TEMPERATURE CONDITIONS OF FUEL ELEMENTS OF WWR-M5 TYPE FUEL ASSEMBLY IN AIR

N.A.Grosheva, G.A.Kirsanov, K.A.Konoplev,
A.N.Syasin, J.A.Shyshkina

Leak-proofness tests of fuel assemblies in a loop channel of the reactor WWR-M require to transport irradiating fuel assemblies in air during their loading and unloading from the channel. The extraction of irradiating fuel assembly to the air is also necessary for the visual inspection of the fuel elements in hot chambers and for the transfer of the fuel assemblies to the additional storage, which have no direct transport connection with the reactor. During this operations the heating of the fuel elements by the residual power must not exceed any permissible level for its leak-proofness not became worse. It necessitated the preliminary calculations of the fuel element temperature or the time delay, the accuracy of which depends essencially on the correct choice of the main mechanism of fuel element cooling.

The investigations of these problems were carried out on the WWR-M5 type fuel assembly model [1], each its element have being equipped with the heaters and the temperature transducers. The heating of the fuel elements was realised proportionally to the ^{235}U isotope content. It was measured at the time the behavior of the temperature of the middle part of each fuel element depending on the residual power for the two cases: when the assembly is hanged up and when it lies on the thermal insulator plate. The last correspondes to the accidental fall of the fuel assembly during the transport works when the time of the assembly stay in air and the danger of the fuel elements overheating essentially increases.

The measuring dependences of the inner an outer fuel elements temperature exceeding over the air temperature (Δt) from the residual power permit to find the simple empirical equations for the operative calculations.

For the most hot fuel element when the assembly is hanget up $\Delta t = (2.14P + 18.5)^{0} C$, when it lies horisontally $\Delta t = (2.5P + 20.0)^{0}C$ for $P = (10 + 90)$ W. It is possible to find the fuel element temperature in unstable state with the help of the ratio of the instant fuel element and air temperature difference $\Delta\Theta$ to the stable one Δt by the equation

$$\Delta\Theta/\Delta t = 1 - e^{-4.62\cdot10^{-2}\tau},$$

where τ is time from the moment of the fuel assembly extraction into air in minutes.

As the result of this experiment the influence of the end-line detailes on the heat removal ($\approx 10\%$) and fraction of power which is carried out by convection flow in interelement gaps ($\approx 7.5\%$) are evaluated. Thermal conductivity equivalent coefficients in interelement gaps for vertical assembly and heat transfer coefficient in gaps for horisontal assembly are determined. This investigations permited to obtain the necessary data for the calculations of the WWR-M5 fuel assembly thermal state in air.

Reference

1. Erykalov A.N., Zvezdkin V.S., Konoplev K.A., Lvov V.S., Petrov Yu.V., Ruzmanov A.P. //At.energiya. V.60. 1986. P.103.