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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 2006

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 2006. 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

- The State is setting up a "Newton Network" with one science contact in each school within the State.
- An educational seismometer has been set up at Red Rock BLM Recreation Area, next to the weather station. It has recorded several small earthquakes (magnitude 1 and 2). Data from this instrument can be viewed on line through the Incorporated Research Institutions for Seismology (IRIS) Web site.
- A Governor's proclamation for Earthquake Awareness Week was made and put on the Web site.
- The pamphlet on *Earthquakes in Nevada and How to Survive Them* has been updated.
- Committee members conducted several activities for Earthquake Awareness Week in southern Nevada. A public service announcement was created, and there were a number of press articles. Committee members manned an earthquake booth at the three-day Cashman Home Improvement fair, and are working with the Clark County Parks and Recreation Department on activities for children at their summercamps.
- The committee is trying to get the schools to do an earthquake drill in 2007. They plan to use Newton's Newsletter to get the word to at least one school teacher in each school in Nevada.
- Committee members spoke about the Nevada On-Line Encyclopedia, which is looking for articles on Nevada; she is looking for help to create entries regarding earthquake hazards. She will contact the education and outreach specialist with the Nevada Bureau of Mines and Geology, who has worked on the encyclopedia to create some entries related to geology and mining.

RESEARCH & INFORMATION COMMITTEE

- Discussed the need for a second conference on seismic hazards in Las Vegas Valley. The last conference was in 1996, with proceedings published by the Nevada Bureau of Mines and Geology. Sessions were held as part of the annual meeting of the Association of Engineering Geologists (AEG) in Las Vegas. Lawrence Livermore National Laboratory has volunteered to support such a workshop.
- It was noted that there will be two meetings this spring to solicit input for the next update of the U.S. Geological Survey's probabilistic seismic hazard analysis (PSHA). This PSHA is what feeds into the National Earthquake Hazards Reduction Program (NEHRP) maps, which, in turn, are adopted in seismic provisions for building codes.

RESEARCH & INFORMATION COMMITTEE *(Continued)*

- It is difficult to get permits from BLM for trenching studies. These require National Environmental Policy Act (NEPA) documents.
- Scott Ball, who chairs the local section of the Association of Environmental and Engineering Geologists, reported on the fissure preserve on the east side of the North Las Vegas Airport. The Department of Aviation has set aside and fenced off this area to allow for research and clean up.
- The April workshop on seismic hazards in the Basin and Range Province was held in Salt Lake City; several recommendations from that workshop will be presented to the U.S. Geological Survey (USGS) as part of its updating of probabilistic seismic hazard maps.
- Several proposals to the USGS's external grants solicitation for the National Earthquake Hazards Reduction Program (NEHRP) have been submitted for studies in Nevada.
- A Nevada Quaternary Fault Working Group is being formed to come to consensus on parameters for faults that could cause earthquakes and make recommendations to the USGS on which faults need further study.
- The Applied Technology Council (ATC) 20 workshop on *Post-Earthquake Safety Evaluation of Buildings* was held at the Sierra Pacific offices in Reno on April 20, with approximately 90 attendees, many from the local building departments. These are the inspectors who would participate after an earthquake. The northern Nevada ICC chapter helped to attract attendance. Hospitals, UNR, the State Public Works Board, and other agencies also participated. It was noted that there recently were two ATC-20 workshops in southern Nevada. The two ATC-20 workshops in southern Nevada were attended by 145 and 130 persons respectively. The southern Nevada chapter of ICC co-sponsored those workshops.
- Copies of FEMA 460, a publication on "Seismic Considerations for Steel Storage Racks Located in Areas Accessible to the Public," FEMA 389 ("Primer for Design Professionals, Communicating with Owners and Managers of New Buildings on Earthquake Risk") and FEMA's publication IS-22 ("Are You Ready? An In-Depth Guide to Citizen Preparedness") were distributed to meeting attendees.
- NBMG geologists are working with the USGS to update information on active faults in Nevada. Ones that have average recurrence intervals on the order of once every 3,000 to 6,000 years (or more frequently) are considered in the USGS probabilistic seismic hazard analysis. This criterion eliminates all but 16 to 20 of the 250 to 300 active faults in Nevada.

