Alaska Seismic Hazards Safety Commission

Report to the Governor and State Legislature

April 18, 2006

100th Anniversary of the Great San Francisco Earthquake

A success story in pre-earthquake engineering, the Trans-Alaska Pipeline is shown here at the Denali fault crossing five days after the November 3, 2002, earthquake. The fault slipped 18 feet at this location. The Richardson Highway was offset (upper left), but the pipeline, designed and constructed to accommodate surface offset on the Denali fault, sustained little damage. No oil was spilled and operation of the pipeline resumed within a few days after the earthquake. *Photo by Gary Carver.*

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EXECUTIVE SUMMARY

This first report to the Governor and Legislature from the Alaska Seismic Hazards Safety Commission identifies priority issues and goals the Commission proposes to address following passage of House Bill 83, which will extend its life beyond the current sunset year. The report begins with a history and status of the Commission, an identification of current membership, and a description of the earthquake risk in Alaska. This initial discussion reinforces the need for the Commission to address seismic risk mitigation activities.

The report recommends five issues to be initially addressed by the Commission membership:

1. Assessing the structural stability of critical facilities, with public schools being a particular concern
2. Address the importance of earthquake insurance
3. Approaches to seismic risk mitigation in future building construction
4. Response and recovery practices to mitigate future seismic risk
5. Hazard identification and public education

We recommend that the basic public-policy goals of the Commission with regard to seismic risk mitigation be:

1. Education
2. Guidance
3. Assistance
4. Implementation

The issues and goals are described more fully in subsequent paragraphs.

INTRODUCTION

The Alaska Seismic Hazards Safety Commission ("the Commission") is charged by statute (AS 44.19.635) to recommend goals and priorities for seismic hazard mitigation to the public and private sectors; recommend policies to the governor and the legislature, including needed research, mapping, and monitoring programs; review the practices for recovery and reconstruction after a major earthquake; recommend improvements to mitigate losses from similar future events; and to gather, analyze, and disseminate information of general interest on seismic hazard mitigation, among other duties, to reduce the state's vulnerability to earthquakes. The Commission consists of nine members appointed by the Governor from the public and private sectors for three-year terms. It is administered by the Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGS).

Commission members include: A representative from the University of Alaska, a representative from local government; a representative from the Department of Natural Resources; a representative of the Department of Military and Veterans Affairs; a representative from an appropriate federal agency; a representative of the insurance industry; and three members of the public who are experts in the fields

of geology, seismology, hydrology, geotechnical engineering, structural engineering, emergency services, or planning. Six members constitute a quorum. The Commission membership elects its own chair and vice-chair. There is no executive director, although DGGS provides administrative, travel, and publication support.

History and status of the Commission

In 2002, the 22nd Alaska Legislature passed, and the Governor signed into law, House Bill 53 establishing the Alaska Seismic Hazards Safety Commission. The legislation originally placed the Commission in the Office of the Governor, but in January 2003, Governor Murkowski issued Executive Order Number 105 transferring the Commission to the Department of Natural Resources. Governor Murkowski appointed eight members to the Commission in May 2005 and the ninth member in October 2005. However, under AS 44.66.010(a)(21), the Commission was scheduled to terminate on June 30, 2005. Consequently, the Commission is currently in its wind-down year to conclude its business.

In 2005, the House of Representatives passed House Bill 83 (HB 83) to extend the Commission to June 30, 2008, add tsunami risks to its purview, and provide two additional Commission members representing local government. HB83 was transferred to the Senate, where it was referred to the State Affairs Committee. The first session of the 24th Legislature concluded with no further action on the bill. Early in the second session, the State Affairs Committee approved the bill with amendments, which included extending the Commission to June 30, 2012. As of the drafting of this report, HB 83 was awaiting hearing in the Senate Finance Committee.

