Summary Minutes

Nevada Earthquake Safety Council

November 9th, 2011

The Nevada Earthquake Safety Council (NESC) met jointly with the Utah Seismic Safety Commission at the Clark County Department of Development Services in Las Vegas, Nevada from about 8:40 AM until about 3:30 PM. Clark County DDS Presentation Room is located at 4701 Russell Rd., Las Vegas, NV 89117. These minutes will be posted on the NESC website.

Ron Lynn co-chaired the meeting, along with Roger Evans (USSC).

Individuals attending the meeting who are members of the Council are:

Elizabeth Ashby, Nevada Division of Emergency Management (DEM)

Doug Bausch, Federal Emergency Management Agency, Region VIII

Alan Bennett*, City of Reno

Michael Blakely*, Blakely, Johnson, and Ghusn

Steve Bowman, Utah Geological Survey

Bob Carey, Utah Division of Emergency Management

Wayne Carlson*, Nevada Public Agency Insurance Pool

Sheila Curtis, Utah Division of Emergency Management

Craig dePolo, Nevada Bureau of Mines and Geology (NBMG)

Diane dePolo, Nevada Seismological Laboratory

Rick Diebold, Las Vegas Office of Emergency Management

Chris Ross, Utah Geological Survey

Roger Evans, Utah League of Cities and Towns

Kimberly Ferguson, NV Energy, who held proxy for Jim Reagan*, NV Energy

Terri Garside, Nevada Bureau of Mines and Geology

Melvyn Green, Melvyn Green and Associates, Inc.

Jeffrey Hahn, Corporate Emergency Management, Boyd Gaming Corporation, Las Vegas

Werner Hellmer, Clark County Building Department

Jenelle Hopkins*, Clark County School District, Las Vegas

Eric Hubbard*, Geological Consultant, Reno

Graham Kent*, Nevada Seismological Laboratory

Jennifer Lynette, Federal Emergency Management Agency, Region IX

Ron Lynn*, Clark County Department of Development Services

Kris Pankow, University of Utah Seismic Station

Jon Price*, Nevada Bureau of Mines and Geology

Woody Savage*, U.S. Geological Survey (retired)

Christopher Smith, Nevada Division of Emergency Management (DEM)

Wanda Taylor*, UNLV Department of Geoscience

Dimitri Theodorou, Clark County School District-EM

Jess Traver*, Builders Association of Northern Nevada

Fred Turner, California Seismic Safety Commission

Jim Walker*, Nevada Department of Transportation

Barry Welliver, Structrual Engineers Association of Utah

Erik Williams, Nevada Seismological Laboratory

* indicates member of the Board of Directors.

Members of the Board of Directors (NESC) who were unable to attend:

Ian Buckle*, University of Nevada, Reno – Center for Civil Engineering Earthquake Research

Press Clewe, Washoe County resident

Jeff Brewer*, American Red Cross, Las Vegas

Joe Curtis*, Storey County Emergency Manager

Steve Koenig*, City Center, Las Vegas

Jim O'Donnell*, UNLV

Jim Werle*, Converse Consultants, Las Vegas

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

PUBLIC COMMENTS

There were no comments from the public

UTAH SEISMIC SAFETY COMMISSION—UPDATE OF ACTIVITIES

(ROGER EVANS)

Roger Evans highlighted recent activities in Utah. The USSC was established in 1994 by their legislature, there are members from a diverse set of agencies. Several standing committees exist today. Successes include "Putting Down Roots in Earthquake Country" delivered through newspapers, websites, etc. The Great ShakeOut is coming to Utah on April 17th, 2012, with over 400,000 citizens already signed up! Student support through "research grants" has been successful. Five ATC20 workshops were held this year alone. The Earthquake Working Group was established in 2003. Its committees include: fault parameters, ground shaking, liquefaction, earthquake probability, and the study of the 2010 M4.9 Randolph earthquake (mostly trenching along the fault line). A FEMA-supported study of school engineering and architecture evaluated 128 schools and concluded that 60% of the buildings required further assessment. A report was published that highlights Utah students at risk; the Structural Engineers Association helped greatly with this project/document. Legislation 2010 HB72 and HB367(current) seismic safety hazard inventory on school buildings, tasked to fund $500K to get a complete inventory (Charter School buildings are most problematic). They ultimately need a plan in place for upgrades. Condos are also problematic with regards to Un-Reinforced Masonry Buildings (URM's). Evaluations must be done on buildings older than circa 1975 before re-roofing. Utah Students at Risk is a new publication and they are receiving positive feedback. "Putting Down Roots in Earthquake Country" is now in its 3rd edition. Steve Bowman and Chris Du Ross discussed the Earthquake Clearinghouse website for Utah. This was triggered by problems associated with the Wells, NV (M6.0) earthquake. Not just earthquake focused, but to encompass all geologic hazards. This is to be fully functional by the April, 2012 Great Utah ShakeOut, and to have multi-event capability. Members can login and share confidential information not available to the public. They will be able to upload data from phones, laptops, etc. There are downloadable PDF forms, maps (surface fault ruptures), and Google Earth file uploads. They are based on all open source tools/protocols. The distribution is Windows & Linux. The purpose of the website is to collect and archive technical and non-technical information. Users can click on the red stars to show active events. There are public and confidential portholes into website. It can show earthquakes, surface ruptures and geo-tagged photos. It can gather information from John Q. Public. The technical way is to upload information with technical forms (PDFs). It can organize folks into technical teams. It's customizable for other agencies and states. Roger highlighted the need for both groups to share successes with respect to software infrastructure.

