AEROSOLS FORMATION AND ALTERATION SIMULATION IN THE PRIMARY HEAT CARRIER CIRCUIT OF A NPP'S REACTOR DURING A HYPOTHETICAL BEYOND DESIGN CONDITIONS ACCIDENT INVOLVING FISSION PRODUCTS RELEASE

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Aerosols formation and alteration simulation in the primary heat carrier, circuit of a NPP's reactor during a hypothetical beyond design conditions accident involving fission products release from fuel into the heat carrier's volume is a necessary condition for estimating the consequences from possible escape of radioactive particles to beyond the reactor pressure vessel boundaries with the following environment radioactive contamination. In the course of such an accident the fuel rods are heated to high temperatures, causing the heat carrier transferring from liquid state into aerosol. Particle unification is one of the most important mechanisms for further evolution of the generated particles. It is exactly the process that accounts for the major part of the computation time.

The kinetic equation for the particle distribution function:

$$\frac{\partial n(r,t)}{\partial t} = S(r,t) - \frac{\partial}{\partial r}\left[G(r,t)n(r,t)\right] - \\ -R(r,t)n(r,t) + \frac{1}{2}\int_0^r K(s,r-s)n(s,t)n(r-s,t)ds - \\ -n(r,t)\int_0^\infty K(r,s)n(s,t)ds \quad (1)$$

In this study, there was given a comparison with the exact (analytical) results solution of different modeling techniques.

For the simplest case with the initial distribution (by the volume of particles) in the form of exponential function the solution of the kinetic equation is given by

$$n(v,t) = \frac{4N_0}{v_0(\tau+2)^2}\exp\left(-\frac{2v}{v_0(\tau+2)}\right)$$

$$When,\ \tau = N_0K_0t \qquad K_0 = 10^{-14}\ \ m^3/s$$

$$N_0 = 10^{14}\ \ m^{-3}\ \alpha = 2$$

$$r_0 = 2.5\ nm \quad (2)$$

It follows from the tabulated data that the Hounslow method and the SOPFAROS module are the most efficient ones. However, the method implemented in the MAEROS module yields more accurate results with the same number of fractions, however Fomm method is the most effective method of all comparable but it hasn't been fully developed yet.

It follows from the performed analysis that the calculation methods used in integral codes for modeling the fission product aerosols behavior give a significant error in calculating the distribution function for large particles in the case of using particle size spectra for which the ratio of particles volumes from neighboring fractions is equal to or greater than two. For more detailed aerosol modeling particle distribution function, it is necessary either to use an essentially larger number of fractions or to develop more efficient new calculation methods.

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IMPROVING THE RELIABILITY AND SAFETY OF NUCLEAR POWER PLANTS

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Introduction

An essential requirement for a nuclear power plant is to ensure conservation of nuclear and radiation safety. NPP safety relevant today the problem is not only in Russia, but all over the world. During normal operation of nuclear power plants do not pose a risk to workers, the public and the environment.

Problems and Solutions

The safety of nuclear power plants may affect emergencies (incidents) and accidents related to:

- The human factor
- Errors in the design
- Natural disasters
- The problem of radiation safety