

# Task for student research project or diploma thesis

## Nuclear Data Sensitivity Analysis and Uncertainty Quantification (SA/UQ) of the AKR-2 nuclear training and research reactor

The AKR-2 nuclear training and research reactor at TU Dresden is a zero-power reactor with a homogeneous, cylindrical core made of a polyethylene and uranium dioxide mixture. The reactor currently serves as a research and educational platform, used for projects such as NAUTILUS, which is being conducted by the Chair of Hydrogen and Nuclear Energy. This reactor is modelled using Monte Carlo transport codes such as MCNP, Serpent and OpenMC. These codes are used to determine and compare neutronic parameters such as the multiplication factor  $k$ -eff, control rod worths, spatial neutron flux, neutron spectra in multiple reactor locations and reaction rates in activated foils with experimental data.

This work will investigate the impact of nuclear data uncertainties from neutron incident cross sections and thermal scattering data in the ENDF/B-VIII.1 and JEFF-4.0 nuclear data libraries, which are stored in the form of covariance matrices, on the aforementioned responses. To accomplish this objective, first-order perturbation theory and the total Monte Carlo method will be employed.

Then, the following points are to be addressed:

- Familiarisation with the Monte Carlo neutron transport code Serpent.
- Determination of reactor responses using the Serpent code.
- Sensitivity coefficients determination to the most relevant reactor nuclides, and thermal scattering data, collected in a ranking table of importance.
- Uncertainty quantification in responses due to cross sections, neutron multiplication factor, prompt fission neutron spectrum and angular distributions with the first-order perturbation theory and total Monte Carlo method.
- Ranking of the most relevant reactions to the uncertainties in the responses.
- Recommendations to data community to decrease the uncertainties of relevant safety responses.
- Documentation of the results of the research project.

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**Internet references:** <https://doi.org/10.1016/j.anucene.2026.112217>; <https://serpent.vtt.fi/>