NEVADA EARTHQUAKE SAFETY COUNCIL—UPDATE OF ACTIVITIES

(RON LYNN)

There has been a recent change in the secretariat of the Nevada Earthquake Safety Council, whereby responsibilities have been transferred from the Nevada Bureau of Mines and Geology (NBMG) to the Nevada Seismological Laboratory (NSL). Dr. Graham Kent will take over as Secretary from Dr. Jonathan Price. NESC has a very diverse membership including: Red Cross, USGS, FEMA, UNR, UNLV, etc. NESC typically has both south and north membership on various committees to help represent both "halves" of the state. NESC has several standing committees ranging from Education and Awareness to Public Policy. NESC produces studies that in turn have found their way into liquefaction and fault rupture protocols. NESC helped formulate a state law that requires the adoption of the seismic provisions of the international building code. NESC was unsuccessful with furthering legislation regarding URMs. NESC is an advisory committee to DEM. A myriad of ATC20 courses have been provided, including most recently in northern Nevada. We participate with the Great Nevada ShakeOut; 195,000 Nevadans participated in 2011. Plenty of work has been done to evaluate the 2008 Wells M6.0 earthquake; this work was led by Dr. Craig dePolo. NBMG undertook a series of HAZUS scenario runs (38 communities) starting at M5.0 increasing in magnitude up to M7.0 to place ranges on the loss of life and financial cost of scenario earthquakes in Nevada. Chairman Lynn also points out that Las Vegas has "Alquist-Priolo" type set-backs (the only locale to do so thus far). NSL and NBMG are in the process of updating the earthquake epicenter map for Nevada and producing a strain map (geodetic) for Nevada. The Nevada Public Agency Insurance Pool and NBMG are working on an inventory of potential URMs in Nevada using publicly available data. An earlier attempt to do this through legislative action received pushback from some communities, which were concerned about the expense of doing the inventory. Wayne Carlson noted that as a first cut, the project is using 1974 as the date when most jurisdictions in Nevada adopted building codes that no longer allowed URM construction. Some communities pushed back on this process (from a legislation standpoint). Jon Price highlighted the geodetic strain map that includes surrounding states. Strain, seismicity and fault maps will be very helpful for public awareness and future evaluations of earthquake hazards.

FEMA STATEMENTS AND UPDATES

(DOUG BAUSCH, JENNIFER LYNETTE)

Doug Bausch, FEMA Region 8, discussed 2012-13 budgets; FEMA could sustain large budget cuts. The FEMA budget for NEHRP is in mark-up; ranges from $10M in the Senate, with only $6M in the house. In either case, they expect large cuts coming in the next fiscal year, FY12. The Virginia earthquake just received (barely) a presidential disaster declaration. The regional perspective; URMs have been a regional priority over the past several years. Competing for other FEMA funds is becoming more important with NEHRP and mitigation grants contributing less of the total load. There have been recent successes in Utah getting funds for Response and Preparedness, and working with the Structural Engineers Association of Utah for a URM

inventory. URMs will drive the rescue and mass casualties during the next large earthquake in Utah. 90% of fatalities are likely be related to this one building type. An outreach strategy (e.g., updated video, Utah Preparedness Now) with respect to ShakeOut has been funded through another unit of FEMA. ShakeOut has now signed up 400,000 with a goal of 800,000.

Jennifer Lynette, FEMA Region 9, highlighted that FEMA will host a free Webinar on E74, Reducing Nonstructural Damages. Other free webinars are also available.

