Revised Methodological Approach to Radiation Protection and Material Performance Evaluation

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This PhD work is about nuclear fuel modelling and a joint project between University of Oslo (UiO) and Institute of Energy Technology (IFE), Norway. Fuel modelling is important for the safe and efficient operation of the research reactors and nuclear power plants. Two fuel modelling and simulation tools are used in this project: HELIOS-2.1 code is a two-dimensional transport code for fuel burnup and flux calculation, designed by Studsvik Scandpower, Sweden and SCALE-6.1 is an ORIGEN-based computer code developed by Oak Ridge National Laboratory, USA.

The main purpose of this work is to compare HELIOS and SCALE/TRITON codes, in order to identify systematic differences between two deterministic codes and validate SCALE/ TRITON code for the building of specific cross sections libraries for Halden boiling water reactor (HBWR), that will be used for the activity and spent fuel calculations, such as fuel handling, transport and long-term storage of used fuel from Halden reactor. HELIOS code is used as a reference tool in this work, because this code has been used for fuel burnup and flux calculation at the Halden research reactor since 1998. IFE would like to switch to SCALE code, because SCALE is more flexible and distributed free-of-charge, while HELIOS code is a commercial power reactor fuel tool with relatively high user costs.The Halden BWR is located in Halden and in operation since 1959. The HBWR is a heavy water moderated and cooled reactor with 25MW thermal power, but usually operates at 18-20MW.

The project is divided into two parts:

1. HELIOS and SCALE deterministic codes are compared on pin cell model both for light water and heavy water reactor cases in first part. The main objective of this part was to identify the origins of discrepancies between two calculational methods and validate SCALE code for the further use in Halden reactor.
2. The second part of project is an application of the method developed in the first part of study for the modelling of Halden fuel with SCALE code and development of cross-section libraries for Halden reactor, which will be validated against HELIOS code and experimental data and applied for Halden spent fuel calculations.

The results of this research will be published in three papers.