The National Earthquake Risk Management Conference
Understanding the Hazards and Managing the Risks
September 17-22, 2000

PROGRAM

SUNDAY September 17

8:00 a.m. – 4:00 p.m.	**Seismic Safety Advisory Boards and Councils Invitational Meeting** Chaired by Ron Lynn, Chairman, Nevada Earthquake Safety Council Recorded by Jonathan Price, Chairman, WSSPC Board of Directors and State Geologist, Nevada Bureau of Mines and Geology	**Evergreen 1 & 2**
12:00 – 1:00 p.m.	**Seismic Safety Advisory Boards and Councils Invitational Lunch**	**Evergreen 3**
9:00 a.m. – 12 Noon	CUSEC Earthquake Program Managers Meeting	Cascade 10
4:00 – 6:30 p.m.	CUSEC Board meeting	Cascade 9
5:00 – 7:00 p.m.	WSSPC Board meeting	Cascade 3

MONDAY September 18

7:15 – 7:45 a.m.	**Prehistoric Earthquake and Tsunami in Puget Sound Area Field Trip** Check-in - WSSPC Staff	**Tower Entrance**
8:00 a.m. SHARP	Prehistoric Earthquake and Tsunami in Puget Sound Area Field Trip departs Seattle Airport DoubleTree Hotel Led by Brian Atwater, USGS, and others	
5:00 p.m.	Prehistoric Earthquake and Tsunami in Puget Sound Area Field Trip returns to Seattle Airport DoubleTree Hotel	
7:45 – 8:15 a.m.	**Mitigation in Action Field Trip** Check-in -WSSPC Staff	**Tower Entrance**
8:30 a.m. SHARP	Mitigation in Action Field Trip departs Seattle Airport DoubleTree Hotel Led by George Crawford, Washington Military Department, Emergency Management Division and Tim Walsh, Washington State Department of Natural Resources	
4:00 p.m.	Mitigation in Action Field Trip returns to Seattle Airport DoubleTree Hotel	
All Day	Seattle self-guided walking tours	
3:00 – 6:00 p.m.	**Conference and Exhibitor Registration**	**Foyer**
6:00 – 8:00 p.m.	**Icebreaker Reception**	**Maxi's Lounge**
after 6:00 p.m.	**Exhibitor Fair Set up**	**Northwest Ballroom**

Posters and National Awards in Excellence projects will be displayed Tuesday through Thursday with the Exhibitor Fair. The Exhibitor Fair will be open and free to the public Tuesday and Wednesday (Public Days).

TUESDAY September 19

	Exhibitor Fair 8:00 a.m. – 9:00 p.m. *Public Day 3:00 p.m. – 9:00 p.m.*	Northwest Ballroom
	PRESS/MEETING ROOM 8:00 a.m. – 5:00 p.m.	Cascade 5 & 6
7:00 a.m. – 3:30 p.m.	**Registration**	Foyer
7:00 – 8:00 a.m.	Exhibitor Fair set up completed	
7:00 – 8:30 a.m.	**Continental Breakfast**	Northwest Ballroom
8:00 – 9:00 a.m.	**Welcome, Introduction, and Keynote Address**	Grand Ballroom 2
8:00 – 8:10 a.m.	**Welcome – Jonathan Price**, State Geologist, Nevada Bureau of Mines and Geology and WSSPC Chairman	
8:10 – 8:15 a.m.	**Welcome – Patti Sutch**, Executive Director, Western States Seismic Policy Council	
8:15 – 8:20 a.m.	**Introduction to Ron Sims – Glen Woodbury**, Director, Washington Military Department, Emergency Management Division	
8:20 – 8:40 a.m.	**Keynote Address – Ron Sims**, King County Executive	
8:40 – 8:55 a.m.	**Introduction to Conference Facilitator – Jonathan Price** **Introduction to Conference Purpose** – Michael Burns, Conference Facilitator Burns Business Strategies, Inc.	
9:00 a.m. – Noon	**Policy Session #1 Lessons Learned** **Glen Woodbury, Moderator** Director, Washington Military Department, Emergency Management Division	Grand Ballroom 2
9:00 – 9:15 a.m.	**Gary Patterson**, Center for Earthquake Research and Information *Lessons Learned from Taiwan*	
9:15 – 9:30 a.m.	**Mark Pierepiekarz**, EQE International, Inc. *Building Performance Lessons from Recent Earthquakes:A Structural Engineer's Perspective*	
9:30 – 9:50 a.m.	**Woody Savage**, PG&E *Lessons Learned from Taiwan and Effects of Recent Earthquakes on Lifelines*	
9:50 – 10:10 a.m.	**Cliff Roblee**, California Department of Transportation *Lessons Learned About Transportation Systems in Recent Earthquakes*	
10:10 – 10:40 a.m.	**BREAK**	Northwest Ballroom
10:40 – 11:00 a.m.	**Craig Weaver**, USGS *Employing Lessons Learned in the Pacific Northwest Seismic Hazards Environment*	
11:00 – 11:20 a.m.	**Steve Bailey**, Pierce County Department of Emergency Management *Employing Lessons Learned in the Pacific Northwest Volcanic Hazard Environment*	
11:20 – 11:45 a.m.	**Discussion – Led by Moderator** Recorder – Linda Noson, AGRA	
11:45 a.m. – Noon	**Summary – Michael Burns**, Conference Facilitator	

TUESDAY September 19, continued

12 Noon – 1:30 p.m. **LUNCH** — Grand Ballroom 1

Introduction to Charles Groat – Jonathan Price
Featured Speaker - Charles Groat, Director, U.S. Geological Survey
USGS Natural Hazards Research: What Do We Need to Understand?

2:00 – 5:00 p.m. **Policy Session #2 New Technologies – New Opportunities** — Grand Ballroom 2

Norman C. Hester, Moderator
Technical Director, Association of CUSEC State Geologists

2:00 – 2:15 p.m. **John Filson**, USGS
Advanced National Seismic System – Opportunities from a Nationwide Real-Time Seismic Monitoring Program

2:15 – 2:30 p.m. **Steve Malone**, University of Washington
Progress in the Development of a Regional ANSS Network

2:30 – 2:45 p.m. **Jim Goltz**, California Institute of Technology, Office of Earthquake Programs
Earthquake Early Warning: Setting the Stage for Introduction in Southern California

2:45 – 3:00 p.m. **Eddie Bernard**, NOAA
New Technologies for Local Tsunami Warnings

3:00 – 3:30 p.m. **BREAK** — Northwest Ballroom

3:30 – 3:45 p.m. **David Wald**, USGS
ShakeMap – A Tool for Presenting Ground Motion Parameters in Near-Real Time

3:45 – 4:00 p.m. **Dallas Jones**, California OES
Potential Use of ShakeMap as a Tool in Emergency Management

4:00 – 4:15 p.m. **Jim Chadwick**, The MITRE Corporation
Early Warning Technology

4:15 – 4:45 p.m. **Discussion – Led by Moderator**
Recorder – Mary Lou Zoback, USGS

4:45 – 5:00 p.m. **Summary** – Michael Burns, Conference Facilitator

5:30 – 6:00 p.m. Conference Debrief – WSSPC Board — Grand Ballroom 2

6:00 – 7:30 p.m. Earthquake Consortia Invitational Meeting – hosted by CUSEC — Grand Ballroom 1

7:30 – 9:00 p.m. **HAZUS Forum** — Grand Ballroom 2
Dr. Ken Taylor, North Carolina Department of Emergency Management
George Crawford, Washington Military Department, Emergency Management Division

WEDNESDAY September 20

Exhibitor Fair and Public Day 7:00 a.m. – 6:00 p.m. — Northwest Ballroom

PRESS/MEETING ROOM 8:00 a.m. – 5:00 p.m. — Cascade 5 & 6

7:00 a.m. – 3:30 p.m. Registration — Foyer

7:00 – 8:30 a.m. Continental Breakfast — Northwest Ballroom

8:00 – 9:00 a.m. Welcome Opening Remarks, and Featured Speakers — Grand Ballroom 2

8:00 – 8:02 a.m. **Welcome – Jonathan Price**

8:02 – 8:05 a.m. **Introduction to Ralph Munro** - Glen Woodbury, Director, Washington Military Department, Emergency Management Division

8:05 – 8:15 a.m. **Opening Remarks** – Ralph Munro, Washington State Secretary of State

8:15 – 8:17 a.m. **Introduction to Carl Cook** – Glen Woodbury, Director, Washington Military Department, Emergency Management Division

8:17 – 8:20 a.m. **Introduction to Michael Armstrong** – Carl Cook, FEMA Region X

8:20 – 8:50 a.m. **Featured Speaker – Michael Armstrong**, Associate Director for Mitigation, FEMA
New Techniques in Creating Seismic-Resistant Communities

8:50 – 9:00 a.m. **Conference Update - Michael Burns**, Conference Facilitator

9:00 a.m. – Noon **Policy Session #3 Strategies to Reduce Impacts of Disasters** — Grand Ballroom 2

James Davis, Moderator
State Geologist, California Department of Conservation, Division of Mines and Geology

9:00 – 9:20 a.m. **Stuart Nishenko**, FEMA
Summary of National Earthquake Loss Estimation Using a Public Model

9:20 – 9:40 a.m. **Mike Reichle and Jim Davis**, California Department of Conservation, Division of Mines and Geology
A State-focused Analysis of Annualized Average Earthquake Loss

9:40 – 10:00 a.m. **Ron Eguchi**, ImageCat
Uncertainties in Loss Estimation Models

10:00– 10:30 a.m. BREAK — Northwest Ballroom

PRESS CONFERENCE — Cascade 5 & 6

10:30 – 10:50a.m. **Sarah Nathe**, UC Berkeley
How to Talk to the Public About Earthquake Risk

10:50 – 11:10 a.m. **Mona Carter**, State of Kentucky Assistant Insurance Commissioner,
How Can Earthquake Insurance Play a Larger Role in Pre-Event Loss Reduction and Post-Event Recoveries?

11:10 – 11:45 a.m. **Discussion – Led by Moderator**
Recorder – Patrick Musick, Alliance of American Insurers

11:45 a.m. – Noon **Summary – Michael Burns**, Conference Facilitator

WEDNESDAY September 20, continued

Noon – 1:30 p.m. *National Awards in Excellence* **Awards LUNCH** — **Grand Ballroom 1**

12:45 – 12:50 p.m. **Announcements – Patti Sutch**

Introduction to Larry Fellows – Jonathan Price

12:50 – 1:15 p.m. **Recognition of Awards Winners** – Larry Fellows, Director and State Geologist, Arizona Geological Survey

12:50 – 12:55 **Overall Winner – Excellence in Mitigation**
California Seismic Safety Commission
Risk Management Tools for Decision Makers
Richard McCarthy, Executive Director (Henry Reyes accepting)

12:55 – 1:00 **Innovations**
Arkansas State Legislature
Arkansas Earthquake Preparedness (2 Acts)
Representative Richard Simmons (Dan Cicirello accepting)

1:00 – 1:05 **Research Projects**
Oregon Department of Geology and Mineral Industries
Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses
Yumei Wang and J.L. Clark (Dennis Olmstead accepting)

1:05 – 1:10 **Use of New Technology**
Northeast States Emergency Consortium
HAZUS Earthquake Loss Estimation Report for Project Impact Communities
Edward Fratto

1:10 – 1:15 **Non-Profit Agency Efforts**
Washington State University Cooperative Extension Office & Island County
WSU Beach Watcher's Program, Ships Naturalist
Donald M. Meehan

2:00 – 5:00 p.m. **Policy Session #4 Identifying Effective Loss Reduction Strategies** — **Grand Ballroom 2**

Stephen Weiser, Moderator
Assistant Deputy Director – Mitigation, Idaho Bureau of Disaster Services

2:00 – 2:20 p.m. **Tom Tobin**, Tobin & Associates
Review of Loss Reduction Policy Options

2:20 – 2:40 p.m. **Robert Freitag**, Institute for Hazard Mitigation and Research
Complementary Roles of National, State and Local Governments

2:40 – 3:00 p.m. **James Mullen**, City of Seattle Emergency Management
Project Impact Experience in Seattle, Washington

3:00 – 3:30 p.m. BREAK — **Northwest Ballroom**

3:30 – 3:50 p.m. **Rickie McCandless**, Salt Lake City School District
Financial Options for Mitigation

3:50 – 4:10 p.m. **Teri Spalding**, State Farm Insurance
Encouraging Retrofit of the Built Environment

4:10 – 4:45 p.m. **Discussion – Led by Moderator**
Recorder – Ken Deutsch, American Red Cross

4:45 – 5:00 p.m. **Summary – Michael Burns**, Conference Facilitator

5:30 – 6:00 p.m. Conference Debrief – WSSPC Board — Grand Ballroom 2

WEDNESDAY September 20, continued

6:15 p.m.	**Bar Opens**	**Grand Ballroom 1**
6:30 – 9:00 p.m.	**Banquet, Featuring**	
7:15 – 7:45 p.m.	**Dennis Mileti** Director, Natural Hazards Research and Applications Information Center *Natural Hazards and Sustainable Development*	
8:00 – 8:45 p.m.	**Hal Stearns** University of Montana History Professor Emeritus *Lewis and Clark Expedition*	

THURSDAY September 21

	Exhibitor Fair 7:00 a.m. – 2:00 p.m.	Northwest Ballroom
	PRESS/MEETING ROOM 8:00 a.m. – 5:00 p.m.	Cascade 5 & 6
7:00 a.m. – Noon	**Registration**	**Foyer**
7:00 – 8:30 a.m.	**Continental Breakfast**	**Northwest Ballroom**
7:00 – 8:20 a.m.	Advanced National Seismic System Open Meeting	Evergreen 1 & 2
8:30 – 9:00 a.m.	**Introduction to Featured Speaker – James Davis**, State Geologist California Department of Conservation, Division of Mines and Geology	**Grand Ballroom 2**
	Featured Speaker – Ellen Corbett, California Assemblywoman *Legislative Perspective of Earthquake Risk Reduction*	
9:00 a.m. – Noon	**Policy Session #5 Earthquake Building Codes in the 21st Century**	**Grand Ballroom 2**
	Robert Bezek, Moderator Coordinator, Wyoming Emergency Management Agency	
9:00 – 9:10 a.m.	**Robert Bezek**, Coordinator, Wyoming Emergency Management Agency *Introduction*	
9:10 – 9:30 a.m.	**Jim Beavers**, Mid America Earthquake Center *What Have Building Codes Achieved?*	
9:30 – 9:50 a.m.	**Tim Sheckler**, FEMA *How Codes Do and Don't Reduce Losses*	
9:50 – 10:20 a.m.	**BREAK**	**Northwest Ballroom**
10:20 – 10:40 a.m.	**Soy Williams**, ICC *Future Building Code Trends*	
10:40 – 11:00 a.m.	**Ron Lynn**, Clark County Building Department *Trends in Building Code Enforcement*	
11:00 – 11:20 a.m.	**Peter May**, University of Washington *Making Building Codes an Effective Tool for Earthquake Hazard Mitigation*	
11:20 – 11:40 a.m.	**Robert Olson**, Robert Olson Associates, Inc., *Adoption and Enforcement of Earthquake Risk-Reduction Measures*	
11:40 – 11:50 a.m.	**Discussion – Led by Moderator** Recorder - Laurence Kornfield, City and County of San Francisco Building Department	
11:50 a.m. –Noon	**Summary – Michael Burns**, Conference Facilitator	

THURSDAY September 21, continued

Noon – 1:30 p.m. ***National Awards in Excellence*** **Awards LUNCH** — Grand Ballroom 3

12:25 – 12:30 p.m. **Announcements – Patti Sutch**, Executive Director, Western States Seismic Policy Council

12:30 – 12:35 p.m. **Introduction to Mayor Schell – Glen Woodbury**

12:35 –12:50 p.m. **Featured Speaker - Paul Schell, City of Seattle Mayor**

12:50 – 1:20 p.m. **Introduction of Larry Fellows – Jonathan Price**
Recognition of Awards Winners – Larry Fellows, Director and State Geologist, Arizona Geological Survey

