Updates on LILW Disposal Facility in Slovenia

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ABSTRACT

Low and intermediate level waste (LILW) disposal facility in Slovenia is designed as a near-surface type. The siting process goes back to year 2004. In 2009 the government approved decree within the state spatial plan and the Vrbina site in municipality Krško was selected. For the disposal facility the environmental consent was gained in 2021 and construction licenses for nuclear facility and infrastructure in 2022 and 2023, respectively.

Work on the infrastructure started in August 2023, i.e. road reconstruction, sewage, electricity, etc. Physical security around the site is already in operation. Construction of nuclear facility itself is planned to start later in the year. Disposal unit – silo consists of primary and secondary lining with inner diameter of 27.3 m and approximately 56 m in depth. The capacity is 990 containers, N2d type, which correspond to 12.157 m^3 of LILW. Besides silo, containers and other engineering barriers, another important barrier of the system is the natural environment which is very low permeable silt. For disposal facility the comprehensive safety assessment and safety case was prepared. All performed analyses showed that the impact of the disposal facility on humans and environment will be negligible.

After the construction the trial operation will start and then operation till year 2030. After that a standby phase with no disposal will last until 2049 and then the remaining LILW will be disposed. Closing is envisioned for 2059 and the institutional control of 300 years will follow, with 50 years of active monitoring and 250 years of passive control.

Keywords: *disposal facility, LILW, radioactive waste management, Slovenia*

1 INTRODUCTION

The primary concern in the storage and disposal of radioactive waste (RW) is ensuring the safety of workers, the public, and the environment. . Slovenia is planning to dispose of low and intermediate level waste (LILW) in a near-surface disposal facility, which combines elements of surface disposal (as in France and Spain) and underground disposal (as in Sweden and Finland).In Slovenian legislation the LILW are alfa emitters with half-life exceeding 30 years and limit value for short-lived is equal or lower as 4000 Bq/g in individual waste package; long-lived waste where alpha emitters exceed the limit value for short-lived LILW.

The paper describes the updates on LILW disposal facility project in Slovenia which is currently under construction.

2 LICENSING PHASE

For the LILW disposal facility several phases of acquiring different licensing were carried out. The procedures are described below.

2.1 Sitting process

The project started in a year 2004 with the site selection phase. A Strategic environmental report was prepared and public display of all the documentation followed in a preparation of state spatial plan. The public was involved throughout public hearings and local partnerships. In the year 2009 the government accepted the Decree on national planning (DPN). With this document the Vrbina site in a municipality Krško was licensed together with near-surface silo as a disposal concept.

2.2 Environmental consent

Field investigations at the site continued from the previous phase and first iteration of safety assessment was done. Results from both processes were used in the preparation of the Environmental impact assessment report (EIA). Application for issuing an environmental consent consisted of EIA report, Design documentation for the construction, Preliminary safety report and Preliminary consent form SNSA for the construction, which was gained in 2019. Environmental consent for the LILW disposal facility was issued in the year 2021.

2.3 Construction license

For gaining a construction license, next iteration of safety assessment had to be prepared and outputs were used in the preparation of the Safety report. SNSA reviewed the report together with Project basis and after the acceptance their consent for the construction of the disposal facility was issued in January 2022. With environmental and SNSA consent together with the Detail design documentation [1] the LILW disposal facility gained a construction license for the nuclear facility in July 2022. The construction license for the infrastructure was issued in March 2023.

3 DESIGN AND DISPOSAL CONCEPT

Together with licensing process the disposal concept evolved, from conceptual design, design concept to final design in the documentation for construction. The concept is as follows: the underground silo just below the surface will be constructed for the disposal of RW. It is a near-surface type of disposal facility and will consists of administrative building, technological facility, hall above the silo and the silo (figure 1) [1, 2].

Figure 1: Planned disposal facility

Slovenian disposal facility is built for short lived LILW in solid form. RW will come from operation and decommissioning of NPP, Central Interim Storage (waste generated in medicine, industry, and research), decommissioning of TRIGA research reactor, operation of the facility and decommissioning waste of buildings at the site.

Defence in depth is thus defined primarily by the multiple barrier approach, which are final package, backfill in the package, silo and barrier between the silo and the geology of the site (figure 2). The last is important passive safety element which limits the disposed RW on people and environment. In the event of the failure of one barrier or bahavior that deviates from its envisaged bahavior, the function of radionuclide containment is taken over by another barrier. After the closure a 300-years period of monitoring is envisioned (50 year of active and 250 year of passive), but the design is based on a passive safety functions.

