PA1-14 MODERN SPENT FUEL DISSOLUTION IN FAILED CONTAINER CONDITIONS (DisCo)

L.Z. Evins[1], I. Farnan[2], D. Hambley[3], E. Gonzalez Robles[4], O. Roth[5], D. Bosbach[6], L. Duro[7], E. Curti[8], A. Valls[7]

1 Svensk Kärnbränslehantering AB, SKB, Sweden
2 The Chancellor, Masters and Scholars of the University of Cambridge, UK
3 National Nuclear Laboratory Limited, NNL, UK
4 Karlsruher Institut für Technologie, KIT-INE, Germany
5 Studsvik Nuclear AB, Sweden
6 Forschungzentrum Jülich GmbH, FZJ, Germany
7 Amphos 21 Consulting S.L., Spain
8 Paul Scherrer Institute (PSI), Switzerland

DisCo (Modern Spent Fuel Dissolution and Chemistry in Failed Container Conditions) is a Collaborative Project funded by the European Commission under the Horizon 2020 Research and Training Programme of the European Atomic Energy Community (EURATOM), addressing key priority R&I issues for the planned nuclear waste geological repositories.

The project started on 1st of June 2017 and will last for 48 months. It is implemented by a consortium of 16 Beneficiaries from 8 countries and the European Joint Research Center (EC). The consortium will be advised by an End User Group (EUG), consisting of Waste Management Organisations from 7 countries: Belgium, Finland, France, Spain, Sweden, Switzerland, and the UK, as well as regulatory authorities in 5 countries: Belgium, Germany, Spain, Sweden, and Switzerland. The inclusion of Waste Management Organisations (WMOs) and regulatory authorities in an EUG ensures that the research conducted in the project will be relevant and useful for the ultimate goal of safe radioactive waste disposal.

The development of robust safety cases for the geological disposal of spent nuclear fuel (SNF) requires a solid understanding of its dissolution mechanisms over very long timescales (up to a million years). Spent fuel dissolution is the main source term for the release of radionuclides under repository conditions and it will control the release of radioactivity to the surrounding environment of a disposal facility once the containment fails and groundwater comes into contact with the spent fuel.

DISCO project represents a logical follow-on from earlier Euratom projects (such as SFS, NF-PRO, MICADO, REDUPP and FIRST-Nuclides) which focused on dissolution and radionuclide release from conventional UO_2 spent fuels. In particular, this project aims to fill the knowledge gap on spent fuel dissolution arising from the development and use of novel types of fuel (Cr/Al- doped and MOX).

Specific objectives of DISCO can be summarized as follows:

- To enhance our understanding of spent fuel matrix dissolution under conditions representative of failed containers in reducing repository environments;
- To assess if the dissolution behaviour of novel fuel types (MOX, doped) differs from the conventional ones.

The expected gain in knowledge is essential for the Waste Management Organisations and of interest for a wider range of potential users (e.g. research organisations). Therefore, an aim of the project is to disseminate the gathered knowledge through different channels in order to reach a wider community.

The work plan is divided into four scientific work packages, as summarised below:

WP2: Preparation and characterisation of model spent fuel samples and spent fuel experimental systems before dissolution experiments are initiated. Characterisation of model samples with advanced micro-analytical tools that could not be deployed on spent nuclear fuel itself.

WP3: Spent fuel dissolution experiments, which remain the primary objective of determining both the matrix dissolution and the instant release fraction (IRF) of various fuel types under different relevant disposal conditions. A total of 12 leaching experiments will be conducted with cladded segments and fragments (without cladding). The experiments will be performed under reducing (H_2), anoxic (N_2, Ar) and oxic conditions.

WP4: Model material dissolution experiments, with the objective of understanding matrix corrosion of modern LWR fuels under deep geological repository relevant conditions. This WP will use model materials that reproduce important features of the spent fuel. This is, for example, samples of natural or depleted UO_2 doped with ^{233}U that will allow defining alpha activity of aged fuel or samples doped with Pd to simulate ε-particles, or with Cr_2O_3 to simulate modern fuels. The results will allow us to (1) determine element release and corrosion rates, (2) characterise the microstructural evolution upon corrosion by advanced micro-analytical tools and (3) establish a link between matrix corrosion behaviour of UO_2-based model systems and spent fuel.

WP5: Chemical modelling workpackage, focused on the development and application of thermodynamic and kinetic models as well as reactive transport modeling. This will provide the basis for understanding the behavior of spent nuclear fuel in the near field. Initially, these models will be developed from existing data. Later in the project, as bespoke results become available, they will be incorporated to improve the models and reduce uncertainties.

The project also has a management and knowledge dissemination workpackage (WP1), which is in charge of ensuring that the project runs according to expectations and that the knowledge generated is disseminated and communicated to all interested stakeholders.

DisCo website (*www.disco-h2020.eu/*) is expected to be running by the time of the Migration conference and will contain information of interest for different scientific and communication purposes.

The research leading to these results has received funding from the European Union's European Atomic Energy Community's (Euratom) Horizon 2020 Programme (NFRP-2016-2017-1) under grant agreement, 755443- DisCo.