In the developed industrial countries, as USA and Japan, much attention is being given to engineering-seismometric service. For instance, 100 seismographs are installed in the network of high-speed railway lines Sinkansan, Japan, as long as 2 thousand kilometers, i.e., 1 seismograph for the 20 km of the track [1]. Seismic instruments were installed in all environmentally hazardous enterprises and important buildings (large bridges, tunnels, television towers) to record seismic effects as well as dynamic loads (man-made vibrations from working equipment and from natural microseisms) for nondestructive test of the state of these constructions.

In Pribaikalye there is a number of industrial works, where because of seismic hazard of the region engineering-seismometric observations are to be carried out to meet federal and industrial safety requirements. In Irkutsk region Baikalsk, Angarsk, Shelekhov, Usolje-Sibirskoe and Sayansk are the cities with the most environmentally hazardous productions. The problem of organizing engineering-seismometric service was especially acute in connection with the introduction of a new map of General Seismic Zoning (GSZ), which implies increase of initial seismicity in the areas with hazardous production.

Following «Seismic safety of Irkutsk» program, Institute of the Earth Crust SB RAS and laser party of SB RAS created the engineering-seismometric station (ESS) [2]. Nowadays ESS are installed in the Angarsk electrolysis chemical plant (AECP), Irkutsk hydro electric power station (HEPS) and 9-storey residence house of 135 series in Akademgorodok (Irkutsk city). In January 1998 a seismic station was put into service in AECP. The station has 48 seismic channels. To cover the overall dynamic range of the record, beginning from earthquakes with intensity less than 1 and ending with earthquakes which intensity is 9, various kinematic parameters of seismic oscillations (displacements, velocities, accelerations) were used to record ground motions and oscillations of the constructions with production equipment. Ground motion acceleration is generally applied to design seismic resistance of constructions. To obtain energy, stress and deformation assessments, vibration velocity is used.

In November 1998 a 32-channel ESS in the Irkutsk HEPS and in December 1998 a 16-channel ESS in 9-storey residence house in Akademgorodok were brought into operation. The quality and reliability of digital seismic information from the engineering-seismometric stations depend largely on the metrological characteristics of prime converters (seismometers, accelerometers) and the path of digital transform of a signal. Determination of basic metrological characteristics of engineering-seismometric station is made by the method of direct measurements using a special vibration platform.

Over the period of operation, the engineering-seismometric stations recorded a number of earthquakes with epicentral distances from 90 to 600 km and energy classes from 9 to 15, involving a series of earthquakes felt in Irkutsk and Angarsk. For example, AECP station recorded earthquakes with maximum amplitude of velocity 0.44 cm/s and maximum amplitude of acceleration 24 cm/s² that corresponds to intensity 4-5 on MSK-64 scale. Relations between the maximum accelerations on the upper floor of constructions with production equipment and the maximum accelerations on the ground for 19 earthquakes, recorded by AECP station, vary from 0.7 to 6.6. This is related with the intensity of seismic effect and frequency composition of oscillations. Amplitude-frequency and dynamic characteristics of supporting structures were determined. The data obtained made it possible to assess possible accelerations of production equipment from earthquakes occurred in major seismically active zones.

42 earthquakes were recorded on the dam of Irkutsk HEPS. Some of these with intensity 5-6 on scale MSK-64 were felt in Irkutsk Records of these earthquakes were used to predict «average» grounds on the territory of the Irkutsk city and to predict oscillation parameters of the dam of Irkutsk HEPS at maximum credible earthquake from zones of Probable Earthquake Foci (PEF) with K=16.8 and M = 7.5. The obtained dynamic characteristics of buildings and...
constructions in which engineering-seismometric equipment was installed enable one to predict their behavior under influence of earthquakes of varying intensity and from various epicentral zones.

In addition to stationary ESS, Baikal-12 and Baikal-14 stations were developed and constructed to perform engineering-seismometric measurements. The former 12-channel station with 24-step analog-to-digital converter is used to measure dynamic characteristics of buildings with the help of microseisms. Measurements made by this station allowed determinations of dynamic characteristics of buildings in introducing passports. The station also makes it possible to perform seismic microzoning using various methods: earthquakes, explosions, crumps, seismic exploration and microseisms. Baikal-14 station is dedicated to the performance of explosion and vibration tests of buildings. The station has four peripheral blocks with 12 sensors connected to each of them. 48 channels keep a record simultaneously.

Engineering-seismometric monitoring in the urbanized territories with high seismic risk is of considerable importance both to specify seismic hazard and control the state of construction and to prevent man-made disasters and reduce losses from large earthquakes.

References