Control rod worth calibration

Jožef Stefan Institute, Exercise JSI-04

Main topic: Reactor Physics

Keywords: Control rod worth calibration, rod swap method, dynamic rod insertion method, digital meter of reactivity

Purpose: The negative reactivity induced by control rod insertion is a parameter of key importance for safe reactor operation. The relation between the control rod position and reactivity is non-linear, therefore the control rod worth calibration curves are of great assistance to the reactor operator, enabling the estimation of the shutdown margin and critical control rod positions. The purpose of the experiment is a demonstration of several methods of control rod worth calibration.

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

What you will learn:
Students will gain knowledge on the dependence of the negative reactivity on the depth of the control rod insertion (integral worth), gain knowledge on the control rod worth at different positions (differential worth), learn how to experimentally calibrate control rods using the rod swap and dynamic rod insertion methods.

Important information:
- Minimal size of student group: 4
- Maximal size of student group: 12
- Overall duration of the experiment (in wall clock hours): 3-4
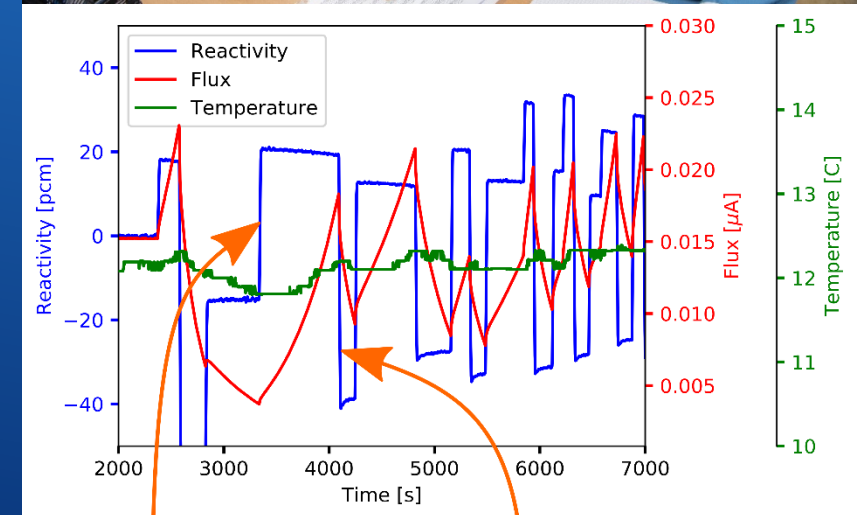
Regulating rod withdrawal

Shim rod insertion

Control rod worth calibration

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Possibility to perform experiment on demand: ☒ Yes   ☐ No
Frequency of occurrence: on demand
Examination modalities: report
Teaching languages: English, Slovenian, Serbian/Croatian, Italian, French

Pre-knowledge required: Basics of Reactor Physics, in particular: definition of the multiplication factor, reactivity, reactor period/reactor doubling time, basics of reactor operation.

Instruments required for exercise:
- Reactor instrumentation
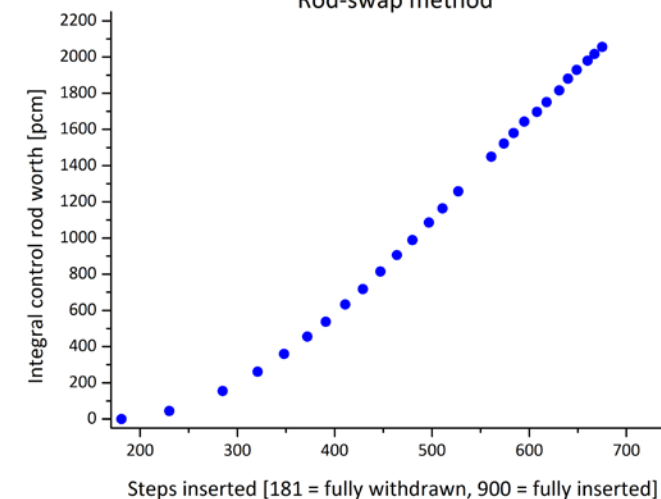- Digital meter of reactivity
- Dedicated software developed by JSI

Execution:
- After discussion of the basic concepts, students determine the integral and differential worth curve for a chosen control rod (e.g. the regulating rod of the JSI TRIGA reactor) using the rod swap method and the dynamic rod insertion method
- In each step of the rod swap procedure, students predict the magnitude of the changes in reactivity due to insertion/withdrawal of the measured/calibrated control rod, and analyze the results on the spot.
- In the dynamic rod insertion method, students coordinate and time the measurement sequence and analyze the results.

Limitations:
None

JSI TRIGA reactor - regulating control rod worth
Rod-swap method

JSI TRIGA reactor - regulating control rod worth
Rod-swap method