Ron Lynn also highlighted an opportunity through Senator Reid's office to meet with FEMA Director Fugate. Ron spent 1 hour and 15 minutes with Director Fugate who agrees that $1.00 of mitigation money saves about $4.00 response dollars down the road. He's an advocate of building codes and mitigation. Ron had a second opportunity to meet with Director Fugate and General Honore at the ICC annual business meeting. General Honore led Katrina recovery efforts. People continue to build back in flood zones along the Mississippi river, which is precisely what we do not want to happen, nevertheless it continues. People die in URMs; which is equally true along the Wasatch Front and rural Nevada.

EARTHQUAKE AND GROUND MOTION POTENTIAL

IN UTAH AND NEVADA

(KRIS PANKOW, GRAHAM KENT)

Craig dePolo introduced the next section of the meeting, beginning with the potential of earthquake generated ground motion in Utah and Nevada, followed by an introduction into the problem of Unreinforced Masonry Buildings (URMs). Then he discussed New Zealand and the recent Christchurch (ChCh) earthquakes, and lessons to be learned from that experience. Mel Green will talk about his lifelong experiences working with URMs and how to rehabilitate these buildings and costs. California made progress in the 1990s on a URM inventory, more lessons to be learned. There may be a possible joint statement regarding URMs from both councils.

Kris Pankow, University of Utah Seismograph Stations, highlighted earthquake distribution in Utah. Seismicity is focused along the Inter-Mountain Seismic Belt, extending from Montana and possibly down to the southern Nevada transition zone (geodetic work by Kreemer and others, NBMG & NSL). National hazard maps reflect this distribution. 80% of the state's population lives along the Wasatch fault. Large historical earthquakes are well dispersed along the IMSB. The take home message: earthquake hazards extend both north and south from the Wasatch fault zone. The highest probability events maybe the M5 to M6.5 events that do not necessarily lie on the Wasatch fault *per se*. The Wasatch fault has 5 active segments. Not only does 80% of Utah population live along the Wasatch fault, but most live on the hanging wall of this fault zone. Shake Map scenarios show significant ground shaking for a Salt Lake City segment event, with strong shaking felt from Provo to Ogden—much bigger than just Salt Lake City. What is the probability along the Wasatch and other faults? The last M5 in Utah was in 1992, but such an event should occur every 5 years. A recent study published in BSSA in October (Roden and others, 2011), focused on ground motion prediction for ruptures along the Salt Lake City segment of the Wasatch fault (M7, recurrence 1350 years). Several dynamic rupture scenarios with realistic fault geometries were undertaken. First step, they constructed a community

velocity model. Realistic ground motions to about 1s, with high frequency scattering used to extend spectral content to 0.1 s (or 10 Hz)—useful for *pga* analysis. They also added non-linear aspects to wave propagation (to be submitted). Scenarios run for north and south propagating earthquakes. For Salt Lake City, a northward propagating rupture is much worse. Non-linear effects help reduce the modeled high ground motion effects, which brings this modeling exercise more in line with global studies. If one averages all 6 scenarios, 0.3 *pga* in the valleys, twice that near the fault itself. Earthquake and ground motion in Utah require 4 things to consider: (1) the smaller, more likely M5-6.5s may have a greater effect on URMs, (2) rupture direction matters, (3) non-linear effects are huge, and (4) largest ground motions are synchronous with population centers.

Craig dePolo asked about directivity versus dynamical rupture. The modeled rupture was for one segment (Salt Lake City). The fault was constrained geologically—step-over is the most controversial. No two faults are the same, and it is likely that no two ruptures on the same fault plane are identical. The most recent study is really the first of many ground motion studies to come out over the next several years, which Kris highlights, is very exciting.

Graham Kent, Nevada Seismological Laboratory, first highlighted the Great Nevada ShakeOut and thanked Diane dePolo for her work with K-12 schools, and Wanda Taylor and Woody Savage for bringing UNLV on board and other ShakeOut day activities. Dimitri helped out enormously and everyone is encouraged that Clark County Schools will be on board next year. President Marc Johnson also played a very active role in ShakeOut on the Nevada campus this year.

