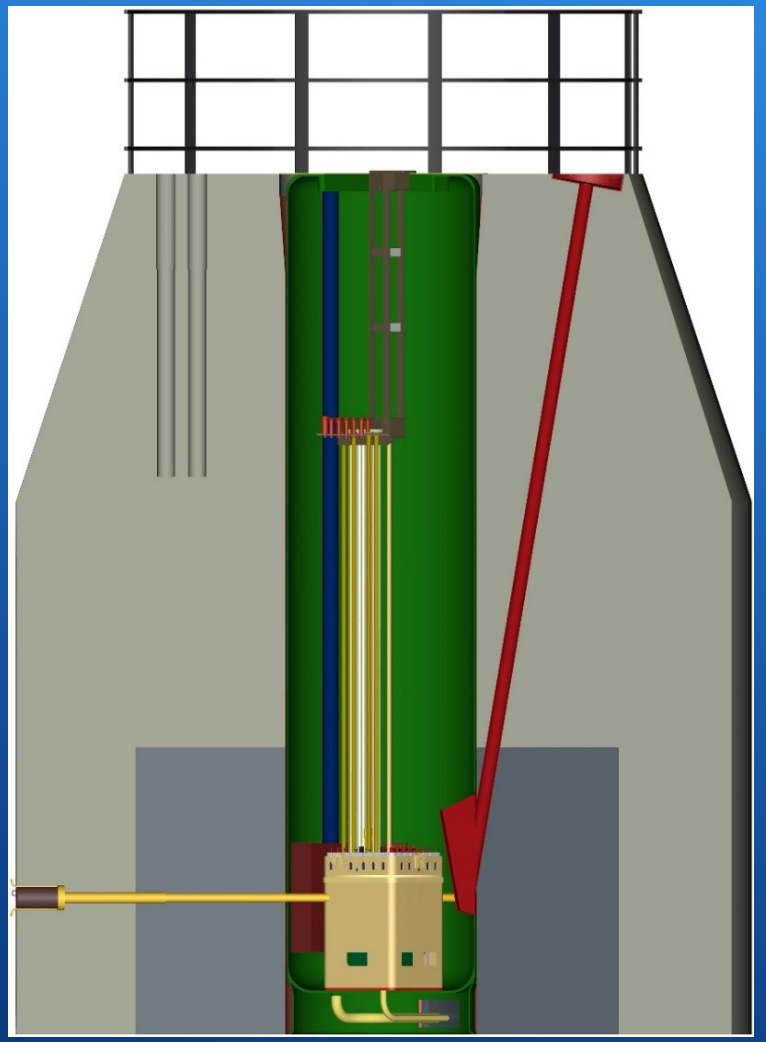
Reactivity worth function of a neutron absorber

BME Training Reactor, Exercise BME-04

Main topic: Reactor Physics / Worth of neutron absorbers, spatial dependence

Keywords: reactivity worth, thermal neutron flux, thermal absorption cross section, adjoint flux, perturbation theory

Purpose: The aim of this experiment is to analyse the reactivity change caused by the insertion/withdrawal of a neutron absorber into a nuclear reactor operating in a critical state. The students learn the experimental technique that is used to determine the space-dependence effect caused by an inserted neutron absorber. During the experiment, the reactor is maintained in the critical state by an automatic reactivity control system. In frame of this exercise the reactivity worth of some neutron absorbing materials is determined.



Level of exercise:	☐ Basic	☒ Advanced	☒ Complex
Level of education:	☐ BSc	☒ MSc	☐ PhD

What you will learn:

Students learn how to determine the spatial dependence of the reactivity worth function of a neutron absorber in the reactor core. They compare the experimentally obtained worth function with predictions of the one-group perturbation theory.

Important information:

- Minimal size of student group: 2
- Maximal size of student group: 6
- Overall duration of the experiment (in wall clock hours): 3-4

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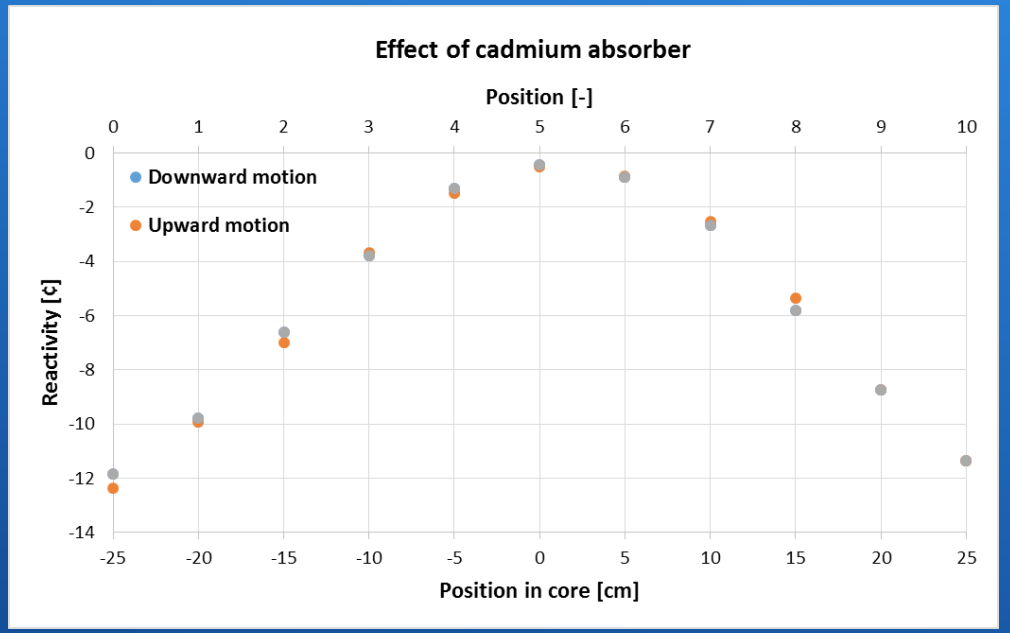
Possibility to perform experiment on demand: ☒ Yes ☐ No
Frequency of occurrence: 10-12 times per year
Examination modalities: short test before measurement, experiment report after
Teaching languages: English, Hungarian

Pre-knowledge required: Basics of nuclear and reactor physics, fundamentals of perturbation theory



Instruments required for exercise:

- Reactor and its neutron monitoring and reactivity control systems.
- Plexi-glass rod, containing a cadmium cylinder
- Reactivity worth calibration curve of the automatic control rod.

Execution:

- After the absorber (a small cadmium tube) is inserted into the critical reactor core between the fuel elements, it is then moved to various positions of the core, and the reactivity change is determined from the movement of the automatic control rod.
- The effect of neutron self-shielding in the case of strong neutron absorbers is shown by demonstrating the reactivity worth of Cd absorber tubes with different lengths (surfaces) and wall thicknesses at the same core position.

Limitations:
None