The Commission first met on October 28, 2005, at which time it elected a Chair and Vice Chair, listened to briefings from the California Seismic Safety Commission and various state and local agencies in Alaska with responsibilities in earthquake-risk mitigation, and began developing goals and priorities for its activities in the wind-down year. The Commission met again on November 29, 2005, and February 17, 2006, to hear additional briefings, refine its short-term goals, and begin developing this report. Additional brief teleconference meetings have taken place on January 10, March 29, and April 11, 2006. Because the Commission is in its wind-down year, it is not pursuing any initiatives to develop

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specific recommendations for earthquake-risk mitigation policy. Rather, it is developing recommendations and rationale for the seismic-safety issues it intends to address upon passage of HB 83 and extension of the Commission past June 30, 2006, the end of its wind-down year. These issues are discussed in this report. The Commission has developed a Web site where it posts basic information about its mission, earthquake risk in Alaska, meeting agendas, minutes, and appropriate links. The Web site address is: http://www.dggs.dnr.state.ak.us/seismic_hazards_safety_commission.htm.

EARTHQUAKE RISK IN ALASKA

Scientists have long recognized that Alaska has more earthquakes than any other region of the United States and is, in fact, one of the most seismically active areas of the world. The second largest earthquake ever recorded shook the heart of southern Alaska on March 27th, 1964, with a magnitude of 9.2 (figs. 1, 2, and 3). The 1964 earthquake was slightly larger than the magnitude 9.0 Sumatra-Andaman Islands earthquake that devastated northern Sumatra in December 2004 and generated a tsunami that killed more than 280,000 people. The largest on-land earthquake in North America in almost 150 years occurred on the Denali fault in central Alaska on November 3, 2002 (fig. 4).

Some additional earthquake statistics for Alaska

- Eleven percent of the world's recorded earthquakes have occurred in Alaska (fig. 5).
- Alaska has more frequent earthquakes than the rest of the United States combined.
- Three of the eight largest earthquakes in the world were in Alaska.
- Seven of the ten largest earthquakes in the United States were in Alaska.

Since 1900, Alaska has had an average of:

- One "great" earthquake (magnitude 8) or larger earthquake every 13 years
- One magnitude 7 to 8 earthquake every year.
- Six magnitude 6 to 7 earthquakes per year.
- Forty-five magnitude 5 to 6 earthquakes per year.
- Three hundred twenty magnitude 4 to 5 earthquakes per year.
- One thousand earthquakes in Alaska each month.

Figure 1. Destruction of homes in the Turnagain Heights subdivision of Anchorage during the 1964 earthquake.

Figure 2. Collapse of the newly completed Four Seasons Apartment Building in Anchorage during the 1964 earthquake.

Figure 3. Tsunami damage in Kodiak resulting from the 1964 earthquake.

Figure 4. Highway damage along the Tok Cutoff during the magnitude 7.9 2002 Denali fault earthquake.

