Void reactivity coefficient

TU Wien, Exercise TUW-11

Main topic: Reactor Physics

Keywords: Void coefficient, reactivity change, heavy water, cadmium

Purpose: In a nuclear reactor, very small disturbances within the reactor can cause major effects in reactivity, which for instance whilst critical or close to criticality, could lead to loss of control and ultimately fuel damage. The purpose of this experiment is to observe the correlation function and void coefficient, by inserting different materials into the core and observing their effects on reactivity. The students will become familiar with those effects on reactivity and hence on reactor power.

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

What you will learn:
During this experiment the participants will gain the principal knowledge of reactor power calibration.

Important information:
- Minimal size of student group: 4
- Maximal size of student group: 8
- Overall duration of the experiment (in wall clock hours): 3

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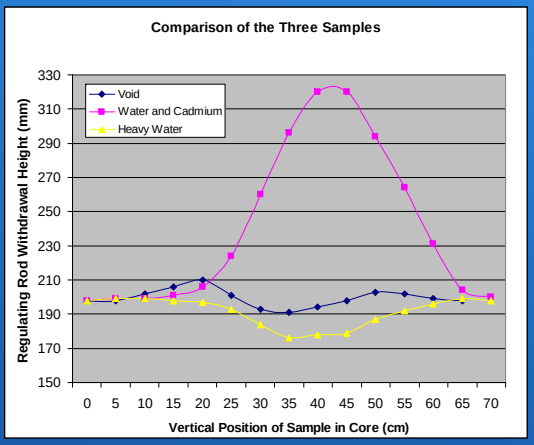
Possibility to perform experiment on demand: ☒Yes ☐ No
Frequency of occurrence: Once a year
Examination modalities: Participation in the experiment, protocol and final written test
Teaching languages: English/German



Pre-knowledge required: understanding in nuclear and reactor physics (nuclear fission, types of decay, cross section, nuclear reactions, multiplication factor, void coefficient of reactivity, criticality, neutron flux density and its behaviour); radiation physics and protection (radioactive decay, dose rate and limits, activity, and all aspects regarding radiation protection).

Instruments required for exercise:

- Reactor I&C system.;
- A dosimeter and count rate monitor for measuring dose rate and activity control;
- A contamination monitor.

Execution:

- This experiment is performed in the central position of the reactor core. Three cylindrical samples are prepared for this perturbation study: respectively void, heavy water and cadmium sample.
- This experiment is performed at low power of 10 W.
- The void sample is inserted into the core central position and moved vertically in 5 cm steps from bottom to top of the core.
- For each 5 cm step, the regulating rod position is adjusted to maintain a steady power of 10 W.
- Once the reactor power has stabilized the rod position and therefore the reactivity effect is recorded.
- The same procedure is repeated for heavy water and cadmium samples.

Limitations:

This experiment will be conducted in a controlled radiation area. Hence. controlled radiation area limitations apply.