WESTERN STATES SEISMIC POLICY COUNCIL

2008 Annual Report

Western States Seismic Policy Council

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Western States Seismic Policy Council
2008 Annual Report

FINAL TECHNICAL REPORT

AWARD No. G09AP00032

2008 WSSPC Annual Report

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The photos on the cover are of buildings damaged in by the February 21, 2008, M6.0 Wells, Nevada earthquake. The photo on the right was taken by Craig DePolo, Research Geologist, Nevada Bureau of Mines and Geology and the photo on the left was taken by Jayne Bormann, Graduate Student, University of Nevada, Reno.

Acknowledgments

This report summarizes the activities of the Western States Seismic Policy Council and its member agencies in 2008.

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Our Affiliate members help defray the costs not covered by these federal agencies. We are grateful for their support. WSSPC Affiliate members in 2008 are:

- California Earthquake Authority
- City & County of San Francisco, Department of Building Inspection
- Clark County Nevada Development Services Building Division
- Degenkolb Engineers, Inc.
- Earthquake Engineering Research Institute (EERI)
- Garner Environmental Services, Inc.
- Kim Torp-Peterson, LLC
- Worksafe Technologies

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2008 WSSPC Members and Affiliate Members

WSSPC Members

Alaska
Alaska Division of Homeland Security and Emergency Management
Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys
Alaska Seismic Hazards Safety Commission

American Samoa
Territorial Emergency Management Coordinating Office

Arizona
Arizona Division of Emergency Management
Arizona Geological Survey

British Columbia
Provincial Emergency Program, Emergency Management British Columbia
British Columbia Geological Survey

California
Governor's Office of Emergency Services
California Geological Survey
State of California Alfred E. Alquist Seismic Safety Commission

Colorado
Colorado Division of Emergency Management
Colorado Geological Survey
Colorado Earthquake Hazard Mitigation Council

Guam
Guam Homeland Security & Office of Civil Defense

Hawaii
Hawaii State Civil Defense
Hawaii State Earthquake Advisory Committee

Idaho
Idaho Bureau of Homeland Security
Idaho Geological Survey

Montana
Montana Disaster and Emergency Services Division
Montana Bureau of Mines and Geology

Nevada
Nevada Division of Emergency Management
Nevada Bureau of Mines and Geology
Nevada Earthquake Safety Council

New Mexico
New Mexico Department of Homeland Security & Emergency Management
New Mexico Bureau of Geology and Mineral Resources

Commonwealth of Northern Mariana Islands
Marianas Office of the Governor, Emergency Management Office

Oregon
Oregon Emergency Management
Oregon Department of Geology & Mineral Industries
Oregon Seismic Safety Policy Advisory Commission

Utah
Utah Division of Homeland Security
Utah Geological Survey
Utah Seismic Safety Commission

Washington
Washington Military Department, Emergency Management Division
Washington State Department of Natural Resources, Geology and Earth Resources Division

Wyoming
Wyoming Office of Homeland Security
Wyoming State Geological Survey

Yukon
Yukon Emergency Measures Organization
Yukon Geological Survey

WSSPC Affiliate Members

Corporate Members
Degenkolb Engineers, Inc.
Garner Environmental Services, Inc.
Kim Torp-Peterson, LLC
WorkSafe Technologies

Local Government/Department of Local Government Members
California Earthquake Authority
City & County of San Francisco, Department of Building Inspection
Clark County (Nevada) Development Services Building Division

Non-Profit Organization Members
Earthquake Engineering Research Institute (EERI)

2008 WSSPC Financial Documents

1……..Preliminary WSSPC FY07-08 Income & Expense
December 2007 through November 2008

2……..FEMA Grant 2007 Final Income and Expense
August 2007 through December 2008

3……..FEMA Grant 2008
August through November 2008

January 2009 edition
Accrual Basis

Western States Seismic Policy Council
Preliminary WSSPC FY07-08 Income & Expense
December 2007 through November 2008

	Dec '07 - Nov '08
Income	
401.0 · Interest Inc	
401.1 · Money Mkt Interest Income	77.69
401.2 · CD Interest Income	199.49
Total 401.0 · Interest Inc	277.18
410.0 · Membership Dues	2,550.00
420.0 · Conf Registration Fees	
428.1 · 2008 Conference Income	20,416.34
Total 420.0 · Conf Registration Fees	20,416.34
450.0 · Grants Earned	
460.0 · FEMA Grants Earned	
460.3 · 2007 FEMA Grants Earned	124,919.21
460.4 · 2008 FEMA Grants Earned	60,079.57
Total 460.0 · FEMA Grants Earned	184,998.78
Total 450.0 · Grants Earned	184,998.78
Total Income	208,242.30
Expense	
160.1 · Computer Assets	789.44
170.1 · Software Assets	2,254.88
500.0 · P/R Expenses	
500.1 · Salary	101,524.10
500.2 · Benefits	
500.7 · Employer IRA Contribution	
500.701 · Sutch IRA Employer Contribution	2,269.00
Total 500.7 · Employer IRA Contribution	2,269.00
500.2 · Benefits - Other	5,549.59
Total 500.2 · Benefits	7,818.59
500.3 · Employer Contrib/Taxes	9,489.79
500.4 · Workers' Comp	1,974.35
500.5 · Payroll Service	4,055.00
500.6 · Job Search	25.00
Total 500.0 · P/R Expenses	124,886.83
506.0 · Prof Fees Accounting	7,600.00
509.0 · Prof Fees Other	1,900.00
510.0 · Office Supplies	2,451.43
515.0 · Telephone	1,975.04
520.0 · Printing	490.30
522.0 · Postage and Delivery	1,016.83
525.0 · Internet Services	2,018.26
530.0 · Staff Expenses	
530.1 · Staff Meals	285.19
530.2 · Staff Mileage	116.94

Western States Seismic Policy Council
Preliminary WSSPC FY07-08 Income & Expense
December 2007 through November 2008

	Dec '07 - Nov '08
530.3 · Staff Transportation	970.44
530.4 · Staff Hotel	1,025.03
530.6 · Staff Meetings	410.00
Total 530.0 · Staff Expenses	2,807.60
535.0 · Executive Committee Expense	
535.1 · Meals Exec Comm	1,017.33
535.2 · Mileage Exec Comm	114.70
535.3 · Transportation Exec Comm	5,501.63
535.4 · Hotel Exec Comm	3,415.30
Total 535.0 · Executive Committee Expense	10,048.96
553.0 · 2007 WSSPC-ICC Annual Conf Reno	
553.5 · AC 07 Meeting Costs	0.00
Total 553.0 · 2007 WSSPC-ICC Annual Conf Reno	0.00
554.0 · Conferences	
554.1 · 2008 NEC Seattle	2,153.83
Total 554.0 · Conferences	2,153.83
570.0 · Insurance	
570.1 · Liability Insurance	1,004.00
570.3 · Insurance Other	-164.74
Total 570.0 · Insurance	839.26
575.0 · Rent	18,624.00
580.0 · Bank Service Charges	567.10
581.0 · Equipment Rental	
581.3 · Postage meter	102.84
581.5 · Copier Maintenance	720.48
Total 581.0 · Equipment Rental	823.32
583.0 · Miscellaneous Expenses	0.00
590.0 · Property Taxes	66.97
591.0 · Licenses and Permits	285.00
Total Expense	181,599.05
Net Ordinary Income	26,643.25

Accrual Basis

FEMA Grant 2007
Final Income and Expense
August 2007 through December 2008

	Aug '07 - Dec '08	Re-Programmed Budget*
Income		
450.0 · Grants Earned		
460.0 · FEMA Grants Earned		
460.3 · 2007 FEMA Grants Earned	200,000.00	
Total 460.0 · FEMA Grants Earned	200,000.00	
Total 450.0 · Grants Earned	200,000.00	
Total Income	200,000.00	200,000.00
Expense		
Total 170.1 · Software Assets	1,737.41	0.00
500.0 · P/R Expenses		
500.1 · Salary	96,334.02	99,573.00
500.2 · Benefits		
500.7 · Employer IRA Contribution		
500.701 · Sutch IRA Employer Contribution	2,350.28	
Total 500.7 · Employer IRA Contribution	2,350.28	2,207.19
500.2 · Benefits - Other	5,237.14	10,262.04
Total 500.2 · Benefits	7,587.42	12,469.23
500.3 · Employer Contrib/Taxes	9,055.74	10,139.36
500.4 · Workers' Comp	1,875.02	2,091.12
500.5 · Payroll Service	3,970.00	4,080.00
500.6 · Job Search	25.00	0.00
Total 500.0 · P/R Expenses	118,847.20	128,352.71
506.0 · Prof Fees Accounting	7,360.00	10,700.00
509.0 · Prof Fees Other	3,918.75	5,125.00
510.0 · Office Supplies	2,558.94	1,274.00
515.0 · Telephone	1,773.21	1,600.00
520.0 · Printing	490.30	0.00
522.0 · Postage and Delivery	838.87	875.00
525.0 · Internet Services	1,956.40	1,438.20
530.0 · Staff Expenses		
530.2 · Staff Mileage	155.32	297.00
530.3 · Staff Transportation	1,091.71	1,382.00
530.4 · Staff Hotel	2,320.02	3,123.00
530.6 · Staff Meetings	1,375.00	300.00
Total 530.0 · Staff Expenses	4,942.05	5,102.00
535.0 · Executive Committee Expense		
535.2 · Mileage Exec Comm	61.07	148.50
535.3 · Transportation Exec Comm	5,077.59	7,760.00
535.4 · Hotel Exec Comm	5,144.82	7,064.00
535.0 · Executive Committee Expense - Other	41.97	0.00
Total 535.0 · Executive Committee Expense	10,325.45	14,972.50

Accrual Basis

FEMA Grant 2007
Final Income and Expense
August 2007 through December 2008

	Aug '07 - Dec '08	Re-Programmed Budget*
553.0 · 2007 WSSPC-ICC Annual Conf Reno		
553.1 · AC 07 Transportation		
553.11 · Airfare	1,384.49	
553.12 · Ground Transportation	91.30	
553.13 · Mileage	141.14	
Total 553.1 · AC 07 Transportation	1,616.93	0.00
553.2 · AC 07 Contractors	1,922.25	
553.3 · AC 07 Hotel	2,596.68	
553.5 · AC 07 Meeting Costs	4,137.29	
553.7 · AC 07 Shipping	676.54	
Total 553.0 · 2007 WSSPC-ICC Annual Conf Reno	10,949.69	0.00
554.0 · Conferences		
554.1 · 2008 NEC Seattle	2,153.83	
Total 554.0 · Conferences	2,153.83	0.00
570.0 · Insurance		
570.1 · Liability Insurance	1,004.00	
570.3 · Insurance Other	166.00	
Total 570.0 · Insurance	1,170.00	1,186.59
575.0 · Rent	18,624.00	18,624.00
580.0 · Bank Service Charges	1,933.05	336.00
581.0 · Equipment Rental		
581.3 · Postage meter	135.85	264.00
Total 581.0 · Equipment Rental	135.85	
583.2 · Borah Peak Scenario	10,000.00	10,000.00
591.0 · Licenses and Permits	285.00	150.00
Total Expense	200,000.00	200,000.00

*** $10,000 Funds moved from Expense Category 500.1 to 583.2**

Accrual Basis

Western States Seismic Policy Council
FEMA Grant 2008
August through November 2008

	Aug - Nov '08
Income	
450.0 · Grants Earned	
460.0 · FEMA Grants Earned	
460.4 · 2008 FEMA Grants Earned	60,079.57
Total 460.0 · FEMA Grants Earned	60,079.57
Total 450.0 · Grants Earned	60,079.57
Total Income	60,079.57
Expense	
500.0 · P/R Expenses	
500.1 · Salary	37,228.40
500.2 · Benefits	
500.7 · Employer IRA Contribution	
500.701 · Sutch IRA Employer Contribution	470.40
Total 500.7 · Employer IRA Contribution	470.40
500.2 · Benefits - Other	2,030.75
Total 500.2 · Benefits	2,501.15
500.3 · Employer Contrib/Taxes	3,112.58
500.4 · Workers' Comp	721.91
500.5 · Payroll Service	1,445.00
Total 500.0 · P/R Expenses	45,009.04
506.0 · Prof Fees Accounting	1,100.00
509.0 · Prof Fees Other	1,262.50
510.0 · Office Supplies	478.66
515.0 · Telephone	729.83
522.0 · Postage and Delivery	212.70
525.0 · Internet Services	479.40
530.0 · Staff Expenses	
530.2 · Staff Mileage	101.79
530.3 · Staff Transportation	128.00
530.4 · Staff Hotel	267.03
Total 530.0 · Staff Expenses	496.82
535.0 · Executive Committee Expense	
535.2 · Mileage Exec Comm	92.44
535.3 · Transportation Exec Comm	2,431.34
535.4 · Hotel Exec Comm	712.08
Total 535.0 · Executive Committee Expense	3,235.86
575.0 · Rent	6,208.00
580.0 · Bank Service Charges	112.00
581.0 · Equipment Rental	
581.3 · Postage meter	34.28
581.5 · Copier Maintenance	720.48
Total 581.0 · Equipment Rental	754.76
Total Expense	60,079.57

2008 National Earthquake Program Managers Meeting
April 22, 2008, Seattle Washington

The following meeting summary was prepared by Brian Garrett of BRI Consulting Group.

MEETING SUMMARY
STATE EARTHQUAKE PROGRAM MANAGERS MEETING
SEATTLE, WASHINGTON
APRIL 22, 2008

OVERVIEW

Earthquake program managers from 17 states attended the annual State Earthquake Program Managers Meeting, held at the Westin Hotel in Seattle, Washington, from 8:00 a.m. to 5:00 p.m. on April 22, 2008. States represented included the following: Alabama, Alaska, Arkansas, California, Hawaii, Idaho, Illinois, Indiana, Kentucky, Mississippi, Missouri, Nevada, New York, Oregon, South Carolina, Utah, and Washington.

The meeting was held in conjunction with the 2008 National Earthquake Conference, which took place at the Westin Hotel during April 22–26, 2008. In addition to state earthquake program managers, about 20 other persons participated in the meeting. They included earthquake program personnel from the Federal Emergency Management Agency's (FEMA) headquarters and regional offices, as well as representatives from the Central United States Earthquake Consortium (CUSEC), Northeast States Emergency Consortium, Western States Seismic Policy Council, and British Columbia Provincial Emergency Program. CUSEC Executive Director Jim Wilkinson served as moderator, assisted by CUSEC Program Coordinator Brian Blake.

During the morning session, the state program managers first shared issues, activities, and approaches that are currently of interest to them. They then discussed the concept of a "model" state earthquake program. Topics addressed during the afternoon session included the following: state clearinghouses, earthquake awareness activities, FEMA activities, NEHRP strategic planning, and future meetings of the state earthquake program managers.

ISSUES OF INTEREST TO STATE EARTHQUAKE PROGRAMS[1]

Utah

The large number of unreinforced masonry (URM) buildings in Utah have been identified as a major seismic risk. As a first step in confronting this risk, the state legislature this year passed a resolution calling for an inventory of all public URM buildings (structures open to the public). The legislature also enacted measures concerning the seismic mitigation of school buildings and a requirement that qualified structural engineers must be involved in the design of specified structures. The state seismic safety commission and structural engineers association were key players in helping to pass this legislation.

Arkansas

The legislature rejected a proposal to upgrade state building codes from the 2000 International Building Code (IBC) to the 2006 IBC. In response to fears that the change would increase construction costs, legislators tabled the measure for further study, despite a prior study that concluded that the newer code would reduce costs by increasing the options available to builders. Resistance to code upgrades is an issue that arises every few years in CUSEC member states.

[1] Listed in the order in which they were presented.

FEMA can provide position papers, expert speakers, and other resources that can help state earthquake programs present accurate information about the impact of code upgrades.

The state is telling rural residents to be prepared to subsist on their own for 7–10 days following a major New Madrid earthquake. The new governor has already held two cabinet-level exercises in the state emergency operations center (EOC). The state is using information developed through a hurricane gap analysis to update county earthquake plans and ultimately the state plan. The state geological survey is surveying soils statewide for use in transportation infrastructure planning, and the state plans to provide the data gathered to USGS for use in seismic hazard mapping.

Kentucky

An issue that has come to the fore in Kentucky concerns financial liability for actions or accidents involving trained disaster-response volunteers. The right people will need to be brought to the table to craft a legislative solution to this issue. The state earthquake program is working to get some of the funding sought by the state from the Department of Homeland Security's (DHS) Emergency Management Performance Grant (EMPG) Program earmarked for seismic projects.

Alaska

The state has been focused on obtaining and putting to use funds from FEMA's Pre-Disaster Mitigation (PDM) Grant Program and Hazard Mitigation Grant Program (HMGP). Mitigation projects have included structural and nonstructural retrofitting of schools and other public buildings. The state has also examined the possibility of implementing all-hazards sirens, and is surveying Alaska's critical infrastructure under a FEMA Hazard Mitigation Technical Assistance Program (HMTAP) project. Outreach activities are under consideration for the 45th anniversary of the 1964 Great Alaska Earthquake. The state earthquake program is still taking advantage of the 2004 Denali earthquake, which impacted small communities, to stimulate cooperation with outreach efforts.

Idaho

The magnitude 6.0 earthquake that occurred near Wells, Nevada, in February 2008 has "helped" state earthquake program personnel in neighboring Idaho, enabling them to remind the state's new governor and emergency management director of the earthquake hazards faced in the region. Program staff have been working with Idaho counties to help them get their hazard mitigation plans in place. It has been challenging to get them to focus on natural hazards given the prominent availability of lucrative homeland security funding. Rural seismic safety seminars are being planned for this fall in conjunction with the 25th anniversary of the Borah Peak earthquake. A new state seismic safety advisory commission has been created, and it has proven challenging to obtain full, balanced participation. The commission includes plenty of representatives from academia but needs more building officials.

Alabama

Alabama has a new state emergency management director whose background is in hurricanes. A state-level planning workshop has been held in connection with the New Madrid catastrophic planning initiative; planning classes have also been organized for interested building inspectors and engineers. HAZUS runs are planned for each county near the seismic zone to provide data that the counties can use in preparing earthquake annexes for disaster response plans.

Washington
Earthquake preparedness has been a recent focus in the state; the governor is interested in preparedness and April is preparedness month. The state earthquake program has been working on updating and integrating the use of HAZUS, ShakeMap, and ShakeCast, and can now generate ShakeMaps within 6 minutes of an event. State cabinet members have used ShakeMap and HAZUS tools in connection with Seattle fault scenario exercises.

Local town-hall meetings have proven to be an effective means of getting seaside communities involved in tsunami preparedness. The state is considering the development of early-warning systems so that bridge traffic, for example, could possibly be shut off in time to save lives. The state has prepared diagrams of school buildings for security preparedness and is looking at incorporating additional information on the buildings' status in relation to earthquake and tsunami preparedness. Tsunami evacuation remains a significant issue; the legislature has provided funding for the development of all-hazards radio, but the state also needs to address landowners' concerns about their potential liability for persons evacuating to higher ground on private property.

Missouri
The state earthquake program has been involved in the New Madrid catastrophic planning project, although this work has been pushed back somewhat by the demands placed on staff by recent natural disasters. The governor has affirmed that earthquakes are the state's top disaster-planning priority, but earthquake program staff and funds are nevertheless declining. Staff have helped the state seismic commission update their strategic plan. The state is not really doing any earthquake mitigation projects at this time, although it has partnered with FEMA and CUSEC on mitigation training for health care facilities. The governor's insurance task force, established to study Katrina-inspired concerns about potential insurance problems following a major earthquake, has drafted a report to the governor. The task force is recommending the creation of a catastrophic insurance fund and an associated seismic advisory committee.

Illinois
The state EOC was activated in response to the magnitude 5.2 earthquake that occurred in southern Illinois on April 18, 2008. This was done as a precautionary measure; although no casualties and little damage resulted from the quake, there was a tremendous amount of media interest in the event. This shows how, in the event of a large, damaging earthquake in the region, the states involved would likely be deluged with media inquiries.

The state has recently been focusing more on response than on mitigation. The earthquake response plan, which was perceived to need a more operational focus, has been revamped to meet standards of the Emergency Management Accreditation Program. Central reception and staging areas for supplies are being addressed under the plan, and the state is looking at using airports in the southern part of the state for these sites. The Mid-America Earthquake Center has prepared some rather conservative loss estimates for Illinois in connection with the New Madrid catastrophic planning project.

Nevada
The earthquake that occurred this past February near the town of Wells caught the state somewhat by surprise. Fortunately only one injury was associated with the quake, but about 2,100 URM structures were damaged. The state responded with proposed legislation that would require a statewide inventory of URMs; this bill was passed by the legislature but vetoed by Nevada's new

governor. Legislative strategy is now shifting toward an all-hazards approach, with the Wells earthquake serving as a potent reminder of the need for action.

Indiana
Although emergency management funds are not earmarked for earthquakes in Indiana, the state nevertheless has some good earthquake planning efforts under way. Thirty-two of the state's 92 counties have been funded for earthquake disaster planning, and six state-level workshops have been held in connection with the New Madrid catastrophic planning initiative. District-level New Madrid workshops are now getting under way in the state.

British Columbia (Canada)
The earthquake program is currently unfunded in British Columbia (that is, the program manager has no funds with which to hire staff or carry out projects). The province does have a disaster response plan; the program manager is trying to make the plan more operational, in part by identifying and prioritizing response routes that can be used to get responders and supplies into disaster areas. The province has not experienced a significant quake since 1946, and as a result, outreach efforts have been neglected.

Mississippi
The earthquake program is working to develop an earthquake annex for the state disaster response plan, and is working with at-risk counties to create their respective annexes.

CUSEC
The Illinois earthquake of April 18, 2008, generated some 38,000 reports from members of the public who felt the shaking. These reports stretched across 13 states. Utilization of the CUSEC Web site surged, from 2,000 page views the day before the quake to 27,000 views the day of the event. In addition, the New Madrid fault was the third most popular Google search topic in the nation during the immediate aftermath of this magnitude 5.2 quake.

Oregon
In recent years the state has used the rapid visual screening procedures developed by FEMA to assess and prioritize earthquake risks among schools and emergency facilities statewide. The state is currently working to mitigate these facilities, and has initiated workshops to examine the vulnerability of ports, energy facilities, and other critical infrastructure. The state earthquake program is focusing on public awareness by working with surrounding states to leverage the attention and resources being generated through their activities. An earthquake response exercise is being planned for April of next year. Oregon's 36 county governments, which are responsible for funding earthquake-related activities at the local level, are hard-pressed to do so because of revenue losses associated with the decline of the timber industry in the state.

South Carolina
The state earthquake program is developing an earthquake preparedness guide for the public. Plans are to distribute the guide in community newspapers during earthquake awareness observances in November. The program continues to try to leverage support for earthquake-related activities by piggybacking onto activities funded for hurricanes and other natural hazards.

Hawaii
The earthquake that struck Hawaii in October of 2006 has led to a study of how the residential post-and-pier construction unique to the state can be mitigated. The state is working to update its earthquake and tsunami preparedness plans.

California
During the 1980s and 1990s, the state had as many as 30 staff working on earthquake preparedness. The earthquake program now has three employees—the manager and one staff person each for Southern California and the Bay Area. The Golden Guardian exercise planned for November 2008 is based on a magnitude 7.8 scenario earthquake on the southern San Andreas fault. Public outreach will be carried out through the Dare to Prepare campaign, and HAZUS runs are being completed for eight impacted counties and seven impacted cities.

The tsunami that hit the northern California town of Crescent City in 2006 caused about $10 million worth of damage. The event rekindled concerns about and efforts to enhance the coastal tsunami warning system. In March 2008, the state conducted the first test of the Emergency Alert System involving live tsunami warning codes in northern California's Humboldt County.

New York
Over the past year the state earthquake program has been involved in updating the earthquake-related portions of the state's multihazard mitigation plan. This effort included adjusting the U.S. Geological Survey (USGS) seismic hazard maps for the state to incorporate the effects of local soil conditions. Adjusted maps were produced for all 62 counties in the state for inclusion in the plan. Schools in areas of relatively high seismicity were identified to state education officials so that they can arrange for seismic assessment of these buildings. The state is also working to develop key data on its 16,000 state government buildings so that their seismic vulnerability can be evaluated.

MODEL STATE EARTHQUAKE PROGRAM
Attendees discussed how earthquake programs differ from state to state and from the programs of years past. The focus was on the essential or common elements that exist or should exist among these programs. Information and opinions shared included the following:

- In the past, when they were funded largely through a FEMA grant program dedicated to earthquakes, state earthquake programs were organized according to FEMA guidance, with required and elective program elements. Although it could be difficult to divide program funds among these elements, it was clear what elements made up each program. Since then, programs have become less regulated and more amorphous. Has the organizational pendulum swung from one extreme to the other? Should some of the old structure or commonalities be reintroduced? If so, how?

- The organizational settings in which earthquake programs operate vary from state to state. Within state emergency management departments, earthquake programs can be part of mitigation, preparedness, operations, or other divisions, or can be autonomous programs that interface with all of these divisions. Earthquake program staffing also varies by state, ranging from multiple, full-time employees to one or more employees who divide their time between earthquakes and other hazards or functions.

- The DHS EMPG program is a principal vehicle through which to obtain federal funds for state earthquake programming. The EMPG program is administered through FEMA's National Preparedness and Grant Programs directorates, while the FEMA earthquake (NEHRP) program is housed in the Mitigation Directorate. FEMA NEHRP staff do, however, provide input for the annual EMPG program guidance, and would be willing to carry forward input from state earthquake programs.

- Annual work plans can be key to obtaining EMPG funds for earthquake programs. State emergency management agencies applying for EMPG funds are required to submit work plans, prepared in cooperation with FEMA's regional offices, that describe how they propose to use the funds. State earthquake programs can work to secure the resources that they need by contributing to the development of these work plans. Also, by developing and implementing their own dedicated work plans in consultation with state emergency management directors, state earthquake programs can become better positioned to influence the EMPG work plans and persuade directors that they deserve a share of EMPG funds. In Idaho, for example, the state earthquake program must prepare annual work plans in order to compete for a share of the state's EMPG funds.

- Rather than seeking a return to separately regulated and funded offices, state earthquake programs should concentrate on how to succeed within their existing organizational environments. In addition to work plans, there are other tools and approaches that the programs can use to enhance their visibility and garner the support they need. Earthquake awareness observances, for example, can be used to boost the visibility of the program as well as awareness of hazards and risks. Other strategies include maximizing participation in disaster exercises and catastrophic planning projects; contributing to the development of state hazard mitigation plans; offering earthquake program orientations to incoming management; and working with state training and exercise officers to shape future exercises and build earthquake-related training resources.

- NEHRP—including FEMA's regional and headquarters earthquake program staff as well as the other NEHRP agencies—is another source of support for state earthquake programs. NEHRP staff at FEMA headquarters communicate with the agency's regional earthquake program coordinators via monthly conference calls, and some regional coordinators similarly communicate with state program managers. FEMA's personnel can provide technical expertise and training resources. The state earthquake program in Utah, for example, has benefitted greatly from its ongoing partnership with FEMA Region VIII earthquake staff.

- Because FEMA's NEHRP program is housed within the Mitigation Directorate, the support that it can provide is perhaps weighted toward mitigation. At the state level, however, earthquake programs need to include elements from all phases of emergency management—preparedness, response, and recovery as well as mitigation. It may be helpful to try to establish a NEHRP subcommittee within the National Emergency Management Association (NEMA) that could advocate for state earthquake program needs at the state and federal levels across all phases of emergency management.

- Among the elements that are important to the success of state earthquake programs are the following:
    - Adequate funding and staffing

- A comprehensive approach that addresses preparedness, public education, warnings, response, and mitigation
- A strategy for engaging local governments, the private sector, and the community on an ongoing basis
- Long-term strategic plans and related annual work plans
- Ways to keep engaged with relevant agencies, academia, and other experts so as to stay abreast of state-of-the-art developments in the field
- Routine training that is comprehensive and standard across states
- Federal partners that provide guidance and identify and promote best practices

ESTABLISHING STATE CLEARINGHOUSES

Attendees talked about the uses of post-earthquake clearinghouses and current plans, approaches, and templates relating to their establishment. In this discussion, "clearinghouses" referred to the temporary field offices described in USGS Circular 1242, *The Plan to Coordinate NEHRP Post-Earthquake Investigations* (2003). According to the circular, immediately after a sufficiently large earthquake,

> "the USGS, FEMA, and EERI will work with state agencies to organize a field technical clearinghouse. Depending on ability and capability, the affected state(s) may take the lead in organizing the clearinghouse. . . . The clearinghouse is the focal point for coordinating activities and promoting the safety of all field parties during initial post-earthquake reconnaissance."

The major points made in this discussion were as follows:

- Under Circular 1242, the USGS has the lead clearinghouse role at the federal level in cooperation with the other NEHRP agencies. Although the Mitigation Directorate, home to FEMA's NEHRP program, has the lead role for FEMA, funding for post-earthquake clearinghouses would come from FEMA's Disaster Operations Directorate.

- CUSEC has had to plan a clearinghouse approach that reflects the likelihood that multiple states would be impacted by a major earthquake occurring in the central United States. Although the traditional approach described in Circular 1242 is to establish a single centralized clearinghouse for each earthquake, the CUSEC states plan to stand up a separate clearinghouse in each impacted state and coordinate their activities regionally.

- The CUSEC states envision that clearinghouses would be set up near joint field offices. They are working to pre-identify schools that would be willing to serve as clearinghouse sites, and to pre-identify and pre-credential the researchers and officials who would likely make up initial post-earthquake field parties.

- Clearinghouses are the interface between emergency management and scientific research communities in post-earthquake environments. Consequently, they provide both challenges and opportunities. To realize their full potential, clearinghouses must ensure that information flows in both directions between field researchers and emergency managers. Researchers can provide expert observations that are of value for response as well as recovery operations, and emergency managers can provide the guidance on access that keeps responders unhindered and researchers safe.

- State emergency management directors may need to be educated on the value of clearinghouses and the two-way communications that these resources can facilitate. And staff from state geological surveys, who are typically called upon to represent the research community in clearinghouses, may need to be introduced to the role of emergency management. CUSEC plans call for state geological surveys to represent researchers in both clearinghouses and EOCs. In Utah, plans call for clearinghouses to be housed in and run by the state geological survey, and for field researchers to be linked into the damage assessment process being coordinated by emergency managers.

