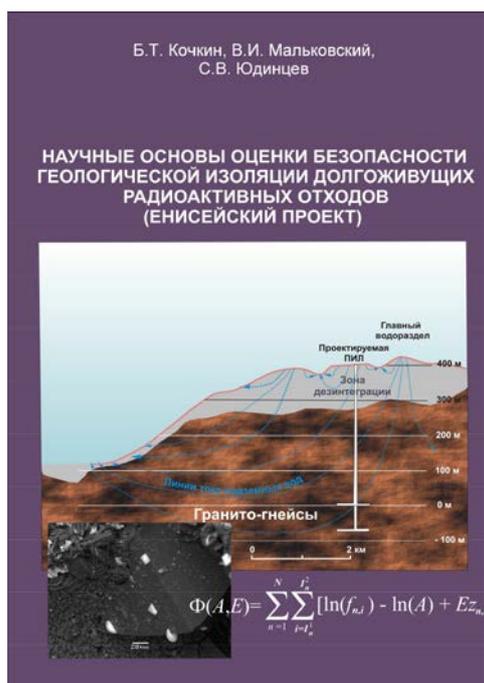


Scientific basis for the safety assessment of long-lived radioactive waste geological disposal (the Eniseyskiy project) / B. T. Kochkin, V. I. Malkovskiy, S. V. Yuditsev. — Moscow: IGEM RAS, 2017. — 384 p.: figures, tables, color illustrations; ISBN 978-5-88918-047-0: 300 copies.



In 2017, a new monograph focused on the geological disposal of radioactive waste (RW) was issued being a continuation in a series of comprehensive publications produced by a group of authors from the IGEM RAN working in this field. In Russia, the subject of RW geological disposal has been investigated and elaborated for several decades. Relevant milestones are marked by publications of only a small number of organizations with the leading ones being V.G. Khlopin Radium Institute, IGEM RAN, VNIPIPT and IFKhE RAN.

In the last decade, this subject matter has been considerably elaborated due to the implementation of the Federal Target Program on Nuclear and Radiation Safety and the adoption of RW Management law. Under these circumstances, importance and relevance of the comprehensive work reviewed below has increased considerably.

To achieve the intended objectives, ten substantial sections varying in size from 6 to over 100 pages have been included to the monograph. Presented below, is the summary of relevant sections given the sequence in which they appear in the book.

Safety of RW geological isolation. This section being an introductory one includes a great

deal of interesting and useful data on the subject matters traditionally thought as IGEM RAN areas of strength, namely, natural analogues for RW geological repositories including both natural deposits and analogues of isolation systems. As for the site selection, this section presents all the points evidencing in favor of the Eniseyskiy site. Two small sub-sections can be pointed out: experience gained from the operation of Russian underground research laboratories mentioning research projects performed in underground openings of the Mining and Chemical Combine (MCC), as well as the one presenting relevant schedules for repository construction. Allegations presented by the authors in the latter one, are believed to be somewhat lacking of criticism when it comes to the analysis of relevant information and its sources which also appears to be quite typical for other sections.

Safety assessment. This relatively brief section offers quite a comprehensive discussion of both globally recognized approaches and authors' own vision of some safety assessment elements. It seems particularly interesting in the context of time-frames for which relevant processes affecting safety assessments can be credibly forecasted.

Geological disposal in crystalline rocks (by the example of the Eniseyskiy project). This section provides a most detailed overview of the disposal system. Of particular focus are the comparisons of different disposal parameters with those from the projects developed abroad. A big number of such differences can be noted, namely, "weak" aluminum phosphorous glass, shorter service life of engineered barrier system. In the Russian project, the latter one accounts for over 1,000 years, in Belgium and Czech Republic — over 10,000 years, in France — over 100,000 years, in Switzerland — over 150,000 years and etc. One of these particular features seems quite unusual for Russian readers constantly thinking of Siberian climate as of a very harsh one: potential areas for repository constructions in so called Northern countries have been continuously covered with ice sheets. No ice sheets have ever reached the Eniseyskiy site, although in the past it entered the continuous permafrost zone of several meters in depth.

