Appendix A: Network of Stations for Robust Noise Monitoring of Anomalous Seismic Processes (RNM ASP)

INTELLECTUAL SEISMIC-ACOUSTIC TELEMETRY STATION
EURASIAN PATENT № 011003 30.12.2008
INTERNATIONAL PATENT № WO/2007/143799

1 – the receiver of seismic acoustic signals
2 – the block of analysis of seismic acoustic signals and noises
3 – the block of analysis of seismic signals
4 – the block of intellectual identifications
5 – the block of telecommunication

Focus of anomalous seismic processes

1. Stations for robust noise monitoring of anomalous seismic processes are designated not for earthquake prediction but merely for monitoring of the beginning of earthquake preparation process, that is, for monitoring of anomalous seismic processes. 5 such stations have been built and experiments have been launched at them. Construction of a fifth station is near completion.

2. The following experimental stations have been built: at Qum Island in the Caspian Sea (operating since July 1, 2010), in the regions of Shirvan, Siazan, Naftalan, Neftchala (2011-2012).

3. Steel bores of oil wells are used as inverted antennas at the depth of 3-6 km. Seismic-acoustic waves are received within a radius of 300-500 km by means of a hydrophone.

4. Analysis of noisy seismic-acoustic signals, both in the presence and in the absence of ASP (earthquake preparation process), by means of conventional technologies gives random estimates.


RNM ASP station locations map
● projected station
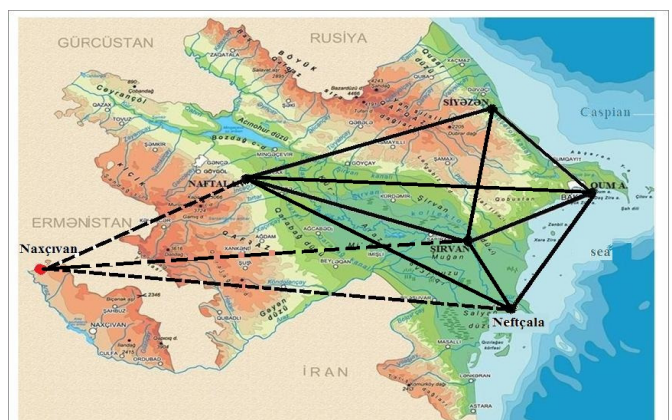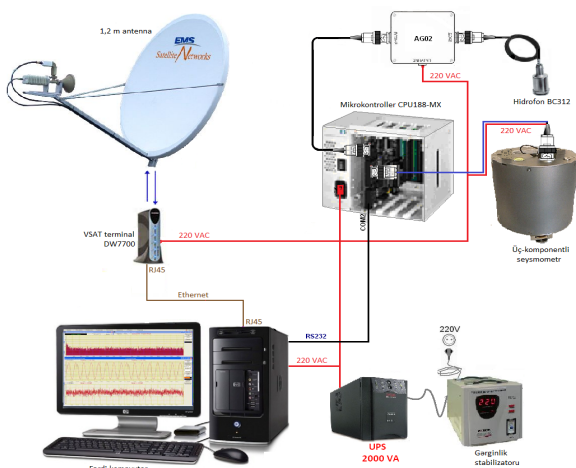
5. At the beginning of ASP, estimates obtained by means of conventional technology are random. On the other hand, estimates of values of noise correlation, cross-correlation function between the seismic-acoustic signal and its noise, as well as noise variance assume non-random nature and exceed the threshold level. These characteristics are used as informative attributes of ASP beginning. This continues till the ASP is over. It is experimentally proved at all 4 stations, making it possible to detect the beginning of ASP, that is, to perform monitoring of ASP.

