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Plan for training course

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FIRST Nuclides

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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	

1. Introduction

One of the important objectives of work-package 5 - 'Knowledge, reporting and training' is to provide training and education for the next generation of spent fuel specialists. This deliverable describes the training activities that will be developed in the frame of the FIRST-Nuclides project.

The project budget for training measures is 25,400 €. Details on cost description included in the DoW of the FIRST-Nuclides project are provided in Table 1.

Table 1. Cost description for training activities

Participant category	Amount/ Person	Nº person	Nº events	TOTAL	Comments
Trainee	5,000 € (max.)	4 training mobilities		20,000 €	Mobility measurements
External experts	900 €	2 experts	3	5,400 €	Training (participation of external experts on workshops)

The following activities are planned to be developed:

- Invited talks by external experts within the project workshops
- Training mobility measures
- Training course

The resources defined for mobility measures in Table 1 will therefore be distributed between training mobilities and the training course.

2. Invited talks

Topical sessions will be organized in all project workshops where external expert will be invited to give a talk about issues related with the context of FIRST-Nuclides.

Wolfgang Goll, from AREVA, was invited to participate in the topical session organized within the 1st Annual Workshop of the project held in Budapest last October 2012. Wolfgang Goll gave a talk about the Characteristics of Spent Nuclear Fuel. The abstract of the talk is presented in the annex of this document.

3. Training mobility measures

Training mobility measures are offered to the project beneficiaries and to organizations (also from Associated Groups, AG) from the EU and Switzerland. These measures are not open to third countries, independently on whether they are AG to the project.

The time schedule of planned training mobility measures is shown in Figure 1. Members interested in benefiting from the measures must send and application form to the Coordination Team which will select the best candidates. The maximum costs that the project will cover are set to 2,000 € per person. The applicability of the training measure must be done within the second and third year of the project.

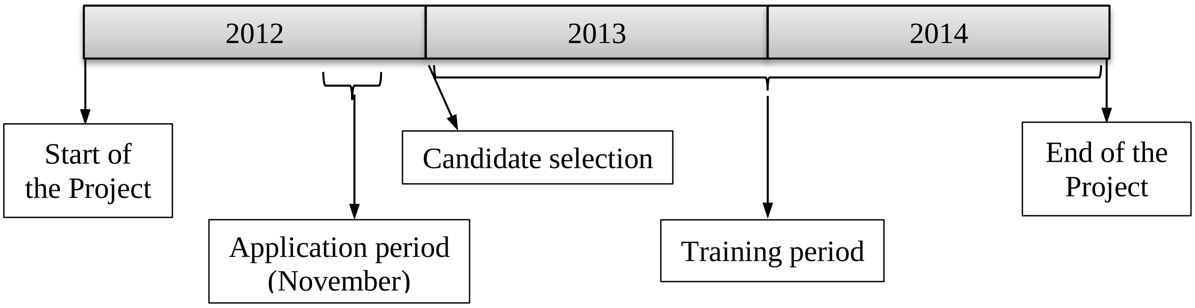

Figure 1: Time schedule of training mobility measures

4. Training course

A two days training course coordinated by KIT-INE and ITU is planned. The course is open to all interested European groups and will be limited to 12 participants. Funding will cover travelling and accommodation costs.

The planning of the course will be done in February and March 2013, when the course will be announced and the contents and the date will be also specified. Following, it is presented a tentative about the contents of the training course. It will be divided into lectures and practical training.

Lecture topics (mornings):

- Concepts for multi-barrier disposal systems and physicochemical conditions in the near-field of repositories
- Radiochemistry and radiation chemistry of spent nuclear fuel

- Spent nuclear fuel radionuclides release (focus on IRF) and radionuclide retention processes
- Introduction into practical afternoon training

Practical training (afternoons):

- Hands-on training in controlled area / hot cells
    - Analysis of surface properties of spent nuclear fuel samples
    - Surface micro analysis of spent nuclear fuel samples / irradiated uranium dioxide (XPS, ESEM-EDX, Raman spectroscopy …)

An evaluation of the course will be presented in the 2^{nd} or the 3^{rd} annual workshop.

Annex I. Abstract of the AREVA talk presented in the 1st. AWS topical session

Characteristics of Spent Nuclear Fuel

Christoph Gebhardt and Wolfgang Goll, AREVA FUEL Business Unit, FDM-G, Erlangen, Germany

The talk provided information on management of UO_2 fuel for Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) fuels, including neutron-physical aspects which are basis of an optimal usage of the fuel. The distribution of spent nuclear fuel in relation to their burn-up - as reported by the utilities - was presented, as well as the histories of the bundle power for some reactors. These bundle powers depend on the reactor operation and on the number of cycles. The radial and axial burn-up distribution was demonstrated for a modern 18x18 fuel assembly with 60 MWd/kgU average burn-up. In this context the pellet centerline temperatures as a function of the rod's linear heat rate and the temperature of the coolant were discussed for BWR and PWR fuel elements.

The fuel pellet manufacturing processes and typical inventories of additives and impurities of fuel pellets were explained. Special attention was given to the typical Al (~100 ppm) and Cr (~800 ppm) contents in the fuel pellets. In the following discussion it was questioned whether trivalent Al and Cr might interact with trivalent actinides under repository conditions. With respect to the cladding, typical PWR and BWR fuel rod cladding materials were described and their irradiation induced alterations in regard to corrosion and hydrogen uptake was quantified. It was shown that an increase in burn-up causes both an increase in hydrogen incorporation and an extension of the Zircaloy oxide thickness. The lecture included the corrosion relevant compositions of PWR and BWR cladding alloys and the behaviour of modern cladding materials such as M5, where the component Sn is replaced by Nb which shows significantly lower corrosion rates under the temperature regime of reactors. In this material, also the hydrogen uptake is lower.

Furthermore, defect mechanisms under interim and final storage were discussed. During handling, transport, discharge operations and interim storage it is required that systematic failures of fuel rods won't occur and the mechanical integrity of the fuel assembly structure is retained. Systematic cladding failures can be avoided by limiting stress and strain of the material. If defective fuel rods are present, these rods need special treatment and/or confinement.

Under disposal conditions, temperatures and, hence, stresses are further reduced excluding systematic failure. Defects under thermal creep conditions are limited to small cracks leading to a prompt loss of rod inner pressure. In the long term, effects from He production, delayed hydride cracking and other post-irradiation processes may become relevant.