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Status of dissolution based fast/instant radionuclide release studies

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Introduction

This report summarizes the progress made in Work Package 3 of FIRST-Nuclides in the 12 first months of the project. The laboratories that participate to WP3 are the Belgian Nuclear Research Centre (SCK•CEN), the Paul Scherrer Institute (PSI), the Karlsruher Institut für Technologie (KIT), Studsvik Nuclear AB (STUDSVIK), the Joint Research Centre – Institute for Transuranium elements (JRC-ITU), the Fundacio CTM Centre Tecnologic (CTM), and the Hungarian Centre for Energy Research (EK).

The overall objective of WP3 is the quantification of the fast release of radionuclides by means of leach tests with spent nuclear fuel, and – to the extent possible – the determination of their chemical speciation. Such leach tests are performed by SCK•CEN, PSI, KIT, STUDSVIK, ITU and CTM. The experiments are done with PWR fuels having a burnup in the range of 50 to 70 MWd.kg_{HM}⁻¹, with BWR fuels of 42-59 MWd.kg_{HM}⁻¹, and a MOX fuel of 63 MWd.kg_{HM}⁻¹ (average burnups). As a complement to the leach tests performed on fuel samples under controlled laboratory conditions, the leaching behaviour of damaged and leaking VVER fuels is studied by EK.

Status after 12 months

The first year has been used to define the detailed experimental matrix and to prepare the leach tests and analytical methods. The sample preparation methods, leachant composition and analytical methods have been discussed between the participating institutes, to come to an optimal program in which the various contributions give complementary information, produced in conditions that are sufficiently harmonized to allow intercomparison. The only laboratory that has already started some of the planned leach tests is STUDSVIK .

Detailed information on the developments in the first year is given in the scientific and technical papers that were prepared for the first annual workshop of FIRST-Nuclides, held in Budapest (Hungary) on the 9th – 11th of October, 2012. The contributions of PSI, KIT, STUDSVIK, SCK•CEN, JRC-ITU, CTM and EK are published in the proceedings of this workshop, and are summarized hereunder.

SCK•CEN [Ref 1] has defined the main experimental parameters of the planned experiments, i.e. the type of fuel, the number of tests and the sample preparation, the experimental setup, the leach test conditions, the sampling scheme and the surface and solution analyses, and ordered the necessary equipment.

The other laboratories have made similar preparations, with some specific aspects.

PSI [Ref 2] has prepared a method that should allow to gain insight into the redox state and the microscopic distribution patterns of some relevant instant release fraction radionuclides via combined X-ray fluorescence (XRF) and X-ray absorption spectroscopy (XAS).

KIT [Ref 3] has focussed particularly on the methodology to measure the fission gas release.

STUDSVIK [Ref 4] has already started two experiments, and has prepared the other experiments, with particular attention to laser ablation studies.

JRC-ITU and CTM [Ref 5] have given special attention to the development of an improved method of Sr determination by ICP-MS.

EK [Ref 6] has summarized the design and operational characteristics of the damaged and leaking fuels, and the isotope inventories.

Further planning

Except for the two tests already started at Studsvik, the start of leach tests in the various participating laboratories is planned for 2013. First data will become available in the course of 2013. The end of the leach tests is foreseen for 2014. Further information exchange of the analytical methods is planned also for 2013.

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