Graham is going to take a slightly different role, relative to Kris, to look at potential ground motion. Basin and Range is used as a generic term, but may not be useful geologically since there are many domains or processes that are ongoing within the “Basin and Range”. Early geodetic work by Wayne Thatcher (USGS) and Bill Hammond (NBMG and NSL) began to highlight the importance of the Walker Lane Deformation Belt that focuses most of the Basin and Range slip along the boundary of the Sierra Nevada–Great Valley microplate. The HWY 50 GPS transect highlights the importance of the physics of plate motion and how that in turn can affect probabilistic ground motion estimates. 12-13 mm/yr. of plate motion (or about 25% of North America–Pacific total motion) is sited in the Basin and Range proper: (1) about 1-2 mm/yr. is seen near the Wasatch Range, (2) the central core of the Basin and Range with the most obvious physiography is not deforming at any marked rate, probably less than 1 mm/yr. So in some sense, it is acting as a micro plate not unlike the Sierra Nevada–Great Valley microplate; this may help explain why some motion still exits on faults along the Wasatch Range. (3) so that leaves probably 80% or more of the motion to lie within the Walker Lane which straddles the California–Nevada state line, which is where most Nevadans live. This distribution problem is common to Utah as well. So, the process of microplate capture of Baja and now the Sierra Nevada–Great Valley block is focusing strain in our populated regions. Of course, we can have large earthquakes in central and eastern Nevada (i.e., Wells), but the physics of microplate capture suggests at a probabilistic level more strain accumulation happening along the eastern edge of the Sierra Nevada (seen in GPS). Fault distribution within the Walker Lane is a bit more complicated than the Wasatch Range. Rupturing of the microplate is ongoing as evidenced by the recent Sierraville deep swarm just northwest of Lake Tahoe. This sequence helps us better understand the physics of plate motion in our region, rupture and gravitation collapse, and where

we expect to see normal faults, dextral and sinistral faulting, etc. Graham highlighted McQuarrie and Wernicke's animation of plate motion of microplate capture and extension within the Basin and Range. Nevada has had seven M6.5s or larger in the first 54 years of the 20th century, and none since—one heck of a streak. For the next century, it is likely that most of the activity should be west of the Central Nevada Seismic Belt in a statistical sense. Recurrence rates show that Nevada is the third most active state in the nation with a M5 every year or so, a M6 every decade, and three M7 earthquakes every century. Most earthquakes should again be in western Nevada/eastern California. National earthquake maps evolve through time—new faults are found. A lot of changes are seen in the seismic hazard of the Walker Lane over the last decade or so. Lake Tahoe is an example where earlier maps under predicted hazard due to elusive faults that were only recently discovered. Las Vegas is another example of hazard that is likely under predicted. John Louie at NSL, and others at UNLV including Barbara Luke, are also predicting ground motions for scenario earthquakes in Las Vegas and other Nevada cities, in a manner analogous to Kris Pankow's presentation.

SEISMIC VULNERABILITY OF UNREINFORCED MASONRY BUILDINGS

(BARRY WELLIVER)

Both Nevada and Utah have large earthquakes however they are spread out over time, so it leads to the "Rodney Dangerfield effect", with a lack of respect for the Unreinforced Masonry Building (URM) problem. What strategy can we implement together to overcome the URM problem? California's inventory of URMs in the 70s was on-order 25,000 buildings. The number in Utah is closer to 185,000 URM buildings — or the "Oh my heck" response.

The URM buildings in Utah are related to the history of Mormon settlements; starting with dugouts, adobe buildings, Mormon forts, and the like (they didn't require a high level of technical expertise). Early cottonwood-based buildings looked ugly, and Brigham Young preferred more sturdy buildings. Next came the stone buildings, then brick buildings. Mormon houses were the defined type of building.

Various factors influence building performance: design, quality, age/maintenance, material used, and level of shaking. Building codes/practices expect about a 50-year use design before additional work. Building design includes: stiffness, strength (keep building intact) and toughness (ductility). Construction quality can be deceptive: for example, stucco is a great disguise for the evaluation of a URM. URM building materials include masonry and interlocking bricks. Unreinforced buildings can be evaluated by how many stacked bricks wide the building is. With in-plane failures, bed joints are problematic. Stair-step cracks appear when the walls yield and "pull-apart". Roof and floor diaphragms (transfer the weight of walls), and shear walls act as stiffening elements. Foundations require seismic design elements, such as base isolation). Things to worry about are floors and roofs that are at different levels and will move differently in an earthquake. Decorative parapets are susceptible to earthquakes and chimneys too. Gable end walls are problematic, as does the triangle wall near a roof, because they are unsupported elements (e.g., wall separation). Retrofit priorities include: brick chimneys, parapets, anchor walls, etc. Incremental approaches are probably the best strategy for retrofitting URMs. The "bolts-plus" approach to retrofitting is a good strategy, and bracing a chimney is not prohibitively expensive. The publication P774 published by FEMA is a good guideline for the retrofit of URMs.

