

Simulation study of nuclear fuel inspection using gamma emission tomography

Master work in applied nuclear physics

Engineering Programme / Master in Physics – Degree project (Exjobb)

Duration: 20 weeks (30 credits), autumn semester of 2016 or spring semester of 2017.

Description:

This project is part of a collaboration between the Applied Nuclear Physics division of Uppsala University, Westinghouse (Sweden) and the OECD Halden Reactor Project, regarding nuclear fuel diagnostics. In the collaboration there are plans for a mobile nuclear fuel inspection instrument to perform gamma emission tomography in the fuel ponds of nuclear reactors.

In the project a study will be performed on the performance of tomographic assessment on Pressurized Water Reactor (PWR) fuel assemblies, which contain 289 fuel rods in a 17 x 17 pattern. Preliminary instrument design(s) will be tested by simulating the transport of gamma radiation from the fuel to the detector positions.

For the purpose of the simulation studies, the code MCNPX will be used. The task of the student will be to arrange the fuel geometry and the relevant simulation parameters in MCNPX input files, and to arrange so that the input files may be automatically altered to simulate the various positions of the detector system relative to the fuel, mimicking a tomographic scan. For the automatic code alterations and for the organization of the read out, batch or matlab programming is suggested.

The data resulting from the simulation study will be used to perform analysis using available tomographic reconstruction codes, and the resulting cross sectional images of the modeled nuclear fuel assembly will be used as a preliminary indication of the performance of the proposed instrument. Conclusions will be drawn on the adequacy of the selected geometrical parameters of the instrument, and may impact the final design.

We are looking for a student interested in nuclear fuel and measurements of ionizing radiation. Any experience using radiation transport simulation codes or experience of radiation measurements will be considered as meriting. A curriculum containing nuclear-energy related courses is also considered to be of advantage.

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