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Performance assessment studies for the long-term safety evaluation of radioactive waste disposal facility.

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ABSTRACT

- Especially during the last ten years, a part of Romanian research program "Management of Radioactive Waste and Spent Fuel" was focused mainly on applicative research for the design of near-surface disposal facility, which intends to accommodate the low and intermediate radioactive waste generated from Cernavoda NPP. In this frame, our contribution was at the acquisition of technical data for the characterization of the future disposal facility.
- In the present, the project of the disposal facility, located on the Saligny site, near Cernavoda NPP, must be licensed.
- As regards to the safe disposal, the location of final disposal, the Saligny site, has been characterized through the five geological formations which contain potential routes for transport of radionuclide released from disposal facility, in the receiving zones(potential receiving zones), into liquid and gaseous phases.
- The technical characteristics of the disposal facility were adapted at the Romanian disposal concept using the reference data from IAEA technical report. Input parameters which characterized from physical and chemical point of view the disposal system, were partially taken from literature.
- The performance assessment studies, which follows the preliminary design development phases and the selection, describes how the source term is affected by the infiltration of water through the disposal facility, degradation process of engineering barriers (reflected in the distribution coefficient values) and solubility limit.

INTRODUCTION

The studies regard the evaluation of the source term, sensitivity and uncertainty analysis provide the information on "how" and "why" were evaluated, following:

- Radiological safety assessment of near-surface disposal facility on Saligny site;

- Complexity standard assessment of the Engineering Barriers Systems (EBS);

- Identification of the elements which must be elaborated for the increase of the disposal safety and the necessity for new technical data for the characterization of the disposal facility.

In the frame of the performance assessment, sensitivity and uncertainty analyses for the Saligny disposal facility have been conducted, consulting the associate activity for the three phases corresponding to the disposal:
- Operational period;
- Institutionalized control;
- Post-operative control.

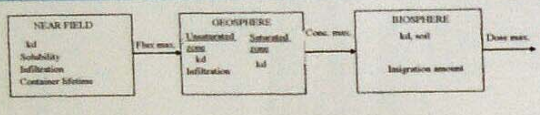
In source term evaluating study and of the sensitivity and uncertainty analyses, we took into consideration radionuclide of Cs-137, H-3 and C-14, these representing the most relevant radionuclide generated by the operation of the nuclear power plant.

Generally uncertainties in assessment are classified as:
-Scenario uncertainty;
-Model uncertainty;
-Parameter uncertainty

RESULTS AND DISCUSSIONS

- For sensitivity analysis, on the basis of the ranking is selected those parameters that have highest impact on dose and consider those for stochastic uncertainty and sensitivity analysis.
- The sensitivity and uncertainty analysis applies to Saligny disposal facility, correlated with special parameters that are influencing the release of radionuclide from repository, was conducted by using a computer code which yielded results allowing the characterization of the disposal facility at the end of the operational period and to eliminate the uncertainties .
- The activity is assumed to be uniform distributed, so the principal mechanism of release in aqueous phase is diffusion.

Figure 1. General methodology for selection of parameters calculations



1. The most relevant parameters that were using to make a sensitivity and uncertainty analysis are kd and infiltration rate;
- The rate infiltration is constant, 2mm / year, with different values for capacity of retaining of concrete;
- The parameters adequately for afferent region an intact concrete;
- The parameters adequately for afferent region by degradation concrete;

2. The rate infiltration is variable: for period of 100 year it is considered that is not contact between infiltration water and waste, after 100 year the rate infiltration is 2mm / year and after 300 years, the rate infiltration is 4mm / year;
- The parameters adequately for afferent region a intact concrete;
- The parameters adequately for afferent region by degradation concrete;
- The values for these parameters are illustrated into Table 1.

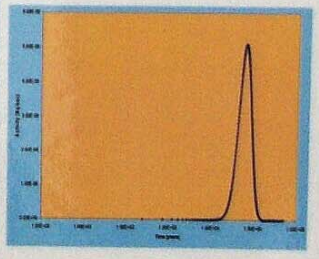
Table 1. The values for kd and diffusion parameters

	Material Radionuclide	kd [ml/g]		Diffusion [cm2/sec]	
		1 - Top and radier zones	2 – Near field cell	1	2
Intact concrete	C-14	2000	2000	1.00E-07	1.00E-06
	H-3	0	0	1.00E-07	1.00E-06
	Cs-137	2	2	1.00E-07	1.00E-06
	Co-60	100	100	1.00E-07	1.00E-06
	Sr-90	1	1	1.00E-07	1.00E-06
Degradation concrete	C-14	500	500	1.00E-07	1.00E-06
	H-3	0	0	1.00E-07	1.00E-06
	Cs-137	0.2	0.2	1.00E-07	1.00E-06
	Co-60	10	10	1.00E-07	1.00E-06
	Sr-90	1	1	1.00E-07	1.00E-06

CONCLUSIONS

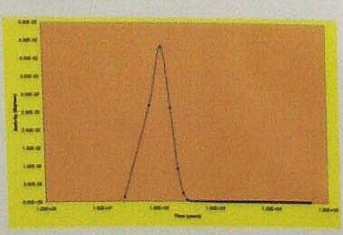
For C-14 radionuclide, it can observed that by raise of infiltration rate, come into a degradation of waste, a containers and engineering barriers who will give a rises about contact between radioactive waste and water infiltration, implicated an more radioactive discharge.
The worst cases analysis it was when the rate infiltration is 4mm / year and the distribution coefficient it is for degradation concrete. In this case is obtained a flux by 4.59 x 10-6Bq/sec.

Figure 2. Calculated flow of C-14 radionuclide into top and radier zones



For tritium, because it retain is practically zero in geological and in concrete medium, it moves with water infiltration in near field. In this manner, the rate of H-3 is the rate water to the near field. From representative parameters, because H-3 is not retained on the engineering barriers, can be observed a rapid release, the factors who delay the migrate are a small permeability of concrete and a small rate of infiltration

Figure 3. Calculated flow of H-3 radionuclide into top and radier zones



For Cs-137, it can observed that the worst case analysis is when the rate of infiltration corresponding to 4mm/y, is obtained a flux by 1.44 x 10-2Bq/sec.

Figure 4 . Calculated flow of Cs-137 radionuclide into top and radier zones)