

**RERTR 2016 - 37th INTERNATIONAL MEETING ON
REDUCED ENRICHMENT FOR RESEARCH AND TEST REACTORS**

**OCTOBER 23-27, 2016
RADISSON BLU ASTRID HOTEL
ANTWERP, BELGIUM**

**Preparatory Studies for the Qualification of Cobra LTA's with
Gadolinium as Burnable Absorber in the BR2 Reactor**

Silva Kalcheva and Geert Van den Branden
BR2 Reactor, Nuclear Materials Science Institute, Belgium Nuclear Research Centre SCK•CEN
Boeretang 200, 2400 Mol, Belgium

ABSTRACT

The feasibility to convert the BR2 reactor from HEU to LEU fuel has been actively studied during the last decade. An important feature of the BR2 standard HEU fuel elements is the use of burnable absorbers, homogeneously mixed with the fuel meat. Therefore, the preliminary neutronic feasibility analyses for HEU-LEU conversion of the BR2 reactor always needed to take the choice of a suitable/compatible burnable absorber into account.

Earlier feasibility studies for various fuel element types using burnable absorbers preserved the current fuel element design in order to avoid significant changes in the thermal-hydraulics characteristics of the reactor core. For instance, the neutronic analyses of burnable absorbers in the form of wires in the aluminium side plates of the fuel elements have shown that for this configuration cadmium has the best burn-up characteristics. LTA irradiations with cadmium wires have been performed in 2011.

Recently, neutronic feasibility studies have been executed for a modified (so-called COBRA) geometry of the BR2 fuel element. In this modified geometry, the fuel meat thickness is slightly increased, while the aluminium cladding is slightly reduced. Neutronic analyses for COBRA-HEU fuel elements have been performed for different burnable absorbers: cadmium wires inside the side plates; B_4C and Sm_2O_3 homogeneously mixed in the fuel meat as for the standard BR2 HEU fuel elements; and the newly considered burnable absorber Gd_2O_3 also homogeneously mixed in the fuel meat. Comparison shows that a COBRA-HEU fuel element with boron and samarium as burnable absorbers behaves similarly to a standard BR2 HEU fuel element, while a COBRA-HEU element with gadolinium as burnable absorber has longer cycle length.

Therefore, the decision has been taken to fabricate and test LTA's with the new COBRA geometry with gadolinium as burnable absorber inside the fuel meat. In total three LTA's will be irradiated in the BR2 reactor in the years 2017 and 2018. Two COBRA-HEU LTA's with Gd_2O_3 as burnable absorber and one COBRA-HEU LTA with B_4C and Sm_2O_3 as burnable absorber. The purpose will be to compare the reactivity performances of the LTA's during several consecutive reactor cycles. Given the differences in the absorption cross sections of the burnable absorbers and the resulting different burn-up evolutions, the present paper discusses the loading strategies of the LTA's during the 4 to 5 consecutive irradiation cycles foreseen for this test irradiation.