12:55 – 1:00 **Educational Outreach to General Public**
Seattle Emergency Management
Seattle Project Impact - Home Retrofit
Inés Pearce

1:00 – 1:05 **Mitigation Efforts**
Seattle Emergency Management
Seattle Project Impact - School Retrofit
Inés Pearce

1:05 – 1:10 **Response Plans/Materials**
Project Impact of King & Pierce Counties
Port to Port Transportation Corridor Seismic Vulnerability Project
Claudia Ellsworth (Eric Holdeman and/or Steve Bailey accepting)

1:10 – 1:15 **Educational Outreach to Business/Government**
FEMA Region IX Coastal States, Tri-State Planning Team
Regional Coastal Earthquake Conference: Building Earthquake Resistant Coastal Communities
George Crawford, Gary Brown, Mark Darienzo

1:15 – 1:30 **Educational Outreach to Schools (3-way tie)**
Washington Military Department, Division of Emergency Management, Plans, Education & Training Unit
Prepare Because You Care
Barbara Thurman

Nevada Seismological Laboratory
Nevada Earthquake Safety Calendar
Diane dePolo (John Anderson accepting)

School Subcommittee, Utah Seismic Safety Commission
Prepared Schools for Effective Drills and Safe Surrounds
Bob Carey

1:30 – 2:00 p.m. Policy Session #5 Debrief – WSSPC Board — Cascade 5 and 6

1:30 – 3:00 p.m. Dismantle Exhibitor Fair and Poster Session (Booths must be vacated no later than 3:00 p.m.) — Northwest Ballroom

THURSDAY September 21, continued

2:00 – 5:00 p.m.	**Policy Session #6 Policy Development** **Jonathan Price, Moderator** **Michael G. Burns, Facilitator**, Burns Business Strategies, Inc. Tom Benthin, Graphic Recorder, The Grove Consultants International Mark Benthien, Recorder, Southern California Earthquake Center	**Grand Ballroom 2**
3:00 – 3:30 p.m.	**BREAK**	**Grand 2 hallway**
5:30 – 6:00 p.m.	Conference Debrief – WSSPC Board	Grand Ballroom 2
7:00 – 8:00 p.m.	WSSPC Engineering, Building Codes, and Construction Committee Meeting Robert Bezek, Chair	Cascade 5 & 6

FRIDAY September 22

7:00 – 8:30 a.m.	**Continental Breakfast**	**Cascade 9**
7:30 – 8:30 a.m.	**WSSPC Committee Meetings** Economic Impacts of Disasters Committee – James Davis, Chair Engineering, Building Codes, and Construction Committee – Robert Bezek, Chair Tsunami Hazards Mitigation Committee – Mark Darienzo, Chair Basin and Range Province Committee – Craig dePolo, Chair	**Cascade 9**
8:30 – 9:30 a.m.	**WSSPC Board Meeting**	**Cascade 12**
9:30 – 10:00 a.m.	**BREAK**	**Cascade 9 &12 hall**
10:00 a.m. – Noon	**WSSPC Annual Business Meeting**	**Cascade 3 & 4**
NOON	**CONFERENCE ADJOURNED**	
Noon – 2:00 p.m.	Lunch for USGS and State Geologists	Cascade 9
2:00 – 5:00 p.m.	USGS-State Geologists' Meeting – James Davis and Patrick Muffler, Organizers	Cascade 12

SATURDAY September 23

8:30 a.m. – Noon	State Geologists' Meeting	Cascade 5 & 6

The National Earthquake Risk Management Conference 2000 Policy Sessions

Overview

In its series of policy theme discussions, WSSPC's National Earthquake Risk Management Conference first reviews the significant lessons learned from earlier natural disaster experiences that offer the greatest opportunities for risk reduction today. Opportunities for further risk reduction derived from the application of emerging technologies are investigated next. This is followed by examination of methodologies of estimating the extent and dimensions of loss/risk and the means of increasing citizens' awareness regarding the extent of their exposure. The potential effectiveness of an array of loss-reduction and mitigation strategies are reviewed to identify priorities that can be employed in future public policies. The current status and potential application of earthquake building codes are considered to seek insights to increase their effectiveness and to evaluate how to make other mitigation strategies more effective. Finally, a facilitated, interactive discussion will explore the most promising policy issues that conference participants and the Western States Seismic Policy Council can pursue further to endorse and to employ in future earthquake risk management.

Session #1 Lessons Learned	Tues. 9/19, 9:00 a.m. – Noon
Session #2 New Technologies, New Opportunities	Tues. 9/19, 2:00 – 5:00 p.m.
Session #3 Strategies to Reduce Impacts of Disasters	Wed. 9/20, 9:00 a.m. – Noon
Session #4 Identifying Effective Loss Reduction Strategies	Wed. 9/20, 2:00 – 5:00 p.m.
Session #5 Earthquake Building Codes in the 21st Century	Thurs. 9/21, 9:00 a.m. – Noon
Session #6 Policy Development	Thurs. 9/21, 2:00 – 5:00 p.m.

Policy Session #1 Lessons Learned

Glen Woodbury, Moderator
Tuesday, September 19, 2000, 9:00 a.m. – Noon

As a matter of course, the patterns of loss of life and damage resulting from earthquakes are scrutinized to learn lessons regarding how future losses from seismic events can be reduced. Residents of Turkey, Taiwan, and Kobe, Japan have recently suffered disasters. Much of their losses could have been avoided if understanding from past earthquakes had been employed in building design and placement, construction quality control, and land-use planning and regulation. There are always, however, new lessons to be learned from every damaging earthquake because new insights of construction performance, site condition effects, etc. can be derived from new observations. These observations, taken together with earlier experiences that have been associated with the impacts of tsunamis in Chile, Hawaii and Japan and volcanic eruptions in the Pacific Northwest, can be used by committed citizens and their governments to manage risk and vulnerability.

Each area in North America with earthquake potential can benefit from lessons learned in previous earthquakes throughout the world. In this session we will explore the implications of recent lessons learned in managing our risk in the Pacific Northwest and in the Central U.S. The similarities in tectonic settings as well as the built environment are taken into account.

Order of Speakers & Abstracts

9:00 – 9:15 a.m. **Gary Patterson**, Center for Earthquake Research Information
Lessons Learned from Geological Observations of the 9/21/99 Taiwan Earthquake

Observations of surface rupture resulting from the 9/21/99 Ji Ji Earthquake in Taiwan provide evidence that earthquake damage can be disproportionately heavy on the hanging wall of large thrust faults. Significant structural damage to well-designed structures on the hanging wall of the Chelungpu fault was observed in the towns of Dong-Se, Shih-kang, and Wufeng. Damage to structures, including unreinforced masonry buildings, located on the footwall of the fault in these same towns was generally less severe. It seems prudent to apply this knowledge when locating sites for critical and essential facilities near active thrust faults.

Unconsolidated Quaternary sediments in the Puli basin, 25 km east of the Chelungpu zone of surface rupture, greatly amplified ground motions and caused the structural failure of dozens of buildings. As learned from other destructive earthquakes that have occurred over the last 2 decades, site conditions should be a major consideration in formulating land use and zonation plans.

9:15 – 9:30 a.m. **Mark Pierepiekarz**, EQE International, Inc.
Building Performance Lessons from Recent Earthquakes – A Structural Engineer's Perspective

The Pacific Northwest has traditionally been considered a region of moderate seismicity; that perception is changing. The majority of local building stock consists of structures designed to outdated code provisions. Many key structures (hospitals, schools, fire stations, hi-tech/ manufacturing, etc.) and non-structural elements lack adequate design to prevent excessive

damage (or collapse). Earthquakes of 1999 (Taiwan, Turkey, and Satsop (Western Washington State)) clearly demonstrate potential destruction. This presentation will discuss techniques and technologies available today to understand and prevent unacceptable damage.

9:30 – 9:50 a.m. **Woody Savage**, Pacific Gas & Electric Company
Lessons for Utility Lifelines from Turkey and Taiwan

The severe earthquakes in 1999 in the Kocaeli region of western Turkey (August 17, magnitude 7.4) and in western central Taiwan (September 21, magnitude 7.6) caused extensive damage to utility systems and disrupted services to customers for hours to weeks. The damage to electric power, natural gas, water and wastewater, and telecommunications systems was consistent with that observed in recent earthquakes, allowing for the characteristics of the Chi-Chi and Kocaeli earthquakes:

- Pipes and wires were damaged by surface fault rupture, landslides, and permanent ground deformation associated with liquefaction.
- Office and utility building damage disrupted utility operations.
- Vulnerable high-voltage substation equipment was damaged by strong shaking.
- Other infrastructure and building damage slowed the recovery of utility services.
- Electric power, which is increasingly essential to emergency response, was restored quickly in Turkey and slowly in Taiwan, primarily due to differences in system redundancy.

These earthquakes provide policy lessons for effective risk management, including:

- Realistic and credible earthquake scenario analyses are needed to reveal potential unacceptable performance of utilities.
- Unacceptable earthquake risks should guide the urgency of making improvements in existing utility systems.
- Performance-based earthquake design standards and guidelines need to be developed and adopted nationally for utility systems.

9:50 – 10:10 a.m. **Cliff Roblee**, California Department of Transportation
Lessons Learned About Transportation Systems in Recent Earthquakes

Earthquakes impact transportation systems via shaking and surface-rupture damage to bridges and roadways, landslide closure of routes, and by the consequences of these phenomena, coupled with public reaction, on transportation network operations. Recent earthquakes suggest that modern-detailed bridges handled ground shaking reasonably well, though greater damage occurred on younger geologic deposits. New ground-motion data needs close examination to better differentiate damaging features of motions, and the performance of newer bridges and technologies (e.g. dampers) needs careful examination to shed light on the definition of "acceptable" levels of performance. Experience in both the Turkey and Taiwan earthquakes suggest that transportation systems are currently vulnerable to surface-rupture displacements. Remediation will require better estimates of surface rupture hazard and more flexible structural systems to accommodate large offsets. Transportation network operations were severely impacted by public reaction in Turkey and by road closures associated with landslides and bridge collapses in Taiwan. Emergency planning would benefit from consideration of large-scale network analyses, including examination of inter-dependencies of various lifeline components (e.g. transportation on communications and power), and the effective support of the electronic media community.

10:10 – 10:40 a.m. Break

10:40 – 11:00 a.m. **Craig Weaver**, USGS
Employing Lessons Learned in the Pacific Northwest Seismic Hazards Environment

1. In areas of high earthquake hazards, but low rates of felt seismicity, most earthquakes raise concern for victims and generate a few days of anguish about lack of preparedness (and more recently mitigation).
2. Few major events have really driven regional change, but increasingly scientific results have pushed major policy changes in Oregon and Washington (building codes, Oregon Seismic Safety Commission, CREW, seismic projects under Project Impact).
3. As scientific community becomes more skillful in explaining their work, natural partnerships form that work both ways. On the one hand, scientific work is adopted quickly by private sector (and some public sector) as the comfort level of accepting science raises. On the other, local community begins to help build scientific agenda (helping build real-time seismic system infrastructure, providing databases for geologic studies, etc).
4. Key is a sustainable scientific effort, adapted to show clear understanding of local needs and capabilities. If the scientific effort stops, retreats into either technical or agency jargon, the partnerships falter.

11:00 – 11:20 a.m. **Steve Bailey**, Pierce County Department of Emergency Management
Employing Lessons Learned in the Pacific Northwest Volcanic Hazard Environment

The Problems

- A lahar (mudflow) 40 foot wall of mud, water trees, rocks moving down the Puyallup river valley at 50+ miles per hour, destroying everything in its path.
- In 1985 in the City of Armero in Columbia, the volcano Nevado del Ruiz erupted shortly after midnight and the mudflow flowing down the valley destroyed the town killing approximately 20,000 people who received no warning even though the threat was well known.
- Scientists have identified Mt. Rainier in Washington State as the most dangerous volcano in America and one of the six most dangerous in the world. There are approximately 30,000 people at direct risk in the Puyallup River valley.

The Resolutions

- Learn what steps are being taken by the USGS, Pierce County and over 20 other government entities to provide warning to the valley.
- See the new technology being deployed at Mt. Rainier to monitor lahar activity, the only kind of system currently in place in the world.
- See what you can do to address the risks from earthquakes in your community.

11:20 – 11:45 a.m. Discussion
Recorder – Linda Noson, AGRA

11:45 a.m. – Noon Personal Action Summary – Michael Burns

Policy Session #2 New Technologies – New Opportunities

Norman Hester, Moderator
Tuesday, September 19, 2000, 2:00 – 5:00 p.m.

Recently developed and nascent capabilities for disseminating scientific and technical information will facilitate applications for managing earthquakes and other disasters before, during, and after they strike. These capabilities vary for different natural perils, but both common and unique elements may be found in the case of earthquakes, volcanoes, tsunamis, tornadoes, hurricanes, and floods. Immediate dissemination of parametric information, including spatial distribution of effects, and rapid loss estimation are some examples of capabilities currently in place in certain locales, and are being considered or are under development in others — including the Pacific Northwest and the central U.S. Early warning is already online for floods and weather disasters. Early warning of residents regarding ground shaking from earthquakes in progress and volcanoes experiencing unrest are still evolving technology applications.

The purposes of this session are to explore common themes and issues among the experiences of the presenters and the participants; to examine lessons that may transfer between different situations; suggest policy direction associated with the opportunities that these new technologies present; and to explore the best manner of assuring that real-time monitoring can fulfill the needs of those utilizing the new technology to reduce natural disaster losses.

Order of Speakers & Abstracts

2:00 – 2:15 p.m. **John Filson**, USGS
Advanced National Seismic System – Opportunities from a Nationwide Real-Time Seismic Monitoring Program

The Advanced National Seismic System (ANSS) is an initiative by the U.S. Geological Survey (USGS) to modernize and expand seismic monitoring in the United States. In 1998 Congress asked the USGS for an evaluation of the status of seismic monitoring in the country. Out of that review came the concept of the ANSS. The ANSS plan calls for the modernization of some 1,000 outdated recording stations in regional seismic networks and the installation of 6,000 new stations in urban areas. The urban stations will be capable of recording strong earthquake motions and transmitting the data to a regional data center. The data from the urban stations can be used to provide rapid assessments of the severity and distribution of strong ground shaking just after a damaging earthquake. Public safety officials, managers of infrastructure facilities, and the general public can use these maps in responding to an earthquake emergency. The urban data can also be used in the design and engineering of safer structures that are more resistant to earthquake motions. The ANSS is off to a modest, but strong, start. In 2000, 40 new seismic stations were installed in northern California and 20 each in the Seattle and Salt Lake City regions.

2:15 – 2:30 p.m. **Steve Malone**, University of Washington
Progress in the Development of a Regional ANSS Network

The Pacific Northwest is subject to the four major geologic hazards of earthquakes, landslides, volcanoes and tsunamis. Each of these types of events generates seismic signals which can be

detected and analyzed to assist with the interpretation or even warning of the event. The Pacific Northwest Seismograph Network (PNSN) has been developing the capabilities to record and analyze seismic signals in order to rapidly provide useful information about the event to emergency managers, the press and public. The PNSN has experience with small to moderate earthquakes, volcanic eruptions and large rockfalls. Information about such events is currently distributed in different ways to different user groups in a rather ad hoc manner based on stated interest, technical capability and usefulness. The emerging development of an "Advanced National Seismic System" (ANSS) provides the opportunity to upgrade and systematize this effort in order to greatly improve its reliability, timeliness and efficiency. The regionalized concept of the ANSS plan is particularly important for the Pacific Northwest where geologic and tectonic conditions are different than they are in the rest of the country. For example, under one scenario a properly configured network and information distribution system could provide over four minutes of warning for strong ground motion in Seattle for a Cascadia mega-thrust earthquake. The national scope of the ANSS is also important to us because the lack of recent large damaging earthquakes here reduces the local political interest in supporting monitoring efforts to the degree needed given the real hazards.

