CHARACTERISTICS OF RADIATION AND SOURCES OF RADIATION AS A RESULT OF HUMAN ACTIVITY

ХАРАКТЕРИСТИКА НА РАДИАЦИЯТА И ИЗТОЧНИЦИ НА РАДИАЦИЯ, В РЕЗУЛТАТ НА ЧОВЕШКАТА ДЕЙНОСТ

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Abstract: *The main features of the radiation environment in the surrounding environment are presented. Over the last 5 years no values other than the natural ones have been observed, with the lowest values in Veliko Tarnovo. The main characteristics of the radiation in operation in nuclear power plants and the major accidents resulting from the operation of the NPP in the development of humanity are shown. Radiation as a result of the uranium mining and uranium processing industry in Bulgaria is also under consideration. It also shows the actions of radiation as a result of other people's activities.*

Keywords: *radiation, features, natural, NPP, uranium mining, actions*

1. Common feature

Detection of radioactivity is one of the greatest discoveries of mankind. Only a few weeks after the X-rays were discovered (in 1896), French physicist Henri Becquerel, having studied the phosphorescent properties of various substances, started an experiment with potassium uranium sulphate. The experience was that, after exposure to daylight, the mineral, well wrapped in light-tight black paper, had been checked for some time whether it was phosphoresciated [1]. The silhouette of the mineral emerged under the influence of strong radiation with great penetrating ability on the photomulsion. Thus, the presence of new urinary bears called Becquerel was found, and the phenomenon was called by Maria Curie radioactivity [2].

This discovery is rapidly entering medicine and the first X-ray machines that have led to a revolution in medicine have been created. Subsequently, advanced and upgraded X-rays from the latest generations increase the repetitive accuracy of diagnostic activity and allow the rescue of hundreds of lives.

At the same time, it is found that radioactive beams are also a serious environmental pollutant with an extremely strong impact on the vital and physiological activity of organisms, ranging from stimulation to killing.

It is well known that all of our plans are designed to prevent the natural and anthropogenic, terrestrial and spacecraft from irradiating beams, ie. in the field of the natural and manufac tured radioactive waste. Ionizing rays accompany the life of the planet in various issues at all stages of the phenomenon [3].

Prez godinite After switching Vtorata svetovna voyna poradi razvitieto na atomnata promishlenost and osobeno usilenoto izpitvane na yadrenoto orazhie iznikva with golyama ostrota vaprosat charter radioaktivnoto zamarsyavane na planetata.Sled atomen blast in vazduha produktite na atomnoto delene zamarsyavat atmosferata, sushata, vodite, rasteniyata, zhivotnite, hranitelnite products and others.

The importance of the problems arising from the radioactive contamination requires the emergence of new sciences that integrate and investigate various aspects of contaminants with radio-nuclides, emerging and developing new scientific disciplines and approaches. Their radio frequencies are aimed at studying the efficacy of migrating radioactive substances into the biosphere and the effects of ionizing radiation on living organisms. The study is considered to be a specific issue for the surface area of the country, which provides life for the living and living world and plays an extraordinary role in the future of the world. [4]

It is only natural radioekologiyata na pochvata depend from the razvitieto na biofizikata, biohimiyata and fizikata na pochvata, but as her predmet is the study of zakonomernostite na vzaimodeystvie na produktite na delene na urana and plutoniya with pochvata, tyahnata sorbtsiya, desorbtsiya, migration, a well and influenced by the food chain of animals - animals - humans [5].

1.1. Classification

The natural gamma background is a physical feature of the environment and is the gamma ray field in which all living organisms on Earth are found. Sources of this ionizing radiation are secondary cosmic radiation and natural radionuclides found in atmospheric air, soil, water, food, and the human body [6]. The measured magnitude is gamma background dose power and is specific for each point, region, region.

Gamma radiation dose data for the country is obtained in real time from 27 permanent monitoring stations of the National Automated System for Continuous Radiation Control (NASCRGP), administered by the Executive Environment Agency (EEA).

The automated system provides operational information in case of accidental increase of the radiation background, both in case of nuclear accident on the territory of our country and in cross-border transmission of radioactive contamination. The system provides with real-time data the Emergency Center of the Nuclear Regulatory Agency and the General Directorate for Fire Safety and Protection of the Population Directorate at the Ministry of Interior (MoI), which provides the opportunity in case of a radiation accident, to implement timely appropriate measures to protect the population and the environment.

Over the last 5 years no values other than the natural ones characteristic of the respective point have been observed [7]. The lowest average annual dose rate for 2016 is determined at the local monitoring station Veliko Tarnovo -59 nGy / h and the highest peak at Orelyak peak - 133 nGy / h [8]. In Fig.1.1. the average annual values of the radiation gamma background for the period 2012 ÷ 2014 are presented in all 27 permanent monitoring stations in the country, including the monitoring station of "Permanent repository for radioactive waste" - Novi Han, owned by the Radioactive Waste . The station in Novi Han is fully integrated into NASCRGF.