URM DAMAGE FROM CHRISTCHURCH NEW ZEALAND EARTHQUAKES

(FRED TURNER)

The Earthquake Engineering Research Institute and Pacific Earthquake Engineering Research Center provided much of the research presented in this talk. EERI has now been defunded; how will this type of investigative work be funded in the future? The strike-slip Alpine fault is the "preoccupation fault" of New Zealand, and is some 100 km distant from Christchurch. Seismicity patterns placed risk at a level equivalent to Sacramento, CA. There are stunning alps with nearly twice the Wasatch topography top to bottom, and Canterbury Plain lies to the east. The present day population is near 450,000 people in this region. The first earthquake was a M7.1 thrusting event, 12 km long surface rupture; and there was no geodetic strain measured before the earthquake. The M6.2 aftershock was very deadly, and near the central business district. Fred Turner showed a small core of town in 1877, and a cathedral that was built in 1880. The spire of the cathedral was damaged in 1888 & 1901 from distant earthquakes. The top spire was replaced thereafter with wood. A 0.26 *g* earthquake was recorded at a church; the spire and the church survived the 2010 earthquake, and only minor damage was recorded but, they collapsed in the aftershock. A Magnitude 6.2 aftershock was a "perfect storm" occurring with a rupture toward city center. It was a direct hit. Cavity walls were poor performer, and lime mortar was very weak — things fell apart. Most deaths were from bricks being thrown out toward the street! Variable ground shaking was felt in the city center, and taller buildings fell into shorter ones. You can find pictures on Twitter, and search for an earthquake by name. It's a great resource. Google Street View is also an amazing resource. The aftershock was around Noon, with many people on the streets. Stone buildings performed worse in the aftershock than brick with a few exceptions. The 1st skyscraper was torn down before the M6.2 aftershock, and probably saved lives. Plywood walls flexed, which allowed bricks to pop out on Knox Church's upper triangle, (i.e., Gable wall). Ground motions of the aftershock were 3 times greater than the main shock. There were very few fires after the power was restored. The indirect economic impact due to URM damage was realized. The false sense of security after the 1st M7.1 event was unfortunate. 70% of URM stock was "tagged" after the initial event. Some URMs fell down in aftershock. Parapet retrofit had been in practice since the 1930s, however it was restricted to the front streets, but not to the side streets. Many buildings had retrofits that were done or underway before earthquake series, so it was a great test of the renovations. There was a retrofit plan which was implemented in 1968, and then strengthened in 2004. After the M7.1 earthquake, they implemented 15 to 30 year milestones for the retrofitting of URMs. This was a $20 Billion USD event, or $50K per person in Christchurch, and shake maps do not tell the whole story. Intelligence capabilities about these types of events are still in need of upgrade. Christchurch officials didn't worry about aftershocks, so no "aftershock" static stress transfer event was considered. *Pager* (USGS) underestimated the death toll by 20X. 2/3rds of all fatalities came from two non-ductile concrete buildings (NDCBs). Shear wall buildings didn't work well for lightly reinforced buildings.

Also, there was a lot learned from victim extrication after the earthquakes. The Google "Royal Commission on the Canterbury Earthquake" has provided a lot of information and reports. There were two more earthquakes on June 13th a M5.5, and M6.0. Also, two more large earthquakes, a M5.8 and a M5.9 occurred after the NESC meeting on Dec. 23rd, 2011.

Barricading after the M7.1 earthquake seemed to work well, however stabilization didn't work as well leaving 10,000 buildings beyond repair. Adhesive anchors with repeated motion failed during the earthquakes. Concrete framed buildings seemed to perform well with 29% of significant damage on retrofitted buildings, however, 58% will need to be demolished. In the Western U.S., 1/3rd of significant earthquakes will occur on unknown faults. The expected variation in ground motion will be huge, think in plurals with respect to an earthquake sequence.

— Lunch Break —

NEVADA BUILDING OFFICIALS PRESENTATION

(RON LYNN)

Ron Lynn presented the President's Award to Jonathan Price and Terri Garside for their contributions in support of a safe environment for the citizens of Nevada. Ron also recognized Terri Garside for her tireless support of the Nevada Earthquake Safety Council.

