



NEVADA EARTHQUAKE SAFETY COUNCIL

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*Jon Price, Secretary
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February 17, 2009

TO: Mr. Ron Lynn, Chairman, Nevada Earthquake Safety Council
Board of Directors, Nevada Earthquake Safety Council

FROM: B. Jim Reagan, Chairman, Strategic Planning Committee

RE: Annual Report of Activities for Plan Year 2008

I am pleased to provide a summary of activities and efforts achieved by the Standing Committees and members of the Nevada Earthquake Safety Council for the calendar year 2008. As with previous years, the committee members and members of the council have made great progress toward the mission and goals of the council and earthquake safety in Nevada. This year's accomplishments include:

EDUCATION COMMITTEE

- NES members along 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.
- 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 education committee asked for volunteers to help with the NES booth for the City of Reno Safety Expo and the Silver State Governor's Safety Conference. Given the recent earthquakes in the Reno area, we anticipate that the NES booth will see lots of traffic.
- Several town-hall meetings were held with residents of the Mogul-Somerset 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.
- 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.
- Diane dePolo and others attended the City of Reno Safety Expo and the Silver State Governor's Safety Conference (Wednesday, June 25th, through Friday, June 27th) on behalf of the NES.
- Nevada Earthquake Awareness Week will be February 22-29, 2009. There will be a request that teachers have classroom earthquake drills. Information will go out at several intervals, beginning in January.
- There will be an EarthScope Basin and Range workshop for education and outreach, October 19-22 in Reno. The focus will be on employees of parks and museums.
- The Nevada Seismological Laboratory is having an information session for volunteers who hosted seismometers at their homes and businesses at 7:00 p.m. on Wednesday, August 13, on the UNR campus.

RESEARCH & INFORMATION COMMITTEE

- There will be a 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, and there will be a Seismic Hazards Summit of the Southern Nevada Region on Thursday, March 20.
- Craig dePolo described a poster on the 1914 Reno earthquakes that was presented at the December 2007 American Geophysical Union meeting. For details about these earthquakes, please refer to\ Nevada Bureau of Mines and Geology Open-File Report 06-2 (<http://www.nbmge.unr.edu/dox/of062.pdf>).
- There was a November 2007 meeting of the Nevada Quaternary Fault Working Group, which was attended by fault experts from the U.S. Geological Survey, U.S. Bureau of Reclamation, Utah Geological Survey, California Geological Survey, Idaho Geological Survey, UNR, UNLV, other universities, and consulting companies. The group evaluated approximately 11 faults in detail. We are in the early stages of understanding earthquake hazards from specific fault sources; much more work is needed to adequately characterize the earthquake hazards. The group will be reconvened in the future to examine additional faults that are considered of high hazard and risk for urban areas in Nevada.
- Craig discussed issues regarding use of the USGS Quaternary Fault and Fold Database. Among all the states, Nevada has the most number of mapped faults within this database. The fault locations were compiled at scales of 1:100,000 to 1:250,000, and transferred to 1:100,000, but people are using the USGS database to locate faults at scales of 1:12,000 or larger. The 1:100,000 scale more or less equates to a Google Earth view from 15 miles above the Earth. The USGS states that the accuracy of the fault locations is no more than 450 feet or 140 meters, but Craig checked several locations and concluded that some faults are actually mislocated by considerably more distance.
- John Louie reported on the January 2008 meeting of a working group on a Nevada Community Velocity Model. Such a model includes seismic velocities for shallow materials important in construction, building foundations, and liquefaction hazards (soil classifications for seismic provisions in building codes), deeper basin-fill materials, and bedrock. Creation of a “community model,” one that is accepted by most experts as a reasonable representation of available data, helps to model ground shaking for building design, local effects, and basin effects related to the geometry of the underlying soils and rocks. The model will also help to understand effects of directionality – the direction in which seismic waves propagate from the earthquake’s hypocenter.
- There is 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:
 - Nevada Public Agency Insurance Pool records for rural public agencies
 - The Insurance Services Office, an insurance company-funded organization that inspects buildings for fire rating purposes
 - Nevada county assessors to determine information collected in their inspection files
 - 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. 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 Nevada Public Agency Insurance Pool agreed to provide matching funds for a FEMA grant that will enable furtherance of the URM data-gathering effort. The state hazard mitigation officer has identified Fernley flood/canal breach disaster-mitigation funds of approximately \$33,000 from FEMA, and the matching funds will be approximately \$11,000.
- The Nevada Bureau of Mines and Geology is taking the lead on a publication on the Wells Earthquake. The goal is for release by the anniversary date of the earthquake (February 21).
- There is considerable ongoing research regarding the Mogul and Wells earthquakes.

