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Performance assessment of a generic repository in salt host rock based on Task F of DECOVALEX-2023 – BASE's lessons learnt and future work

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Abstract. The evaluation of coupled effects of mechanical deformation, fluid and gas flow, thermal loading, and chemical reactions is an important element of the performance and safety assessment of disposal systems for high-level radioactive waste and spent nuclear fuel in deep geological formations. Early investigations showed that to be able to conduct such an evaluation there was a need to enhance process understanding and to develop models capable of simulating coupled thermal–hydro–chemical–mechanical processes over relevant timescales and spatial scales. Recognising these challenges and needs, the DECOVALEX (DEvelopment of COupled models and their VALidation against Experiments) (https://decovalex.org, last access: 24 July 2023) was initiated in 1992 as an international cooperative project of nuclear waste organisations. BASE is one of the funding organisations for the current phase of DECOVALEX-2023 (running from 2020 to 2023) and actively contributes to Task F of the project (https://www.base.bund.de/DE/themen/fa/soa/projekte-aktuell/projekte-aktuell_node.html, last access: 24 July 2023, – "Beteiligung an der internationalen Forschungskooperation DECOVALEX").

Task F (https://www.decovalex.org/D-2023/task-f.html, last access: 24 July 2023) of DECOVALEX seeks to build confidence in the models, methods, and software used for performance assessment of deep geologic repositories and to highlight additional research and development needed to improve performance assessment methodologies. The task focuses on two illustrative disposal concepts for spent nuclear fuel: a generic repository in a fractured crystalline host rock and a generic repository in a salt formation. For each of the disposal concepts a reference case is defined that includes a set of conceptual models and parameters describing features, events, and processes that impact repository performance. Modelling teams work independently and are responsible for determining how best to implement and couple the models. Each team develops its own model(s), calculates agreed performance indicator values, and performs uncertainty and sensitivity analysis. The comparison of model results is conducted in stages, commencing with a comparison of key outputs of individual process models, followed by a comparison of a single deterministic simulation of the full reference case, and proceeding to uncertainty and sensitivity analysis.

The present contribution describes recent BASE activities within Task F Salt of DECOVALEX-2023. Lessons learnt are discussed and possible future steps are presented.

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