Technical area 6: Fast Spectrum Reactors

THEORETICAL REQUIREMENTS TO TOLERANCES TO BE IMPOSED ON FUEL ROD DESIGN PARAMETERS FOR RBEC LEAD-BISMUTH FAST REACTOR

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Development of advanced reactors with innovative coolant and fuel requires comprehensive analysis of fuel rod design parameters and tolerances necessary for providing reliable and safe reactor operation. Fabrication of fuel rods of new design with the use of innovative materials requires introduction of new technologies. Tolerances to be imposed on fuel rod parameters are not specified for these technologies. At the stage of development of technologies these tolerances can be found by estimating the fraction which certain parameter introduces in total uncertainties of major reactor operational and safety parameters. These analysis can be useful for finding which technological stages should be improved.

The paper presents such analysis for fuel rod design of the RBEC lead-bismuth fast reactor option with (U-Pu)N fuel. The main stages of this study are as follows:

- choice of important reactor operational and safety parameters to be optimized (in presented study: core peaking factors and reactivity to be compensated by control rods);
- specification of required margins of uncertainties for these parameters;
- specification of fuel rod design parameters for which required tolerances are searched (the influence of these parameters are not well known because of new fuel type: fuel density, plutonium content in fuel and fuel stoichiometry), tolerances for other fuel rod parameters are fixed based on technological experience (fuel and cladding dimensions, fuel grain size, content of impurities in fuel, etc.);
- calculational analysis by perturbation theory methods to estimate the fraction which certain fuel rod design parameter introduces in total uncertainties of the chosen reactor operational and safety parameters;
- calculation of tolerances to be imposed on the chosen fuel rod parameters to keep reactor characteristics within specified uncertainties;
- verification of the results by methods of mathematical statistics based on multiple direct calculations.

The data obtained should be accounted while specifying requirements to technologies of new-type fuel rod fabrication and while estimating the cost of such fabrication.