Compensated Ionization Chambers and Self-Powered Neutron Detectors

TU Wien, Exercise TUW-02

Main topic: Reactor Physics

Keywords: Neutron flux, compensated ionization chamber, neutron detector

Purpose: This exercise studies the properties and limitations of different types of neutrons detectors used in a reactor.
The first part of this experiment will be focused on compensated ionization chambers. It specially examines the effects of varying the applied high voltage to a compensated ionization chamber installed in the TRIGA reactor, and determines its saturation voltage for the detectors.
After that participants will learn the functioning and use of the self-powered neutron detectors (SPND) .

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

What you will learn:
During this experiment the participants will learn the properties and limitations of different neutron detectors used in a nuclear reactor. Namely compensated ionization chambers and self-powered neutron detectors.

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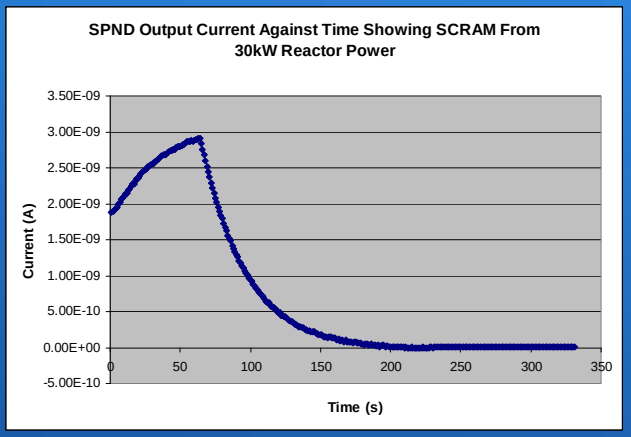
Possibility to perform experiment on demand: ☒Yes ☐ No
Frequency of occurrence: Once a year
Examination modalities: Participation in the experiment, protocol and final written test
Teaching languages: English/German



Pre-knowledge required: understanding in nuclear and reactor physics, radiation physics and protection, principles of different types of neutron detector.

Instruments required for exercise:

- Reactor I&C system;
- A compensated ionization chamber installed in the reactor;
- A vanadium self-powered neutron detector;
- A contamination monitor.

Execution:

- The reactor is stabilized at different power levels and a positive high voltage is applied to the compensated ion chamber, which is increased stepwise.
- The resulting chamber current output is recorded until a plateau is reached.
- Next at a fixed positive and negative high voltage (+800 V, -150 V) the reactor power is increased incrementally from 1 kW up to 250 kW and the chamber current is recorded.
- A SPND is exposed to a power level of 30 kW in the core centre. The current of the SPND will increase due to the activation of the emitter material. It takes about 10 half-lives until a constant signal is obtained. Then the reactor is shut down and the decrease of the signal is observed, which again depends on the half-life of the emitter material. From these values the emitter material can be identified.

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