Seconds before earthquakes, an early-warning system

Scientists have devised a way to detect seismic waves, triggering an alert in California before tremors hit.

By Mark Sappenfield | Staff writer of The Christian Science Monitor

SAN FRANCISCO – When the “Big One” strikes, seismologist Richard Allen likes to think that southern California will be prepared. Today, he will announce that scientists are ready to create the most sophisticated earthquake-warning system in the country’s history.

If implemented, the system would transform the way everyone from factory workers to freeway commuters responds to damaging temblors. Power plants would be able to shut off before the shaking starts. Trains could slow down. School children could take cover.

There is, however, one important asterisk: The alerts would go out only seconds before a quake hit.

After decades of study dedicated to predicting earthquakes days or months ahead of time, such an achievement might seem inconsequential. After all, three seconds is hardly enough time to get out of a chair. But in a time of interconnected networks and “smart buildings” that can instantly counteract fault shifts with computer-controlled hydraulics, even a few seconds could dramatically improve public safety.

"If you know what’s coming up in an earthquake, you can have the system account for it and prepare,"
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says B.T. Spencer, an engineer at the University of Illinois in Champaign.

The early-warning system, laid out in today's issue of Science, is possible because of the nature of earthquakes. When a quake begins, it convulses the rock with two different waves. The faster wave, called the P-wave, causes little damage. Its slower partner, the S-wave, is what topples buildings.

By studying three earthquakes in southern California, Dr. Allen and Hiroo Kanamori of the California Institute of Technology determined how data from the P-wave can accurately predict the severity of the S-wave. Further study will examine whether the data is applicable to other parts of the world.

Southern California, though, was a logical place to start. With 155 seismic sensors regionwide, computers can instantly process and disseminate massive amounts of data from P-waves.

Areas closest to the epicenter would have the least warning. Distant places might have as many as 40 seconds.

"[The time] we have to work with here is the difference between the P- and S-waves," says Allen, a scientist at the University of Wisconsin in Madison.

Clearly, even 40 seconds is not enough to evacuate a building. But Allen suggests that workers handling dangerous chemicals might have time to move to safety. Traffic lights on highway on-ramps could turn red to stop cars from entering. In Japan, where a similar system is already in place, the warnings let bullet trains decelerate.

Yet it is Japan's use of seismic sensors in buildings that intrigues Allen and Dr. Kanamori most. Some 30 Japanese buildings use counterweights in upper floors or shock-absorber-like pistons beneath the ground to survive earthquakes. If similar buildings are constructed in America, and their sensors can get data from an early-warning system, performance could improve further.

The idea, most agree, holds promise. But there are concerns. Some of these countermeasures need electricity, which could be lost in a quake. Moreover, small quakes or errors could cause false alarms.

For his part, Allen imagines a system that would allow every business or institution to determine for itself when it would be sent a warning - and what it would do with it. It would require an educational effort, he acknowledges. But it is the future.

"You won't find very many seismologists saying we'll be successful in predicting earthquakes in the foreseeable future," he says. "In the meantime, there are other things we can do to mitigate the hazards."