URM SEISMIC REHABILITATION TECHNIQUES

(MEL GREEN)

Mel Green is a structural engineer from the Los Angeles area. Among other topics: cost and phase-in /integration of unreinforced masonry buildings (URMs) were discussed. This is a worldwide problem —damage from a 1927 earthquake in Israel near the Dead Sea was shown. Then the Pakistan earthquake of 2005 was shown; 80,000+ people died in that event. Lime mortar was intended as bedding plane for buildings and not as a bonder. The solution is to mitigate problems toward a positive load path and take a deterministic approach towards mitigation. Which structures fail during earthquakes? Parapets and gables fail and fall outward (out-of-plane failure), and wall stability is a concern with bracing needed for the walls of URMs. Only 1% of URMs actually collapse. More commonly, the parapets of URMs fall into the building as they did during the Santa Cruz–Loma Prieta Earthquake. Sometimes the largest parapets are near door entrances—which is not good for egress during an earthquake, and walls typically fall outward, which is a common theme. If less mortar used near the top of buildings these portions are structurally less sound. What's the priority? Remove/brace parapets first, gable bracing, wall anchors, diagram stiffness, and shear resistant upgrades. There are barriers to seismic retrofitting besides money, such as determining what to do with tenants. That's a real problem. Incremental upgrades are the only path based upon a recent study of Bucharest, Romania. Utah has in place a re-roofing trigger that occurs in the worst seismic zones and requires the building owner to fix parapets, gables, etc. when reroofing occurs. Portland, Oregon requires the building owner to anchor the walls and parapets at the roof-line, and then gives them a 10 year obligation to fix the rest. Incremental opportunities for retrofitting arise everywhere. One can do nothing, or replace the building, or rehabilitate the structure, but incremental upgrades are the most realistic. FEMA has an Incremental Seismic Rehabilitation and Building workbook to encourage incremental upgrades, such as the West Jordan School District, Utah. Seattle schools "stitched in" their upgrade projects. Many other FEMA guideline publications for incremental upgrades exist. Law allows for "baby steps" to retrofitting and any improvement is permissible. Costs are important. These projects may cost in the thousands to the tens of

thousands or more for larger projects. There can be lots of things to retrofit on a URM... For example, wall anchors are about $130 each to place (labor included). However, some tasks are much more expensive. The price becomes less expensive as buildings get larger, so for a 2,500 sq. ft. vs. 10,000 sq. ft. building, the prices goes up from $30K to $47K (for wall anchors and parapets), but doesn't scale with size. Larger buildings become less expensive to retrofit per square foot. There are a number of FEMA publications, including FEMA 154 a rapid visual screening guide from street and alley. Following building codes can reduce the chance of failures, but there are no guarantees. Retail shopping malls are difficult to retrofit, because anchor stores (e.g., Macys) own their own space, but not for the middle stores who are owned by someone else.

IMPLEMENTATION AND INCENTIVES OF URM SEISMIC REHABILITATION (FRED TURNER)

Which incentives worked in California and which haven't? What is the common theme? We are all flirting with disaster, but how do we engage it? Establishing relationships, building a consensus, being patient, and expecting a multi-decadal process are keys to gauge success. Strategies include having the public personalize the dangers to their own building and asking them to think about what may or may not happen during an earthquake; whether they're at school, a shopping mall, at their workplace, etc. Take steps to reduce future earthquake losses. Don't assume that the government is going to bail you out after an earthquake; work towards a market driven approach to retrofitting however difficult that may be. Shine a light on those who have succeeded in their efforts. California doesn't have its act together with regards to seismic retrofitting as much as outsiders perceive. In 1927 California published its first unreinforced masonry building (URM) code, but it wasn't implemented. California is on their second generation of retrofits which mainly consists of public schools. Again, shine the light on the successes not the failures. In 1986, California enacted its first URM law after nearly a century of incremental gains. It's important to establish metrics for retrofitting. Loss of life due to earthquakes is going down per capita, while property cost per capita for earthquakes goes up. This skew may result from unusually low loss earthquakes (i.e., Loma Prieta and Northridge) and the lack of an event like the southern San Andreas. Various tiers are related to property value. The top tiers are the best performers, the middle tier have no revenue stream, and the bottom tier should be demolished and replaced without retrofit. Retrofitting a building is only good for one shake, and then the building needs to be torn down. Financial incentives include: tax incentives, fee waivers, grants, special assessments, and easy loans, etc. This strategy is best implemented at the local level. Its best implemented to date in well-to-do neighborhoods, but poorer areas seem to under-perform. Redevelopment may be best in these regions but there's a need for an economic engine. 87% of URMs are already in mandatory strengthening programs in California. With respect to voluntary programs: we need to ask what degree of incentives is needed to change thinking? The fear of liability may drive retrofitting but that's not the case so far. The "Acorn Building" in the San Simeon earthquake resulted in the death of two people who ran outside (key point: stay inside) and were killed from the façade, falling, but the main point has to do with litigation. Common Law owners are also liable, for example the "old woman's" defense

to a law suit. Her husband was negligent, and she was unaware of the need to retrofit their building, but it didn't matter - she's also liable.

