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Requirements for inventory models of radioactive waste

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Abstract. The aim of the final disposal of radioactive waste is to ensure the best possible safety for the long-term protection (i.e. 1 million years) of humans and the environment from ionizing radiation and other harmful effects of this waste. In Germany, the Site Selection Act (StandAG) regulates the procedure for determining the site with the best possible safety for a repository with high-level radioactive waste. One of the mandatory aspects of the StandAG is to perform various preliminary safety assessments in order to assess the expected extent of the safe confinement of the radioactive waste. For this purpose, all information (in particular on the quantity, type, composition and activity) of the waste (i.e. the inventory) is required to conduct the respective safety assessment.

On behalf of the Federal Office for the Safety of Nuclear Waste Management (BASE) and within the framework of the research project "Significance of the radioactive waste inventory in the site selection for a repository (InvEnd)", Brenk Systemplanung GmbH identified the characteristics of the inventory required for the preliminary safety assessments. To determine these inventory characteristics, two main data sources were analysed, namely the generic but host-rock-specific concepts for a German high-level radioactive waste repository and the inventory data and approaches of other countries with technologically developed repository programmes.

The identified characteristics can be divided into different groups (e.g. geometric, chemical, radiological and physical) and categories such as primary inventory data that are essential for carrying out the preliminary safety assessments or secondary inventory data which validate the primary inventory data.

The evaluation of the impact of the identified characteristics shows that especially data on component-specific chemical composition and component-specific radionuclide inventory have a high impact on the results of safety assessments. These characteristics are, in turn, dependent on other characteristics, such as the irradiation history and the original chemical composition of the fuel in addition to the structural parts of the fuel assemblies.

Furthermore, the study assesses uncertainties of the inventory characteristics, such as data uncertainty and conceptual uncertainty. The extent of data uncertainty depends on the inventory characteristic. However, in most cases, only qualitative assessments are possible. Conceptual uncertainties depend on the degree of simplification used to define reference wastes but cannot be quantified yet, as no reference wastes have been defined.

The results of this study enable authorities and waste management organizations to identify the key data of high-level radioactive waste inventories that are essential for conducting safety assessments of repositories, even during early stages of site selection and planning.

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