

Validation of the core physics codes for MYRRHA in VENUS experiments

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Abstract

Essential differences in calculational to the experimental results due to the nuclear data someone can found in the papers have been presented earlier [1, 2].

Recently, the validation of nuclear data and neutronic codes has been performed in both critical and sub-critical fast VENUS-F lead and lead-bismuth cores in order to address a part of nuclear data needs for the neutronic design of MYRRHA.

Comparison of experiments and calculations using Monte Carlo code with general-purpose nuclear data libraries (JEFF, ENDF-B, JENDL) have been performed for: criticality, delayed neutron parameters,

worth of control and safety rods, spectral indices, spatial fission rate distributions, reactivity effects - coolant void, fuel temperature effect.

Sensitivity and uncertainty analysis was also addressed in order to identify the uncertainties of which parameters need to be improved in order to reduce the uncertainty in k_{eff} .

Concerning nuclear data used in Monte Carlo code, several clear trends have been observed:

- calculations overestimate k_{eff} by 200-1100 pcm depending on a nuclear data library used;
- calculation underestimate control and safety rod worth by 10-15% in case 6-group delayed neutron parameters are used and by 5-10% in case 8-group delayed neutron parameters are used;
- calculated and experimental spectral indices (fission rate ratios) show discrepancies for ^{238}U , ^{240}Pu , ^{242}Pu , ^{237}Np and ^{241}Am to ^{235}U indices. C/E differs from 1 by more than the uncertainties (3.0-3.5%) and is usually in the range 0.90-1.05;
- measured and calculated spatial fission rate distributions and ^{239}Pu to ^{235}U spectral index are generally in a good agreement;
- calculations can approximately predict the trend of the coolant void effect but they underestimate the experiment in absolute terms;
- the rate of the temperature effect calculated with MCNP is in agreement with the measured one.

1. A.Kochetkov et.al., “Validation of Neutron Data for Pb and Bi Using Critical Experiments”, *Proceedings, International Conference on Nuclear Data for Science and Technology (ND 2001), Tsukuba, Japan, October 7-12, 2001*

2. A.Kochetkov et al. “Benchmark-experiments for Pb and Bi Neutron Data Testing Advances in nuclear analysis and simulation” : *PHYSOR 2006; September 10 - 14, 2006, Vancouver, BC, Canada*