NUCLEAR TECHNOLOGY EDUCATION CONSORTIUM

N32 Part-Time EXPERIMENTAL REACTOR PHYSICS

Summary

The module takes place at the Training Reactor VR-1 which is operated by Czech Technical University in Prague. The module consists of various experiments and hands-on training focused on the reactor and neutron physics, nuclear reactor dynamics, nuclear safety, and operation of nuclear reactor. The participants take active part in all experiments, and independently evaluate experimental data. The principles of neutron detection, the importance of delayed neutrons and their properties, the operating parameters of nuclear reactor, basic phenomena of reactor kinetics and dynamics are studied and demonstrated during various reactor experiments and measurements. Knowledge of the reactor I&C and safety aspects of nuclear reactor operation are gained during the hands-on reactor control.

On completion of this module students will be able to:

- Demonstrate a full understanding of the basic phenomena of reactor physics, behaviour of nuclear reactor and conditions for its safe operation.
- Analyse and interpret data from reactor experiments and measurements.
- Set-up neutron detection system and use it for an in-core reactor measurement.
- Determine the delayed neutrons properties, their importance and utilize them for further measurements.
- Measure and determine the neutron flux, control rod worth and reactivity by various methods.
- Analyse and explain the reactor behaviour at various operating states and conditions and the reactor response to reactivity changes.
- Start-up and control zero-power reactor.
- Evaluate the experimental results, prepare the lab protocols and present them.

Syllabus

- Set-up of the neutron detection system and study of the properties of gas filled neutron detectors (pulse height spectrum and detector dead-time).
- Measurement of the axial neutron flux profile; study of the flux tilt and the influence of control rods position on the neutron flux profile.
- Determination of the delayed neutron properties and analyses of the delayed neutrons decay curves; determination of fissionable material mass using delayed neutrons detection.
- Reactivity measurement by various methods (Source Jerk method, Rod Drop method, Positive period method, Source multiplication method).
- Control rod calibration by inverse rate method and reactimeter; study of the control rod interference effects.
- Study of the reactor behaviour in critical, supercritical and subcritical state with and without the external neutron source.
- Study of the reactor responses to various reactivity changes (pulse, transient and oscillation characteristics measurement).
- Influence of the temperature on behaviour and operation of nuclear reactor; determination of the thermal and void coefficient.
- Prediction of the reactor critical state by inverse rate method; approaching the critical state by movement of control rods.
- Start-up and control of the VR-1 Reactor by students.