2:30 – 2:45 p.m. **Jim Goltz**, Cal Tech
Earthquake Early Warning: Setting the Stage for Introduction in Southern California

An objective of the TriNet Project in southern California is to develop a pilot earthquake early warning project at Caltech. Although this early warning objective is limited in scope, it provides a context in which to consider the implications of establishing an earthquake early warning system in a large metropolitan region located in a major seismic zone. This presentation will introduce the concept of earthquake early warning as applied to the social, economic and tectonic environment of southern California. A computer animated simulation and data from ongoing studies, including a survey to identify potential earthquake early warning users, will be presented. Based on preliminary findings from these studies and consideration of public policy issues, an attempt will be made to answer the question: are we ready to implement an earthquake early warning system in southern California?

2:45 – 3:00 p.m. **Eddie Bernard**, NOAA
New Technologies for Local Tsunami Warnings

Local tsunamis can devastate a coastal community within minutes of the earthquake shaking and persist for hours threatening rescue operations. Two technological developments can alleviate the sudden tsunami impact - evacuation maps and real-time tsunami data. The maps identify areas that can be flooded and need to be evacuated to save lives. The maps also guide community planning for optimal routing of evacuees and designated shelters to proved some level of comfort during the repeated attack of waves. Real-time data can supply critical information on the existence or state of the tsunami to assist first responders in rescue and recovery operations. Instruments that can measure tsunamis in the offshore environment and report these data in real time provide the best information for making these life-preserving decisions. In addition, these instruments operate independent of local power and communications infrastructure.

3:00 p.m. – 3:30 p.m. Break

3:30 – 3:45 p.m. **David Wald**, USGS
ShakeMap – A Tool for Presenting Ground Motion Parameters in Near-Real Time

Immediately following an earthquake, emergency managers must quickly make response decisions using limited information. Automatically and rapidly generated computer maps of the intensity of shaking (ShakeMaps) are now available within 5 minutes after in earthquake in southern California. This quick, accurate and important information can aid in making the most effective use of emergency response resources. In this presentation I will discuss how ShakeMap is made, give recent examples from important earthquakes, and show how different maps are customized for different uses and users.

3:45 – 4:00 p.m. **Dallas Jones**, California OES
Potential Use of ShakeMap as a Tool in Emergency Management

4:00 – 4:15 p.m. **Jim Chadwick**, MITRE Corporation
Policy Implications of Technology Trends in Hazard Warning Systems

- GPS is an enabling technology that supports more geographically specific warnings – a major shift in policy is possible
- The variety of wireless communications networks that is emerging makes the distribution of warnings to remote areas practical
- The cost of these technologies has dropped to the point where small communities and even individuals can be provided with warnings
- Several projects are on the drawing board that will use these technologies in Alaska and "Tornado Alley" for proof-of-concept demonstrations that can test new policies

4:15 – 4:45 p.m. Discussion – Led by Moderator
Recorder – Mary Lou Zoback, USGS

4:45 – 5:00 p.m. Personal Action Summary – Michael Burns

Policy Session #3
Strategies to Reduce Impacts of Disasters

James Davis, Moderator
Wednesday, September 20, 2000, 9:00 a.m. – Noon

Natural disasters cast a significant shadow on national economic growth and well-being. The most severe disasters are infrequent and have profound direct and indirect economic effects that defy traditional actuarial analysis. Policies necessary to deal with the costs of disasters require:

- Consensus on the best models to determine future disaster costs, given their limitations and uncertainties;
- Methods of increasing the awareness of the public and its policy makers regarding the costs of future disasters in order to achieve commitment to loss-reduction policies;
- Consensus on the roles of state and federal governments, lending institutions, insurers and the business community in implementing policies that can limit disaster costs and hasten post-disaster recovery.

This session focuses on risk analysis, loss estimation and means to communicate this understanding in the selections and adoption of policies in public and private quarters that will reduce future losses from earthquakes and other perils.

Order of Speakers & Abstracts

9:00 – 9:20 a.m. **Stuart Nishenko**, FEMA
Summary of National Earthquake Loss Estimation Using a Public Model

9:20 – 9:40 a.m. **Mike Reichle and Jim Davis**, CA Division of Mines and Geology
A State-focused Analysis of Annualized Average Earthquake Loss

9:40 – 10:00 a.m. **Ron Eguchi**, ImageCat, Inc.
Uncertainties in Loss Estimation Models

10:00– 10:30 a.m. Break

10:30 – 10:50 a.m. **Sarah Nathe**, UC Berkeley
How to Talk to the Public About Earthquake Risk

The goal of risk communication is to change people's behavior. Getting from information to raised awareness, and from there to protective actions is a complicated journey through many distractions and competing needs. Through research and experience, however, we have learned about effective ways to communicate with non-specialists about earthquake risk. How to frame the message, disseminate it, and persist in the process will be covered in this presentation. Examples of successful information campaigns and programs will be discussed.

10:50 – 11:10 a.m.	**Mona Carter**, State of Kentucky Assistant Insurance Commissioner *How Can Earthquake Insurance Play a Larger Role in Pre-Event Loss Reduction and Post-Event Recoveries?*
11:10 – 11:45 a.m.	Discussion – Led by Moderator Recorder -
11:45 a.m. – Noon	Personal Action Summary – Michael Burns

Policy Session #4
Identifying Effective Loss Reduction Strategies

Stephen Weiser, Moderator
Wednesday, September 20, 2000, 2:00 – 5:00 p.m.

The understandings that certain types of disasters will recur and that our built environment has specific components that can fail are not causing comprehensive spontaneous efforts to reduce future losses. Neither public mitigation policies such as regulating land-use placement of structures, building codes and emergency preparedness, nor private voluntary actions such as insurance, structural retrofitting and personal preparedness are optimally utilized. Since these mitigation efforts make sense as abstractions, what public and private strategies can encourage more extensive action? What are the most effective collaborative strategic and tactical roles of the federal, state, and local governments and private institutions in achieving improved future loss reduction? How can the citizen consensus that is required to create public mitigation policies be reached nationally and locally in regions that are most at risk? How can we prioritize prospective options? What are the most promising approaches based upon our experience?

This session will address these issues and questions based upon experience and analysis of the potential outcomes of new approaches.

Order of Speakers & Abstracts

2:00 – 2:20 p.m. **Tom Tobin**, Tobin & Associates
Review of Loss Reduction Policy Options

2:20 – 2:40 p.m. **Robert Freitag**, Institute for Hazard Mitigation and Research
Complementary Roles of National, State and Local Governments

2:40 – 3:00 p.m. **James Mullen**, City of Seattle Emergency Management
Project Impact Experience in Seattle, Washington

3:00 – 3:30 p.m. Break

3:30 – 3:50 p.m. **Rickie McCandless**, Salt Lake City School District
Financial Options for Mitigation

Salt Lake City School District conducted a study of their buildings, over a decade ago, to determine the life safety issues and loss of life related to seismic activity along the Wasatch Front in Salt Lake City. It was determined serious loss of life would occur in schools in the event there was a serious earthquake. Costs associated with conditions of some buildings, liquefaction issues and even recent building codes made the task of bringing buildings to a Zone 4 an arduous task. Several elections and school board members later the plan to replace or retrofit all schools, within a ten year period, to a seismic Zone 4 is taking place. The process from identifying the need to

making funding available within a reasonable length of time and the actual scheduled timeline will be reviewed. Entering into the fourth year of an aggressive ten-year program we can tell you what we have we learned, where are we going and how happy the constituents are with the end product.

3:50 – 4:10 p.m. **Teri Spalding**, State Farm Insurance
Encouraging Retrofit of the Built Environment

4:10 – 4:45 p.m. Discussion – Led by Moderator
Recorder – Ken Deutsch, American Red Cross

4:45 – 5:00 p.m. Personal Action Summary – Michael Burns

Policy Session #5
Earthquake Building Codes in the 21st Century

Robert Bezek, Moderator
Thursday, September 21, 2000, 9:00 a.m. – Noon

During the last half of the 20th century, construction that has complied with building codes is generally credited with significantly reducing earthquake losses in jurisdictions where codes exist. Consensus-based engineering judgments used in code development consider past structural performance and estimation of effects of anticipated earthquakes. Emerging technologies continue to offer challenges to design adequate resistance into new types of construction as well as to offer opportunities to design foundations and other elements that can minimize structural responses.

At the beginning of the new century, International Building Code 2000 will be the standard across the nation. The 2000 Code is performance-based so that the level of design resistance can be matched to the past earthquake functional capability intended by the owner. Avoidance of collapse hazard is no longer the single criterion for the threshold design.

Mitigation through the medium of building codes in the 21st century can be advanced by: extending the use of codes in more jurisdictions with appreciable risk; improving code compliance and quality of construction; and further improvements in engineering design requirements.

In this discussion we address the following questions: Why do some exposed jurisdictions have codes and others do not? How can the code development process itself be improved? What are the most promising directions for future code evolution? How can codes more effectively address retrofitting existing structures?

Order of Speakers & Abstracts

9:00 – 9:10 a.m. **Robert Bezek**, Introduction

9:10 – 9:30 a.m. **Jim Beavers**, Mid America Earthquake Center
What Have Building Codes Achieved?

Key points will include:

- How far we have come with building codes
- Examples of success
- Code adoption issues
- Future opportunities for success

9:30 – 9:50 a.m. **Tim Sheckler**, FEMA
How Codes Do and Don't Reduce Losses

Key points will include:

- What codes are designed to do and not do regarding loss prevention
- Describe the problems with the goals of the current codes
- How the letter of the code is used for loss reduction
- What the code needs to do to be more effective in reducing losses.

9:50 – 10:20 a.m. Break

10:20 – 10:40 a.m. **Soy Williams**, ICC
Future Building Code Trends

Now that the 2000 editions of the International Codes® series are complete, it's time to start looking ahead to the future of building codes. Answers to the following commonly asked questions will be discussed in brief:

- Who is ICC and our vision?
- Where are the individual model code organizations headed?
- What's in store for the building industry and professionals in the ICC process?
- What is the status and future of building code adoption nationally?

In addition, a sneak peak at the final draft of the soon-to-be-released ICC Performance Code for Buildings and Facilities will be provided.

10:40 – 11:00 a.m. **Ron Lynn**, Clark County Building Department
Trends in Building Code Enforcement

For over 4,000 years, man has exercised controls over the construction and utilization of buildings throughout the civilized world. Early trends in code enforcement emphasize consequences for failures rather than performance criteria to assure success.

Theoretical discussions, academic dissertations, and advancement in building design do not always yield the expected results. While scientific and engineering research are driving forces in the evolution of seismic design building codes, both in their promulgation and adoption, are most profoundly influenced by disasters. Yet code adoption in itself does not ensure compliance. Consistently absent from effective implementation is the failure to educate front line inspectors and contractors who are burdened with assuring code and project specific designs are incorporated in the built product.

The need to refine and adopt appropriate codes, combined with communication and education, represents a realignment of resources that are necessary to effectively accomplish safety in the built environment.

11:00 – 11:20 a.m. **Peter May**, University of Washington
Making Building Codes an Effective Tool for Earthquake Hazard Mitigation

This segment addresses gaps in enforcement and compliance with seismic provisions of building codes in the Western United States and what it would take to make such codes more effective. The discussion emphasizes thinking of the problem not as one of achieving stronger enforcement but one of obtaining better compliance. This leads to consideration of a variety of ways of making codes more effective instruments for earthquake mitigation in considering altering incentives and disincentives for adoption and compliance of seismic provisions of building codes.

11:20 – 11:40 a.m. **Robert Olson**, Robert Olson & Associates
Adoption and Enforcement of Earthquake Risk-Reduction Measures

This presentation focuses on incentives, primarily financial, that facilitate the application of codes or standards and the commitment to hazard mitigation. Incentives seek to change financial relationships and behaviors in ways that make the taking of desired mitigation actions more acceptable to those governed and who have to pay the costs. Incentives linked with minimum codes or voluntary programs, where they exist, governing earthquake resistant construction or the retrofitting of existing buildings are receiving increasing attention in a policy climate characterized by non-mandation and the devolution of power to state and local governments.

11:40 – 11:50 a.m. Discussion – Led by Moderator
Recorder – Laurence Kornfield, City and County of San Francisco Building Department

11:50 a.m. – Noon Personal Action Summary – Michael Burns

Policy Session #6 Policy Development

Jonathan Price, Moderator
Michael G. Burns, Facilitator, Burns Business Strategies, Inc.
Thursday, September 21, 2000, 2:00 – 5:00 p.m.

Policy Session 6 is an interactive and facilitated forum for discussion of the policy issues emerging from the conference and consideration of actions to be taken. WSSPC members will consider the outcomes of these discussions in formulating future policy recommendations for the earthquake loss reduction community.

Thursday, September 21, 2000
2:00 – 5:00 p.m.

Moderator – Jonathan Price
Facilitator – Michael G. Burns
Tom Benthin - Graphic Recorder, The Grove Consultants International
Mark Benthien – Recorder, Southern California Earthquake Center

Mitigation & The International Codes

National Earthquake Risk Management Conference

Soy L. Williams, AIA

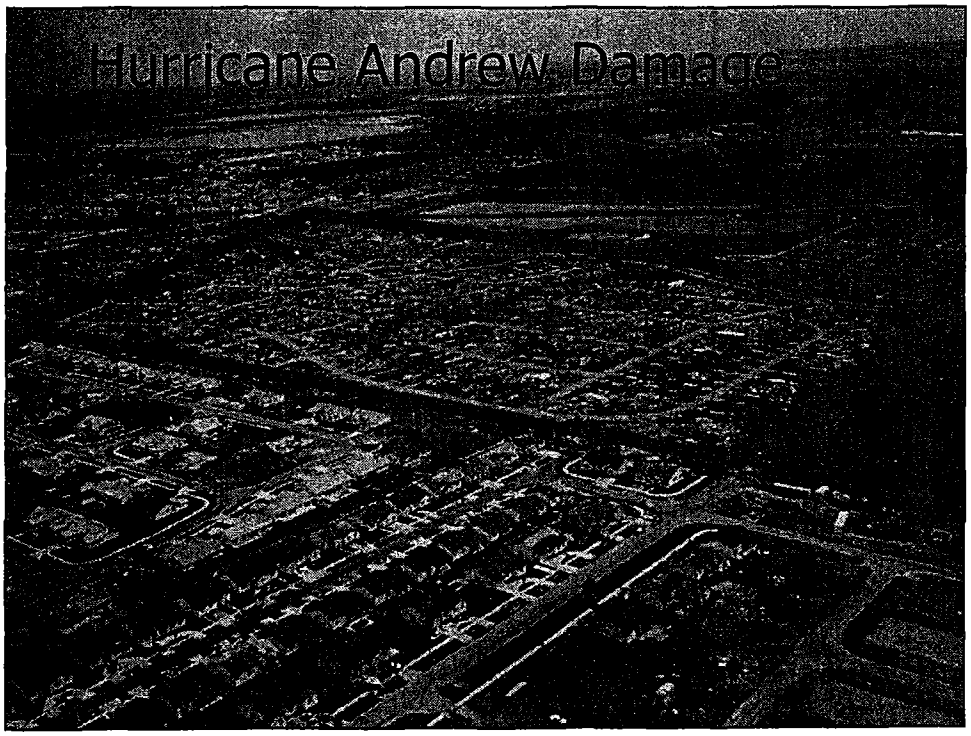
International Code Council, Inc.

September 21, 2000

"The First Line of Defense"

"When disaster strikes, no matter where or how, building codes - and local code officials - are America's first line of defense against tragedy."

James Lee Witt, Director
FEMA
ICC Joint Annual Conference, 1999



International Code Council

- **Created in 1994**
- **Three statutory members**
- **Not-for-profit organization**
- **Governed by a 12-member BOD**
- **Corporate Officers**

ICC Mission

To promulgate a comprehensive and compatible regulatory system for the built environment, through consistent performance-based regulations that are effective, efficient and meet government, industry and public needs.