POLICY COMMITTEE

- The Council unanimously adopted the proposed policy statement regarding Special Planning Consideration Zones.
- The Council unanimously adopted the proposed policy statement regarding Activating Applied Technology Council 20 Post Earthquake Inspections.
- The Council unanimously adopted a motion to present a bill draft request for a Nevada All Hazards Safety Action Priority Act to Assemblyman Anderson, Assemblyman Mortensen, and Senator Hardy for consideration during the 2009 legislative session.
- The Nevada Sr. DSG noted that 50% of federal Department of Homeland Security funding coming to Nevada is supposed to be focused on improvised explosive devices (IEDs). Several individuals noted that buildings that are likely to collapse during an earthquake may also more easily collapse from an explosion than buildings that were designed to withstand earthquakes without any loss of life.
- Wayne Carlson discussed his inventory of unreinforced masonry buildings. He distributed a spreadsheet indicating preliminary data from the assessor's offices of 14 mostly rural counties. The list included 877 commercial buildings in 10 counties (with a combined replacement cost of \$384,670,818) and 1,260 residential buildings in 14 counties (with a combined replacement cost of \$152,718,596).
- The State Historic Preservation Office is putting its building information on the Web in a searchable database in a geographic information system.
- At its November annual meeting, the Nevada Association of Counties will hold a session on interactions between FEMA, the State Division of Emergency Management, and insurance companies.

SCIENTIFIC AND INFORMATIONAL PRESENTATIONS

Ad-Hoc Committee on Anchoring of Propane Tanks

It was noted that there are no requirements at the national or state level for anchoring horizontal propane tanks. The Nevada Board for the Regulation of Liquefied Petroleum Gas has authority in this regard. The tank manufacturers have specific requirements for installation in areas where tanks may be toppled (such as flood areas and earthquake-hazard zones). Tanks of all types need to be anchored, according to building codes, but building codes are superseded by regulations of the Nevada Board for Regulation of Liquefied Petroleum Gas. It was noted that these tanks will fail during earthquakes if not properly bolted down. An action item will be added to the agenda for the May NESC meeting to discuss adoption of a letter from the Council Chair to the "Nevada Board for the Regulation of Liquefied Petroleum Gas"

NESC Support of the Western States Policy Council's Policy Recommendations

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

Seismicity Report and Seismic Monitoring Needs for Southern Nevada

John Anderson reported on a cooperative agreement between UNR and UNLV, signed by the presidents of both universities, for working together on earthquake monitoring in southern Nevada.

2007 was near a record low for earthquakes in terms of numbers of magnitude 3 or greater earthquakes (36 earthquakes of M>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. Although we don't know what the future will bring, statistically we have normally seen more earthquakes than in 2007 and would expect more in coming years.

John reviewed a recent article by Bernard Guest and others on the Stateline fault zone in the Pahrump area of southern Nevada. That paper proposes a slip rate for the fault (on the order of 2 mm/year) that is much higher than had previously been recognized. The rate is based primarily on displacement of a volcanic feature that is several million years old. Craig dePolo noted that critical studies are needed of the recent activity (last few thousands or tens of thousands of years). If the higher rate is applicable for recent activity, the earthquake hazard for Pahrump and Las Vegas would be higher than currently modeled by the USGS.