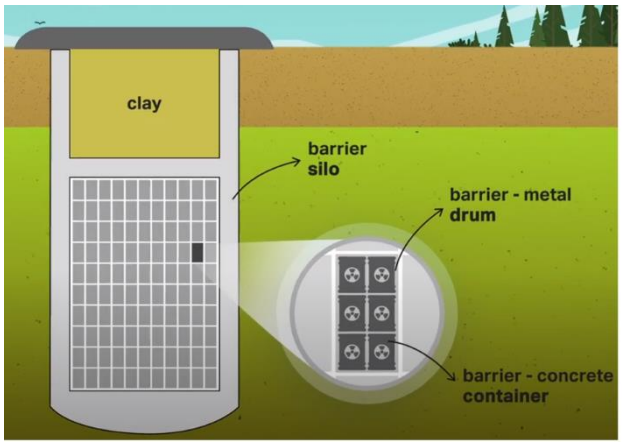

Figure 2: Silo with shown barriers

For the facility the safety assessment and safety case was prepared. After the adoption of the DPN for the needs of obtaining the environmental consent the first safety assessment was drawn up. The next iteration of safety assessment was conducted for a specific site (Vrbina, Krško), and for the developed waste disposal concept, namely near-surface underground silo. The third revision of safety assessment was done for gaining the construction license. The modelled scenarios for operational safety besides normal operational safety scenario were accident scenarios: fire, container drop of, airplane crash, terrorist attack, earthquake. Modelled post-closure safety scenarios were nominal with variations of well water included, early failure of engineered barrier, early failure of concrete barriers, river meander scenario and inadvertent human intrusion. A conservative approach was taken in the production of the safety analysis, the main purpose of which was to analyse the most adverse scenarios during operation and after closure of the disposal facility. The results thus obtained represent an envelope showing the repository's maximum possible impact on people and on the environment.

The dimensions of a final package (N2d container) are 1.95 m x 1.95 m x 3.30 m, net volume is 6.31 m^3, maximum weight is 40 t [2]. The containers will be placed in the silo from above with portal crane, 99 containers per layer in the silo. Portal crane has a capacity of 40 t and the "single failure proof" principle is incorporated into design [2]. The disposal capacity of the silo totals 990 disposal containers which correspond to 12.157 m^3 of LILW. The voids between containers will be filled with concrete.

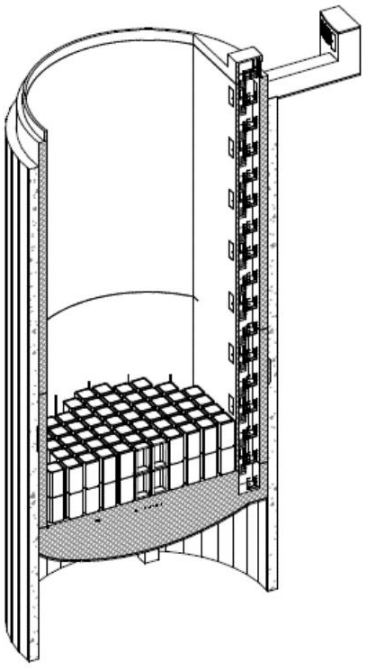

Figure 3: Silo in the operation with two layers of concrete containers disposed

The inner diameter of the silo is 27.3 m and it goes 56 m deep. It consists of primary and secondary wall and the maintenance shaft (figure 3). First the primary wall will be built to ensure protection of a construction pit. Then the secondary wall will be built from the bottom towards the surface. The bottom of the silo will be made of solid concrete, with a planned drainage pool for potential drainage water. The design of the silo is technically advanced because of: i) relatively deep excavation (primary wall construction will be a challenge because of low tolerances), ii) use of very durable concrete (silo will be in operation for approximately 30 years, after that the phase of active and passive control will follow for 50 and 250 years, respectively, after that it is planned that the concrete will degrade as slow as possible to prevent the migration of radionuclides from the silo), iii) use of a lot steel reinforcement because of anti-earthquake construction.

The hall above the silo will protect the silo and the portal crane from the weather. The concept illustrating the idea of safely disposed RW losing their potential danger over time, with increasing height towards the roof increasingly loses its materiality, fullness and is replaced by a transparent, the “empty” surface of the façade.

4 CONSTRUCTION OF A DISPOSAL FACILITY

The construction will take approximately a three-and-a-half-years. The construction itself was divided in three parts, i.e. construction of the infrastructure, construction of disposal unit and all the buildings and construction and placement of a portal crane.

The public procurement process for the construction of the infrastructure was finished early in year 2023 and the contractor was selected. Work started in August 2023. The first construction works on infrastructure, namely road renovation, sewage, electricity and telecommunications, has been completed. The physical and technical security with the outside fence (around the site of nuclear facility) was completed in April this year and is already in operation.

The public procurement process for the construction of nuclear facility and other buildings was published in June 2023 and the contractor was selected in April 2024. The contract was signed at the

end of April. The work is planned to start in the second quarter of this year. The tender process for the portal crane was published in March 2024 and is still open.

The construction of nuclear facility will start with primary wall (diaphragm) which purpose is to protect excavation pit. After that the excavations for the silo will begin and then the construction od secondary wall (the disposal unit itself). The other buildings will be constructed in parallel with each other.

In the second half of 2027 a trial operation is expected to begin. The facility will operate until 2030, after which the standby with no disposal will start until resuming the operation in 2049. At that time the remaining "Slovenian" LILW from Krško NPP will be disposed. After closure in a year 2059 a 50 years of active long-term monitoring and 250 year of passive monitoring is envisioned. After the end of institutional control, the area will pass to unlimited use.

5 CONCLUSION

Slovenian type of disposal facility is the first of its kind in the world. It is a combination of a surface disposal concept and underground disposal concept. Construction work started in 2023 with the infrastructure, and it will follow with the construction of the nuclear facility in the present year. At the end the portal crane will be placed above the silo and with that the construction is planned to be finished in a year 2027.

REFERENCES

[1] IBE d.d., Design basis, rev. C. 2018

[2] IBE d.d., Detailed design, 2021.