Why a Single Family of Codes?

- **Facilitate the adoption of contemporary model codes**
- **Compatibility of codes across borders**
- **Central focus for code matters and national regulatory issues**
- **Universal educational programs**
- **Enable and encourage innovative product development**
- **Better position U.S. products and technology in the world market**

International Code Council

- **Building Officials and Code Administrators International**
  BOCA National Codes
- **International Conference of Building Officials**
  ICBO Uniform Codes
- **Southern Building Code Congress International**
  SBCCI Standard Codes

International Codes/2000

- **Coordinated and Comprehensive**
- International **Building** Code
- International **Residential** Code
- **Electrical, Energy, Fire, Fuel Gas, Mechanical,**
- **Plumbing , Private Sewage Disposal, Property Maintenance, Zoning**
- **Code Commentaries**

International Code Council

BOCA, ICBO and SBCCI

- **Membership**
- **Non-Profit Organizations**
- **Governing Body**
- **Support Services to All Members**
- **Virtually identical code development processes**

International Code Council

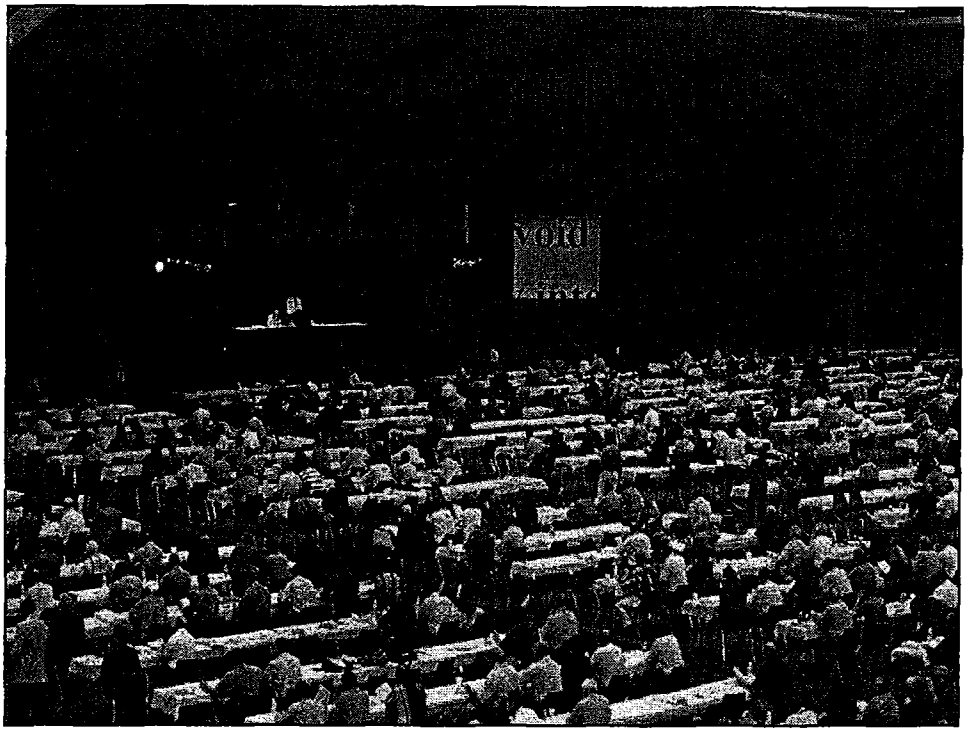
BOCA, ICBO and SBCCI

- **Merged code development efforts under ICC**
- **Have continued as independent organizations**
- **Serve their members in use/application of I-Codes**
- **Cooperate on matters of mutual concern/interest**

International Code Council

BOCA, ICBO and SBCCI

Merge into a single organization?



ICC Code Development

- **Pro-active vs reactive**
- **"Who writes this thing?" and "What does it mean?"**
- **"I don't have time to get involved, I have a full time REAL job."**

ICC Code Development

- Code officials
- Design professionals (e.g. ASCE, AIA)
- Trade associations
- Builders/contractors
- Manufacturers/suppliers
- Gov't agencies (e.g. FEMA, HUD)
- Insurance representation (e.g. IBHS)
- Anyone with vested/nonvested interest

ICC Code Development

- 18-Month Cycle
- Committee Composition
- Floor Vote – Who's Eligible?
- Consensus Process
- Impact on Industry

Statewide Building Codes

- 7 States - no statewide building code
- 10 States - building codes apply to certain buildings and voluntary for all other applications
- 7 States - prohibit local amendments
- 11 States - local amendments with State approval
- 15 States - local amendments without State approval

Performance Code

- THE OBJECTIVE
  Establish the public policy intent
- FUNCTIONAL STATEMENTS
  Why objective is to be achieved
- PERFORMANCE REQUIREMENTS
  How to achieve the functional statements
- ACCEPTABLE METHODS/SOLUTIONS
  How to comply with performance requirements

Performance Code

- **THE OBJECTIVE**

  "To provide a desired level of structural performance when structure are subjected to the loads that are expected during construction or alteration and throughout their intended life."

Performance Code

- **FUNCTIONAL STATEMENTS**
  - **"...designed and constructed so as to prevent injury to occupants due to loading of a structural element or system consistent with the design performance level determined in Chapter 3."**
  - **"...designed and constructed to prevent loss of property and amenity consistent with the design performance level determined in Chapter 3."**

Performance Code

- **PERFORMANCE REQUIREMENTS**
  - **"...shall remain stable and not collapse during construction or alteration and throughout their lives."**
  - **"...shall have a low probability of causing damage or loss of amenity through excessive deformation, vibration or degradation..."**
  - **"...shall be designed an constructed taking into account all expected loads...associated with events, magnitudes that would affect their performance..."**

Performance Code

- **ACCEPTABLE METHODS AND SOLUTIONS**
  - **"Prescriptive" code or standard**
  - **Alternative designs through modeling, testing**

Code of Hammurabi* (1700s BC)

228. If a builder build a house for some one and complete it, he shall give him a fee of two shekels in money for each sar of surface.

229. If a builder build a house for some one, and does not construct it properly, and the house which he built fall in and kill its owner, then that builder shall be put to death.

230. If it kill the son of the owner the son of that builder shall be put to death.

231. If it kill a slave of the owner, then he shall pay slave for slave to the owner of the house.

232. If it ruin goods, he shall make compensation for all that has been ruined, and inasmuch as he did not construct properly this house which he built and it fell, he shall re-erect the house from his own means.

233. If a builder build a house for some one, even though he has not yet completed it; if then the walls seem toppling, the builder must make the walls solid from his own means.

*Translated by L. W. King

INTERNATIONAL CODE COUNCIL®

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Article Reprinted from *EQ* Winter 2000 Issue for Reference during Policy Session #5

Development of the 2000 IBC and 1997 UBC seismic codes

Douglas S. Thompson, S.E. , Executive Vice President, *STB STRUCTURAL ENGINEERS, INC*
Saiful Islam, Ph.D., S.E., President, *SAIFUL/BOUQUET Consulting Structural Engineers, INC*
Robert Bachman, S.E., *FLUOR DANIEL, INC*

For over 40 years the seismic provisions in the *Uniform Building Code (UBC)* have been based primarily on recommendations by the Structural Engineers Association of California (SEAOC) These recommended seismic provisions are contained in a document called *SEAOC Recommended Lateral Force Requirements and Commentary* and is commonly referred to as *Blue Book* This *Blue Book,* like the UBC has been updated regularly.

These recommended seismic provisions were submitted by SEAOC, to the International Conference of Building Officials (ICBO), for review, adoption and inclusion into the UBC. These recommended seismic provisions were submitted by either the SEAOC Seismology Committee or the SEAOC Code Committee In the distant past, building code provisions developed on the "national level" through the American Concrete Institute (ACI), the American Institute of Steel Construction (AISC) and the American Forest and Paper Association (AFPA), to name just a few, and were not as focused on seismic provisions as was SEAOC Earthquakes had been perceived as a local "California" problem.

The Federal Government began changing this perception of seismic provisions twenty years ago with the creation of the National Earthquake Hazards Reduction Program (NEHRP). Federal Emergency Management Agency (FEMA) was charged with the task of creating a document on national earthquake regulations. The Building Seismic Safety Council (BSSC) under the direction of FEMA was then created and specifically assigned to create the *Recommended Provisions for Seismic Regulation for Buildings (NEHRP Provisions)* This document first came out in 1985.

Both FEMA and BSSC continued with the updating of the *NEHRP Provisions* on a three-year cycle, with revised provisions in the 1988 and 1991 editions For the most part these provisions were not used by the model codes or by the practicing engineers This drastically changed when President Clinton signed an executive order mandating that all new federal buildings must meet minimum standards set by the 1991 *NEHRP Provisions*

In 1995, the three national model code agencies, Building Officials Code Administrators (BOCA), the International Conference of Building Officials (ICBO) and the Southern Building Code Council International (SBCCI), voted unanimously to work together in the creation and publishing of one model building code. This one model building code would be called the *International Building Code (IBC).* These national model code agencies have been publishing the *National Building Code*, the *Uniform Building Code* and the *Southern Building Code* respectively.

The International Code Council (ICC) was formed from members of each of the three national model code agencies. The ICC then formed a group of code writing committees (Occupancies, General, Structural, Means of Egress, and Fire Safety), from these members, for the creation of the one national code. Provisions from all three national codes were looked at in the formation of the *IBC* drafts.

At the time that the ICC was formed, both BOCA and SBCCI had already adopted the *NEHRP Provisions* for seismic design. Also, the three code agencies were leaning strongly towards the inclusion of the *NEHRP Provisions* into the *IBC.* This presented somewhat of a problem for SEAOC and the western states using the *Uniform Building Code* for its seismic provisions. The seismic provisions in the *Uniform Building Code* were considerably more stringent then the 1995 *NEHRP Provisions* After considerable

negotiations with SEAOC, BSSC, the National Council of Structural Engineering Associations (NCSEA), SEAOC decided to support the 1997 *NEHRP Provisions.* As a compromise, BSSC agreed to allow SEAOC enough input and comment to ensure that the provisions necessary to California practice would be included into the 1997 *NEHRP Provisions*

Many of the changes in the 1997 *UBC* are a direct result of California changing from the *Blue Book* provisions, to the *NEHRP Provisions* and many of the changes found in the 1997 NEHRP are a direct result of including concepts found in the 1997 UBC. These changes in the 1997 *UBC* were made as a transition to the 2000 *IBC* and the 1997 *NEHRP Provisions.* Both the 1997 *UBC* and the 1997 *NEHRP Provisions* were in most cases identical, and for similar building types, would result in nearly identical building designs.

Other problems that arose in the development of the 1997 *NEHRP Provisions*, is that the 1994 *NEHRP Provisions* as written, were not acceptable as "code language" but rather more as a "reference document". Also, there was not enough time for a regular "consensus standard", as was used in the development of the 1994 *NEHRP Provisions* To assist the process FEMA formed the Code Resource Development Committee (CRDC) through the BSSC. The CRDC assisted the ICC committees in converting the 1994 *NEHRP Provisions* into code language. The CRDC committee also helped in filling voids that existed in the 1994 *NEHRP Provisions.* One of these voids was that the 1994 *NEHRP Provisions* only recognized load and resistance factor design (LRFD or strength design). In this case, the 1997 *UBC* was used as a model for the inclusion of allowable stress design (ASD) into the document.

How seismic provisions will be developed in the future

Now that the process of completing the 2000 IBC is complete, the process of how to incorporate revisions to the seismic provisions into future editions of the IBC has yet to be determined. Currently, the BSSC has been holding meetings to determine how the seismic provisions should be developed in the future. Although not yet finalized, the process seems to be heading towards adopting the seismic provisions by reference as a "national standard". This would then be the same process for adoption as is used for each of the material sections of the code.

The adoption by reference process have both advantages and disadvantages. An advantage for this system would be to preclude a rapid adoption process for massive changes, like that occurred for the seismic provisions in the 1997 UBC. This on the whole would be a more simplified process allowing enough time for input and comment from all interested parties.

However, the disadvantage to this would preclude the emergency enactment of lessons learned from earthquakes. One example of this would be the emergency enactment of no longer allowing the "pre-Northridge" welded steel connection. Through direction from SEAOC, the code section for this connection was removed and re-written by ICBO, in the fourth printing of the 1994 *UBC.* Had a full consensus process taken place, literally thousands of buildings would have been permitted and built using the old connection that was now known to be flawed.

New provisions in the 1997 UBC

Related to seismic design in the 1997 UBC, there were many significant changes in the code. The two most notable are, 1) the reliability/redundancy factor, 2) the near source factor.

Based upon past earthquakes, it has been observed that structures with adequate redundancy perform better than structures without adequate redundancy. Simply put, structures with redundancy have more elements resisting the seismic forces or in other words, have not put "all their eggs in one basket". Lateral resisting elements are shear walls, steel frames or concrete frames. Prior to the 1997 UBC, similar structures were designed for similar forces. The reliability/redundancy factor, in the 1997 UBC, has

placed a penalty on structures with lesser redundancy. This reliability/redundancy factor can place as high as a 50 percent penalty (or design force increase) requirement on structures.

Based primarily upon recorded ground accelerations in the Northridge and Kobe earthquakes, ground accelerations from a seismic event can be considerably higher at close proximity to the fault. Prior to the 1997 UBC, seismic regions were merely divided into broad categories, that being seismic zones 0 through 4. The California Department of Conservation, Division of Mines and Geology (DMG), has prepared a map book of known active fault "near-source zones" in California and adjacent portions of Nevada A "near-source zone" is defined as within 2 kilometers of a known fault zone. The maximum increase for near source effects occurs within 2 km The amount of increase in the seismic force used for the design decreases with distance from the fault and there is no increase at and beyond 15 km from the fault. This "near-source zone" can place as high as a 100 percent increase in design force requirements on structures.

