



Real-Time Earthquake Risk Mitigation Of Infrastructures Using Istanbul Earthquake Early Warning and Rapid Response Network

Can Zulfikar, Ali Pinar, Suleyman Tunc, and Mustafa Erdik

Bogazici University, Kandilli Observatory and Earthquake Research Institute, Istanbul, Turkey

The Istanbul EEW network consisting of 10 inland and 5 OBS strong motion stations located close to the Main Marmara Fault zone is operated by KOERI. Data transmission between the remote stations and the base station at KOERI is provided both with satellite and fiber optic cable systems. The continuous on-line data from these stations is used to provide real time warning for emerging potentially disastrous earthquakes. The data transmission time from the remote stations to the KOERI data center is a few milliseconds through fiber optic lines and less than a second via satellites.

The early warning signal (consisting three alarm levels) is communicated to the appropriate servo shut-down systems of the recipient facilities, that automatically decide proper action based on the alarm level. Istanbul Gas Distribution Corporation (IGDAS) is one of the end users of the EEW signal.

IGDAS, the primary natural gas provider in Istanbul, operates an extensive system 9,867 km of gas lines with 550 district regulators and 474,000 service boxes. State of-the-art protection systems automatically cut natural gas flow when breaks in the pipelines are detected. Since 2005, buildings in Istanbul using natural gas are required to install seismometers that automatically cut natural gas flow when certain thresholds are exceeded. IGDAS uses a sophisticated SCADA (supervisory control and data acquisition) system to monitor the state-of-health of its pipeline network. This system provides real-time information about quantities related to pipeline monitoring, including input-output pressure, drawing information, positions of station and RTU (remote terminal unit) gates, slum shut mechanism status at 581 district regulator sites. The SCADA system of IGDAS receives the EEW signal from KOERI and decide the proper actions according to the previously specified ground acceleration levels. Presently, KOERI sends EEW signal to the SCADA system of IGDAS Natural Gas Network of Istanbul.

The EEW signal of KOERI is also transmitted to the serve shut down system of the Marmaray Rail Tube Tunnel and Commuter Rail Mass Transit System in Istanbul. The Marmaray system includes an undersea railway tunnel under the Bosphorus Strait. Several strong motion instruments are installed within the tunnel for taking measurements against strong ground shaking and early warning purposes. This system is integrated with the KOERI EEW System. KOERI sends the EEW signal to the command center of Marmaray. Having received the signal, the command center put into action the previously defined measurements. For example, the trains within the tunnel will be stopped at the nearest station, no access to the tunnel will be allowed to the trains approaching the tunnel, water protective caps will be closed to protect flood closing the connection between the onshore and offshore tunnels.