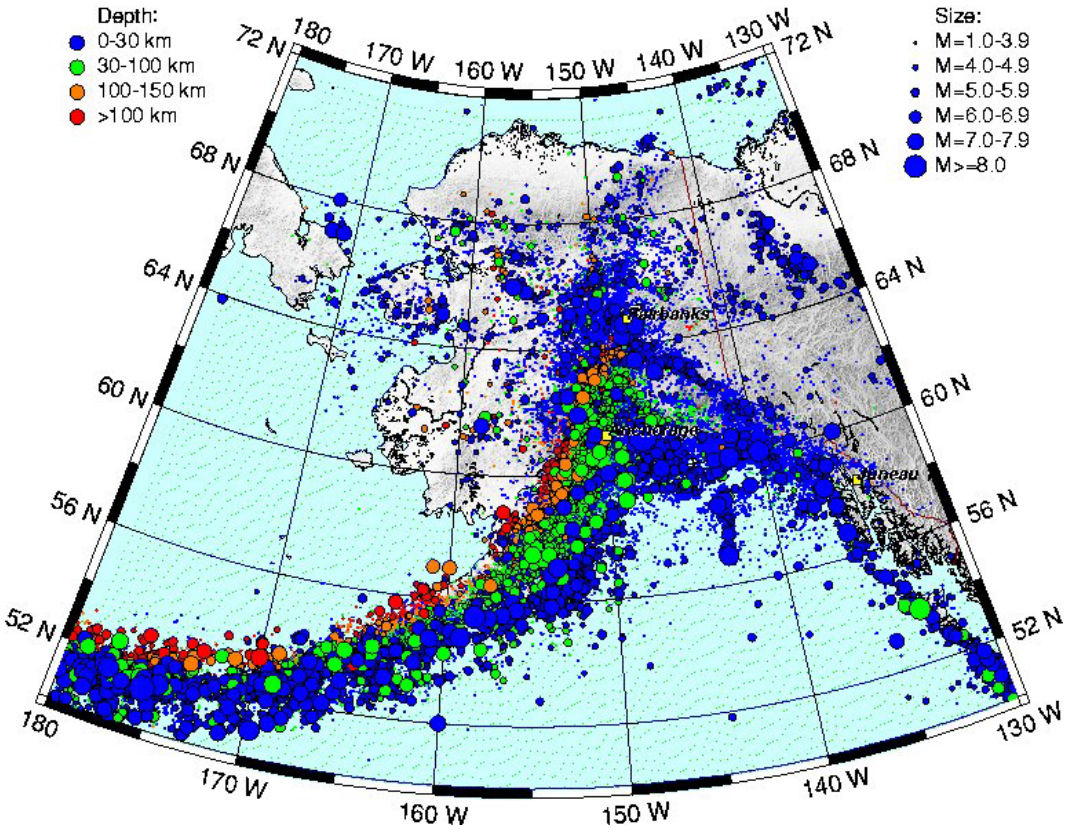

Figure 5. All recorded earthquakes in Alaska from 1898 to the present. Symbol size indicates earthquake magnitude and color indicates depth.

It is not possible to predict the time and location of the next big earthquake, but the active geology of Alaska guarantees that major damaging earthquakes will continue to occur. Scientists have estimated where large earthquakes are most likely to occur, and the probable levels of ground shaking to be expected throughout the state (fig. 6). With this information, as well as information on soil properties and landslide potential, it is possible to estimate earthquake risks in any given area. It is also possible to estimate the potential for earthquakes to generate tsunamis, and to model the extent to which tsunamis will inundate coastal areas.

Alaska has changed significantly since the damaging 1964 earthquake, and the population has more than doubled. Many new buildings are designed to withstand intense shaking; some older buildings have been reinforced, and development has been discouraged in some particularly hazardous areas. Despite these precautions, and because practices to reduce vulnerability to earthquakes and tsunamis are not applied consistently in regions of high risk, future earthquakes may still cause life-threatening damage to buildings, cause items within buildings to be dangerously tossed about, and disrupt the basic utilities and critical facilities that we take for granted.

The Federal Emergency Management Agency[1] estimates that with the present infrastructure and policies, Alaska will have the second highest average annualized earthquake-loss ratio (ratio of average annual losses to infrastructure) in the country. Reducing those losses requires public commitment to earthquake-

