

# THE NNC RK NUCLEAR TEST MONITORING SYSTEM: EVOLUTION AND POTENTIAL

N.N. Belyashova, N.N. Mikhailova

*Institute of Geophysical Research NNC RK, Kurchatov, Kazakhstan*

Monitoring system of nuclear explosions and earthquakes in the framework of International Monitoring System (IMS) was established and successfully operates in Kazakhstan recent decades. Its development was associated with transfer of special control stations of former USSR to the National Nuclear Center of the Republic of Kazakhstan in 1994 locating on the Kazakhstan territory – Borovoye, Kurchatov, Aktyubinsk and Makanchi. Then the network was completely upgraded and added with the new stations. Network development reason was Kazakhstan signing of Comprehensive Nuclear-Test-Ban Treaty (CTBT) in 1996. According to CTBT five IMS objects have to be built in Kazakhstan. The basis of new modern national monitoring system was the stations which were built and started during 2000 – 2005 due to effective cooperation with a number of international organizations. At present NNC RK monitoring system includes: seismic monitoring network stations; - infrasound monitoring stations; Kazakhstan National Data Center in Almaty (KNDC); station communication system with National and International Data Centers.

NNC RK *seismic monitoring network* feature is that it consists of mainly high-tech seismic arrays which are regional-teleseismic upon their function. These arrays are located along the perimeter of Kazakhstan. All network stations have digital records and data transfer in real time to Data Centers. Network consists of: Makanchi seismic array (PS-23) – IMS primary station; Borovoye seismic array (AS-057) – IMS auxiliary station; Akbulak and Karatau seismic arrays establishing with AFTAC (USA); Aktyubinsk 3 C station (AS-059) – IMS auxiliary station; 3 C station of IRIS system – Borovoye and Kurchatov, KNDC 3 C station in Almaty; old large-aperture “triangle” in Borovoye. Upgraded system “Kurchatov-Krest” (AS-058) – IMS auxiliary station is coming up to operate.

*Infrasound monitoring system* consists of new infrasound array Aktyubinsk (IS31) which is in the subsystem of IMS infrasound monitoring. Moreover there are old infrasound stations Borovoye and Kurchatov which require significant upgrading.

All new stations are high-efficient both teleseismic and regional monitoring. It is due to some conditions. First, accurate site location. Second, successful choice of array aperture and configuration. Third, recording equipment installation in the boreholes. One of the main station characteristics is spectral level of seismic noise. Seismic noise spectral density analysis in broad frequency range shown that noise models at all NNC RK stations are close to low level of world noise models, and noise variations, associated with diurnal variation, are small. This condition determines a high efficiency of the stations both recorded signal quantity and record quality.

*Data Center* was established *in Almaty* in 1999. NORSAR (Norway), AFTAC (USA), LDEO (USA), IRIS (USA), CEA/DASE (France) made a great contribution in Center establishment. Main objectives of Data Center are regular data collection and transfer from the network stations in real time, verification of network operation, and data processing. With the purpose to conduct all these objectives communication system of Center and stations was established and was being constantly improved. Data from all stations through radiotelemetry and uplink channels transfer to Center. Computerized testing of communication channels and recording equipment are conducted in streaming operation in real time. Data Center outgoing data is transferred through the uplinks and Internet to IDC in Vienna, Austria, NDC in Florida, USA and in IRIS, USA.

Data processing multi-level system and KNDC product exchange with the other Centers and interested organizations were established. KNDC data processing results are used in

European Mediterranean Sea Center (EMSC) (France), International Seismic Center (ISC) (England), Geophysical Survey Data Center (Russia), and Institute of Seismology MES RK.

The investigations for detection efficiency increase and signal evaluation, location accuracy and identification reliability of different nature seismic event are conducted in Center. Station capability evaluation in regional and global monitoring in the view of magnitude sensitivity for events from different parts of the earth is conducted in the Center. Data basis on different aspects of seismic and infrasound processing are established.

Due to the new stations NNC RK and Data Center the number of located events is significantly increased in Central Asia including Kazakhstan. It is important to estimate seismic hazard of these territories. For the first time unique data has been taken for such Kazakhstan areas which were earlier considered aseismic according their seismicity. Seismotectonic environment in the central and east parts of Kazakhstan were studied for the first time as well. Seismic array data allowed determining new features of the Central Asia strongest sources. Kazakhstan stations play an important role for the seismic event global monitoring. The evidence of this fact is their high participation in Reviewed Event Bulletin (REB) in International Data Center.

NNC RK monitoring system requires both technical and methodical developments. It is desirable to develop monitoring system for full and accurate seismicity estimation throughout all Kazakhstan territory especially in the central and western parts of Kazakhstan. It will be good to build the new modern seismic array in the Central Kazakhstan. Highly sensitive 3 C stations can be established in the western Kazakhstan which will help jointly with Akbulak and Aktyubinsk stations to obtain accurate information for natural and man-caused seismicity of this important industrial area. Global and regional monitoring requires upgrading of current large-aperture system in Borovoye.