

CONSIDERATIONS ON SOILS ISOLATIVE PROPERTIES FOR SITING OF A NEW NEAR-SURFACE RADIOACTIVE WASTE REPOSITORY IN POLAND IN THE LIGHT OF THE LONG TERM SAFETY

RAZMATRANJE BRTVENIH SVOJSTAVA TLA U SVRHU LOCIRANJA NOVOG PRIPOVRŠINSKOG ODLAGALIŠTA RADIOAKTIVNOG OTPADA U POLJSKOJ KROZ PRIZMU DUGOTRAJNE SIGURNOSTI

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Abstract

The paper presents a brief description of the occurrence of favorable isolative conditions for new surface radioactive waste repository in Poland. Selected soils may be used as a natural bottom layer or engineering barrier in multi-barrier system of RW repository. Currently, there is no regulation establishing standards for the bottom isolation, and the only quantifiable parameter with regard to water permeability is given for the repository objects, which in their case has to be lower than 10⁻⁹ m/s. For the purposes of this paper, treating on providing suitable bottom isolation for the new repository, this parameter has been transferred onto the consideration for soils suitability with a statement that it shall not be lower than the one given for the infrastructure. Submitted information should be taken into consideration by updating the information for the siting process according to IAEA Safety Standards.

Sažetak

Članak predstavlja kratki opis pojave traženih brtvenih svojstava materijala za novo površinsko odlagalište radioaktivnog otpada u Poljskoj. Odabrana tla mogu se primijeniti kao prirodna podina ili inženjerska barijera u višeslojnom sustavu odlagališta radioaktivnog otpada. Trenutno, ne postoji regulativa koja definira standarde za podinsku izolaciju, a jedini kvantitativni parametar vezan uz propusnost vode dan je za objekte na odlagalištu, koji u ovom slučaju mora biti manji od 10⁻⁹ m/s. U svrhu izrade ovog članka ovaj parametar se mora uzeti u razmatranje za temeljno tlo uz uvjet da neće biti manje od traženog za infrastrukturu odlagališta. Ova tvrdnja mora se uzeti u razmatranje zajedno sa standardima Međunarodne agencije za nuklearnu energiju (IAEA – International Atomic Energy Agency).

1. Introduction

The only radioactive waste repository (National Radioactive Waste Repository, NRWR) existing in Poland is sited in Różan, NE Poland. It is a surface type repository dedicated and licensed for disposal of **Short-Lived Low Level Waste/ Intermediate Level Waste** (SL-LLW/ILW, T_{1/2} < 30yrs) It began operations in 1960s and is expected to reach its target capacity in 2020, the year in which its closure is expected. Due to the capacity constraint, it is necessary to conduct a new site selection and characterization process, as well as to design, construct and put into exploitation a new surface repository for SL-LLW/ILW radioactive waste. This issue has to be managed taking into account projected waste streams estimations that will be significantly enlarged by **nuclear power plant** (NPP) waste expected as a result of the nuclear power program

announced in 2009 (total target capacity to be reached in 2020 is 3000 MW(e)).

Several decades of research on site selection for the new NRWR have been undertaken, in line with the IAEA Safety Standards, and the siting process is now entering its final phases. To support final decision making, the on-going site selection work needs to be undertaken by a multidisciplinary team of scientists and engineers, building on the accumulated experience from previous years.

2. Discussion

The process for site selection for the new repository reaches late 90s. In this times, due to various circumstances being then in place, a huge State project known as Strategic Governmental Program (further: SGP) was established. Among multiple issues relevant to radioac-

tive waste and spent fuel management, one of its main considerations was to conduct a site selection process for a new surface radioactive waste repository. This process was held accordingly to the international requirements and guidance, which have not changed in their fundamentals since then. Experience gained and described at this time, also within the SGP frames, is described in multiple papers (Mitreęa et al. 1994; Włodarski, 1995; Mitreęa et al. 1995; Włodarski et al, 1996; Frankowski et al., 1997, 1997-1999; Frankowski & Mitreęa, 1998). These reveal the importance of properly addressing environmental and natural factors that are important for radioactive waste disposal before making the final decision about the choice of a repository site. An appropriate level of detail has to be delivered at each of the site survey stages, from planning and conceptual design, through site selection, characterization of candidate sites and the specific detailed studies, such as safety assessments, that are required for confirmation and regulatory approvals necessary for the selected site.