- The clearinghouse set up in the wake of Hurricane Katrina is still in operation. Geographic information system (GIS) and remote-sensing expertise have been integral to this operation, along with the expertise of emergency managers and geological surveys. Earthquake clearinghouse plans should perhaps incorporate GIS support as a third main component along with emergency management and geological surveys. The Katrina experience has also demonstrated that it is possible for clearinghouses to attract and greatly benefit from donated equipment and services.

- In California, the clearinghouse concept dates back to the 1970s. Plans have been built through a partnership among the state earthquake program, the state geological survey, the state seismic safety commission, and others. Interaction between EOCs and clearinghouses has become more important as those involved have recognized the potential value of such communication. A clearinghouse will be incorporated into the Golden Guardian exercise play this fall in southern California.

- Sample state plans for the establishment of post-earthquake clearinghouses are available from California, Utah, and WSSPC, among others.

EARTHQUAKE AWARENESS ACTIVITIES

The observances and activities that various states are using to increase public awareness and preparedness were discussed. These activities are summarized below.

Earthquake awareness week and tsunami awareness week observances are held together each year in Alaska. The governor issues a proclamation and television weather reports feature earthquake and tsunami trivia. In some years there have also been tests of broadcast emergency alert systems with live earthquake or tsunami warning codes.

Earthquake and tsunami awareness events are also linked in Hawaii. The state holds two large earthquake or tsunami preparedness exercises each year, which are timed to coincide with regular monthly tests of Hawaii's tsunami warning sirens. April is tsunami and earthquake awareness month; media events are held during the first week to launch the observance, and outreach to specific groups takes place during the remainder of the month. The state Web site allows visitors to enter their address to see where they are in relation to tsunami evacuation zones, and also offers interactive quizzes that enable citizens to test their preparedness knowledge.

During the 1980s and 1990s, the State of California sponsored earthquake awareness observances every year. State funds used for those events were redirected to other uses about 5 years ago. Since then, local governments have stepped in to keep these observances going. The state has secured EMPG funds with which to reinstate its activities in 2009. In the past, each week of earthquake awareness month had a different theme involving outreach to different target groups

such as business, unions, local governments, etc. This year, in conjunction with the Golden Guardian exercise, an art college has been engaged to put up earthquake preparedness messages on the sides of buildings in downtown Los Angeles.

CUSEC has worked for years to coordinate the annual observances of its eight member states. Six of these states held their observances together in February this year. This coordination helps to increase awareness that everyone across the region faces the same hazard and similar risks related to that hazard. Observances have typically featured outreach to the public through town-hall meetings, workshops for local public officials and business leaders, and varied training activities. This year in Missouri, the state partnered with FEMA to provide training designed for public and private health care facilities on nonstructural mitigation and incremental rehabilitation.

In South Carolina, the state has partnered with the National Weather Service to place special emphasis on "drop, cover, and hold" drills in schools during earthquake awareness week. In last year's observance, four counties had 100 percent of their schools participate in these drills.

All businesses over a certain size are required to participate in earthquake preparedness exercises during Oregon's annual earthquake awareness observances. These businesses are required to report to the state on their participation. In some years, donations have been solicited from the private sector to fund the purchase of prizes for school systems achieving 100 percent participation in earthquake drills.

FEMA NEHRP ACTIVITIES

Earthquake program personnel from FEMA's headquarters and regional offices spoke about their recent activities and the challenges and opportunities faced by the program. Their remarks are summarized below in the order presented.

Marie Gonzalez, Caribbean Area Division, FEMA Region II

FEMA's office for Puerto Rico and the Virgin Islands maintains a strong partnership with the University of Puerto Rico at Mayaguez, which has carried out studies to map tsunami evacuation zones and operates a clearinghouse for FEMA's local earthquake and tsunami awareness and preparedness materials. Videos are used as the primary public awareness tool. FEMA has also produced interactive CDs for children and adolescents, and uses an earthquake simulator that is sponsored by local businesses.

The regional seismic monitoring network is now operating 24/7 with the help of local funding. Hurricanes remain the number one threat, but in the event of hurricane-related disaster declarations the islands seek HMGP projects relating to earthquakes and tsunamis as well. Currently a large HMGP project is under way to develop protected underground power distribution for the local banking industry.

Joe Rachel, FEMA Region IV

Last year South Carolina held a daylong observance marking the 120th anniversary of the state's 1886 earthquake. This was a good opportunity to bring together public officials, community members, and the media to focus on the earthquake hazard and the work of the state earthquake program.

Region IV held its first joint mitigation-earthquake meeting in 2007. This event highlighted several model seismic mitigation efforts in the region, and provided an opportunity for state

earthquake program managers to meet and discuss how to work together with state and regional mitigation personnel. Georgia Tech talked about their research on bridge retrofitting, and Memphis Light, Gas and Water described their $1.2 million PDM-funded retrofit project. This project addressed both earthquake and flood risks, although it was the benefit-cost modeling related to flooding that got the project funded.

Region IV staff have also been working with the Mid-America Earthquake Center and HAZUS in connection with the New Madrid catastrophic planning project.

J. P. Marsch, FEMA Region V
Mr. Marsch became the earthquake program coordinator for Region V in September of last year. In March he participated in an all-office briefing on how Region V would respond to a major earthquake in the New Madrid Seismic Zone (NMSZ). In October, the office will participate in a regional planning workshop held for the New Madrid catastrophic planning project.

Mr. Marsch has been assisting Illinois and Indiana with their state hazard mitigation plans. The Illinois plan features detailed risk assessment information on 33 counties that was developed through collaboration between earthquake program staff and mitigation and planning personnel. Southern Illinois University has received a grant to help 20 counties in the southern part of the state develop plans that will enable them to better compete for PDM and HMGP funding. The City of Waterloo, Illinois, located southeast of St. Louis, is using an $800,000 PDM grant to seismically retrofit their new high school as it is constructed.

Kent Baxter, FEMA Region VI
Mr. Baxter replaced Chuck Gregg as the earthquake program coordinator for Region VI in May of last year. He is assisted by Patricia Schaffer, and they look forward to working further with Arkansas and New Mexico on seismic matters.

Sue Evers, FEMA Region VII
Staff from Regions IV and VII recently assisted with an earthquake tabletop exercise conducted at the annual conference of the Four Corners Emergency Management group. The group, which comprises local emergency management officials from counties in the four-corners region of Kansas, Missouri, Oklahoma, and Arkansas, used the exercise to learn how to respond to earthquakes outside the NMSZ, as well as how to assist in the event of a major New Madrid quake.

Several training activities were recently conducted in Missouri in connection with earthquake awareness month. These included nonstructural mitigation workshops, structural assessment and visual evaluation training, and a course on earthquake medicine.

Doug Bausch, FEMA Region VIII
The seismic vulnerability of existing URM buildings is of major concern to Utah and other states in and beyond Region VIII. In Utah, where URM structures continued to be built until the mid-1970s, scenarios indicate that these buildings could account for 80 percent of severe casualties in a damaging earthquake. Consequently, the state is undertaking efforts to inventory, prioritize, and ultimately mitigate these structures.

Region VIII is supporting these efforts in several ways. FEMA headquarters and Region VIII have worked together to develop a soon-to-be-completed guidebook on URM mitigation designed

for local officials nationwide. And FEMA has developed an automated version of the FEMA 154 rapid visual screening tool that is designed for use on handheld devices. This tool, which reduces screening time per building, is being pilot-tested in Utah for use in the state's URM inventory. Region VIII is also supporting a pilot project aimed at further integrating HAZUS with the USGS ShakeMap tool.

David Kennard, FEMA Region IX
Mr. Kennard is the interim acting earthquake program coordinator for Region IX until a new coordinator is hired to replace Jeff Lusk. Region IX has been working with the State of California on several planning documents, including a disaster response CONOPS plan, which was partially implemented recently for wildfires in southern California, and CONPLAN1, which scripts the initial 14-day response to a major northern California earthquake.

FEMA is participating in the Earthquake Country Alliance, a broad-based public-private partnership that is promoting earthquake awareness and preparedness and improved response and mitigation capabilities in southern California. This year, the group is focusing on the Great Southern California ShakeOut, a series of events scheduled for November. The ShakeOut will include the nation's largest-ever public earthquake preparedness drill as well as the Golden Guardian emergency response exercise and other activities. Golden Guardian will be based on a catastrophic southern San Andreas fault scenario that FEMA has helped to develop.

Region IX has employed a multihazard approach in responding to disasters. Support for earthquake-related training was secured following flooding in Nevada, and several projects were funded in the wake of the October 2006 earthquake in Hawaii. These include a HAZUS validation study and a study of harbor vulnerability and mitigation.

Ed Laatsch, FEMA Headquarters, Mitigation Directorate
Mr. Laatsch introduced the NEHRP program staff from FEMA headquarters: Cathleen Carlisle, Larry Hultengren, Mike Mahoney, Mike Tong, and Anita Vollmer. They and Mr. Laatsch reside organizationally within the Mitigation Directorate, Risk Reduction Division, Building Science Branch.

Mr. Laatsch spoke about some of the major challenges and opportunities faced by the FEMA earthquake program. Resource availability has become a challenge as program funding has declined from 70 percent to 30 percent of the levels authorized over the last 5 years. In response, NEHRP staff have been using every available opportunity to make a business case for augmenting the program's budgeted funds, including developing performance measures for the program. These efforts have begun to show some success; Mr. Laatsch is cautiously optimistic that the program may receive additional funds in FY 2009 with which to reestablish an earthquake state assistance program at about half of its former strength.

The program is also trying to leverage existing funds by maximizing public-private partnerships and by providing written input to the EMPG program guidance for states. NEHRP staff provided input for the FY 2008 guidance, with some success, and will provide input again this year for the FY 2009 guidance. The intent is to try to more clearly articulate that earthquake projects are as eligible for EMPG funding as are projects relating to other hazards.
Building codes pose another challenge for the program. Despite the successes achieved in standardizing building codes nationwide through the International Code Council (ICC), some communities have continued to amend out seismic provisions when adopting these codes. In

response, NEHRP staff are talking with the ICC to put together a memorandum of understanding on an approach to reducing such amendments.

Critical infrastructure and lifelines are another challenge, since the earthquake program no longer has enough funding to support lifelines work. In response, headquarters staff are pursuing contacts in the DHS Office of Infrastructure Protection to try to leverage support for this work through their activities. The independent NEHRP advisory committee has cited program implementation, largely the province of FEMA, as a deficiency within NEHRP. In addition to its efforts to secure additional assistance for state earthquake programs, FEMA is responding by developing a new model outreach and awareness initiative. This effort, undertaken through a contract with the Safe America Foundation, will entail working with local chambers of commerce and others to design and implement earthquake awareness campaigns in selected cities on the West Coast and in the NMSZ.

Mike Pawlowski, FEMA Headquarters, Disaster Operations Directorate
Along with similar projects under way in California and Florida, the New Madrid catastrophic planning project is currently a major focus of FEMA disaster operations staff. Through this project, FEMA is working with CUSEC and other partners to develop a comprehensive, integrated set of plans for responding to a major earthquake in the NMSZ at local, state, regional, and national levels. Based on a magnitude 7.8 earthquake scenario, this project has the attention of the President and members of Congress.

HAZUS has been used to analyze potential losses in 220 counties across the eight-state NMSZ under this scenario. FEMA has brought local emergency management officials together with project planners to develop response plans based on the impacts forecast by HAZUS. So far, the project has sponsored more than 40 workshops at local and state levels to develop and refine these plans.

The response plan developed in Tennessee has emerged as a model that other states in the region can draw from. FEMA has also begun to work with Nebraska on plans for accommodating some of the NMSZ residents who would be displaced by the disaster. The project will culminate with a topoff exercise in 2011.

NEHRP STRATEGIC PLANNING
Mr. Laatsch briefly described the new draft *Strategic Plan for the National Earthquake Hazards Reduction Program: Fiscal Years 2008–2012*. The National Institute of Standards and Technology developed this draft in consultation with the other NEHRP agencies. The draft is available for public review and comment on the NEHRP Web site (*www.nehrp.gov*) through May 9, 2008.

The draft plan includes 3 program goals, 14 objectives, and 9 cross-cutting strategic priorities. Mr. Wilkinson urged attendees to review the plan and submit comments by the deadline.

ONLINE STATE TOOLKIT
Anita Vollmer, from FEMA headquarters, described the two “toolkit” handouts distributed to attendees. NEHRP staff at headquarters have been thinking about developing a new Web site designed specifically for state earthquake program managers. The site would add to and become a component of current FEMA earthquake Web content. The handouts included a draft outline of proposed toolkit content, and a sample Web page illustrating some of this content. The intent is to

provide a single online location where state managers can go to find information, links, and resources of use to them. Ms. Vollmer asked attendees to think about the sorts of content that would be useful to them and send comments and suggestions to her (anita.vollmer@dhs.gov) by June 30, 2008.

FUTURE MEETINGS

Attendees discussed potential locations and dates for the next annual state earthquake program managers meeting. It was suggested that the next meeting be held somewhere out East in late April or early May of 2009. The most popular site suggested was the Emergency Management Institute in Emmitsburg, Maryland. Ed Fratto of the Northeast States Emergency Consortium agreed to check with his member states for possible alternative locations, and Mr. Wilkinson will assemble a committee to plan for the meeting.

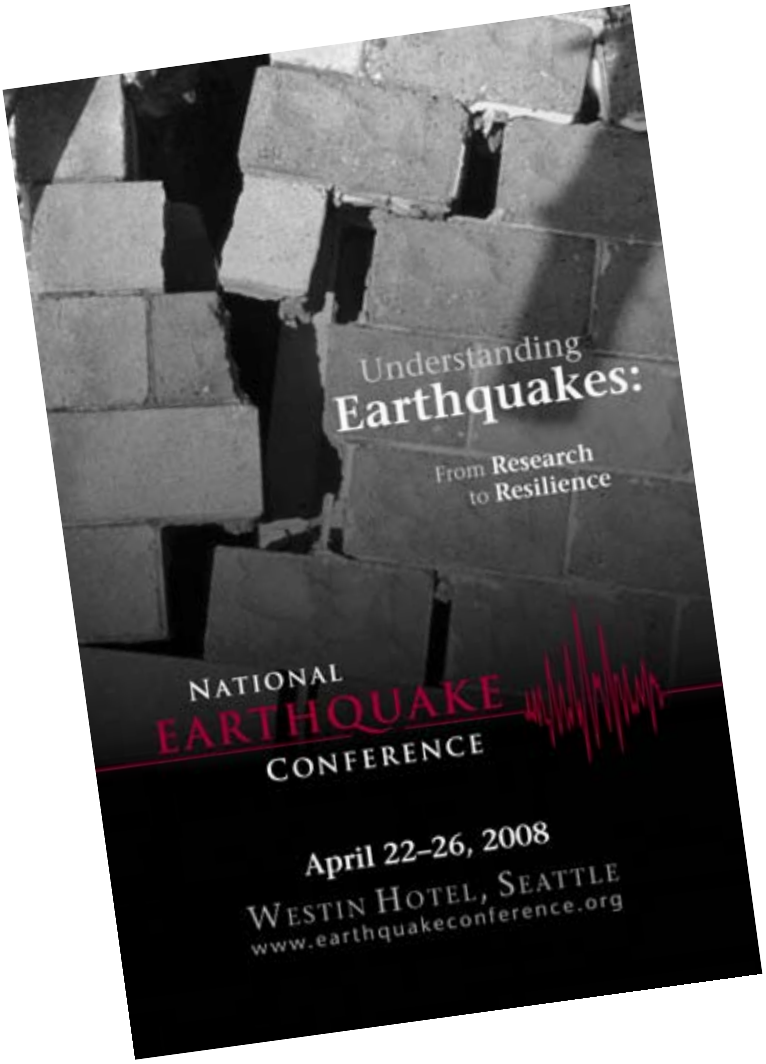
2008 National Earthquake Conference
Understanding Earthquakes: From Research to Resilience

The following report summarizing the 2008 National Earthquake Conference was prepared for the National Earthquake Conference Steering Committee and funded by the Cascadia Region Earthquake Workgroup (CREW). Conference presentations are linked from the WSSPC homepage at *www.wsspc.org*.

After the 2008 National Earthquake Conference:

From Research to Resilience

What next?



2008

CREW AHEAD OF THE WAVE

Cascadia Region Earthquake Workgroup

Sharing Information to Promote Mitigation

Executive Summary

From April 22-26, 2008, more than 400 people came to Seattle for the National Earthquake Conference with its theme, *Understanding Earthquakes: From Research to Resilience.*

The five conference objectives were to: understand the research; exchange ideas about tools for earthquake hazard and risk reduction; showcase successful programs; learn from past disasters, and build resiliency.

Evaluations from participants showed a high level of satisfaction (approximately 4.3 on a scale of 1-low to 5-high). Attendees said this conference is an important event because a variety of disciplines come together to exchange information and insights.

Though several people offered descriptions of resiliency, most had components in common:

- A public educated about their risk;
- A multidisciplinary approach;
- An approach that applies to all hazards;
- A focus on all four aspects of emergency management: mitigation, preparedness, response, and recovery;
- A structure and resources to recover from a damaging event.

Some impediments to resiliency were also mentioned including:

- People think it won't happen to them, to their location, or in their lifetime.
- Lack of will. Information exists, but is not incorporated into current activities.
- Earthquake safety must be prioritized along with all other demands on the resources of governments, businesses, organizations, neighborhoods, and families.

Day 1 of the conference presented lessons from the past.

- Appropriate messages about the earthquake hazard are critical. People perceive whether they're safe, not whether they're at risk in the future.
- Community resilience has occurred after many disasters through the years. Lessons from those cities give important steps for us to take.

Day 2 focused on the present.

- Many parts of the US, not just the West, are at risk from earthquakes.
- A national HAZUS study shows annualized earthquake losses of $5.3 billion per year. Relatively high earthquake loss ratios exist in the western US (including Alaska and Hawaii); the New Madrid Seismic Zone; the Charleston, South Carolina area; and some parts of New England.
- Vulnerability science helps explain why some places are more vulnerable than others. Coupling the Social Vulnerability Index with seismic hazards can highlight the highest areas of vulnerability.
- A FEMA study showed that between 1993 and 2003, earthquake grants of $947 million led to a benefit of $1.4 billion. The study showed that mitigation is most effective when carried out on a comprehensive, community-wide, long-term basis.

The future was the target of Day 3.

- Even where mitigation activities are undertaken, they are often fragmented among various agencies, organizations, missions, and resource providers.
- Developing partnerships for funding, planning, and implementation is critical.
- After a major earthquake, many areas will need to respond to their own damage. Breaking communities into small neighborhoods and training them before an event can save lives and allow professional emergency responders to attend to major events.
- Some in the earthquake field would like to spend more time on mitigation than they are currently able to do, believing it to be the most cost-effective use of resources. However, funding sources are often not geared to mitigation, but to response or planning. In addition, funding to prepare for hazards is often targeted mostly to terrorism/national security. Although many tasks are useful for a variety of hazards, there are some earthquake-specific activities that are not being done.
- Local efforts are underfunded and understaffed. There are probably many reasons, but the most commonly identified culprits were the lack of local resources and political will. Neither governments, businesses, nor the general public are asking for greater earthquake protection.
- Earthquake measures generally happen after an event causes great damage and/or injury.

For more information, abstracts were published in the pre-conference agenda and many presentations are available online at http://www.earthquakeconference.org/Presentations/presentations.htm.

2008 National Earthquake Conference

Understanding Earthquakes: From Research to Resilience was the theme of the event. More than 400 participants came to Seattle from April 22-26 for the conference. Five field trips, 27 exhibits, and 23 posters supplemented the plenary, breakout, and webcast sessions.

The conference was organized by:

- Cascadia Region Earthquake Workgroup (CREW)
- Western States Seismic Policy Council (WSSPC)
- Northeast States Emergency Consortium (NESEC)
- Central US Earthquake Consortium (CUSEC)
- Earthquake Engineering Research Institute (EERI)
- Emergency Preparedness for Industry and Commerce Council (EPICC).

In addition, funding and support came from:

- Department of Homeland Security's Federal Emergency Management Agency (FEMA)
- US Geological Survey (USGS).

Conference objectives were to:

- Understand the research.
- Exchange ideas about tools for earthquake hazard and risk reduction.
- Showcase successful programs.
- Learn from past disasters.
- Build resiliency.

Awards were presented for excellence in the field. The 2008 WSSPC Lifetime Achievement Award went to Dr. Walter J. Arabasz, Director of the University of Utah Seismograph Stations. Other awards:

- Overall Award in Excellence to the Washington Military Department, Emergency Management Division, for *Map Your Neighborhood: Building and Strengthening Disaster Readiness Among Neighbors.*
- For Mitigation, the Oregon Department of Geology and Mineral Industries, for *Statewide Seismic Needs Assessment of Oregon Schools and Emergency Facilities;* and the Capitol Preservation Board, for the *Utah State Capitol Seismic Retrofit and Restoration.*
- For Response and Recovery, the Washington Military Department, Emergency Management Division, *Broadcasters Tsunami Emergency Guidebook.*
- For Innovations, Ridg-U-Rak, Inc., for the *Ridg-U-Rak Seismic Base Isolation System.*
- For Outreach, the Washington Military Department, Emergency Management Division and the Earthquake Engineering Research Institute, for *Seattle Fault Earthquake Scenario Project;* and Cascadia Region Earthquake Workgroup, for *Cascadia Subduction Zone Earthquake: A Magnitude 9.0 Earthquake Scenario.*
- For Plans/Materials, the *Emergency Preparedness for Industry and Commerce Council.*

Fields trips were taken to: tsunami sites; the University of Washington Seismic Lab; the Seattle Fault; seismic retrofit projects; and the Washington State Emergency Operations Center.

The program

The three days of plenaries and breakout sessions were organized into Past, Present, and Future. Abstracts were published in the pre-conference agenda. Presentations that were submitted are available at the conference website, http://www.earthquakeconference.org/Presentations/presentations.htm.

Because of the amount of information presented, only a few key points from plenaries are included here.

Learning from the Past

Washington Governor Chris Gregoire, FEMA Region X Director Susan Reinertson, Washington State Emergency Management Division Director Jim Mullen, and conference chair and CREW President Bob Zimmerman welcomed participants.

The first plenary, *Toward Resiliency: What We've Learned from Past Events*, set the tone for Day 1. Dennis Mileti began by describing resiliency.

- It requires interdisciplinary contributions.
- It's about mitigation, preparedness, response, and recovery.
- It's not earthquake specific: it applies to all hazards.
- It's the ability to thwart and recover from consequences.
- It's analogous to "sustainable development."

He set out four goals to achieve societal resilience.

1. Understand risk and embrace safety.
    - Put safety at the forefront of public priorities.
    - Communicate risks to the public and decide how much risk is acceptable.
2. Re-evaluate and harden high loss-potential structures.
    - Rethink the approach from a systems viewpoint, combining engineering strategies with other loss-reduction strategies.

3. Revamp the management of risk management.
    - A single person should be in charge and be responsible for managing the entire approach.
    - Improve interagency coordination.
4. Demand engineering quality.
    - Upgrade engineering design procedures.
    - Put safety first.

At the same time, the human element must be taken into consideration. People are often the greatest constraint to resiliency.

- People perceive safety, not risk. We must craft messages to reflect that.
- We manage risk with hindsight not foresight. Most (99%) of seismic safety laws from 1906-2006 were adopted after earthquakes.
- Normalize new risk information so it is available *before* the next earthquake.
- Engineering solutions lead to the perception that "we" are safe, and disasters happen to others.
- Many people focus on disciplinary solutions that are expensive and difficult to enforce.
- People think in the short term: "It won't happen today or to me."

Lawrence Vale reviewed past earthquakes to explore the resiliency of modern cities to be rebuilt. He presented 12 axioms of resilience that include political, financial, and social factors in post-disaster recovery.

Plenary 2 featured staff from the NEHRP agencies (USGS, FEMA, NSF, and NIST) to outline *NEHRP Strategies and Challenges.*

USGS Director Mark Myers spoke at lunch. He reinforced the USGS commitment to advancing the science of earthquakes and helping communities prepare for them.

Scientific and Engineering Lessons from Past Earthquakes was the focus of Plenary 3. Hiroo Kanamori discussed slow earthquakes, like the 2006 Java event that produced weak shaking but a large tsunami, and how they differ from "regular" earthquakes. He emphasized that our seismological data base is too short to fully understand earthquake diversity. Singular events can have large, unexpected consequences.

Chris Poland discussed performance-based engineering and how to use it to improve the performance and buildings and utilities in earthquakes.

Afternoon breakout sessions were:

- Critical Infrastructure
- Impact of Earthquakes on Rural Communities
- Spreading the Risk: The Role of Earthquake Insurance in Economic Recovery
- Business Continuity Lessons Learned from Past Events: Hurricane Katrina, Kobe, Japan Earthquake and Research Findings
- Land Use Planning, Policy and Earthquakes 101
- Scientific and Engineering Lessons from Past Earthquakes

Dealing with the Present

Seattle Mayor Greg Nickels, WSSPC Executive Director Patti Sutch, and Washington State Military Department Adjutant General Timothy Lowenberg opened Day 2.

Plenary 4, *Earthquake Hazards in the US,* followed. Mary Lou Zoback highlighted the geologic underpinnings of earthquake-prone regions across the US, and their resulting hazards. She pointed out that in most earthquakes, single-family residences (including both structure and contents) account for a majority of losses.

Jack Moehle presented a variety of scenario earthquake results, showing what would happen if selected earthquakes happened today.

- A repeat of the 1906 San Francisco earthquake could leave 1,800 to 3,400 dead, with 250,000 displaced households. Direct economic losses could total $150 billion.
- A projected magnitude 6.7 earthquake on the Seattle Fault could cause 1,600 deaths and 24,000 injuries. Nearly 10,000 buildings could be destroyed, with 27,000 unsafe to occupy. Direct economic losses could total $33 billion.
- A repeat of the 1811-1812 New Madrid earthquakes would affect 126,600 square miles with a population of 11 million. Damaged structures could leave 120,000 displaced households, 35,000 casualties, and $50 billion in direct economic losses.

National Earthquake Risk—Impacts and Vulnerabilities was the topic of Plenary 5. Philip Schneider presented HAZUS as an important planning tool. A national HAZUS study showed annualized earthquake losses

of $5.3 billion per year. Relatively high earthquake loss ratios exist in the western US (including Alaska and Hawaii); central states (New Madrid Seismic Zone); the Charleston, South Carolina area; and some parts of New England.

Susan Cutter explained vulnerability science: why some places are more vulnerable to natural hazards than others. Coupling the Social Vulnerability Index with seismic hazards can highlight the highest areas of vulnerability. Memphis was used as an example of how this tool can help policymakers.

Keith Porter reported on a major study that showed FEMA spent $3.5 billion on flood, earthquake, and wind hazards from 1993 to 2003, that led to a savings of $14 billion. In particular, earthquake grants of $947 million led to a benefit of $1.4 billion, a 1.5 benefit to cost ratio. The study also showed that mitigation is most effective when carried out on a comprehensive, community-wide, long-term basis.

Jim Stanton, Director of Communications for the British Columbia Olympia and Paralympics Winter Games Secretariat, was the luncheon speaker. He related the importance of preparation and mitigation before an international event such as the Olympics, and how natural hazards like earthquakes must be considered along with more traditional security issues.

Jack Hayes presented the Awards in Excellence.

Financial risks were highlighted in Plenary 6, *Earthquake Risk Management from a Financial Accountability Viewpoint*. Jill Combs, Joel Gaither, and Rebecca McQuade examined how to manage financial risks caused by earthquakes. Businesses are used to dealing with risks, and in one sense, natural hazards like earthquakes are of no more concern than others. Even regional disasters where facilities are located can happen with other hazards.

However, earthquakes provide specific problems, many of which can be foreseen, even though there is no warning time. USGS and local maps are an invaluable resource which some companies supplement with their own modeling. Another benefit from government programs is the upgrade of codes by cities and states to provide for safer buildings, which are the primary cause of earthquake damage.

For companies themselves, the cost of mitigation must compete with other priorities, always with an eye on shareholder returns. The enormous exposure of some companies causes them to employ several insurance and reinsurance companies.

Afternoon breakout sessions were:

- Tools of the Trade: ShakeMap, ShakeCast, PAGER, ENS, HAZUS, GIS, Scenarios, AGORA
- Building Earthquake Science and Engineering into Codes and Policies
- Temporary Populations: Evacuation, Planning, Problems and Procedures
- Addressing Tsunami Risk
- Communicating Risk and Risk Reduction
- Turning Mitigation into an Economic Advantage

The evening session was the webcast *Learning from the December 2004 Tsunami.*

Future Directions

King County Executive Ron Sims and NESEC Executive Director Ed Fratto opened Day 3.

Next was Plenary 7, *Overview of Resiliency—A Working Goal*. David Maurstad talked about the importance of a nation of communities that are resilient for all natural hazards. Mitigation can be supported by federal agencies, but must begin at home, with stakeholders such as elected officials, land use planners, builders, business leaders, and homeowners.

Kathleen Tierney outlined what contributes to resiliency. The number, size, and type of entities involved (businesses, governments, individuals, etc.), their relationships, interdependence, capacity for cascading failures, technological design, and organizational processes are just a few of the most important factors.

From the perspective of a community, resilience encompasses four domains: connection and caring; resources; transformative potential; and the extent of disaster management activities.

Rich Eisner explained the Bay Area Preparedness Initiative (BayPrep). An analysis of the San Francisco Bay Area preparedness showed that though the concept was seen as critical, no single sector (government, corporate, philanthropic, or non-profit organizations) was truly prepared. Problems included: unclear defi-

nition of preparedness; lack of objective measures; knowledge fragmented across sectors; duplication of efforts; lack of collaboration across sectors; and lack of intermediaries to facilitate regional approaches. The next step in the program is for philanthropic organizations to continue their efforts to improve area-wide capabilities.

Plenary 8 focused on *Building Community Resilience—Applications of Resiliency.* Krista Dillon explained that building local capacities takes community-based planning efforts; local commitment; leveraging funding and public-private partnership resources; quarterly training; service learning components; and identifying applied research needs. In addition, sustainable programs need: institutionalization; leadership; professional coordination; funding; and public-private partnerships.