POTENTIAL URMS IN NEVADA

(JON PRICE)

Jon's PowerPoint presentation on potential URMs in Nevada is posted online at http://www.nbmg.unr.edu/Geohazards/Earthquakes/Presentations/Potential_URMs_in_Nevada_9Nov2011_NESC.pdf. He described an active project that is near completion to make a first cut evaluation of URMs in Nevada. Wayne Carlson has helped greatly in this endeavor; he worked with County Assessor offices to identify potential structures. Gary Johnson, geographic information system (GIS) specialist with NBMG, added information from the State Public Works Division, located the buildings geographically, and produced graphics and statistics from the data. Background: the URM problem is statewide; therefore a statewide inventory is required. The project is addressing the question: What's the order of magnitude of Nevada's exposure to losses from the failure of URMs during earthquakes? A "Wells-size" earthquake can happen anywhere in Nevada; using the U.S. Geological Survey's probabilistic seismic hazard analysis, the probability of a M6.0 is about the same for Wells and Las Vegas! Substantial risk occurs throughout the state. There are certainly tens of thousands of URMs in Nevada. The approach of the project has been to use the County Assessors' databases to identify as potential URMs those buildings built before 1974 with brick, stone, or masonry structures. On the basis of knowledge about specific communities, we know that some URMs were missed in this approach, and some identified buildings are probably not actually URMs. Nonetheless, this is a good first estimate. NBMG will publish a report summarizing the project. The strategy is to send a draft of the report to the counties for their review prior to publication, so that they will be aware of the content, have an opportunity to comment, particularly regarding disclaimers about the accuracy of the estimated numbers and locations of potential URMs, and be ready for follow-up and ultimately ground truth to check for actual URMs. The total number of potential URMs throughout the state is approximately 24,000, including 7,354 residential, 16,145 commercial and public (city, county, and school district), and 98 state owned buildings. Preliminary results are posted on the web at: gisweb.unr.edu/URM_project in a user-friendly interface that is similar to the fault database constructed by Craig dePolo and Gary Johnson (available at http://www.nbmg.unr.edu/Pubs/of/of09-9/index.html). One can view the locations of potential URMs on a base map of aerial photos, topographic maps, or street maps. The number of potential URMs in Clark County is about 14,359, with about one-third as many (5,788) in Washoe County.

Many URMs are older than 50 years; mortar is aging and deteriorating. Craig dePolo noted a 5-story apartment building in Reno that has X fractures (characteristic of earthquake damage). He stated that 1 in 3 URMs in Reno seem to be damaged, perhaps from a1914 earthquake. UNR has about a dozen potential URMs; two of which are dormitories. Using the web interface, one can click on a building location and get information from County Assessors' databases.

72 of the 98 of state owned buildings are in Carson City. Winnemucca is particularity bad. URMs are nearly everywhere in the older part of town; many are historical. In general, URMs are in business districts and along main thoroughfares in most Nevada towns.

The main conclusions from the project are that there are tens of thousands of URMs in Nevada; they occur in every county; many are historical (which means there would be pressure to retrofit rather than demolish the buildings), and many are concentrated in downtown regions (which means there may be economic pressures to delay mitigation).

The group discussed what to do next. Ron Lynn highlighted the need to vet the database, but it is a good start. It was noted that the Western States Seismic Policy Council, in its Policy Recommendation 11-4, notes "Unreinforced masonry bearing-wall structures represent one of the greatest life safety threats and economic burdens to the public during a damaging earthquake. 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 that will effectively address the reduction of this risk." The NBMG project and report is a first step in identifying the extent of the risks. Follow up is needed to unambiguously identify URMs. Funds from FEMA's hazard-mitigation assistance programs can be used, particularly for retrofitting high-occupancy public buildings. Communities and the State can set priorities for mitigating URMs in their hazard-mitigation plans.

URMS IN UTAH

(BOB CAREY)

Nondisclosure of hazards to potential buyers in Utah is disallowed. Utah state government spends money to rehabilitate public buildings, and some flooding projects as well. HAZUS has driven Utah's need to understand and respond to hazards. Early HAZUS estimates were around twelve billion dollars in damages. Introduced geoscience, which doubled this amount, and it doubled again with assessor's database; this example shows that better data drives up estimates, not down. The first inventory estimated 65,000 unreinforced masonry buildings (URMs). A 2003/2004 estimate pulled that same number in Salt Lake County alone. There are 386 K-12 buildings included in that inventory. So, they tried to go to Legislature, and they tried to prioritize, make changes in building codes, and tried to count public schools statewide including elementary, middle and high schools. Elementary schools were mostly likely to be a URM. 60% of them failed the rapid rover, initial visualization test. 128 schools are at risk mostly elementary schools. There was a 5:1 non-structural vs. structural damages in HAZUS. 2637 buildings checked on the ground. A FEMA Rover tool was used. A lot of 3-4 story apartment buildings in downtown, Salt Lake City. However, in smaller communities, 75% of URMs are commercial. So, in a disaster the economy may be wiped out; Ogden is a poster child of URMs. A M6.5 scenario for Ogden, Utah would require more than 600 inspectors to finish in one month! The Sugarhouse area is also problematic with its 1940s and 1950s construction. An earthquake scenario in Salt Lake City may result in 63,552 red-tagged buildings. Estimated causalities for a M7 earthquake may hit near 2,451deaths and 31,425 injured (in one event: nine counties or 80% of the state's population may be affected). The high inventory of brick buildings may historically be related in part to Mormons being burned out of their homes back east before migrating westward.

