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Title: Thermal-Mechanical Model Analysis used for Evaluating a Repository Concept for Heat-Generating Radioactive Waste in Salt-Rock

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The "Preliminary Safety Analysis for the Gorleben Site" (Vorläufige Sicherheitsanalyse für den Standort Gorleben – VSG) is a research project of the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) mbH funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit – BMU) of the Federal Republic of Germany. The purpose of the project is to assess the suitability of the site for a potential repository for heat generating wastes based on currently available site information and knowledge. Furthermore, the project will provide insights into additional research areas and site characterization needs. The project is divided into thirteen work packages (Arbeitspakete – AP) that will be executed in a cooperative manner between the participating project partners. Many of the work packages have strong time and scope inter-dependencies associated with them. For example, the waste inventory (AP3) determines the subsurface layout design requirements (AP5) which in turn provides input to both the evaluation of the thermal design (AP6) and mechanical integrity assessment (AP9) of the design as well as in the long term performance safety assessment (AP10). The focus of the authors in work package AP6 is to evaluate the repository concept with respect to its thermal response behavior as well as the subsurface design and design optimization needs.

In this paper, the results of thermal-mechanical (TM) model calculations of the design and optimization of the design layout for gallery emplacement of the POLLUX containers are presented. The POLLUX containers are shielded, thick-walled waste packages, weighing up to 65 tonnes that can contain fuel rods from 10 PWR fuel assemblies or 9 HAW canisters from reprocessing. Calculations were performed using three-dimensional models of repository emplacement areas. The models were generated using codes employing the finite-difference (FD) method as well as codes using a semi-analytical approach. The results show that the implementation of the thermal input criteria alone are not sufficient for evaluating and optimizing the design, but rather a coupled thermal-mechanical analysis approach is required. Therefore this paper also identifies the effects of different processes, components, and parameters on the analyses, including:

- Mechanical behavior of the host rock
- Thermal behavior of the crushed salt backfill
- Effects of excavating a waste package emplacement trough
- Waste package spacing
- Interim storage time for waste package (aging and cooling)

The results show that the design of repository components and systems in addition to the overall favorable geologic conditions of the host formation are necessary elements for the development and optimization of the final repository design.