to be occupied until a more detailed inspection by a structural engineer has been completed (red tagged), o.k. for limited entry but not for full, normal occupation until a more detailed inspection has been completed (yellow tagged), or fine for normal occupation (green tagged). There is no fee for this course, but pre-registration is required, so that FEMA provides the correct number of materials.

If you are interested in the June 3rd class in Reno (7:30 a.m. to 5:00 p.m. on the UNR campus), please contact Terri Garside (tgarside@unr.edu, 775-784-4415) to register. There are 140 slots available for this class, and 103 are already taken.

If you are interested in the June 4th class in Las Vegas (7:30 a.m. to 5:00 p.m. at the Clark County Department of Development Services, 4701 Russell Road), please contact Dawn Rivard (mdawn@co.clark.nv.us, 702-455-8367) to register. There will be up to 160 slots available for this class.

Dave Kennard will provide Terri with a list of a number of FEMA classes that could be offered through NESC.

Invited Speaker

John Anderson suggested that NESC participate in an invitation for Chris Poland to speak in Reno about what it means to have a resilient city. Chris is this year's William B. Joyner Memorial Lecturer of the Seismological Society of America and EERI. This lecture could be coordinated with the next NESC meeting. The audience should include elected politicians and the business community. Jim Reagan noted that the theme of Chris Poland's lecture, which is how to build a resilient city, is very much on the minds of the Economic Development Authority of Western Nevada, and suggested that they will be eager for this kind of information.

ACTION ITEM: John Anderson will invite Chris Poland to give his Joyner Lecture. Jim Reagan will help coordinate the lecture with the Economic Development Authority of Western Nevada. One suggested time for the lecture is in conjunction with the next NESC, although the window of opportunity associated with the current earthquakes might end quickly so a sooner time might be better.

Announcements

Future NESC meeting dates are as follows:

Wednesday, August 6, 2008 in Reno (Sierra Pacific Power office)

Wednesday, November 12, 2008 in Las Vegas at the Clark County Department of Development Services

Public Comment Period

There were no additional comments.

The meeting adjourned at approximately 3:00 p.m.

REVIEW OF ACTION ITEMS

Jim Reagan will produce a draft of the 2007 NESC annual report for adoption at the August meeting. Terri Garside will place adoption of this report on the agenda for that meeting.

Terri Garside will prepare the letter to the Nevada Board for the Regulation of Liquefied Petroleum Gas for Ron Lynn's signature.

Jon Price will contact Kamala Carmazzi to investigate the possibility of getting a representative from the Nevada Earthquake Safety Council on the State's Homeland Security Grants Working Group.

Terri Garside will work with FEMA on scheduling a training class on non-structural retrofits for hospitals.

Terri Garside will prepare the letter to the Nevada Board of Professional Engineers & Land Surveyors on the accuracy of fault locations in the USGS Quaternary Fault and Fold Database for Ron Lynn's signature. Jon Price will send a copy of the letter to the USGS earthquakes program, requesting that the disclaimer be more prominent.

John Anderson will invite Chris Poland to give his Joyner Lecture. Jim Reagan will help coordinate the lecture with the Economic Development Authority of Western Nevada. One suggested time for the lecture is in conjunction with the next NESC, although the window of opportunity associated with the current earthquakes might end quickly so a sooner time might be better.

respectfully submitted by Jon Price, 16 May 2008

Nevada Earthquake Safety Council

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