

Uncertainty and sensitivity analysis of the ANNA critical assembly benchmark using SCALE

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Between 1961-1972 four critical assemblies were constructed at the Institute of Nuclear Research (now National Centre for Nuclear Research - NCBJ) in Swierk, near Warsaw known under the names: ANNA, MARYLA, AGATA and PANNA, and one exponential assembly HELENA. ANNA was a graphite-light water moderated assembly with enriched fuel, designed primarily as a mock-up of the high-flux reactor. ANNA consisted of a core, top and bottom reflectors, all surrounded by the radial graphite reflector. The whole system was 240 cm high and its horizontal cross section, octagonal in form, has an equivalent radius of 137.5 cm. The core was composed of 21% U-235 enriched fuel elements immersed in vertical coolant channels passing through a graphite matrix. The coolant channels and the graphite matrix extend throughout the top and bottom reflectors. The first critical experiment was carried out in June, 1963. The Polish Ministry of Energy commissioned the benchmarking of this reactor for the needs of the OECD database "The International Handbook of Evaluated Criticality Safety Benchmark Experiments".

Sensitivity and uncertainty methods have been developed to aid in the establishment of areas of applicability and validation of computer codes and nuclear data for nuclear criticality safety studies. This work presents the determination of uncertainties of effective multiplication factor (k_{eff}) associated with geometry, masses and compositions of the constituents of the critical assembly. The uncertainty of k_{eff} , caused by nuclear data, were determined by TSUNAMI/SCALE code, which uses the Generalized Perturbation Theory (GPT) for cross-sections perturbations.

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