Evolution of geological isolating system. This section, the largest one of the monograph (over 100 pages), was developed based on the

international methodology enabling to evaluate safety functions of such facilities — so called features, event and processes (FEPs). Many of these FEPs presented in the monograph are exemplified based on a review of multiple literature sources mostly international ones. This comprehensive properly arranged body of data is believed to be of a key practical importance for further development of repository safety case.

Two brief sections “Scenario development” and “Modelling strategy for the safety assessment” features quite successful attempts on adjusting international developments in accordance with the modelling tasks specified for the Eniseyskiy project.

The following three sections provide an overview of ground water flow, heat transfer and radionuclide migration models.

Final section of the monograph provides an analysis discussing the effects produced by different features, events and processes on radionuclide migration in the underground environment of the Eniseyskiy site.

Considering the goals of this review and our outlook on the quality of the analysis presented in the monograph it seems quite worthwhile to list the key objectives that had been set by the authors themselves, namely:

1. *From the standpoint of fundamental science and considering relevant international experience, to state key scientific and engineering challenges for the safe implementation of the geological disposal project in Russia (Eniseysiy project);*

2. *To give an overview of the project considering current progress in science and engineering. Given the interest expressed, the information presented should be understandable for key stakeholders, namely, project administrators, local authorities and public.*

3. *To set the tasks for future operations, but not a program of specific R&Ds for researchers who will be involved in the project for the next decades...*

The first of these key objectives has been fully accomplished. Vision of main challenges is provided for a perspective almost identical to the real one. The only exception are the authors perceptions regarding the tasks associated with characterization of RW subject to disposal — to date only the data regarding glasses was summarized.

As regards the current scientific and engineering status of the Eniseyskiy project this information seems to be not comprehensive enough. This point has been acknowledged by the authors themselves in the final section of the monograph which was rather convincingly explained referring to the classified nature of this subject in the past. Relevant conclusion seems quite interesting and should be pointed out:

“It is mostly due to the fact that relevant materials were classified. Preliminary materials of R&D reports have never been presented in open press. For this reason, unbiased evaluation seems to be impossible for most of public statements made on the reliability and safety of Russian disposal technologies. Secondly, engineered barrier system (EBS) has not been subject to enough detailed elaboration when compared to similar projects implemented abroad. Possible third reason is the long-term safety concept itself with a focus placed on geological environment, thus, reducing the need of conducting more detailed research to evaluate the robustness of engineered barriers. For over 25 years, geological investigations were performed under site selection process. Their findings were presented in a number of article, conference proceedings and monographs. At present time, an underground research laboratory is planned for construction at the selected site. Various experiments enabling to evaluate technical properties, performance and feasibility of EBS components will be performed in the URL during several years. Relevant knowledge will be gained based on them”.

Another goal regarding the discussion of tasks for future operations has been also accomplished. Furthermore, for some tasks a program involving specific R&Ds has been provided.

Apart from the big amount of data presented (including not only the text of the monograph itself, but also relevant references), yet another valuable aspect should be noted. This book serves a practical evidence suggesting that scientific potential in this field exists in the Russian Federation being independent from design development entities and able to state and argue for relevant assumptions. This aspect is believed to be of importance considering the final goals of the Eniseyskiy project. Considering the changes introduced to the way in which the project is performed, it seems important to address a number of tasks presented below. Firstly, detailed information on the project must be made available to monograph authors and other independent experts providing for its acceptability by the scientific community. Secondly, proper conditions have to be set enabling to generate ideas and proposals on setting the required experiments in the URL and those regarding the R&D program. This seems quite important considering the operations associated with the development of the facility itself, namely, development and implementation of RW pre-disposal program, which has not been mentioned by the authors due to their field of expertise.

The latter one is mostly important for the executive management team running the Eniseyskiy project and for the editorial team of Radioactive Waste Journal.

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