Unfortunately, the analysis of loading patterns of ISF-1 pool compartments shows that there is a significant amount of fuel that does not satisfy the conditions of loading curve (Fig. 5).

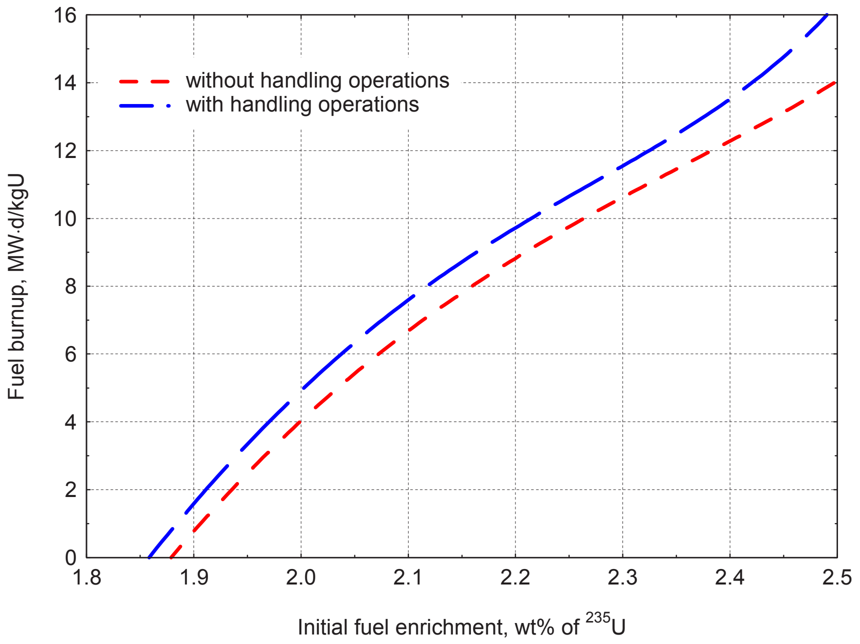

Fig. 5 – Loading curves for ISF-1 pool compartments

A procedure was developed for the criticality safety assessment of each pool compartment with burnup credit:

1) HELIOS code is used to calculate the isotopic composition of spent nuclear fuel from RBMK reactors at ChNPP.

2) In the analysis of ISF-1 criticality safety with burnup credit, change in the concentrations of the following five isotopes is considered:

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

3) Burnup credit is applied only for standard and regenerated fuel. For other types of spent fuel assemblies, it assumed that the fuel is "fresh".

4) Non-uniformity of burnup distribution along the fuel length in criticality safety substantiation is taken into account by a conservative three-step burnup profile (Fig. 4, curve 4).

5) In view of a large number of cells with assemblies, all standard and regenerated spent fuel assemblies are divided into groups, having one of the five values of power release:

0, 470, 940, 1400, 1870 MW*d/FA.

Result of the implementation of burnup credit for nuclear safety analysis of ISF-1 compartments

For optimal distribution of the moderator (steam-water mixture) in the system, the maximum effective neutron multiplication factor excluding fuel burnup is [1]:

$$K_{eff} \pm \sigma = 1.02652 \pm 0.00046.$$

Considering the optimal neutron moderation, for a conservative load pattern of the ISF-1 compartment, the effective neutron multiplication factor obtained with fuel burnup credit is equal to:

$$K_{eff} + 3\sigma = 0.9392.$$

Taking into account handling operations in the compartment and conservatively assuming that each row in the transportation corridor between halves of rows has a canister with a fresh fuel assembly with the highest multiplication properties, the neutron multiplication factor is:

$$K_{eff} + 3\sigma = 0.9447.$$

Conclusions

A more realistic assessment of criticality safety, based on the calculations of K_{eff} with burnup credit improves the situation and proves compliance with the regulations of Ukraine, $K_{eff} < 0.95$.

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