

**THE ANALYSIS
OF GASEOUS FISSION PRODUCTS
ON SERVICEABILITY OF VARIOUS TYPES
OF FUEL ELEMENTS
USED IN RESEARCH REACTORS**

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The analysis of the work to license U-Mo dispersion fuel that has been carried out by program RERTR shows that at high burnups the U-Mo particles interacts with an Al matrix to form porosity in the central areas of the fuel meat.

This results leads to change the loading of cladding due to the formation of long-length defects in the fuel meat. As a result, the pressure of gases leads to a larger shape change (pillowing) of fuels and in some instances to their failure.

At the present moment in Russia the first results have been received of in-pile testing U-Mo dispersion fuel having fuel loading of 5.4 g U/cm^3 in experimental fuel elements (FE) of the IVV-2M tubular type at the average burn-ups of $\sim 40 \%$ and $\sim 60 \%$. The MIR tests have been completed that used U-Mo dispersion fuel of fuel loading from 4 to 6 g U/cm^3 in the minirods of the rod type. The average burn-up in the minirods made up 40-60 %. The post-irradiation examinations (PIE) have been launched. The results of PIE are planned to be available in mid 2005.

The PIE results on the tubular type fuel have revealed the following. The fuels of 40 % burn-up are in a good condition, the U-Mo/Al interaction is moderate (maximally $\sim 4 \mu\text{m}$), no porosity within the matrix or U-Mo/Al interaction material are observable.

The fuels of 60 % burn-up demonstrate a stronger U-Mo/Al interaction (maximally $\sim 10\text{-}12 \mu\text{m}$) to form a damaged fuel layer (meat porosity merge to form a single large crack) in the central areas of the meat at the maximal fuel burn-up. In the end this results in a stronger shape change in the form of pillowing at the outer and inner cladding.

Based on the results of studying the U-Mo fuel the modeling of the pillowing process in the tubular fuels tested in the IVV-2M reactor was carried out.

The elastic-viscous-plasticity straining problem was solved in the statement of the generalized plane deformation using the finite-element complex MARC.

The results allowed the assumption of the mechanism of pillowing in tubular and plate fuels.

The main factors were determined that influence the pillowing process, viz., length of damaged fuel meat and low rigidity of fuel element design.

To access the influence affected by the design of a fuel element on its shape changes under irradiation rod type fuels tested in MIR were considered.

It is shown that in comparison to plate and tubular FE the rod type FE features a higher resistance to FG pressure. This is primarily due to the design FE as well as to the higher "rigidity".