

Evaluation of the Dynamic Rod Worth Measurement technique

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Aim of this Master's Thesis

- With each refueling shutdown, some tests must be carried out to ensure that the reactor, with the new fuel loading pattern, is safe throughout the cycle at full power. These tests, the reload startup physics tests, aim to compare theoretical values of nuclear parameters obtained by a neutronic code with measured values. The control rods worth measurement is one of the test and aims to ensure a sufficient antireactivity in case of an emergency shutdown.
- The method used by Tractebel to measure this parameter is the boron dilution method. But this method generates radioactive waste and is a slow process which costs the operator money.
- A new method, the Dynamic Rod Worth Measurement or DRWM, consists of rapid insertion, at 72 steps/min, of the rods until the bank is fully inserted. The reactivity before insertion and after insertion is measured and the total rod bank worth is calculated.
- My master's thesis consists of the evaluation of this method by simulations with the Panther-3D calculation code and through sensitivity studies.

Methodology

- Panther transient simulations on three different cycles of Tihange 2.
- Python code development for the excore reactivity measurement.
- Sensitivity studies on the neutron source value, the kinetics parameters, the criterion used to determine the Doppler flux, the neutron time generation and the fuel loading pattern.
- Comparison between DRWM method and dilution method.

Results

- The results show there is a same pattern in the evolution of the excore reactivity, calculated by the Python code, and the incore reactivity, calculated by Panther, for the three cycle.
- The sensitivity studies shows that the only parameter which the uncertainty has an impact on the reactivity is the delayed neutron fractions.
- Duration time is more than two times shorter in the DRWM method and there is no generation of effluents.

Conclusion

- The Dynamic Rod Worth Measurement method was evaluated in this Master's Thesis by Panther simulations and sensitivity studies. The results show that the method is robust and precise.
- The conclusion of this study is that the method has a potential for a demonstration test by the measurement of a bank by the DRWM method and by the dilution method.