

THE NATIONAL ACADEMIES
DIVISION ON EARTH AND LIFE STUDIES
BOARD ON EARTH SCIENCES AND RESOURCES
COMMITTEE ON SEISMOLOGY AND GEODYNAMICS

Committee on the
Economic Benefits of Improved Seismic Monitoring

Award Number 03HQGR0114

Final Technical Report
July 1, 2003 to June 30, 2005

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Funding for the study on the *Economic Benefits of Improved Seismic Monitoring* was received from the U.S. Geological Survey in July, 2003. A call for nominations for the study committee was widely distributed, and the following committee was appointed in August, 2003:

Chris D. Poland (Chair), Degenkolb Engineers, San Francisco
James Ament, State Farm Fire and Casualty Co.
David S. Brookshire, University of New Mexico
James D. Goltz, California Governor's Office of Emergency Services
Peter Gordon, University of Southern California
Stephanie A. King, Weidlinger Associates, Inc.
Howard Kunreuther, University of Pennsylvania
Stuart Nishenko, Pacific Gas and Electric
Adam Z. Rose, The Pennsylvania State University
Hope A. Seligson, ABS Consulting
Paul G. Somerville, URS Corporation Inc.

Liaison from the Committee on Seismology and Geodynamics: **Terry C. Wallace**,
University of California (Los Alamos National Laboratory)

This committee was charged to address the following statement of task:

“An NRC ad hoc committee will provide advice regarding the economic benefits of improved seismic monitoring, with particular attention to the benefits that could derive from implementation of the Advanced National Seismic System (ANSS). In particular, the committee will:

- Review the nature of losses caused by earthquakes.
- Examine how improved information from seismic monitoring systems could reduce future losses in a cost-effective manner, taking into consideration the major impact-

reduction approaches (for example, hazard assessment, building codes and practices, warning systems, rapid response, and insurance).

- Assess the capabilities for loss reduction provided by existing seismic monitoring networks, and identify how the ANSS and any other new monitoring systems would improve these capabilities.
- Describe concepts and methods for assessing avoided costs (both direct and indirect) that would result from improved seismic monitoring.
- To the extent possible, provide an estimate of the potential benefits that might be realized from full deployment of the ANSS.”

The committee first assembled in October 2003 in Washington, D.C., to carry out committee establishment procedures and to receive briefings from USGS sponsors, other federal agency personnel (including the NEHRP partner agencies), and DC-based interested parties. Time was also put aside for the committee to commence their closed session deliberations (see attached agendas). The second meeting was held in San Francisco, Calif., in December 2003 to receive a series of briefings from federal, state, and local agency personnel as well as private industry experts with west coast perspectives on seismic monitoring benefits. During closed session committee deliberations, as the components of the committee’s final report were being considered, there were indications that the complexity of the statement of task would mean that the accelerated timeline originally envisioned was unlikely to be realistic. The third meeting was held in January, 2004 in St Louis, Mo., to receive briefings on the characteristics and economic benefits of mid-continent seismic networks. Initial drafts of report chapters were considered and agreement reached on modifications that would be required. The final committee meeting was held in March 2004 back in Washington, D.C. Additional briefings that had not been able to be presented at earlier meetings were presented, but most of the time was spent addressing a number of challenging issues that had become apparent as the report was being drafted. The report was completed and sent for external review in February 2005. Once reviewer comments had been addressed, the committee’s report, entitled *Improved Seismic Monitoring—Improved Decision-Making: Assessing the Value of Reduced Uncertainty*, was released and delivered to the sponsor in prepublication format in June, 2005. The report was copy-edited and printed, and the final printed reports were distributed during January, 2006.

One of the characteristics of many NRC committees is that they consist of experts from more than a single discipline. In this case, committee members were drawn from a particularly broad range of disciplinary areas—earthquake engineering, earthquake seismology, loss estimation economics, economic aspects of urban planning, insurance, and emergency management. During the course of the committee deliberations and report compilation, this diversity of disciplinary background inevitably required extensive discussion and explanation of concepts that seemed relatively simple to a particular component of the committee. In hindsight, it is possible to see that the original accelerated committee timeline was too optimistic even without the need for substantial additional deliberation and interaction produced by this disciplinary diversity.

The report emphasized that the potential benefits of improved seismic monitoring far exceed the costs—the annual dollar costs for improved seismic monitoring are in the tens of millions, whereas the potential dollar benefits are in the hundreds of millions. Additional key findings presented in the report are:

- Seismic monitoring provides the key to understanding how the built environment responds to significant earthquakes, and improved records offer the potential for fine-

tuning the design process so that seismic safety requirements are adequately—but not excessively—met.

