

JRC SCIENTIFIC AND POLICY REPORTS

DELIVERABLE (D-N^o: 2.1)

Status of fission gas release studies (12 months)

FIRST-Nuclides
(Contract Number: FP7-295722)

D.H. Wegen, E. González-Robles, A. Puranen

2012



Courtesy of the Joint Research Centre, European Commission. © European Atomic Energy Community, 2012

Classification: No restriction
Unit: E05 and E02
Action No:51102

European Commission
Joint Research Centre
Institute for Transuranium Elements

Contact information

Address: Postfach 2340, D-76125 Karlsruhe
E-mail: Detlef.Wegen@ec.europa.eu
Tel.: +49 7247 951 885
Fax: +49 7247 951 640

<http://itu.jrc.ec.europa.eu/>
<http://www.jrc.ec.europa.eu/>

This publication is a JRC Scientific and Policy Report by the Joint Research Centre of the European Commission.

Legal Notice

Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

***Europe Direct is a service to help you find answers
to your questions about the European Union***

**Freephone number (*):
00 800 6 7 8 9 10 11**

(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet. It can be accessed through the Europa server <http://europa.eu/>

JRC 77249

© European Atomic Energy Community, 2012

Reproduction is authorised provided the source is acknowledged.

Printed in Germany





FIRST-Nuclides

(Contract Number: **FP7-295722**)

DELIVERABLE (D-N°: 2.1)

Status of fission gas release studies (12 months)

Author(s): D.H. Wegen, E. González-Robles, A. Puranen

Reporting period: e.g. 02/01/12 – 31/12/12

Date of issue of this report: 28/12/12

Start date of project: 02/01/12

Duration: 36 Months

Project co-funded by the European Commission under the Seventh Euratom Framework Programme for Nuclear Research & Training Activities (2007-2011)

Dissemination Level

| | | |
|-----------|---|---|
| PU | Public | X |
| RE | Restricted to a group specified by the partners of the FIRST-Nuclides project | |
| CO | Confidential, only for partners of the FIRST-Nuclides project | |



DISTRIBUTION LIST

| Name | Number of copies | Comments |
|------|------------------|---|
| | | This report was distributed in electronic form. |

FIRST-Nuclides

(D-N°: 2.1) – [Status of fission gas release studies](#)

[\(12 months\)](#)

Dissemination level: PU

Date of issue of this report: **28/12/12**



FIRST-Nuclides

(D-N°: 2.1) – Status of fission gas release studies

(12 months)

Dissemination level: PU

Date of issue of this report: **28/12/12**



Table of Contents

| | |
|--------------------------|---|
| Objectives | 8 |
| Status and results | 9 |
| Dissemination | 9 |

FIRST-Nuclides

(D-N°: 2.1) – [Status of fission gas release studies](#)
(12 months)

Dissemination level: PU

Date of issue of this report: **28/12/12**



Status of fission gas release studies (12 months)

D.H. Wegen, E. González-Robles, A. Puranen

¹Institute for Transuranium Elements (ITU), (EC)

²Karlsruher Institut für Technologie (KIT), (DE)

³STUDSVIK Nuclear AB (STUDSVIK), (SE)

*Corresponding author: Detlef.Wegen@ec.europa.eu

Objectives

In the first component of work package 2 (WP2) “Experimental determination of fission gas release” the focus is on the quantification of fission gases and fission gas release in high burn-up (HBU) UO₂ spent nuclear fuels (SNF). Fission gas sampled in the plenum of a fuel rod will be analysed as well as the grain boundary inventory and the cross sectional distribution of fission gases and volatile fission products. The experimental part in WP2 started in project month 4 and will end in project month 33 [1], [5].

The JOINT RESEARCH CENTRE – INSTITUTE FOR TRANSURANIUM ELEMENTS (JRC-ITU) is the leading organization of WP2. In the first project year the fission gas release from a spent fuel rod owned by KIT was to be measured. The determination of the inventory of fission gas and fission products in grain boundaries are foreseen for the second and third project year.

The KARLSRUHER INSTITUT FÜR TECHNOLOGIE (KIT) wanted in the first project year to analyse fission and activation products in the gas phase from a punctured fuel rod segment. The development, testing and implementation of analytical methods for fission and activation products will be carried out in project year one and two. Leaching experiments in which gas and solution analyses are foreseen are started in the first year and last until project month 33.

STUDSVIK NUCLEAR AB (STUDSVIK) will in the frame of WP2, investigate the radial fission gas and volatile fission product distribution (Xe, I, and Cs) by Laser-Ablation Mass Spectroscopy (LA-MS) on HBU BWR SNF.