During siting for a surface repository, the factors that need to be considered include a group of natural hazards which, among others reflect geological conditions such as seismicity and tectonics, and the effects of climate and related hazards that may impact the surface environment, such as geotechnical hazard, flooding or groundwater migration paths. In relation to these natural hazards, their frequency of occurrence and enhanced magnitude due to human induced events shall be taken into account, such as induced seismicity or flooding. These analyses should be complemented with intrusive scenarios for the long term safety assessments regarding to the closure and post closure stages.

On the basis of desk-studies, environmental and geological field works and analysis and socio-economic studies (Biderman, 1997; Frankowski et al. 1997–1999), a total number of 24 selected sites have been investigated on a regional level and selected for further investigations for their suitability to host a surface repository of radioactive waste. Further detailed characterization, which included a variety of geological investigations, was further undertaken for 15 of these sites, however, due to the lack of support from local communities, no final decisions on site selection and therefore, detailed safety assessments, were made during this time. Thus, it is now necessary to update the previous results with new data, which need to reflect condition changes, e.g. flooding, population distribution throughout the last 20 years, as well as to consider new sites proposed on the basis of volunteering approach etc.

According to national regulations (Rozporządzenie Rady Ministrów Dz.U. Nr 230, poz. 1925) surface radioactive waste repositories shall be sited, constructed, operated and closed in a way that prevents the public from reaching an annual effective dose rate, taking into account all the intake pathways, higher than 0,1 mSv over a 500

years period. This requirement provides assurance concerning the long-term safety of a disposal facility already during the early stages of the development program. Also, the national regulations set out the requirements that must be adhered to by any proponent of a radioactive waste disposal facility. According to these national regulations, there does not any requirement for ground layers isolation exist and the only quantitative parameter describing the isolation properties given in value is permeability with regard to repository objects, which shall be lower than 10^{-9} m/s. This requirement was transferred to the considerations on ground isolation properties in this paper with a condition, that for providing a proper level of long term safety, bottom isolation should not be lower than the permeability of the repository infrastructure.

Great importance is attached to ensuring that the required level of isolation and containment is met. The requisite isolation and containment can be achieved through the application of multiple barriers, which shall mean not only providing a multi barrier approach at the stage of closure due to the construction of the cover cap, but also ensuring that there is the proper bottom isolation, to be achieved through an appropriate choice of site providing suitable natural geological barriers which may or may not require engineering enhancement.

Another dependence to be considered is that according to the state of the art, the engineered repository characteristics should be designed to function in a complementary manner along with the natural site conditions. Nevertheless, bottom isolation as a key factor significantly influencing the long-term safety can be considered as a stand alone factor on the basis of the soil parameters, both in natural as well as reinforced soil conditions.

Near-surface geological conditions for over 70% of the country have been created in response to eight Quaternary glaciation periods, therefore most of the territory of Poland is covered by glacial tills, fluvioglacial sands and gravels, periglacial loess, ice-dammed clays and interglacial non-cohesive soils as well as organic sediments such as: peat, gyttja and lacustrine chalk. These, which meet requirements of geological barriers are illustrated on the Figure 1, along with the display of some of negative conditions occurrence such as mining activity and groundwater depressions induced by human and industry. The overlap of both preferable and negative geological conditions reveals part of sites which needs to be excluded from considerations, simultaneously displaying these of favorable features. With regard to a prospective surface repository for radioactive waste, this creates a set of widespread possibilities for choosing a suitable site within the areas of occurrence of soil and near-surface geological conditions that might meet criteria to be considered for natural geological barriers.

3. Conclusions

On the basis of the regulatory requirements and previous research considerations, the abovementioned low permeability cohesive soils and near-surface geological strata should be considered as the preferable material upon which to site a radioactive waste surface repository. Alternatively, if the natural ground conditions are such

that this quantitative permeability requirement cannot be met, it would be necessary to choose a site displaying soil and near-surface conditions as close to the desired permeability values as possible and appropriate engineering means should be applied to meet this criteria in the long-term perspective of the very early stages of repository development pathway, i.e. site selection process.