Diagrams of estimates of cross-correlation function between seismic-acoustic signal and noise:
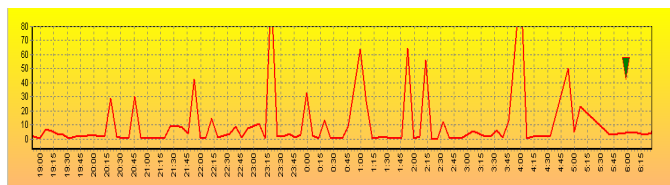
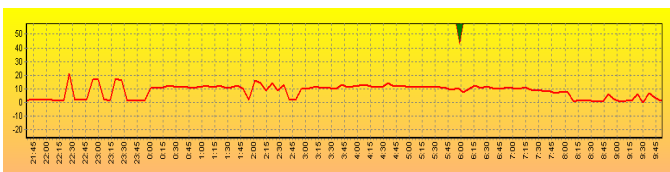Shirvan: 23 October 16:00:25 East Turkey M=5.6
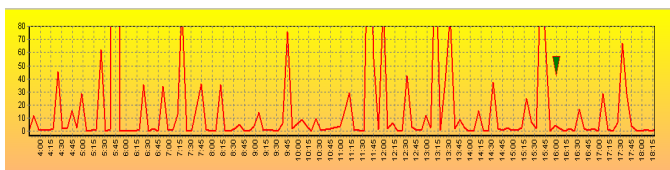
Qum Island: 23 October 16:00:25 East Turkey M=5.6
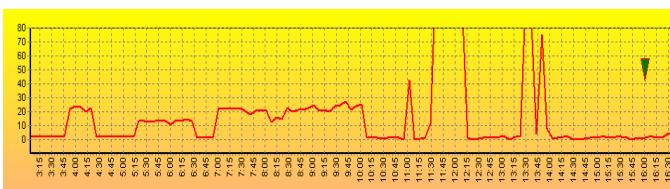
Shirvan 24 October 06:57:59 East Turkey M=3.8 prolonged earthquakes


Qum Island: 24 October 06:57:59 East Turkey M=3.8 prolonged earthquakes

6. Each station performs monitoring of ASP within a radius of 300-500 km 10-20 hours before an earthquake with 100% guarantee. However, each station taken separately does not allow determining the coordinates of ASP focus.

7. Determination of the coordinates of ASP focus requires synchronous analysis of seismic-acoustic signal received from 4-5 and more stations.

8. Models and technologies have been developed allowing one to determine the coordinates of ASP focus.
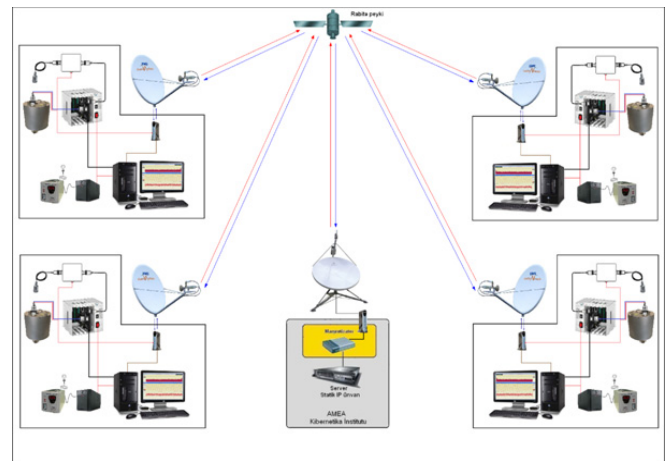
9. Models and technologies have been developed for determination of minimal magnitude of expected earthquake, as well as technologies that allow adjusting both accuracy of determined coordinates and accuracy of determined magnitude of an earthquake after a certain training period.
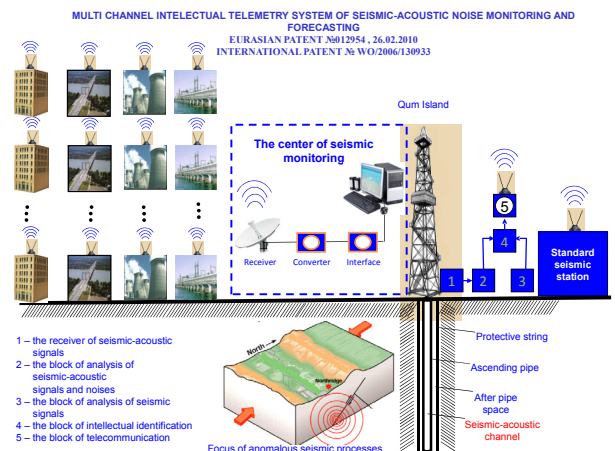
10. Models, technologies, networks and systems have been offered that allow minimizing damage caused by destructive earthquakes.

11. All applied technologies, devices and systems developed by the authors have been published and patented.