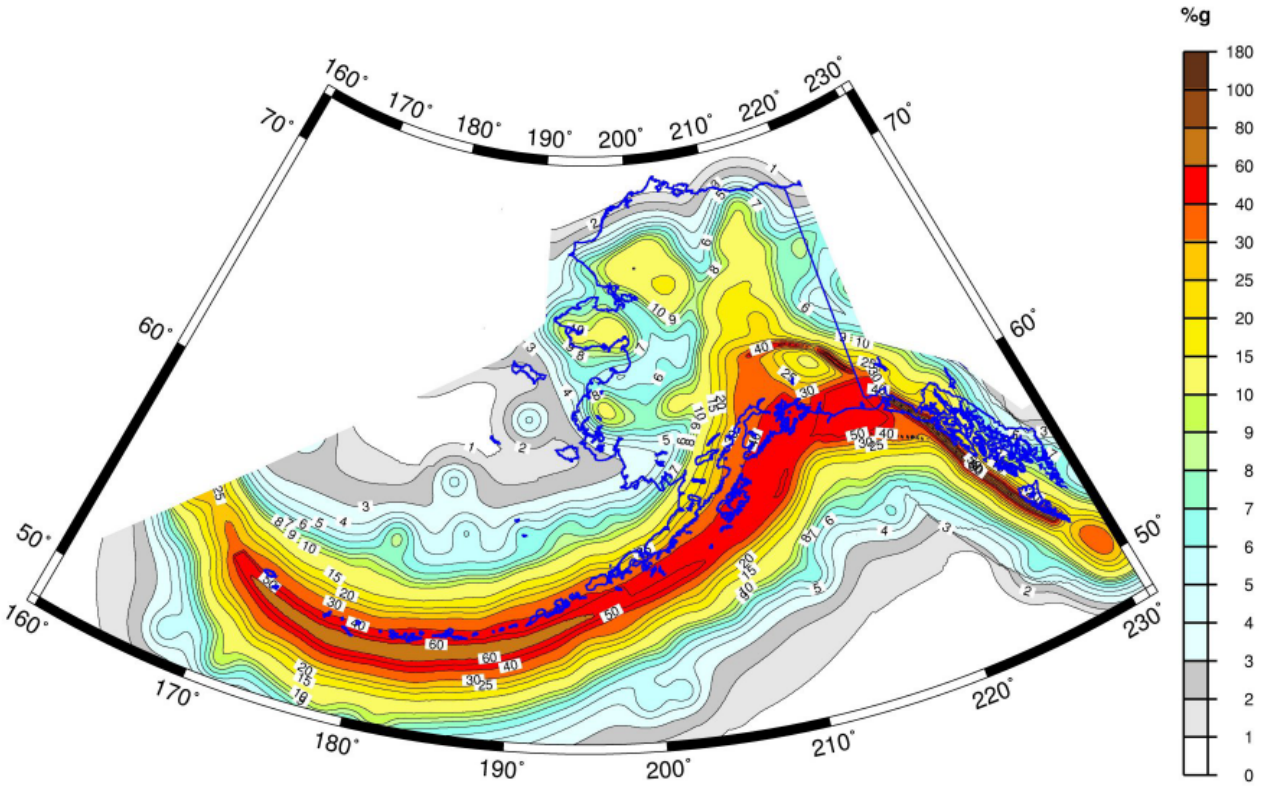

Figure 6. Probabilistic ground-acceleration map for Alaska. Colors depict the peak acceleration that has a 10 percent probability of being exceeded in a 50-year period.

[1]HAZUS 99 Estimated Annualized Earthquake Losses for the United States, Federal Emergency Management Agency Report 66, September 2000.

conscious siting, design, and construction. The Seismic Hazards Safety Commission is committed to addressing these issues. Earthquake-risk mitigation measures developed by similar boards in other states have prevented hundreds of millions of dollars in losses and significant reductions in casualties when compared to other seismically active areas of the world that do not implement effective mitigation measures. The San Francisco (1989), Northridge (1994), and Nisqually (2001) earthquakes caused comparatively low losses as a result of mitigation measures implemented in those areas. Many of these measures were recommended by the states' seismic safety commissions.

RECOMMENDATIONS FOR ISSUES TO BE ADDRESSED BY THE ALASKA SEISMIC HAZARDS SAFETY COMMISSION

1. Assessing the Structural Stability of Critical Facilities

Description of the Issue: Some existing critical buildings in the state may not be constructed in a manner to withstand future earthquake and tsunami events. A specific concern is school buildings. Hospitals, clinics, and fire, rescue, and police stations across the state are also vulnerable to failure. Also at possible risk are large Federal, State, and private complexes such as military bases, Coast Guard stations, airports, college campuses, harbors, power-generating stations, communication centers, water and waste-water treatment facilities, jails and detention facilities, pipelines, and highways and bridges.

