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Statistical Analysis Methods Application for the Determination of the Radionuclide Migration in the Near-Surface Storage Facilities

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At the present moment the age of the most of near-surface waste storages is more than several decades and most of protective barriers have lost their original characteristics and are not able to provide necessary insulation. As a result, atmospheric precipitations penetrate into the storage and redistribution of radionuclides within the storage as well as their removal beyond the storage zone into the ground become possible. To evaluate the safety of the storage, first of all, it is necessary to determine the presence or absence of the storage tightness violation and, in case of need, try to evaluate its quantitatively and qualitatively. Examination of the storage facilities condition is effected by means of drilling of observation and research wells in the body of the storage and the ground of the nearby zone.

The results of the statistical evaluation of the geochemical studies of the geological objects has determined that as a rule the normal concentration distribution is typical for rock forming distributed elements and the concentration of rare chemical elements which quarks are less than 0.05% are distributed by lognormal. Also it was indentified that the nature of the statistical distributions of the components in the array is connected with the genesis of this geological formation. Normal distribution involves the exposure of a number of factors that are in addition relations, while the lognormal distribution causes their multiplicative interaction. The same patterns are observed in the study of the technogenic pollution arising under the influence of industrial facilities for relatively small period of time.

For the near-surface RAW storage formation of a new geochemical solid field occurs under the conditions corresponding to the theoretical scheme of a lognormal distribution of radionuclides. It allows to conclude that there is connection between the intensity of migration and geochemical properties of the field, in particular, the statistical characteristics of the distribution of values of exposure rate.

The closeness of the empirical distribution to the theoretical lognormal distribution the exposure dose rate (EDR) values indicates the degree of conversion of geochemical field of the RAW array and the development of radionuclide migration. With the development of migration the shape of the distribution is changing. That allows us to estimate the intensity and dynamics of migration. Correspondence of the empirical distribution to the theoretical one is determined by Pearson criterion (χ^2). This evaluation has been effected according to the results of several surveys of existing storage. First of all we should mention uneven distribution of the values of EDR and different nature of variability for different parts of the storage facilities. Clearly pronounced anisotropy of the geochemical fields of the RAW array points to the predominance of the horizontal migration of radionuclides. According to the results of the calculation of the coefficients of the correlation between neighbouring wells within the same section and on different sides of the walls, areas of probable destruction of the intersectional partitions inside the storage and availability of migration flows have been identified. The conformity of the statistical distribution of EDR for these sites (approximately at the depth of 2,0m) as well as the areas with a clear multimodal histogram which indicates the high heterogeneity of the studied complex has been determined. In these areas the RAW array has not been subject to the "smoothing" action of the migration and has kept the features of primary heterogeneity.

The proposed method of statistical studies of the geochemical structure of the RAW array provide the unique possibility to obtain more complete data on the state of the array RAW and to evaluate the presence and intensity of migration processes in different parts of the storage that allows to examine the degree of preservation

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Primary author: Mrs VESELOVA, Elena (Russia, Moscow, SIU "RADON")

Presenter: Mrs VESELOVA, Elena (Russia, Moscow, SIU "RADON")

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