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Towards design guidelines for fast reactor oxide fuel pins with high Pu content: driving post irradiation examination by benchmarking European fuel performance codes

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In the framework of the European Commission call for proposal "Horizon 2020", the project Plutonium Management for More Agility, called PuMMA, is granted. This project starts in October 2020 and will last four years. A work package is dedicated to the behaviour and safety of mixed oxide fuels with high plutonium content, which is essential for plutonium multi-recycling or plutonium burning in fast reactors. This paper describes main goals and status of this work package. Major task is the comparison of a large set of european fuel performance codes (FPC) on the basis of three passed experimental irradiations of oxide fuel pins containing around 45 % of plutonium: CAPRIX, irradiated Phenix French Reactor, TRABANT 1 and TRABANT2, irradiated in High Flux Reactor, HFR, in the Netherland.
The first phase of the work consists in the definition of irradiation conditions for fuel pins simulation, involving CEA and NRG. In a second phase, 10 various FPC will be used by 13 European nuclear research organizations in order to simulate these three irradiations: SIMMER-V, TRANSURANUS, OFFBEAT, FEMAXI, FUROM, FRED, MACROS, FINIX, TRAFIC and GERMINAL. Results will be compared in terms of global and local quantities: fission gas release, fuel pin elongation, profilometry, central hole radius, Pu redistribution, internal corrosion, etc. Moreover, this first set of simulations will be used to define the post-irradiation examinations programme, which will be carried out in the framework of the PuMMA project in JRC-ITU and CEA facilities. In a third phase, simulation tools will integrate new thermal properties measurements to be realized in PuMMA (other workpackage), the back-up of first comparisons, and these irradiations simulations will be re-launched and compared to experimental measurements. This mixed approach simulation/examination will allow to improve fuel codes reliability and to reduce uncertainties in the design process of this kind of fuel, which is outside of the validation area of all the existing codes. The experimental programme will be devoted to FPC validation as well as knowledge improvement. Last part of the work package will also tend to propose specific safety recommendations for the design of this kind of fuel.

Country/Int. organization

France

Speaker's email address

victor.blanc@cea.fr

Speaker's title

Mr

Affiliation/Organization

French Alternatives Energies and Atomic Energy Commission (CEA)

Primary authors: BLANC, Victor (French Atomic Energy Commission); VAN TIL, Sander (NRG); VENARD, christophe (Commissariat à l'Energie Atomique); Dr GUBERNATIS, Pierre (CEA, DES, IRESNE, DTN, Cadarache F-13108, Saint-Paul-Lez-Durance, France); Mr PERRIN, Benoit (FRAMATOME); GICQUEL-PETIT,

Solène (EDF); DEL NEVO, Alessandro (ENEA); FIORINA, Carlo (EPFL, Switzerland); GIANFELICI, Simone (KIT); GADÓ, János (physicist); LUZZI, Lelio (POLIMI); MIKITYUK, Konstantin (Paul Scherrer Institut); LEMEHOV, Sergio (SCK--CEN); BĚLOVSKÝ, Ladislav (ÚJV Řež, a. s.); PELTONEN, Jussi (VTT); CHREBET, Tomas (VUJE); LAVARENNE, Jean (University of Cambridge); FAYETTE, Laurent (CEA); STAICU, Dragos (European Commission, Joint Research Centre); ALVAREZ-VELARDE, Francisco (CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS, CIEMAT, established in Avenida Complutense 40, Madrid 28040, Spain); Mr FONTAINE, Bruno (CEA); CHAUVIN, nathalie (CEA)

Presenter: BLANC, Victor (French Atomic Energy Commission)

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