Analysis of the Impact of Zaporizhia Nuclear Power Plant on the Environment

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Abstract – this paper analyzes the impact of the Zaporizhzhya NPP on the environment was the analysis of the current design configuration of the units. And the offered scheme of radioactive waste management and spent nuclear fuel.

Key words – analysis of the impact, radiation effects, radioactive waste, the state of the environment, Zaporizhya nuclear power plant.

I. Introduction

In our time the very issue of the day for all humanity is energy. With every year of traditional power sources of such as oil, gas and coal of становиться all less than and less than, and prices on these power resources grow unceasingly.

Thus, came it is time to search new energy sources. Most real way of decision of this problem - to develop it nuclear energy. Nuclear energy in Ukraine has strategically an important value: AEC produce almost 50 % electric power in a country. Especially as the supplies of uranium in our country will last the hundred years forward. After the volumes of the found out beds Ukraine occupies a 6 place in the World, and it means that nuclear power plants yet long will serve as basis of her power safety.

In comparison with thermal power plants, nuclear power plants are more friendly to the environment. In the production of nuclear electricity no emissions of sulfur, carbon monoxide and other gases, the specific activity of TPP emissions is 5-10 times higher than nuclear power plants.

For safe operation of the NPP observed the pollution of the environment due to leakage of radioactive substances, emissions of ventilating air, the disposal of radioactive materials, tools, workwear, etc, water coolers, plant carry a large thermal effect on the environment, and cause changes in the microclimate adjacent to the plant areas.

It should be noted that nuclear power currently is environmentally cleaner and cheaper than thermal. Nuclear energy in the development process in practice proved its benefits and economic efficiency.

II. Potential radioactive impact

In the process of NPP operation, generation of gaseous, solid and liquid material containing radioactive chemical isotopes is indispensable. Radiation impact of a power unit is related to their release to the environment.

In normal operation conditions, any release of elements from fuel cladding or partial damage of this cladding leads to ingress of certain amount of fission products to primary coolant. Small amounts of radioactive products can also get to the primary coolant as a result of neutron activation of the structural materials. The processes of 7 erosion and corrosion of activation products facilitate the transfer of these materials to primary coolant.

Tritium which is in primary coolant is one of the components of these activation products. Tritium release from the primary coolant is possible during the following: controlled leakages; draining of the primary coolant to the primary coolant drain tanks.

Tritium 3H is radioactive isotope with half-decay period equal 12.34 years. In WWER reactors tritium is generated: directly during the fuel nuclei fission as a triple fission product; as a result of interaction of neurons with deuterium nuclei contained in the primary coolant as D_2O; as a result of different reactions of fast neutrons with structural materials of the reactor core; as a result of boric acid activation in the primary coolant.

Besides, the processes of air activation in close proximity to the RPV lead to generation of insignificant amounts of gaseous radioactive particles including evaporation of tritium water and inert gases.

As a result of periodic replacement of these resins, both liquid and solid radwaste are generated. The process of radioactive environment treatment on special water treatment facilities located at the special building leads to generation of the radwaste: solid, liquid and gaseous.

Primary to secondary leaks acceptable in the steam generator lead to generation of radioactively contaminated water of the secondary circuit.

Gases accumulated in the primary circuit during operation are removed from it. This leads to generation of gaseous releases flow. Releases to the atmosphere can also be generated due to ventilation of flying emissions from the primary coolant generated due to small leaks, both collected and non-collected. Such releases usually contain tritium water steam, inert gases, aerosols and other gaseous particles.

During annual reactor shutdown pressure in the cooling systems is decreased, the reactor lid is removed and one third of the fuel assemblies is removed and placed in the spent fuel pond for storage. Other two thirds are relocated for maintaining optimum integrity of neutron flux, and fresh fuel is loaded to the core. Besides the spent fuel, the fuel reloading procedures can lead to increase of liquid radwaste generation and releases to the atmosphere from the spent fuel pond, reactor inspection pit and protection tube bank inspection pit. These radwaste in its nature are similar to the waste released from the primary coolant.

Besides, the maintenance and repair procedures conducted during the RPV shutdown are also sources of different radwaste generated in the process of opening and maintenance of the equipment. Independent components of the primary circuit contaminated in the process of neutron irradiation, as well as reactor compartment equipment and special building components subjected to radioactive contamination can be replaced, which fact causes additional generation of solid radwaste.

The reference and permissible levels of releases at SUNPP specified by RG.0.0026.0159 "Permissible gas and aerosol release and allowable discharge of radioactive substances into the environment and water body. (Radiation and hygiene regulations of Group I)" are given in tables 1 and 2:

TABLE 1

Type and parameter of monitoring	Unit	Reference level
Daily monitoring		
Inert radioactive gases (IRG)	GBq/day	1200,0
Radioiodine	MBq/day	140,0
Long-lived radionuclides	MBq/day	4,3
Monthly monitoring		
^{60}Co	MBq/month	12,0
^{134}Cs	MBq/month	5,8
^{137}Cs	MBq/month	11,0

TABLE 2

Type and parameter of monitoring	Unit	Release limit
1	2	3
Long-lived radionuclides	GBq/day	0,75
IRG	GBq/day	45000,00
Radionuclides of iodine	GBq/day	3,90
^{51}Cr	GBq/day	850,00
^{54}Mn	GBq/day	5,90
^{59}Fe	GBq/day	12,00
^{58}Co	GBq/day	15,00
^{60}Co	GBq/day	0,32
^{89}Sr	GBq/day	20,00
^{90}Sr	GBq/day	0,38
^{95}Zr	GBq/day	19,00
1	2	3
^{95}Nb	GBq/day	41,00
^{110m}Ag	GBq/day	0,53
^{134}Cs	GBq/day	0,45
^{137}Cs	GBq/day	0,45
^{3}H	GBq/day	2100,00

Conclusion

Radiation impact of ZNPP gas and aerosol releases in normal operation is significantly less than the established dose limits for population in contiguous countries (this limit is within 0.2-0.3 mSv/year).

Main criterion of the population irradiation limitation in Europe due to manmade sources is the limit of individual effective dose (by all irradiation ways) that is established at the level of 1 mSv/year. The performed assessment demonstrated that the expected summary effective dose for 50 years would not be greater than 18mcSv (0.018 mSv) for no one of the considered accidents at the boarder of Russia and European countries

In normal operation conditions of ZNPP as well as accident occurrence, the environmental impact in a transboundary context, i.e. on the territories of neighboring states, does not occur, because the normative requirements on air contamination and dose limits for population are not exceeded, and already at the distance of 200 km from ZNPP are at the level that is significantly lower than the limit.

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