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FEATURES OF THE CREATION OF UNDERGROUND NUCLEAR POWER PLANTS AND SOME ISSUES OF RADIATION COLD-FASTNESS AND WORKING CAPACITY OF STRUCTURAL MATERIALS OF THE REACTOR VESSEL

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At present, in the energy balance of most economically developed countries, nuclear power takes a solid place and continues to develop successfully. In 31 countries, 440 nuclear power units are operated with a total installed capacity of 359.9 GW, which accounts for about 17% of all electricity produced in the world, and in some countries (Lithuania, France, Sweden, Japan, Belgium) more than half of the energy produced is generated by nuclear power plants. For example, in France, nuclear power accounts for about 80% of the generated energy. Under construction are 30 power units with a total capacity of 31 GW, including in countries that previously did not have nuclear power plants (Iran). Only in 2002, 7 power units with a total capacity of 5.9 GW were commissioned in the world (China, Korea, Czech Republic).

The cardinal way to improve the safety of nuclear power plants is their underground location. The shelter of the roof from the natural rock of the nuclear and radiation-hazardous blocks of the station localizes the consequences of any nuclear (even beyond design) and radiation accident in a sealed underground space. The thickness of the Earth's layer is a reliable protection against any external impact - the fall of heavy aircraft, large meteorites, the use of concrete concrete shells, bombs, air and space attack, as well as sabotage and terrorist acts.

The second important advantage of underground nuclear power plants is the possibility of processing and storing radioactive waste in the underground space. This eliminates the need for their transportation and the creation of special storage facilities, which is fraught with a radiation accident.

An integral part of safety is the reliability and strength of the elements of equipment, pipelines, structures, etc. The specifics of the operating conditions of structural materials of the main units and equipment of nuclear power plants required the development of a new approach to the creation of structural materials, manufacturing technology and evaluation of efficiency.

The operation of the first nuclear submarines and experimental-industrial reactors advanced the science of strength and metallurgy far ahead. Data on the change in the properties of structural materials under the influence of neutron and gamma radiation, on the change in the strength characteristics of structural materials under the influence of powerful neutron fluxes (1014 n / cm2 * s in thermal neutron reactors and up to 1016 n / cm2 * s in fast reactors neutrons), etc. A new section of material science has been developed - radiation material science, which studies the properties of structural materials and their variation under irradiation.

The further development of nuclear energy poses to solid state physics and radiation material science a number of complex fundamental and applied problems related to the low resistance of materials under irradiation. The issues of operability and reliability of construction materials are very relevant in connection with the increase in the life of the projected and possible prolongation of the service life of operating reactors to 60-80 or more years. Therefore, it is necessary to pay special attention to the theoretical and applied questions of the influence of the time factor in the conditions of the continuous growth of neutron irradiation and gamma radiation on a complex of mechanical, chemical, corrosive and other properties.

The most important factors affecting the efficiency of structural materials of nuclear power plants are hardening and embrittlement. It should be noted that there is no superplastic and brittleness, but there are conditions under which steel and alloys become superplastic and brittle. In such a case, a premature (with respect to the calculated) brittle failure testifies to a reduction in plasticity that is unacceptable under certain temperature-time or temperature-deformation cycles, when the metal can no longer remove the overvoltage peaks, and they become commensurable with the strength. This contributes to the advancement or growth of the existing fracture or the inception and unacceptable development of it in time. Thus, the exhaustion of plasticity is the determining factor in the operability of structures and their reliable operation. Increased metal propensity to brittle fracture due to loss of ductility and limits the operational life of reactor shells.

The change in the physico-mechanical properties of structural materials in the process of neutron irradiation is largely determined by the nature of the interaction of the dislocation structure with a complex of radiation defects. The processes of formation and evolution of radiation damage, the processes of their annihilation depend not only on the conditions of neutron irradiation, but also on the structural state of the metal at various stages of solid solution decomposition under temperature-time and temperature-deformation cycles.

Restoration of the properties of structural materials is possible by creating conditions that lead to the elimination of radiation-induced structural damage. Heating the steel above the irradiation temperature increases the diffusional mobility of point defects and is a prerequisite for the appearance of thermodynamic instability of various radiation defects, thus creating conditions for the restoration of its physico-mechanical properties. Therefore, one of the further ways to increase the efficiency and reliability of nuclear power plants should be associated with the removal of radiation damage to reactor shells when special annealing is applied to them to revive the cold-resistance of ferrite-pearlitic steels.

Issues of radiation cold-brittleness, as one of the most important factors determining the operability and reliability of structural materials, are of great importance in the case of emergency shutdown of the reactor. In this case, as a result of a sharp drop in temperature, the cold-brittle fracture threshold transition occurs and metal failure can occur without much work - the metal becomes unreliable.

The present work is devoted to the issues of creating specially protected underground nuclear power plants, as well as the improvement of structural materials, types of reactors, the prolongation of the operating life of the PPU, and the removal of the radiation impact on the population and the environment.

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REAGENTLESS METHODS OF WATER TREATMENT AT TPPS AND NUCLEAR POWER PLANTS

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The main share in the generation of electricity in Russia comes from steam turbine power plants that use organic fuel (coal, gas, fuel oil), and nuclear power plants that use nuclear fuel. At the same time, the most developed coolant for Thermal Power Plants and Nuclear Power Plants is natural water from surface or underground water sources, which are subject to the following requirements:

1. Low corrosive aggressiveness.
2. High heat capacity and thermal conductivity.
3. Low viscosity.
4. Small cross section for the capture of thermal neutrons.
5. Chemical, temperature and radiation resistance.
6. Poor activation.
7. Non-combustibility, non-toxicity, explosion safety.
8. Low cost.

Disadvantages of water as a coolant are as follows:

1. High cross section for the capture of thermal neutrons.
2. Radiolysis - decomposition under the influence of ionizing radiation.