JOINT URM STATEMENT OF COUNCILS

(RON LYNN, ROGER EVANS)

Chairman Lynn began the discussion by asking everyone in attendance to give suggestions for drafting a joint statement from both councils about un-reinforced masonry buildings (URMs). There was much discussion about how to reach the general public about this concern. Chairman Lynn urged the Utah delegation to use the joint statement of the councils as a basis for introducing URM legislation urging lawmakers to at a minimum provide retrofits to public schools. He suggested that if Utah were able to pass such legislation, that Nevada wouldn't be far behind.

The general discussion from both groups was that elementary schools are usually the older buildings, and are more likely to need be retrofitted than middle school or high schools. Also, elementary schools are much more likely to gain support from voters for a retrofit. There were also suggestions made that schools could use the risk of URMs as a class project teaching the children about the dangers of such construction, and how to best handle being in an earthquake in such a building.

Ultimately, the discussion about the joint statement was postponed for future discussion. The item will be added to the February 8th meeting of the NESC.

FUTURE DIRECTIONS, DISCUSSION, PRIORITIES, AND ACTION ITEMS

There was no discussion or action on these items

CLOSING STATEMENT FROM THE CHAIRMEN, AND FEMA

There was no discussion or action on these items.

PUBLIC COMMENT

There were no comments from the public.

The meeting adjourned at approximately 4:00 p.m.

Respectfully submitted by Graham Kent, January 11, 2012
Nevada Earthquake Safety Council
c/o Nevada Seismological Laboratory
University of Nevada, Reno/MS0174
Reno, Nevada 89775-0174
775-784-4975

FUTURE NESC MEETINGS ARE SCHEDULED AS FOLLOWS:

Wednesday, 8 February 2012, in Reno
Wednesday, 9 May 2012, in Las Vegas
Wednesday, 8 August 2012, in Reno
Wednesday, 14 November 2012, in Las Vegas.

NEVADA EARTHQUAKE SAFETY COUNCIL

Members of the Board of Directors and Officers
(as of 9 November 2011)

Business and Industry, Southern Nevada	Steve Koenig Bellagio Resorts
Business and Industry, Northern Nevada	Jess Traver Builders Association of Northern Nevada
Insurance Industry (statewide)	vacant
State Government (statewide)	Jim Walker Nevada Department of Transportation
Local Government, City	Wayne Carlson Nevada Public Agency Insurance Pool (Carson City)
Local Government, County	Joe Curtis Storey County Emergency Management
Seismology (statewide)	Graham Kent Nevada Seismological Laboratory (UNR)
Geosciences, Southern Nevada	Woody Savage U.S. Geological Survey (retired)
Geosciences, Northern Nevada	Jonathan G. Price Nevada Bureau of Mines and Geology
Engineering, Southern Nevada	Jim Werle Converse Consultants (Las Vegas)
Engineering, Northern Nevada	Mike Blakely Structural Engineers Association of NV
Education (statewide)	Jenelle Hopkins Clark County School District, Las Vegas
Community Organizations, Southern Nevada	Jeffrey Brewer American Red Cross
Community Organizations, Northern Nevada	Jim Reagan Sierra Pacific Power Company
University, Southern Nevada	Wanda Taylor UNLV Geoscience Department
University, Northern Nevada	Ian Buckle UNR Center for Civil Engineering Earthquake Research
Building Official, Southern Nevada	Ronald L. Lynn Clark County Department of Development Services
Building Official, Northern Nevada	Alan Bennett City of Reno
State Senate	vacant Nevada State Senator
State Assembly	vacant

		Nevada State Assemblyman or Assemblywoman
Member at Large, Southern Nevada	Jim O'Donnell	UNLV
Member at Large, Northern Nevada	Eric Hubbard	Geological consultant, Reno

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