

THE INITIAL STAGE OF THE LITHUANIAN DEEP GEOLOGICAL REPOSITORY PROJECT

1. Background

Spent nuclear fuel, classified as high-level radioactive waste, was transferred to special storage facilities at Ignalina NPP by 2022 and other long-lived radioactive waste will be transported in special containers to the relevant INPP storage facilities by 2038.



By the end of the safe operational period of the casks (which was foreseen in the project) and high-level radioactive waste storage facilities (in 2050 and 2067 respectively), preparations must be made for the final disposal of high-level and long-lived radioactive waste.

“Development Program for Decommissioning of Nuclear Power Facilities and Radioactive Waste Management for 2021–2030” (hereinafter - the Program), which replaced the previous Program of 2015, was approved by the Resolution No. 76 of the Government of the Republic of Lithuania on 3 February 2021.

The Program establishes that the only sustainable final method of disposal of spent nuclear fuel and other long-lived radioactive waste, that currently can be considered, is their placement in a **deep geological repository** (hereinafter - DGR).

State Enterprise **Ignalina Nuclear Power Plant** (hereinafter - INPP) was appointed as the institution responsible for the implementation of the DGR project in Lithuania.

Currently, following the recommendations of the IAEA, INPP is carrying out the initial stage of the conceptual planning project - site selection.

2. Initial stage of site selection

2.1. DGR potential formations

The only sustainable solution is to construct DGR in stable, sufficiently deep geological formations. There are 4 geological formations in Lithuania, which are potentially suitable for DGR construction:

- Crystalline basement,
- Cambrian clay,
- Permian evaporates,
- Lower Triassic clay.



Geological formations potentially suitable for DGR construction in the territory of Lithuania (layout scheme)

2.2. Initial list of potential sites

Negative screening was performed to identify potential sites for DGR, i.e. preliminary unsuitable sites were identified under the following established boundary conditions (ineligibility criteria):

- water body protection zones;
- protected areas;
- areas of mineral deposits;
- cities;
- European Natura 2000 sites;
- formation thickness < 50 meters;
- depth of formation < 200 meters;
- paleo-incisions of the pre-Quaternary;
- areas (land plots), with an area not exceeding 10 km².

After eliminating the areas according to the ineligibility criteria **110 potential sites** were identified in all geological formations. Their total territory is **5 632 km²**.

2.3. Assessment of Initial list of potential sites

For the selection of DGR site, all potential territories are assessed in accordance with the general requirements set by the IAEA, i.e. (I) *Long-term safety*, (II) *Technical suitability and operational safety*, (III) *Socio-economic, political and environmental circumstances*, related criteria.

The assessment shall cover the priority factors, the most important of which are the factors ensuring long-term safety.

At the initial stage, in order to identify subset of sites with highest potential as a group, potential territories suitable for the construction of DGR were independently assessed according to the following selection criteria:

• Geological suitability criteria

A group of criteria preconditioning the sufficient stability of the DGR (consisting of 11 criterion) and a group of criteria preconditioning the sufficient physical isolation of the DGR from the ecosphere (consisting of 5 criterion) were identified in 2021. *Assessment of previously detected 110 potential DGR locations, considering geological parameters, was executed in 2022.*

• Socio-economic criteria

A comprehensive set of 32 indicators was established based on 3 dimensions (1-Territory planning, 2-Environmental, 3-Socio-economic) to perform individual impact assessment. Assessment of previously detected 110 potential DGR locations, considering non-geological parameters, i.e. Territorial conditions, Natural environment conditions, Socio-economic conditions, was executed in 2022.

• General safety criteria

General safety assessment of geological formations potentially suitable for the construction of DGR in Lithuania and preparation of general safety criteria for the construction of DGR in Lithuania were carried out in 2023.

For the comprehensive assessment of the results, conclusions and recommendations of the studies carried out in the DGR project, the following works were completed in 2023:

• Comprehensive assessment of the results of the studies carried out in the DGR project

After applying all - geological suitability, socio-economic and general safety - criteria parameters and their indicators, 33 potential sites totally were eliminated based on 7 criteria. 77 sites are considered suitable for further studies.

Based on the Analytic Hierarchy Process (AHP) methodology, a complex method for further evaluation of potential DGR construction sites will be developed. Assessment will be performed in accordance with the developed method.

3. IAEA ARTEMIS Mission

On 27 October 2022, the Ministry of Energy of Lithuania requested the IAEA to undertake an ARTEMIS review of the DGR project in Lithuania for spent fuel and intermediate level radioactive waste.

The ARTEMIS review provided an independent international evaluation of the studies carried out by Lithuania on the first phase of the siting process of the envisaged DGR, as part of the Programme, approved by the Government of the Republic of Lithuania on 3 February 2021.

The ARTEMIS Review Team commends Lithuania for its early development and implementation of the DGR programme, in particular by initiating a site selection process and actively planning for the next steps of the project. The Artemis Review Team considers that the geological, socio-economic and safety studies provide a comprehensive basis to support the initial stage of the siting process, the next stages of site evaluations and conceptual design.

As such, Lithuania is one of the few countries factually developing and implementing a programme for the safe and long term disposal of radioactive waste and spent fuel in a deep geological repository. In line with the above, the ARTEMIS Review Team noted as a good practice that at this point a peer review was requested on the site selection process.

The ARTEMIS Review Team provided 8 recommendations (R) and 6 suggestions (S) to support Lithuania in the site selection process for their DGR project.

4. Knowledge sharing

The planning and implementation of the initial stage of the Lithuanian Deep Geological Repository project, the involvement of independent IAEA experts, the experience gained and lessons learned may be relevant for other institutions planning to develop national DGRs.