FIRST-Nuclides

(D-N^o: 2.1) – [Status of fission gas release studies](#)
(12 months)

Dissemination level: PU

Date of issue of this report: **28/12/12**



Status and results

After nine month experimental work programme in WP2 the outcome is coined by preparatory work, testing of new experimental set-ups and characterisation of materials and samples.

JRC-ITU has done fission gas sampling and analysis from a PWR fuel rod owned by KIT. The total amount of gas, the gas pressure in the rod and the free volume was determined. The gas samples were shared with KIT for further analyses [2], [3], [6].

The gas composition was determined by KIT using a quadrupole mass spectrometer with batch inlet system (GAM400, InProcess Instruments, Bremen, Germany). A method to determine ^{14}C in gas and aqueous solutions by liquid scintillation counting is under development [4], [7].

STUDSVIK has performed laser ablation studies on two BWR fuel samples. The samples studied are cross sections from a standard UO_2 fuel and an Al/Cr-additive fuel [8].

Dissemination

Publications, reports, or contributions in reports, proceedings:

- [1] D.H. Wegen (2012). FIRST-Nuclides 1st Annual Workshop - WP2 Summary Report - Contribution to WP2 of the collaborative project FIRST Nuclides. JRC Scientific and Policy Reports, JRC76116, European Atomic Energy Community, Germany, 2012.
- [2] D. H. Wegen, D. Papaioannou, W. De Weerd, V.V. Rondinella, J.-P. Glatz (2012). *Fission Gas Release Measurement on a 50.4 GWd/tHM PWR Fuel Segment*. 1st Annual Workshop Proceedings, 7th EC FP – FIRST-Nuclides, 9th-11th October 2012, Budapest, Hungary.
- [3] D.H. Wegen, D. Papaioannou, R. Nasyrow, R. Gretter, W. de Weerd (2012). *Non-destructive testing of segment N0204 of the spent fuel pin SBS1108*. JRC Scientific and Policy Reports, JRC75272, European Atomic Energy Community, Germany, 2012.
- [4] E. González-Robles (2012). *Fission Gas Measurements and Description of Leaching Experiments with of KIT's Irradiated PWR Fuel Rod Segment (50.4 GWd/tHM)*. 1st Annual Workshop Proceedings, 7th EC FP – FIRST-Nuclides, 9th-11th October 2012, Budapest, Hungary.

Presentations:

- [5] D.H. Wegen (2012). *WP2: Fission Gas Release & Rim and Grain Boundary Diffusion*. 1st Annual Workshop, 7th EC FP – FIRST-Nuclides, 9th-11th October 2012, Budapest, Hungary.
- [6] D.H. Wegen, D. Papaioannou, W. de Weerd (2012). *Sampling and Measurement of Fission Gas from Spent Nuclear Fuel*. 1st Annual Workshop, 7th EC FP – FIRST-Nuclides, 9th-11th October 2012, Budapest, Hungary.

FIRST-Nuclides

(D-N°: 2.1) – [Status of fission gas release studies \(12 months\)](#)

Dissemination level: PU

Date of issue of this report: **28/12/12**



- [7] E. Bohnert, E. Gonzáles-Robles, M. Herm, B. Kienzler, M. Lagos, V. Metz (2012). *Determination of Gaseous Fission and Activation Products Released from 50.4 GWd/t PWR Fuel*. 1st Annual Workshop, 7th EC FP – FIRST-Nuclides, 9th-11th October 2012, Budapest, Hungary.
- [8] A. Puranen, O. Roth (2012). *Laser Ablation studies*. 1st Annual Workshop, 7th EC FP – FIRST-Nuclides, 9th-11th October 2012, Budapest, Hungary.

FIRST-Nuclides

(D-N°: 2.1) – [Status of fission gas release studies](#)
(12 months)

Dissemination level: PU

Date of issue of this report: **28/12/12**



Joint Research Centre – Institute for Transuranium Elements

Title: DELIVERABLE (D-N°: 2.1) Status of fission gas release studies
(12 months)

FIRST-Nuclides

(Contract Number: FP7-295722)

Author(s): D.H. Wegen, E. González-Robles, A. Puranen

Abstract: This report summarises the activities planned and performed in project months 1 - 12 by the beneficiaries collaborating in the component “*Experimental determination of fission gas release*” of work package 2 (WP2) of the CP – FIRST-Nuclides project in 2012. The main achievements in the first project year are given.

The research leading to these results has received funding from the European Union’s European Atomic Energy Community’s (EURATOM) Seventh Framework Programme FP7/2007-2011 under grant agreement no. 295722 (FIRST-Nuclides project).

FIRST-Nuclides

(D-N°: 2.1) – Status of fission gas release studies

(12 months)

Dissemination level: PU

Date of issue of this report: **28/12/12**