- In just one benefit area, performance-based engineering, dollar estimates for benefits are estimated at \$142 million annually—about three times the cost of operating the full ANSS.
- In the area of loss estimation modeling, improved monitoring information will greatly reduce uncertainty, potentially decreasing the cost of insurance and reinsurance.
- Improved seismic monitoring can significantly increase the accuracy of tsunami warnings and reduce the risk of missed warnings or costly false alarms, which constitute 75% of the warnings issued since 1948.
- The U.S. should rank seismic risk reduction as highly as other critical national programs, should track the growth of risk nationally, and should make the necessary long-term investments to reduce it.
- Full deployment of ANSS offers the potential to substantially reduce earthquake losses and their consequences, whereas existing funding levels are insufficient to even maintain present capabilities.

Board on Earth Sciences and Resources
Committee on Seismology and Geodynamics
ECONOMIC BENEFITS OF IMPROVED SEISMIC MONITORING

The National Academies Keck Center, Room 110
500 Fifth Street, N.W.
Washington, D.C. 20001

October 14-15, 2003

AGENDA

Tuesday, October 14th, 2003

CLOSED SESSION

8.00 a.m. - 12.15 p.m.

OPEN SESSION

12.15-1.15 Lunch

- | | | |
|-----------------|--|---|
| 1.15 | Welcome and Introductions | <i>Chris Poland
Committee Chair</i> |
| 1.30 | Significance and Potential Impacts of this Study | <i>Linda Gundersen
USGS - GD</i> |
| 1.40 | Charge to the Committee | <i>John Filson
USGS - GD</i> |
| 1.50 | USGS Seismic Monitoring and the Advanced National Seismic System | <i>William Leith
USGS - GD</i> |
| 2.30 | Comments on Seismic Monitoring from House Committee on Science | <i>Dan Byers
House Committee on Science</i> |
| 3.00-3.30 Break | | |
| 3.30 | ANSS, EarthScope and IRIS: Plans and Opportunities for Collaboration | <i>David Simpson
IRIS</i> |
| 4.00 | ANSS and NEHRP - the NSF/ENG Perspective | <i>Steven McCabe
NSF-ENG</i> |
| 4.30 | ANSS, NEHRP, and ES - the NSF/GEO perspective | <i>Kaye Shedlock
NSF-GEO</i> |
| 5.00 | Miscellaneous 'off-the-wall' comments | <i>Priscilla Nelson
NSF-ENG</i> |
| 5.30 | Adjourn | |

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500 Fifth Street, N.W.
Washington, D.C. 20001

October 14-15, 2003

AGENDA

Wednesday, October 15th, 2003

OPEN SESSION

- | | | |
|-------------|--|---|
| 8.30 a.m. | Welcome and Introductions | <i>Chris Poland</i> |
| 8.45 | Seismic Monitoring and OSTP's Subcommittee on
Disaster Reduction | <i>Gene Whitney
OSTP</i> |
| 9.15 | Seismic Monitoring from the NIST / ICSSC Perspective | <i>Stephen Cauffman
NIST</i> |
| 9.45-10.15 | Break | |
| 10.15 | Benefits of Improved Seismic Monitoring to State and
Local Emergency Managers | <i>Michael Mahoney
FEMA</i> |
| 10.45 | Assessing Federal Research and Development for Hazard
Loss Reduction | <i>Charles Meade
RAND</i> |
| 11.15 | Seismic Monitoring and Congress - the social
and scientific imperatives | <i>Steven Bohlen
Joint Oceanographic Institutions</i> |
| 11.45-12.45 | Lunch | |

CLOSED SESSION

1.15 p.m. - 5.00 p.m.

Board on Earth Sciences and Resources
Committee on Seismology and Geodynamics

ECONOMIC BENEFITS OF IMPROVED SEISMIC MONITORING

Argonaut Hotel, Golden Gate C Meeting Room
495 Jefferson Street at Hyde
Fisherman's Wharf,
San Francisco, CA 94109

December 15-16, 2003

AGENDA

Monday, December 15th, 2003

CLOSED SESSION

8.00 a.m. - 10.15 a.m.

