Radiation monitoring system at the enterprises of uranium mining by ISL method

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1. Background

Uranium in the Republic of Kazakhstan is mined by the enterprises of NAC Kazatomprom JSC by in-situ recovery method. The main radiation factors are external gamma radiation, and internal irradiation with long-lived alpha isotopes and due to radon and its daughter products.

The sources of radiation-hazardous factors are natural uranium, which occurs at all stages of the technological chain. External irradiation occurs largely in areas where uranium is concentrated in a large volume – ion exchange columns, finished products with natural uranium concentrate, during the transportation of uranium. Long-lived alpha-radionuclides can be contained in occupational dust, mainly in areas where there is a dry circulation, as well as in the case of spills of process solutions, depressurization of technological equipment and pipelines – when they dry out. Sources of radon and its fission products appear together with uranium when it is extracted from the earth interior, and since the pumping of pregnant solutions goes through pipelines to technological equipment, the greatest release of radon and its daughter products is in sorption and desorption sites, when the air-tightness of the capacitive equipment within the processing plant is violated. In addition, sources of internal radiation can be radioactively contaminated materials and equipment, as well as radioactive waste, if handled incorrectly.

Radiation monitoring is carried out in order to control the radiation situation and manage the radiation protection of personnel and the environment. Radiation monitoring is carried out using radiation-monitoring equipment according to the developed schedules by qualified personnel.

2. General information

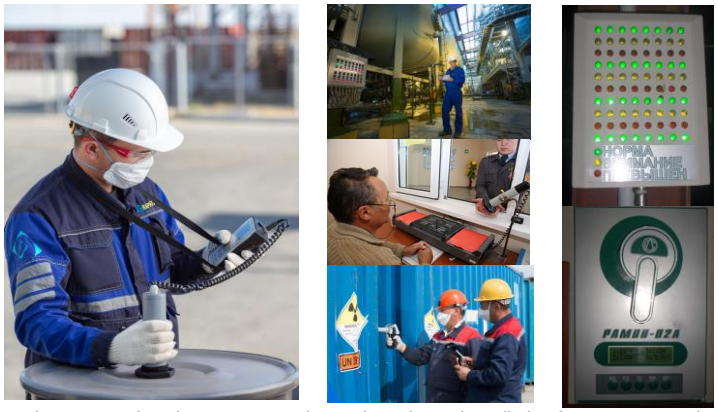
2.1. Radiation Monitoring

The schedule of radiation monitoring is developed taking into account the technological chain, the places of radiation-hazardous factors, as well as the degree of their impact on personnel and the environment. As a rule, radon and its daughter products is monitored in the shop of processing of pregnant solutions in automatic mode displaying the information on the board, the power of gamma radiation in the workplace is determined from daily measurements at the main workplaces to quarterly measurements in the territory of the sanitary protection zone and residential territory.

Examples of gamma-ray surveys of a wellfield and the territory of a settlement located near the production sites

2.2. Radiation monitoring equipment

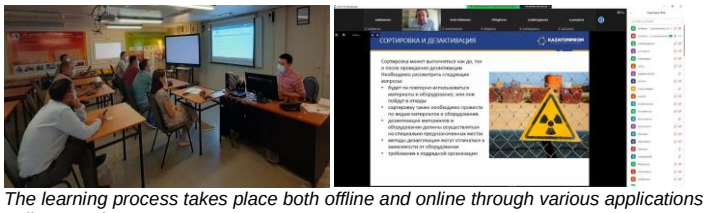
Each enterprise has different equipment for radiation monitoring to register various indicators. The radiation monitoring equipment used must be certified for use on the territory of the Republic of Kazakhstan, in accordance with the legislation, it passes annual verification by a certified organization, as well as calibration before starting work in accordance with the manufacturer's recommendations.



Various types of equipment are used to register the main radiation factors – external gamma radiation, radon and its daughter products, long-lived alpha isotopes, radioactive surface contamination

2.3. Qualification of personnel

In accordance with the legislation, mandatory training is carried out for all personnel involved in working with ionizing radiation sources. Separate requirements are imposed on employees of the units that carry out and are responsible for radiation monitoring. All employees of such units have professional training, the employees appointed responsible for radiation control are certified by the authorized state body in the field of atomic energy use. Certification is carried out once every three years.



The learning process takes place both offline and online through various applications for online meetings

2.4. Individual Monitoring

Thermoluminescent dosimeters are used to determine the dose of external radiation. They are used by all workers who work with ionizing radiation sources. For individual works, when an excess in the dose of external radiation may occur, when evaluating newly introduced production capacities, or when eliminating radiation accidents, the use of direct-indicating electronic personal dosimeters is provided. The dose of internal radiation is determined based on radiation monitoring data and the time spent by personnel at specific sites.

The uranium content in personnel bioassays is analysed at ISR enterprises. However, legally, at the moment, the data from the analysis of bioassays are not the source of calculating the dose of internal radiation, but allow us to assess the control measures applied.

The main methods of individual monitoring are thermoluminescent dosimeters, personal dosimeters as well as the use of computational methods

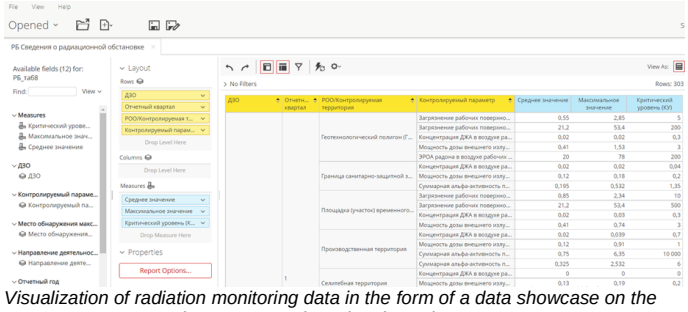
3. Analysis and recording

3.1. Monitoring compliance with radiation protection requirements

Depending on the degree of risk, selective audits of workplaces, equipment and personal protective equipment used, and the quality of maintenance of ventilation equipment are carried out. Inspections are also carried out by the authorized body in the field of the use of atomic energy. Controlled levels of radiation-hazardous factors have been introduced at enterprises, which make it possible to respond in a timely manner to changes in the radiation situation. If the controlled levels are exceeded, an investigation is conducted.

3.2. Analysis and recording

Every enterprise individually and Kazatomprom as a whole analyzes radiation monitoring data, compares data with control and acceptable levels, determines the causes of deviations in case of presence. The analysis of doses between uranium mining enterprises is also carried out. All data is stored in electronic systems, from relatively simple tabular editors to a corporate data warehouse system.



Visualization of radiation monitoring data in the form of a data showcase on the Corporate Data Warehouse system by using the BI instruments

4. Continuous improvement

The level of radiation exposure at ISL enterprises is consistently low; the level of the average radiation dose is about 1.5 mSv /year, taking into account natural irradiation. Measures are being taken to increase the competencies of personnel, as well as the use of scientific developments that reduce the radiation impact on personnel.