RADIONUCLIDE RELEASE INTO THE UNDERGROUND WATER FROM HYPOTHETICAL REACTOR AT THE NEW NPP SITE IN LITHUANIA

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Introduction. Lithuania is planning to construct a new nuclear power plant (NPP) nearby the closed one (**Fig. 1**). The proposed new NPP will be constructed and operated within Ignalina NPP industrial area. The landscape of the site is industrial and characterized by power production units and buildings related to power production (operative spent fuel storage facility, household wastewater treatment plant, and ducts for the district heating system of Visaginas and electricity transmission lines). Groundwater characterization is an important issue in the siting process of new NPP. The main task of the present study is applying computer code FEFLOW to predict radionuclide (^{3}H, ^{14}C and ^{137}Cs) transport from hypothetical reactor of Visaginas NPP.

Methods. For analysis of radionuclide transport within groundwater all transport mechanisms were analyzed using the computer code FEFLOW 5.0. The computer code FEFLOW 5.0 is based on the physical conservation principles for mass, chemical species, linear momentum and energy in a transient and three-dimensional numerical analysis. The model domain of the Visaginas NPP site into a numerical model is attributed to 4 layers (5 slices). The main parameters (hydraulic conductivity, porosity, density, etc.) were set based on laboratory estimates and pumping tests. Other parameters (dispersivity, Kd, etc.) were selected from relevant lists and data bases. The model was calibrated using monitoring data of water level.

Results. Radionuclide release to the aquatic pathway from the hypothetical reactor of the NPP and consequent contaminant plume transport has been assessed taking into account site-specific geological and hydrogeological conditions and based on a normal evolution scenario. The reactor type is not chosen yet. This scenario described the expected annual average liquid radionuclide release from ABWR reactor [ABWR Design…, 1997]. In this study was not taken account into engineering barriers and other boundaries limiting radionuclide release into the environment. According ABWR reactor feature and computer code requirements radionuclide release to aquatic pathways was assess. The simulated radionuclide activity concentration in confined aquifer downstream from the NPP is presented in **Figs. 2-4**.

Fig. 1. The area of potential new NPP site in Lithuania

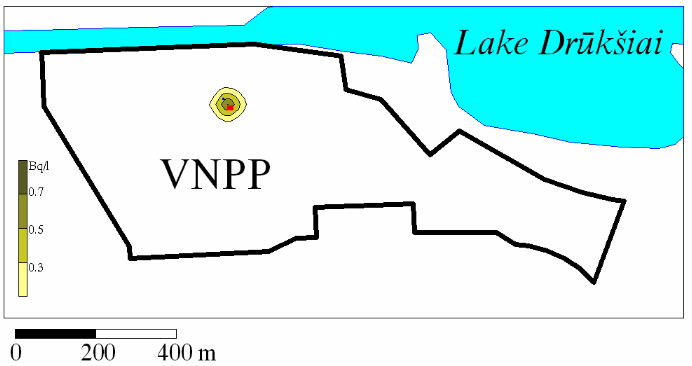

Fig. 2. Predicted contamination plume of ^{3}H in the confined aquifer in the moment of 10 years of the beginning operation of the hypothetical reactor (square symbol represents hypothetical reactor; circular - observation point)

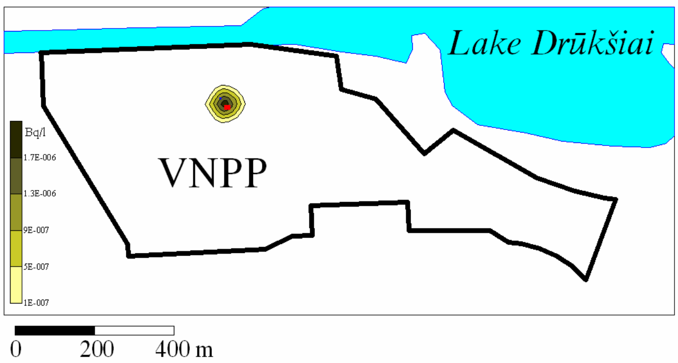

Fig. 3. Predicted contamination plume of ^{14}C in the confined aquifer in the moment of 100 years of the beginning operation of the hypothetical reactor (square symbol represents hypothetical reactor; circular - observation point)

The tritium in the confined aquifer will appears after 0.3 years of reactor operation. The tritium activity concentration in the confined aquifer after 10 years of reactor operation will be about 0.4 Bq/l (maximum allowed tritium activity concentration in drinking water is $1.5\cdot10^{4}$ Bq/l). The maximum radiocarbon activity concentration will be very small, about $1.5\cdot10^{-6}$ Bq/l in confined aquifer, when the maximum allowed radiocarbon activity in drinking water is 472 Bq/l. ^{137}Cs transport will be observed only in the first year of NPP's operation. The highest ^{137}Cs activity concentration will be in undergroundwater near a hypothetical reactor and will reach $1\cdot10^{-6}$ Bq/l in confined aquifer. The maximum allowable ^{137}Cs activity concentration in drinking water is 21 Bq/l.

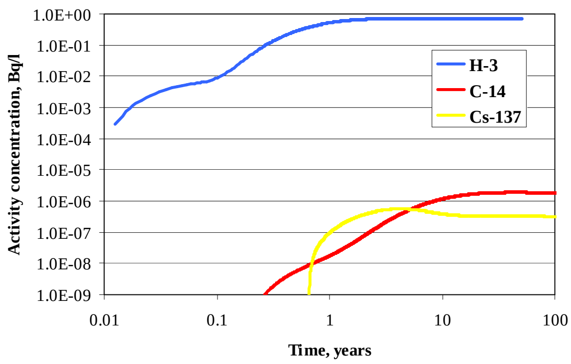

Fig. 4. Predicted radionuclides activity concentration in the confined aquifer

Conclusions. Using computer code FEFLOW 5.0 the radionuclide transport in groundwater was modeled. The obtained results of the radionuclides (^{3}H, ^{14}C, ^{137}Cs) activity concentration distribution at the NPP site shows that according to the chosen scenario the contamination in the groundwater will not be found. These results can assist in predicting groundwater contamination spread at the NPP.

Reference

ABWR Design Control Document, 1997. GE Nuclear Energy.
http://pbadupws.nrc.gov/docs/ML1112/ML11126A113.pdf