THE NATIONAL DISPOSAL FACILITY FOR RADIOACTIVE WASTE IN BULGARIA

T. v Berlepsch¹, E. Gonzalez Herranz², I. Stefanova³, B. Haverkamp¹, G. Nieder-Westermann¹

¹DBE TECHNOLOGY GmbH, Peine, Germany
²WESTINGHOUSE ELECTRIC Spain, Madrid, Spain
³Bulgarian State Enterprise for Radioactive Waste Management (SERAW), Sofia, Bulgaria

E-mail contact of main author: thilo.berlepsch@dbe.de

Abstract. The need for building a National Disposal Facility (NDF) is recognised by the Bulgarian government and the Bulgarian State Enterprise for Radioactive Waste Management (SERAW). To address this need SERAW is endeavouring to build a near-surface repository for short-lived low- and intermediate-level radioactive waste to discharge its statutory responsibilities in waste management. The European Union finances the establishment of the NDF through the Kozloduy International Decommissioning Support Fund (KIDSF). SERAW placed a contract for the development of the design to the Consortium of Westinghouse Electric Spain S.A.R, DBE TECHNOLOGY GmbH, and ENRESA. Two Bulgarian companies participate also in the project as subcontractors – EQE Bulgaria and to a lesser extent КК–Project. After obtaining SERAW's approval for the preferred repository conceptual design variant, the repository project usually referred to as R Project 5, focused on developing the Technical Design and preparation of the Intermediate Safety Analysis Report (ISAR) that demonstrates the safety and suitability of the proposed NDF design. These documents were delivered to the relevant Bulgarian authorities. The required permits have either been received or are expected before the end of 2016. This paper summarises the main steps and achievements of R Project 5.

Key Words: R-Project 5, National Disposal Facility, Radioactive Waste Management, Licensing.

1. Introduction

In the framework of the accession treaty to the European Union the Republic of Bulgaria committed itself to the early decommissioning of the four WWER 440-V230 reactors at the Kozloduy Nuclear Power Plant (KNPP). Due to this early decommissioning large amounts of low and intermediate radioactive waste will arise much earlier than initially scheduled. Consequently, Bulgaria has intensified its efforts to provide a near surface disposal facility for low and intermediate level waste (LILW) with the required capacity. It is supported in this endeavour by a compensation mechanism established by the European Union, the “Kozloduy International Decommissioning Support Fund (KIDSF)”, aimed at alleviating the significant impact of the early NPP phase out on Bulgaria’s economy. The fund is managed on behalf of the European Union by the European Bank for Reconstruction and Development (EBRD).

In a series of projects the State Enterprise for Radioactive Waste (SERAW) selected a site for the National Disposal Facility (NDF) in the vicinity of the KNPP at Radiana, which is located on the terraces of the Danube River valley's south rim. This early work also specified Enresa’s facility at El Cabril as the reference design for the NDF. SERAW placed a contract for the development of the design of the NDF with the Consortium of Westinghouse Electric Spain S.A.R and DBE TECHNOLOGY GmbH of Germany, with ENRESA, the Spanish National Waste Management Agency providing technical review and support. Two Bulgarian companies participate also in the project as subcontractors – EQE Bulgaria and KK–Project. The project's official name is “Technical Design and ISAR Preparation for the National Disposal Facility at Bulgaria”, usually referred to as “R-Project 5”.

03b – 17/ID 183. Disposal of Very Low Level Waste & Low Level Waste
The NDF design work started in October 2011. Initially, two repository conceptual designs were developed considering the particular characteristics of the Radiana site. The most favourable variant was selected by means of a formal multi-attribute analysis with evaluation criteria such as operational and long-term safety, environmental impact, constructability, initial investment, and operational costs. SERAW approved the recommended Conceptual Design on December 2012, and authorised the Consortium to begin development of the Technical Design. Since then the Technical Design work has been completed and submitted to SERAW. Simultaneously to the preparation of the Technical Design for the NDF, the consortium also developed the Intermediate Safety Analysis Report (ISAR), currently awaiting final approval.