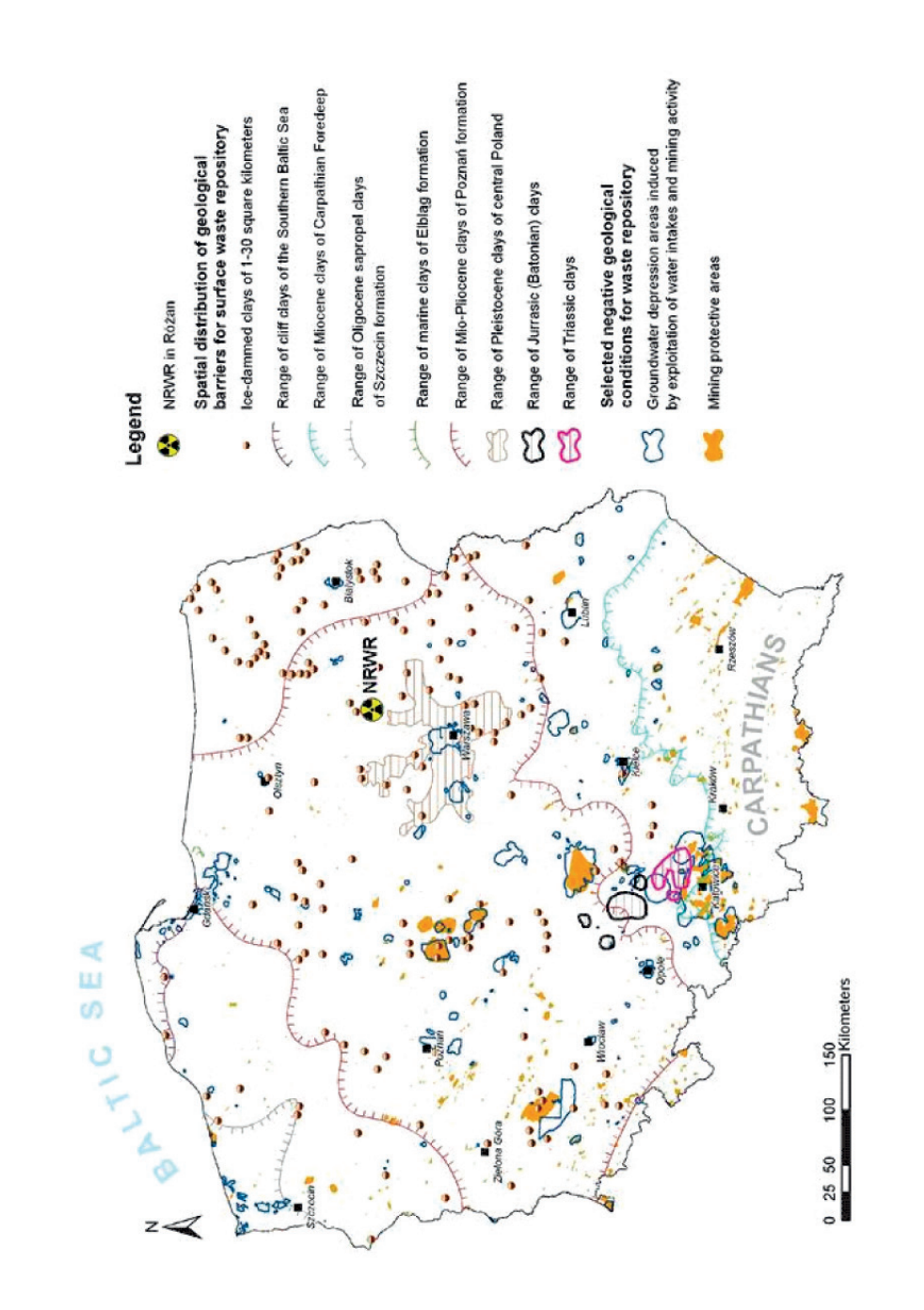


Figure 1. Spatial distribution of selected favorable and negative geological conditions with regard to siting process of new near-surface radioactive waste repository in Poland. Map courtesy of Majer et al., 2007 .

Slika 1. Spatična distribucija odabranih pozitivnih i negativnih geoloških uvjeta s obzirom na traženje lokacije novog pripovršinskog odlagališta radioaktivnog otpada u Poljskoj (karta preuzeta iz Majer et al., 2007)

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