Map Your Neighborhood is an application for community resiliency presented by LuAn Johnson. It breaks communities into neighborhoods of 15-20 households and shows what should be done in the first hour after an earthquake to ensure that people in the neighborhood are safe. *The 9 Step Response Plan* includes how to make a neighborhood map, showing items such as gas meters and homes of neighbors with special needs, and use it as a guide for response. For example, the simple act of keeping sturdy shoes under the bed would eliminate many instances of the most common injury—cut feet.

Post-earthquake disaster response must include more than providing food, water, and shelter, said William Matthews. The people who need such services after a disaster are only a fraction of the families and communities that must rebound from the event. Resiliency has been a hallmark of communities; it is only the tools they need in today's society that change.

The luncheon speaker was Jim Wilkinson, who discussed the next National Earthquake Conference.

A new electronic voting system was pioneered. During lunch, it was tested by polling the audience. A few of the questions and answers:

A. Which area of the country best represents where you live and/or work? (182 responses)

West	117
Midwest	11
East	17
South	16
Outside US	21

B. Who should be the target audience for the New Madrid Bicentennial Conference? (rating 1-low to 5-high)

Emergency managers	4.4
Elected officials	3.3
Business (CEO, CFO)	3.2
Government planners	2.7
Citizen groups	2.2
Engineers	1.3
Developers	1.0
Educators	0.9

C. What area should be the most important focus of the conference? (178 responses)

Preparedness	45
Mitigation	60
Research	18
Multi-state planning	38
Historical aspects	4
Other	13

Afternoon breakout sessions were:

- Establishing State Post-Earthquake Technical Clearinghouses
- Public/Private Partnerships for Economic Resiliency
- Creating and Using Earthquake Scenarios
- Cultural Implications of Earthquakes and Tsunamis
- Motivating and Preparing the Next Generation
- Volcano Science, Hazard, and Risk

Kathleen Tierney moderated the closing event, Plenary 9. The electronic voting system was used again. This time, discussion of questions was encouraged.

A few of the questions and answers presented, with major discussion points:

A. What discipline do you represent? (74 responses)

Earth sciences	20
Engineering	9
Emergency management	34
Social sciences	5
Business sector	6

Composition of the audience might have been more heavily geared toward emergency management and West Coast attendees than the rest of the conference.

B. What are the largest impediments to successful state earthquake programs? (80 responses)

Lack of resources (money and staff)	39
Lack of state and local level political support	36
Lack of coordination with federal partners	0
Lack of federal support	2
Other	3

State programs suffer from a lack of resources. There is still a disconnect between what science and history show is needed and what state and local policymakers support. There may be several reasons for this disconnect. Static or declining budgets give elected officials less money to work with. The relative infrequency of earthquakes makes them a low priority. The general public is not putting political pressure on elected officials for more earthquake protection.

C. What are the major barriers to local adoption and utilization of research findings (82 responses)

Lack of local commitment and funding	19
Research results that don't reach potential users	18
Lack of federal stimulus and resources	4
Lack of interaction between researchers and users	32
Other	9

As in question B, lack of local resources is a significant issue. However, more people found a problem with the relationship between researchers (and their research) and users. The more that local staff can interact with researchers, the more likely current research will be transferred to and implemented by local jurisdictions.

*D. Where are you expending most of your efforts **now** in doing your day-to-day job? (81 responses)*

Prevention	2
Preparedness	33
Mitigation	37
Response	6
Recovery	3

*E. Where would you like to be expending most of your efforts **three years from now?** (81 responses)*

Prevention	1
Preparedness	25
Mitigation	44
Response	5
Recovery	6

The greatest movement was people who wanted to move to mitigation (these are emergency management terms and might not mean the same thing to those outside that profession). The discussion that followed centered on funding. Responses were that most funding is not targeted to mitigation. It tends to be more available for preparedness, and sometimes must be intertwined with antiterrorist activities.

In many cases, using resources for multiple hazards is economic and useful. There are, however, some earthquakes programs have very specific needs, and those activities are often difficult to fund.

Mitigation covers a wide array of activities but as one person said, "Mitigation is fun." It's a positive action that feels good to do and results in more safety.

"Recovery is dreary," said one participant. Another disagreed, saying, "Recovery can be exciting, that's when you get the most done."

Everyone agreed that there are windows of opportunity for educating the public and policymakers, funding programs, and other projects. These moments are commonly found right after an event. The interlude between damaging earthquakes and tsunamis can be used to develop and write down projects and programs that need resources. When the opportunity presents itself, it can be taken advantage of with materials that are already prepared and ready to go.

Rating the conference

Attendees

After the conference, 196 participants turned in evaluations. Most people found the conference well-organized with new, relevant information.

The evaluation included a question about each attendee's background. Because they were able to choose more than one descriptor, the totals added up to over 500 responses.

The most common categories were:

Government/public administration	96
Emergency management/response	90
Geoscience	35
Risk management	35
Education/research	34
Strategic planning	30
Engineering	28
Policymaker	24
Private, for-profit	23
Insurance	22
Private, not-for-profit	16

Post-conference evaluations showed high marks.

	1 (no!)	2	3 (so-so)	4	5 (yes!)	Average rating	Number of responses
Did you gain insight into the earthquake risk issue at this conference?	3	5	19	72	89	4.3	188
Overall, was the conference worthwhile?	2	5	18	65	94	4.3	184
Will you attend a similar conference in four years?	6	18	25	52	85	4.0	186
Will you recommend the conference to others?	2	5	26	62	92	4.3	187
Will you take action(s) on what you learned about the earthquake issue?	3	9	18	69	86	4.2	185
Did you network with others whom you expect to hear from in the future?	4	8	22	48	105	4.3	187

Suggestions for the next event

Most people were happy with organization and content of the conference, but a few had suggestions for the future.

- Several people cited a desire for additional private sector representation and perspective. One commenter said, "I suggest marketing to business continuity, risk management, and security groups for the next conference and let them know that if they have employees in earthquake risk areas, this information, and the contacts available, are invaluable."
- Another commenter noted that most emergency management attendees were from state levels and added, "Having more participation from locals would make this better to help 'close the circle' between researchers, policymakers, facilitators, and implementors."
- Another suggested, "Collaborate with FEMA's Emergency Management Institute (EMI) and see if there are classes that could be taught at the conference. Perhaps state governments, such as California, have state-specific earthquake related courses that can be modified to be taught to anyone. Ask DHS for a catastrophic planning course, or some ICS courses. Work with private sector business continuity trainers, such as DRII. Make it so credits count for CEU's."
- In the discussion the last afternoon, several people expressed a desire for more policymakers to attend. Increasing this sector will require more thought about marketing to them and about how their experience at the conference would be most useful.

Program

The diversity of opinions about the content of the conference, probably reflected the diverse group of people attending. Most were happy with the spread of topics available and as one commenter said, "A real plus for the program was the multi-hazard application for most presentations." Another said, "People loved the 'Past, present, future' format."

Individual comments included:

- Some wanted more science and engineering, some wanted less. One evaluation said, "The three of us [engineers] were expecting a little bit more technical information especially on the breakout sessions." On the other hand, a commenter said there were, "Too many technical breakouts, geared more to the technical side than a general audience even though one of the objectives was to 'develop a shared understanding of scientific, engineering, and social research.' " Another said that, "It was difficult for those of us who do not hold that [scientific and technical] knowledge to follow along on some of the plenaries."
- Several comments focused on emergency management. Again there was a split between whether there should have more or less time devoted to it. One request was, "Add focus on response and recovery...mitigation and planning are before the event...what can be done immediately and longer term after the shake?"
- There was general approval of the growing amount of social sciences in the presentations, though like other sciences, the level of language was too technical for some.

- Ironically, the word "communication" showed a split in how participants of various disciplines use specific terms. To some, communication meant working with various constituencies to deliver appropriate messages. To others, it meant part of the critical infrastructure that must be maintained or restored quickly after an earthquake.
- The use of the same word to mean different things seems to be typical of the problems of having a wide variety of disciplines participating. One person cited the need for a lexicon of conference acronyms. Another suggested that researchers learn the Incident Command System and use that as a common language and structure for applying new information.

Suggestions for the next event

While people were generally satisfied with the content of the program, many suggestions were given for future plenary and breakout sessions, both organization and content.

Whatever the topic, several commenters liked the format of telling stories, rather than just data to convey information. Summed up one commenter, "…One of the recurring statements made at this conference was that people do not understand the concept of risk, but they do understand the idea of their own personal safety. That Webcast session demonstrated the power of a message about personal earthquake safety in a tsunami story presented by one that did not experience damages, and another that did and was well into recovery. I think future conferences should have at least one of these personal story telling sessions … all decision makers at any level act on their personal feelings, and nothing is more personal than safety. I believe that is why the antiterrorist movement in this country was able to divert funds and the attention of decision makers away from natural disasters, and if we are going to regain some of what we lost, we are going to have to use their tactics. A small dose of on point, personal story telling in the middle of all that logic based on hard science can go a long way."

1. Fewer plenaries, more breakouts

In general, the plenaries were popular sessions. The two commonly cited concerns about them were that some were too technical for a broad audience, and that people couldn't get to all the breakout sessions they wanted because of the amount of time spent in plenaries.

- However, several commenters wanted more breakouts and fewer plenary sessions. The plenaries need to be sessions that are targeted to the entire group of attendees, not an easy task with so diverse a base. As one emergency manager said of researchers, "I think what you do is very important but I really don't need all the details." The continuing challenge for this conference, however, is to fine tune the amount of detail given in plenaries, so they continue to satisfy participants like the one who said, "I appreciate the very broad yet focused discussions."
- Some suggested repeating breakouts, or having theme-tracked sessions, so more people could get to the sessions that most interested them. As one person said, "Breakout choices were tough—excellent competing subjects."

  A. "One [track] for emergency managers, another for researchers, tools/applications, emergency responders, private sector/business continuity, local/state government (decision-makers, land-use planners, etc). Solicit the help from each of these communities for development committees to bring in, or create, earthquake-related speakers and breakouts. Beefing up the breakout sessions and reducing the plenaries will increase personal choices and satisfaction."

  B. "Breakout tracks [for] building codes, mitigation, insurance, emergency planning, and research."

The program was rated well-organized and relevant.

	1 (no!)	2	3 (so-so)	4	5 (yes!)	Average rating	Number of responses
Was the program well organized?	0	3	8	81	99	4.5	191
Were the topics relevant to you?	0	10	40	77	63	4.0	190
Was most of the information presented new to you?	2	20	76	61	28	3.5	187
If you attended, how was your Blake Island evening experience?	2	3	8	18	17	3.9	48

C. "Concurrent workshops should be divided on three main topics: buildings and infrastructure, risk and vulnerability, outreach & best practices."

2. Potential topics

Many suggestions for future topics were made, some contradictory. Perhaps more breakouts would resolve some of these issues.

A. Geoscience/emergency management balance

- At one end were comments like, "I would like to see more on mitigation and preparedness... It seemed a lot of it was engineering, both structural and infrastructure."
- At the other end were comments like, "More focus on science/predicting/understanding physical risk/ building codes—engineering." More information about lifelines and critical infrastructure was also requested by a few.
- One suggestion to tie the two groups together was an exercise: "A plenary session could bring together scientists (to develop the scenario) and exercise EM staff in an effort to tie it together. This would be productive in stressing the importance of testing and validating plans to better prepare for the real world response to the event/incident."
- Some commenters wanted information about a wider geographic area. "It would be very helpful to have more information that can be used by areas that are not West Coast or New Madrid," said one. Others would have liked more rural topics, more coverage of Alaska and Territories (and please include Alaska and Hawaii on maps, asked several, especially in light of their earthquake risk). Because of the international scope of earthquakes, there was one plea to, "continue [the conference] in future while giving special chances for the peoples of countries like Pakistan, India etc."

B. Other science

- Commenters wanted to keep increasing the quantity and quality of social science representation. Information specific to the health care sector was also requested.

C. Insurance

- Another thread of comments requested more information about earthquake insurance. "There was one session on earthquake insurance, and it dealt strictly with the New Madrid fault and the Northwest area. No mention of other parts of the country, California for example, and their earthquake insurance policies," summed up one participant.

D. Communication and program development

- "How can I move the needle in my area?" asked one person, reflecting a general concern. " There was no information on how to convey the risk to people in your area in a REAL way… ."
- "I would like to see a conference with some sessions on steps to take in educating the public on preparedness and steps we can take in our mitigation efforts," said another. "Also, how can we communicate risk and safety to a population who is either resistant or face barriers such as language, disabilities, or who are poor and lack resources for information?"
- Many people asked for more information to bridge the gap between information and application. Typical requests were, "Specifics on program development and planning efforts," "Examples of how to bring the community into preparing," and "More on-the-ground experience with a real live event." A specific idea was, "A field trip to a Tsunami Ready Community and talk with the people in their neighborhood to get 'messages' from them."

Electronic voting

On the last day, a new electronic voting system was pioneered. The two caveats that emerged were the small number of people left at the Friday afternoon session (about 80 people participated) and the sometimes uneasy flow of questions and discussion. According to comments on the evaluations, some questions provoked discussions that could have lasted much longer, while other questions really didn't need discussion.

Some thought the session could have moved faster. Another summed up a popular response by saying, "The audience voting system was good at fostering conversation. However, the comments from the audience are always more important than the questions and should be fostered more."

Suggestions for the next event

- Most commenters were very supportive of this technology and would like to see it used again. One suggestion to improve it was, "Polling after each plenary/breakout; but reduce [the number of] questions." Another comment was, "I liked the last afternoon discussion. I wish people were more open…There were only a few, and the same people, talking."

The speakers were found to be knowledgeable, prepared, and informative.

	1 (no!)	2	3 (so-so)	4	5 (yes!)	Average rating	Number of responses
Overall, were the speakers informative, prepared, and understandable?	0	0	14	89	89	4.4	192
Were the speakers prepared?	0	0	7	78	106	4.5	191
Was the material presented understandably?	1	6	15	98	71	4.2	191
Were questions and discussion handled to your satisfaction?	0	4	25	84	74	4.2	187

- One person suggested using the tool at the next conference, with a different focus: "That [last] session might have better served to ask realistically about what the field needs to move forward.… That session could have been used to create a charge for research, projects, and policy development, so that when you all meet again in 2012, you can see how far you've made it."

Speakers

A big part of the success of the conference was the choice of speakers. More than 190 people answered the question, "Overall, were the speakers informative, prepared, and understandable?" An overwhelming 93% rated the speakers 4 or 5 (with 5 being high).

Speakers were deemed to be informative, prepared, and able to handle questions and discussions they provoked. A number of speakers were cited by multiple participants. Several people commented on the ability of the speakers to present information to participants from multiple disciplines.

A very common response was some version of, "Very good group of speakers!" "Excellent," "professional," "knowledgeable," even "amazing" were used frequently.

Suggestions for the next event

- Several commenters made suggestions for improvement. Some of these reflected the breadth of backgrounds in the audience. "Heavy on science," and "hard to understand the systems and engineering language" fell into this category. One commenter said the speakers were the best in their fields, which was great, but they heavily favored academia.
- Another group of comments focused on the downside of having speakers from government and political arenas. These ranged from a general statement that there was too much on government and policy to strongly felt comments that a particular speaker was so political that the participant wanted to walk out on him.
- Some participants were looking for more variety in presenters. "It often seems like the same speakers present at almost every earthquake conference…. Some people presented and/or moderated more than once," said one.
- Suggestions were also made on the slides used by presenters. One commenter said, "Death by PowerPoint!" Simpler (and readable by the audience) slides and diagrams were requested by others.
- Because of the amount of information given and the difficulty in taking notes, many participants were looking forward to getting copies of the presentations Many of them are available online, though not everyone was clear where they would be posted.

Exhibits

There were 27 exhibits and 23 posters at the conference. "I thought the vendors added to the conference and the attendees had ample time to spend with them," summed up one commenter. But more exhibits would have been welcome by a few.

Exhibitors were generally satisfied, though less so than other conference participants. Nine of them submitted evaluations. The average rating to the question, "Overall, was the conference worthwhile?" was 3.3 (with 5 being high).

In general, the accommodations and visitors to the booths were as expected, but exhibitors would have liked more motivation to get people to the area. As one commented, "You have to make people *have* to go into the exhibit area with food, drinks, etc. They should have to go through the exhibit hall to get to meetings, if possible."

Logistics

As with other aspects of the conference, those who filled out the evaluation forms were generally happy with the logistics of the event. The hotel, registration, and time of year were more than satisfactory.

Many specifically commented on the evaluation form that the conference staff and hotel were terrific. There were, however, some problems and suggestions for improvement:

Cost

- Most found the cost acceptable, but there were a few comments about the high price of the hotel, food, and Seattle in general. As one commenter said, "Our per diem is only $160 a day. Is NEC pricing itself out of the business of communication? While the hotel was overpriced, it was a first class operation. Meals, bar, and rooms were killers. If I was not supported, I could not attend at the price." However, another said, "Thank you for keeping the cost of the conference in check, this allows those of us from small/rural areas an opportunity to attend these valuable learning and networking functions."

Hotel and food

- Most people were happy with their rooms, but there were some registration problems, including the hotel running out of rooms at the conference rate.
- The most common complaint was that more coffee service and mid-morning/mid-afternoon snacks were needed. Using plastic bottles for water sparked several negative comments. One commenter said there was no thought given to food for special medical needs.

Timing

- Though most of the participants who filled out an evaluation sheet thought April was an appropriate time, not everyone agreed. "April is a busy month for natural hazards conferences meetings," explained one person. Another reason given to change the date was that Spring is hurricane/flood/tornado preparation season for some emergency managers.
- Some would like the frequency of the event increased. One commenter said, "Hold annually to provide momentum on seriousness and reality of earthquake…once every four year is like its outta sight and outta mind." Others suggested holding it every two or three years.

Networking

- Several people asked for greater networking opportunities. One suggestion was to cut down the amount of time speakers took at lunch. Another was to use, "breakfast as round-table for topics. I have seen the use of signs at tables to foster discussions (i.e., one morning regional signs, another could be an interesting question to discuss)." Yet another was to have an afternoon social hour each day.

Logistics were well handled.

	1 (no!)	2	3 (so-so)	4	5 (yes!)	Average rating	Number of responses
Were the hotel layout and accommodations adequate?	3	1	13	63	104	4.4	184
Was the conference food good?	0	6	41	66	74	4.1	187
Were session starting and ending times convenient?	1	2	10	77	99	4.4	189
Was your registration handled smoothly?	3	2	8	42	136	4.6	191
Was the time of year (end of April) convenient?	1	4	14	69	103	4.4	191
Did you find out about the conference in a timely manner?	0	1	2	57	130	4.7	190
Did the exhibits add to the value of the conference for you?	5	12	49	48	75	3.9	189

2008 National Awards in Excellence Winners

Awards were presented at the 2008 National Earthquake Conference
Awards in Excellence Luncheon, Thursday April 24, 2008

2008 WSSPC Lifetime Achievement Award

Lifetime Achievement Award in Earthquake Risk Reduction
Walter J. Arabasz
University of Utah Seismograph Stations

Overall Award in Excellence

Overall Excellence in Outreach
Washington Military Department, Emergency Management Division
Map Your Neighborhood: Building & Strengthening Disaster Readiness Among Neighbors

Awards in Excellence

Mitigation
Oregon Department of Geology and Mineral Industries
Statewide Seismic Needs Assessment of Oregon Schools and Emergency Facilities

Mitigation
Capitol Preservation Board
Utah State Capitol Seismic Retrofit and Restoration

Response & Recovery
Washington Military Department, Emergency Management Division
Broadcasters Tsunami Emergency Guidebook

Innovations
Ridg-U-Rak, Inc.
Ridg-U-Rak Seismic Base Isolation System

Outreach Program
Washington Military Department, Emergency Management Division and
Earthquake Engineering Research Institute
Seattle Fault Earthquake Scenario Project

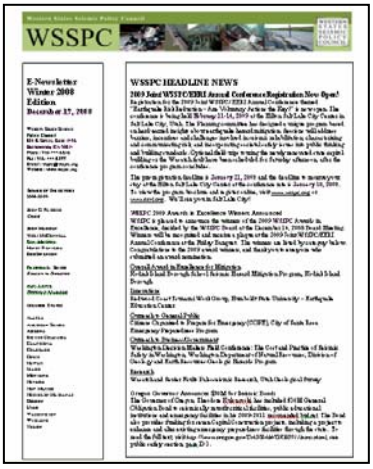
Outreach Program
Cascadia Region Earthquake Workgroup
Cascadia Subduction Zone Earthquake: A Magnitude 9.0 Earthquake Scenario

Plans/Materials
Emergency Preparedness for Industry and Commerce Council (EPICC)

For a complete listing of these and past award winners, visit our website at *www.wsspc.org/Awards/index.html.*

WSSPC eNewsletter

In 2008 WSSPC began a quarterly "eNewsletter" that highlights WSSPC news, recent earthquakes and other information relevant to the earthquake and emergency management communities. The eNewsletter is emailed to WSSPC members as well as other earthquake consortia, and FEMA and USGS contacts. After the eNewsletter has been emailed, it is posted to the WSSPC website, where previously released editions of the eNewsletter are also available for download. The WSSPC eNewsletter has been well received and we've begun receiving information and news items from WSSPC members and other organizations to be included in upcoming editions. To view the previously released eNewsletters at the WSSPC website, please visit *www.wsspc.org/Newsletters/index.html*.


WSSPC

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Winter 2008
Edition
Decemb er 17, 2008

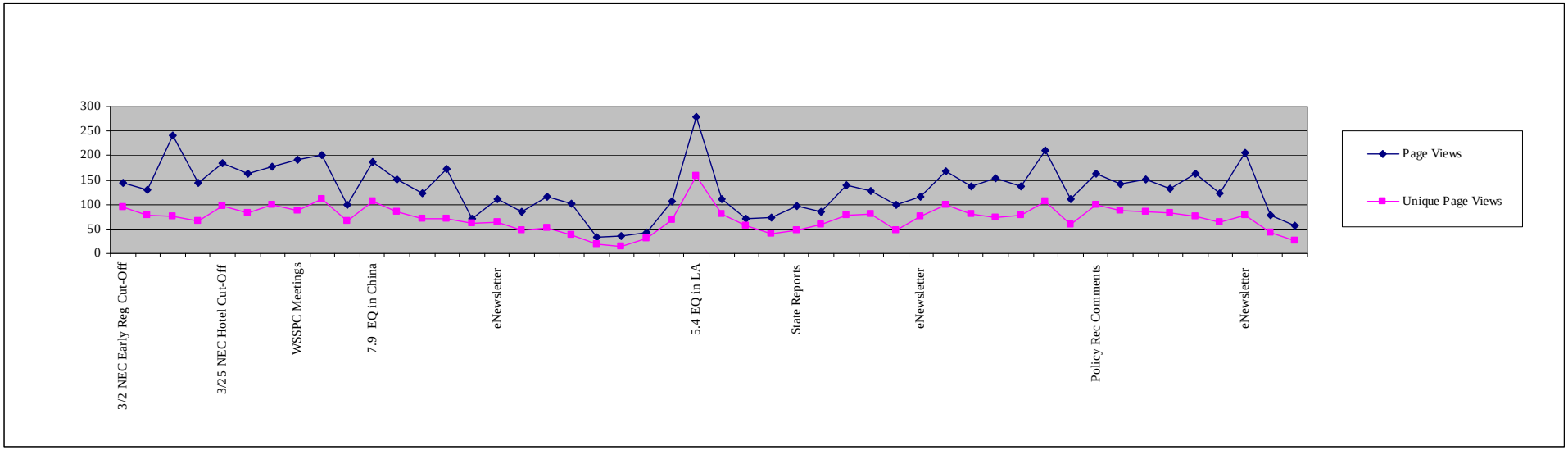
WSSPC HEADLINE NEWS

WSSPC Webpage Visitor Statistics

www.wsspc.org

On March 1, 2008, WSSPC began monitoring the number of visits to the WSSPC webpage through *www.mywebstats.org*. The online service tracks the number of visitors and unique visitors, and stores the information in daily and monthly reports. This information allows us to track the number of visitors to the WSSPC site on a regular basis and compare those numbers with the number of visitors to the site after an earthquake or WSSPC event. Statistics on Monday's visitors to the WSSPC site are collected every Tuesday morning and entered into an Excel spreadsheet. At the end of every month, the month's daily statistics are also entered. Any earthquakes that might have occurred, the release of the eNewsletter and/or other events that may prompt an increase in visitor base are recorded.

The number of visitors to the WSSPC site increased dramatically in the days following the Sechuan, China and Chino Hills, California Earthquakes and the dates leading up to 2008 National Earthquake Conference deadlines. There have also been spikes in visitors to the page upon the release of the WSSPC eNewsletters. The table and graph with the Monday counts are included on the following pages.


300
250
200
150
100
50
0
3/2 NEC Early Reg Cut-Off
3/25 NEC Hotel Cut-Off
WSSPC Meetings
7.9 EQ in China
eNewsletter
5.4 EQ in LA
State Reports
eNewsletter
Policy Rec Comments
eNewsletter
Page Views
Unique Page Views

Web Stats					
Date/Day	**Page Views Today**	**Total Views Since 03/01**	**Unique Views Today**	**Total Unique Views Since 03/01**	**Event**
Mon. 03/03/08	**144**	**247**	**94**	**137**	**NEC Early Reg Cut-Off (3/2/08)**
Mon. 03/10/08	129	925	78	583	
Thurs. 03/20/08	240	2163	75	1204	
Mon. 03/24/08	144	2379	67	1338	
Mon. 03/31/08	**184**	**3284**	**96**	**1807**	**NEC Hotel Cut-Off (3/25/08)**
Mon. 04/07/08	164	4115	82	2249	
Mon. 04/14/08	178	4882	100	2664	
Mon. 04/21/08	**191**	**5767**	**87**	**3161**	**2008 NEC/ WSSPC Meetings**
Mon. 04/28/08	200	6617	111	3706	
Mon. 05/05/08	99	7408	65	4199	
Mon. 05/12/08	**187**	**8283**	**107**	**4740**	**7.9 Magnitude EQ in China**
Mon. 05/19/08	152	9,240	84	5,248	
Mon. 05/27/08	124	9966	72	5677	
Mon. 06/02/08	173	10683	71	6020	
Mon. 06/09/08	71	11198	62	6321	
Mon. 06/16/08	**110**	**11723**	**63**	**6619**	**WSSPC eNewsletter Released**
Tues. 06/17/08	86	11800	47	6661	
Mon. 06/23/08	115	12281	52	6895	
Mon. 06/30/08	101	12787	37	7133	
Mon. 07/07/08	32	13043	18	7255	
Mon. 07/14/08	36	13323	14	7393	
Mon. 07/21/08	42	13601	31	7545	
Mon. 07/28/08	107	14000	69	7790	
Tues. 07/29/08	**278**	**14278**	**158**	**7948**	**5.4 Magnitude EQ in LA**
Mon. 08/04/08	110	14851	81	8276	
Mon. 08/11/08	71	15470	56	8623	
Mon. 08/18/08	73	15955	40	8849	
Mon. 08/25/08	**98**	**16333**	**47**	**9059**	**State Reports Announcement**
Mon. 09/01/08	85	17096	58	9370	
Mon. 09/08/08	139	18133	79	9932	
Mon 09/15/08	127	18950	81	10361	
Mon 09/22/08	100	19593	48	10706	
Wed 09/24/08	**115**	**19803**	**75**	**10836**	**WSSPC eNewsletter Released**
Mon 09/29/08	167	20331	100	11135	
Mon. 10/06/08	137	21345	80	11596	
Mon. 10/13/08	154	22141	74	12053	
Mon. 10/20/08	137	22898	79	12478	
Mon. 10/27/08	211	23843	107	12987	
Mon. 11/03/08	112	24803	60	13633	
Mon. 11/10/08	**164**	**25547**	**99**	**14007**	**Email : Policy Rec Comments**
Mon. 11/17/08	142	26710	88	14625	
Mon. 11/24/08	152	27660	85	15165	
Mon. 12/01/08	132	28147	83	15482	
Mon. 12/08/08	162	28979	76	15972	
Mon. 12/15/08	122	29776	64	16402	
Wed. 12/17/08	**206**	**30112**	**77**	**16551**	**WSSPC eNewsletter Released**
Mon. 12/22/08	79	30550	43	16740	
Mon. 12/29/08	57	30822	27	16888	

2008 WSSPC Policy Recommendations

Policy recommendations approved by the WSSPC membership are reviewed for currency every three years.

The following are current policy recommendations issued by WSSPC:

Policy Recommendation 08-1
Improving Tsunami Public Education, Mitigation, and Warning Procedures for Distant and Local Sources

Policy Recommendation 08-2
Definitions of Fault Activity for the Basin and Range Province

Policy Recommendation 08-3
Earthquake Monitoring Networks

Policy Recommendation 08-4
Identification and Mitigation of Unreinforced Masonry Structures

Policy Recommendations 07-1 & 07-2
Rapid Tsunami Identification and Evacuation Notification

Policy Recommendation 07-3
Post-Earthquake Technical Clearinghouses

Policy Recommendation 07-4
Seismic Provisions in the International Building Code

Policy Recommendation 07-5
Basin and Range Province Earthquake Working Group(s)

Policy Recommendation 07-6
Post-Earthquake Information Management System

Policy Recommendation 06-1
Developing Earthquake Risk-Reduction Strategies

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 08-1

Improving Tsunami Public Education, Mitigation, and Warning Procedures for Distant and Local Sources

Policy Recommendation 08-1

WSSPC supports strong, immediate and positive action from federal and state agencies to reduce the potential loss of life caused by tsunamis.

Specifically, WSSPC recommends robust, effective, and fully maintained implementation of the deep-sea tsunami detection system by NOAA, and expanding the efforts by NOAA and the USGS and WSSPC members to enhance public education programs about the potential for local tsunami impacts and the need to evacuate threatened areas immediately after strong or sustained ground shaking.

WSSPC recommends full and timely appropriation of specified funds to the National Tsunami Hazard Mitigation Program (NTHMP) as described in the Tsunami Warning and Education Act of 2006.

Background

Tsunamis can be the most destructive and deadly hazard that results from an earthquake, not only to nearby coastal areas, but occasionally to regions thousands of miles from the source. The 1946 and 1964 Alaskan earthquakes produced tsunamis that caused damage and/or loss of life in Hawaii, American Samoa and along the coasts of British Columbia, Washington, Oregon and California. The Pacific Tsunami Warning Center at Ewa Beach, Hawaii, and the West Coast and Alaska Tsunami Warning Center at Palmer, Alaska, were established as a result of these destructive tsunamis and because of the need to warn coastal populations of tsunamis from distant sources.

