ADVANCED FUEL CYCLE FOR LONG-LIVED CORE OF SMALL-SIZE LIGHT-WATER REACTOR OF ABV TYPE

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Advanced small reactors could be considered as an important component of the future nuclear power structure. Approaches to design of the core and primary cooling system should account for operational experience of marine reactors, but should be revised for safety enhancement. To simplify reactor control, monitoring and maintenance, safety of small reactors should mainly be provided by passive systems and inherent properties of core design and materials. One of the major safety requirements to a small reactor operation is reduction of reactivity accident probability and consequences.

Reactivity to be compensated by control rods at the beginning of fuel cycle in existing marine pressurized-water reactors (PWR) is 8 up to 20 % $\Delta k/k$. Technological difficulties of introduction of reactivity control by boric acid in primary coolant and low core breeding ratio are the main reasons of such high reactivity margins for burnup.

The paper presents results of advanced fuel cycle optimization for long-lived core of ABV-type PWR by selection of fuel composition and by the use of advanced burnable absorbers. ABV is a marine PWR project of 38 MWt at 15 MPa with natural circulation of primary coolant and inert matrix fuel U-Zr-Al.

Replacement of inert matrix fuel by uranium dioxide and the use of ZrB_2 and gadolinium as burnable absorbers in the core central zone allowed to obtain the following parameters of the fuel cycle for ABV-type reactor:

- time of operation at nominal power level is 2450 effective days;
- reactivity to be compensated by control rods is about 3 % $\Delta k/k$;
- fuel assembly power peaking factor does not exceed 1.4 during the whole fuel cycle;
- fuel assembly peak and average fuel burnup is 41 and 37 MWd/kg U, respectively.

The reduced value of reactivity to be compensated by control rods allows for significant safety enhancement by reducing the possible consequences of control rod ejection accident.