

Case Study

Earthquake Early Warning TGV High-Speed Railway Marseille, France

Background

When the LGV Méditerranée high-speed rail service was launched in France, it was a massive undertaking. Five hundred bridges and 20 viaducts were built between Valence and Marseille (approximately 250 km), during 100 million worker hours. One million trees were planted to meet environmental regulations. The CEA's Environmental Assessment and Monitoring Department (DASE), in partnership with the French rail company SNCF, wanted to mitigate potential disaster with the TGV south-east high-speed train traveling between Valence and Marseille in the case of earthquake.

Challenge

Because the train travels at speeds up to nearly 300 km/h, the potential for injury is elevated should anything deform the tracks. Each train can carry between 500 and 700 passengers, making it a significant risk.

Solution

The aim of the system is to automatically slow down or if necessary stop the train a few seconds after detection of an earth tremor liable to deform the tracks, to avoid it reaching the damaged areas at full speed.

Configuration of the system designed by the CEA and DASE consists of 24 measurement stations, set 10 km apart, which are installed along the tracks in the seismic area between Valence, Marseille and Nîmes. In the event of ground motion above certain thresholds, a central sign posting unit in Marseille -- collecting and processing all station data -- sends an order to slow down or stop trains to the SNCF system, which centralizes all safety alarms for the line.

At the same time, a separate automatic decision support system, located in Bruyères-le-Châtel, integrates data from 14 stations of the CEA's national seismic monitoring network, to confirm (or not) the presence of an earthquake within a 10 minute interval. This allows the SNCF to take an informed decision (resume normal operation of the line or inspect the tracks).

The devices are connected via the SNCF's fiber optic networks and dedicated lines.

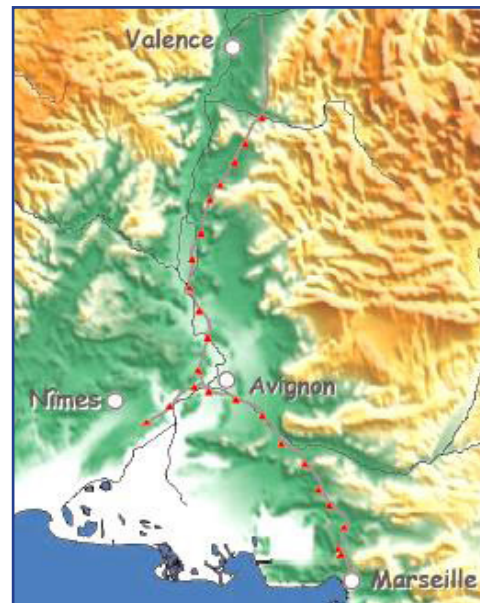
For reliability and security reasons, the emergency stop system's main features are redunded. This system is a world first. Only Japan has set up a system of this kind, but based on a different principle and not suited to the seismic conditions found in south-east France.

System performs seismic processing, data centralizing and real-time decision support based on data from the 24 stations and alarm transmission.

Automatic alarm confirmation system is utilised, integrating data from CEA network seismometers. These data provide additional information due to the sensors' superior resolution and more extensive geographical distribution, and are therefore valuable for locating earthquakes and determining their magnitude.



The TGV south-east high-speed train travels between Valence and Marseille.



The earthquake early warning system includes 24 stations housing AC-23 accelerometers, set every 10 km apart, which transmit data and alarms to a central sign posting unit in Marseille.



AC-23 sensors

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