Joint Activities update
EF preparation

EF Meeting N°3
Joint Activity N° 1

Waste forms and their behaviour – FIRST NUCLIDES

SRA | Key Topic : N°2 | Topic : 1 | Topic priority : High

Leader: Bernhard Kienzler, KIT-INE, Karlsruhe

EG Members = end-users:
ANDRA
Enresa
Nagra
BWMi
Ondraf/Niras
SKB

EF Participants: See next slide

Other

grant agreement no. 295722, the FIRST-Nuclides project, Budget: 4,741,261 €
2,494,513 € EU contribution
The Consortium (1)

1. Partners / Beneficiaries

- KIT
- AMPHOS
- ITU
- JÜLICH Forschungszentrum
- PSI
- SCK·CEN
- CSNS
- Centre National de la Recherche Scientifique
- CTFM
- Hungarian Academy of Sciences, Centre for Energy Research
- Studsvik

Subatech

2. Associated Groups (AG)

Groups participating at their own costs with specific RTD contributions or particular information exchange functions, or mobility measures (for European AGs only)

- Los Alamos National Laboratory
- Sandia National Laboratories
- CEA
- National Nuclear Laboratory
- NDA
- POSIVA
- TVO
- GRS
- University of Cambridge
Objectives and Expected Results of the Joint Activity

Objectives: Fast / Instant Release of Safety Relevant Radionuclides from Spent Nuclear Fuel

• Improvement in understanding.
  o high burn-up \( \text{UO}_2 \), linear power, temperature, ramping, ...
• Relationship FGR and release of non-gaseous FPs
  o gases, \(^{135}\text{Cs},^{129}\text{I},^{14}\text{C\ compounds},^{79}\text{Se},^{99}\text{Tc and}^{126}\text{Sn}\).
• Grain boundary effects.
• Chemical speciation of relevant elements.

Complex structure of spent fuel

Spent fuel

- Cladding: C
- Gap region: C, I, Cs, Se, Tc
- Enriched rim: Pu

Fuel grains
U, Pu, Ln, Sr

Fission gas bubbles
Kr, Xe, I

Grain boundaries
C, I, Cs, Se, Tc

Rim enriched with Pu

- E-particles metallic precipitates
  Mo, Ru, Pd, Tc, Rh
  Ag, Cd, In, Sb, Sb

- Oxide precipitates
  Rb, Cs, Ba, Zr, Nb
  Mo, Tc
Work Programme:

WP 1: Samples and tools

Selection, characterization and preparation of and set-up of tools for handling and transportation of the highly radioactive material

WP leader: Volker Metz (KIT)

<table>
<thead>
<tr>
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<th>PWR</th>
<th>BWR</th>
<th>THTR / VVER</th>
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<tbody>
<tr>
<td>Pellet Enrichment</td>
<td>3.80 – 4.94 %</td>
<td>3.30 -4.25 %</td>
<td>2.4 -16.8%</td>
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<tr>
<td>Irradiation</td>
<td>50.4 – 70.2 GWd/t</td>
<td>48.3 – 57.5 GWd/tU</td>
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<td></td>
<td>2 - 14</td>
<td>5 – 7</td>
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<td>lin. Power average</td>
<td>186 -330 W/cm</td>
<td>160 W/cm</td>
<td>130 – 228 W/cm</td>
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<td>FGR</td>
<td>4.9 – 23 %</td>
<td>1.2 – 3.1 %</td>
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WP 2: Gas release and rim and grain boundary diffusion
WP leader: Detlef Wegen (JRC-ITU)

- Experimental determination of fission gas release

Scheme of the fuel rod puncturing device. by JRC-ITU

- Experimental investigation of rim / grain boundary diffusion
WP 3: Dissolution based release
WP leader: Karel Lemmens (SCK·CEN)

- Dissolution based radionuclide release and to the extent possible the chemical speciation of the relevant isotopes.

Partners: KIT-INE, JRC-ITU / CTM, PSI, Studsvik, EK (MTA), SCK·CEN

Agreement on experimental details to cover the whole range of conditions:
- Samples/sample preparation (powder – pellets)
- Conditions (oxic – anaerobic)
- Groundwater
WP4: Modelling
WP leader: Joan de Pablo (CTM/UPC)

Aims of the conceptual and numerical modelling

- Quantify the fast/instant release fraction of fission products.
  - FP migration along the grain boundaries and fractures,
  - effects of defects in the cladding on the fast release.
- Up-scaling from fragments/pellets to fuel assemblies.

- Modeling the chemical state of relevant elements.
- Delineation from matrix dissolution process.
WP5: Knowledge, reporting and training:
WP leader: Alba Valls (AMPHOS21)

- Knowledge management and documentation of the State-of-the-Art with regular up-dating.
- Stepwise build-up of scientific-technical reporting
- Dissemination and Communication,
- Training

Please see the project webpage
www.firstnuclides.eu