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№ 7101

Features of Radioactive Situation Monitoring in Surface Air Layer and Atmospheric Precipitation in Zones with Agricultural Activities.

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November 28, 2021

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1 Introduction

The development of mankind requires more and more electrical energy every year [1-3]. It should be noted that the consumption of electrical energy is currently almost evenly distributed in the afternoon [3]. At this time, large powers are constantly required. Nuclear power plants provide the necessary electrical power to consumers at any time of the day. Unlike other plants, their operation does not depend on fuel supplies, fuel prices (thermal power plants) and weather conditions (such as hydroelectric power plants, etc.). Therefore, there is a rapid development of nuclear power [1, 2].

On the other hand, the population is constantly increasing, and people need more and more food [4]. Lack of land for agricultural production has led to the location of agricultural fields and small settlements near nuclear power plants. Nuclear power plants are a source of increased danger to people and plants. It was found that the volume of hazardous emissions from nuclear power plants due to the adoption of stringent control measures is less than that of other types of power plants. But the pollution that can enter the atmosphere is more dangerous than, for example, from a thermal power plant. Therefore, it is necessary to carefully monitor places with potentially dangerous conditions for people and the environment. Especially at distances less than 200 km from the site of the NPP. Many countries, including the Russian Federation, cannot afford to create exclusion zones around nuclear power plants with such a radius. The maximum exclusion zone is 5 km in radius around the NPP. With an average wind speed of 5 m/s, this distance is covered very quickly. Precipitation with radioactive emissions falls far beyond the exclusion zone (at distances of 30-40 km and more with a higher

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wind speed). Distances can reach over 150 km. It follows from this that monitoring of the radioactive situation in the surface air layer and atmospheric precipitation at distances of up to 150 km from the NPP should be given increased attention. In our work, one of the options for this control is considered, considering the peculiarities of the formation of a radioactive environment.

2 Methods and results of monitoring the radioactive environment

To control the radioactive situation in a certain radius from the NPP, stations for air sampling are located, with the help of which it is possible to control the amount of radionuclide emissions into the atmosphere in an automatic mode. A feature of control in the Russia at the beginning of 2021 was the fact that ^{14}C and ^{3}H emissions, which are extremely dangerous for the population and plants, are not monitored. This problem must be solved by installing additional equipment at the existing monitoring stations. In addition, the ^{3}H has a long decay time, accumulates in living media and is extremely difficult to remove from them.

Another feature of control is a special system for the location of monitoring installations. If there are zones with agricultural fields and industries that introduce distortions in the measured data, the following methodology for their placement is proposed. The stations should be located far enough from the place of discharge. One of the stations needs to be in a place where the largest volume of emissions is expected. The distance to it from the nuclear power plant is about 5-10 km, the direction depends on the prevailing winds in this area. In addition, samples should be taken from at least ten locations. One of the stations should be located near the settlement, near which the highest dose of radionuclides is expected, four - from the windward sides, among them one - outside the monitoring zone. Four - next to agricultural fields to compare pollution in the absence of emissions that form from the fields.

With an increase in the power of nuclear power plants and their density, separate monitoring requires emissions of ^{60}Co, ^{131}I, ^{134}Cs, ^{137}Cs, ^{54}Mn, ^{65}Zn, ^{90}Sr, specific to the standard emissions of most nuclear power plants. In most cases, the content of these radionuclides in atmospheric fallout is less than the level acceptable for the population and is safe for nature. But an increase in the number of nuclear power plants changes this situation, since these radionuclides accumulate in the places of their fallout.

3 Conclusions

Analysis of the data obtained showed that the accuracy in monitoring atmospheric deposition is insufficient. This makes it difficult to quantify the radiation situation in the zones of agricultural fields and small settlements. In order to improve the accuracy of the measurements, it is recommended to use, when analyzing radionuclide emissions, not cuvettes with sides, which are ineffective in heavy atmospheric precipitation and strong winds in winter, but universal collection tanks, they are convenient to carry out both daily and monthly samples.

In general, the emission monitoring data show that the location of the control stations for collecting samples of the surface air layer and atmospheric deposition meets the IAEA recommendations. An exception is the monitoring system to control the volumetric activity of ^{14}C and ^{3}H, where it is necessary to develop a way to effectively take these samples from atmospheric emissions.

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