APPROACHES FOR ESTIMATING THE DURABILITY INDEXES OF THE CYLINDRICAL CLADDING OF NUCLEAR FUEL ELEMENTS TAKING INTO ACCOUNT UNCERTAINTY OF THE WORKING TEMPERATURE

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As well-known, the nuclear reactors core is consisted of the large numbers of fuel assemblies, containing a large number of fuel elements, such that the core contains about 50000 fuel elements. Due to the inhomogeneous and non-stationary neutron field and other difficult for considering factors it is impossible to predict absolutely exactly the operating conditions for each of about 50000 fuel elements. Due to this circumstances, it is impossible to predict exactly durability of a cladding of fuel elements in nuclear reactors, but it is necessary to predict this durability with the given probability such that are available the failures of the cladding of not more than three fuel elements from about 50000 of a general number. The approaches for estimating the durability of the cladding of fuel elements considering with probability of the failure are not fully developed now, although durability of the cladding of fuel elements significantly limits the efficiency and safety of nuclear power reactors. Due to these circumstances, the theme of this research, which deals with the approaches for estimating the durability indexes of the cladding of cylindrical fuel elements, is of current interests at present.

The high-temperature creep of zirconium-based alloys widely used to make the claddings of fuel elements for nuclear reactors significantly limits durability of the cladding. It is well-known, that the creep is significantly depended on the temperature, which is closed to limits of abilities the zirconium-based alloys for modern nuclear reactors. At the same time, it is impossible to predict exactly the temperature of claddings for all fuel elements in the nuclear reactor core, and the temperature of the cladding is defined with some uncertainty. Due to uncertainties of the temperature it is impossible to predict exactly the durability indexes of the cladding of fuel elements considering with the high-temperature creep.

It is proposed the approaches for estimating the durability indexes of the cladding of cylindrical fuel elements of nuclear reactor considering with the high-temperature creep and uncertainties of the working temperature of the cladding. The general scheme of these approaches is to find the temperature dependences of the durability indexes and to take into account the uncertainties of the temperature by considering the temperature as the random value, which haves the especially defined expected value and dispersion. These temperature dependences can be find by solving numerically the problem of the theory of creep for the cladding for each of some numbers of the necessary given temperature values. The probability density distribution for the temperature value can be estimated from the heat conduction and heat transfer analyses or from the experience of operating for the given type of nuclear reactor. Estimating of durability indexes can be finding by using well-known theorem about the probability density of a function of one random argument.