

Feasibility study of neutron generator assisted gamma emission tomography system for the OECD Halden Reactor Project

Master work in applied nuclear physics

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

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

Description:

This project is part of a larger ongoing collaboration between the Applied Nuclear Physics division of Uppsala University and the OECD Halden Reactor Project, regarding nuclear fuel diagnostics.

The project entails a feasibility study of two possible upgrades of a gamma emission tomography system for irradiated nuclear fuel. The current tomography system, which is operational at the Halden Reactor, uses the characteristic gamma rays from a nuclear fuel that has undergone neutron irradiation. The instrument uses a spectroscopic gamma detector to measure the intensity of the characteristic gamma rays emitted by fission, activation and decay products in the fuel. Mathematical reconstruction of the recorded data is used to assess the activity distributions of various isotopes in the fuel cross section. The resulting data can be used to study features of nuclear fuel such as the burnup and power distributions, fission product migration and release, and fuel distribution after LOCA transient tests.

In this project it will be investigated if the instrument may be modified by using either a transmission tomography system, by applying 1) an external radiation source (X-ray or gamma ray), or by applying 2) an external neutron source to measure the emission distribution of prompt and delayed fission gamma in the fuel.

The work will include literature review on the investigated techniques. Conceptual designs will be developed and evaluated. Preliminary determination of the required radiation intensity for the useful implementation of the respective techniques will be performed. The availability of sources with the required intensity will be investigated in order to determine the feasibility of the proposed upgrades.

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 an advantage.

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