Earthquake early-warning system soon to enter testing

October 20 2009, By Bruce Newman

It is the Holy Grail of seismology, sought by earthquake scientists for more than a century: the ability to provide advance warning of the Big One, so the public can react before a massive quake unleashes its rolling thunder upon the land.

Twenty years after the Loma Prieta earthquake, a magnitude-6.9 shocker that took seismologists at the U.S. Geological Survey completely by surprise, that elusive prize is nearly within reach.

Earthquake early warning -- a system that could have provided up to 15 seconds of advance notice to Oakland, Calif., before the Loma Prieta quake killed 42 people there -- has just begun a final round of tests in California. If the system receives a costly round of state and federal funding, sensors buried deep in the Earth could start flashing nearly instant warnings to densely populated urban centers within three years.

When this safer city of the future arrives -- assuming the warning system being devised by seismologists at three California universities and the USGS receives an additional $50 million for geophysical observation stations -- its warnings could:

• Stay the scalpel of a surgeon seconds before an earthquake rocks his -- and his patient's -- world.

• Halt elevators at the nearest floor, so people in high-rises don't have to be rescued and can evacuate safely.

• Open doors at fire stations automatically, so vital emergency equipment and first-responders aren't trapped inside.

• Slow Caltrain and BART trains to reduce the likelihood of derailments.

• Switch freeway metering lights to red and activating alerts on message boards.

• Broadcast an alert to your smart phone, locating you via the phone's GPS device, then using an application to tell you how soon the first stomach-churning jolt will hit, and what its magnitude will be.

A system designed to do those things -- plus perform less obvious tasks such as protecting the data at government offices and corporations by switching computers to safety mode -- will begin real-world testing here as soon as next year. Even so, it will lag behind similar systems already in use in Japan, Mexico, Turkey and Taipei.

In fact, Seismic Warning Systems, a small, privately held company in Scotts Valley, has already installed smaller, cheaper systems at Cisco Systems, the Lawrence Berkeley National Laboratory and in many firehouses throughout the state.

"In our preparedness review, we noted that if an earthquake were to occur, the likelihood was that the doors to the firehouse would jam," said Rocky Saunders, emergency services manager about a firehouse at the lab. "Now they'll pop open, and the water tanks automatically shut down to retain our potable water."

Saunders said the system has performed perfectly but only in simulations. A spokesman for Seismic Warning Systems said its on-site equipment performed flawlessly during the Alum Rock quake -- a magnitude-5.6 shaker -- in 2007.

"At the beginning of this project, it's fair to say that most people didn't think early warning was technically feasible in California," said University of California-Berkeley seismology professor Richard Allen, principal architect of the far-larger USGS network. "The question now is to what extent it could be useful. How would you take advantage of those few seconds of warning?"

Those precious seconds represent the gap between primary, or P-waves -- the seismic forerunners that alert animals to earthquakes before humans feel anything -- fluttering almost imperceptibly through soil and bedrock at a rate 1.8 times faster than secondary, or S-waves. It's those slower-moving S-waves that topple buildings, burst gas mains and snap bridges like Tinker Toys.

For every five miles a P-wave travels from the earthquake's epicenter, it provides one second of warning time. The debate becomes, Where should alarms be heard? And by how many people?

Allen said training on a massive scale is "crucial" to the success of the government-funded system. "You have to train people with a very simple response," he said, "such as, 'Earthquake! Get under a table.' "

The USGS system will gather information from more than 400 sensors scattered throughout California.

"We try to push the envelope as hard as we can," said David Oppenheimer, a seismologist at the USGS in Menlo Park, Calif. "I think that's what the public expects us to do."

But there's a daunting problem: An early warning system will cost $50 million to $80 million to install, and millions more each year to maintain.

"California is dead broke, so they're not going to be able to fund the

system," said Mike Price, chief technology officer of Seismic Warning Systems and a sharp critic of the USGS program. "What they're building is a massive, government-centric research project. At the moment, they're nowhere."

Seismic Warning Systems produces an on-site P-wave detector that performs many of the same functions that the larger system will execute, but without the big price tag. The company focuses on places where it can bring about what Price calls "consequential benefit." He is particularly scornful of Allen's idea of an iPhone application to alert the public that a quake is coming.

"This idea of producing an alert on a cell phone to the general public is a joke," he said. "We're focused on producing a reliable alert, not a toy. You're talking about AT&T's network, and they can barely do Web surfing reliably. We give you the maximum time possible to slow down a train, jump under a table or kiss your butt goodbye."

Both systems are designed to react so quickly that humans must be taken out of the data loop, creating the likelihood of false alarms that would needlessly panic the public. Once the system is in place, it will be a little like the Doomsday Machine in the movie "Dr. Strangelove," acting on its own authority, based on algorithms that only machines can feel.

Two months ago, the Microsoft Windows-based computers at the U.S. Department of Interior received a software patch, rebooted, then a distorted electronic handshake created a corrupted stream of data. The machines misinterpreted data from field instruments as a massive earthquake in Northern California. But this time, no alarm went out.

"Who would have thought Bill Gates could trigger an earthquake early warning message?" Oppenheimer said. "That's why we're trying to make sure it's reliable. The public has a very low tolerance for failure."

And even less tolerance for surprises.

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