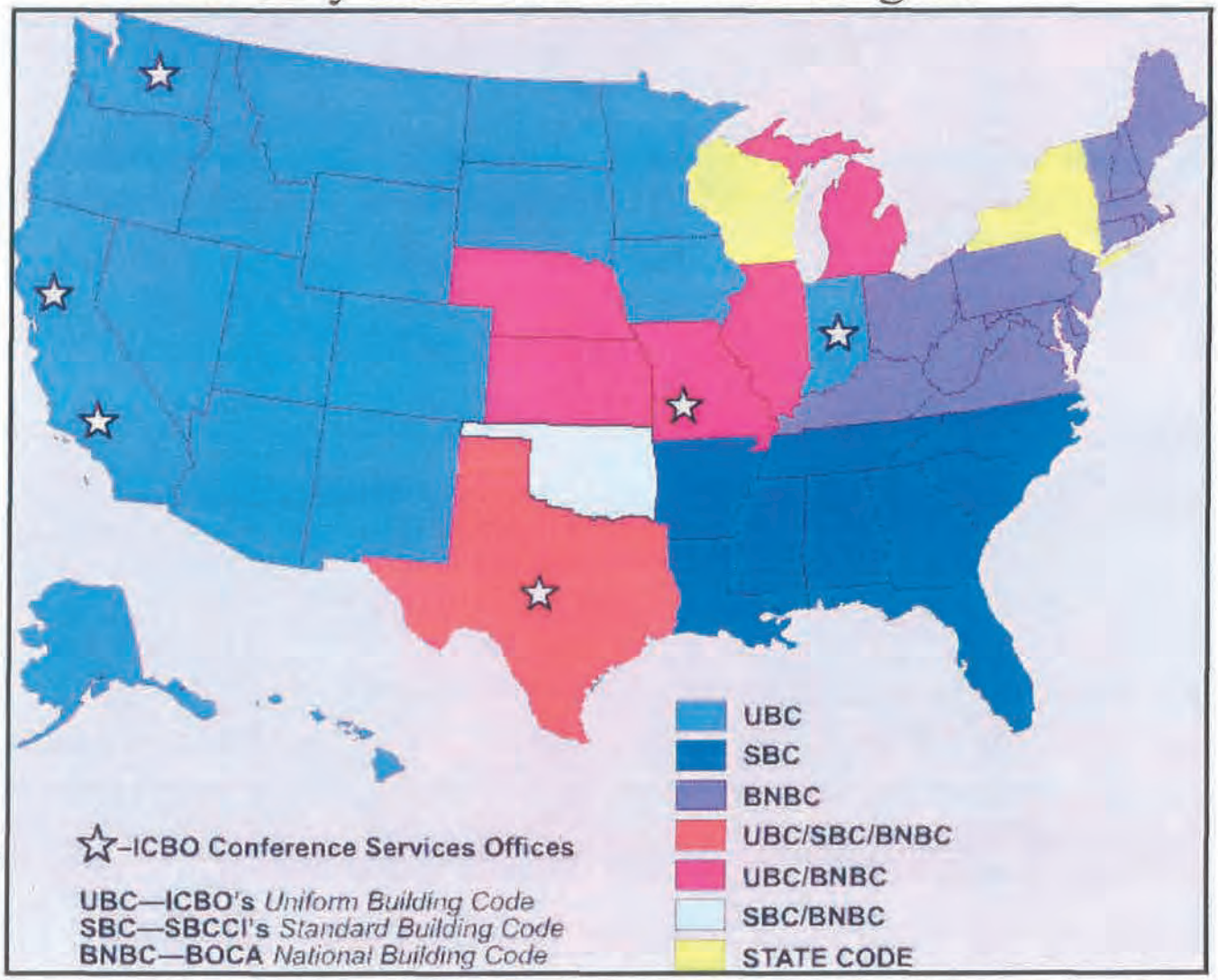
New provisions in the 2000 IBC

Related to seismic design in the 2000 *IBC*, one of the most significant changes from the *UBC* is the seismic zone mapping. In the 1997 *UBC* and earlier editions, the seismic zones had number designations. These zones were from 0 to 4 with 4 being the area of highest seismically potential. California, for example, has only two zones (3 and 4). The 2000 *IBC* has "Spectral Response Acceleration" maps. These maps appear as contour lines. A CD-Rom will also be provided with the *IBC* that will provide spectral values for a given longitude and latitude.

Also related to seismic design, the 2000 *IBC* also has another significant change. The 2000 *IBC* is specifically written to include all types of structures except for one and two family dwellings For design of one and two family dwellings (residential), another new code has been created the *International Residential Code (IRC)*. A potential problem with this new code system is the *IRC* does not contain many of the stringent seismic provisions contained within the *UBC.*

See also accompanying graphic

State By State Status of Building Codes



Conference Sponsor Information Pages

Western States Seismic Policy Council

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WSSPC Mission Statement

The mission of the Western States Seismic Policy Council is to provide a forum to advance earthquake hazard reduction programs throughout the Western Region and to develop, recommend, and support seismic policies and programs for the region through information exchange, research, and education.

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Basin and Range Province Committee

Seeks to accurately characterize seismic hazards in the western region and maintain a high level of awareness in policy-making bodies of the attendant seismic risk faced by the region.

Tsunami Hazard Mitigation Committee

Coordinates and implements tsunami hazards mitigation plans and focuses on developing policies based on the current technology and science.

Economic Impacts of Natural Disasters Committee

Explores and encourages discussion of public and private policy issues that can reduce future casualties, costs, and damages from natural disasters.

Committee for Engineering, Construction, and Building Codes

Considers the need for and requirements of seismic building codes and incentives for building owners to retrofit older buildings.

WSSPC Members

Alaska
Division of Geological and Geophysical Survey
Alaska Division of Emergency Services

American Samoa
TEMCO, Department of Public Safety

Arizona
Arizona Division of Emergency Management
Arizona Geological Survey

British Columbia
British Columbia Geological Survey
British Columbia Provincial Emergency Program

California
California Division of Mines and Geology
California Office of Emergency Services

Colorado
Colorado Office of Emergency Management
Colorado Geological Survey

Guam
Civil Defense, Guam Emergency Services Office

Hawaii
Hawaii State Civil Defense
Hawaii Department of Land and Natural Resources

Idaho
Idaho Geological Survey
Idaho Bureau of Disaster Services

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

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

New Mexico
New Mexico Bureau of Mines and Mineral Resources
Office of Emergency Management

Northern Mariana Islands
Northern Mariana Islands Emergency Management Office

Oregon
Oregon Department of Geology and Mineral Industries
Oregon Office of Emergency Management

Utah
Utah Geological Survey
Utah Division of Comprehensive Emergency Management

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

Wyoming
Wyoming Emergency Management Agency
Wyoming State Geological Survey

Yukon
Emergency Management Organization

WSSPC Affiliate Members and Partners

Affiliate Members

(Affiliate Member applications in back pocket)

Corporate Members

Degenkolb Engineers

Earth Consultants International, Inc.

EQE International, Inc.

State Farm Insurance Companies

Taylor Devices, Inc.

Local Government/Department

City of West Hollywood

City and County of San Francisco, Department of Building Inspection

University/Department of University

California Institute of Technology, Seismological Laboratory

Partners

Federal Government

Department of Transportation

Federal Emergency Management Agency

National Oceanic and Atmospheric Administration

United States Geological Survey

Earthquake Consortia

Central United State Earthquake Consortium

Northeast States Emergency Consortium

State Seismic Advisory Boards

Arizona Council of Earthquake Safety

California Seismic Safety Commission

Nevada Earthquake Safety Council

Oregon Seismic Safety Policy Advisory Commission

Utah Seismic Safety Commission

Association/Non-profit/Voluntary

Association of American State Geologists

Association of Bay Area Governments

California Universities for Research in Earthquake Engineering

Cascadia Region Earthquake Workgroup

Council of State Governments

Earthquake Information Providers Group

Emergency Information Infrastructure Partnership

Idaho National Engineering and Environmental Laboratory

Institute for Business and Home Safety

International Association of Emergency Management

National Emergency Management Association

National Institute for Urban Search and Rescue

Pacific Earthquake Engineering Research Center

Seismological Society of America

Southern California Earthquake Center

Western States Seismic Policy Council State and Provincial Member Reports

On the following pages are annual reports submitted by the WSSPC member states and provinces covering their activities over the course of the preceding year.

Alaska
Arizona
British Columbia
Colorado
Idaho
Montana
Nevada
New Mexico
Oregon
Utah
Washington
Wyoming

ALASKA

Earthquake and Tsunami Program Activities

Division of Emergency Services

The State of Alaska, Division of Emergency Services (DES) had a full agenda and a successful year with respect to its earthquake and tsunami programs.

We continue to support the Municipality of Anchorage's (MOA) Building Safety Division's Post Disaster Damage Assessment Program. During this period, August 99/00, the MOA's PDDA Coordinator conducted four initial courses, two in Anchorage, one each in Valdez and Kenai and one refresher course in Anchorage. He also conducted courses in Critical Building and Shelter Survey, Non-Structural Hazard Reduction in Schools, Post Disaster 'Rapid Evaluation of Educational Facilities and Wind and Flood Damage Assessment with a total of 248 participants. Furthermore, he participated in National Building Safety Week – Anchorage promoting the use of Building Codes within the Anchorage Bowl area.

This partnership has forged strong ties and fostered commitment from Project Impact communities, school districts, The Army Corp of Engineers, the Department of Interior and other communities throughout the State. Disaster awareness and preparedness has dramatically increased. The program design has prompted the Army Corp of Engineers to adopt several aspects of it at the national level

The Division of Emergency Services continues to aggressively seek opportunities to deliver the earthquake preparedness message. To that end we purchased the "Quake Cottage" from Safe-T-Proof, of Westlake Village, CA. It is a small "country cottage," complete with a simulated thatched roof. It is mounted on springs and roller bearings to a dual axle trailer with a 220-volt gearhead motor with a cam driven actuator arm. This combination can produce up to an 8.0 earthquake. (We typically demonstrate it at approximately a 4.0-4.5 magnitude.) It is furnished with seating for three (with safety harnesses), a small computer and cabinet, large entertainment center with VCR, speakers and TV and several framed pictures. All have been fitted with safety retention hardware to prevent damage to the items or "Quake Cottage" occupants

The "Cottage" is a resounding success. We took it to three fairs: Fairbanks, Nimilchik and the State Fair in Palmer, Alaska. It has been very popular with approximately 250, 500 and over 1000 individuals, respectively. Occupants experienced a near source 4.0-4 5 earthquake. The unanimous response was surprise that it was "only a 4.5 earthquake."

Participation in fairs provides us the opportunity to spread the preparedness and mitigation message through hundreds of conversations with fair-goers, by playing disaster videos, and distributing thousands of pamphlets, booklets, and brochures. The handouts include the "Ernie Earthquake" Coloring Book (which was designed and printed by DES and has been a big promotional and educational item), pamphlets from Red Cross, FEMA, and NOAA. DES also staffs a separate a booth at the State Fairs in Fairbanks and Palmer, as well as at the annual Alaska Municipal League Conference. The messages are similar but the audience at the conference is focused more towards State and local government officials, i.e. those people who are in the position to directly influence State/local programs and policies. We also receive and are responsive to numerous inquiries and requests for earthquake preparedness information and presentations from other sources, such as schools, day care centers, hospitals, medical offices, community centers, local businesses and military bases throughout the State. We are becoming

increasingly more effective in getting the message out before a disaster and this is instrumental in reducing damage and saving lives.

The NOAA and State of Alaska sponsored Tsunami Inundation Mapping project for three communities on Kodiak Island is nearing completion. The University of Alaska's Geophysical Institute and the Alaska Division of Geological & Geophysical Surveys, respectively, are in the final stages of completing the modeling and production of inundation maps. We have identified the next three communities to be modeled and mapped. The three communities are Seward, Sitka and Sand Point. Seward and Sitka have the greatest need, unfortunately, neither one has accurate bathymetric information available. This situation has been identified and coordinated with NOAA's Pacific Marine Environmental Laboratory (PMEL) and Tsunami Inundation Mapping Efforts (TIME). The communities of Sand Point, Homer/Seldovia and Whittier are the next up for inundation modeling and mapping.

DES has a funding and management role in the Microzonation Project for Anchorage, which is nearing completion. Major support for the multi-institutional project is from the Alaska Science and Technology Foundation. This grant is in year seven of eight and involves installing seismic investigation and monitoring equipment that produces data to develop more accurate seismic maps for Site Response Maps and for use in HAZUS Loss Estimation Program. They will be used to provide the design and engineering community, MOA agencies, and the public, more complete seismic information. This translates to a seismically safer community through zoning and building code regulations and enforcement.

The State's Tsunami Signs Project funded by NOAA is moving forward. Sitka, Alaska was our first community with Sand Point a close second to complete requirements and place tsunami signs throughout their communities. The communities of Homer and Seward, Alaska have received their signs and are in the final stages of getting them installed. Seldovia is preparing their plan and determining their needs. Funding permitting, DES is offering every at-risk coastal community in Alaska the opportunity to participate in the tsunami sign program.

One project of note is with the Alaska Department of Parks and Recreation. They are the first in the nation to identify and place tsunami hazard warning and route signs in remote (inaccessible by road) coastal locations. They saw a need to inform backcountry hikers, kayakers and other outdoor adventurists of the tsunami dangers associated with their activities in remote locations.

Submitted by R. Scott Simmons, Division of Emergency Services

ALASKA

ALASKA GEOSCIENCE REPORT

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

The **Alaska Division of Geological & Geophysical Surveys** (ADGGS) finished compiling geotechnical borehole data and water-well logs for western Anchorage under a project funded by the Earthquake Hazards Reduction Program (NEHRP) of the U.S. Geological Survey (USGS). The GIS database currently contains about 4,500 georeferenced boreholes and well logs. ADGGS published a preliminary geologic map and seven geologic cross sections of central and east Anchorage in 1999 based on these data, and will extend the map and cross sections westward with the newly entered data. The subsurface stratigraphic modeling resulting from this project is providing important data for site-response and seismic soil-type maps being prepared as part of the Anchorage Seismic Microzonation Project (see below). In cooperation with the University of Alaska Fairbanks, ADGGS will publish a set of three spectral site-response maps of Anchorage by December 2000. Site-response values shown on these maps directly complement the ground-motion calculations prescribed by the 2000 International Building Code.

ADGGS is compiling data on Quaternary faults and folds in Alaska under a project partially funded by USGS. The project will result in an atlas of these structures in the state, including a GIS database of fault traces and fold axes. ADGGS is also beginning a project to produce generalized earthquake ground-shaking hazard maps of coastal districts in southeastern, southcentral, and southwestern Alaska. This two-year project is funded by the National Oceanic & Atmospheric Administration (NOAA) through the Coastal Policy Council. HAZUS loss-estimation software will be used to produce the maps, based on the USGS probabilistic ground-acceleration maps of Alaska and derivative seismic soil-type mapping.

The **University of Alaska Geophysical Institute** (UAGI) in Fairbanks operates the Alaska Earthquake Information Center (AEIC) in cooperation with 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 550 channels of seismic data. 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 1/2 hour. Expansion of the network has proceeded in three directions. Staff at the UAGI seismology lab participate in the Princeton Earth Physics Project (PEPP) to develop workshop demonstrations for Alaska K-12 teachers. Through PEPP, UAGI has obtained 11 new broadband seismometers to install in high schools throughout the state. Second, as part of the National Tsunami Hazard Mitigation Program, UAGI is upgrading and augmenting the seismic network with modern digital broadband seismic stations. Five of the planned 21 sites have been installed to date. Third, the Alaska Volcano Observatory (AVO), a cooperative program between UAGI,

ADGGS, and USGS, continues to expand the seismic monitoring of Alaskan volcanoes, most recently in the Adak Island vicinity and Wrangell Mountains.

UAGI is leading the Anchorage Seismic Microzonation Project, which is funded by the Alaska Science and Technology Foundation and involves researchers from several institutions. ADGGS is a formal participant in this project. The purpose of the project is to determine the surface and subsurface seismic characteristics of the soil and substrata beneath Anchorage. A network of state-of-the-art weak-motion seismometers, operating for about 6 months, recorded 114 microtremors in the Anchorage bowl at 0.2 and 1.0 Hz. Additionally, surface measurements of shear-wave velocities in the upper 30 m have been conducted at 36 sites throughout Anchorage. In combination with the subsurface geologic data being compiled by ADGGS, the results are being used to prepare site-response and NEHRP soil-type maps. Additional products will include shear-wave velocity structure to several hundred meters depth and probabilistic acceleration and velocity maps.

As part of the National Tsunami Hazard Mitigation Program, UAGI and ADGGS are collaborating on a Tsunami-Inundation Mapping Project with funding from NOAA through the **Alaska Division of Emergency Services**. Kodiak Island is the first area for which inundation modeling and hazard mapping will be completed. Supplemental funding will be provided by the Alaska Science and Technology Foundation to extend the mapping to additional communities. Completion of inundation maps for the Kodiak area is expected by December 30, 2000. Project information is available on the National Tsunami Hazard Mitigation Program web site (http://www.pmel.noaa.gov/tsunami-hazard/) and on the AEIC web site (http://www.aeic.alaska.edu/tsunami/index.html). The project includes installation of 21 new broadband seismometers.