POLICY COMMITTEE

- Committee Chair reported on recent discussions within the insurance industry. He described the term "critical catastrophe" for certain earthquakes and wind storms. Nevada is categorized as just under the highest level of risk. He explained that the insurance market generally shrinks its capacity and raises its prices after major events.
- The Legislative Counsel Bureau doesn't release pending bills until July 1. There will be bills regarding housing and highway infrastructure. The Legislature anticipates that the State will be about $600 million ahead on its budget. Nevada Assemblyman Bernie Anderson stated that he welcomes ideas for legislation from the Council. In response to Wayne Carlson's question whether there may be one-shot funding for non-structural earthquake mitigation efforts, Bernie replied that such efforts might best be accomplished under an all-hazard umbrella.
- "WSSPC strongly encourages the development of long-term, comprehensive statewide and community-level earthquake risk-reduction strategies as part of an all-hazards plan to reduce injury, loss of life, property damage and economic disruption from earthquakes. WSSPC believes comprehensive statewide and local plans and strategies should include the following elements:
  - Assessment of all seismic hazards to quantify and define the risks to communities
  - Implementation of land-use and development policies to reduce exposure to earthquake hazards
  - Adoption and enforcement of the International Building Code for the seismic design, inspection, and construction of new buildings and structures

- Adoption of the International Existing Building Code for the maintenance and retrofit of seismically "at risk" structures
- Development and implementation of retrofit, redevelopment, grant, and abatement programs to help strengthen existing structures, where necessary
- Support of [ongoing] public-education efforts and public/private partnerships to raise awareness of seismically induced threats and build constituent support for earthquake hazard reduction programs

- There is a bill draft request for the Nevada Legislature regarding seismic issues (Bill Draft Request 716), but the details will not be released until the legislative session begins. The NESC may want to follow WSSPC's lead in developing a rigorous process for the adoption of policy-recommendations.

SCIENTIFIC AND INFORMATIONAL PRESENTATIONS

LOSS-ESTIMATION MODELING OF EARTHQUAKE SCENARIOS FOR EACH COUNTY IN NEVADA USING HAZUS-MH

- Jon Price gave a PowerPoint presentation about the newly released report from the Nevada Bureau of Mines and Geology, in which the authors (Ron Hess and Craig dePolo) used FEMA's loss-estimation model, HAZUS-MH, to estimate the effects of potential earthquakes near each of the county seats in Nevada. The report and PowerPoint presentation are available on line at the Earthquakes page on NBMG's Web site (www.nbmg.unr.edu).

AD HOC COMMITTEE ON ROCKERY WALLS

- Werner Hellmer moved that the NESC endorse the "Rockey Wall Construction Nevada Standard Guidelines, dated April 15, 2005." Ron Lynn noted that the guidelines have already been adopted by the Clark County Building Department and the Southern Nevada Building Officials. "Rockery walls are not engineered structures. Construction is a craft depending on the skill and experience of the builder. Their performance is therefore unpredictable. This document is not a standard, specification, or code. It is instead a set of recommendations that may be useful in the design and construction of such walls. However it must be understood that following these recommendations will not necessarily assure their satisfactory performance or prevent their collapse during an earthquake."

AD HOC COMMITTEE ON THE 1906 SAN FRANCISCO EARTHQUAKE

- Craig dePolo discussed the effects to and response from Nevada to the great 1906 San Francisco earthquake. He and Phillip Earl of the Nevada Historical Society are co-authoring a presentation during the centennial celebration of the earthquake (moment magnitude 7.9). In 1908, Professor George D. Louderback, Professor of the Mackay School of Mines at the University of Nevada, reported on the shaking effects in Nevada, mostly within 30 miles of the east side of the Sierra Nevada. There was minor damage to the metal conduit for lights along the Virginia Street bridge in Reno. It appears that there were several local earthquakes in Nevada on April 19 that may have been triggered by the April 18, 1906 San Francisco earthquake.
- Many mining companies were headquartered in San Francisco at that time, and most Nevadans knew people who lived in San Francisco at the time of the earthquake. Over $38,357.50 was reported collected by Nevada communities for San Francisco disaster relief. Reno, Lovelock, and Winnemucca fed and clothed refugees traveling east on the railroad. Nevada donated tons of clothes, bread, beef, potatoes, blankets, and coffee. Displaced men were given jobs on the Western Pacific Railroad and in mines in Nevada. Refugees stayed in Reno, Carson City, Virginia City, Gold Hill, and Silver City.
- Lessons learned for Nevada include:
    - Nevada is subject to long-period ground motion from distant earthquakes (such as a repeat of the 1906 earthquake on the San Andreas Fault or earthquakes in the Cascadia region of the Pacific Northwest).
    - The 1906 earthquake is a classic case for rebuilding a city after an earthquake; considerable planning went into rebuilding.

- There are significant response issues between regions and states.
- There may be triggered earthquakes in Nevada from large events in other states, particularly California. In the years following the event (perhaps even including the large earthquakes in Nevada in 1954) people had a heightened awareness of shaking and fire potential that could be caused by earthquake.

