California Develops Earthquake Early-Warning System

by Amy Standen

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Enlarge Russel A. Daniels/AP
Academy of Art University students Lisa Allen (left) and Shaofu Zhang take part in the California ShakeOut — a statewide Drop, Cover and Hold earthquake drill in San Francisco on Thursday. University of California, Berkeley scientists are working on an earthquake early-warning system.

September's devastating earthquakes in Indonesia and Samoa were a brutal reminder of the sudden force of seismic shifts. That hits close to home in California's San Francisco Bay Area, which experienced a magnitude 7.1 earthquake 20 years ago. Sixty-three people died in that quake.

Lives could have been saved with an earthquake early-warning system — the kind that's already in place in Japan and Mexico. But here in the U.S., such a system is still several years away.

If you ever find yourself with five seconds in front of you — five seconds before you know that a major earthquake is about to hit — Richard Allen gives this warning: "The best thing you want to do is get under a table," he says. "It's that simple. There's nothing else. Get under a table."

Advanced Earthquake Warning Technology

Allen is a seismologist with the University of California, Berkeley. He's spent the past decade working on a system that can warn people when a major earthquake is on its way. The system, which receives federal funding through the Interior Department, undergoes a final testing phase this fall, and researchers say it should be up and running by 2013. It's based on a network of seismic monitoring stations — some 400 of them — hidden around the state.

The detection instruments are stored in a narrow concrete vault that extends 100 feet into a rocky hillside above the UC Berkeley campus. Like many of these monitoring stations, it was built during the Cold War, to eavesdrop on nuclear bomb tests around the world.

These instruments are so sensitive that even turning out the lights in the vault could throw their measurements off. They're housed in bell jars and wrapped in layers of foam padding. When a quake hits, they record not just its strength and duration but the different kinds of energy it comprises. Allen says these "P" waves and "S" waves, as they're called, are the key to prediction.

The first energy is P waves. They travel more rapidly through the subsurface, but carry very little energy. The second is S waves. They have a lot more energy and do most of the damage. But they also travel more slowly. So you detect the P wave and then you can predict something about the S waves that follow.

How 'Early' Are The Warnings?

When Allen and other scientists talk about earthquake early warning, they aren't talking about hours, or even minutes. They're talking about tens of seconds — or fewer, depending on your proximity to the epicenter.

"Unfortunately, our faults run beneath our metropolitan regions," Allen says. "If you're right above the earthquake, even with the early-warning system, you probably won't get a warning. But if you're 10, 20 30 kilometers away, then you start to get some warning."

In the Loma Prieta quake two decades years ago, residents in Oakland — where most of the deaths were — could have had about 20 seconds of warning, had the system been in place. But in future quakes, the warning could be as few as five or 10 seconds.

Nevertheless, some measures can still be taken, says David Oppenheimer of the United States Geological Survey.

"Alarms in schools saying, "Duck and cover" with, you know, a voice telling you what to do," says Oppenheimer. "One example that I always like to give, because people cringe, is what if someone's performing cataract surgery on you, and obviously you'd like the surgeon to remove the scalpel away from your face."

Oppenheimer says he can imagine cell phone applications that pick up P-wave alerts and start counting down until the quake hits.

But what if it doesn't?

A Tough Sell

Oppenheimer says false alarms, which have happened in Japan, are inevitable. It's one of the reasons that early warning hasn't always been an easy sell here in the states. Allen agrees.

"I think it's fair to say that funding has been a struggle," Allen says. "And there's a lot of interest in the kinds of information that these networks can provide, immediately after an earthquake, but that wanes very rapidly."

This is starting to change. Last month, the project received $5 million in stimulus funds to replace old computers in the monitoring stations. Allen and Oppenheimer say the new computers can process quake data faster, adding five seconds of warning time.

Still, some potential users ask if the warning is worth the investment it would take to implement it. Paul Overseir, assistant general manager for the Bay Area Rapid Transit, is one of these people.

"It depends on how much advance notice we have," said Overseir.

He says with a few seconds' warning, trains can begin to slow down — but not by much.

"There's of course a question as to whether a train doing 64 miles per hour is substantially safer than a train doing 70 miles an hour," said Overseir.

Allen and Oppenheimer say they could increase warning times by adding monitors to more rural parts of the state. The price tag for such an expansion is $80 million. About the same amount, they argue, that it might cost to do earthquake-proof retrofits to just one or two large buildings.