Alarms triggered by earthquakes that failed to produce tsunamis have been a major concern associated with past warning systems and continue to be a concern even as warning systems improve. Unnecessary evacuations not only create financial burdens on coastal communities, but may cause people to ignore a real threat in the future. Additionally, unnecessary evacuations are risky to public safety. Programs to reduce unnecessary evacuations have been developed and implemented through the NTHMP. These programs are designed to ensure that the messages

from the tsunami warning centers are accurate and timely, and that they significantly reduce the number of unnecessary evacuations.

Nevertheless, Pacific States, Provinces and Territories still must plan for local coastal earthquakes that provide little or no time to issue a general public warning of a destructive tsunami. Subduction zone earthquakes, like the December 2004 Sumatra Earthquake (M 9.1) and subsequent tsunami, can cause the largest loss of life in tsunami-at-risk coastal communities, particularly those close to the source. The recently released 2008 Uniform California Earthquake Rupture Forecast (UCERF) estimates a ten percent probability of a M 8.0 or greater earthquake somewhere along the Cascadia Subduction Zone (Cascadia Megathrust) in the next 30 years. During the past century, the Alaska-Aleutian subduction zone had a M 8.0 or greater earthquake on the average of every 16 years, four of which produced destructive tsunamis.

Therefore, it is vitally important to educate coastal residents, businesses, and visitors about the importance of immediate evacuation to high ground upon cessation of strong or sustained ground shaking. In areas where no high ground is nearby, vertical evacuation in approved engineered structures may be the only option to survive a tsunami impact. Through the use of scientifically researched and developed tsunami inundation models and maps, community evacuation plans must be developed showing evacuation routing and safe zones.

Tsunami Outreach

WSSPC supports the vital efforts to reduce loss of life caused by tsunamis through concentrated public education. Public education must be institutionalized and consist of continuous instructional programs that are reinforced by exercises and training, and subsequently measured using social science surveys to determine programmatic effectiveness. In the case of many locally sourced tsunamis, the time before impact is so brief that the most effective means for protecting the public is not through warning systems, but through community outreach and education. Buoys, sirens, and loudspeakers, etc., are meaningless if the general public does not know what to do in the critical few minutes following an earthquake that generates a damaging tsunami.

Distant Source Tsunamis

WSSPC supports the efforts of the U.S. Geological Survey (USGS) and National Oceanic and Atmospheric Administration (NOAA) to expand the deployment, maintenance, and improvement of the nation's seismic monitoring system and the deep-ocean tsunami detection system for the

purposes of rapidly and accurately detecting distant-source tsunamis, and reducing false warnings and watches that result in unnecessary evacuations. WSSPC further supports NOAA's effort to develop tsunami forecasting tools for coastal communities.

Local Source Tsunamis

WSSPC supports expanding the efforts of NOAA, the USGS, and the coastal members of WSSPC through the National Tsunami Hazard Mitigation Program (NTHMP) for: (1) research and identifying all forms of local tsunami sources (such as submarine landslides); (2) mapping and modeling of the tsunami inundation zone; (3) developing tsunami evacuation maps and routes; (4) implementing a public rapid warning system; and, (5) maintaining a continuous public education program about the potential for local tsunamis and the need to evacuate immediately after strong or sustained ground shaking stops.

Facilitation and Communication

WSSPC will write letters to NOAA, the USGS, and FEMA offering continued support for increased deployment of deep-ocean tsunami detection systems, the development of a tsunami forecasting model, continued improvement of seismic monitoring to better detect tsunami-generating earthquakes, public education, and other long-term risk reduction efforts. While WSSPC supports these Federal activities, the activities should not be funded at the expense of continued and required support of State and local tsunami mitigation and education activities.

WSSPC will write letters to key Congressional representatives and to NOAA urging their support and funding for the Tsunami Warning and Education Act (2006), and for the full and timely appropriation of specified funds to the state programs as described in the Act.

Assessment

The effectiveness of the support letters will be measured in part by the continued financial support for the seismic monitoring system, the open ocean tsunami detection system, inundation mapping and mitigation by the NTHMP, and the full funding of the Tsunami Warning and Education Act.

In turn, the effectiveness of the seismic monitoring and tsunami detection systems will be measured by the successful and timely identification of destructive tsunamis from local and distant sources and the continued reduction of unnecessary evacuations.

The effectiveness of the evacuation route maps and educational campaigns can be measured in the short term by public awareness polling funded through the National Tsunami Hazard Mitigation Program, and in the long term by the minimal loss of life from a local tsunami, because people responded appropriately.

History

WSSPC Policy Recommendation 08-1 was first adopted in 1999 as WSSPC Policy Recommendation 99-1. It was reviewed, revised and re-adopted as WSSPC Policy Recommendation 02-1 by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting September 18, 2002. It was reviewed, revised and re-adopted as WSSPC Policy Recommendation 05-1 by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting September 14, 2005. It was reviewed, revised and re-adopted as WSSPC Policy Recommendation 08-1 by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting April 22, 2008.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 08-2

Definitions of Fault Activity for the Basin and Range Province

Policy Recommendation 08-2

WSSPC recommends that the following definitions of fault activity be used to categorize potentially hazardous faults in the Basin and Range physiographic province:

Holocene fault – a fault whose movement in the past 10,000 years (11,500 cal yr B.P.) has been large enough to break the ground surface.

Late Quaternary fault – a fault whose movement in the past 130,000 years has been large enough to break the ground surface.

Quaternary fault – a fault whose movement in the past 1,800,000 years has been large enough to break the ground surface.

It should be emphasized that some historical magnitude 6.5 or greater earthquakes that produced surface faulting in the Basin and Range Province occurred on faults that have not been active in the Holocene; furthermore, earthquakes in the Province may occur on faults in all three categories. It is the responsibility of the user to decide what level of earthquake hazard (surface fault rupture and ground shaking) is acceptable for a specific structure or application.

Background

Future large, surface-rupturing earthquakes in the Basin and Range Province most likely will occur on faults that display evidence of prior large surface displacements during Quaternary time. The time when the last major earthquake occurred on a fault and the time interval between the most recent earthquake and earlier earthquakes are factors that influence the probability of when a similar-size earthquake might occur within a given time period. For example, a fault that has a major earthquake on average every 1000 years is more hazardous than one that has a major earthquake on average every 100,000 years. It is up to the user to decide what degree of fault activity is considered “hazardous” and what level of hazard is acceptable. Depending on the intended use of the land (critical facilities, fire stations, hospitals, schools, residences, picnic grounds, etc.), different levels of seismic hazard and risk may be acceptable. In addition, understanding the frequency and size of earthquakes on a fault is critical when deciding whether to build across the fault, and when estimating the probabilities of ground shaking at varying distances

from the fault. It should be noted, that historical, damaging, moderate to large (< M 6.5) earthquakes have occurred on faults in the Basin and Range Province which do not have any obvious expression at the ground surface.

A **Holocene** criterion (10,000 years {11,500 cal yr B.P.}) to characterize potential fault activity has significant precedence, principally from its past usage and application in California. For purposes of implementing the Alquist-Priolo Earthquake Fault Zoning Act, the California Code of Regulations defines an active fault as *Holocene Active*, that is, there is evidence of surface rupture within approximately the past 11,000 years, although local governments may use a broader definition. The *Holocene Active* definition also has a practical applicability because climate change following the most recent major glaciation has resulted in many recognizable soil horizons and geomorphic surfaces that are used to help date fault activity. Because major historical earthquakes have occurred in the Basin and Range Province on faults that do not show surficial evidence of previous Holocene activity, the Holocene Epoch is too short to span the range of average earthquake recurrence intervals (average earthquake repeat times) on faults in the Province.

A **late Quaternary** criterion (130,000 years) uses the onset of the Sangamon interglacial period as a datum and spans many of the average fault recurrence intervals in the Basin and Range Province. All but one of the major historical earthquakes in the Province occurred on faults that show evidence of late Quaternary activity.

The **Quaternary** Period (1,800,000 years) represents the onset of a major climatic change to the current cycle of glacial/interglacial intervals, during which most of the surficial alluvial deposits and much of the present landscape in the Basin and Range Province formed. All the major historical earthquakes in the Province have occurred on faults that show evidence of Quaternary-age movement at the surface. A Quaternary criterion encompasses an average recurrence interval for essentially all the faults that might produce future earthquakes.

The Basin and Range Province is a large extensional tectonic domain that contains thousands of normal-slip and strike-slip Quaternary faults involved in contemporary deformation. Large earthquakes in the Province, especially those that are associated with surface rupture, commonly involve multiple, distributed faults, and have occurred on faults that have a wide range in the time since their most recent surface-faulting earthquakes. This tectonic behavior in the Province differs

from the more focused, higher slip-rate tectonics of the plate boundary system in western California. These different characteristics may warrant different considerations, such as the activity criterion used when establishing fault setbacks and identifying potential earthquake sources.

The identification of faults that pose an earthquake hazard requires application of a fault-activity criterion to exclude ancient faults that are unlikely to rupture during future earthquakes. This criterion allows society to develop guidelines for identifying potential surface-rupture and ground-motion sources. Two fundamental parameters are needed to characterize fault activity for the purposes of hazard assessments: the amount of displacement that occurred during large, surface-faulting earthquakes and the time interval over which the earthquakes occurred, which in some cases can be expressed as an average recurrence interval between earthquakes. These data are used to calculate the fault's geologic slip rate, which is net displacement divided by the time interval over which the strain accumulated that resulted in displacement. Fault slip rates, typically expressed in mm/yr or m/kyr, provide a quantifiable measure of fault activity; the higher the slip rate, the more active the fault.

There are several examples of Basin and Range Province faults that have had major historic movement, but lacked evidence of Holocene or late Quaternary activity. The most dramatic example of the latter is the 1887 Sonoran earthquake in northern Mexico. Different lines of reasoning suggest that prehistoric surface rupture occurred at least 100,000 to 200,000 years ago (Bull and Pearthree, 1988). The 1954 Fairview Peak, Nevada, earthquake (Bell and others, 2004) is another example of a major historic earthquake on a fault that lacked evidence of Holocene displacement (Pearthree, 1990; Caskey and others, 2004). The 1954 Dixie Valley, Nevada, earthquake occurred on a fault zone that has evidence of Holocene activity, but also ruptured major portions of fault traces that lacked Holocene displacement (Bell and Katzer, 1990). Major earthquakes have occurred on faults that had Holocene displacement as well, such as the 1983 Borah Peak, Idaho, earthquake (Hanks and Schwartz, 1987). More than one-half of the major historical earthquakes in the Province produced surface faulting on faults that appear to lack Holocene activity. Thus, the Holocene criterion is a useful but not an complete indicator of where future large earthquakes may occur in the Basin and Range Province.

Prehistoric earthquakes that produced surface ruptures on faults within the Basin and Range Province have a range of recurrence intervals that span from hundreds of years to hundreds of

thousands of years. Recurrence intervals of a few thousand to tens of thousands of years are typical. One of the most comprehensive and detailed paleoseismic studies in the Province was undertaken as part of the site characterization of the proposed high-level nuclear waste repository at Yucca Mountain, Nevada. That study revealed that average recurrence intervals for many of the faults at and near Yucca Mountain are between 20,000 and 100,000 years (e.g., Wong and others, 1995). A range of earthquake recurrence intervals can be estimated by considering the typical range of vertical slip rates for faults in the Basin and Range Province (0.01 to 1.0 mm/yr) and typical surface displacements during major earthquakes (1 to 3 m). This yields a range of potential recurrence intervals of 1,000 to 300,000 years.

Elapsed time since the most recent large earthquake and average earthquake recurrence intervals are important parameters needed when determining fault activity levels and earthquake hazard. They should be evaluated along with other considerations related to levels of acceptable hazard and cost/benefit ratios when evaluating earthquake risk for a specific purpose.

Facilitation and Communication

WSSPC recommends that government agencies, regulators, and owners consider these fault-activity definitions when determining which faults are hazardous for specific facilities or purposes. For some facility types, active fault definitions are contained in state and federal regulations. Such regulations commonly use different definitions of fault activity based on the societal importance of the facility being built. Definitions that include less active faults or require more restrictive mitigation measures are typically used for critical facilities where the effect of the facility's failure has grave consequences.

When assessing the impact of future earthquakes, factors to consider are the type of facility and its societal importance; level of acceptable risk; goals, costs, and benefits of risk reduction; and geologic practicality of applying the definition. An example of the latter is found in areas of the Basin and Range Province where widespread latest Pleistocene pluvial lake or glacial deposits facilitate the use of a Holocene criterion, but where the use of a late Quaternary criterion may be impractical because the evidence of activity on some faults of that age is buried by younger deposits. The expense of risk-reduction measures must be balanced against the probability of earthquake occurrence and the resulting risk to society in terms of public safety and potential economic loss. Use of these three broad fault-activity definitions (Holocene, late Quaternary, Quaternary) aid in choosing the appropriate activity class for a proposed facility. It is ultimately up

to the regulator and owner to decide how the hazard should be categorized and addressed, although uniform treatment among Basin and Range Province states is desirable.

Assessment

The success of this Policy Recommendation can be assessed based on the use of the definitions by states and local governments in regulations and ordinances. Utah, Colorado, and Clark County, Nevada have adopted these definitions in an earlier version of this WSSPC Policy Recommendation. A periodic re-evaluation of these and other federal, state, and local entities should be made to determine the extent to which these definitions are being incorporated into future seismic-hazard rules, regulations, and guidelines.

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History

WSSPC Policy Recommendation 08-2 was first adopted in 1997 as WSSPC Policy Recommendation 97-1. It was reviewed and re-adopted as WSSPC Policy Recommendation 02-3 by unanimous vote of the WSSPC membership at the Annual Business Meeting September 18, 2002. It was reviewed, revised, and re-adopted as WSSPC Policy Recommendation 05-2 by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting September 12, 2005. It was reviewed, revised, and re-adopted as WSSPC Policy Recommendation 08-2 by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting April 22, 2008.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 08-3

Earthquake Monitoring Networks

Policy Recommendation 08-3

WSSPC advocates the continuation and expansion of earthquake monitoring networks as envisioned and supported by the Advanced National Seismic System (ANSS). ANSS emphasizes strong-motion instrumentation of urban ground-motion monitoring sites and selected engineered structures as well as increased broadband seismograph instrumentation. The resulting data provide better understanding of future ground shaking potential, provides rapid information for emergency response, and insights for the design of more earthquake-resistant new and retrofitted construction.

WSSPC calls upon all parties committed to earthquake loss reduction to advocate greater support of the U.S. Geological Survey's efforts to expand ANSS monitoring and to standardize data collection, processing, and storage. WSSPC encourages the USGS to strengthen partnerships to further these efforts with emergency managers, engineers, and corporate response and business interruption planners, as well as State and local agencies.

Background

Earthquake monitoring networks are vital both to respond to earthquakes and to characterize earthquake hazards. The earthquake parameters produced by modern seismic networks, when combined with historic earthquake catalogs and the paleoseismic record, are essential input for developing the Nation's probabilistic seismic hazard maps and analyses. Automated processing of earthquake information by seismic networks in the United States provides near-real time information on earthquake locations, magnitudes, and patterns of moderate and damaging ground shaking. In the last few years, seismologists have expanded the capabilities of the seismic network system in some areas to routinely produce ShakeMaps, fault orientations and slip distributions, and aftershock probabilities. In California, ShakeMap has become a valuable tool to assist emergency responders in identifying the possible extent of earthquake damage. Finally, strong-motion data (now increasingly available in real-time) are essential to evaluate the engineering relationship of structural damage to severity of ground shaking.

During the 1960s, the U.S. Geological Survey (USGS) began to operate, support and coordinate local seismic networks that were sensitive enough to detect microearthquakes, including aftershocks of

larger earthquakes. Data from these early seismograph networks were used to delineate the spatial relationships between earthquake epicenters and active faults. Earthquake networks provide fundamental earthquake data in the form of catalogs describing hypocenter location, time of occurrence, and magnitude. These data find uses in diverse applications ranging from earthquake hazard analysis to disaster response. Seismic networks throughout the U.S. have provided fundamental data for the U.S. Geological Survey's National Seismic Hazard Mapping Project, which is generating state-of-the-art earthquake hazard maps for the U.S. The availability of earthquake monitoring network data has led to new and innovative research that has advanced the field of seismology through an improved understanding of the physics of earthquake occurrence.

Despite the importance of its products, earthquake monitoring in the United States faces many problems and challenges, the most notable of which are:

- Outdated, inadequate instrumentation
- Separation of functions between strong- and weak-motion monitoring systems
- Lack of sufficient and uniform geographic coverage in areas at risk
- Lack of uniform operational standards
- Well-established independent networks with non-standardized and even incompatible equipment, operations, products, and funding sources.

Many of the currently deployed instruments record only high frequency (1-25 Hz), vertical motions over a very limited dynamic range. Known as "short-period" seismographs, these analog instruments are extremely sensitive, recording even tiny microearthquakes. However, moderate and larger magnitude earthquakes drive short-period seismograph signals off-scale. The full amplitudes of shaking cannot be recorded and the resulting waveforms are highly distorted.

For the western states, modern monitoring of earthquakes is crucial. The largest proportion of the Nation's seismic risk is in the western states. However, large and damaging earthquakes are not limited to California. Two of the largest earthquakes in the lower 48 states during the past four decades have occurred in the Northern Rocky Mountain region (magnitude 7.3 1959 Hebgen Lake, MT; and magnitude 6.9 1983 Borah Peak, ID). Yet, the Northern Rocky Mountain region remains the largest seismically active region of the lower 48 states without sufficient modern instrumentation.

The recent advent of digital instrumentation has revolutionized seismology. High-fidelity earthquake data transmitted in real-time via terrestrial and satellite communication links and analyzed with

modern techniques rapidly provide data and results essential for all aspects of seismology. Modern dataloggers coupled with broadband and strong-motion sensors have the capability to record the full spectrum of earthquake-related ground motions—everything from the high frequencies of nearby earthquakes to the low-frequency, rolling motion of distant earthquakes. Most importantly, digital instruments have dynamic range sufficient to detect tiny earthquakes and yet able to remain on-scale for a major, nearby earthquake. Additionally, all three axes of ground motion (up-down, north-south, and east-west) are recorded (as opposed to only the vertical direction of ground motion recorded by most current network seismographs). High-quality recordings by even a few broadband seismographs from earthquakes with magnitudes as small as 3.5 allow computations that uniquely characterize the type of faulting, amount of energy released, and the stress field responsible for the quake. Likewise, high-quality strong-motion recordings in the urban environment are necessary to understand how seismic shaking can cause damage to buildings and other structures. All this information is now immediately posted to the Internet, and datacenters provide ready access to the information for rapid response and recovery and long-term research.

The vision of the next generation of national earthquake monitoring, the Advanced National Seismic System (ANSS), was issued in 1999 by the U.S. Geological Survey, which has now begun its implementation. Its design has been developed in consultation with earthquake specialists in academia and the States together with the engineering community. The mission of the Advanced National Seismic System is to provide accurate and timely data and information on earthquakes and their effects on buildings and structures, employing modern monitoring methods and technologies.

Since the ANSS was established by Congress in 2000, the USGS has fostered the organization of seven regional networks developed through incorporation of local efforts into regional systems. The seven networks are in California, the Pacific Northwest, Alaska, Hawaii, the Intermountain region, the Central U.S. (including the Southeast), and the Northeast. With USGS support, the newly established ANSS regional networks have installed almost 800 new and upgraded monitoring stations in 24 states since its inception. The largest numbers of new stations are in Alaska, California, Nevada, Utah and Washington, and most have been installed in urban areas where seismic risk is high.

Automated processing of earthquake information by seismic networks provides near-real-time information on the Internet about earthquake location, magnitude, fault orientation, slip distribution, and aftershock probabilities. Together with other parties, the USGS has developed ShakeMap, an analytical methodology that creates maps of the severity of ground shaking developed from ground-

motion data recorded by the newly installed ANSS instrumentation and other modern stations. ShakeMaps are posted to the Internet within minutes following earthquakes and also are distributed through technologies like CISN Display and ShakeCast. The initial maps are automatically revised as new seismic data become available. In areas of California with a relatively dense distribution of strong-motion seismometers, ShakeMap can help emergency managers immediately identify areas that have been exposed to strong shaking before damage reports are available. ShakeMap is being used in conjunction with earthquake loss modeling to make preliminary estimates of earthquake damage costs.

The planned ANSS instrumentation of engineered structures to monitor their responses to earthquake ground motion is just beginning. Because of limited funding, only a few buildings have been instrumented so far. This type of monitoring is very important to the establishment of better building code requirements and design practices to achieve improved earthquake resistance in both new construction and retrofitted structures. Following damaging earthquakes, real-time monitoring of the response of lifelines and buildings will also be valuable in emergency response.

Facilitation and Communication

WSSPC recommends expansion of the regional free-field real-time earthquake monitoring in the western states and throughout the Nation. WSSPC also endorses the expansion of monitoring of engineered structures in order to use insights from investigation of their earthquake performances in the creation of better design procedures and construction standards. To accomplish such expansion, WSSPC encourages the USGS to form partnerships to further these efforts with the emergency managers, engineers, and corporate response and business interruption planners, as well as State and local agencies. In addition, recognizing the synergistic aspects of the National Science Foundation's EarthScope Program, which is deploying temporary seismic and GPS instruments, WSSPC encourages the USGS to take full advantage of EarthScope instruments in fulfilling the mission of ANSS. WSSPC commends those states that are partnering with ANSS to fund modernizing and increasing the numbers of seismic monitoring stations.

The ANSS funding to date as being a small fraction of the planned and requested capitalization needed to build out ANSS, although there has been some incremental growth. By 2009, most of the appropriated funds will be needed to maintain the operation of the current ANSS complement of stations, not to add more. There are more than 6,000 stations needed to meet the ANSS requirements.

Assessment

The success of this policy can be assessed by the increase in the number of engineered structures with strong motion instruments, the level of funding available for maintaining and enhancing networks, and the evidence of partnerships implementing seismic networks among the USGS, state and local agencies, and the private sector.

History

WSSPC Policy Recommendation 08-3 was first adopted in 1997 as WSSPC Policy Recommendation 97-4. It was reviewed, revised, and re-adopted as WSSPC Policy Recommendation 02-5 by unanimous vote of the WSSPC membership at the Annual Business Meeting September 18, 2002. It was reviewed, revised, and re-adopted as WSSPC Policy Recommendation 05-3 by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting September 12, 2005. It was reviewed, revised, and re-adopted as WSSPC Policy Recommendation 08-3 by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting April 22, 2008.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 08-4

Identification and Mitigation of Unreinforced Masonry Structures

Policy Recommendation 08-4

Unreinforced masonry bearing wall structures represent one of the greatest life safety hazards and economic burdens to the public during a seismic event. WSSPC recommends 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 which will effectively address the reduction of this hazard.

Background

During earthquakes, unreinforced masonry (URM) structures are vulnerable to catastrophic collapse and represent a significant life safety threat, as occurred in the 2008 Wells, Nevada earthquake. Unreinforced masonry structures are made from brick, hollow clay tile, stone, concrete blocks, or adobe materials that are not strengthened by the addition of steel rods or other bracings. Common building examples include older industrial complexes, schools, mercantile establishments, and private residences.

Also of concern are components of these structures such as walls, unsupported parapets, and fireplace chimneys, which can fall on pedestrians or other people trying to exit a building. The masonry usually is held together with weak mortar and is unable to resist lateral forces. Wall and roof anchorage tend to be inadequate, allowing floors and roofs to separate from the walls and collapse. Historically, this has been a major contributing factor to loss of life in earthquakes throughout the world.

Unreinforced masonry is recognized by the Federal Emergency Management Agency as one of the structural types most prone to failure during an earthquake. A review of the USGS Hazards Program listing earthquakes which generated 1,000 or more deaths since 1900 shows that unreinforced walls are a significant contributing factor in losses to both the financial sector and in human lives.

WSSPC strongly believes that jurisdictions must be proactive to address this threat to their citizens. Legislatively mandated programs and/or local municipally adopted ordinances have proved effective at addressing this risk.

WSSPC recognized that there is a societal cost to the inventory and remediation of unreinforced masonry buildings, but in those areas of high seismicity, failure to address this issue will have chilling effects. In order to minimize the cost and make programs more politically acceptable, the three-stage approach of identifying the population of hazardous buildings, analyzing the risk presented by these buildings, and retrofitting those buildings deemed to be a hazard is recommended.

It is realized that resistance is to be expected when dealing with retroactive ordinances. However, as can be seen by those areas which have adopted fire sprinklers retroactively, versus those which have not, even minimal remediation can yield discernable life saving results. Standardized retrofit concepts for unreinforced masonry structures are available through FEMA publications; however, this in no way negates the need for local engineering analysis and design.

Facilitation and Communication

Implementation

WSSPC recommends that States adopt a program to identify the extent of risk that unreinforced masonry structures represent in a community.

The first phase involves creating an inventory of unreinforced masonry structures and is a relatively low cost process. State and local entities, including school districts, should be responsible for identifying their own URM structures. A review of the locally adopted codes is necessary. All structures built under the Uniform Building Code of 1961 or later should have been reinforced, although this should be verified by field inspections.

Private owners of structures erected prior to the effective date of the 1961 Uniform Building Code should be notified that their buildings may be a potential threat to human health and safety and require professional structural inspection with submittal of the inspection findings to an appropriate agency. This inventory process may take several years, but upon completion a more accurate assessment of a community's risk will be evident.

As a second step, the development of a plan to mitigate this hazard will need to be addressed. Using a multi-pronged approach, including obtaining grant funding when possible, incentives to reduce taxes, possible adjustment of permit application fees, or the providing of design and construction assistance, may make mitigation a more workable option. Neither litigation nor forced abandonment of these structures is desirable. The reduction in occupancy or limitations on use may be an acceptable risk option. Permits issued for the sole purpose of seismic retrofitting should not affect or trigger additional jurisdictional requirements or property tax increases.

Alternate Implementation Plan

WSSPC recommends that each State, province or territory implement the three-phase approach to reducing the risk presented by unreinforced masonry buildings by doing the following:

1. Adopt a legislative initiative requiring the inventory of unreinforced structures within a jurisdiction ;
2. Develop, or cause to have developed, a mitigation plan that identifies hazardous structures and includes a cost benefit analysis; and,
3. Implement a URM structures program through:
    a. Completing mitigation design and retrofit,
    b. Abandoning use of the structure, or
    c. Controlling use and occupancy to minimize the potential risk.

Assessment

The effectiveness of this policy can be determined by maintaining an inventory of states, provinces and territories with active programs to mitigate the dangers of unreinforced masonry bearing wall structures. By collecting and identifying these individual efforts, WSSPC will provide a clearinghouse of information which can be used to help promote the policy and advocate its use.

The inventory should be administered annually and contain sufficient detail to help identify the types of programs instituted and their effect in the affected regions.

History

WSSPC Policy Recommendation 08-4 was adopted by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting April 22, 2008.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATIONS 07-1 and 07-2

Rapid Tsunami Identification and Evacuation Notification

Policy Recommendation 07-1

Promote the development of tsunami evacuation and re-entry notification systems, supplemented with an education campaign, that insure all populated coastal areas in the WSSPC coastal states, territories and provinces are guided by at least one type of system, appropriate to local conditions.

Policy Recommendation 07-2

WSSPC recommends the implementation of modern technological systems that rapidly identify the tsunami potential generated from a local earthquake and that immediately alert locally responsible emergency operations personnel about coastal areas likely to be affected by a tsunami. Information provided by these systems would augment any area evacuation decisions based on ground shaking.

Background

Tsunamis have caused considerable damage and casualties to populated areas in the Pacific region over the last 100 years. Tsunamis usually are created by the rapid uplift of the sea floor during subduction zone earthquakes. Tsunamis not only affect nearby coastlines within a few minutes following an earthquake, but they travel long distances and impact distant shorelines within a few hours.

Where nearby coastlines are affected, the public is instructed to move away from the shoreline and to high ground whenever strong ground shaking is felt, or in some cases, when any ground shaking is felt. People would only return to low lying coastal areas following receipt of an official all clear message. Whether the tsunami is generated from a distant source or from a local source, effective notification of the public is paramount.

Permanent residents and tourists are found in a variety of geographical locations and structures along the shoreline. Therefore, the use of redundant warning systems (such as radio broadcasts and

outdoor sirens on beaches) would increase the immediacy and the coverage of the evacuation notification. Only with multiple systems can the best and most immediate coverage be obtained, thereby potentially minimizing the number of injuries and loss of life from the tsunami.

In some instances, ground shaking may be a precursor, and an "early warning", to the hazard of a tsunami. Coastal communities that are known to be vulnerable to the hazards of a tsunami should be prepared to evacuate for higher ground when ground shaking is experienced. Because few earthquakes cause tsunamis, a tsunami warning system should also be able to determine if evacuation activities are necessary as quickly as possible. Unnecessary evacuations are costly not only in terms of lost commerce, but in the public's negative reaction to the next earthquake experienced on the coast. The warning system should include: 1) earthquake and tsunami detection by a modern seismic network and Tsunami Warning Centers, respectively; 2) tsunami warning transmissions from the Tsunami Warning Centers to state emergency operations personnel; and, 3) direct notification to the coastal inhabitants, through the use of broadcast media, to initiate emergency response plans.

Facilitation and Communication

1. Encourage representatives from state agencies and state lobbyists to use Policy Recommendation 07-1 in efforts with their legislative delegations to develop rapid, multiple tsunami education and notification systems in their respective states, territories and provinces. This includes promoting tsunami task forces or similar groups, soliciting local government support, and requesting funds. In addition, education and evacuation planning are critical components of overall tsunami risk reduction and, therefore, should be promoted along with tsunami notification systems.

2. Forward Policy Recommendation 07-2 to the National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration, United States Geological Survey, and other organizations as appropriate, for their budget and technical support.

Assessment

The assessment of these policies can be measured by: 1) the adoption of tsunami hazard policies at state, territorial and provincial, as well as local governments on tsunami warning dissemination and evacuation; 2) comprehensiveness of notification systems adopted by state, territorial, provincial

and local jurisdictions; 3) Public Law 109-424 that requires improvement in tsunami detection, forecasting, warning, notification, outreach, and mitigation in tsunami communities; 4) communities being designated by NOAA/National Weather Service as a TsunamiReady™ Community; and 5) number of public education workshops and surveys completed in at-risk tsunami communities.