Importance of the Issue: If attention is not brought to bear on this issue before an earthquake or tsunami, communities in the state could see massive structural failure of important community facilities, resulting in human casualties, economic loss, and environmental damage. Furthermore, Alaska's remote nature and extreme weather conditions can cause delays in response efforts and put displaced building occupants at severe risk from exposure. Adequate preparedness is imperative to timely rapid response and recovery from a significant seismic event.

Benefits of Addressing the Issue: Some private and public entities have taken important steps to improve the seismic resistance of key facilities and infrastructure. For example, prior to constructing the Trans-Alaska Pipeline System, Alyeska hired geologists and engineers to specifically address seismic hazards. The resulting design and earthquake-resistant construction prevented the loss of any oil during the M7.9 Denali fault earthquake of November 3, 2002. The Alaska Department of Transportation and Public Facilities is undertaking a seismic retrofit program for State owned bridges, and is focusing on upgrading bridges that provide critical access to communities. Some boroughs and cities across the State have taken the initiative to identify and begin retrofitting seismically vulnerable school buildings and other essential facilities.

Despite the recency of most construction in Alaska and implementation of modern building codes, many buildings and key infrastructure remain vulnerable due to proximity to seismic hazards, some of which are known and others of which are poorly understood. Building codes continue to change and have been significantly upgraded in the period between 1976 and 1997. The Federal Emergency Management Agency (FEMA) and earthquake consortia such as the Cascadia Regional Earthquake Workgroup (CREW) in the Pacific Northwest, have long recognized that addressing the problems prior to a catastrophic event can have long-standing benefits in the future. However, building codes are often inadequately implemented and recommendations of advisory bodies are often ignored.

How the Commission Will Address the Issue: The Commission will encourage mitigation efforts by presenting information about earthquake hazards and risks and suggesting approaches to addressing the strengthening of at-risk critical facilities. Public education must include the correct mix of information on potential damage and suggestions of effective actions to be taken.

2. Address the Importance of Earthquake Insurance

Description of the Issue: Catastrophic natural perils, particularly earthquakes, are unpredictable, relatively infrequent, and can be financially disastrous. Earthquake risk is especially difficult to insure against because insurers are unable to accumulate adequate reserves for such high severity, low frequency losses.

Importance of the Issue: Insurers are unwilling to provide insurance in a market where premium rates are inadequate to create the reserves necessary to pay for damages in the event of a major earthquake. This can create a severe deficiency in availability of insurance as existing insurers withdraw from the market and new insurers are unwilling to enter.

Benefits of Addressing the Issue: Improved pre-loss mitigation efforts, such as retrofitting existing structures; emergency planning to speed post-loss recovery; and actuarially sound earthquake insurance rates encourage additional insurers to enter the market. This in turn improves availability of insurance products and results in more competitive premiums.

How the Commission Will Address the Issue: The Commission will encourage development of public-private partnerships that provide education and mitigate the potential impact of future events. We will examine the seismic-hazard information needs of the insurance industry and provide recommendations for improvement.

3. Approaches to Seismic Risk Mitigation in Future Building Construction

Description of the Issue: Sustainable development entails maintaining environmental quality, improving a community's quality of life, and fostering social equity while maintaining a healthy economy. Therefore, sustainable development includes incorporating disaster resilience and mitigation into a community's decisions and actions. Building codes normally have a performance goal of life safety, which is considered a minimum safety level, but are typically the maximum level to which buildings are designed. Codes do not appropriately address the effects of ground failure, ground shaking amplification, or provide guidance to designers and construction contractors.

Importance of the Issue: Communities need to know the potential earthquake risk and impacts at a structure site and should implement appropriate standards to mitigate the identified risk so new buildings are not subjected to the effects of massive ground failure and strong ground shaking.

Benefits of Addressing the Issue: The results of addressing the issue are more effective mitigation and an assurance that counter-measures are not only adequate but the cost of implementation is not prohibitive.

