INNOVATIVE MOX FUEL FOR FAST REACTOR APPLICATIONS

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Abstract

In the framework of the development of fast reactor technology it is important to expand the knowledge on innovative types of fast reactor fuels. JNC, PSI and NRG have started a project to investigate the properties of Sphere-Pac and Vipac fuels under fast reactor conditions and to compare these results with the results of pellet fuels and existing computer models. Sphere-Pac and Vipac fuels have the major advantage compared to pellet fuels that their fabrication is relatively simple, which is especially important for trans-uranium elements containing fuel pins. The project consists roughly of the following phases:

- Testing of various production techniques, production and characterisation of the various fuel pins.
- Irradiation at high power of these various types of fuels.
- Post irradiation examination and validation of computer models.

The present paper describes some details of the current stage of the project

The 16 fuel pins to be irradiated.
The tests will be performed using 16 fuel segments having a fuel stack length of 250 mm in most cases. Fourteen pins contain $(U_{0.75}Pu_{0.25})O_2$ fuel, while two segments contain $U_{0.7}Pu_{0.25}Np_{0.05}O_2$ spheres. Neptunium is inserted in the fuel in order to test the possibilities to transmutate neptunium as a part of an overall recycling strategy. Nine segments contain Sphere-Pac fuel, two segments contain Vipac fuel and five segments contain pellet fuel. The Sphere-Pac fuels will be prepared with two different densities.

The results of the tests of the various production techniques.
Successful irradiations require well-characterised and optimised fuel segments. The results of first Sphere-Pac and Vipac and pellet fabrication tests and fuel segment filling tests will be discussed. These results are amongst others data on filling fractions and data on the intermixing between the fuel phase and the depleted UO_2 thermal insulator phase. The initial fabrication tests are performed jointly by JNC and PSI, while the final fabrication of the 16 fuel segments will be done by PSI.

The results of the design computations for the irradiation experiment.
The irradiation will be performed in the High Flux Reactor (HFR) in Petten. The irradiation of the 16 segments will be done in four separate irradiation runs. In each of these irradiation runs four segments will be irradiated under almost identical conditions. The duration of the four separate irradiation runs varies between 36 hours and 132 hours and the final power ranges between approximately 500W/cm and 800W/cm. Since the HFR is a light water cooled reactor the flux conditions are not identical to

those in a fast reactor. The methods applied to obtain an optimum temperature distribution inside the fuel segments are discussed. The predicted fuel behaviour (temperature distribution, restructuring, melting etc.) will also be discussed. The results obtained during irradiation and PIE will be used to improve computer models describing these types of fuels.

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