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BRILLIANT

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Master's Thesis No. 3 offered by the project

Main author(s): Y. Hrabara, W. Gudowski (KTH)

Contributing author(s):

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Dissemination Level		
PU	Public	X
RE	Restricted to a group specified by the partners of the BRILLIANT project	
CO	Confidential, only for partners of the BRILLIANT project	

Master's Thesis No. 3 offered by the project:

Development, benchmarking and validation of the Advanced Nuclear Fuel Cycle Simulator – FANCSEE and advanced use of Monte Carlo methods in nuclear reactor calculations

Master student name: Yuliia Hrabara

Thesis supervisors: prof. Wacław Gudowski, waclaw@kth.se

Blazej Chmielarz, MSc.

Kungliga Tekniska högskolan – Nuclear Reactor Physics, Stockholm, Sweden

The objective of this Master Project is to further develop a pre-release version of the Advanced Nuclear Fuel Cycle Simulator Code *FANCSEE*, developed at the Division of Reactor Physics at KTH. The core physics of the code is based on a state-of-the-art solution to Bateman equations for burnup matrices. The matrices correspond to an array of reactor types and are based on calculations with Monte Carlo Particle Transport codes – MCNP/Serpent, separate for each reactor type.

The software can be controlled graphically through pre-defined and well simulated objects of the nuclear fuel cycle model: reactors, mines, enrichment plants, fuel manufacturing facilities and repositories, in very broad timescales.

The project is focused on the following topics and deliverables:

1. Fast Sodium-cooled Reactor model calculations with a Monte Carlo code SERPENT. The model should take into account the following parameters of the core:
    a. grid spacers,
    b. core support structure,
    c. fuel assembly structure,
    d. fuel pins, with specific fuel gas gaps
    e. material composition of the fuel
    f. radiation shielding and neutron reflectors,
    g. reactivity control rods,
    h. instrumentation tubes,
    i. coolant,
    j. fuel arrangement as well as composition depending on batch number and thermal power.
2. Perform SERPENT calculation of burnup cycles for this Fast Reactor core design. The goal is to obtain depletion matrices from the burnup cycles in order implement this model into FANCSEE simulator. The calculations will be performed for Thermal Design Power ranging from 60% to 105% in 5% increments.
3. Implementation of a Heavy Metal Cooled Reactor model into the FANCSEE simulator. The necessary SERPENT model development will be delivered by other projects.
4. Implementation of an Accelerator Driven System based on the Myrrha design into the FANCSEE simulator. The necessary SERPENT model development will be delivered by other projects.

5. Benchmark fuel cycle calculations for those three reactor model based either on comparison with the SERPENT results or with the published data
6. Partial validation of the FANCSEE fuel cycle calculations based on the comparisons with the experimental data from Swedish nuclear fuel cycle

The Master thesis project will be supervised by prof. Waclaw Gudowski and by the FANCSEE developer Blazej Chmielarz, MSc. This project will be concluded by the mid of 2019.