Other UAGI earthquake-hazards research projects include:

- Accurate cataloging of ground-motion characteristics and spatial parameters of Alaskan earthquakes
- Crustal deformation measurements using GPS and SAR interferometry
- Cooperative project with Norway for joint seismic monitoring of the Arctic
- IRIS/PASCAL transect across the Alaska range to evaluate crust & upper mantle structure
- NSF-funded project to use the Arctic Regional Supercomputer (Cray) to model three-dimensional seismic wave propagation throughout Alaska
- NEHRP-funded project to study crust and upper mantle attenuation in Alaska

Submitted by Rod Combellick, Engineering Geology Section Chief, Alaska Division of Geological & Geophysical Surveys and Roger Hansen, State Seismologist, University of Alaska Fairbanks

ARIZONA

Arizona Geological Survey

Summary of Seismic Hazard Activities

The Arizona Geological Survey (AZGS) has been engaged in several earthquake-hazard related projects in the past year. The AZGS released Map 34, "Earthquake Hazards in Arizona", developed in cooperation with the Arizona Division of Emergency Management, the Arizona Earthquake Information Center at Northern Arizona University (AEIC), and FEMA. This publication builds on a new historical earthquake catalog for Arizona developed by the AEIC and a Quaternary fault data set developed by the AZGS in cooperation with the USGS Earthquake Hazards Reduction Program (AZGS Open-File Report 98-24) The centerpiece of Map 34 is a 1:1,000,000-scale map showing Quaternary faults and historical earthquake epicenters in Arizona over a shaded relief background. In addition, information on notable historical earthquakes and selected Quaternary faults is summarized in tables. Several smaller panels with theme maps, illustrations and text provide some basic information about earthquakes and faults, describe the historical earthquake record and the geologic record of young faulting in Arizona, and consider the relative level of seismic hazard in Arizona.

The AZGS and the Utah Geological Survey are conducting a cooperative research effort to evaluate seismic hazard associated with the Hurricane fault in rapidly developing southwestern Utah and northwestern Arizona. This research is jointly funded by the state surveys and a NHERP grant from the U.S Geological Survey, and researchers at Arizona State University and the University of Utah have contributed to the investigations in Arizona. The results of our work in the past few years indicate that two sections of the Hurricane fault ruptured during the early to middle Holocene, generating earthquakes with estimated magnitudes of between 6.5 and 7. We are conducting further detailed investigations to estimate the ages and lengths of young ruptures along other sections of the Hurricane fault. New Ar/Ar and cosmogenic dates for basalt flows displaced by the fault are providing better constraints on long-term slip rates for various sections of the fault The results of this work will significantly improve our understanding of the hazard associated with this major normal fault.

During the past year, AZGS staff responded to numerous inquiries regarding earthquake hazard in Arizona and actively participated in the Arizona Council for Earthquake Safety.

Submitted by Philip A. Pearthree, Research Geologist

PROVINCE OF BRITISH COLUMBIA

Provincial Emergency Program

The Attorney General of British Columbia, minister responsible for the Provincial Emergency Program (PEP), has agreed to the creation of a senior management body which will proceed to development of a structured earthquake preparedness program.

As this is being written, staffing is underway to create an Earthquake Preparedness Section within PEP incorporating a program manager, an emergency management analyst, a professional engineer, and clerical support. The main function of that section will be to support a multi-disciplinary Seismic Safety Committee that has been authorized and mandated to develop a long-term seismic safety strategy. A senior public information officer will also be assigned to several major awareness campaigns that have been identified.

The Committee will not have to start from scratch. Much work has already been accomplished, and the scope of the future directions we must take has been identified by the principal agencies that need to be involved because of their jurisdictional responsibilities. Much of the long-term work will lead to mitigative initiatives (including tsunami mitigation).

As has been the case for 12 years, BC planners will continue to work with our counterparts in the WSSPC states.

Submitted by David Gronbeck-Jones, Provincial Emergency Program

COLORADO

Colorado Geological Survey
and
Colorado Office of Emergency Management

The Colorado Geological Survey (CGS) and Colorado Office of Emergency Management (OEM) are actively engaged in several projects related to earthquake hazards and awareness in Colorado. The COEM released a map titled "Colorado Earthquake Hazards" last fall. This map depicts historic earthquake epicenters, Quaternary faults and folds, and high consequence dams, and includes information on earthquake preparedness and magnitude and intensity scales. The CGS recently released Bulletin 52, an interactive CD-ROM on "Colorado Earthquake Information, 1867-1996". This report contains a descriptive table and map with information on Colorado earthquakes during the historical period. Isoseismal maps and felt reports for many of the larger events are included in the report. It summarizes results from regional seismographic networks that have operated in Colorado and describes known focal mechanisms.

A press release on CGS Bulletin 52 and an open-file report on Quaternary faults generated considerable interest in earthquakes in the media. Several articles on Colorado earthquake hazards appeared in newspapers, and both radio and television carried stories. The CGS recently hired Vince Matthews to manage their Earthquake Program.

The Earthquake Subcommittee of the Colorado Natural Hazards Mitigation Council has been very active during the past year. Its members include Bob Kirkham of the CGS and Marilyn Gally of the OEM The subcommittee released an informational update on Colorado earthquakes that has been widely distributed and frequently used by the media and private citizens. The subcommittee is currently working with the City and County of Denver Office of Emergency Management to use HAZUS to analyze earthquake risk for this urban area. Other local government agencies wishing to utilize HAZUS to analyze earthquake risk for their communities are encouraged to coordinate with the subcommittee, especially in regards to the review any proposed earthquake scenarios. The subcommittee is charged with selection of professionals to represent Colorado on the Advanced National Seismic System Intermountain West region.

Last fall the governor of Colorado signed an honorary proclamation declaring November 7-13, 1999 as Colorado Geological Hazards Awareness Week As part of this effort, maps and brochures on earthquake hazards and awareness were distributed to the school districts.

Submitted by Bob Kirkham, Colorado Geological Survey, and Marilyn Gally, Office of Emergency Management.

IDAHO

Idaho Geological Survey
and
Idaho Bureau of Disaster Services

The Idaho Geological Survey and the Idaho Bureau of Disaster Services continued an extensive annual program in hazard mitigation A summary of the highlights from the past year follows

Seismic Activity
The Bureau of Disaster Services tracks six seismic networks in and around Idaho for events that impact the state and reported 816 events M2 0 and greater, 64 events M3.0 and greater, and 2 events M4 0 and greater for the 12-month period ending December 31, 1999. No damage was reported, but a M5.3 event in western Montana was felt in Boise, over 270 miles distant.

Earthquake Studies
Based on experience from a previous study of the ground-shaking hazard in Pocatello and Idaho Falls, the Idaho Geological Survey initiated an urban earthquake study of Boise using the SHAKE program. Surficial geologic maps and data from 84 well logs was used to characterize the seismic parameters. Characteristic and random earthquake scenarios were selected from the best available data. A characteristic earthquake of M 7 at a distance of 40 km with a recurrence of 6.7ka or less and a random earthquake of M 6.0 at 14 km with a recurrence of 10ka were used for the model These preliminary data are being processed and the final results will include period, amplification and acceleration maps of the Boise area.

Field investigations of faults in the Hells Canyon region continued in cooperation with the State of Oregon and Boise State University. A geology graduate student from Oregon State University has begun a thesis-mapping project and undergraduates participating in the EDMAP program from Boise State University continue quadrangle mapping in this structurally complex area.

Fault Studies
The fault map of Idaho (Miocene and younger) was presented for review and comment by the IGS at the Rocky Mountain Section of the Geological Society of America meeting in Missoula this spring. The map benefited by the input from several individuals who generously shared new information These changes are being incorporated into the map and the linked database for a final product this fall.

Earthquake Education
The Idaho Geological Survey conducted an annual Teachers field workshop in central Idaho in partnership with the Bureau of Disaster Services and the Idaho Earth Science Teachers Association. The workshop included seismicity of the Stanley basin-Sun Valley area, which has experienced MMI VI shaking from several historical events, and demonstrated some of the difficulties in assessing tectonic structures resulting from glaciation's obliterating surface features

The Idaho Geological Survey instituted a project to capture classroom activities generated from the teachers workshop. The project provided an inventory of all the classroom activities generated by previous workshop participants. Five participating teachers designed and developed exercises based on their field experiences. Results will be presented at the National Science Teachers Association annual meeting in Boise in October and is also planned for the National Geological Society of America meeting in Reno this November.

School Mitigation Projects
The state's Hazard Mitigation Grant Program used funds from recent disasters to fund three non-structural seismic mitigation projects for Idaho schools. In Coeur d'Alene, the school district facilities manager sold the program as overall safety rather than seismic, since the hazard is not universally accepted in this moderate-risk area For

instance, teachers and administrators were receptive to securing cabinets and library shelves because they knew that students and faculty were known to climb on them rather using step-stools

At the summer IGS teacher's field workshops, IBDS often presents a quick course in rapid visual screening for potential earthquake hazards based on the methodology described in ATC-21/FEMA 154 The objective is to provide awareness training for the school environment. A Twin Falls teacher took the methodology to the classroom and combined the data with an ESRI grant. Her students visited downtown and attempted to identify building types and then mapped them using ArcView. A Moscow teacher had his students identify nonstructural hazards in their high school During this exercise the students noted that an assigned evacuation route passed below a chimney they felt was of unreinforced masonry construction. Below the chimney was the main gas meter, and next to it the main electrical transformer. When this was brought to the attention of the school's administration, students were offered the opportunity to determine alternative routes

Project Impact
As part the City of Boise's Project Impact earthquakes task, Wiss Janney Elstner evaluated several city-owned buildings, including an unreinforced masonry fire station Using USGS hazard maps exclusively—despite recent demonstration of active faulting within 50 miles of the city—the report suggested minimal risk in the Boise area, leaving local building officials in an awkward defense of their more stringent building code.

Despite this disappointing engineering report, Boise has formed a Regional Earthquake Safety Committee, which is in the early stages of organization

Blaine County, Idaho's most recent Project Impact community, plans to assess schools for seismic safety and carry out any indicated retrofits, thus combining community benefits since schools also serve as emergency shelters

Landslide Mitigation
Idaho experienced continued landslide damage to transportation routes and urbanizing areas As a result of a recommendation made by the 1997 Governor's Landslide Taskforce, the Idaho Geological Survey designed a GIS landslide database, and is ready to populate it with data from other state and federal agencies. A pilot area was chosen in the Little Salmon River corridor an area heavily impacted by landslides in 1997 and 1998. This year the IGS is producing landslide information for county officials coping with shoreline development pressures around Lake Coeur d'Alene

Post-earthquake Clearinghouse
Both IBDS and IGS participated in WSSPC's Basin-and -Range subgroup looking to transfer the "California model" of clearinghouse operations to states with smaller and less-experienced response structures. In conjunction with these activities, IBDS assessed implementation of a clearinghouse operation as part of the revised state emergency plan and determined that it is consistent with state emergency response and can be implemented through procedure writing

Building Code Legislation
While adoption and implementation of building codes remain a local option, new legislation requires that, if a jurisdiction adopts a building code, it must be the same code and version adopted by the State, and that the jurisdiction's building inspectors must be certified by the State.

Submitted by Roy Breckenridge, Idaho Geological Survey and Stephen Weiser, Idaho Bureau of Disaster Services

MONTANA

Disaster and Emergency Services Division

Montana's Earthquake Program has been quite busy this year. In addition to regular program duties, several other important projects are underway. As you may already know, this year's fire season has consumed our agency's time and resources and little else is currently being addressed. However, we have managed some great accomplishments. Here is a listing of some of Montana's Earthquake Program highlights for 2000:

- **Hazard Assessment Steering Committee:**
  The first convening of the Hazard Assessment Steering Committee took place April 7. Definitions for the document were developed and a comprehensive outline was discussed and outlined. Due to the magnitude of the project, a Request for Proposal was put together and a successful candidate will help with the timeline, budget and scope of work necessary to complete this long term endeavor.

- **HAZUS**:
  We have used this program to run scenarios which have been used to develop exercises, determine training priorities, and provide insight to the legislature. We are currently attempting to gather the resources necessary to update to Level II and Level III data. This data will provide us with much more accurate scenarios.

  HAZUS will be a major component of the Hazard Assessment development process.

- **Newsletter**:
  Our newsletter continues to be an effective means of sharing information about emergency management with a wide array of individuals and organizations. If anyone would like to receive a copy, please contact our office and we will put you on our mailing list.

- **All-hazard educations**:
- The program manager is currently serving on the School Preparedness Resource Committee. Two current highlights include:
  - Created a brochure for dissemination regarding information about our group and how we can be of assistance.
  - Currently working on an All-Hazard Flip Chart which is at the printers and will be made available to all schools within the state. If you are interested in either, please contact our office.
- In addition, the program manager is serving on the Storm Ready Advisory Council for Montana. This is a great partnership with the National Weather Service and the benefits overlaps into many other areas of the program's responsibilities.

- **Earthquake Preparedness Month**:
  This is, by far, the Earthquake Program's most successful program. Last year's activities won WSSPCs Awards in Excellence for Outreach to the General Public. With continual support from the counties and increasing growth in the participation rate, earthquake risk awareness is on the rise in our state. Preparation for this year's event has started and will emulate last year's activities; however, we have some new things in the works. The "Earthquakes Rock" slogan will continue to be the theme for our campaign. Flyers and bookmarks will be disseminated once

again as they were a big success last year. A poster is being developed to reflect Montana's risk and we are working on All-hazard "Safety Spots". Finally, through MSU, PBS is doing a documentary on earthquakes in Montana and has asked me to participate. This should be a fun project and will be a great resource and fun avenue to educate our citizens.

Submitted by Monique Lay, Montana Disaster and Emergency Services Division.

MONTANA

Montana Bureau of Mines and Geology

In February 2000, the Montana Bureau of Mines and Geology completed work on the Hazard Grant Mitigation Program that the Montana Disaster and Emergency Services Division awarded in 1998. New products include 1) Montana's first permanent broadband seismograph (purchased, installed, and operated cooperatively with the US Geological Survey's National Seismic Network); 2) a new map showing Quaternary faults along with recent and historic earthquake epicenters in western Montana (prepared in cooperation with the US Geological Survey); 3) institutional membership in the Incorporated Research Institutions for Seismology (IRIS); 4) a new earthquake-hazard information pamphlet for general distribution; 5) a new traveling display that describes earthquake hazards in Montana and mitigation techniques; and 6) an uninterruptable power supply for the Earthquake Studies Office.

The new seismograph is housed in an underground vault 30 miles west of Bozeman and became operational on November 13, 1999. It is an extremely quiet site that yields excellent seismic records. The new fault map includes Quaternary fault data compiled by the US Geological Survey. An extensive database containing information about these faults is available on CD-ROM. The uninterruptable power supply was in place and operational during two significant power outages (the first lasted 36 hours) on the Montana Tech campus last spring.

The operation of the seismograph network was significantly enhanced in June 2000 with the addition of three new Earthworm nodes and a real-time database. New Earthworm nodes were installed (with assistance from the Confederated Salish and Kootenai Tribes and the USGS) in Ronan and Missoula, Montana, and also in Rexburg, Idaho. The Ronan node sends data from six seismograph stations operated by the Confederated Salish and Kootenai Tribes to the Earthquake Studies Office in Butte in real-time via the Internet. The Missoula node sends data received at the University of Montana from five stations in west central Montana and the Rexburg, Idaho node contributes data received at Rick College from three stations in eastern Idaho. All nodes perform various levels of local data analysis depending on the local institution's desires. The Earthworm system at the Earthquake Studies Office combines data from the twenty stations received in Butte, data from the three nodes, and data received from other networks operating in the surrounding region. Seismic events recorded by these stations are analyzed within two to three minutes of being received and are stored in an Oracle database connected to a web page. The web page is still under development but maps and seismograms may be viewed at URL: http://192.160.47.132/earthworm/. This web page also includes seismogram images for the most recent week from each of the 32 stations in the Montana seismograph network. Seismic data from the Montana network is also continuously fed to a separate computer operated as part of an NSF experiment (awarded to the University of Colorado Boulder, University of Oregon, and the University of Utah) to record and analyze seismic waves traversing beneath the Yellowstone Hotspot.

