BURNUP CREDIT APPLICATION IN NUCLEAR SAFETY SUBSTANTIATION OF ISF-1 SPENT FUEL STORAGE

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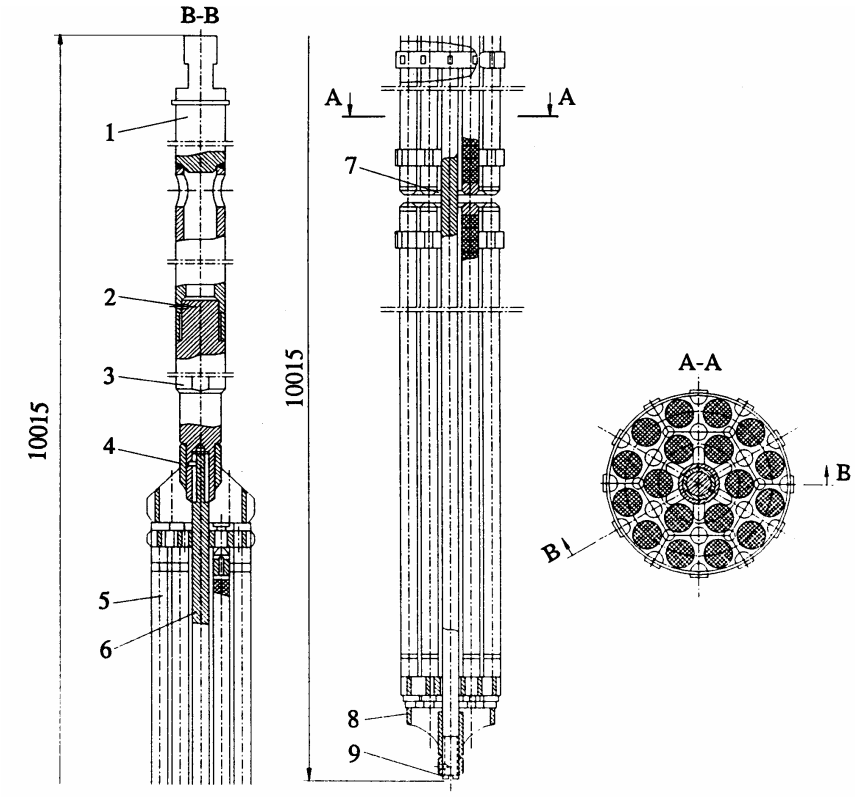
The power units of Chernobyl NPP (ChNPP) are currently under decommissioning. ChNPP spent fuel is stored in the wet-type interim spent fuel storage facility (ISF-1). Calculations performed previously with fresh fuel assumption show that K_{eff}<0.95 requirement is not met [1].

Description of the storage facility for spent nuclear fuel of RBMK-1000 reactors at Chernobyl NPP, ISF-1

The design capacity of ISF-1 is 17520 spent fuel assemblies, which may be placed in five compartments, 4380 FA each. Spent fuel assemblies are stored vertically in canisters filled with water. The canisters completely isolate the internal volume from pool water.



1 – suspension bracket; 2 – top plug; 3 – adapter; 4 – connecting rod; 5 – fuel element; 6 – carrier rod; 7 – end sleeve; 8 – end cap; 9 – retaining nut
Fig. 1 –RBMK-1000 fuel assembly

The list of isotopes to determine the neutron multiplication factor for the storage system with fuel burnup credit

Based on the measured and calculated data on RBMK spent fuel isotopic composition and experience in burnup credit application for PWR and VVER spent fuel [2]-[4], the following five isotopes were chosen to carry out criticality safety analysis with burnup credit:

$$^{235}U,\ ^{238}U,\ ^{239}Pu,\ ^{240}Pu,\ ^{241}Pu$$

Use of data on the concentration of only five transuranic isotopes in the neutron multiplication factor calculations leads to overestimation of their results, Fig. 3.

