RSO Discipline Update:

Applied Mathematics

Subject Matter Expert:
Oliver Hall
Nuclear Waste Services

Discipline Lead:
Robert Zimmerman
Imperial College London

Discipline Lead

Robert Zimmerman Professor of Rock Mechanics at Imperial College London, was appointed as Discipline Lead for Applied Mathematics in January 2021.

Editor-in-Chief of the *International Journal of Rock Mechanics and Mining Sciences*, and co-author of the definitive monograph *Fundamentals of Rock Mechanics*, 4th ed. (Wiley-Blackwell, 2007).

Ten years of experience as a researcher and PI on the US DOE's Yucca Mountain nuclear waste repository project, was PI on the €3M Euratom THERESA project, PI on the £2.5M NERC-RWM-EA-funded Hydroframe project, has been a PI on two rounds of the DECOVALEX project, an international collaboration on the development of computational codes for simulating processes relevant to Geological Disposal Facilities, and is currently working with SKB on rock spalling in the Swedish GDF in Forsmark.

Subject Matter Expert
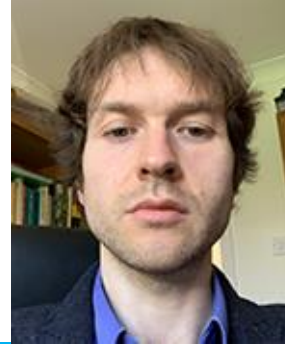
Oliver Hall is a Post-closure Safety Specialist at NWS. His background is in Theoretical & Computational Physics, with a PhD from Durham in 2014.

His interests are in demonstrating the long-term safety of a GDF, through assessments of system performance, as well as more general mathematical and computational modelling.

Background

- Regulatory guidance requires a quantitative evaluation of the performance of the GDF during each of the transport, operational and post closure phases.

- The applied mathematics theme will explore the development and application of quantitative descriptions for the key features, effects and processes which impact the safety and operation of the GDF throughout its lifecycle.

- It will complement existing Nuclear Waste Services expertise in mathematical modelling and the quantification and management of uncertainties.

Background

Prior to the formation of the RSO, NWS had a four-year contract with the Smith Institute for the supply of advice relating to applied mathematics.

This work included a detailed review of mathematical modelling within NWS, and the development of methodologies for uncertainty quantification, and for decision-making under uncertainty for site characterization.

Initially, NWS did not expect there to be further direct research needs in this discipline, prior to site-specific work. Consequently, the applied mathematics discipline has had a largely supporting role to projects involving mathematical modelling. (see forward look)

Activities in 2022

- Participated in the NERC Scoping workshop on Geological Disposal of Nuclear Waste in Lower-Strength Sedimentary Rocks, London, 15th and 16th June 2022

- Organised a well-attended RSO webinar on 23 June 2022, on "Coupled Process Modelling", with speakers from the University of Manchester, Imperial College, and the Spanish National Research Council

- Contributed material on Challenge 3 to the LSSR Science Plan document, that was submitted to NERC in July

- Attended and participated in the NWS-RSO Discipline Lead & Subject Matter Expert Away Day at Harwell on 14th October 2022

Forward look

- LSSR workshops suggest that there needs to be additional work to develop coupled thermo-hydro-mechanical-chemical simulation codes for geological media

- Explore applications of methods like Machine Learning/AI to modelling GDF-relevant processes - in particular, the use of such techniques for uncertainty quantification

- Provide support to projects in other disciplines with a modelling reliance. For example, the science case that was approved in Summer 2022 for NERC funding.