The northern Intermountain Seismic Belt remained seismically active. From August 1, 1999 through July 31, 2000, the Earthquake Studies Office located and cataloged 567 earthquakes of magnitude 1.5 or larger from western Montana and nearby parts of Wyoming, Idaho, and Canada. Residents reported thirty-two of these earthquakes as felt. The largest Montana earthquake in 25 years occurred on August 20, 1999 in the Red Rock Valley of extreme southwestern Montana. The Red Rock Valley earthquake measured 5.2 and was widely felt but caused no significant damage. A network of portable seismographs deployed in the epicentral area recorded a magnitude 4.0 aftershock along with hundreds of smaller events. A swarm of 181 earthquakes from March 21 though July 29, 2000 centered east of Townsend (between Bozeman

and Helena) included magnitude 4.0 earthquakes on April 8 and May 24. Residents living in the epicentral area reported feeling earthquakes as small as magnitude 1.9.

The results of research projects on western Montana seismicity were presented through talks and posters at the American Geophysical Union meeting in San Francisco in December 1999 and at the Rocky Mountain Section meeting of the Geological Society of America in Missoula, Montana in April 2000. An earthquake awareness program sponsored by Montana State University, Gallatin County Disaster and Emergency Services, and the Montana Bureau of Mines and Geology was presented in Bozeman last October, which is earthquake awareness month and the anniversary of the 1935 Helena earthquakes.

Submitted by Mike Stickney, Montana Bureau of Mines and Geology.

NEVADA

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 state agencies are the Nevada Division of Emergency Management, the Nevada Bureau of Mines and Geology, and the Nevada Seismological Laboratory. 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 and the Nevada Earthquake Risk Reduction Program of the Division of Emergency Management.

In the 1999-2000 fiscal year outstanding projects of the Nevada Earthquake Risk Reduction Program include 1) preparation of a booklet on earthquake hazards and risk reduction titled *Living with Earthquakes in Nevada*, 2) completion of the first draft of the *Nevada Earthquake Risk Mitigation Plan*, 3) preparation and wide distribution of the *Nevada Earthquake Safety Calendar, 2000*, and 4) state-agency functional exercise hosted by FEMA at Emmitsburg, Maryland based on the *Planning Scenario for a Major Earthquake in Western Nevada.*

Living with Earthquakes in Nevada is a 34-page, color booklet designed to inform Nevadans about the earthquake threat in the state, earthquake preparedness and mitigation measures, and a science background about earthquakes. The booklet uses *Putting Down Roots*, written for Southern California, as a core and tailors this for Nevada as well as updates it. Sections on what happens during a disastrous earthquake, eliminating nonstructural hazards, and avoiding earthquake-related fires were also added. The booklet is for sale from the Nevada Bureau of Mines and Geology for $3, and it is hoped to gain statewide distribution as a newspaper insert.

The *Nevada Earthquake Risk Mitigation Plan* sets forth a statewide policy in pursuit of an earthquake-resistant Nevada within the next 30 years. The plan addresses seven elements: Geosciences, Earthquake Awareness and Education, Land Use, Existing Buildings, Earthquake Preparedness, Earthquake Response, and Earthquake Recovery. There are 12 objectives distributed among these elements, and 31 strategies for achieving these objectives.

The *Nevada Earthquake Safety Calendar, 2000* was prepared using the winning posters from a statewide school contest with the theme "Get Your Kit Together." The calendar features guidelines for a 72-hr earthquake kit, emergency instructions for shutting off utilities, an earthquake safety crossword puzzle and wordsearch, home earthquake-safety tips, and information about nonstructural hazards. Also included are Web sites for earthquake safety and selected FEMA publications and videos. The calender was distributed to all schools in Nevada.

The Nevada Division of Emergency Management put together a functional exercise for state agencies hosted by FEMA and using a major earthquake disaster. The exercise was attended by 100 participants, including representatives from the governor's office and the directors and chiefs of many agencies. The exercise tested the operation and effectiveness of the state emergency operations center, policy-makers, many support functions, and the emergency management program EM-2000™.

Submitted by Craig M. dePolo and Jonathan G. Price, Nevada Bureau of Mines and Geology, and James L. Walker, Nevada Division of Emergency Management

NEW MEXICO

New Mexico Bureau of Mines and Mineral Resources
and
New Mexico Office of Emergency Management

According to seismologists Drs. Allan Sanford and Kuo-wan Lin, earthquake activity in New Mexico was low for the year through August 31, 2000. "Nearly all events with magnitudes greater or equal to 2.0 occurred in a 5,000 km^2 region surrounding Socorro in the central Rio Grande rift or in a small area ~45 km northwest of Carlsbad. The strong shocks in the Socorro area occurred during short-duration swarms at five different locations. The strong shocks northwest of Carlsbad are a continuation of a swam that commenced in January of 1997."

Dr Rick Aster reports that seismological research in New Mexico includes cooperation by several groups: (1) the New Mexico Tech Earthworm network consists of 18 stations in NM and data feeds from several other regional stations (see www.ees.nmt.edu/Eworm/eworm.html). The Earthworm system also sends continuous data streams to USGS-Golden. (2) A seismological network to monitor activity near the Waste Isolation Pilot Project (WIPP) in southeastern New Mexico. (3) The IRIS/PASSCAL (Incorporated Research Institutions for Seismology/Program for Array Seismic Studies of the Continental Lithosphere) instrument group in Socorro (http://passcal1.nmt.edu/index.html), which reached 12 full-time professional positions, supported 55 projects around the world last year (including 2 major broadband projects in New Mexico· Ristra, and CD-ROM). Ristra now has 55 stations operating continuously in New Mexico and nearby states (see www.ees.nmt.edu/Geop/Ristra/ristra.html) and is supporting two NMT graduate students Understanding the detailed structure of the earth's crust and upper mantle in the southern Rocky Mountains and adjacent Great Plains is the goal of Continental Dynamics-Rocky Mountain Project (www geo.utep.edu/CDROM) (4) Cooperation continues with the U.S. Geological Survey in Golden, Colorado, and the Albuquerque Seismological Laboratory (http://aslwww cr.usgs.gov).

With two arrays now operating in southeastern New Mexico, the New Mexico Tech seismologists recently recorded the pipeline explosion southeast of Carlsbad and received media attention (see www.ees nmt.edu/Geop/Pipeline/pipeline html for a few details).

Educational outreach included a completely new display of seismology at the New Mexico Museum of Natural History and Science, an updated display at the New Mexico Bureau of Mines & Mineral Resources Mineral Museum at New Mexico Institute of Mining and Technology, some teacher workshops, and additions to the Tremor web site(http //tremor nmt.edu). Several new maps and other publications are pending (see below)

At the DPS, Evonne Gantz was hired to help Susan Walker with the Earthquake Mitigation Program

Several seismological and paleoseismological studies are on-going or recently completed in New Mexico during the past year Information concerning some of this work is in the following reports

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McCalpin, J P. Olig, S. S., Harrison, J B. J., and Berger, G. W., in review, Paleoseismicity and soil formation in the past 55 ka on the County Dump Fault, Albuquerque, New Mexico: New MexicoBureau of Mines and Mineral Resources, Circular.

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Submitted by David Love, New Mexico Bureau of Mines and Geology

OREGON

Oregon Department of Geology and Mineral Industries
and
Oregon Office of Emergency Management

Earthquakes
The Department of Geology and Mineral Industries (DOGAMI) released Seismic Hazard Maps for 1) fifty small urban areas in Western Oregon, providing an inexpensive general hazard assessment for small communities that could not afford their own mapping program but were not large enough to justify a major state-funded mapping efforts, and 2) Eugene-Springfield. They also released Portland Metro Scenario Hazard Maps, which show the distribution of various accelerations from various scenario earthquakes, and an Earthquake-Induced Slope Instability of Salem Hills map. A seismic risk assessment for Klamath County was completed by DOGAMI. Three hazard maps (ground motion amplification, liquefaction potential, and earthquake-induced landslide/rockslide potential) were produced and used in the risk assessment. The 1993 Klamath Falls earthquake scenario, using HAZUS loss estimation methodology, would cause damage to about 3,500 buildings, with losses of about $36 million, and several injuries which are in the same magnitude as the reported damage and losses during the 1993 earthquake DOGAMI is characterizing crustal faults in northern Willamette Valley, concentrating on the Mt. Angel Fault, which is perhaps the best-known, and which may have been the source of the damaging 1993 Scotts Mills earthquake. The preliminary results show that the Mt. Angel Fault offsets near surface Pleistocene sediments at depth from 20 to 100 feet. DOGAMI has secured Benchmark status for geologic hazard characterization and risk reduction efforts in the state. The state prioritizes expenditure of public funds based in a general way on benchmarks, which are very broad performance measures that cross agency bounds.

Oregon Emergency Management (OEM) coordinated HAZUS training for local GIS specialists, emergency managers, and others The training was offered at Oregon State University. Schools and state agencies participated in the third annual OEM-coordinated State-wide April earthquake and tsunami drill OEM developed a web-site for non-structural earthquake hazard mitigation that includes a checklist and diagrams. The building that houses Oregon Emergency Management was seismically upgraded and expanded Two National Earthquake Technical Assistance Program proposals were funded, including ATC-21 (Pre Earthquake Rapid Visual Screening of Buildings) training for Marion County personnel and seismic surveys of eleven school buildings in Benton County. The U.S. Geological Survey in coordination with local counties, OEM, DOGAMI and the Oregon Department of Transportation, will soon complete a lifelines/earthquake hazards map for the southern Willamette Valley.

Negotiations continue to attract Showcase Status recognition to the state by the Institute of Business and Home Safety, a national consortium of firms and businesses interested in various means to reduce risk throughout the nation. Oregon hosted the Geological Society of America Penrose Conference: Cascadia Subduction Zone Earthquake Tricentennial in Seaside The conference brought scientists, policy makers, emergency managers, planners, and private citizens together to share the information on Cascadia subduction zone, earthquake history, hazard and risk, as well as policy to deal with the hazard and risk posed by the zone.

The Oregon Seismic Safety Policy Advisory Commission recently completed an Oregon Earthquake At-Risk document and drafted three legislative concepts, including mandatory earthquake drills for state

employees, structural seismic rehabilitation surveys of school buildings, and the identification and rehabilitation of fire stations and essential hospital buildings.

Tsunamis

Tsunami evacuation map brochures were developed for Clatsop and Douglas Counties and educational brochures for Nestucca Rural Fire Protection District (southern Tillamook County). NOAA tsunami brochures, tsunami hazard, evacuation, and site signs were purchased and distributed to coastal counties. School evacuation planning and evacuation route signing for schools in the tsunami inundation zone have occurred in Clatsop and Tillamook Counties. All of this information is being summarized in a GIS database. Oregon tsunami inundation mapping continues. Detailed computer modeling of inundation of the Coos Bay area is nearly done and the Gold Beach area is complete. Digital versions of the Senate Bill 379 inundation boundaries were edited and accomplished for the entire State coastline. An article outlining Cascadia fault dislocation modeling problems has been accepted for publication in the Science of Tsunami Hazards.

A workshop for coastal lodging facilities was held February, 2000 at the Inn at Spanish Head, Lincoln City, OR to assist lodging facilities located in high risk areas with their education and tsunami evacuation. This workshop consisted of 92 participants (including speakers) and gave the audience a chance to learn of the tsunami dangers and to also work with their emergency managers in learning how to develop an evacuation planning.

Submitted by Mark Darienzo, Oregon Office of Emergency Management, and Zhenming Wang Oregon Department of Geology and Mineral Industries

UTAH

Division of Comprehensive Emergency Management

HAZUS training was conducted in January 2000 in the Command Center at the Utah Division of Comprehensive Emergency Management (CEM) for 20 state and local government participants It was the first training on the latest version of HAZUS to be conducted in the country. The training was conducted by Ken Taylor, Earthquake Program Manager from North Carolina.

Changes in the HAZUS Coordination Group have resulted with the Salt Lake County Planning Department leaving and the addition of the University of Utah Seismic Stations (UUSS) and the Utah State Automated Geographic Reference Center (AGRC). AGRC will be the storage facility for HAZUS data. Efforts are currently underway to perform a level two analysis on Salt Lake City, a Project Impact Community and Salt Lake County. This project is being undertaken by a University of Utah Geography Graduate Student with the UUSS.

The EPICenter has provided funding to assist the Utah Geological Survey with their work on a microzonation study of Salt Lake County. The product of this study will be used in the HAZUS modeling for Salt Lake County.

The Schools Subcommittee of the Utah Seismic Safety Commission (USSC) for the second year sponsored the "Effective Drills and Safe Surroundings" certification for schools. In conjunction with the certification program, a Gubernatorial Proclamation was signed, designating April as "School Earthquake/Disaster Preparedness Month."

The EPICenter has provided training in developing emergency plans for schools and school districts This is a joint effort of the Schools Subcommittee of the USSC and the CEM Training Section The EPICenter traveled to five school districts to deliver training and two additional training sessions were conducted by the CEM Training Section at their new training facility.

The EPICenter continues to fund and support of the University of Utah Earthquake Education Services' "Earthquake in the Science Core Curriculum" Workshops and the UUSS traveling earthquake display. The Utah Museum of Natural History's interactive earthquake display should be open to the public sometime in October of this year. The EPICenter and the UUSS are also partners on this project.

The EPICenter, working with International Conference of Building Officials' Parapet Committee have created an information brochure on securing parapets as part of reroofing projects as required by an amendment to the Uniform Building Code. The target groups for the brochure are building owners, roofing contractors, engineers, and enforcement officials. Distribution of the brochure will be accomplished through association mailings and conferences.

Submitted by Bob Carey, Utah Division of Comprehensive Emergency Management, Utah EPICenter

UTAH

Utah Geological Survey

The Utah Geological Survey (UGS), with partial support from the U.S. Geological Survey (USGS) National Earthquake Hazards Reduction Program (NEHRP), is completing several major earthquake projects. Paleoseismic investigations with the Arizona Geological Survey, Southern Utah University, and Richard Stockton College of New Jersey on the Hurricane fault zone in southwestern Utah and northwestern Arizona are wrapping up. URS Greiner Woodward Clyde, in conjunction with the UGS and the University of Utah Seismograph Stations, is producing probabilistic and deterministic ground-shaking maps for the Salt Lake Valley. These maps will be used in another on-going NEHRP project to derive scenario maps of geologic effects of a surface-faulting earthquake in the Salt Lake Valley to estimate losses and plan emergency response. We revised and updated the UGS earthquake emergency response plan, and held a tabletop exercise to test it. A full-scale exercise is planned for next year.

Also with partial support from the USGS NEHRP, we are working with GEO-HAZ Consulting, Inc., to produce a folio of GIS earthquake-hazards maps (1:24,000-scale) for the Cache Valley area near Logan. The GIS techniques will also be used to produce earthquake-hazards maps for the St. George area of southwestern Utah. We have also nearly completed our update of Utah's Quaternary fault database to make it compatible with the USGS national database used to produce the national seismic-hazard maps.

Public-outreach efforts during this period concentrated on earthquake education. In partnerships with the Utah Division of Comprehensive Emergency Management (CEM), and the University of Utah Earthquake Education Services and Center for Integrated Science Education, the UGS participated in workshops to train earth-science teachers. The Association of Engineering Geologists held its 1999 annual meeting in Salt Lake City, and we helped organize a symposium on "Earthquake Hazards in Extensional Regimes" and led a field trip highlighting the Wasatch fault and general Wasatch Front earthquake hazards.

The UGS and CEM provide staff for the Utah Seismic Safety Commission (USSC), and the UGS heads the USSC Geoscience Committee. This year the UGS and USSC Geoscience Committee presented workshops on earthquake hazards to the Utah and Bonneville Sections of the International Conference of Building Officials, Utah Risk Management Mutual Association, and the Utah Chapter of the American Planning Association.

Submitted by Gary Christenson, Utah Geological Survey

WASHINGTON

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

The Earthquake Program continues to provide public education and mitigate against earthquakes through policies adopted by the Seismic Safety Subcommittee Examples of the Program's activities include the following accomplishments in Federal Fiscal Year 1999.