THE LAS VEGAS VALLEY FAULT SYSTEM

- A presentation on the Las Vegas Valley fault system was presented at the September 2005 Association of Environmental and Engineering Geologists meeting. There has been controversy over the years about the origin of scarps within Las Vegas Valley. The study drew them a conclusion that the faults in the valley are latest Quaternary tectonic faults. The Eglington scarp is up to 50 feet (15 meters) high. Other faults include the Decatur, Valley View, Cashman Field, and Whitney Mesa faults. Evidence for the faults as tectonic (rather than compaction) features includes:
  - Faulted bedrock; that is, sub-basin bedrock fault offsets below fault scarps (200 meters in the case of the Eglington scarp)
  - Control of Quaternary sedimentation along the faults
  - Similarity in fault orientations with regional faults
  - Tilted panels between faults and intra-strike distances
  - Bifurcating fault patterns (perhaps suggesting northward propagating events)
  - Consistency of fault orientations with active tectonics (favorably oriented with respect to regional NW-SE extension).
- Further evidence that earthquakes have occurred on these faults includes:
  - Rapid paleo-surface offsets in potentially ductile deposits exposed in excavations
  - Colluvial deposits on paleo-fault scarps
  - Possible lateral ruptures.

UPDATE ON RECENT EARTHQUAKES

- 2005 had one of the lowest rates of earthquakes in recorded history in terms of earthquakes of magnitude 4 and larger (only 2 in 2005, tied for the record lows in 1989 and 1946).
- The two magnitude 4 earthquakes in Nevada in 2005 were in relatively populated areas (one near the north end of Lake Tahoe and one east of Carson City). Although many magnitude 4 earthquakes in remote areas go unnoticed by people, these two events were felt by many local residents.

INVITATION TO JOIN WSSPC AS A VOTING MEMBER.

- The Council unanimously approved a motion for the Nevada Earthquake Safety Council to join the Western States Seismic Policy Council as a voting member. The NESC Council chair, or his/her designee, will be the representative to WSSPC.

100TH ANNIVERSARY CONFERENCE OF THE 1906 SAN FRANCISCO EARTHQUAKE

- John Anderson described and displayed posters of several of the presentations that scientists from the Nevada Seismological Laboratory made at the 100th Anniversary Earthquake Conference Commemorating the San Francisco Earthquake. The Laboratory has done much cutting-edge research on the forces needed to topple objects during earthquakes (such as precariously balanced boulders on the side of a cliff or tombstones in graveyards). This research could be applied to studies of how likely slot machines are to fall over during an earthquake.
- Also discussed was a list of "Earthquake Professionals' Top Ten Actions for Northern California," which was presented at the 100th Anniversary conference. These include:

Develop a Culture of Preparedness

1. Every household, government agency, and business must know the seismic risks of the buildings they occupy, the transportation systems they use, and the utilities that serve them, as well as the actions they can take to protect themselves.
2. Every household, government agency, and business needs to be prepared to be self-sufficient for at least three days (72 hours) following a disaster.
3. Citizens and governments need to take steps to ensure adequate response care for special needs and vulnerable populations.
4. Government agencies, the region's major industries, and earthquake professionals have to work together to prepare the region to respond to and recover from major earthquakes. This can be done through region-wide, multi-organizational plans, training, exercises and coordination assessments, as well as continuing improvements in our collective understanding of seismic risks.

Invest in Reducing Losses

5. Building owners, governments, and the earth science and engineering professionals must target potential collapse-hazard buildings for seismic mitigation, through retrofit, reduced occupancy, or reconstruction.
6. Governments and other relevant agencies must retrofit or replace all facilities essential for emergency response to ensure that they function following earthquakes. These facilities include fire and police stations, emergency communications centers, medical facilities, schools, shelters, and other community-serving facilities.
7. Governments and other relevant agencies must set priorities and retrofit or replace vulnerable response- and community-serving infrastructure, including cellular communications, airports, ports, roads and bridges, transportation, water, dams and levees, sewage and energy supplies, to ensure that functions can be resumed rapidly after earthquakes.

Ensure Resiliency in Recovery

8. Government agencies, the region's major industries, and earthquake professionals have to plan collaboratively for the housing, both short- and long-term, of residents displaced by potential fires, large numbers of uninhabitable buildings, and widespread economic and infrastructure disruption following a major earthquake.
9. Every household, government agency, and business has to assess and plan for financing the likely repair and recovery costs following a major earthquake.
10. Federal, state, local governments, the insurance industry, and the region's major industries have to collaborate to ensure adequate post-event funding to provide economic relief to individuals and communities after a major earthquake, when resources are most scarce yet crucial for recovery and reconstruction.