2. The Repository Design

The Radiana Site, a quasi-rectangular 46-hectare area with approximate maximum dimensions of 470 m x 1250 m, is located between the KNPP Administrative Road connecting the town of Kozloduy with the NPP on the north and Road No. 11 to the south connecting Hurletz and Kozloduy. The site is located on sloping terrane between the second and sixth loess terraces of the river Danube.

The NDF shall be able to accept and dispose of all Category 2a radioactive waste (RAW), corresponding to what is usually referred to as Short-Lived, Low and Intermediate-Level Waste (SL-LILW), arising in Bulgaria from the operation and dismantling of the national nuclear facilities. According to forecasts the NDF will receive conditioned waste packed in 18,615 cubic-shaped concrete containers (i.e., waste packages). The waste packages have a side length of 1.95 m and a weight of up to 20 tons. The total volume occupied by these waste packages will be 138,200 m³. The radionuclide inventory is approximately $2.4 \times 10^{14}$ Bq.

The NDF design relies on a multiple barrier isolation system. The isolation function is guaranteed by the system as a whole so that possible deficiencies of a barrier or its degradation over the course of time are compensated by other barriers, thus ensuring that the protection objectives are achieved. The safety of the facility is based on a defence-in-depth concept consisting of a system of physical barriers and administrative measures.

For practical and operational safety reasons the repository facilities have been grouped into:

- Disposal zone, in which the disposal cells are located
- Building zone, in which the Waste Reception and Buffer Storage (WRBS) Building, the site administration, control room and ancillary and support buildings are located.

The NDF has 66 disposal cells for waste package disposal. These disposal cells are located on 3 equal platforms, each with 22 disposal cells and their related systems. A first disposal platform will be constructed prior to disposal start, the second approximately after 20 years, and the third after 40 years of operation. The disposal cells are arranged in two lanes, each with 11 disposal cells. The disposal cells are monolithic rectangular boxes with two inner walls made of reinforced concrete, with a capacity for 288 waste packages emplaced in 3 chambers of 96 waste packages each (8 x 3 waste packages in plan, 4 layers in height). The external dimensions of each disposal cell are 20.15 m long by 17.05 m wide. The height is 9.45 m measured from the foundation level up to the top of a full and sealed disposal cell. Each storage platform will host 6,336 waste packages corresponding to about 20 years of repository operation. The total disposal capacity of the NDF will be 19,008 waste packages.

After a disposal cell is fully loaded with waste packages, it will be closed with a reinforced concrete slab. During the disposal process and construction of the concrete slab the disposal cell will remain covered by a mobile roof to protect loading and closure operations from
inclement weather conditions. The mobile roof also houses the overhead crane used to emplace waste packages into their final position within each disposal cell. Before the mobile roof is relocated to the next disposal cell position, hydro insulation protective measures are applied over the exposed surfaces of the closed disposal cell.

A critical component of the disposal system is the Infiltration Control Network, which consists of a pipe system to collect and control the water that could enter a disposal cell after closure and interact with waste. The pipes are located in an accessible underground gallery below the disposal cells. The system includes a pipe connection coming from each disposal cell and a collection tank. Water is exclusively driven by gravity.

The Building Zone contains the entire infrastructure needed for the efficient and safe operation of the NDF. The most important structure in this zone is the Waste Reception and Buffer Storage (WRBS) Building. The WRBS Building is designed to receive each radioactive waste package delivered to the NDF by truck. The building also provides a buffer storage capacity of 120 waste packages that allows for the regulation and optimization of the waste package flow to the disposal cells.

The NDF has a single main access that links the Kozloduy NPP road with the Building Zone. The waste package disposal operation begins in the WRBS Building waste package loading/unloading area. Here an internal transport vehicle is loaded with a waste package. This vehicle goes to the assigned disposal cell and parks under the mobile roof where the overhead crane lifts the waste package and hoists it to its storage position within the disposal cell.

