Automatic Shutdown System in Gas Regulators for Real-Time Seismic Risk Reduction of a Populated City: Bursa, TurkeyAutomatic Shutdown System in Gas Regulators for Real-Time Seismic Risk Reduction of a Populated City: Bursa, Turkey

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Bursa is a city located within a region of first grade earthquake risk, and it has occasionally suffered devastating and massive earthquakes for more than 2000 years. After a large disastrous earthquake in Izmit in 1999, many earth scientists are expecting the next large earthquake on the western extension of the Izmit earthquake rupture zone. Bursa is located south of the western end of the 1999 earthquake rupture and there are many active faults in and around Bursa. Bursa has now almost three million inhabitants, many heavy/industrial factories and historical monuments. Most of the people are using natural gas for heating, cooking and production in their buildings. Bursagaz is an inner-city gas distribution company and they are aware of the high seismic risk in Bursa city, so, they want to reduce causalities, fires and explosions in their natural gas district regulators and main pipelines. For these reasons, we have started to install accelerometers inside some of the main gas regulators and set up an algorithm for initiating an automatic gas shutdown system into their network for reducing the seismic risk in the city. We plan to install seismic instrumentation within a four-year-project and each year the seismic network will be growing by installing new accelerometers. We are also testing different algorithms to reduce false alarms aiming at a more secure and robust shutdown system. There are five different active fault lines in and around Bursa city having potential for creating M6.5 or larger earthquakes. Our first aim is to install accelerometers inside the inner city regulators located on and next to the main fault crossing highly populated regions of Bursa city center as a priority. By installing accelerometers very close to the active fault, we can detect PGAs more quickly and effectively. In the first phase of the project, we installed 15 accelerometers in the field and provided data collection and processing algorithm software in Bursagaz central building. All digital data are transferred by using GSM lines to this data center. In the second phase of the project, we installed another 10 accelerometers along the second active fault located in the Bursa city center. The project has not completed yet. During third and fourth project phases, the total number of accelerometers will be reach up to 50 within 2 years. At present, Bursagaz has 163 district regulators working in the city and all these regulators are connected to the company center with online SCADA communication system. Our main idea is to install one accelerometer at the central regulator and controlling at several district regulators in the surrounding to this instrument. Whenever the processing algorithm detects a certain level of acceleration due to a moderate or large earthquake, it will firstly observe PGA values for each single instrument and then calculate PGA values by using attenuation relationships for all regulators to finally compare these values with predefined threshold values. In case of exceedance of a threshold level, a shut-off signal will be send to those district regulators having higher PGA values than their threshold values. The installed algorithm will also calculate and estimate damage information in gas distribution infrastructure and create damage distribution maps very quickly and correctly. This information will be send to Bursagaz Technical and Emergency Response Teams that they could take all necessary actions to mitigate the disaster quickly and effectively. Our second aim is to use

Bursagaz seismic network as a core unit of Bursa City Earthquake Early Warning and Rapid Response System. The project team is going to cooperate with local authorities to integrate their system with the national network and increase the number of accelerometers for having a better station coverage for implementing an early warning and rapid response system for Bursa. To this aim, ArNET seismic network is integrated with Bursagaz network. Thus ArNET data of fifteen online seismic stations will be combined with Bursagaz data in the Bursagaz operation center. The SEISAN and SeisComp data acquisition and automatic location software are already installed and at present local earthquakes are monitored and located automatically. We are still working on the improvement of the system to reduce false alarms and time delays of information about location and magnitudes of earthquakes. Installation procedure of Bursagaz Real-Time Seismic Risk Reduction System, algorithms of automatic shutdown system, integration of seismic monitoring network, recorded events, system response, combination and integration with earthquake early warning and rapid response system will be discussed.

Keywords: seismic risk, early warning and rapid response, shutdown system