How the Commission Will Address the Issue: The Commission will encourage continued Federal, State, and private partnerships in updating ground failure susceptibility mapping of Anchorage, ground shaking characterization in high-risk Alaskan communities, and determination of structural

response of buildings and bridges. We will work with the technical community and the construction industry to inform, educate, and work with communities to provide guidance to improve building and land-use codes.

4. Response and Recovery Practices to Mitigate Future Seismic Risk

Description of the Issue: Communities don't have a good understanding of the costs and resources needed for response and recovery. First responders to a damaging earthquake in one of Alaska's major cities will be overwhelmed in the initial hours following the event. Damage to transportation systems will make movement of people and goods difficult. Demand for emergency shelter, food, and water will strain communities' resources. Disruptions to lifeline systems will complicate recovery.

Importance of the Issue: An understanding of response and recovery issues is critical to assessing the impacts to State and local resources.

Benefits of Addressing the Issue: Implementing effective response and recovery practices will reduce economic and social costs of recovery and will help mitigate risks from future events.

How the Commission Will Address the Issue: The Commission will promote and assist in the development and use of "earthquake scenarios" to define the impact of future damaging earthquakes and will communicate lessons learned from past events to provide guidance to communities on recovery planning and preparation.

5. Hazard Identification and Public Education

Description of the Issue: A damaging earthquake has not affected a major population region in Alaska since 1964. The majority of the population is unaware of the consequences of a major seismic event. The 2002 Denali fault earthquake resulted in relatively minor damage to smaller rural communities but had little effect in larger communities such as Anchorage and Fairbanks. It was evident, during damage assessment evaluations after the Denali fault event, that the residents of the smaller at-risk communities had little understanding of the earthquake hazard, had not implemented measures to mitigate damage, and were unprepared to respond to the consequences of damage. It is important that the population of Alaska be aware of the earthquake hazard and be informed of the measures that can be taken to mitigate risk.

Importance of the Issue: There is a high probability that Alaskans will experience the results of a damaging earthquake in the future. All Alaskans will be better prepared to take measures ahead of time to reduce losses and casualties and to respond to the event if they are informed of, and truly understand, the hazard and the resultant risk.

Benefits of Addressing the Issue: An educated public has a greater potential of responding appropriately before, during, and after a damaging earthquake. Improved knowledge and public awareness of hazard and risk can change behavior and lead to more cost-effective mitigation.

How the Commission Will Address the Issue: The Commission will examine the need for greater public investment in identification and assessment of earthquake hazards, and the most effective ways of communicating this information to the public. The Commission will examine and promote

the concept of seismic resilience of communities, addressing reduced failure probabilities, reduced consequences of failure, and reduced time to recovery.

6. Recommended Public-policy Goals of the Commission

a. Education
   - Develop an effective public education and outreach program.
   - Convey scientific and technical information from credible authorities.
   - Communicate information in a manner that is understandable by the public.

b. Guidance
   - Provide advice on seismic risk mitigation and recommend policies to improve preparedness.
   - Recommend goals and priorities for risk mitigation to public and private sectors.
   - Recommend needed research, mapping, and monitoring programs.
   - Offer advice on coordinating disaster preparedness and seismic risk mitigation.

c. Assistance
   - Review seismic and tsunami hazard notifications and recommend appropriate response.
   - Review predictions and warnings and suggest appropriate responses.

d. Implementation
   - Establish and maintain working relationships with other private and public agencies.
   - Gather, analyze, and disseminate information.
   - Conduct public hearings.
   - Appoint committees from Commission membership and/or external advisory committees to address risk mitigation issues.
   - Accept grants, contributions, and appropriations.

This publication was released by the Department of Natural Resources. Its purpose is to report the findings and recommendations of the Alaska Seismic Hazards Safety Commission to the Governor and to the Legislature of Alaska. It was printed at the Division of Geological & Geophysical Surveys office in Fairbanks, Alaska. This publication is required by AS 44.37.067.