OPEN SESSION

10.15-10.45 Break

10.45 Welcome and Introductions *Chris Poland
Committee Chair*

11.00 Expectations and Importance of ANSS Committee Findings
to the USGS *Pat Leahy
USGS - Reston*

11.30 Role of the Advanced National Seismic System in Basic
and Applied Research for Earthquake Loss Reduction *Bill Ellsworth
USGS – Menlo Park*

12.00 The OMB Perspective on Seismic Monitoring and
Economic Benefit Analysis *Jason Freihage
Office of Management and Budget*

12.30-1.30 Lunch

1.30 ANSS and Earthquake Engineering *Woody Savage (given by Bill Ellsworth)
USGS – Menlo Park*

2.00 Use of ANSS Data in Improving Earthquake Ground
Motion Maps and Building Codes *E.V. Leyendecker
USGS – Colorado*

2.30 Quantitative Policy Analysis at USGS *Richard Bernknopf
USGS – Menlo Park*

3.00-3.30 Break

- 3.30 Uses of modern seismic networks: The TriNet experience in southern California *Lucy Jones
USGS – Pasadena*
- 4.00 GSA's Seismic Instrumentation Program *Bela Palfalvi
GSA Region 9*
- 4.30 Short Term and Long Term Benefits of Seismic Monitoring in California *Darryl Young
CA Dept of Conservation*
- 5.00 The California Integrated Seismic Network: Benefits to Emergency Response and Recovery *Rich Eisner
CA Office of Emergency Services*
- 5.30 Adjourn
- 5.30-6.30 Open Reception

Board on Earth Sciences and Resources
Committee on Seismology and Geodynamics

ECONOMIC BENEFITS OF IMPROVED SEISMIC MONITORING

Argonaut Hotel, Golden Gate C Meeting Room
495 Jefferson Street at Hyde
Fisherman's Wharf,
San Francisco, CA 94109
December 15-16, 2003

AGENDA

Tuesday, December 16th, 2003

OPEN SESSION

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| 8.30 a.m. | Welcome and Introductions | <i>Chris Poland</i> |
| 8.45 | Benefits of Improved Seismic Monitoring
for Highway Transportation | <i>Cliff Roblee
CA Dept. of Transportation</i> |
| 9.15 | Using Seismic Monitoring to support Post-Earthquake
Building Inspection | <i>Zan Turner
City and County of San Francisco</i> |
| 9.45-10.15 | Break | |
| 10.15 | Practical benefits of real time seismic monitoring for
a university campus [Cancelled because of Illness] | <i>Craig Comartin
Comartin-Reis</i> |
| 10.45 | The role of privately owned seismic monitoring networks | <i>Lloyd Cluff
PG&E</i> |
| 11.15 | Linking Seismic Monitoring and Public Decision-making | <i>Bruce Clark
Leighton & Associates</i> |
| 11.45 | Benefits of Dense Instrumentation for Development
of Performance-based Design [No-show] | <i>Ronald Hamburger
Simpson Gumpertz & Heger</i> |
| 12.15-1.15 | Lunch | |

CLOSED SESSION

1.15 p.m. - 5.00 p.m.

Board on Earth Sciences and Resources
Committee on Seismology and Geodynamics
ECONOMIC BENEFITS OF IMPROVED SEISMIC MONITORING
Hyatt Regency Hotel, Missouri Pacific Meeting Room
One St. Louis Union Station
St Louis, MO 63103
January 19-20, 2004

AGENDA

Monday, January 19th, 2004

CLOSED SESSION

8.00 a.m. - 12.00 p.m.

OPEN SESSION

12.00-1.00 Lunch in the Frisco Room

1.00 Economic Value of Existing and Planned Mid-continent Seismic Networks *Mitch Withers*
University of Memphis-CERI

1.30 ANSS and Mid-America -- A perspective *Robert Herrmann*
Saint Louis University

2.00 Seismic Monitoring and Seismic Engineering in the Central US *Richard Howe*
Consultant

2.30-3.00 Open Discussion with Speakers

3.00-3.30 Break

CLOSED SESSION

3.30 p.m. - 5.30 p.m.

Tuesday, January 20th, 2004

CLOSED SESSION

8.00 a.m. - 5.00 p.m.

Board on Earth Sciences and Resources
Committee on Seismology and Geodynamics
ECONOMIC BENEFITS OF IMPROVED SEISMIC MONITORING
The National Academies Keck Center, Room 201
500 Fifth Street, N.W.
Washington, D.C. 20001
March 8 – 9, 2004

AGENDA

Monday, March 8, 2004

CLOSED SESSION

8.00 a.m. - 12.00 p.m.

OPEN SESSION

12.00-1.00 Lunch

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| 1.00 | Welcome and Introductions | <i>Chris Poland
Committee Chair</i> |
| 1.10 | Value of Improved Seismic Monitoring - A Humanitarian Agency View | <i>Doug Sandy
American Red Cross</i> |
| 1.40 | Are we there yet? Potholes along the road of usefulness of earthquake information in mitigation and response decisions | <i>Craig Weaver
USGS-Seattle</i> |
| 2.10 | Open Discussion | |

2.30-3.00 Break

CLOSED SESSION

3.00 p.m. - 5.30 p.m.

Tuesday, March 9, 2004

CLOSED SESSION

8.00 a.m. - 4.30 p.m.