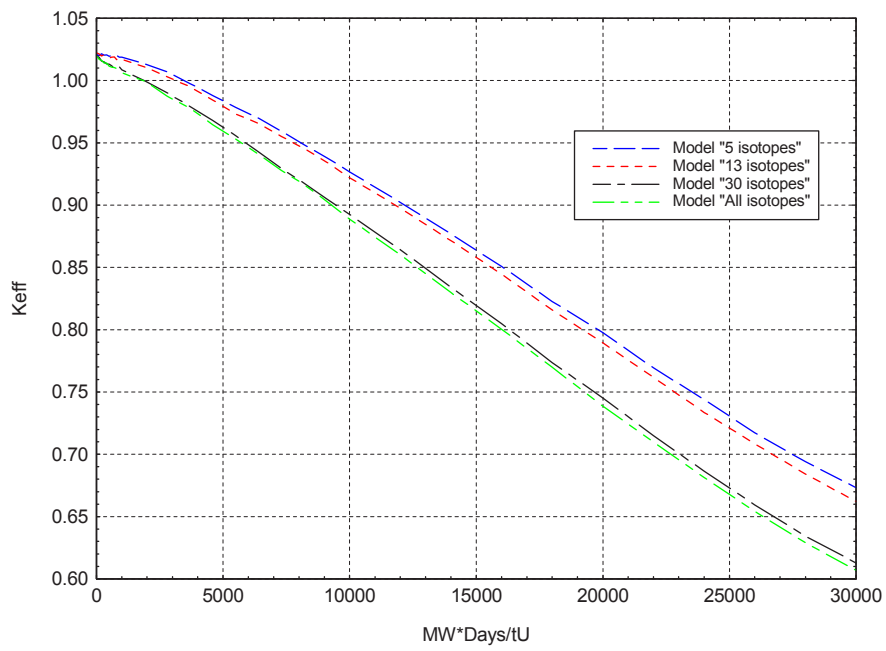
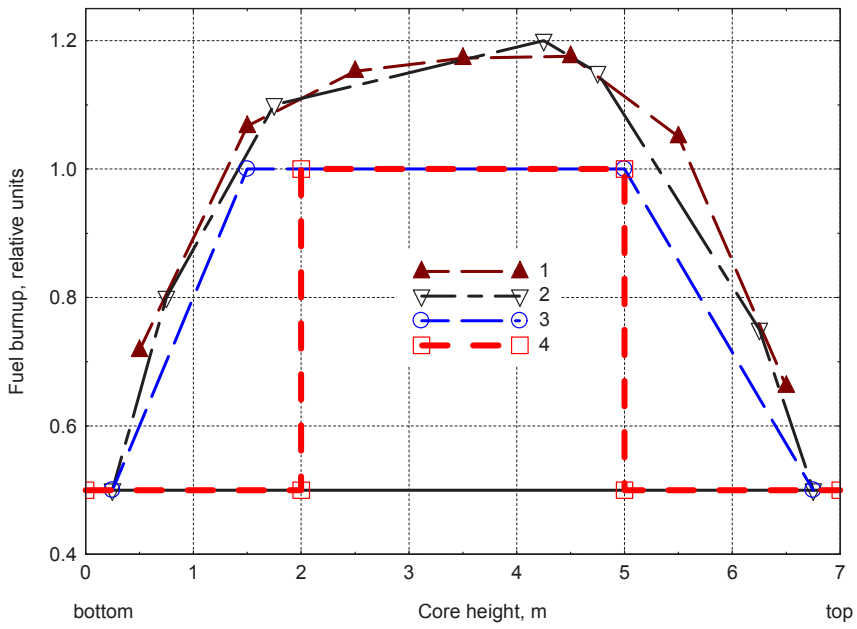


Fig. 3 – Calculation of the neutron multiplication factor taking into account different number of isotopes

Determination of the fuel burnup profile

In studying the possibility to use burnup credit for spent fuel from RBMK reactors, the influence of non-uniform burnup distribution along the radius and height of the fuel assembly on multiplication properties of spent nuclear fuel was studied. This resulted in the introduction of a conservative three-step burnup profile along the assembly height, Fig.4.



1 – burnup distribution profile according ChNPP operational data; 2 – burnup distribution profile from [5]; 3 – conservative enveloping burnup distribution profile; 4 – conservative three-step burnup distribution profile proposed for burnup credit
Fig. 4 – Determination of conservative burnup distribution profile

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