- Washington State highway bridges prone to damage from earthquakes continue to be retrofitted by the Washington State Department of Transportation. To date, approximately 26 9% of state-owned bridges have been completed.
- In the past year, the Washington Division of Geology and Earth Resources (DGER) completed GM-47, Geologic Folio of the Olympia-Lacey-Tumwater Urban Area, Washington: Liquefaction Susceptibility Map.
- April is designated "Disaster Preparedness Month". The theme of the campaign is "Prepare Because You Care". Local jurisdictions, state agencies, schools, businesses, and general public distribute materials. During April, a statewide earthquake "Drop, Cover and Hold" drill is conducted and over 1 5 million citizens participate.
- The Emergency Management Division Public Education Section developed a Comprehensive All Hazard Planning Guide and Model School Plan for Washington State Schools The guide provides direction and instruction for developing the model school plan
- EMD developed a partnership with the National Weather Service, Navy, Coastal Counties, Tribal Nations and private sector for 100% coverage of the Washington State Coast and shipping lanes with the NOAA Weather Radio
- DGER, in cooperation with the Oregon Graduate Institute, has prepared maps of expected tsunami inundation for a Cascadia Subduction Zone earthquake for the southern Washington coast Draft maps have been supplied to Grays Harbor and Pacific counties, with final publication expected this fall
- DGER in cooperation with the National Tsunami Hazard Mitigation Program developed a tsunami mitigation information program for the five Pacific states The program's newsletter, *TsuInfo Alert*, is sent to more than 300 subscribers
- As part of Washington's Tsunami Education Program, 30 tsunami interpretive signs were placed in coastal communities at locations of high visibility. A template similar to Oregon was used to keep the message consistent.
- EMD and DGER have participated in launching a series of Cascadia Region Earthquake Work Group (CREW) forums on post-earthquake business survival strategies.

Submitted by George Crawford, Washington Military Department Emergency Management Division and Tim Walsh, Washington State Department of Natural Resources, Division of Geology and Earth Resources

WYOMING

Wyoming State Geological Survey
and
Wyoming Emergency Management Agency

The last year has been productive for Wyoming's Earthquake, Project Impact, and State Hazard Mitigation Programs. An earthquake web page was finalized, two new publications were completed, HAZUS was modified, an earthquake video was initiated, digital landslide maps were readied for presentation in a 3D format, Teton County (Jackson Hole area) entered Project Impact, and mitigation funds were made available for retrofit of select mobile homes in a high hazard area. A summary of select accomplishments is presented below.

Earthquake Web Page
Wyoming's first earthquake web page was made operational in 1999. The web site was generated by the Wyoming State Geological Survey and their subcontractor, the Wyoming Water Resources Data System. The URL for the site is http://www.wrds.uwyo.edu/wrds/wsgs/hazards/quakes/quake.html. The site contains a searchable database and an interactive epicenter map of the State. The user specifies the timeframe of interest, and an epicenter map for the period is generated. Placing the mouse cursor over an epicenter results in a display of the earthquake date and time of occurrence, location in latitude and longitude, depth, source of information, and other related data. In addition, a complete data listing for the period of interest is presented below the map. Current press releases are accessible from the web page, as are links to interesting sites.

Earthquake Pamphlets
The Wyoming State Geological Survey (WSGS) completed two Information Pamphlets on earthquakes. WSGS Information Pamphlet 5, titled "How to Make Your Wyoming Home More Earthquake Resistant", contains detailed information and diagrams on projects a person can undertake to make their house, mobile home, or manufactured home more earthquake resistant. WSGS Information Pamphlet 6, titled "Earthquakes in Wyoming", is a brochure that contains information on causes of earthquakes, earthquake measurements, an abbreviated seismic history of Wyoming, a discussion on future earthquake potential, and guidelines on what to do during an earthquake. The information pamphlets, which are free of charge, have been widely distributed in Wyoming. Approximately 500 copies of Pamphlet 5 were distributed at an earthquake preparedness fair in Lincoln County, Wyoming.

HAZUS
The WSGS worked with Risk Management Solutions, DTI, Inc., and the National Institute of Building Sciences to correct problems in the application of HAZUS to Wyoming. The census tract grid approach did not work well in Wyoming due to the small population in some areas. A new base grid was developed by the WSGS, which contains cells as small as a square mile in population centers and near exposed active faults. In other relatively unpopulated areas of the State, 7.5-minute Quadrangles were used as the grid cells. This approach allows for the more accurate modeling of damage in the near vicinity of known seismic hazards.

Wyoming's All-Hazard Mitigation Plan
The Wyoming Emergency Management Agency and their contractor organized a series of meetings for State and Federal agencies in Wyoming in order to update and reformat the State's All-Hazard Mitigation Plan. Hazard summaries and recommended mitigation activities were revised for floods, earthquakes,

landslides, dams, tornadoes, fires in the wildland/urban interface, hazardous materials, winter storms, hail, high winds, lightning, and drought

Project Impact
The Wyoming State Geological Survey (WSGS) and the Wyoming Emergency Management Agency worked with Teton County, the Town of Jackson, and the Red Cross to finish the Teton County application for Project Impact. The WSGS also worked with the Teton County Fire Department, the Town of Jackson, the Teton County Emergency Management Coordinator, and the Red Cross on designating potential earthquake-resistant emergency shelters. Teton County was accepted as the year 2000 Project Impact community, and a coordinator was hired. Previously, Fremont and Natrona Counties were accepted into Project Impact, and have developed successful programs and projects.

Earth Science Week
The Wyoming State Geological Survey organized school tours and lectures for Earth Science Week and gave hazards presentations to five school groups. Approximately 205 students and 13 teachers attended Pertinent press releases on hazards were submitted to the media during the week.

Earthquake Video
The Wyoming State Geological Survey received funding through the Earthquake Program to generate a video on Earthquakes in Wyoming. The video will cover topics such as what is an earthquake, what earthquakes have occurred in Wyoming, what is the future earthquake potential in Wyoming, what can be done to make a dwelling more earthquake resistant, and what should be done during and after an earthquake Filming of the video will begin during the week of the WSSPC annual meeting

3D Interactive Maps
The Wyoming State Geological Survey and their contractor, the Water Resources Data System, digitized all landslide maps of Teton County and began generating 3D representations of all 7.5-minute Quadrangles in the County The 3D representations are generated by combining digital elevation models with digital orthophoto quadrangles, and serving the images through the internet. Landslides will be superimposed on the 3D images The images can be viewed from all angles and magnifications, and supplied software will allow the viewer to "fly" through the image. These images should be useful tools to first responders to disasters.

Mobile/Manufactured Home Retrofit
WEMA organized an Application Review and Proposal Selection Committee to distribute Wyoming disaster funds from FEMA. The Wyoming Energy Council was funded to retrofit a limited number of mobile homes in the Star Valley (western Wyoming). The WSGS has been coordinating with the Wyoming Energy Council on a monthly or weekly basis Relatively new engineered tie-down systems are being used to stabilize the homes, seismic gas shut-off valves are being installed, and water heaters are being stabilized

Submitted by Jim Case, Wyoming State Geological Survey

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United States Geological Survey

Earthquake Hazards Program

http://earthquake.usgs.gov/about_us.html

Mission Statement

To provide and apply relevant earthquake science Centers and knowledge for reducing deaths, injuries, and property damage from earthquakes through understanding of their characteristics and effects and by providing the Centers and knowledge needed to mitigate these losses.

The USGS Earthquake Hazards Program (EHP) of the U.S. Geological Survey (USGS) is part of the National Earthquake Hazards Reduction Program (NEHRP) lead by the Federal Emergency Management Agency (FEMA).

The USGS role in NEHRP is to provide Earth sciences Centers and products for earthquake loss reduction. The goals of the USGS' EHP are:

1). Improve earthquake hazard identification and risk assessment methods and their use;
2). Maintain and improve comprehensive earthquake monitoring in the United States with focus on "real-time" systems in urban areas
3). Improve the understanding of earthquakes occurrence and their effects and consequences.

The USGS's EHP also supports an External Research Program, which funds external cooperators and awards external grants through a competitive, peer-reviewed proposal process. Participants in the Earthquake ERP include State and local government, the academic community, and the private sector. Priorities for both the internal and external programs are guided by the Earthquake Hazards Program's Five Year Plan (1998-2002).

Cascadia Region Earthquake Workgroup

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www.crew.org

The Cascadia Region Earthquake Workgroup (CREW) is a coalition of private and public representatives working together to improve the ability of Cascadia Region communities to reduce the effects of earthquake events.

Goals

- Promote efforts to reduce the loss of life and property.
- Conduct education efforts to motivate key decision makers to reduce risks associated with earthquakes.
- Foster productive linkages between scientists, critical infrastructure providers, businesses and governmental agencies in order to improve the viability of communites after an earthquake event.

In less than 50 years, a number of great Cascadia-like earthquakes have occurred around the Pacific Rim, including Chile (1960), Alaska, (1964) and Mexico (1985). A unique aspect of a great Cascadia earthquake is the strong likelihood that the three greater metropolitan areas of Portland, Seattle, and Vancouver will simultaneously feel the effects of strong and sustained ground shaking. This wide-spread ground shaking combined with accompanying elevation changes and the likely generation of a tsunami along the Pacific coast, will cause loss of life, property damage, and business interruption in vulnerable locations through out southwestern British Columbia, Washington, Oregon, and northwestern California. The broad geographic distribution of damaging impacts will generate special challenges and severely stress the response and recovery resources of the three Pacific states and British Columbia.

The regional exposure of people and property to earthquake hazards in the Pacific Northwest and southwestern British Columbia has continued to expand over the past century. In just the period of 1980 to 1990, the population in the state of Washington increased by nearly 20% (US Census). This increased exposure is reflected in dense urbanization along the I5 corridor and in southwestern British Columbia, the development of forestry and fishery industries along the coast, and the continued expansion of Pacific Rim trade involving Ports like Vancouver, Seattle, Tacoma, and Portland.

CREW Staff

Rob Johnson, Executive Director

CREW Board of Directors

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The Northeast States Emergency Consortium (NESEC) is a not-for-profit natural hazard mitigation and emergency management organization, located in Wakefield, Massachusetts. NESEC is the only multi-hazard consortium of its kind in the country and is supported and funded by the Federal Emergency Management Agency (FEMA).

The states of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont form the consortium. NESEC has a full-time Executive Director and Assistant. It is governed by a Board of Directors. The Board is comprised of the Directors of the State Emergency Management Agencies from the six New England States and the States of New York and New Jersey. At NESEC, ingenuity and cooperation have fostered unique disaster prevention partnerships with federal, state and local governments, as well as the private sector. The Power of Prevention Grant Program applies varying amounts of seed money to spur community-based disaster prevention projects. In the past two years, NESEC has funded 13 communities in the Northeast. The purpose of these grants was to help communities put in place measures that will prevent or reduce damage to homes, businesses, and families, should a disaster occur.

NESEC has also made an effort to help protect children in school from the effects of weather-related emergencies and natural disasters. NESEC has developed an innovative program to provide NOAA Tone Alert Weather Radios to the 1200 school districts across New England at not cost. With the help of our corporate sponsors, weather radios have been installed in nearly 600 schools throughout the Northeast.

NESEC has also used computer technology to help reduce the impact of natural Disasters in the Northeast. HAZUS ™ is a computer program that uses geographic information system (GIS) software to estimate losses due to earthquakes. HAZUS ™ is funded by the Federal Emergency Management Agency through a Cooperative Agreement with the National Institute of Building Sciences. Many federal, state and local governments including NESEC use HAZUS ™ to analyze the type of damage that may occur in an area due to earthquakes. With this information we are able to reduce the impacts of earthquakes through mitigation and emergency preparedness planning. HAZUS ™ is being expanded to include hurricanes, flooding, tornadoes and wind analysis.

Preparing for the inevitable natural disaster is a responsibility we all share. And whether it's providing weather radios to protect school children or grants to make communities safer, NESEC is always striving to make communities and people in the Northeast safer from natural disasters.

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Central United States Earthquake Consortium

Information on following pages

The Central US Earthquake Consortium, CUSEC

Working in Partnership to Address the Seismic Hazard in the Central US

Disaster Resistant Community Projects

Clay County, Arkansas, West Memphis, Arkansas, and Ballard County, Kentucky have initiated mitigation projects through the state emergency management agencies and CUSEC'S Disaster Resistant Community (DRC) initiative. The DRC initiative is a stepping-stone toward applying for Project Impact status through FEMA. CUSEC works with state earthquake program managers, state hazard mitigation officers and citizens in small communities to help them identify manageable mitigation projects that can be completed inexpensively, with local input and labor.

Working with the state Department of Emergency Management, Clay County sought and received funded Project Impact Status, the first rural community brought into the program. Piggott Hospital, the only hospital in the county, was selected for a non-structural hazard mitigation project. Assessment of the hospital environment was completed in August 1999, with mitigation completed in early 2000. Several projects are ongoing: structural retrofit of schools in the small communities of Corning, Rector, and Piggott, installation of gas shutoff valves in selected schools, and structural retrofit to the City Hall in Corning.

Ballard County, Kentucky initiated a nonstructural mitigation project in the preschool and elementary school in Wickliffe. Gas shutoff valves are scheduled to be installed at the lower schools, as well as the middle and high schools. Safety film will be installed on windows in all schools.

In addition to the mitigation projects, a Level 3 HAZUS evaluation will be conducted and a community preparedness plan will be developed. Recently the county has received unfunded Project Impact status.
West Memphis, Arkansas is the most recent community to become involved in the DRC initiative. A local disaster preparedness council has been formed and potential mitigation projects are in the process of being identified.

Central U.S. Partnership (CUSP) Inaugural Meeting

The first meeting CUSP meeting was held at Kentucky Dam State Resort Park May 23-24, 2000. The highly interactive meeting provided current and prospective partners the opportunity to define their various roles in the organization and to begin to devise the long-term strategic plan that will be the foundation for programs that will ultimately contribute to community sustainability the Central U.S.

CUSEC State Transportation Task Force

Representatives from state departments of transportation in Arkansas, Mississippi, Tennessee, Indiana, Illinois, Kentucky and Missouri met in Memphis on June 28-29 to discuss common transportation issues related to the earthquake threat from the New Madrid and Wabash Valley seismic zones. The meeting resulted in the formation of a new organization to coordinate planning and response to a major earthquake. This will provide a regional framework not only for post-earthquake issues, but also for ongoing and future mitigation projects for roadways and bridges in the Central U.S. An MOU was drafted and will be submitted to representatives for review before being signed. The creation of the task force will foster a greater interaction among end-user groups with the CUSEC State Geologists, and other institutions associated with earthquake risk in the Central U.S.

NEW CUSEC Web Page

A more colorful, updated, and informative CUSEC web page will go on line in July. New features include a monthly calendar of events and meetings, an on-line library of CUSEC Journals, expanded products list, and more information about the role of CUSEC in earthquake hazard mitigation activities in the Central U.S. Check us out at: www.cusec.org .

CUSEC Journal, Fall 2000

Much of the research done on the effects of earthquakes in the Central U.S. has focused on urban areas. But approximately 50 percent of the region is suburban, non-urban, or rural. With most state and federal resources directed to urban areas immediately following a major earthquake, a significant number of people could be without outside help for a considerable time. The fall CUSEC Journal will look at the issues these non-urban areas face post-earthquake, drawing from the experiences of small communities in California and Washington, and from northwestern Mississippi following a devastating ice storm in 1994.

Millennial Appointments

Jim Wilkinson, former mitigation specialist at CUSEC, was appointed Executive Director in December 1999. Peggy Young, former Administrative Officer was promoted to Associate Director in December of 1999. Jill Stevens Johnston was hired as the new Mitigation Program Coordinator in March 2000 and Kerri Hall, was hired to fill the vacancy as Executive Secretary in May 2000. As CUSEC moves into the 21st century, they and the rest of the CUSEC staff, Board of Directors, and partnership will continue to cultivate and expand the culture of community sustainability in the Central U.S.

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