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Alert system could give brief, advance notice of quakes

By ANDREW BRIDGES
AP Science Writer

Scientists have proposed a means of interpreting the initial, feeble tremors that herald the arrival of a large earthquake to give residents of Southern California advance warning of more violent shaking to come.

The system theoretically could give anywhere from seconds to tens of seconds of advance notice - enough time to send schoolchildren diving below their desks or to cut the flow of gas through pipelines vulnerable to rupture, scientists said.

Details appear Friday in the journal Science.

The alarm system would not predict or forecast earthquakes. Instead, it would exploit the staggered way in which energy travels from the underground source of quakes to the surface.

The first indication at the surface that a large earthquake has occurred is typically the jolt caused by the arrival of a fast-moving but low-energy wave called the primary or P wave.

It is followed by the more energetic but slower moving shear, or S wave, that causes far more violent shaking.

Richard Allen of the University of Wisconsin-Madison and Hiroo Kanamori of the California Institute of Technology developed a way to determine the location, origin, time and - most importantly - magnitude of an earthquake from as little as four seconds of measurements of the frequency of the energy in the P wave. The system would rely on a network of seismic instruments already deployed across the greater Los Angeles region.

"If we can detect this P wave and use the information contained in it to estimate the hazard associated with an earthquake, then there is the potential to issue a warning before any significant ground motion reaches the surface," Allen said.

The amount of forewarning would depend on the distance of the sensors from an earthquake's epicenter.

If directly above the epicenter, there would be no time for a warning, since the S wave would arrive almost immediately after the P wave. At 37 miles from the

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epicenter of a major quake, the system could give a magnitude estimate 16 seconds before the arrival of the S wave and the strong ground motion that accompanies it, Allen said.

A similar system is already in use in Japan, where individual sensors are used to provide early warnings.

Following the 1989 Loma Prieta earthquake that rocked the San Francisco Bay area, seismologists tracked P waves to warn rescue workers on a section of collapsed freeway about oncoming aftershocks. And a Nevada company has sold siren devices triggered by P waves to several fire stations in California.

Other systems in place in Taiwan and Mexico rely on measurements of the peak ground motion associated with the S wave to relay warnings to locations far from an earthquake's epicenter but still vulnerable to shaking.

Allen and Kanamori used data from past earthquakes to simulate how their system would work. They are now testing it on the regular earthquakes that shake the Los Angeles region to determine if it can provide accurate magnitude estimates in real time. There are no immediate plans to go on and develop an actual warning system.

If developed, it would work best if plugged into a region's infrastructure, allowing it to automatically prompt shutdowns of everything from trains to factories during major quakes, Allen said.

Such a system would allow a utility to quickly cut power to its grid, minimizing but not eliminating damage, said Philip Mo, a structural engineer with Southern California Edison, a Rosemead, Calif., utility.

The study may settle the question of whether earthquakes of different magnitudes begin in different ways, said Lucy Jones, scientist in charge of the U.S. Geological Survey office in Pasadena, Calif. The study suggests they do.

"There's debate whether quakes start differently or if a (magnitude-) 6 is just a 2 that doesn't stop," said Jones, who was not connected with the study.

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