SCIENTIFIC AND INFORMATIONAL PRESENTATIONS (Continued)

Seismicity Report and Seismic Monitoring Needs for Southern Nevada (Continued)

The seismic monitoring network in southern Nevada doesn't have enough stations to adequately determine locations and magnitudes of earthquakes. With a denser network, the Nevada Seismological Laboratory could locate earthquakes on specific faults in and around Las Vegas Valley, understand how stresses are transferred from the Eastern California shear zone across Nevada into Utah, and eventually allow for early warning of seismic shaking in Las Vegas Valley from earthquakes on distant faults, including major faults near Death Valley and in southwestern Utah. An additional 20 seismic stations in southern Nevada would create the necessary denser network.

Report on Seismicity Since 7 February 2008

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>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.

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). 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 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 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.

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 NBMG did not establish a physical, scientific and technical clearinghouse. In a larger event, such a clearinghouse would be a place near the epicenter 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

SCIENTIFIC AND INFORMATIONAL PRESENTATIONS (Continued)

Report on the Wells Earthquake (Continued)

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. 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.

Craig showed slides of damage from the Wells earthquake. Several buildings collapsed. Most damage occurred to URM's. 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. Power stayed on during the Wells earthquake. One water line broke during the main shock, and another broke during an aftershock. 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. A leaking liquid propane tank was handled by Wells Propane quickly and without injuries. 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. 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.

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

FEMA released its new report, *FEMA 366*, "HAZUS-MH Estimated Annualized Earthquake Losses for the United States." This report 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 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. 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. 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, 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."

SCIENTIFIC AND INFORMATIONAL PRESENTATIONS (Continued)

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

The USGS has indicated to Jon Price that they probably will update the 2002 USGS Earthquake Probability Maps, 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.

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 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.

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 letter included: "The Nevada Earthquake Safety Council has witnessed misuse of the United States Geological Survey's (USGS) online fault and fold database, 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. ... Consequently, known faults are not being explored and are erroneously dismissed because of the negative field results from misplaced locations.... 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.

Comparison Between Earthquake-Damaged Unreinforced Masonry Buildings (URMs) in Wells and Reno

Craig dePolo reported on lessons learned regarding URM s from the Wells earthquake. Major hazards were from debris falling from the URM s. In contrast, the insides of the URM s and adjacent buildings survived fairly well. These observations reinforce the point that the best action is to "duck, cover, and hold" rather than run outside. Craig also showed photos of URM s in Reno, some of which have cracks in brick walls. He estimated that there are between 30 and 80 URM s in Reno. Most are moderately to well maintained. He emphasized that URM s continue to be a major challenge for earthquake mitigation.

Hotel Owner's Guide to Handling Visitors During a Disaster

Craig mentioned that hundreds of people left Reno after the largest of the Mogul earthquakes. He proposes that the NESC update its guide for hotel owners (see www.nbmng.unr.edu/nesc). Ron Lynn suggested that NESC's guide be presented to the tourism industry as a draft for their input before final adoption by NESC. He noted that from experience at a fire emergency in Las Vegas, getting tourists the paperwork they need to return to their homes (passports, airline tickets, etc.) is a major hassle, as is dealing with over 100 foreign languages.

Vigilant Guard After-Action Report

The Nevada National Guard is compiling a report. Jon Price and Terri Garside reported on search-and-rescue exercises at the rubble pile constructed at the Washoe County EOC. Jon also participated in the initial press conference and in the Washoe County post-earthquake recovery exercise. Rick Martin mentioned frustrations in having to work the exercise without computers and other electronic equipment in their new EOC in Carson City.