History

Policy Recommendations 07-1 and 07-2 were first adopted as Policy Recommendations 01-1 and 01-2. PR 01-1 was revised and adopted as PR 04-1 by unanimous vote of the WSSPC membership at the Annual Business meeting September 30, 2004. PR 01-2 was re-adopted as PR 04-2 by unanimous vote of the WSSPC membership at the Annual Business meeting September 30, 2004. The Assessment section was revised and Policy Recommendations 04-1 and 04-2 were readopted as PR 07-1 and PR 07-2 by unanimous vote of the WSSPC membership at the Annual Business Meeting October 3, 2007.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 07-3

Post-Earthquake Technical Clearinghouses

Policy Recommendation 07-3

WSSPC recommends that each member state, province, and territory establish a plan for a post-earthquake technical clearinghouse to be activated within 24 hours after each major earthquake within its jurisdiction.

Background

Post-earthquake technical clearinghouses have been an important component of emergency response, recovery, and mitigation following large earthquakes. Seismologists deploy instruments that measure aftershocks and investigate the mechanics of earthquakes. Geologists and geotechnical engineers document ground failures, including fault displacements, fissures, landslides, rock falls, and liquefaction. Geodesists investigate ground deformation and related strain. Structural engineers evaluate the effects of the earthquake on various types of buildings, bridges, dams, utilities, and other structures. Social scientists study direct and indirect impacts to people and businesses. This information is then used to improve our assessments of earthquake hazards, earthquake engineering, mitigation strategies for nonstructural hazards, and emergency response to damaging earthquakes.

The data collected in the days immediately following a major earthquake can be critical during emergency response and recovery. Scientists and engineers can determine the likelihood that landslides will move (from rain or aftershocks), and can assess the susceptibility of structures to collapse. Some data are perishable and must be collected as soon as possible, before erosion or bulldozers eliminate the evidence or before aftershocks die out.

Data collected through clearinghouses help us to be better prepared for future large earthquakes. In addition, data on strong ground motion and damage to buildings helps to calibrate loss-estimation models. The Federal Emergency Management Agency's (FEMA) HAZUS, can be an important

component of a Governor's or the President's disaster declaration as well as provide useful information for response, recovery and hazard mitigation.

A technical clearinghouse can serve to coordinate post-earthquake investigations and to share resources and information among investigators. The clearinghouse also serves to integrate and disseminate information so that it is available to decision makers and the media.

Post-earthquake technical clearinghouses were successfully implemented following the Landers, California (1992); Northridge, California (1994); and Nisqually, Washington (2001) earthquakes. A clearinghouse provides a place for scientists and engineers to report on their findings each day. In some post-earthquake situations, a clearinghouse may serve as one of the chief mechanisms for relaying critical information from scientists and engineers investigating the earthquake to emergency managers.

Only California, Utah, and Nevada have developed plans for post-earthquake technical clearinghouses. Few WSSPC members have the resources to fully staff and operate a clearinghouse. Opportunities exist for members to collaborate with one another and to coordinate with the U. S. Geological Survey (USGS), FEMA, Earthquake Engineering Research Institute (EERI), university researchers, and other groups. The National Earthquake Hazards Reduction Program (NEHRP) agencies (USGS, FEMA, National Institute for Standards and Technology, and National Science Foundation) developed *The Plan to Coordinate Post-Earthquake Investigations* in 2003 (USGS Circular 1242) that includes provisions for cooperating with states to establish post-earthquake technical clearinghouses. Under this plan, the NEHRP agencies can step in and take the lead if WSSPC members are not prepared to establish a clearinghouse.

Facilitation and Communication

WSSPC recommends that its members establish a plan for a post-earthquake technical clearinghouse to be activated within 24 hours after a major earthquake within its jurisdiction. WSSPC further encourages its members to form MOAs to facilitate the operation of clearinghouses, including sending employees from one jurisdiction to another to assist in collection of field data and in staffing a clearinghouse. WSSPC will construct a roster of experts who are

willing to participate and disseminate information on clearinghouses that are established after an earthquake.

The NEHRP agencies' post-earthquake investigations plan specifies coordination with states to operate clearinghouses. WSSPC members should develop MOAs with NEHRP agencies to facilitate clearinghouse staffing and operations, and to specify whether a member wishes the NEHRP agencies to take responsibility for establishing a clearinghouse. These MOAs could include triggers, such as USGS or EERI deployment only if moment magnitude exceeds certain values for an urban epicenter or for a rural earthquake. WSSPC members may wish to activate clearinghouses at lower triggers for purposes of training or when sufficient resources exist to respond to the earthquake. Any MOA should recognize the considerable role and interest of FEMA in post-earthquake technical clearinghouses.

To achieve the above goals, WSSPC will establish a Post-Earthquake Technical Clearinghouse Committee (PTCC) to update the WSSPC model post-earthquake technical clearinghouse plan, and to develop model MOAs for use among members and between members and NEHRP agencies for post-earthquake technical clearinghouse operation and assistance. PTCC should conduct workshops and use other means to help members establish individual post-earthquake technical clearinghouse plans and implement clearinghouse MOAs.

WSSPC recommends that the USGS provide mirrored or parallel access to its post-earthquake website. One ultra-high volume portal should be available to the general public. A second, password-protected site should be maintained. State emergency management agencies, state geological surveys, state seismic safety commissions and councils, earthquake consortia, university seismological laboratories and engineering-research centers, and the press should have access to the password-protected site.

WSSPC recommends that emergency response and recovery plans incorporate and refer to post-earthquake technical clearinghouse plans. There should be links between the technical clearinghouse and emergency management operations. Because the clearinghouse can provide vital information during emergency response and recovery, FEMA should work with emergency

managers to assure that appropriate federal funding and FEMA staff support are provided for the clearinghouse, whenever a clearinghouse is established following an earthquake.

Once members have established post-earthquake technical clearinghouse plans, WSSPC recommends that they hold regular training sessions and exercises to ensure readiness and compatibility with other emergency response functions. WSSPC also recommends that those responsible for mobilizing post-earthquake clearinghouses participate in large-scale earthquake exercises sponsored by states or local jurisdictions to test procedures that link research activities with emergency operations centers.

Funding will be required to pay travel to update WSSPC's model post-earthquake technical clearinghouse plan, prepare model MOAs, and hold workshops. WSSPC and the PTCC should take the lead in developing a proposal to acquire the necessary funding if work cannot be performed at WSSPC annual meetings and by electronic means.

Assessment

Measures of the success of this Policy Recommendation will be (1) the number of additional WSSPC members that develop post-earthquake technical clearinghouse plans, and (2) the number of MOAs established to facilitate clearinghouse operation. A periodic assessment should be made to determine the number of functioning clearinghouse plans and supporting MOAs. WSSPC will periodically update its model post-earthquake technical clearinghouse plan, and will post this and individual member plans on the WSSPC website.

History

Policy Recommendation 07-3 was first adopted as Policy Recommendation 01-3 by unanimous vote of the WSSPC membership at the Annual Business meeting October 24, 2001. PR 01-3 was revised and re-adopted as PR 04-3 by unanimous vote of the WSSPC membership at the Annual Business meeting September 30, 2004. The Background section was revised and PR 04-3 was readopted as PR 07-3 by unanimous vote of the WSSPC membership at the Annual Business Meeting October 3, 2007.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 07-4

Seismic Provisions in the International Building Code

Policy Recommendation 07-4

WSSPC endorses the prompt adoption and enforcement by states, territories, provinces and/or local jurisdictions of the seismic provisions of the *International Existing Building Code*, the *International Building Code*, and the *International Residential Code*. Further, WSSPC discourages modifications or amendments that would weaken the Code or its required inspections. WSSPC also encourages Code organizations to continue the development and refinement of building codes to include National Earthquake Hazards Reduction Program (NEHRP) provisions with a specific focus on purpose, education, incentives, lifelines and the business/industry and homeowner sectors.

Background

Policy Session Number 5 (Earthquake Building Codes in the 21st Century) of the National Earthquake Risk Management Conference in Seattle, Washington (September 2000) generated considerable discussion and resulted in a number of recorded points from the audience. A process to compile the comments into grouping and distilling actions resulted in a potential arena for a WSSPC Policy Statement relative to "codes". A consensus at the Conference from the presenters and the structured audience participation concluded that adoption by local jurisdictions of the 2000 *International Building Code* and the *International Residential Code* should be the first order of business. Some states, and many jurisdictions, have not adopted the *International Building Code*, potentially leaving their citizens at continued risk. States should be encouraged to remove obstacles which hinder adoptions, and to motivate local jurisdictions to diligently update existing codes. It is recognized that some jurisdictions which have adopted the International Codes have drastically modified or omitted the seismic provisions in the Codes. This action not only jeopardizes their structures by not providing for earthquake resistant structures, but provides a false sense of security to their communities. Once adopted, the Codes must be uniformly and consistently enforced if they are to be effective. This will necessitate the training of building inspectors to some required standards for certification. Partnerships with the homeowners, residents, builders, insurers, owners,

elected officials, scientific groups, etc., with focused concerns on lifelines and public safety will be required to overcome the inertia of commitment to meet the desired outcomes.

Facilitation and Communication

Incentive measures will need to be developed that involve federal, state, territorial, provincial and local funding to "encourage" adoption of building codes that recognize local natural hazards caused by earthquakes. Education of the public on the need and purpose for codes must work towards a mindset to mitigate damage from earthquakes before they happen. Local building code inspectors will require training and certification in the new codes.

Assessment

A measure of the acceptance of this policy recommendation is the number of states, provinces, territories and local jurisdictions that have adopted seismic provisions that meet or exceed the seismic provisions in the *International Building Code, International Residential Code* and *International Existing Building Code*.

History

Policy Recommendation 07-4 was first adopted as Policy Recommendation 01-4. PR 01-4 was revised and redesigned as PR 04-4 and re-adopted by unanimous vote of the WSSPC membership at the Annual Business Meeting September 30, 2004. The Policy Recommendation statement was revised and PR 04-4 was readopted as PR 07-4 by unanimous vote of the WSSPC membership at the Annual Business Meeting October 3, 2007.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 07-5

Basin and Range Province Earthquake Working Group(s)

Policy Recommendation 07-5

WSSPC recommends convening a technical Basin and Range Province Earthquake Working Group(s) (BRPEWG) to meet with experts from Basin and Range Province (BRP) states to arrive at consensus average recurrence intervals (RI) and slip rates (SR) and other seismic hazard parameters with related uncertainties for active faults. Best available RI and SR values with appropriate uncertainties are critical to U.S. Geological Survey (USGS) seismic-hazard evaluations and for determining which faults should be included on the National Seismic Hazard Maps (NSHMs). The BRPEWG(s) should be convened under the auspices of the USGS NSHM project.

Background

With release of the Quaternary fault and fold database of the U.S. by the USGS, based in part on completion of databases by states, the need arises to look critically at existing paleoseismic-trench data, and where the data permit, develop consensus regarding appropriate average RI and SR values and related uncertainties for faults in each state.

Only two BRP states (California and Utah) have completed comprehensive reviews of their paleoseismic trenching data to determine consensus RI and SR values, and the process is currently underway in a third state (Nevada). In most instances, currently available RI and SR values are the result of individual studies performed over a period of decades by a variety of investigators with varying levels of experience and resources. Older studies lack the advantage of recent advances in paleoseismic techniques, particularly refinements in sampling strategies and dating technologies. Consequently, available RI and SR values are not all of equal reliability, and often uncertainties associated with those data are either poorly defined or not reported.

Achieving consensus on complex technical issues requires a process of inquiry, discussion, and agreement. Technical working groups have successfully reached consensus in many instances, including the Working Groups on California Earthquake Probabilities, the Utah Quaternary Fault

Parameters Working Group, and various Utah geologic-hazards-mapping working groups. A previously convened BRPEWG successfully brought together scientists to identify issues, discuss evidence, and define strategies for resolving issues regarding fault behavior in the BRP important to the next update of the NSHMs.

Facilitation and Communication

WSSPC recommends that individual BRP states identify the faults for which sufficient paleoseismic trenching data are available to develop average RI and SR values and related uncertainties. The national Quaternary fault and fold database and state Quaternary fault databases form the basis for identifying these faults. Once identified, the BRPEWG(s) can meet with appropriate state experts to arrive at consensus RI and SR values as has already been done in California and Utah. Where consensus can be achieved, the BRPEWG can make recommendations for the USGS to consider in future updates of the NSHMs. Where consensus is not yet possible, an interim recommendation can be made for consideration in the NSHMs, and a research program outlined to resolve the issues so that consensus can ultimately be reached. Thus, a principal product of the process will be a list of priorities for future studies needed to achieve consensus that can provide support for the USGS in setting priorities both for internal studies and for the National Earthquake Hazard Reduction Program (NEHRP) External Grants program.

Funding will be required to pay travel and some salary expenses to hold workshops and to prepare reports. The WSSPC Basin and Range Committee, BRP state geological surveys, or other organizing entity should take the lead in developing a proposal to acquire funding. The BRPEWG(s) will serve only for the time it takes to complete their work, and then will be disbanded until additional information becomes available for consideration.

Given the importance of RI and SR data to the NSHMs, the completion of such reviews is critical in all WSSPC BRP states. WSSPC should work with the USGS to encourage such work by giving it a priority in the annual NEHRP Request for Proposals to help provide necessary funding. Other potential funding sources include the Federal Emergency Management Agency and internal funding from individual BRP states.

Assessment

The success of this Policy Recommendation can be assessed based on: (1) the number of states that empanel a BRPEWG to develop consensus RI and SR values, (2) the use of the resulting consensus RI and SR values by the USGS in future updates of the NSHMs, and by states and local governments in regulations and ordinances, and (3) the presentation of BRPEWG results to state emergency managers to ensure that the results reach the general public in a timely manner. A periodic assessment should be made to determine the extent to which the consensus RI and SR values are being incorporated into the NSHMs; individual probabilistic seismic hazard analyses; and state and local seismic-hazard rules, regulations, and guidelines.

History

Policy Recommendation 07-5 was first adopted as Policy Recommendations 04-5 by unanimous vote of the WSSPC membership at the Annual Business Meeting September 30, 2004. The Policy Recommendation statement was revised and PR 04-5 was readopted by unanimous vote of the WSSPC membership at the Annual Business Meeting October 3, 2007.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 07-6

Post-Earthquake Information Management System

Policy Recommendation 07-6

WSSPC supports the development of a national Post-Earthquake Information Management System. The Management System would provide permanent archiving of essential data related to natural and socio-economic earthquake effects and the performance of the built environment from earthquakes within the United States, and could be combined with similar systems to assemble and archive data from other natural hazards events.

Background

Future improvements in the ability to engineer and construct buildings and other structures and infrastructure systems that can perform as needed in strong earthquakes depends on knowing about the performance resulting from current and past design and construction practices. No mechanisms are in place to systematically collect and archive these performance data for future use. Technical clearinghouses provide a means to assemble damage data reports that provide decision support for emergency management operations immediately following a significant event; however, much of that data is incompletely documented and becomes essentially lost soon thereafter. Data collected through post-earthquake technical clearinghouses (see WSSPC Policy Recommendation 07-3) and activities such as those sponsored by the Earthquake Engineering Research Institute (EERI) can help us to be better prepared for future earthquakes – if the data are adequately documented, securely archived, and identified in a manner to make them available for use decades into the future.

The Management System data archive would contain technical information collected by post-earthquake clearinghouses as well as other information related to the particular event. The Post-Earthquake Information Management System would be consistent with the recommendations in National Earthquake Hazards Reduction Program (NEHRP) Plan to Coordinate Post-Earthquake Investigations (USGS Circular 1242):

"It is critical to develop strategies for the formal and systematic archiving of data collected during post-earthquake investigations. These data, which focus on the natural, built, and socioeconomic

environments, address a wide variety of phenomena. The data are voluminous and are acquired in many forms (for example, digital recordings, digital images, clipboard survey sheets, photographs, and narratives). If not organized and archived soon after an earthquake event, these data are often lost. No mechanism currently exists either to archive these data or to make them readily accessible to the research community. Because of this failure to adequately document, preserve, and access data, an enormous volume of highly relevant data has been effectively lost."

Facilitation and Communication

Adequate funding is necessary to establish this data collection guidance, and WSSPC supports use of federal funding, through NEHRP and/or the Stafford Act to support these activities for significant events. Earthquake clearinghouses may be established through specific mission assignments under the Stafford Act or through individual state authorizations.

WSSPC supports the development of a pilot or demonstration Post-Earthquake Information Management System project as soon as possible. This pilot could use data previously collected from a recent disaster, and would serve as a model to facilitate the implementation of a more general Management System following the next earthquake disaster.

WSSPC members are encouraged to develop public and private partnerships and Memoranda of Understanding with owners and regulators for the purpose of assuring that earthquake performance and damage information would be collected and made available for future use. These partnerships would identify critical data gaps and work to develop data collection strategies to fill those gaps in the aftermath of a significant event. These memoranda will need to address such issues as the need for inventory information, restrictions on facility access, security of confidential or sensitive data, etc.

WSSPC encourages its members to support operation of a standardized national Post-Earthquake Information Management System. Members are encouraged to coordinate their data post-earthquake collection and clearing house activities with the national Management System, and provide collected data and information to the post-earthquake data archive that is a component of the Management System. A key element in the Management System is standards for the specification of the types and formats of information necessary to be collected to ensure a thorough and accurate documentation of performance of the built environment during the earthquake.

Assessment

Measures of the success of this policy will be (1) the annual communication of WSSPC members' support to NEHRP (and to other federal agencies as appropriate) for the establishment of a national Post-Earthquake Information Management System, (2) written support for the establishment of a pilot or demonstration Post-Earthquake Information Management System as developed by the American Lifelines Alliance or some other entity, and (3) preparation of an annual summary of WSSPC members' state-level progress in establishing in their jurisdictions one or more local or regional partnerships and agreements for the purpose of assuring the collection of post-earthquake performance and damage information for long-term use. This assessment procedure assumes that the success of the policy may take many years to accomplish.

History

Policy Recommendation 07-6 was first proposed for adoption by the WSSPC membership at the Annual Business Meeting October 3, 2007, where it was unanimously approved as amended.

WESTERN STATES SEISMIC POLICY COUNCIL
POLICY RECOMMENDATION 06-1

Developing Earthquake Risk-Reduction Strategies

Policy Recommendation 06-1

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 risk to communities;
- Implementation of land-use and development policies to reduce exposure to earthquake hazards;
- Adoption and enforcement of the International Building Codes 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.

Background

WSSPC has long supported reduction of losses from seismic events through policy recommendations and annual conferences. One of the WSSPC Policy Recommendations (PR04-4) states that WSSPC supports the adoption and enforcement of the International Building and Residential Codes to reduce vulnerability to earthquakes. Given the high seismic activity in the western United States, Pacific territories, and Canada, mitigation of earthquake hazards is a common interest among all the western states, territories, and provinces. FEMA's Report 366, "HAZUS 99 Estimated Annualized Earthquake Losses for the United States", clearly shows that the western states are most at risk, with 88% of the nation's estimated annual dollar losses from earthquakes. WSSPC, as a consortium of 13 western states, 3 Pacific territories, and a Canadian territory and province, is the ideal organization to promote the benefits of earthquake risk-mitigation policies, to promote collaboration among its members and the federal government, and to share mitigation successes between WSSPC and other organizations. WSSPC should mentor parties who are responsible for public safety about the necessity and benefits of earthquake risk-mitigation policies and

activities. WSSPC should promote the development of educational materials on mitigation for the general public. WSSPC encourages private and public organizations to form partnerships that will develop earthquake risk-mitigation plans and risk-reduction strategies that will benefit local communities. Mitigation policies and activities are long-term, multifaceted processes where effective coordination, collaboration and communication among partners are critical. WSSPC is partnering with various organizations to promote these processes.

The Seismic Safety Boards and Commissions of the various states are important WSSPC partners. Each member state, territory and province has other affiliations with potential partners, such as the Oregon Natural Hazards Workgroup (ONHW), the Partners for Disaster Resistance & Resilience: Oregon Showcase State Program, and the Cascadia Region Earthquake Workgroup (CREW).

WSSPC should encourage its partners to seek potential outreach activities, mitigation plan development, or construction projects that can be submitted for funding through FEMA's various mitigation program grants. These efforts complement FEMA's Pre-Disaster Mitigation initiatives.

Facilitation and Communication

This policy recommendation will be sent to all identified policy and decision makers (elected officials, heads of key departments, such as emergency managers, building officials and planners and chairs of the State Seismic Safety Commissions and Boards) as well as to WSSPC representatives in the member states. Policymakers' decision to support earthquake risk mitigation and foster partnerships is the key to effective mitigation in their state.

Assessment

Successes in policy implementation are occasions when mitigation actions or requirements are incorporated into public policies and decisions, and subsequently integrated into important public or private projects.This statement of earthquake risk-reduction strategies should be adopted by all WSSPC partners. Successes should be submitted in a timely manner to WSSPC for posting on its website.

History

First adopted in 2003 as WSSPC Policy Recommendation 03-1. Reviewed, revised, and re-adopted as WSSPC Policy Recommendation 06-1 by unanimous vote of the WSSPC membership at the WSSPC Annual Business Meeting April 17, 2006.

2008 WSSPC Member State Agency Reports

This section contains earthquake program reports from the following state agencies.

Alaska
Alaska Division of Geological and Geophysical Surveys
Alaska Division of Homeland Security and Emergency Management

British Columbia
Provincial Emergency Program, Emergency Management British Columbia

California
California Geological Survey
Governor's Office of Emergency Services

Colorado
Colorado Geological Survey
Colorado Earthquake Hazard Mitigation Council

Hawaii
Hawaii State Civil Defense
Hawaii State Earthquake Advisory Committee

Idaho
Idaho Geological Survey
Idaho Bureau of Homeland Security

Montana
Montana Bureau of Mines and Geology

Nevada
Nevada Bureau of Mines and Geology
Nevada Division of Emergency Management

New Mexico
New Mexico Bureau of Geology and Mineral Resources
New Mexico Department of Homeland Security & Emergency Management

Oregon
Oregon Department of Geology & Mineral Industries
Oregon Emergency Management
Oregon Seismic Safety Policy Advisory Commission

Utah
Utah Geological Survey
Utah Division of Homeland Security

Washington
Washington State Department of Natural Resources, Geology and Earth Resources Division
Washington Military Department, Emergency Management Division

Alaska Division of Geological & Geophysical Surveys and University of Alaska Fairbanks Geophysical Institute

The Alaska Division of Geological & Geophysical Surveys (ADGGS) conducted its third field season of a state-funded project to perform detailed geologic mapping and hazards evaluation, including earthquake hazards, along a 200-mile portion of the proposed natural gas pipeline corridor. The proposed gas pipeline will deliver North Slope gas to the conterminous U.S. and other markets. The 12-mile-wide study corridor begins at Delta Junction, where the proposed pipeline would depart from the existing Trans-Alaska Oil Pipeline corridor, and follows the Alaska highway to the Canadian border. High-resolution airborne geophysics, acquired in 2005, are helping to identify potentially active faults and other hazards, and greatly assist in detailed geologic mapping of this heavily vegetated area. Field geologic studies, including trenching, have identified several previously unmapped faults that show evidence of Holocene offset. Continued geologic studies aim to determine the style of offset and long-term slip rates along these faults, as well as associated earthquake hazards. One of the newly identified faults is a range-front thrust that crosses the probable pipeline centerline in multiple locations. Three trenches on this fault confirm thrust-fault geometry and late Quaternary offset. One more field season will be sufficient to complete the geologic mapping and data collection.

By spring 2009, ADGGS anticipates filling a geologist position with emphasis on neotectonics. The initial priority for this position will be to complete the GIS database of Quaternary faults and folds in Alaska, then develop a program to map active faults in and near urban and developing areas.

The University of Alaska Fairbanks Geophysical Institute (UAFGI) operates the Alaska Earthquake Information Center (AEIC, *www.aeic.alaska.edu*) with primary support from the State of Alaska, National Oceanic and Atmospheric Administration (NOAA), and United States Geological Survey (USGS). AEIC records and analyzes Alaska earthquake data and disseminates earthquake information to the public. AEIC monitors seismicity in the state and surrounding regions using a network of roughly 500 stations of seismic data. More than 27,000 earthquakes were processed and cataloged for the past year through August 2008. AEIC staff responds to significant earthquakes on a 24-hour basis and faxes or emails information releases on felt events to interested agencies, individuals, and the media within ½ hour. The UAGI seismology lab continues to participate in education and outreach activities.

The efforts of the Plate Boundary Observatory part of EarthScope in Alaska were completed in summer of 2008 with the installation of additional permanent GPS and co-located Seismic stations by AEIC in southern Kodiak Island and Chirikof Island. These observations will provide very interesting and useful data on the continuing deformation occurring within Alaska.

As part of the National Tsunami Hazard Mitigation Program (NTHMP), UAFGI and ADGGS continue their collaboration on tsunami-inundation mapping projects with funding from NOAA. Modeling is completed for Seward, including simulation of tsunami waves and run-up resulting from multiple submarine landslides. ADGGS will publish the inundation maps in 2009. The Alaska Tsunami Hazard Mapping Team has visited Sitka, Seward, and Valdez to establish close coordination with local officials for both information and data purposes. In conjunction with this program, UAFGI is upgrading and augmenting the seismic network with modern digital broadband seismic stations. All 21 planned sites have been installed and are being maintained and shared among the earthquake and tsunami processing centers. In addition more sites are being installed with University resources, including two new stations within the proposed natural gas pipeline corridor in support of the geological work mentioned above. Additional

University/NOAA project funds are assisting in a joint enhancement of the Alaska Tsunami Warning Center seismic network. NOAA is providing upgraded VSAT telemetry while AEIC is providing modern broadband instrumentation.

UAFGI continues the NSF-funded St. Elias Erosion/ Tectonics Project (STEEP) in southern Alaska to explore the tectonics and related processes of the Yakatat block collision. As part of this effort, 22 new seismic stations, installed in 2006, continue to provide real-time telemetry back to UAFGI. These new data feeds allow much more precise locations of events associated with the areas of the large earthquakes near Mt. St. Elias and the surrounding region.

Other current UAFGI earthquake-hazards research projects include:

- Accurate cataloging of ground-motion characteristics and spatial parameters of Alaskan earthquakes
- Crustal deformation measurements using GPS and Synthetic Aperture Radar interferometry
- Tsunami Warning and Environmental Observatory (TWEAK) is a collaborative project to improve observation, modeling and mitigation of the effects of large earthquakes and tsunamis
- National Science Foundation/Incorporated Research Institutions for Seismology/Program for the Array Seismic Studies of the Continental Lithosphere (NSF/IRIS/PASSCAL) Collaborative Research to study STEEP
- NSF/IRIS/PASSCAL transect south of the Alaska range to evaluate crust & upper mantle structure
- Study of crust and upper mantle structure and attenuation in Alaska
- Upgrade and expansion of the Alaska seismic network through the federally funded Advanced National Seismic System (ANSS). ShakeMaps are now being produced by AEIC, and will soon be the official center for ShakeMaps for all of Alaska.
- Transition to modern broadband and strong motion seismic stations at the 11 Trans-Alaska Pipeline stations. Monitoring of the pipeline includes threshold alarms and ShakeMaps.

WSSPC Policy Recommendations
The state of Alaska has not formally adopted any WSSPC policy recommendations to date.

Submitted by Rod Combellick, Deputy State Geologist, Alaska Division of Geological & Geophysical Surveys, and Roger Hansen, State Seismologist, University of Alaska Fairbanks.

Alaska Division of Homeland Security and Emergency Management

Partnerships
The State of Alaska's Division of Homeland Security and Emergency Management (DHS&EM) coordinates the State Tsunami and Earthquake Programs through the Division's Mitigation Section in a statewide effort to eliminate the loss of life, reduce damage and educate the public about "short/no notice" seismic hazards.

The effort this year engaged multiple State, local and federal agencies in partnership including: the University of Alaska Fairbanks Geophysical Institute/ Alaska Earthquake Information Center (UAFGI/ AEIC), Alaska Division of Geological and Geophysical Surveys (DGGS), Alaska Department of Transportation and Public Facilities (AKDOT&PF), Federal Emergency Management Agency (FEMA), West Coast / Alaska Tsunami Warning Center (WC/ATWC), National Weather Service (NWS), National Oceanographic and Atmospheric Administration's Pacific Marine Environmental Laboratory (NOAA/PMEL) and Tsunami Inundation Mapping Effort (TIME), and Alaska's local, tribal and borough governments.

State Seismic Hazard Safety Commission
The Alaska Seismic Hazard Safety Commission (ASHSC) is chartered to advise the Governor, Executive Branch, the State Legislature and the public on seismic issues. The Commission holds public meetings monthly and promotes development of effective practices and policies for earthquake loss reduction.

This year the Commission's agenda focused on prioritizing and identifying earthquake-related hazards including: critical facilities' structural stability, earthquake insurance necessity and availability, approaches to incorporating seismic risk mitigation into future construction, changes to response practices, mitigation of future seismic risk, and public education initiatives.

DHS&EM State Hazard Mitigation Officer, Mark Roberts, serves as one of the eleven commission board members appointed by the Governor.

Quake Cottage Earthquake Simulator
DHS&EM used two key tools this year for earthquake outreach and education: the "Quake Cottage" earthquake simulator and the "Earthquake-Resistant Model Home". These "hands-on" displays teach non-structural seismic hazard mitigation, preparedness and lessons about the effects of seismic hazards on structures and their contents. The "Quake Cottage" and its accompanying mitigation, earthquake and tsunami education materials made visits to schools, community fairs, company safety days and military bases in Alaska this year.

Preparedness Education
This year DHS&EM coordinated funding for printing thousands of copies of the children's disaster preparedness books *Molly and the Earthquake* and *Heidi and the Tsunami*. The books were written and illustrated by an Alaskan resident and are targeted at young people in Kindergarten through the Fourth Grade. The books describe a fictional story of a family's natural hazards experiences and give safety tips on what to do before, during, and after an event. These publications are distributed throughout the state at various outreach events. The books are available for download at: *http://www.borough.kenai.ak.us/emergency/books/watkins.htm*.

