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Multiphase flow modeling at the component level for the Swiss deep geological repository

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Abstract. In a deep geological repository for radioactive waste, anaerobic corrosion of various metals lead to the formation of hydrogen. In Switzerland, the implementor (i.e., Nagra) is commissioned to describe and evaluate safety-relevant processes related to gas that can affect the long-term evolution of low- and intermediate-level waste (L/ILW), high-level waste (HLW), and combined L/ILW and HLW repositories. Key tasks include the evaluation of gas and radionuclide release pathways and the pressure and temperature evolution in the repository using multiphase and multicomponent flow and transport models.

The Swiss repository design foresees the installation of multiple seals (engineered barriers) in the repository: (i) the V1 seals next to the waste emplacement caverns and tunnels, (ii) the V2 seals located in the access tunnels toward the emplacement caverns and tunnels, and (iii) the V3 seals positioned in the shafts of the repository. These seals are designed to satisfy a wide range of requirements, including requirements related to the hydraulic evolution of the repository and the associated transport of gas, water, and radionuclides.

A modeling workflow is currently being developed that integrates modeling performed both at the repository scale using site-specific models and at the component scale using semi-generic models. The repository-scale models are built to assess the thermo-hydraulic evolution in the entire repository, whereas the component-scale models allow for more detailed evaluations of the gas and water flows in key structures of the repository, such as the V1, V2, and V3 seals as well as the emplacement caverns and tunnels. This conference contribution describes the methodology and workflow developed to integrate these models, with a focus on the development and functionality of the component-scale models.

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