Seismicity of the Wells and Mogul-Somersett Earthquake Sequence

Ken Smith with the Nevada Seismological Laboratory reported that the Wells was on an east-dipping normal fault. The initial epicenter location from the United States Geological Survey (USGS) backbone array of seismometers was 15 kilometers away from the actual location, which was determined by incorporating data from the National Science Foundation's (NSF) EarthScope instruments with data from the USGS's instruments. Unfortunately, NSF's EarthScope instruments will begin leaving Nevada this fall, as the array of seismometers is moved in a continent-wide, multi-year experiment. The Wells Rural Electric Company helped the Nevada Seismological Laboratory with deployment of portable instruments that were used to measure aftershocks. These stations were in place for two months; one has remained. With the aid of aftershock data, locations of all the earthquakes have been recalculated. These allowed for locating earthquakes with more accurate hypocenters than those using only the network seismometers. Activity rates have declined substantially in the last two months; however, small earthquakes (~ magnitude 1) continue. Relocated earthquakes are mostly along a fault zone that extends approximately 8 km along strike. Most of the information that Ken showed is available at the Nevada Seismological Laboratory's website

Effects of the Mogul-Somersett Event and the Sequence

Craig dePolo showed photos and described effects of the Mogul sequence. The biggest emergency was the break of an irrigation ditch that diverted water into the Mogul neighborhood. The Truckee Meadows Water Authority quickly responded to the emergency by installing pumps to move water from the flume to another irrigation ditch. Several rocks fell into the irrigation ditch, keeping them from falling into houses. Otherwise, there would have been landslide-related damage to some homes. People were under stress but motivated into action by the sustained exposure to the earthquakes, which began in late February and continued beyond the April 25 main shock. The Nevada Bureau of Mines and Geology distributed copies of *Living with Earthquakes in Nevada* (the booklet prepared with partial funding from FEMA through the Division of Emergency Management and NESC) to local residents before the main shock. Many people anchored water heaters to walls before the main shock, including the day of that earthquake, after two magnitude 4.0 foreshocks the day before. One house experienced damage from the main shock and from smaller aftershocks. Rockery walls had mixed performance. Although most did not have cracks, there were a number of cases in which cracks formed inboard of the rockery walls. One crack was at least 100 feet long. Some other rockery walls had evidence of compaction behind the fronts of the walls. There was much non-structural damage – broken mirrors and pictures, glassware that fell from cabinets, computers that fell to the floor, unsecured water heaters that moved, and loss of bricks from a few chimneys. Mitigation efforts worked; for example, rubber bands effectively kept cabinets closed, thereby reducing the potential damage from broken glassware and dishes. Modified Mercalli Intensities reached VI in much of the Mogul area (and barely VII in some locations). Earthquakes with magnitudes of less than 6.0 to 6.5 typically do not have surface ruptures of faults, but it was important to check for fault displacements at Mogul, because the main shock was shallower than the typical earthquakes in the Basin and Range province.

Ground Motion from the Mogul-Somersett Earthquakes

Peak accelerations were much higher than expected from an earthquake of the size of the main event (local magnitude, $M_L = 4.7$; moment magnitude, $M_w = 5.0$). The Laboratory measured ground motions of as much as 1.18 g (g is the acceleration due to gravity, 9.78 m/sec²) during the April 25 event. Other instruments near the epicenter measured 0.85 g and 0.65 g. The measurements were made on temporary instruments that were deployed to the Mogul area before the main shock. These ground motions are substantially higher than the current design standards in the International Building Code. Local residents greatly appreciated the presence of local experts with first-hand knowledge and up-to-date information. John noted that the Mogul record is one of the top 25 accelerations recorded in the world up to that date. Had building codes allowed unreinforced mud-and-brick construction, as in Iran, where thousands of people died in 2003 from an earthquake with similar ground motions, there would likely have been significant damage in Mogul.

Report on Seismic Activity Since May 2008

John Anderson noted that although the frequency of earthquakes in the Mogul area has decreased, the sequence is definitely not over. Small earthquakes have not stopped. Very small earthquakes are no longer being recorded, because the temporary, portable Texan instruments have been returned to IRIS. Citizens throughout Nevada are encouraged to mitigate their homes for earthquakes. The Chino Hills, California earthquake (magnitude 5.4, near Log Angeles) was recorded on seismometers in the Las Vegas area.