MYRRHA core design – version 1.8

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Abstract

MYRRHA, as in *Multi-purpose hYbrid Research Reactor for High-tech Applications*, is worldwide recognized as one of the most prominent projects in terms of ADS technology. Developed at SCK•CEN, MYRRHA is intended to be a research facility able to work in subcritical mode as an accelerator-driven system, and in critical mode when decoupled from the proton accelerator. With lead-bismuth eutectic serving both as coolant and as a spallation target for the proton beam, MYRRHA acts as a technology demonstrator and a test platform for Heavy Liquid Metal (HLM)-cooled reactor technology for Gen IV systems. The high constant fast neutron flux levels achieved in the reactor core make it the ideal candidate for a flexible fast spectrum irradiation facility for fusion reactor development and fuel development for innovative reactors. Furthermore, MYRRHA contributes to demonstrating the technological feasibility of burning high-level nuclear waste, and in particular minor actinides, in a ADS system by achieving significant transmutation levels in representative conditions.

Over the last 20 years, several neutronics designs of the MYRRHA critical and subcritical core configurations were investigated. Each release aimed at complying with requirements made available by the technical advancement of the project as a whole. The optimization process driving the latest core design (version 1.6) targeted an effective core fuel management and new layouts for material irradiation. Compared to the very first versions, the plutonium content in the MYRRHA MOX fuel is now of 30%. Also, irradiation rigs are included to reproduce a range of neutron spectra that are representative of thermal, fast and fusion reactors.

In 2019, SCK•CEN released version 1.8 of the subcritical core design. Despite the major constraints of a smaller core and a lower cladding temperature (400ºC), the core guarantees the highest performances in terms of transmutation and material irradiation as required by its application catalogue. In this work, a description of the subcritical core design is provided. The major neutronics characteristics are also reported for two core layouts, namely at beginning-of-life and at equilibrium.