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BEFORE THE SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES
COMMITTEE ON NATURAL RESOURCES
U.S. HOUSE OF REPRESENTATIVES
THURSDAY MARCH 27, 2014

Chairman Lamborn, Ranking Member Holt, and Members of the Subcommittee, thank you for inviting me to testify on "Advances in Earthquake Science: 50th Anniversary of the Great Alaskan Quake". As a Professor at University of California Irvine, I am one of millions of US residents who lives with earthquake risk every day. Today I speak primarily as President-Elect of the Seismological Society of America (SSA), which was founded after the devastating 1906 San Francisco earthquake and is now the largest and most respected society of seismologists in the world. The core purpose of SSA is to advance seismology and the understanding of earthquakes for the benefit of society.

My message is threefold:

- In the 50 years since the Great Alaskan Earthquake, there has been a scientific revolution in understanding of earthquakes.
- Federal investment in science has been directly responsible for tremendous advances in understanding earthquakes and the threat they pose to society.
- This investment has yielded valuable returns that benefit society by helping us to become an earthquake resilient nation.

Let me begin with the Great Alaskan Earthquake on Good Friday 1964. I've heard the stories many times from extended family. Donna Grant was shopping in downtown Anchorage when the earthquake struck. As buildings collapsed in front of her and chasms opened in the street, she grabbed a parking meter and "hung on for dear life". The shaking lasted for nearly 5 minutes and she had time to think: it was the beginning of World War III and the end of the world as she knew it. Her experience is important because it illustrates the link between earthquake science and national security. When downtown Anchorage was collapsing around her, neither Donna Grant nor anyone else, knew it was caused by a megathrust earthquake due to subduction of the Pacific plate beneath North America. In 1964, the World-Wide Seismographic Network (WWSN), which had been emplaced for monitoring nuclear weapons testing in the cold war, was also collecting earthquake data, and this data was critical to the breakthrough discovery of plate tectonics.

We now know that she experienced the most powerful recorded earthquake in U.S. history and the second largest of all time. The Alaskan earthquake was so large, at Magnitude 9.2, that seismologists had to develop a new scale to measure it. The earthquake generated a tsunami with peak height of 220 feet in Valdez Alaska, which affected the entire west coast and Hawaii, causing significant damage. The recent, widely televised Japanese tsunami in 2011 provides a vivid illustration of the devastation that can follow a major subduction zone earthquake, and the need to protect our nation from similar future events.

The development of plate tectonics, a product of seismic monitoring and geological studies, also provided a powerful tool for identifying areas that are most susceptible to earthquakes. The greatest concentration of earthquakes, and the greatest earthquake hazard, occurs at the plate boundaries. These plate boundaries have been imaged by seismologists, and mapped by geologists. Modern seismic instruments and sophisticated digital data processing methods allow the locations of earthquakes of all sizes to be precisely determined. The methods and technology are similar to ultrasound instruments commonly used in medical imaging and diagnosis. The earthquake locations reveal the presence of active faults within the Earth's crust. Some faults that reach the surface, such as the San Andreas fault in California, can be further investigated by geologists, or paleoseismologists, to determine their past earthquake history, and their potential to produce future earthquakes. For example, research on the San Andreas fault conducted by myself and others, has shown that the average time between surface-rupturing earthquakes is about a century. These findings are a call to action. The last two "Big Ones" on the San Andreas fault, in 1906 and 1857 in northern and southern California, respectively, occurred more than a century ago, so it is important to prepare for the next one. I have become so concerned about the implications for my own community that I joined UC Irvine's Program in Public Health to work on protecting health and safety in addition to conducting earthquake science research.

Earthquakes are not just a California problem. Research in paleoseismology, the study of prehistoric earthquakes using geologic methods and advanced dating techniques such as high resolution radiocarbon dating, has revealed much about the potential for large earthquakes in many seismically active regions. In Alaska, huge earthquakes similar to the 1964 quake have occurred, on average, hundreds of years apart. Similar research along the coast of Washington, Oregon and northern California has shown that large subduction zone earthquakes have occurred every few centuries, and the last great earthquake on the Cascadia subduction zone occurred in 1700.

The old saying "those who ignore history are condemned to repeat it" should not apply to earthquake hazard in the US because we now know, as a direct result of federally supported research and seismic monitoring, that we have a significant earthquake problem. We also have the scientific knowledge and technological tools to develop an earthquake resilient nation. We know the areas that are most likely to be affected, and the type of earthquakes that are most

likely to occur. For example, many researchers are working on simulating earthquakes and developing scenarios that can be used for planning and preparation. Advanced computing technologies and access to supercomputers have enabled calculation of expected shaking from earthquakes on the San Andreas fault, the Cascadia subduction zone, and other important fault zones. The Great Southern California ShakeOut earthquake preparedness exercise which started in 2008 to prepare for the "Big One" on the San Andreas fault, has expanded into annual earthquake preparedness drills throughout seismically active areas of the US, and the world, with approximately 25 million participants last year. Earthquake data collected by the USGS, university researchers, and others, are used for development of National Seismic Hazard Maps which are incorporated into building codes for earthquake-resistant design.

Unfortunately, earthquakes cannot be prevented. We can trigger them, but we cannot stop them. In my opinion, we must protect ourselves from this natural terrorist beneath our feet. Congress is our first line of defense, through support of a real-time Earthquake Early Warning (EEW) system, continued funding of the Advanced National Seismic System (ANSS), and reauthorization of the National Earthquake Hazard Reduction Program (NEHRP) with appropriation of funds at levels that reflect the significant threat that earthquakes pose to our national security. EEW is a proven technology for alerting communities in advance of strong shaking, and EEW systems have already been deployed in Japan and other countries, but not yet in the U.S. Created by Congress in 1977, NEHRP has provided the resources and leadership that have led to significant advances in understanding the risk earthquakes pose and the best ways to counter them. Through NEHRP, the federal government and university partners have engaged in seismic monitoring, mapping, research, testing, engineering and related activities for building code development, mitigation, and emergency preparedness. NEHRP has served as the backbone for protecting U.S. citizens, their property and the national economy from the devastating effects of large earthquakes. Although NEHRP is well known for its research programs, it is also the source for hundreds of new technologies, maps, design techniques, and standards that are used by design professionals every day to mitigate risks and save lives, protect property, and reduce adverse economic impacts.

NEHRP makes Americans safer and our Nation more secure and financially stronger by implementing the results and insight from research in the earth and behavioral sciences, public policy, and engineering. NEHRP was reauthorized by Public Law 108-360 in 2004. However, this authorization expired in October of 2009, a few months before the devastating Haiti earthquake. As Chairman Lamborn pointed out in his statement on March 9, 2011 "...earthquakes can and do kill hundreds of thousands of people, in the case of Haiti a magnitude 7 earthquake killed over 230,000 people." The tragedy in Haiti was surprising to many outside the community of earthquake scientists, but it was well known among seismologists that Haiti is on a seismically active plate boundary and susceptible to earthquakes. Such knowledge is powerful if it is acted upon. I am here today to tell you that federal investment in earthquake science has given us the

knowledge we need to protect ourselves from the type of tragedy we saw in Haiti. But in science, as in life, you get what you pay for. It is in the best interest of our nation to invest in earthquake science and to continue working toward our common goal of becoming an earthquake resilient nation.

I would like to close by expressing my sincere thanks to the committee for inviting me to testify about this important and urgent problem.