Post-Disaster Damage Assessment (PDDA)
DHS&EM aggressively supports and provides funding to the statewide Post-Disaster Damage Assessment (PDDA) training program managed by the Municipality of Anchorage's (MOA) Building Safety Officer. The PDDA Coordinator conducts the modified ATC-20 courses to provide initial and recertification training for Post-Disaster Damage Assessment Evaluators who assess a building's structural integrity for safe occupancy following a catastrophic event. The State currently has approximately 650 trained and certified damage assessors. The training program continued this year with three 16-hour courses, which trained seventy-one additional personnel. The program manager is working to develop an instructor's guide, student manual and field exercise manual as part of the FEMA Emergency Management Institute Master Trainer program.

Historically, the program demonstrated success when trained individuals were deployed in Alaska's 2002 Denali Fault Earthquake.

Real-Time Seismic Display for Emergency Operations
DHS&EM, through joint FEMA and State Hazard Mitigation Grant Program (HMGP) funds, funded the installation of a near-real-time earthquake-monitoring system in seven emergency operations centers around the State. This project, produced by UAFGI/AEIC, provides a near-real-time display of the full Alaskan seismic network, quake epicenter solutions, quake magnitudes and "Shake Maps" of ground motions. The displays allow the emergency operations centers to have a common operating picture, statewide seismic situational awareness and real-time data. This real-time seismic data provides information for earthquake response, assessing aftershocks and planning following a major seismic event. The displays incorporate two different systems in a dual monitor that allows immediate, simultaneous presentation of UAFGI/AEIC data, NOAA tsunami bulletin information, and USGS seismic maps. Future enhancements of the system are being considered as available technology improves.

Improved Seismic Hazard Identification
This year the State continued a major effort to provide funding and technical assistance for local communities' hazard mitigation planning. In 2007-2008 an additional seventeen Alaskan communities throughout the State developed plans. The hazard mitigation planning process includes surveys and community meetings in which seismic risk and mitigation are considered. These plans result in communities that have thought through the impacts of seismic events on their community and have developed long-term strategies to address them.

In addition, the State updated its hazard mitigation plan in November 2007 with additional seismic risk data and seismic mitigation strategies. Each local community hazard mitigation plan integrates with the State plan with the overall result being enhanced seismic resilience for the State's citizens, property and infrastructure.

These initiatives are consistent with **WSSPC Policy Recommendation 06-1** promoting the development of risk-reduction strategies.

Seismic Hazard Mitigation Retrofit Projects
Alaska DHS&EM managed several structural and non-structural seismic hazard mitigation grant projects this year. One series of projects retrofitted several schools in the Kodiak Island Borough that the Borough assessed to be at seismic risk. This series of projects was initiated through a community concern for the seismic safety of children attending public schools in an area with historic seismic causalities. The projects address seismic structural safety in elementary, middle

and high schools in the Borough and are funded through a combination of State, FEMA and local sources.

A second series of projects installed seismic safety gas shut-off valves in several schools, fire stations and other critical facilities in the Municipality of Anchorage. The devices automatically shut off gas to the structure in the event of a major seismic event enhancing the building post-earthquake fire safety. The projects were funded by a combination of State, FEMA and local funds. The Municipality intends to expand the installations to other key facilities in 2009.

Tsunami Mapping, Signage, Warning Systems and TsunamiReady
The State of Alaska coordinated tsunami inundation mapping projects for the City of Seward, Sitka, and Valdez this year. This project will provide tsunami hazard mapping so that community planners can then develop evacuation maps, emergency response plans and mitigation objectives. The maps are a cooperative effort between DHS&EM, UAFGI/AEIC, DGGS and NOAA.

DHS&EM, in cooperation with federal partners, funded and managed the installation of tsunami / all-hazard warning systems in the communities of Valdez, Sitka, Yakutat, Cordova, Sand Point and Whittier. Communities funded for installation next year include Nikolski, Adak and Atka. Each of these systems gives the community the ability to warn their citizens of an impending tsunami and enhance overall life safety, as they are all-hazard.

DHS&EM, in cooperation with the National Weather Service's "TsunamiReady" program, certified the City of Valdez and recertified the City of Seward. This certification includes verification of the community's twenty-four hour tsunami warning capability, evacuation route planning, shelter locations and signage. DHS&EM, through the TsunamiReady program, also coordinated and funded installation of tsunami warning and evacuation signs in the City of Yakutat.

Tsunami Education and Outreach
DHS&EM also collaborates in the "TsunamiReady" program to promote community tsunami preparedness and mitigation education. This year a joint DHS&EM, WC/ATWC, UAFGI/AEIC, and National Weather Service team made community visits to the communities of Seward, Lowell Point, Kodiak Island Borough, Chignik Bay, Ouzinkie, Old Harbor, Port Lions and Whittier. The community visits included elected officials, emergency responders and citizens in the tsunami planning effort for their community.

National Tsunami Policy
The State of Alaska is a member of the National Tsunami Hazard Mitigation Program (NTHMP) Coordinating Committee and through DHS&EM participated in the NTHMP budget development, policy reviews and five-year strategy development.

DHS&EM also provided testimony to National Academy of Sciences review of the national tsunami preparedness and vulnerability study. Alaska's involvement in these national tsunami programs provides the State with a crucial opportunity to contribute to the discussions of the unique threats and challenges Alaska faces.

Statewide Tsunami Awareness and Systems Test
The Governor has declared the last week of March as tsunami awareness week each year to coincide with the historic date of the 1964 Alaska earthquake. DHS&EM and our partners participated this year in outreach events and a statewide test of the tsunami warning system during this week. Some communities used the statewide test to activate their local warning

systems and to practice actually moving to tsunami shelters along pre-planned evacuation routes. This year the test followed a real tsunami warning issued in December following a magnitude 7.3 earthquake in the Aleutian Island chain.

The awareness week provides communities, schools and other organizations in the State a yearly opportunity to review their seismic preparedness, conduct emergency drills and to educate on seismic hazards and mitigation.

Submitted by Mark Roberts, State Hazard Mitigation Officer, Alaska Division of Homeland Security and Emergency Management.

Emergency Management British Columbia
Provincial Emergency Program

Earthquake planning remained in the forefront of hazard planning in 2008 for the Provincial Emergency Program (PEP) of Emergency Management British Columbia (EMBC). Launched in July 2007, the Seismic Integrated Response Planning (SIRP) Project is a multi-year project designed to refresh the British Columbia Earthquake Plan.

Provincial Earthquake Planning

Phase one of the SIRP Project resulted in the 2008 version of the British Columbia (BC) Earthquake Response Plan which was released in December 2008. The 2008 Plan incorporates the BC Emergency Response Management System (BCERMS), and identifies planning assumptions, responsibilities, and response actions through integrated planning with all levels of government and extensive collaboration with and input from external stakeholders.

The plan describes a high level concept of operations for an integrated provincial response to a damaging earthquake impacting British Columbia. The intended audience for this plan includes local authorities and First Nations, provincial ministries and crown corporations, federal agencies, regional services, non-government organizations, individuals, and businesses.

The integrated planning exemplified in the development of the 2008 BC Earthquake Response Plan sets a new benchmark for provincial plans in BC.

Using the 2008 Plan as a foundation, phase two of the SIRP project is currently underway to develop a 2009 version of the BC Earthquake Plan. The 2009 version will incorporate earthquake planning scenarios and additional integrated planning through the SIRP steering committee and subsidiary working groups.

Scenario Development

A series of earthquake planning scenarios are being developed through collaboration with Natural Resources Canada, The School of Community and Regional Planning at The University of British Columbia, and The School of Earth and Ocean Sciences at The University of Victoria.

A series of plausible events have been selected throughout all seismically active regions of the province. These earthquake planning scenarios will outline a realistic approximation of the impacts that could be expected for different earthquakes (with various locations, magnitudes, and depths) in the province and their implications. In September, Maiclaire Bolton, Seismologist and Head of the Seismic Program with PEP, participated in the scenario development workshop sponsored by the Earthquake Engineering Research Institute. At this workshop, Maiclaire gleaned a significant amount of information to incorporate into BC's earthquake scenarios as well as gained an appreciation of what can be accomplished given the resources available.

Earthquake Exercise Planning

A provincial earthquake exercise is currently planned for June 2009. This exercise will involve the Provincial Emergency Program (Provincial Emergency Coordination Centre and three Provincial Regional Emergency Operations Centres), six local governments (City of Richmond, City of Vancouver, North Shore Emergency Management Office, City of Victoria, City of Nanaimo, and Capital Regional District), other provincial ministries and external stakeholders.

In 2008 BC was fortunate to be invited to observe two major exercises in the western US. In March, nine representatives from British Columbia (PEP, EMBC, City of Vancouver, City of Richmond, and the Capital Regional District) travelled to Washington State to observe Sound Shake '08. In November 2008, Maiclaire Bolton participated in the Great Southern California ShakeOut and shadowed the Earthquake Program of the California Governor's Office of Emergency Services in the Golden Guardian exercise in Pasadena. Additionally, PEP's Exercise Coordinator and three local government representatives (City of Vancouver, North Shore Emergency Management Office, and the Capital Regional District) observed the Golden Guardian exercise at the State Operations Center in Sacramento. Many valuable lessons learned from both exercises are being incorporated into BC's earthquake exercise.

International Working Group Participation

In addition to being an active member of WSSPC, British Columbia continues to collaborate with colleagues throughout the U.S. and internationally regarding earthquakes, tsunamis, and volcanoes. BC is an active participant in the Cascadia Region Earthquake Workgroup (CREW), of which Maiclaire Bolton currently sits as the Vice President. Additionally, Maiclaire was part of the steering committee for the National Earthquake Conference in Seattle in April.

Provincial Emergency Program New Facility

In July, 2008 the Provincial Emergency Program headquarters relocated to a new facility. The new, modern facility is more than twice the size of the old office, thus significantly enhancing the program's surge capacity and allowing for future expansion.

Submitted by Maiclaire Bolton, Seismologist, Head, Seismic Program, Provincial Emergency Program, Emergency Management British Columbia.

California Geological Survey

In 2008 the California Geological Survey (CGS), U.S. Geological Survey (USGS), and Southern California Earthquake Center (SCEC) completed the first official earthquake forecast for all of California. This forecast, known as the "Uniform California Earthquake Rupture Forecast (UCERF)," was developed by a multidisciplinary group of scientists and engineers, known as the Working Group on California Earthquake Probabilities (WGCEP).

The WGCEP found that California has more than a 99% chance of having a magnitude 6.7 or larger earthquake within the next 30 years. The new statewide probabilities are the result of a model that comprehensively combines information from seismology, earthquake geology, and geodesy (measuring precise locations on the Earth's surface). The likelihood of a major quake of magnitude 7.5 or greater in the next 30 years is 46%—and such a quake is most likely to occur in the southern half of the state. The new information is being provided to decision makers who establish local building codes, earthquake insurance rates, and emergency planning and will assist in more accurate planning for inevitable large earthquakes.

The consensus of the scientific community on forecasting California earthquakes allows for meaningful comparisons of earthquake probabilities in Los Angeles and the San Francisco Bay Area, as well as comparisons among several large faults. The probability of a magnitude 6.7 or larger earthquake over the next 30 years striking the greater Los Angeles area is 67%, and in the San Francisco Bay Area it is 63%, similar to previous Bay Area estimates. For the entire California region, the fault with the highest probability of generating at least one magnitude 6.7 quake or larger is the southern San Andreas (59% in the next 30 years). For northern California, the most likely source of such earthquakes is the Hayward-Rodgers Creek fault (31% in the next 30 years). For the far northwestern part of the State, a major source of earthquakes is the offshore 750-mile-long Cascadia Subduction Zone, the southern part of which extends about 150 miles into California. For the next 30 years there is a 10% probability of a magnitude 8 to 9 quake somewhere along that zone. Such quakes occur about once every 500 years on average. The new model does not estimate the likelihood of shaking (seismic hazard) that would be caused by quakes. Even areas in the state with a low probability of fault rupture could experience shaking and damage from distant, powerful quakes.

2008 National Seismic Hazard Maps

The fault information developed by CGS and others for California was incorporated into the updated National Seismic Hazard Maps released by the USGS in 2008. These maps are the basis for seismic design provisions of building codes, insurance rate structures, earthquake loss studies, retrofit priorities, and land-use planning. Their use in design of buildings, bridges, highways, and critical infrastructure allows structures to better withstand earthquake shaking, saving lives and reducing disruption to critical activities following a damaging event. The maps also help engineers avoid costs from over-design for unlikely levels of ground motion.

ShakeOut Scenario

CGS, USGS, and others used one of the potential earthquakes considered by the WGCEP as the basis for the most detailed and comprehensive earthquake planning scenario yet. The scenario describes how a magnitude 7.8 Southern California earthquake would impact the region, causing loss of lives and massive damage to infrastructure, including critical transportation, power, and water systems.

The ShakeOut Scenario is the product of an interdisciplinary collaboration of over 300 scientists, engineers, and other experts from several agencies, including USGS, CGS, SCEC, California Governor's Office of Emergency Services and the Seismic Safety Commission.

To create the Scenario, geologists determined the amount of potential motion on the part of the San Andreas fault with the greatest risk of imminent rupture, a 200-mile long section from the Salton Sea in the Coachella Valley to just south of Gorman. From this, seismologists and computer scientists modeled the ground shaking. Engineers and building professionals used the models of ground shaking to estimate damage to the built environment. And from these damages, social scientists evaluated emergency response, casualties, and the impact on our economy and society.

In the Scenario, the earthquake would kill 1800 people, injure 50,000, cause $200 billion in damage, and have long-lasting social and economic consequences. This is the most comprehensive analysis ever of what a major Southern California earthquake would mean, and is the scientific framework for what will be the largest earthquake preparedness drill in California history, scheduled for November 13, 2008.

The November preparedness exercise, "Golden Guardian '08," will test the ability of emergency responders to deal with the impact of a magnitude 7.8 earthquake on the San Andreas fault in Southern California, and is being jointly organized by the Governor's Office of Emergency Services and the California Office of Homeland Security. The Golden Guardian exercise will occur during a week-long series of public events planned for the "Great Southern California ShakeOut."

Review of Geologic and Seismic Hazard Reports for School and Hospitals

The Department of General Services, Division of State Architect (DSA), and Office of Statewide Health Planning and Development (OSHPD) have the responsibility of ensuring that schools and hospitals are built according to code and are seismically safe. Both DSA and OSHPD contract CGS to perform geologic and seismic hazard evaluations for new school and hospital projects. From 2004 through 2007, CGS reviewed an average of about 350 school and 65 hospital construction projects each year. These reviews by CGS ensure that the Seismic Hazards Mapping Act and the Alquist-Priolo Earthquake Fault Zoning Act are complied with, and all projects within those zones are reviewed by a Certified Engineering Geologist. CGS also ensures that new construction is designed for the proper level of earthquake ground shaking and other potential hazards such as landslides or liquefaction are adequately considered in the planning and design of new school and hospital structures.

Seismic Hazards Zonation

Under the Seismic Hazards Mapping Act of 1990, development permits within designated Seismic Hazard Zones are issued by local building departments upon approval of a seismic hazard investigation report that includes mitigation to reduce hazards at the development site to a safe acceptable level. Applied research in support of the seismic zonation programs during the 2004-2007 period include a project funded by the Pacific Earthquake Engineering Research Center to incorporate new findings from recent worldwide post-earthquake investigations into the state hazard-mapping program. The project resulted in a new, more accurate and more efficient method of assessing and zoning the hazard of liquefaction. Rather than basing the zones merely on the potential for triggering liquefaction, which may or may not be of severity to cause damage to buildings, the new method is based on the potential magnitude of ground shifting and

permanent displacements, which closely correlates with damage potential. The result is elimination of land that need not be in a seismic hazard zone.

The National Earthquake Hazard Reduction Program funded two other applied research projects to zone active faults. These projects include application of advanced remote sensing, including high-resolution LiDAR for surface fault mapping, and compilation of California's contribution to the National Fault Database compiled by the USGS. CGS acquired digital aerial stereo imagery of the entire state taken in 2005. Although not part of the original air-photo campaign, CGS staff worked with the provider and software developers to make stereo capability possible, thereby permitting greatly enhanced interpretation of landslides and other geologic features for routine mapping. All of these projects are aimed at lowering the cost and improving the accuracy and efficiency of hazard evaluation, zoning, and information dissemination.

Under the Alquist-Priolo Earthquake Fault Zoning Act of 1972 (AP) development permits within designated Earthquake Fault Zones are issued by local building departments upon approval of a fault zone investigation that demonstrates that the proposed project will be set back from any earthquake fault designated as active by at least 50 feet.

A technical advisory committee was established under the Geohazards Committee of the State Mining and Geology Board to review the policies of the AP Act in light of current geotechnical practice. A principal focus is to consider whether secondary minor distributed faults need to be zoned and whether mitigation of such conditions is possible and should be allowed. Review is currently underway, and a report with recommendations is planned for completion in FY 2008/09.

Submitted by John Parrish, Director and State Geologist, California Geological Survey

California Governor's Office of Emergency Services

- Developed procedures and protocol for involvement of the Earthquake and Tsunami Program staff in response to a significant earthquake or tsunami warning. These procedures define the role of program staff in an earthquake or tsunami emergency and establish an Earthquake and Tsunami Duty Officer who will be available to fulfill the assigned duties on a 24/7 basis.

- Conducted the first "live code" tsunami communications test in California history in Humboldt County on March 26, 2008. This test involved the use of tsunami event codes that activated the Emergency Alert System and caused a message to appear on television announcing the "The National Weather Service has issued a tsunami warning for Humboldt County." The purpose of this test was to assure that the final stage in the tsunami warning system functioned properly and could be relied upon in an actual tsunami emergency.

- Participated in the development of a detailed earthquake scenario for the southern San Andreas fault, a M7.8 event which will drive the Golden Guardian exercise in November 2008 and serve as a fundamental component of southern California's "ShakeOut" earthquake preparedness campaign.

- In cooperation with the Hazard Mitigation section and the California Geological Survey (CGS), the Office of Emergency Services Earthquake and Tsunami Program developed and beta tested an interactive web portal entitled "What's My Hazard?" This program allowed users to enter an address or location and obtain mapped and narrative information about hazards in that location, as well as information for mitigation.

- Initiated work on a second generation of tsunami inundation maps for coastal California. These new maps take advantage of new scientific research on seismic source, improved modeling and data.

- Continued to promote the use of new real-time seismic information technologies including ShakeMap, ShakeCast, the CISN Display and HAZUS.

- Contributed to the education and training of local emergency management officials through lectures at the California Specialized Training Institute, training workshops, invited presentations, conference exhibits and written materials.

- Administered contracts that support the development, operation and maintenance of the California Integrated Seismic Network.

- Convened the California Earthquake Prediction Evaluation Council to review methods and results of a new assessment of California earthquake probabilities.

- Contributed to the larger emergency management community by active involvement in the California Emergency Services Association, the National Tsunami Hazard Mitigation Program, the Western States Seismic Policy Council, the Cascadia Region Earthquake Workgroup, and the Earthquake Engineering Research Institute.

Submitted by Jim Goltz, Earthquake and Tsunami Program Manager, California Governor's Office of Emergency Services.

Colorado Geological Survey and
Colorado Earthquake Hazard Mitigation Council

The Colorado Geological Survey (CGS) study of the 95-mile-long Anton escarpment on the eastern plains is complete and the results were presented at the Association of Environmental and Engineering Geologists meeting in October 2008. As a result of detailed studies of our 2,500-foot-long trench, the escarpment is interpreted to be a result of eolian processes, rather than tectonic processes.

The Critical Infrastructure Conference at the end of October 2008 focused on a $HAZUS_{MS}$ scenario for a strong earthquake in the Denver area.

Various entities in Colorado are cooperatively exploring how best to take advantage of the EarthScope seismic array for obtaining permanent additions to the limited seismic coverage in Colorado.

The ad hoc Colorado Earthquake Hazard Mitigation Council (CEHMC) continues to meet bi-weekly on the campus of the Colorado School of Mines. Two major accomplishments by the CEHMC in 2008 were the publication of *Colorado Earthquake Hazards* and the completion of a policy recommendation on seismic design that will be submitted to the Colorado Geological Survey for use when reviewing proposed construction projects at public schools.

Colorado Earthquake Hazards provides general information about earthquake hazards in the state and is intended to increase public awareness of the hazard. The publication includes a 1:1,500,000-scale map with text on the back side of the map plate. The map shows the locations and sizes of historical earthquakes, known and suspected Quaternary faults, and locations of broadband seismographs that are part of the Advanced National Seismic System. In addition to general descriptions of Colorado's faults and earthquakes, the text summarizes the potential for future earthquakes in the state, what to do before, during, and after an earthquake, and where to find further information on Colorado's earthquake hazards. The free publication is available from the CGS.

Effective April 25, 2004 all public school construction projects in Colorado need to meet the requirements of the 2003 International Building Code. The design and construction is regulated through the State of Colorado, Department of Labor and Employment, Oil and Public Safety Division. As part of this process, the CGS reviews geologic suitability and soils reports for the site and makes recommendations on their adequacy. The CEHMC's policy recommendation to the CGS is intended for use during this review process. The recommendation states that the International Building Code Seismic Design Category A should not be used for the design of schools in Colorado, and that schools in Colorado should be designed for a minimum of Seismic Design Category B. Also, where the code would otherwise allow the use of Seismic Design Category B, the design requirements for the school should be increased to Seismic Design Category C. The CEHMC recommends that the exemptions for non-structural attachments, as allowed by ASCE-7-05: 13.1.4 or by ASCE 7-02: 9.6.1, should not apply to schools.

Submitted by Vince Matthews, Director and State Geologist, Colorado Geological Survey.

Hawaii State Civil Defense and
Hawaii State Earthquake Advisory Committee

Hawaii State Civil Defense (SCD), through the Hawaii State Hazard Mitigation Forum, provided support to several key working groups during 2008, including the Hawaii State Earthquake Advisory Committee (HSEAC) and the Tsunami Technical Review Committee (TTRC). The committees have helped guide research and secured funding for mitigation projects for the State of Hawaii. The HSEAC and TTRC continued to work with partners in the private sector, government agencies, the University of Hawaii, and the Pacific Disaster Center (PDC) in an ongoing commitment to and focus on earthquake and tsunami concerns, risks, and planning. State and County Multi-Hazard Mitigation Plans include statewide risk and vulnerability assessments of seismic exposure, as well as proposed mitigation actions and capabilities in the State of Hawaii.

Earthquake

The Hawaii State Earthquake Advisory Committee (HSEAC) continues to promote retrofitting to mitigate earthquake damage. Investigations of post-and-pier foundation systems in private residences following the Kiholo Bay earthquake (October 15, 2006) revealed a disproportionately large number of building failures. HSEAC has developed generic retrofit measures to post-and-pier foundations that can be performed by a homeowner or contractor. Several outreach workshops and seminars have been conducted to provide Hawaii residents with information on how to strengthen and stabilize their homes.

A Wind-Blown Debris Impact Testing Research project being conducted by the University of Hawaii in partnership with SCD will provide more information on how to strengthen and stabilize residential buildings. The wind cannon used in this project is one of two in the United States and will enable engineers to test retrofit schemes against many different scenarios. Data generated from these tests will also factor into building code recommendations made by HSEAC to State Civil Defense and the State of Hawaii.

HSEAC is currently working with FEMA, SCD, and PDC to transfer the custom Hawaii building inventory database, which contains over 10 years of data, from HAZUS-99 to HAZUS-MH. HAZUS-MH stands for Hazards U.S. Multi-Hazard and is a risk assessment software program that can analyze the potential effects of natural disasters like flood, hurricane, and earthquake. The software provides multi-faceted loss estimates for physical damage, economic loss, and social impacts. Switching to HAZUS-MH will improve SCD and PDC's capabilities to provide reports to emergency responders in future earthquake events.

This year SCD exercised response to a large earthquake with an accompanying locally-generated tsunami. The exercise, entitled Kai Mimiki (literally translated from Hawaiian to mean receding wave), focused on how various federal, state, and county agencies would respond to a large (moment magnitude 8.0) earthquake off the Big Island while also warning the public of an approaching tsunami event.

Tsunami

April is Tsunami Awareness Month in Hawaii due to the historical significance of the April 1, 1946 tsunami. Every year SCD conducts a Distant Tsunami exercise and a Local Tsunami exercise. This year the Distant Tsunami exercise was held on April 1, 2008. The exercise included a news conference announcing the modeling of new tsunami inundation zones for Hawaii, the development of a tsunami curriculum, and the posting of a tsunami fact test on the

SCD website. The news coverage also served as a reminder to the public to check their home, workplace, and schools to see if they're in a tsunami evacuation zone and to plan accordingly. The Local Tsunami exercise was held on October 1, 2008. To increase the realism and difficulty, a large-scale earthquake event was added to the scenario.

Both exercises were coordinated with the monthly testing of the warning sirens. The participants included: Pacific Tsunami Warning Center (PTWC); Hawaii County Civil Defense Agency; Maui County Civil Defense Agency; Kauai County Civil Defense Agency; and Honolulu City and County Department of Emergency Management; the State and County Warning Points, and the National Weather Service (NWS).

The October 1st exercise included a workshop for selected Emergency Support Functions (ESFs) and State Emergency Response Team (SERT) personnel. ESFs and SERT participants included: Department of Health, Department of Transportation, Public Safety Department, and Department of Human Resources Development. The workshop was successful and helped clear up several issues, particularly the release of state workers during an emergency.

Tsunami Inundation Mapping continues through an effort coordinated by SCD with the University of Hawaii to upgrade existing one-dimensional tsunami evacuation maps. Currently two-dimensional (LiDAR topographic data) inundation maps are being generated. These inundation maps will be used to draw new evacuation maps which will replace the current one-dimensional evacuation maps available to the public in local telephone books. The Island of Oahu mapping was completed in early 2008 and the data is currently undergoing peer review. The mapping activity has shifted to the Island of Hawaii with Maui, and Kauai to follow over the next couple of years.

Department of Education/Tsunami Curriculum Project was awarded to the Pacific Tsunami Museum in Hilo, Hawaii in March 2007. This project includes the development, testing, and distribution of a formal educational package which will contain student materials and a teacher's guide in addition to supplemental materials that are "teacher-ready" for expanded lesson plans. Progress is slow but continues to advance; we are now awaiting the expected completion by the end of the year.

Through a collaborative effort between Hawaii State Civil Defense and NOAA's Pacific Services Center, a web application called Tsunami Evacuation Zone Mapping Tool, has been created, featuring an interactive online mapping system. A resident or visitor may enter an address and immediately see the tsunami evacuation zones on the hazard map. This has been well received and is very successful. The tsunami awareness tool is easy to use and can be placed on any website. Since the Google Maps interface is provided to developers for customization at no cost, both users and stakeholders may take advantage of this free application. See the user-friendly, on-line format at *www.scd.hawaii.gov*. Another related web-page site is the "Are You Tsunami Akamai" quiz which asks the reader a series of tsunami awareness and response related questions which are scored.

SCD has an active outreach program that goes to schools, public meetings and other venues to provide presentations, open forum discussions, and to support community disaster planning efforts for all hazards.

WSSPC Policy Recommendations
Hawaii State Civil Defense actively searches for improvement opportunities to mitigate the natural hazards we face. WSSPC policy recommendations align well with our efforts. The following are some examples:

WSSPC Policy Recommendation 08-1: Improving Tsunami Public Education, Mitigation, and Warning Procedures for Distant and Local Sources
- Educational outreach utilizing our public information
- Two annual statewide exercises (one local and one distant)
- Other efforts: Tsunami Observer Program, Water Level Monitoring Project, Tsunami Inundation Mapping Project, and Tsunami Awareness Curriculum Project

WSSPC Policy Recommendation 08-3: Earthquake Monitoring Networks
SCD monitors many active networks 24-hours a day. Primary networks include NWS, PTWC, and CISN.

WSSPC Policy Recommendation 08-4: Identification and Mitigation of Unreinforced Masonry Structures
The hazard mitigation committees actively engage in identifying opportunities to enhance and identify hazards as it relates to our particular island construction. We are currently working on the statewide Building Code adoption. Also, after the October 15, 2006 earthquake we've worked to develop Post and Pier (30% of the homes on the Island of Hawaii) retrofit engineering. We also have a large number of homes built with single-wall construction which requires a different type of engineering to make these structures more seismic resilient.

Submitted by Kevin Richards, Earthquake and Tsunami Program Planner, Hawaii State Civil Defense.

Idaho Geological Survey and
Idaho Bureau of Homeland Security

Earthquakes
It was a quiet year for Idaho earthquakes. The U. S. Geological Survey (USGS)/National Earthquake Information Center catalog lists nine Idaho earthquakes ranging from magnitudes 2.5 to 3.8 between November 2007 and October 15, 2008. No damage was reported. Central Idaho had four earthquakes and five occurred in southeastern Idaho.

The M 6.0 Wells, Nevada earthquake on February 21, 2008 was widely felt across southern Idaho. The event raised awareness of seismic hazards among Idaho citizens and underscored the vulnerability to earthquake damage of historic masonry structures found in many Idaho towns.

Purchase of USArray Seismic Station
The Idaho Geological Survey (IGS) purchased one USArray seismic station (TA-J11A) with funding from the Idaho Bureau of Homeland Security (BHS). The station is located 23 miles east of Boise. It will provide seismic monitoring for the largest population in Idaho. The IGS is negotiating with the Advanced National Seismic System (ANSS) to assume permanent operation and maintenance of the station.

Mark Stephensen, Idaho Bureau of Homeland Security with USArray Seismic Station Outside of Boise, Idaho

Seismic Hazard Advisory Committee
A meeting of the Idaho Seismic Hazard Advisory Committee was held on October 16, 2008 in Boise. The committee is sponsored by the BHS and is organized and chaired by IGS. Ten representatives from federal, state and local agencies participated. This ad-hoc committee has been established to advise the BHS on issues pertaining to its earthquake program from the perspective of multiple disciplines. The purpose of the meeting was to construct a charter that defines the mission, objectives, membership, and operating procedures of the committee.

Mitigation Activities
The Idaho State Controller's Office (SCO) completed a non-structural seismic mitigation project to protect their computer servers in mid January 2008. Funding for the project was provided by BHS through the Hazard Mitigation Grant Program (HMGP). The project mounted all of SCO computer servers and tape robot on Iso-Base base isolation racks to protect the servers from damage associated with toppling and shaking. The complete project cost $100,000 with a projected benefit-cost ratio of 14:1.

