The total cost of the recovery operation for one RBMK unit is 2.5 billion rubles. Special devices for RRC and reactor's calibration cost 1.5 billion rubles. Replacement of the cracked fuel channels costs about 1 billion rubles. When this method is applied, the reactor's operating time increases for 5-15 years which can help our country to prepare for the future reactors' decommissioning and their gradual replacement.

In conclusion it's necessary to add that it is obvious that RRC is better than the first method, because it is more efficient and it can save huge amount of money (2.5 billion rubles vs. 400+45 billion rubles) and RRC can help to prepare for further reactors' decommissioning and their gradual replacement in the RF.

REFERENCES:

1. L.A. Belyanin, V.I. Lebedev, L.V. Shmakov, Y.G. Skok Nuclear Power Plant Safety in inventions. - Moscow: Energoatomizdat, 1998.- 208 p.
2. L.A. Belyanin, V.I. Lebedev, Y.V.Garusov. Safety barriers at nuclear power plants with RBMK reactors . - Moscow: Energoatomizdat, 1997.- 192 p..
3. A.I. Berezyuk, A.I. Timonin, M. E. Lebedev. Forming of graphite stacks industrial uranium-graphite reactors and their safety during operation // Nuclear Energy.- 2002.- T. 92.- p. 291-298.

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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

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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:

$$\frac{\partial n(r,t)}{\partial t} = S(r,t) - \frac{\partial}{\partial r}\left[G(r,t)n(r,t)\right] -$$

$$-R(r,t)n(r,t) + \frac{1}{2}\int_0^r K(s,r-s)n(s,t)n(r-s,t)ds - \qquad (1)$$

$$-n(r,t)\int_0^\infty K(r,s)n(s,t)ds$$

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

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

$$When,\ \tau = N_0K_0t \qquad K_0 = 10^{-14}\ \ m^3/s \qquad (2)$$

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

$$r_0 = 2.5\ \ nm$$

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.

LITERATURE:

1. V.P. Spasskov, Yu.G. Dragunov, S.M. Ryzhov, et al., Calculated Substantiation of the Thermal and Hydraulic Characteristics of the VVER Reactor and Reactor Plant (Akademkniga, Moscow, 2004)
2. V.N. Piskunov, Theoretical Models of Aerosol Formation Kinetics (Russian Federal Nuclear Center-VNI-IEF, Sarov, 2000).
3. I.M. Ivkov, M.A. Zatevakhin, V.V. Bezlepkin, et al. "Studying the Kinetics of Aerosols in the Containment in Analyzing Emergency Releases at a Nuclear Power Station," At. Energ.109(1), 52 (2010).

4. A.M. Afrov, S.A. Andrushechko, V.F. Ukraintsev, et al., VVER-1000: Physical Principles of Operation, Nuclear Fuel, and Safety (Universitetskaya Kniga, Logos, Moscow, 2006)

Scientific advisor: S.V. Lavrinenko, Senior lecturer, National Research Tomsk Polytechnic University.

СРАВНЕНИЕ ЭФФЕКТИВНОСТИ ИСПОЛЬЗОВАНИЯ АБСОРБЦИОННЫХ И КОМПРЕССИОННЫХ ТЕПЛОВЫХ НАСОСОВ В СХЕМАХ ПОДОГРЕВА СЕТЕВОЙ ВОДЫ НА ТЭЦ

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Подогрев сетевой воды в нижнем и верхнем подогревателях двухступенчатой сетевой установки (НСП и ВСП соответственно) в течение отопительного сезона значительно отличается от равномерного. При снижении температуры наружного воздуха тепловая нагрузка нижнего теплофикационного отбора и доля подогрева воды в НСП растет. При снижении расхода сетевой воды и росте температуры в обратной магистрали при прочих равных условиях неравномерность подогрева увеличивается [1, 2, 3].

В настоящей работе приводится расчетный анализ использования абсорбционных и компрессионных тепловых насосов (АТН и КТН соответственно) для выравнивания ступенчатого подогрева сетевой воды при уменьшении температуры наружного воздуха. Включение АТН (КТН) в схему двухступенчатого подогрева сетевой воды на ТЭЦ представлено на рисунке 1. В испарителе теплового насоса (ТН) происходит охлаждение обратной сетевой воды, понижение её температуры. Отнятая теплота передаётся сетевой воде в конденсаторе ТН, что приводит к уменьшению температуры сетевой воды за ВСП с соответствующим снижением давления пара в верхнем регулируемом отборе. Одновременное снижение температуры обратной сети и давления пара в ВСП позволяет приблизить режим работы сетевой установки (СУ) к расчетному с равномерным подогревом сетевой воды. Давление в нижнем отборе и соответствующая ему температура сетевой воды за НСП устанавливаются на основе совместного решения формулы Стодолы –Флюгеля для промежуточного отсека турбины и уравнения теплового баланса НСП.