At the end of NDF operations, a long-term multi-layer cover, specifically designed to prevent the intrusion of water into the disposal cells during the surveillance phase will be constructed.

3. Repository Licensing

Licensing of a radioactive waste repository in Bulgaria comprises separate licenses pursuant to different legal instruments that govern the use of land and spaces, the environmental impact of any industrial facility and/or construction works, as well as nuclear matters. Ancillary permits including site security, fire protection, and protection of the groundwater are required.

The NDF is specifically defined as a nuclear facility by the "Act on the Safe Use of Nuclear Energy" (ASUNE) and must be licensed as per the ASUNE requirements. In addition, as all industrial facility construction or infrastructure works in Bulgaria, the requirements of the Act on Territory Arrangement also apply. The responsible licensing authority for the NDF as nuclear facility is the Bulgarian Nuclear Regulatory Agency (BNRA). The responsible organisation for licensing the NDF as per the requirements of the Act on Territory Arrangement is the Ministry of Regional Development and Public Works (MRDPW). The investment proposal on establishment of the NDF is also subject to an Environmental Impact Assessment (EIA). The responsible authority for issuing decisions on the EIA is the Bulgarian Ministry of Environment and Waters (MEW).

In addition, commitments under the EURATOM Treaty have to be followed. Article 37 requires consideration of the cross-border effects, in the case of the NDF especially upon Romania. Article 41 requires projects relating to this article to be communicated to the European Commission (EC) in order to allow the EC to discuss with the Investor (i.e., SERAW) all aspects of the investment project.
3.1. Technical Design – TD

In order to assure sufficient quality in the development and review of the Technical Design the document has been structured following Bulgarian requirements for investment projects into 19 separate design parts. Additionally, in each design part of the Technical Design the documentation, which corresponds to the respective buildings and facilities in the General Layout Plan (GPL), is arranged in up to 23 separate sub-parts. The use of sub-parts is optional, i. e. they are only considered if necessary. For example, the design part Architecture is subdivided into 19 subparts describing in detail the fundamental connections and parameters for the various facilities and common areas, while there is only one subpart for the Design Part Geodesy providing the topographical base for the project. In total the Technical Design documentation prepared by the Consortium fills around 50 folders with approximately 6500 pages.

3.2. Intermediate Safety Analysis Report – ISAR

As previously stated, the license for repository construction requires completion of an Intermediate Safety Analysis Report (ISAR). The ISAR assesses the behaviour of the disposal facility and, in particular, the NDF potential radiological impact on humans and the environment. The report considers potential pathways for radionuclide releases into the environment and the resulting health effects. The ISAR shall provide convincing proof that the NDF design, as laid down in the Technical Design documents, and the planned operations are safe in accordance with applicable regulations, taking into account:

- Characteristics of the site
- Characteristics of the wastes to be disposed
- Planned activities and personnel involvement
- Characteristics of the risks associated with the NDF

4. Project Implementation

As previously described the NDF will be constructed in three stages. The auxiliary installations and the first platform of disposal cells will be built during the first stage and will provide a fully compliant disposal facility, but without the full complement of disposal cells. Subsequently, a second and third stage of construction will expand NDF to full capacity. The design takes into consideration ongoing operations during the second and third expansion campaigns. To minimize construction interference on operations a secondary access road (also used as an emergency evacuation route) will be used to access construction areas.

Full implementation of the project will include the following NDF lifecycle phases:

- Operation: 60 years – receiving and emplacing waste packages
- Closure phase after disposal end: 15 years – building of multi-layer cover;
- Institutional control after closure: 300 years – surveillance of site.

5. OUTLOOK

In principle all licensing documents have been finalised and submitted by SERAW to the responsible authorities. In expectation of a generally positive acknowledgement of the submitted documentation SERAW signed a contract with NUKEM for the construction of the NDF on July 7th, 2016. It is expected that construction works can commence at the beginning of next year.