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SNETP Forum

Eurad-2 WP8 SAREC
Release of safety relevant radionuclides from spent nuclear fuel under deep disposal conditions

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1. Introduction

Direct disposal of Spent Nuclear Fuel (SNF) requires understanding of how the radionuclide inventory is distributed in the various parts of the fuel structures: spent fuel matrix, gap & grain boundaries, and structural components such as the cladding (Fig 1). The rate of radionuclide release from these different parts is central to the safety assessments of the geological disposal facilities. The research planned in WP8 Sarec in Eurad-2, which started October 2024, will increase the amount of available data, compare and develop models and improve knowledge management in the spent fuel research domain. The focus lies in radionuclide release from the SNF matrix and the so-called Instant Release (IRF). This fraction is for some radionuclides correlated to the Fission Gas Release (FGR).

2. Objectives

- Improved quantification and mechanistic understanding of the release of safety relevant radionuclides covering most representative types of SNF.
- Clarification of fuel evolution both prior and posterior to contact with groundwater to better predict the radionuclide source term for post-closure safety assessment.
- Contribution to the expected outcomes connected to implementation safety, scientific insight and knowledge management as expressed in the Eurad Strategic Research Agenda.

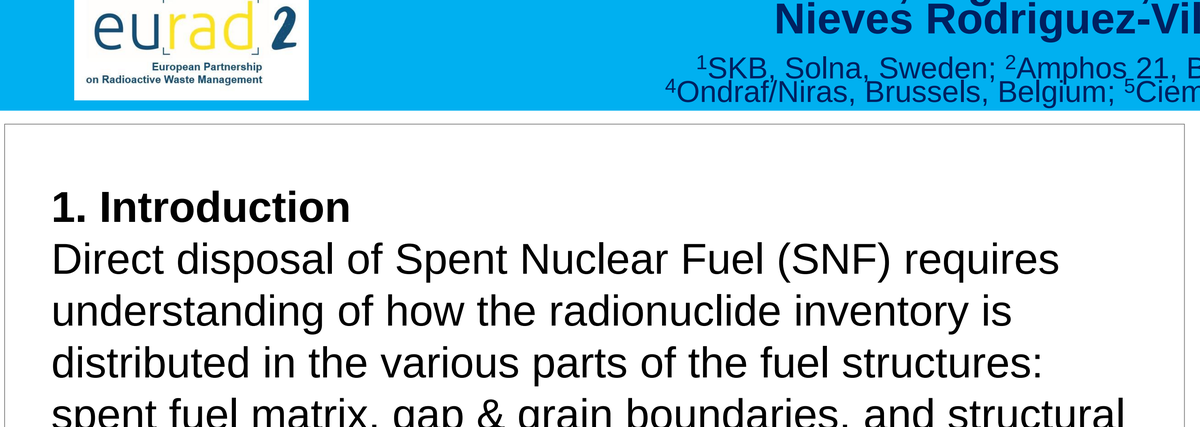

Figure 2. Examples of autoclaves in a Hot Cell at KIT-INE (Karlsruhe, Germany) used for SNF leaching experiments. Pieces of fuel rod are leached inside the pressure vessels and fluid and gas are sampled at intervals.

6. Acknowledgements

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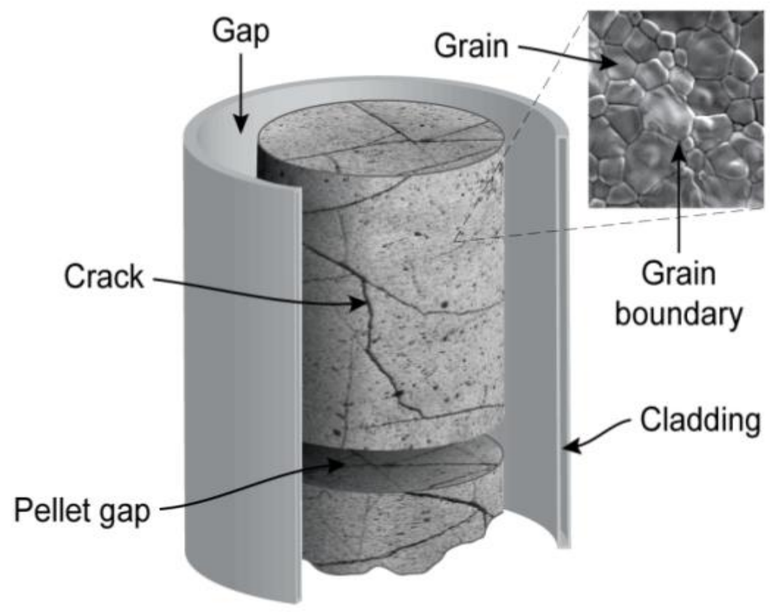

Figure 1. Illustration of a part of a spent fuel rod. Different fractions of the radionuclide inventory is found in the different parts.

3. Methodology

The work package is divided in 6 tasks:
1) WP management and coordination; 2) Knowledge management; 3) IRF/FGR Performance of Spent Nuclear Fuel; 4) Role of Grain Boundaries in Spent Fuel Corrosion; 5) Studies on Model Materials; 6) Mechanistic modelling.

The three experimental tasks (3,4,5) will provide data and information to be used in modelling (Task 6) and in a data base for SNF experiments (Task 2), which will be publicly available. Since the focus is radionuclide release in deep disposal conditions, leaching experiments will focus on reducing environments with leachants that will mimic the most important aspects of mainly two disposal environments: granitic and clayey host rocks, with influence of engineered barrier materials, such as iron and concrete. Keeping the experiments under reducing conditions requires particular experimental set-up (Fig 2).

4. Results

The progress of the work package over the first 6 months is indicated via the submission of the first deliverable: Initial State-of-the-Art report, and the reaching of the first Milestone. At this first milestone, decisions were made regarding samples, materials and data to be used. The starting date of the experiments varies depending on required preparation time, but all leaching experiments will be started in 2026.

5. Conclusions.

As a part of Eurad-2, WP8 Sarec will undertake experiments with SNF and model materials as well as mechanistic modelling and knowledge management activities to improve scientific insight and implementation safety of geological disposal of spent nuclear fuel.

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