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RESULTS OF POST-IRRADIATIONS EXAMINATIONS OF MIXED NITRIDE PINS WITH GAS AND LIQUID METAL SUB-LAYERS

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Today the investigations have been completed on helium-bonded fuel pins with mixed uranium-plutonium nitride of BN-600/BN-800, BN-1200 and BREST reactors types after irradiation as a part of ten EFAs of BN-600 reactor up to maximum burn-up of 7.5;6.0 and 4.5at%, respectively. Also the PIE of mixed nitride pins of BREST type with helium and lead sub-layers after intermediate tests to maximum burn-up of 4,8 and 3,9at% as part of dismountable EFAs of BOR-60 reactor are over. As a result of post-irradiation examinations, the main intra-fuel pin processes that affect on materials properties change and fuel pins state, their relationship with the initial nitride state were identified. The regularities and quantitative characteristics of nitride swelling, the behavior of fission products, cladding corrosion and mechanical properties change are revealed.
The average for the irradiation time rate of fuel swelling in cross sections near the central core plane in gas-bonded pins of different EFAs irradiated in BN-600 reactor is equal to (1.6-2.0)%/at%. With an increase of fuel burn-up there is a tendency to slow down of swelling rate. According to the results of irradiation in BOR-60 reactor, the fuel swelling rate in lead-bonded pins is lower than in helium-bonded pins: 1.4±0.2 and 1.7±0.2%/at%, respectively.
The presence of carbon and oxygen impurities in the fuel can lead to local areas of claddings carburization and oxidation, randomly distributed along the height and perimeter of its inner surface. The key characteristics of the fuel that determine the cladding carburization and oxidation, and ways to prevent them, are determined. The maximum depth of the corrosion zone is located in the upper part of the fuel column and is equal to 40μm. The results of cladding mechanical tests showed the significant margin of strength and ductility of cladding materials along the entire height of fuel pins. High values of strength characteristics indicate a weak influence of corrosion on the strength of studied claddings materials. The mechanical cladding properties of a lead–bonded pins have the same pattern of change along the pin height depending on irradiation and testing temperatures, as of fuel pins with helium sublayer, keeping enough ductility in the area of low-temperature irradiation embrittlement. At irradiation and test temperatures of 350-380℃, the values of the strength limit from 1070 to 1200MPa were obtained with the values of the total elongation of not less than 2%.

Country/Int. organization

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