Select Committee on Science, Innovation and Public Policy
INFORMATIONAL HEARING
Wednesday, October 15, 2014

BACKGROUND PAPER
"Realizing California's Earthquake Early Warning System"

Introduction

Ninety percent of the world's earthquakes and over eighty percent of the world's largest earthquakes occur along the Circum-Pacific Belt, also known as the Pacific Ring of Fire. The Pacific Ring of Fire includes the very active San Andreas fault zone here in California. The San Andreas is the "master" fault of an intricate fault network that cuts through rocks of the California coastal region. The entire San Andreas fault system is more than 800 miles long and extends to depths of at least 10 miles within the Earth.

Predictions from the Uniform California Earthquake Rupture Forecast released in 2008 states there is a 99.7% likelihood of a magnitude 6.7 earthquake and a 94% chance of a 7.0 magnitude earthquake in California within the next 30 years. In other words, a major earthquake in California is not a matter of *if*, but *when*.

In January, 2013, the California Institute of Technology and the Japan Agency for Marine-Earth Science and Technology published a study concluding for the first time that a *statewide* California earthquake involving both the Los Angeles and San Francisco metropolitan areas may be possible.

While earthquakes cannot be predicted or prevented, using advanced science and technology we can detect seismic activity to provide an advanced warning, save lives and help mitigate damage.

The objective of earthquake early warning is to rapidly detect the initiation of an earthquake, estimate the level of ground shaking to be expected, and issue a warning before significant ground shaking begins. This can be done by detecting the first energy to radiate from an earthquake, the P-wave energy, which rarely causes damage. Using P-wave information, we can first estimate the location and the magnitude of the earthquake. We then use this to estimate the anticipated ground shaking across the region to be affected. The method can provide warning before the S-wave, which brings the strong shaking that usually causes most of the damage, arrives.

According to the United States Geological Survey, California is one of the most seismically active states, second only to Alaska. California has experienced dozens of disastrous earthquakes, which have caused loss of life, injury, and economic loss. Some of the most significant earthquakes in California's history include:

- The 1906 San Francisco earthquake, which, at a magnitude of 7.8, resulted in an estimated 3,000 deaths and over $500 million in property losses.
- The 1971 San Fernando earthquake, which, at a magnitude of 6.7, resulted in at least 65 deaths and caused property damage of over $500 million.
- The 1989 Loma Prieta earthquake, which, at a magnitude of 6.9, caused 63 fatalities and over $6 billion in property damage.
- The 1994 Northridge earthquake, which, at a magnitude of 6.7, claimed the lives of 60 people and caused estimated property damage of between $13 and $32 billion.

California currently has the California Integrated Seismic Network (CISN), which is a demonstration earthquake early warning system. By building upon the California Integrated Seismic Network and processing data from an array of sensors throughout the state, a fully developed earthquake early warning system would effectively detect some strength and progression of earthquakes and alert the public within seconds, sometimes up to 60 seconds, before potentially damaging ground shaking is felt. A fully developed system would process data from an array of sensors throughout the state.

Early warning systems are in place, or in the works, in a number of earthquake prone nations including Japan, Taiwan, Mexico, Turkey, Italy, China and Romania. Their success has been demonstrated in recent earthquakes.

Japan's earthquake early warning system provided the public with critical advanced warning of the 9.0 magnitude earthquake in March 2011. Earthquake warnings were automatically broadcast on television and radio, and 52 million people received the warning on their smartphones. Millions more downloaded the early warning app after the quake to receive warnings in advance of large aftershocks.

The warnings allowed people to take cover, assist loved ones, pull to the side of the road or exit a building. The system brought bullet trains to a stop, and triggered the automatic shutdown of operations at critical companies. A professor at the University of Sendai received a text message of the warning and was able to warn his students to duck for cover before the shaking began and the light fixtures fell from the ceiling.

Earthquake early warning systems not only alert the public, they also speed the response of police, fire and other safety personnel by quickly identifying areas hardest hit by the quake.

SB 135

Senate Bill 135 (Padilla) Chapter 342, Statutes of 2013, designated the California Office of Emergency Services develop a comprehensive statewide earthquake early warning system to alert Californians in advance of dangerous shaking. This would be achieved through a collaborative public-private partnership between the California Institute of Technology (Caltech), the California Geological Survey, the University of California Berkeley, the United States Geological Survey, the Alfred E. Alquist Seismic Safety Commission, and other stakeholders.

SB 135 granted The Office of Emergency Services until January 1, 2016 to identify funding for the system. The initial cost estimate to build a statewide system is $80 million which includes the initial build out and 5 years of operation and maintenance costs.

Conclusion

Having progressed one year into the implementation of SB 135, this informational hearing is designed to facilitate discussions on the benefits of establishing an earthquake early warning system to promote its development and funding. We have examples in from other countries which demonstrate the benefit an early earthquake warning system has to save lives. This is an opportunity to further explore the benefits of an earthquake early warning for not only the individual Californian, but also for the various sectors that comprise California's infrastructure. Furthermore, we look forward to hearing from the California Office of Emergency Services on the progress made in the past year regarding potential funding proposals and arrangements to build a comprehensive earthquake early warning system for California.