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# W1 Online power determination in fuel irradiation experiments at BR2

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SCK CEN has nearly 50 years of experience in conducting fuel performance assessments and qualifications, irradiating rod segments or plates in dedicated facilities installed at the high flux Belgian Reactor 2 (BR2). When those facilities are equipped with flow rate and temperature measurement, it is possible to deduce in real time the linear power produced in the tested fuel segments. Corrections must always be applied to the raw calculation results to obtain the local values in the fuel stack only. Those corrections are based on neutronic models, accounting for the contributions coming from prompt and delayed radiation of all types and all origins. Gamma thermometers and flux monitors help assessing the actual axial power profile in the irradiation channel and help fine-tuning the reactor physics models. Over the course of years, the post-irradiation measurements also helped fine-tuning the calculation models. Successful experiments were conducted in the past, operating in fast transient or in burn-up accumulation mode, for pressurized water reactor (PWR) and boiling water reactor (BWR) fuel in pressurized water capsules (PWC) or loops (CALLISTO –CApabiLity for Light water Irradiation in Steady state and Transient Operation), sometimes with instrumented fuel pins. Furthermore, a thermal balance system has been applied to the materials test reactor (MTR) fuel qualification (for the Jules Horowitz reactor at Cadarache) in the primary, using the EVITA (Enhanced Velocity Irradiation Test Apparatus) loop.

Today, accurate power determination is possible at SCK CEN with 4% max uncertainty (1 sigma) on the performed thermal balances. The system is applied to high power load-following experiments for EdF (Electricité de France) fuel, high burnup assessment with instrumented needles (performed within the OECD/NEA FIDES —Nuclear Energy Agency Framework for Irradiation Experiments —framework), and driver fuel assembly qualifications for the high enriched uranium (HEU) to low enriched uranium (LEU) conversion of the US Department of Energy's MTRs.

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