UPDATE ON THE EARTHQUAKE ENGINEERING LABORATORY

- Ian Buckle, Director of the Center for Civil Engineering Earthquake Research, and staff members, discussed earthquake engineering at the University of Nevada, Reno, and led a tour of their laboratory. He stressed that life safety is the principal objective of building codes. There is some success in meeting this objective in the United States, economic losses from earthquakes in the US are enormous. Ian described research on design of seismic elements for bridges (including the new bridge across San Francisco Bay), shake tables that simulate earthquake motions, and the National Science Foundation's George E. Brown Jr. Network Earthquake Engineering Simulation (NEES) network, of which UNR is a part.

THE EARTH AS A CLASSROOM (TEAC) 2006 TEACHER'S PROGRAM

- Ken Smith described the collaborative program between the Nevada Seismological Laboratory and the UNR College of Education. Jacque Ewing-Taylor from the College of Education's Raggio Research Center for Science-Technology-Engineering-Math (STEM) explained that the program has been running for a few years. It begins with a Saturday in the spring followed by another Saturday and six days in the field in the summer. The science content provided by Ken includes tectonics of the Sierra Nevada and western Nevada and earthquake hazards in the region. Teachers are required to write a report based on their experience. Ken and Jacque feel that the teachers learn much with this intensive course. They do a pre-post test on content. The teachers scored a low of 2 and a high of 28 from a total of 40 on the pretest but 22 to 38 on the post-course test.

THE EARTH AS A CLASSROOM (TEAC) 2006 TEACHER'S PROGRAM *(Continued)*

- Ken described the program in 2006. Day 1 started in Reno and investigated the Mohawk Valley fault. Days 2 and 3 focused on the geology of Lake Tahoe; Day 4 hit the Fairview Peak fault and 1954 earthquake. Days 5 and 6 visited more faults in the Walker Lane portion of Basin and Range and ended in the Long Valley caldera near Mammoth Mountain, California. Funding for the program comes from the federal Department of Education.

DISCUSSION OF PROPOSALS FOR POSSIBLE YEAR-END FUNDING

- The Council considered three proposals for use of possible year-end funding available from FEMA or the Department of Homeland Security through the Division of Emergency Management. These proposals had been submitted to and reviewed by either the Education Committee or the Research Committee. The Council voted by secret ballot on priorities for funding as follows (with 1 being the highest priority):
  1. Earthquakes in Nevada Public Awareness Program ($13,186 in FEMA/DEM funds), from UNLV (Gaye Cote)
  2. Quaternary Fault Map of Nevada ($11,350 in FEMA/DEM funds), from UNR/NBMG (Craig dePolo)
  3. Three-Dimensional Ground-Motion Modeling for Nevada Urban Areas ($20,000 in FEMA/DEM funds), from UNR/NSL (John Louie)

DISCUSSION OF A JOINT MEETING WITH THE UTAH SEISMIC SAFETY COMMISSION AND THE NESC

The Utah commission has invited NESC to a joint meeting, perhaps in Zion National Park. One option for dates is May 10-11, 2007, immediately following the May 7-9 meeting of the Rocky Mountain Section of the Geological Society of America in St. George, Utah.

EFFECTIVE EARTHQUAKE RISK MITIGATION:
PART 1 – WHY WE UNDER-PREPARE FOR HAZARDS

- Craig dePolo gave a presentation on this topic. Even in San Francisco Bay Area, where about 70% of the population recognizes the earthquake threat, only about 20% feel that they are prepared for an earthquake. In his research into this topic, drawing heavily on a 2006 article by Meyer, he found two primary answers: (1) people's lives are too busy, and (2) human cognitive behavior confounds learning, decisions, and actions regarding mitigation for major hazards, for which repetitions are few and far between.
- There are innate human tendencies (biases) toward (a) learning by focusing on short-term feedback, (b) seeing the future as a simple extrapolation of the present, and (c) overly discounting the value of ambiguous future rewards compared to short-term costs. To overcome these problems, four conclusions are:
  - (1) Be sensitive to biases when interacting with people. Avoid language that might invoke a bias in a majority of people. Recognize when people are engaging in a "bad: bias.
  - (2) Add reasoning, language, arguments, graphics, etc. to help people get past thresholds to mitigation invoked by the largest biases. Tell people in a friendly way biases to avoid and why.
  - (3) Develop mitigation strategies that are consistent with people's busy lives and are perceived to enrich people's lives. Create or use opportunities to help people mitigate. Make mitigation easy.
  - (4) Be proactive following events that are counter-motivational for earthquake risk mitigation; maintain mitigation momentum.

In summary, the Nevada Earthquake Safety Council has provided a successful venue for science, research, and information on Nevada's Earthquake Hazards to be promulgated in legislature, provided to business and industry, and delivered to the citizens of Nevada. Additional information and details of these accomplishments are noted in the minutes of the quarterly meetings. The many contributors to this outstanding effort are recognized in the minutes, and it is important to note that it does indeed take many contributors, individually and in concert with one or more committees, to achieve the goal of Earthquake Safety in Nevada.