Tape Robot Mounted on ISO-Base Platform

Computer Servers Mounted on ISO-Base Platform

Outreach Activities

In July, 19 teachers from around Idaho gathered in McCall to participate in the IGS's annual Idaho Earth Science Educator Field Workshop. The week-long workshop focuses on natural hazard education including earthquakes. The McCall area has experienced several earthquake swarms adjacent to the Long Valley fault zone, most recently in 2005. The teachers viewed infrastructure at risk to seismic hazards and completed a short course on risk analysis.

In October, IGS and BHS sponsored activities for Idaho educators commemorating the 25th anniversary of the M 6.9 Borah Peak earthquake. Held in conjunction with the Idaho Science Teachers Association annual meeting, the activities began in Idaho Falls with lectures and a demonstration of how to teach seismic hazards using a shake table. A day-long field trip made stops along the Lost River fault culminating at the 1983 fault scarp near Borah Peak. Twenty-two participants viewed evidence for prehistoric faulting at a paleoseismology trench near Arco, learned about seismic monitoring at the nearby Idaho National Laboratory, and visited Mackay, the town most damaged during the 1983 earthquake.

WSSPC Policy Recommendations

The State of Idaho has not specifically adopted any of the policy recommendations. Our Seismic Hazard Advisory Committee is very new and just getting started. However, we do have some alignment with the WSSPC Policy Recommendations.

WSSPC Policy Recommendation 08-4: Identification and Mitigation of Unreinforced Masonry Structures – The 2007 State of Idaho Hazard Mitigation Plan specifically lists the identification and mitigation of URM buildings as one of our specific mitigation actions for Idaho's earthquake hazard. The 2007 State of Idaho Hazard Mitigation Plan also has language that aligns with **WSSPC Policy Recommendation 07-4: Seismic Provisions in the International Building Code** and **06-1: Developing Earthquake Risk- Reduction Strategies.**

Idaho uses the definitions of **WSSPC Policy Recommendation 08-2: Definitions of Fault Activity for the Basin and Range Province** for describing definitions of fault activity, and our acquisition of one of the USArray Seismic Stations in the Boise Area aligns with **WSSPC Policy Recommendation 08-3: Earthquake Monitoring Networks**.

Submitted by Bill Phillips, Research Geologist, Idaho Geological Survey and Dave Jackson, Earthquake Program Manager, Idaho Bureau of Homeland Security.

Montana Bureau of Mines and Geology

The northern Intermountain Seismic Belt remained seismically active during the period covered by this report, October 1, 2007 through September 30, 2008. Using data from the Montana Regional Seismograph Network, the Earthquake Studies Office of the Montana Bureau of Mines and Geology (MBMG) determined hypocenter locations for 1475 earthquakes during this period. This total included two earthquakes greater than magnitude 4.0 and 24 earthquakes with magnitudes ranging from 3.0 to 3.9. Residents reported feeling 10 of these earthquakes but none caused any damage. Information about recent Montana earthquakes is available on the Earthquake Studies Office website *http://mbmgquake.mtech.edu*.

The largest earthquake in the northern Rocky Mountains during the past year occurred just outside Montana in the northeastern corner of Yellowstone National Park on March 25, 2008 and had a magnitude of 4.6. This earthquake was felt but caused no damage in this undeveloped area. Visit *http://volcanoes.usgs.gov/yvo/* for information about this and other earthquakes in Yellowstone National Park.

The largest Montana earthquake occurred in central Montana, a region of very low historic seismicity. Centered 12 km SSW of the small town of Grassrange and 130 km NNW of Billings, this magnitude 4.2 earthquake on November 26, 2007 was felt and heard loudly by the sparse population living near the epicenter. No foreshocks or aftershocks occurred. Such earthquakes demonstrate that no area is immune from the possibility of an earthquake.

The most energetic earthquake swarm during the reporting period occurred near the small town of Big Arm on the western shore of Flathead Lake. A total of 107 earthquakes occurred from July 5 through November 29, 2007. Numerous earthquakes were felt or heard as loud booms by local residents but the six largest earthquakes of the swarm ranged from only 2.2 to 2.4. The majority of the activity occurred between October 2 and October 19, the dates of the first and last of the "larger" events. Despite the small magnitudes of these earthquakes and abundant historic seismicity in the Flathead Valley, the Big Arm swarm generated a significant amount of public interest.

Going into its third year, the aftershock sequence of the July 26, 2005 magnitude 5.6 Dillon earthquake continues. During the past year the Earthquake Studies Office located 177 additional aftershocks with magnitudes ranging from 0.3 to 3.1. Neither of the magnitude 3.1 aftershocks were reportedly felt by local residents. This brings the total number of located aftershocks since the main shock to 1676.

From October 2007 through September 2008, 24 additional aftershocks of the May 8, 2007 magnitude 4.7 Sheridan earthquake were located. These aftershocks ranged from magnitude 0.1 to a magnitude 2.9 earthquake on October 22, 2007 that residents in the epicentral area reported feeling.

A swarm of 59 earthquakes centered 8 km east of the small town of Toston in the southern Townsend Valley (62 km NW of Bozeman and 70 km SE of Helena) began on August 20, 2008 with two felt earthquakes, a magnitude 3.3 followed by a 3.5 about 3½ hours later. Activity at this location continued through the end of September 2008.

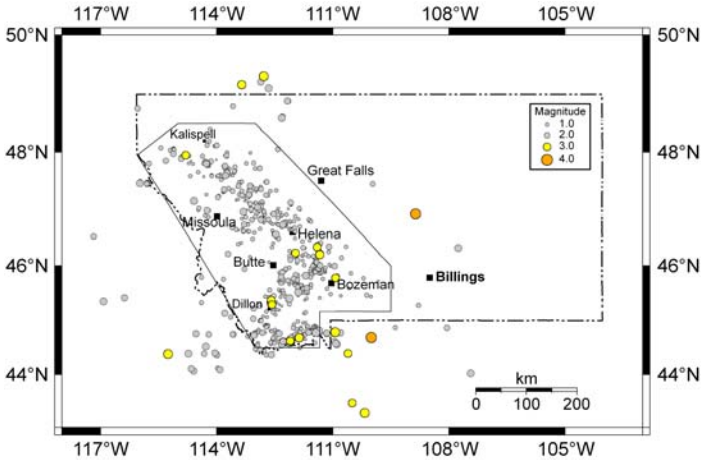
From March 26 through May 4, 2008, a swarm of 35 earthquakes occurred along the south shore of Lima Reservoir (70 km south of Dillon) in the Centennial Valley. Earthquake magnitudes ranged from 0.8 to 2.5. This cluster of recent activity is one of several along a persistent ENE-WSW-trending seismic zone that extends 80 km from the Interstate 15/Montana-Idaho border to the southern Madison range just west of Hebgen Lake.

The Earthquake Studies Office continues to receive funding from the U.S. Geological Survey National Earthquake Hazards Reduction Program for partial support of the Montana Regional Seismograph Network. These funds are used for technical assistance with repair and maintenance of seismographs and telemetry equipment, data archival, and general network operations. This funding together with generous support by the Confederated Salish and Kootenai Tribes allowed the MBMG to hire Debbie Smith as a full-time assistant/seismic analyst in the Earthquake Studies Office. With Debbie's assistance the 3-month backlog of unprocessed regional seismic network data has been analyzed and cataloged.

Seventy-six stations of the Incorporated Research Institutes for Seismology's Transportable Array (*http://anf.ucsd.edu/stations.php*) are currently operating in western and central Montana. The MBMG picks P and S arrival times from waveform data from this temporary research array and incorporates them into routine hypocenter locations. These data significantly improve spatial coverage of our seismic monitoring efforts throughout Montana. We now typically have over 40 readings for magnitude 2 earthquakes and unprecedented numbers of P-wave first motions for determining fault plane solutions. Incorporating these data into routine network processing is time consuming but results are well worth the effort.

In September, the State of Montana awarded the MBMG an equipment grant that will allow us to take over operation of 10 Transportable USArray sites after the experiment moves eastward. Final site selection is underway and a purchase order has been awarded for acquisition of the station data loggers. We expect this deployment over the next year to provide lasting improvements to the coverage and data quality of the Montana Regional Seismic Network.

The MBMG continues to work cooperatively with Silver Bow County on a FEMA Pre-Disaster Mitigation Grant to delineate geologic hazards. Two field geologists spent the summer mapping and gathering geologic information. The MBMG will provide GIS data and interpreted geologic hazards information to Silver Bow County officials by October 15, 2009 for inclusion in the next revision of the County preparedness plan.



Map of 1475 earthquake epicenters from October 1, 2007 through September 30, 2008 determined from Montana Regional Seismograph Network data. The polygon shows the Montana Regional Seismograph Network authoritative region.

WSSPC Policy Recommendations
Montana has not formally adopted any of the WSSPC policy recommendations. However, we are informally implementing some of the elements of the WSSPC recommendations as listed.

WSSPC Policy Recommendation 08-3: Earthquake Monitoring Networks
Taking advantage of the EarthScope Transportable Array (TA) data for enhanced local and regional seismic monitoring, Montana will retain ten TA sites after the experiment moves eastward; however, we will utilize less expensive instrumentation and data telemetry systems than currently operating at those sites.

WSSPC Policy Recommendation 08-4: Identification and Mitigation of Unreinforced Masonry Structures
Provide training to identify problematic structures.

WSSPC Policy Recommendation 07-3: Post-Earthquake Technical Clearinghouses
Utilizing GIS.

WSSPC Policy Recommendation 07-4: Seismic Provisions in the International Building Code
Local jurisdictions utilize international building codes – the state has to a degree, but most of the enforcement comes from the local jurisdictions and it is not to the degree WSSPC suggests in the recommendation. The state provides oversight.

WSSPC Policy Recommendation 07-6: Post Earthquake Information Management System
The preliminary damage assessment and continuous assessments done by the state and FEMA will allow us to collect data regarding damage that will be used to assess future events and for planning efforts. It is a formal process we request, but not as complete as the recommendation.

Submitted by Mike Stickney, Director, Research Studies Office, Senior Research Geologist, Montana Bureau of Mines and Geology.

Nevada Bureau of Mines and Geology and
Nevada Division of Emergency Management

Earthquake programs in Nevada are interconnected among state and local agencies through the Nevada Earthquake Safety Council. The lead agencies are the Nevada Division of Emergency Management *(http://dem.state.nv.us/)*, the Nevada Bureau of Mines and Geology (*http://www.nbmg.unr.edu/)*, and the Nevada Seismological Laboratory *(http://www.seismo.unr.edu/)*. The Council facilitates public input, develops consensus about seismic issues within public and private sectors, and is the public advisory body for state seismic policy. Minutes of the Council's quarterly meetings and related documents are posted at *http://www.nbmg.unr.edu/nesc/index.html*.

2008 has been a busy year for the Nevada Earthquake Preparedness Program, as the state experienced two damaging earthquakes. The first, a magnitude 6, occurred on February 21, 2008 in Wells, Nevada. This is a rural community of 1,500 people in the northeastern part of the state. This part of Nevada has some of the lowest seismic hazard in the state, underscoring that damaging earthquakes can happen anywhere in Nevada, even places that are the least likely. The earthquake collapsed one building, partially collapsed three others, and partially brought down walls and parapets in about a dozen buildings, most of which are historical buildings in the old town area. Over 60 chimneys were damaged or fell. There were no deaths or major injuries, perhaps mostly due to the morning time of the event. There was one small fire put out by a resident, one HAZMAT incident in the high school chemistry storage locker, and three minor injuries. The earthquake occurred during cold days with intermittent snow showers and would have had much more serious consequences had the power not stayed on and propane gas tanks or connections been damaged. Other consequences included breaks in a water main, two broken gas lines in manufactured homes, and several isolated instances of electrical line damage to homes. Each home had nonstructural damage totaling anywhere from hundreds to thousands of dollars.

The emergency response was rapid, effective, and completed in about a day. The people of Wells and surrounding communities rallied together immediately following the event, gathering donations and volunteers to help. These were administered by a committee of interfaith leaders who vetted and prioritized help. For several Saturdays following the event, people came to Wells to take down broken chimneys, reinstall stove pipes, and clean up homes of folks who needed a little help.

Recovery is proceeding rapidly for Wells, but the restoration of damaged buildings in the historical old district will be more difficult and require significant amounts of capital. Damage to city and school buildings was covered by earthquake insurance. The balance of the damage was not enough to qualify for a Presidential Disaster, but aid is being given by the state to a few home owners that qualified for assistance, and state government is reimbursing much of the emergency response effort. Members of the Nevada Earthquake Safety Council have been working with Wells, distributing information, and documenting the lessons learned.

In late February 2008 an earthquake sequence began to be felt just west of Reno, culminating in a magnitude 5 earthquake in April. This earthquake sequence occurred at shallow depths, directly below two suburban communities, and people were subjected to hundreds of felt foreshocks causing quite a bit of anxiety. Ten days before the M5 event, activity increased to a threatening level and local emergency personnel began to review their preparedness levels and plans. Weather permitting, doors on fire stations were kept open, and following a pair of M4

aftershocks, equipment was kept out of the stations, ready for response. Information began to be distributed to the affected neighborhoods starting about seven days before the main event, with over 1000 *Living with Earthquakes in Nevada* booklets distributed to the area by the day of the event. There was a significant amount of pre-event mitigation that occurred prior to the magnitude 5 event, including removal of pictures and mirrors from walls, strapping of water heaters, and the removal of obvious toppling and safety hazards. This was motivated by a combination of feeling earthquakes that were escalating in size and frequency and the available information on how to prepare for earthquakes. Mitigation activity was the highest immediately following the main shock, when a local large chain hardware store estimated that about 70% of its sales the day after the event were related to earthquake mitigation supplies.

The State of Nevada and FEMA teamed up to print 75,000 *Living with Earthquakes in Nevada* booklets and distributed them in northern Nevada's largest circulation newspaper within an approximate two week period following the Mogul-Somersett magnitude 5 event. This was near the middle of the very small window of opportunity in awareness that existed in Nevada following these events and led to a record number of Nevadans being familiar with this booklet and earthquake preparedness information.

Policy Recommendations

WSSPC Policy Recommendation 07-3 (01-3): Post-Earthquake Technical Clearinghouses
The Nevada Earthquake Safety Council endorsed this Policy Recommendation in November 2001 and the Nevada All Hazards Mitigation Advisory Committee approved it in January 2002.

The Nevada Bureau of Mines and Geology established a Technical Earthquake Clearinghouse webpage for the 2008 Wells, Nevada earthquake and the 2008 Mogul-Somersett earthquake sequence. In the case of the Wells earthquake, this effort was begun by the Utah Geological Survey with Nevada's consultation. The Survey established the clearinghouse page until the Nevada Bureau of Mines and Geology could get their page up. The difference was that Utah had a page ready to go and just had to modify it to the specific event, and we encourage this practice for those with webpage responsibilities.

WSSPC Policy Recommendation 07-4 (01-4): Seismic Provisions in the International Building Code
The Nevada Earthquake Safety Council endorsed this Policy Recommendation in November 2001 and the Nevada All Hazards Mitigation Advisory Committee approved it in January 2002.

Submitted by Craig dePolo, Research Geologist and Jonathan Price, Director and State Geologist, of the Nevada Bureau of Mines and Geology, and Rick Martin, Program Supervisor/ Individual and Households Program Officer, Nevada Division of Emergency Management.

New Mexico Bureau of Geology and Mineral Resources and New Mexico Institute of Mining and Technology, Department of Earth and Environmental Science

With the Earth and Environmental Sciences Division, Los Alamos National Laboratory

Seismic studies

Notable earthquakes in New Mexico this past year occurred primarily along the northeastern border of the state, associated with the continuing earthquake swarm near Trinidad, Colorado, and northwest of Carlsbad in the southeast part of the state, where a swarm of earthquakes continues near the Dagger Draw oil field, and in the central portion of the state near the Socorro magma body. Other notable earthquakes within the past 18 months include an unusual minor event west-southwest of Reserve. This magnitude 3 earthquake, part of a small swarm that lasted several hours on September 8, 2007, produced felt reports up to 20 miles away, especially in the local population center and county seat of Reserve. A 2.1 magnitude quake about 25 miles south-southeast of Chama was also felt and reported by local residents. There have also been small earthquakes in the Socorro area, including 2 small (magnitude 1.0 and 1.5) events recently noted on September 3, 2008.

Our geodetic and broadband seismic monitoring has continued during 2007-2008. The GPS and broadband seismic site adjacent to the long-established CAR station site east of Socorro has been recording data since 2004, with downtimes associated with equipment swaps with the Mount Erebus seismic network in Antarctica. Collaborations with Los Alamos National Laboratory (LANL) allowed us to temporarily deploy two new broadband seismometers north of Socorro, co-located with two new continuous GPS stations, to explore uplift and seismicity associated with the Socorro magma body. For more network information, see *http://www.ees.nmt.edu/Geop/NM_Seismology.* Current research efforts include relocation of small earthquake swarms in the Socorro magma body region and a recently completed M.S. thesis has linked several clusters of seismicity to regional fault structures (Morton, 2008).

Studies at the surface around the uplift above the Socorro magma body continued. These efforts included basic geologic mapping, installation of two new continuous GPS stations, and a small network of tiltmeters, and previous sets of campaign GPS measurements being compiled by researchers and students at the New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology (NMT) Department of Earth and Environmental Science, and at the Georgia Institute of Technology.

Following the earthquake catalogs compiled by Al Sanford and colleagues (2002), the Geophysics group at NMT has also recently completed an earthquake catalog through 2004 (Sanford et al., 2006). Data from the catalogs may be downloaded from *http://geoinfo.nmt.edu/publications/earthcat.* Current efforts at NMT include the continued monitoring and cataloging of local earthquakes in the Socorro and Carlsbad regions.

Ongoing research projects using seismology to image the lower crust and upper mantle in New Mexico and adjoining regions of the southwest include Colorado Plateau/Rio Grande Rift Seismic Transects Experiment (LA RISTRA), a teleseismic Incorporated Research Institutions for Seismology (IRIS) Program for the Array Seismic Studies of the Continental Lithosphere

(PASSCAL) -supported experiment along a great-circle transect spanning west Texas, New Mexico, Arizona, and Utah (see *http://www.ees.nmt.edu/Geop/Ristra/ristra.html*).

Recent funding from Los Alamos Institute of Geophysics and Planetary Physics (IGPP) supported an extension (RISTRA 1.5) of the original 1999-2001 RISTRA deployment that incorporated an additional 18 stations and extends the experiment across the Colorado Plateau and into the Great Basin. Ongoing work includes understanding of mantle anisotropy and small-scale convection at the edges of the Colorado plateau (Sine et al., 2008; Wang et al., 2008) A National Science Foundation (NSF) Continental Dynamics and Los Alamos National Laboratory-funded project in which NMT is a major partner, the Colorado Rockies Experiment and Seismic Transects (CREST; *www.ees.nmt.edu/Geop/CREST*), had 59 instruments installed in the Colorado Rockies by August 2008, and will expand knowledge of the Rocky Mountains regional lithosphere, including addressing the question of the timing of uplift in the central Rockies and the nature of the Colorado Mineral Belt and possibly related Four Corners region mantle anomalies noted from RISTRA studies (Aster et al., 2008). CREST has been closely coordinated in association with EarthScope seismic and other seismograph deployments in the region.

Beginning with the funding of EarthScope in the NSF Major Research Equipment and Facilities Construction account beginning in Fiscal Year 2004, the IRIS Consortium and NMT have operated the USArray Array Operations Facility (AOF) to site and support 2000 state-of-the-art EarthScope USArray seismic stations being deployed in a 400+ station movable array across the conterminous U.S. The AOF is co-sited with the IRIS PASSCAL portable seismology instrument center and the combined facility has a total professional seismology/geophysics support staff of over 35. As of October 2008, USArray occupied over 448 sites from Montana to west Texas, including all of New Mexico (see *http://anf.ucsd.edu/stations.php*). Discussions are underway in New Mexico to try to keep a number of USArray stations operating in New Mexico after their presently scheduled pullout in late 2009 through EarthScope's station adoption program.

More generally, New Mexico Tech continues to carry out a wide variety of seismographic research projects, ranging from studies of seismic ocean noise to volcano and mantle imaging seismology in Antarctica. The IRIS PASSCAL Instrument Center and EarthScope USArray Array Operations Facility supported over 60 distinct seismic experiments in 2007-2008. The Instrument Center and New Mexico Tech also served as the site for the IRIS NSF-supported Intern Orientation program in May of 2008, the third year of hosting this event. NMT was also a major partner in hosting the 2008 meeting of the Seismological Society of America meeting in Santa Fe.

WSSPC Policy Recommendations

The Sate of New Mexico supports WSSPC's currently adopted Policy Recommendations, but has not taken the steps to formally adopt any of them.

Recent relevant New Mexico and regional seismology-related publications and abstracts are as follows:

Aster, R., MacCarthy, J., Heisler, M., Kelley, S., Karlstrom, K., Crossy, L., Dueker, K., and the CREST Team, 2008, in press, CREST experiment probes the roots and geologic history of the Colorado Rockies: The Outcrop, 2008.

Aster, R., Van Wijk, J.,and the RISTRA Group, 2007, Colorado Plateau Crust and Upper Mantle Structure: Implications for Uplift Mechanisms: Western U.S. Geodynamics Workshop, Santa Fe, August 30-September 2, 2007.

Beaudoin, B., Aster, R., 2008, 2007-2008 Activities at the IRIS PASSCAL Instrument Center: IRIS Consortium 18th Workshop, Stevenson, WA, 3-6 June, 2008.

Bilek, S., Newman, A., Morton, J., Aster, R., Rowe, C., Farmer, G., 2008, Comparison of seismicity patterns and uplift in the Socorro Magma Body region, central New Mexico: Annual Meeting of the Seismological Society of America, Santa Fe, NM, Seism. Res. Lett., Vol. 79, No. 2.

Hubenthal, M., Taber, J., Aster, R., Frassetto, A., 2007, Developing virtual REU cohorts: Reflections from the IRIS Undergraduate Internship Program: EOS Trans. AGU, Vol. 88, No. 52, Fall Meet. Suppl.

Hubenthal, M., Taber, J., Aster, R.,2007, IRIS Undergraduate Internship Program and Orientation Enters its Second Year: Proc. EarthScope National Meeting, Monterey, CA.

Karlstrom, K., Dueker, K., Aster, R., Kelley, S., Crossey, L., Kirby, E., Hilton, D., Coblentz, D., Farmer, L., MacCarthy, J., 2007, Cenozoic uplift associated with the Aspen Anomaly, central Colorado, and update on the CREST Colorado Rockies Experiment and Seismic Transects: Proceedings of the Geological Society of America, Denver, CO, 28-31 October 2007.

Karlstrom, K. E., Dueker, K., Aster, R., MacCarthy, J., Crossey, L., Heizler, M., Hilton, D., Takacs-Vesbach, C., 2007, Colorado Rockies Experiment and Seismic Transects (CREST): Cenozoic Uplift, Magmatism, and Mantle to Surface Fluid Interconnections Associated with the Aspen Anomaly: Proc. EarthScope National Meeting, Monterey, CA.

Karlstrom, K., Dueker, K., Aster, R., MacCarthy, J., Crossey, L., Heizler, M., 2007, Cenozoic Uplift, Magmatism, and Mantle to Surface Fluid Interconnections Associated with the Aspen Anomaly of central Colorado: the CREST experiment (Colorado Rockies Experiment and Seismic Transects): NM Geological Society Annual Spring Meeting, 13 April, 2007.

Land, L., Aster, R., Seismic recordings of an anthropogenic sinkhole collapse: Proc. 22nd Syposium on the Application of Geophysics to Engineering and Environmental Problems, Fort Worth, TX, March 29-April 2, 2008.

Mooney, W., Aster, R., Snelson, C., Humphreys, J., 2007, Introduction to "The Lithosphere of Western North America": Proceedings of the Geological Society of America, Denver, CO, 28-31 October 2007.

Morton, J.J., Bilek, S.L, Aster, R., Rowe, C.A., 2007, Waveform cross-correlation of earthquake clusters to determine loci of active processes within the Socorro Seismic Anomaly, New Mexico: New Mexico Geological Society Annual Spring Meeting, April 13, 2007.

Morton, J., 2008, High precision relocation of earthquakes in the Socorro Seismic Anomaly, New Mexico, New Mexico Institute of Mining and Technology, M.S. Thesis, p. 185.

Ni, J., van Wijk, J., Wilson, D., Sine., C., Grand, S., Aster, R., Baldridge, W.S., van Hunen, J., 2007, Edge driven convection along the Colorado Plateau – Great Basin Transition Zone: Implications for the morphology and dynamics of the Plateau: EOS Trans. AGU, Vol. 88, No. 52, Fall Meet. Suppl.

Sanford, A., Mayeau, T., Schlue, J., Aster, R., Jacksha, L., 2006, Earthquake catalogs for New Mexico and bordering areas II: 1999-2004: New Mexico Geology, Vol. 28, No. 4, 99-109.

Sine, C., Wilson, D., Gao, W., Grand, S., Aster, R., Ni, J., Baldridge, W.S., 2008, Mantle structure beneath the western edge of the Colorado Plateau: Geop. Res. Lett., Vol. 35, L10303, doi:10.1029/2008GL033391.

Stankova, J., Bilek, S.L., Rowe, C., Aster, R., 2008, Characterization of the October 2005 microearthquake swarm in the Socorro region, New Mexico: Bull. Seismo. Soc. Am., Vol. 98, p.93-105.

Wang, X., Ni, J., Aster, R., Sandvol, E., Wilson, D., Sine, C., Grand, S., Baldridge, W.S., 2007, Shear wave splitting and mantle flow beneath the Colorado Plateau and the Colorado Plateau-Great Basin transition: EOS Trans. AGU, Vol. 88, No. 52, Fall Meet. Suppl.

Wang, X., Ni, J.F., Aster, R., Grand, S., 2008, Seismic Anisotropy beneath the Colorado Plateau and Great Basin transition: Annual Meeting of the Seismological Society of America, Santa Fe, NM, Seism. Res. Lett., Vol, 79, No. 2.

Wang, X., Ni, J., Aster, R., Sandvol, E., Wilson, D., Sine, C., Grand, S., Baldridge, W.S., 2008, Shear wave splitting and mantle flow beneath the Colorado Plateau and its boundary with the Great Basin: Bull. Seism. Soc. Am., Vol. 98, p.2526-2532, doi: 10.1785/0120080107.

Los Alamos National Laboratory*

Paleoseismic studies

Jamie Gardner retired from LANL in July 2008. Claudia Lewis has assumed leadership of the LANL Seismic Hazards Geology Team.

In the last two years, the LANL Seismic Hazards Program has focused on two main activities. The first was completing an update to the Probabilistic Seismic Hazards Assessment for LANL (Wong et al., 2007). Incorporating results from paleoseismic studies completed over the last 10 years, the new PSHA shows that horizontal peak ground accelerations are about 0.5 g at a return period of 2,500 years. This represents a substantial increase in probabilistic ground motion over the last PSHA (Wong et al. 1996), which calculated 0.33 g for a 2,500-year return period. This result arises from an improved paleoseismic event chronology showing earthquake clustering in the Holocene, revised attenuation relations, and inclusion of synchronous (multiple sub-events) as well as simultaneous (single large event) rupture models. There is no reason to expect these relations are unique in the Rio Grande rift.

The second activity involved a detailed study of the geology and structure exposed on the walls of a large pit, excavated at the proposed site of the Chemistry and Metallurgy Research Facility Replacement building. The main purpose of this study was to evaluate the potential for seismic

surface rupture at the proposed site. Geologic structures at the site originated from fumarolic activity and immediate post-depositional cooling and compaction, and pose no seismic surface rupture hazard.

2007-2008 seismology-related publications and abstracts are as follows:

Gardner, J.N., Schultz-Fellenz, E.S., Caporuscio, F.A., Lewis, C.J., Kelley, R.E., and Greene, M.K., 2008, in press, Geology and structure of the Chemistry and Metallurgy Research Facility Replacement Site, Los Alamos National Laboratory, New Mexico: Los Alamos National Laboratory miscellaneous report.

Kelley, S., Gardner, J., Lewis, C., Kempter, K., Rogers, M.A., Broxton, D., Vaniman, D., Goff, F., and Whiteis, J., 2007, Geology of the Los Alamos area: Thrid-day road log: New Mexico Geological Society 58th Field Conference Guidebook, p. 93-102.

Lewis, C.J., Gardner, J.N., Schultz-Fellenz, E., Lavine, A., Reneau, S.L., and Olig, S., in review, Lateral displacement variation and fault interaction in the Pajarito fault system, Rio Grande rift, New Mexico: submitted to Geosphere, July 2008.

Wong, I., Kelson, K., Olig, S., Bott, J., Green, R., Kolbe, T., Hemphill-Haley, M., Gardner, J., Reneau, S., and Silva, W., 1996, Earthquake Potential and Ground Shaking Hazard at the Los Alamos National Laboratory, New Mexico: New Mexico Geological Society, Guidebook to 47th Field Conference, pp. 135-142.

Wong, I.G., Silva., W., Olig, S., Dober, M.C., Gregor, N., Gardner, J., Lewis, C., Terra, F., Zachariasen, J., Stokoe, K., Thomas, P., and Upadhaya, S., 2007, Update of the probabilistic seismic hazard analysis and development of seismic design ground motions at the Los Alamos National Laboratory: unpublished consulting report, URS Corporation, 11 sections, 8 appendices, 2 maps.

*Los Alamos National Laboratory technical information release number LA-UR-08-06373.

Submitted by Susan Bilek, Associate Professor of Geophysics and Richard Aster, Professor of Geophysics, New Mexico Institute of Mining and Technology, Department of Earth and Environmental Science; Dave Love, Principal Environmental Geologist, Bureau of Geology and Mineral Resources, and Claudia Lewis, Earth Environmental Sciences Division, Los Alamos National Laboratory.

New Mexico Department of Homeland Security and Emergency Management

Mitigation
Statewide efforts continue in the development of local hazard mitigation plans that will meet the Federal Emergency Management Agency's (FEMA) Disaster Mitigation Act requirements. These mitigation plans are assessing risk from various hazards, including earthquakes, and studying ways to reduce that risk. At this time, 24 local mitigation plans have been approved by FEMA. One plan is FEMA approvable, pending its adoption. Ten plans are under development and another four are in application stages. The new plans will all address the same hazards as were profiled in the 2007 State Hazard Mitigation Plan update, which include seismic and geologic hazards across the state.

Cooperation between the Department of Homeland Security and Emergency Management (OEM) and the New Mexico Bureau of Geology and Mineral Resources resulted in another successful "Rockin' Around New Mexico" for 25 teachers throughout New Mexico. The three-day workshop in Socorro and Sevilleta National Wildlife Refuge featured talks on earthquake hazards and local geologic history and processes.

Submitted by David Freeborn, Former State Hazard Mitigation Officer, New Mexico Department of Homeland Security and Emergency Management.

Oregon Department of Geology and Mineral Industries, Oregon Emergency Management and Oregon Seismic Safety Policy Advisory Commission

Vicki McConnell, Oregon State Geologist, is a WSSPC Board-Member-Elect. Althea Turner is the new Office of Emergency Management (OEM) earthquake and tsunami coordinator, filling Jay Wilson's former position. Paulina Layton is the newly hired OEM Seismic Rehabilitation Grants Program coordinator.

Oregon Seismic Safety Policy Advisory Commission
Oregon Seismic Safety Policy Advisory Commission (OSSPAC) Chair Gerry Williams and Vice Chair Carl Farrington have directed activities for four committees: OEM Seismic Grants (chaired by Jim Doane), Legislative (chaired by Autumn Rudisel), Education and Communication (chaired by Diane Merten), and Strategic Planning (chaired by Tom Manning). New appointments include: Senator Fred Girod, Oregon State Legislature and Chris Shirley, Department of Land Conservation and Development.

Earthquake Program
OEM staff and grant committee members began work on the development of the eligibility criteria for the Seismic Rehabilitation Grant Program. Data from the WSSPC award winning Department of Geology and Mineral Industries (DOGAMI) 2007 statewide seismic needs assessment report, *www.oregongeology.com/sub/projects/rvs/*, will be incorporated as one factor in determining funded projects. Much more work will be done in the coming months.

Several Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation (PDM) activities are ongoing or were completed, including building upgrades at Western Oregon University and Oregon State University. Updated hazard maps and HAZUS results, conducted as part of a PDM'03 planning grant, were published in DOGAMI Interpretive Map Series 24 (*Geologic Hazards, Earthquake & Landslide Hazard Maps, Future Earthquake Damage Estimates from Six Counties in The Mid/Southern Willamette Valley Including Yamhill, Marion, Polk, Benton, Linn and Lane Counties and the City of Albany, Oregon*, 2008, by W. J. Burns, R. J. Hofmeister, and Y. Wang). Many other counties and cities, with assistance from Oregon Partnership for Disaster Resilience, received or are in the process of receiving FEMA-approved plans. No seismic grants were awarded in 2008.

A Leadership Forum and Seismic Critical Energy Infrastructures Workshop featured top state officials including Senate President Peter Courtney and Governor's advisor Mark Ellsworth. A summary, including corporate sponsorship, is provided by the Oregon Public Utility Commission and DOGAMI in DOGAMI Open-File Report O-08-10.

National press highlighting seismic safety of schools in Oregon as a result of the May 12, 2008 Wenchuan, China quake included coverage in the NY Times (May 27, 2008) and NewsHour with Jim Lehrer (July 25, 2008). In response to the tragic death of 10,000 Chinese students[1], the Oregon Department of Education launched the Quake Safe Schools webpage (*http://www.ode.state.or.us/search/page/?id=2061*) and the International Sustainable Development Foundation hosted a forum on rebuilding schools using sustainable practices.

1. Note: The death toll is much higher than originally reported – over 19,000 students were killed in the China quake.

The enhanced rapid visual screening (E-RVS) method (*Portland State University Ondine Residence Hall Seismic Rehabilitation Demonstration Project*, 2007, by Yumei Wang and Christopher J. Heathman, DOGAMI Special Paper 38) was applied to the Oregon School for the Deaf and School for the Blind campuses. Similar improvements made in the E-RVS method were incorporated in the FEMA-funded ATC 67 pilot program on Rapid Observation Vulnerability and Estimation of Risk (ROVER).

OSSPAC, OEM, DOGAMI, and other Oregon stakeholders participated in the 2008 National Earthquake Conference in Seattle; NEHRP earthquake scenario workshop in San Francisco; National Science Foundation National Earthquake Engineering Simulation annual conference, Cascadia Regional Earthquake Workgroup activities, and the co-writing of National Earthquake Hazards Reduction Program Advisory Committee on Earthquake Hazard Reduction report "Effectiveness of the National Earthquake Hazards Reduction Program, A Report from the Advisory Committee on Earthquake Hazards Reduction," dated May 2008.

Tsunami Program

As part of the National Tsunami Hazard Mitigation Program, DOGAMI is working with Oregon State University and Oregon Health and Sciences University on tsunami inundation modeling for the Oregon coast. As a significant step toward publishing the results of the forthcoming Cannon Beach tsunami hazard assessment, the technical methodology of the study has been extensively vetted and revised according to peer review by three outside experts. Maps incorporate new geologic source models of the Cascadia Subduction Zone fault rupture to better estimate the various tsunami inundation hazards and the recommended evacuation zones. *The Oregonian* (March 9, 2008) article covered the new tsunami hazards mapping. A new Cannon Beach Evacuation Map (2008) is being distributed to the public *(www.oregongeology.org/sub/earthquakes/Coastal/tsubrochures/CannonEvac.pdf*).

Additional publications have been released, including DOGAMI Tsunami Fact Sheet (*http://www.oregongeology.com/sub/earthquakes/Coastal/TsunamiIntro.htm*), and *Reconstructing Hydrodynamic Flow Parameters of the 1700 Tsunami at Ecola Creek, Cannon Beach, Oregon* (Final Technical Report, U.S. Geological Survey National Earthquake Hazards Reduction Program, Award No. 07HQGR0089, 59 p.).

An ad hoc team of engineers and an architect, including DOGAMI, are emphasizing the need for a feasibility study to build a new Cannon Beach city hall that serves as a tsunami evacuation building, using FEMA P646 (*Guidelines for Design of Structures for Vertical Evacuation from Tsunamis*) on tsunami-resistant structures.

DOGAMI has taken a leadership role and initiated the Oregon Tsunami Advisory Council, an ad hoc working group of local stakeholders that includes elected officials from coastal cities, emergency responders, emergency managers, and parks, public health, and education experts. The Council has provided recommendations on developing an effective and accurate tsunami evacuation map for Cannon Beach that would be used as a model from which to develop future evacuation maps for other coastal communities that are consistent in style and content. Specific recommendations by the Council include:

- Modeling two evacuation zones that differentiate worst-case inundation by a local tsunami generated by a nearby Cascadia earthquake versus a distant tsunami generated by an earthquake far away,
- Including explanations in both Spanish and English,
- Featuring well-known landmarks,
- Including shaded relief showing topography,
- Identifying tsunami assembly areas on the map,
- Making maps visible to people with color vision disabilities, and
- Plotting locations of tsunami sirens, if installed, on the map.

DOGAMI is now beginning a new comprehensive tsunami hazard assessment in Bandon, Oregon. First tasks involve benchmark testing of tsunami models, which will employ high-resolution topographic data acquired by LiDAR.

WSSPC Policy Recommendations
The state of Oregon has not adopted any of WSSPC's policy recommendations to date.

Submitted by Yumei Wang, Geohazards Section Leader, Oregon Department of Geology and Mineral Industries, Althea Turner, Earthquake, Tsunami & Volcano Programs Coordinator, Oregon Office of Emergency Management, and Rob Witter, Regional Coast Geologist, Oregon Department of Geology and Mineral Industries.

Utah Geological Survey

The Utah Geological Survey (UGS) and U.S. Geological Survey (USGS) conducted a cooperative paleoseismic investigation of the Brigham City segment of the Wasatch fault zone. We excavated trenches at three separate sites with the intent of resolving the timing of the youngest paleoearthquakes on both the northern and southern parts of the segment. The UGS recently submitted a National Earthquake Hazards Reduction Program collaborative proposal with the Arizona Geological Survey to investigate the paleoseismology of the Washington fault in southwestern Utah and northwestern Arizona; if funded, we plan to begin the trench study in March 2009. In 2008, the UGS published the results of a cooperative paleoseismic study of the Nephi segment of the Wasatch fault, a paleoseismic reconnaissance of the Sevier fault in southwestern Utah, a surficial geologic map of the Levan and Fayette segments of the Wasatch fault, and completed an evaluation of per-event displacement on the Wasatch fault, to be published in the Bulletin of the Seismological Society of America. The UGS is finalizing a report on the 2007 UGS/USGS cooperative trenching study of the Weber segment of the Wasatch fault, due for publication in 2009.

The UGS completed an analysis of earthquake site conditions in the Wasatch Front urban corridor. Earthquake site conditions were mapped and characterized using shear-wave velocity data and provide the basis for predicting soil response to moderate- and large-magnitude earthquakes. The UGS also published a Geographic Information System database of geologic-hazard special-study areas (e.g., surface-fault-rupture-hazard areas) for the Wasatch Front and nearby areas. The UGS continued working with the University of Utah and Brigham Young University in 2008 to finish liquefaction-induced ground-displacement maps for Salt Lake Valley using the updated 2007 National Seismic Hazard Maps (NSHM) and collected data to produce similar maps for Utah Valley.

In February 2008, the UGS assisted the Nevada Bureau of Mines and Geology with the scientific response to the magnitude 6.0 Wells, Nevada, earthquake. The purpose of the UGS field investigation was to search for surface faulting or ground cracking associated with mapped Quaternary faults, document geologic evidence of strong ground shaking (e.g., liquefaction or landslides), and provide geologic information to emergency response teams as necessary. The UGS also provided a temporary post-earthquake technical clearinghouse website for the event.

The UGS, USGS, and Utah Seismic Safety Commission (USSC) held the 2008 meetings of the Utah Ground Shaking, Quaternary Fault Parameters, and Liquefaction Working Groups in February 2008. Each working group heard results of completed and ongoing studies, and set priorities for 2009 work.

The UGS, University of Utah Seismograph Stations, Utah Division of Homeland Security, and the Structural Engineers Association of Utah have cooperated with the USGS and finalized a Utah version of the popular California *Putting Down Roots in Earthquake Country* publication. The pamphlet is due for release in 2008.

Implementation of WSSPC Policy Recommendations

WSSPC Policy Recommendation 08-3: Earthquake Monitoring Networks

WSSPC Policy Recommendation 08-3 advocates the continuation and expansion of earthquake monitoring networks as envisioned and supported by the Advanced National Seismic System (ANSS). ANSS emphasizes strong-motion instrumentation of urban ground-motion monitoring sites and selected engineered structures as well as increased broadband seismograph instrumentation. In 2007, the Utah State Legislature funded the University of Utah Seismograph Stations (UUSS) to improve seismic monitoring outside of the Wasatch Front region with specific emphasis in southwestern Utah. In response to this initiative, UUSS installed 12 urban stations—the majority in the greater St. George and Cedar City regions—and is in the process of permitting 12 regional stations—with emphasis on southwestern Utah and other areas with poor seismic coverage. Currently, 11 urban stations are recording on-site. The improved instrumentation in southwestern Utah will allow for: (1) near-real-time earthquake information for emergency response and public awareness; (2) automated maps of strong ground shaking for rapid impact assessment, loss estimation, and expedited federal disaster declarations; (3) obtaining data for cost-effective earthquake engineering of buildings and infrastructure; and (4) improved understanding of earthquake hazards for science, insurance, and planning.

WSSPC Policy Recommendation 08-4: Identification and Mitigation of Unreinforced Masonry Structures

WSSPC Policy Recommendation 08-4 recommends that states inventory and develop a plan to reduce the risk from unreinforced masonry structures (URMs). The State of Utah has partially addressed this recommendation by adopting HJR7, a Joint Resolution Recognizing Unreinforced Masonry Buildings. The resolution tasks the Utah Seismic Safety Commission (USSC) with conducting an inventory of public URMs statewide and recommending priorities for reducing risk. The USSC plans to partner with the Structural Engineers Association of Utah to complete the inventory, which will include all state, local government, public school, college, and university buildings.

Submitted by Chris DuRoss, Project Geologist, Utah Geological Survey, William Lund, Senior Scientist, Utah Geological Survey and Kris Pankow, Deputy Director, University of Utah Seismograph Stations.

Utah Division of Homeland Security

The Utah Earthquake Program has made significant progress on projects reported in the 2007 State Report. The progress is the result of individual efforts from the private sector and government agencies.

During the 2008 Utah Legislative Session, the Utah Seismic Safety Commission (USSC) supported House Bill 162 which would establish a school seismic safety committee tasked with creating an inventory of seismically hazardous schools. These dangerous buildings would be ranked and funding strategies could be developed to mitigate the seismic hazards in the most dangerous buildings. Even in light of the destroyed schools in the China earthquake and the damage to schools in the Wells, Nevada earthquake, the legislature defeated the measure. Supportive legislators will be sponsoring the "Safe Schools Initiative" again in the 2009 legislative session.

Work continues on the "URM Initiative". The Commission successfully pushed a joint House resolution, House Joint Resolution 7 (HJR7), through the House and Senate. HJR7 instructs the USSC to inventory public unreinforced masonry buildings statewide. This would include local and state government buildings. State government buildings would include K-12 schools, colleges and universities. The Existing Buildings Committee, a joint USSC-Structural Engineers Association of Utah committee, has been tasked by the Commission to bring together all stakeholders to develop strategies on how to perform the inventory.

The earthquake scenario project is nearing completion. Twenty-six different ShakeMap scenario earthquakes have been developed by the University of Utah Seismograph Stations. Each ShakeMap scenario will have a HAZUS analysis run on it. A suite of maps generated from a HAZUS analysis will be provided to emergency managers, first responders, local jurisdictions, and the private sector. The maps will be used to develop response strategies, pre- and post-earthquake planning, mitigation planning, and enhancing exercises.

The Utah Division of Homeland Security's (UDHLS) Pre-Disaster Mitigation (PDM) Grant Program completed another seismic project this past year. The City of Ogden rededicated a fire station retrofit with PDM funds. Weber State University completed a retrofit project on their Student Union Building with Hazard Mitigation Grand Program funds.

The UDHLS's Earthquake Program Manager was invited to Missouri to meet with state and local emergency management officials, the state geological survey, and the Missouri Seismic Safety Commission. The purpose of the meetings was to look at some of the successes of the USSC and identify how they may be implemented in Missouri. The Missouri Seismic Safety Commission was interested in Utah's "URM Initiative" and House Bill 162.

Submitted by Bob Carey, Earthquake Program Manager, Utah Division of Homeland Security.

Washington State Department of Natural Resources, Division of Geology & Earth Resources and Washington State Military Department, Emergency Management Division

Washington State continued to focus on reducing the impact of earthquakes and other geologic hazards through public education efforts and by providing the necessary tools for communities to become more disaster resistant. Activities include the following accomplishments in Federal Fiscal Year 2008:

April was designated "Washington State Disaster Preparedness Month". Educational materials were developed and posted to the Emergency Management Division's (EMD) website. Local jurisdictions, state agencies, schools, businesses, and the general public were able to download and make copies as needed. A statewide earthquake "Drop, Cover and Hold" (DCH) drill was also conducted.

May was designated as "Volcano Awareness Month". In partnership with the United States Geological Survey (USGS), EMD distributed volcano materials and publications to local jurisdictions, state agencies, schools, businesses, and the general public. These materials were also posted to the EMD website.

September was designated as "National Preparedness Month":

- Developed materials to support the month's activities, including the DCH drill and National Oceanic Atmospheric Administration (NOAA) Weather Radio Month.
- Distributed materials to citizens via the website and that were translated into alternate languages. Materials included information on the Earthquake DCH drill and preparing your 72-hour Comfort Kit.
  Conducted Tsunami Communications Test and Emergency Alert System (EAS) broadcast for the statewide DCH Drill.
- Local jurisdictions, in partnership with their local businesses and amateur radio operators, programmed newly purchased NOAA Weather radios.

Efforts continue to train local jurisdictions on how to implement and publicize the community-based public education Map Your Neighborhood (MYN). This program, originally developed for earthquake recovery, empowers people to prepare for emergencies and shows them how to organize their neighborhoods before an earthquake so they will be better able to care for each other after a disaster.

Programs such as "Prepare in a Year" and "Getting Ready-Home" were also developed and launched for earthquake impacted areas. These programs educate and enable people to prepare their families and home to be disaster resistant and resilient. "How to" videos were developed and purchased to assist people in completing home safety projects.

The Preparedness section continues to be a popular section of the EMD website. The "In-Focus" campaign section offers new seasonal based materials on a monthly basis to encourage citizens to prepare in advance for potential emergencies and disasters.

EMD continued to partner with Federal Signal to develop and design the All Hazard Alert Broadcast (AHAB) Radio System that provides both tone and voice alert notification to at-risk communities for any hazardous situation. A total of 39 AHAB Radios have been placed in at-risk population areas along the coast. These systems utilize satellite based control and can be activated from the EMD Alert and Warning Center as well as by the local jurisdiction. Jurisdictions are testing systems on a monthly basis and the State Alert and Warning System has activated them as well. There are 11 additional warning systems in the state that are not satellite controlled – eight located in the Orting Valley primarily for lahar hazard and three around the Seattle waterfront that are equipped with seismic instrumentation and radiation monitoring.

During the 2007 legislative session an appropriation was made to the Division of Geology and Earth Resources (DGER) for mapping of earthquake-induced ground failure hazards in tsunami hazard areas to assist local jurisdictions in creating effective tsunami evacuation and response plans. The first of these maps, for the Aberdeen, Hoquiam, and Cosmopolis areas, is in press. Similar work for the Long Beach Peninsula is currently in progress.

Washington DGER published GM-67 in 2007, titled *Geologic map of the Fall City 7.5-minute quadrangle, King County, Washington*, by J. D. Dragovich, M. L. Anderson, T. J. Walsh, B. L. Johnson, and T. L. Adams. The adjacent North Bend quadrangle (Dragovich and others, 2008) is in press. Current mapping efforts focus on the Snoqualmie quadrangle. This mapping demonstrates that the Rattlesnake Mountain fault deforms late Wisconsinan sediment and may be an active fault that is part of the Southern Whidbey Island fault system.

DGER participated in the production of a scenario for Benioff zone earthquakes in the Pacific Northwest with the Cascadia Region Earthquake Workgroup (CREW) published jointly by CREW and DGER. The DGER version is available as OFR 2008-1, *Cascadia Deep Earthquakes*, 26 p. DGER also published a database of shear wave velocities to be used in determining site classes in the International Building Code and this information will be the basis for subsequent investigations. It is available as OFR 2008-2, *Shear-wave Database for Quaternary and Bedrock Geologic Units, Washington State*, by E. L. Bilderback, S. P. Palmer, D. S. Folger, J. L. Poelstra, S. L. Magsino, and R. A. Niggemann.

T. J. Walsh (DGER) and G. L. Crawford (EMD) participated in the production of *Guidelines for Design of Structures for Vertical Evacuation from Tsunamis,* FEMA P646 / June 2008, by the Applied Technology Council. The document was jointly funded by the National Tsunami Hazard Mitigation Program (NTHMP) and the Federal Emergency Management Agency (FEMA). It provides design guidance for structures to be used for vertical evacuation in areas where a tsunami could be generated by a nearby earthquake and would arrive too soon for an orderly evacuation.

Department of Natural Resources (DNR) hosted a Washington State Decision-Makers Field Conference titled “The Cost and Practice of Seismic Safety in Washington” which was held in the Olympia area. Participants learned first-hand, in an outdoor setting, about earthquakes, their effects on our lives, buildings and their potential impacts on our safety, commerce, economic development, and transportation. Participants discussed measures that make our communities and infrastructure more disaster resistant. DNR and its partners demonstrated how preparation and mitigation can aid in faster economic recovery for the state so business is not permanently lost.

EMD continues to partner with the University of Washington (UW), Pacific Northwest Seismograph Network (PNSN) to better understand regional earthquake hazards and to support risk reduction policies and hazard mitigation. The following is an overview of PNSN activities:

- Seattle Area ShakeMap: The PNSN in concert with Washington EMD, the City of Seattle, Washington DNR, the Pacific Northwest Center for Geologic Mapping Studies (GeoMapNW), and FEMA developed a high-resolution ShakeMap for the greater Seattle Area. The ANSS has agreed to work on modifications to the national databases and web products to be able to serve these and future high-resolution maps nationally. These are currently served from PNSN website, *http://www.pnsn.org/seashake/shake/index.html*.
- ShakeCast: The PNSN and Washington EMD are partnering to help integrate USGS-developed ShakeCast software at the State EOC. The program is currently used to upload ground motion data and initiate HAZUS loss estimates with PNSN-generated input ground motions. The PNSN is working with Washington State Department of Transportation (WSDOT) engineers and GIS staff to automate the production of tables and maps displaying the probable damage to Washington bridges following earthquakes. WSDOT, working with PNSN programmers, will soon implement ShakeCast Lite to pull ground motion data to the WSDOT operations center in Olympia to gain the capability to run the UW damage calculation software in-house. WSDOT will also experiment with the capabilities of the full ShakeCast software package for possible future adoption.
- PNSN scientists have implemented programs to produce moment sensors from regional seismic data rapidly following significant earthquakes. PNSN is also working to develop aftershock probability estimates for Pacific Northwest earthquakes, and to develop the capability to receive high sample rate, real-time GPS data streams that can be used to confirm fault motions and rupture of the locked portion of the Cascadia Subduction Zone, which would also advance the development of an early warning capability for earthquakes along this dangerous fault.
- The PNSN remains active in The Contingency Planners and Recovery Managers group and the CREW and helped plan and manage the 2008 National Earthquake Conference in Seattle April 2008.
- PNSN provided tours and lectures on earthquake hazards to thousands of school children this year and provided speakers for dozens of organizations and public lectures. The PNSN provided interviews, consultations, and information services to citizens and media providers in the region and throughout the world.

The EMD Earthquake Program, three counties, numerous cities, and state and federal agencies participated in the Sound Shake 2008 functional exercise. The scenario was a Seattle fault earthquake with a magnitude of 6.7. The hypothetical earthquake ruptured or broke the surface for a distance of 14 miles, from Harbor Island (Seattle) to an area east of Lake Sammamish, passing through Seattle, Mercer Island, Bellevue and Issaquah. It was a shallow earthquake; therefore, ground shaking was severe, much greater than experienced during the 2001 Nisqually earthquake.

EMD Earthquake Program in coordination with DNR, USGS, and University of Washington partnered with Sound Shake ’08 to present a seminar on Puget Sound Earthquake Hazards and Risks. Presentations were delivered by subject matter experts on Earthquake History, Active

Faults, Spring Weather, Landslides, Soil Conditions, Engineering Infrastructure, Seismic Retrofit Programs, PNSN ShakeMap, Alert and Warning Center, and HAZUS.

During the National Earthquake Conference, the EMD Earthquake Program conducted and participated in the plenary session "Learning from the December 2004 Tsunami." The presenters discussed steps taken to help Indian Ocean countries to recover from the December 2004 tsunami and to make their countries more resilient from similar events in the future. The session was telecast live over the Internet, allowing representatives from impacted countries to participate remotely.

The Washington State Tsunami Program representatives from EMD and DNR attended the National Tsunami Hazard Mitigation Program (NTHMP) steering group meeting in Honolulu, Hawaii from October 29 - November 2, 2007. Federal Fiscal Year '08 budget submissions were proposed and voted on and the national group worked on tsunami messages, warning protocols, and preparedness and mitigation efforts/products that will be developed over the next year.

The EMD Earthquake Program and USGS hosted an Eastern Washington Earthquake Workshop in Yakima on October 16, 2007. Presentations included the earthquake history of Eastern Washington, the hazards of pump storage, Hanford earthquake risks, the bridges seismic retrofit program in Eastern Washington, dam safety, earthquake monitoring capabilities, and international building codes in Eastern Washington.

The Seismic Safety Committee completed their annual report that was accepted by the Emergency Management Council. It was then adopted into the Statewide Emergency Preparedness 2007-2008 Annual Report to the Governor. That report is to inform the Governor about the state's critical hazards, the level of preparedness to respond to these hazards, and to provide recommendations for improving overall emergency preparedness statewide.

EMD facilitated a State/Local Tsunami workgroup meeting in Ocean Shores, April 17, 2008. Presenters included representatives from the National TsunamiReady Program and Patra Dewi from Padang City, West Sumatra, Indonesia, discussing what TsunamiReady means in Padang and the December 24, 2004 tsunami event.

WSSPC Policy Recommendations 07-1 and 07-2: Rapid Tsunami Identification and Evacuation Notification

The Consolidated Reporting of Earthquakes and Tsunamis (CREST) is a National Oceanic and Atmospheric Administration (NOAA)-funded project to improve the nation's ability to rapidly assess the likelihood and severity of a damaging earthquake-generated tsunami. The PNSN operates 13 CREST stations in Washington and Oregon with digital broadband seismometers and strong motion accelerometers. Real-time data from these stations is made available to the National Earthquake Information Center and the West Coast/ Alaska Tsunami Warning Center. The PNSN has been working within the ANSS to acquire real-time geodetic monitoring (high-sample-rate GPS positioning) in the Pacific Northwest. This advance will significantly strengthen the region's ability to rapidly detect the crustal displacement signals that are associated with tsunami generation, facilitating more rapid and accurate regional warnings. The PNSN has also set a long-term goal of providing early warning for strong shaking. These technologies would provide up to three or four minutes of warning that a Cascadia megathrust earthquake is underway before the shaking reaches the Portland-Seattle urban corridor. Shorter-lead-time warnings would be provided for crustal earthquakes.

WSSPC Policy Recommendation 07-3: Post-Earthquake Technical Clearinghouses
The Washington Department of Natural Resources, Division of Geology and Earth Resources (DGER) has established the ability to implement a post-earthquake clearinghouse. DGER will be able to implement an effective clearinghouse within 24 hours after an earthquake and will be able to coordinate between agencies as a result.

WSSPC Policy Recommendation 08-1: Improving Tsunami Public Education, Mitigation, and Warning Procedures for Distant and Local Sources
A Pilot Project for a Community-Specific Public Education Component of the NTHMP Tsunami Educational Strategic Plan was conducted and hosted by the Shoalwater Bay Tribe in Pacific County. Participants included tribal leaders and representatives from the communities of Tokeland and North Cove, from county and community organizations, as well as Tribal Council, Emergency Management, Fire Department, Community Emergency Response Team (CERT), and Chambers of Commerce.

EMD continued to partner with New Zealand's Institute of Geological and Nuclear Sciences on assessing education and preparedness of our citizens by conducting the following activities:

- Survey managers of key hotels on the Long Beach Peninsula and conduct a focus group to assess the understanding of tsunami risk, planning issues, levels of staff training, and identify training needs, barriers to implementing mitigation, and ways to overcome negative impacts of false alarms.
- Conduct focus groups with the aim of exploring residents' experiences and perceptions of tsunami risk and preparedness in selected coastal communities north of Ocean Shores.
- Review methods for collecting data from warning system tests, develop guidelines for analyzing the data, participate in an actual exercise to evaluate and improve these guidelines, and submit a report on the data collection.

An EMD Earthquake Program Representative served as an ATC-64 Project Review Panel Participant on the 3rd phase of developing guidelines for tsunami structures in areas of strong ground shaking. This guidance is due to be released in early 2009. This group provided guidance and feedback to the Applied Technology Council who is FEMA's contractor for this project.

The PNSN continues to support and participate in educational outreach activities to populations that are vulnerable to tsunamis and participates on the advisory board of the UW/ NOAA Internationally-focused Certificate Program in Tsunami Science and Preparedness.

In 2007 the PNSN arranged for USGS funding and managed the acquisition of 15 computer workstations and programmed them with a variety of software packages including the CISN Display linked to ShakeMap and the tsunami watch and warning information. System distribution and user training for 14 Tribal and costal communities occurred in two workshops organized and supported by EMD. The PNSN continues to administer the CISN Display accounts and lend support for these communities.

WSSPC Policy Recommendation 08-3: Earthquake Monitoring Networks
Network improvements:
The PNSN represented the National Emergency Management Association (NEMA) at an Advanced National Seismic System (ANSS) Steering Committee meeting. The committee reviewed regional efforts in the United States to enhance seismic monitoring of infrastructure in

urban areas. The Committee also discussed the latest technologic advances to support the USGS and regional seismic network capabilities to provide emergency managers with products that support rapid response and decision making. The committee also made recommendations on funding, distribution of seismic equipment, and research projects needed to support ANSS program goals and objectives.

The PNSN is the ANSS authoritative agency for Washington and Oregon and a USGS partner in the operation of the Cascades Volcano Observatory. National funding constraints have severely limited the ability of the USGS to support needed ANSS instrumentation improvements in the PNSN. In spite of this constraint, monitoring in the region has improved significantly through the establishment of 15 high-fidelity, 6-channel seismic stations purchased from the EarthScope USArray project with a $500,000 grant from the Murdock Family Foundation and 6 more purchased with support from PNSN partners, the State of Oregon and the Pacific Northwest National Laboratories [PNNL] with support from the Department of Energy. State of Washington support for PNSN operations contributed to the purchase of an array of 6 portable broadband and strong-motion seismographs, which have been used this year to test methods of monitoring structures. This array greatly improves the ability of the PNSN to perform swarm monitoring, targeted research activities, aftershock monitoring, and to rapidly respond to seismic emergencies. PNSN has undergone a major hardware upgrade, including a new analog data telemetry node at the UW, new powerful and redundant computer servers to process and analyze data, and a new media-friendly lab for earthquake information dissemination.

WSSPC Policy Recommendation 08-4: Identification and Mitigation of Unreinforced Masonry Structures

The PNSN and our USGS Earthquake Program partners at the University of Washington have provided input into the City of Seattle Unreinforced Masonry Building policy development plan. The City contracted with the engineering firm of Reid Middleton to collate information from earlier studies and to fill in knowledge gaps by conducting sidewalk surveys of suspect URMs in parts of the city where data was missing or incomplete. The City is organizing stakeholder representatives to study potential incentives and regulations that would reduce the risk of losses from these dangerous structures and provide the City Council and Mayor with policy recommendations to be acted upon in 2009. The City is also convening a committee of technical experts to recommend possible retrofit performance standards and provide the City with other technical advice.

"… [the City of Seattle] estimates there are up to 1000 URMs in the city, most of which have not been seismically retrofitted…. This is a public safety issue," said Mayor Nickels. "No one's rushing into this decision, and we will deliberate over the coming months before reaching any conclusions. But Seattle is in earthquake country and URM's are our most vulnerable structures. We need to address the issue of safety in these structures in a major quake."

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