It is known that natural radionuclides: uranium, radium, thorium and the products of their decay, as well as the radioactive isotopes of potassium, rubidium, etc., have a wide spread in the earth's crust. Due to their specific physicochemical properties, they have a specific presence in the composition of the individual components of the environment: lithosphere (rocks, soils), hydrosphere (underground, river, lake and sea waters), atmospheric air, flora and fauna. Their ionizing radiation, along with secondary cosmic radiation, forms the natural gamma-background background, which inevitably affects all living organisms.

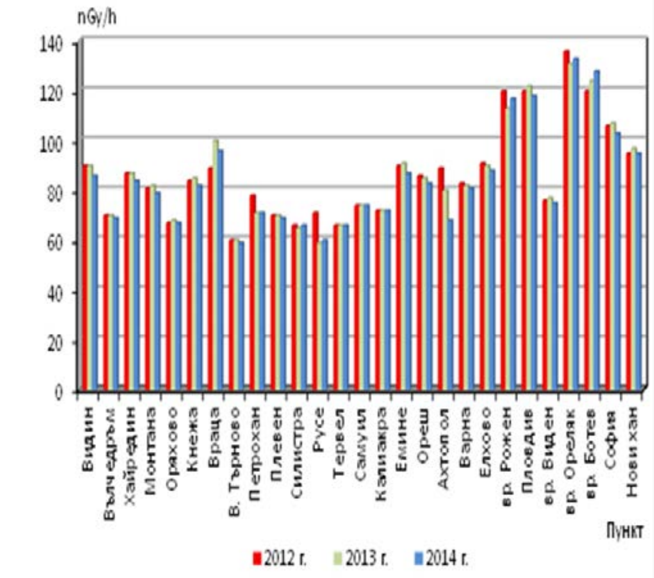

Fig. 1.1. *Annual average values of the background gamma background in Bulgaria [9]*

As a result of the human activity, the environmental elements with natural and technogenic radionuclides and their spatial redistribution are further enriched. These anthropogenic sources of radioactivity determine the technogenic component of the radiation background. The following should be addressed:

• Waste water and weighed rock in the mining of heavy and rare metals;

• gas-aerosol discharges from the nuclear power and thermal energy objects;

• sludge and ash from solid fuel stations;

• mineral fertilizers derived from certain phosphorites;

• building materials other products [8].

The National Radiological Monitoring System aims at early detection of deviations from the radiation parameter values in the main environmental components and provision of available radiological information to detect both the natural and the nuclear accidental radiological status. Particular attention is paid to areas with potential radioactive contamination, such as Kozloduy NPP.

Fig. 1.2. *Radiation characteristics of the environment [9]*

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In the use of nuclear technology in the national economy, medicine, research and others, too, a small amount of radioactive substances fall into the environment. Gaseous waste in small quantities is discharged into the atmosphere by nuclear fuel reactors and plants, from which they fall into the soil and through the path of food chains reach plants, animals and humans.

Let us not forget that the stimulatory and lethal doses of radiation for the different types of organisms are very different. Studies have shown that some plant species have a fairly high dose of radiation, and under the conditions of increased radiation, the populations of some insect pests, for example aphids, are rapidly growing and causing great damage to agriculture.

Under normal operating conditions of nuclear installations and appliances, too small quantities of radioactive substances are released in the rivers. Compared to radioactive contamination and exposure to nuclear explosions, especially in the atmosphere, these sources of pollution are usually insignificant. Nevertheless, the large number of isotopic laboratories increases the risk of radioactive contamination in the event of non-compliance with the rules on waste handling and storage. We also have such an example for our country when, in an inconsiderable work in June 2011, in one of the companies working with radioactive elements, several workers received a higher radiation dose than the eligible one and were sent to treatment in France.

2. Radiation characterization

2.1. Radiation characterization of NPP operation

In nuclear power plants, nuclear reactors, all radioactive substances are in closed systems and can only be thrown out in an emergency. In water cooled reactors, water is activated and contaminated with radioactive substances, but prior to discharge, it is subjected to complex purification and is passed through columns of ionites to contain the radioactive pollutants. Irrespective of the most stringent safety measures in the operation of nuclear reactors through valves, pumps, etc., sometimes leakage of contaminated water and air is allowed. It is quite natural that emergency situations are the most dangerous in terms of radioactive contamination [10].

Serious levels of radioactive contamination are allowed in reactor failures of nuclear power plants, although all known precautions against accidents are taken in the design and construction of nuclear reactors. The failures that have occurred in reactors in England, the United States, Ukraine and Japan undoubtedly show the great danger to mankind when the atom drops out of human control.

Statistics show that in case of reactor failures at nuclear power plants, despite all the known precautionary measures taken in the design and construction of nuclear reactors, radioactive contamination reaches enormous scale. The consequences of the major accidents in the nuclear power plant are similar to the consequences of the explosion of atomic bombs and, on their scale, are close to geological disasters.

In modern nuclear reactors with a high degree of safety, all radioactive substances are in closed systems and can be ejected out only in emergencies [11]. In water cooled reactors, water is activated and contaminated with radioactive substances, but prior to discharge, it is subjected to complex purification and is passed through columns of ionites to contain the radioactive pollutants. Irrespective of the most stringent safety measures in the operation of nuclear reactors through valves, pumps and others, it is sometimes possible to leak out contaminated water and air that directly or indirectly through rainfall reaches the soil. The most dangerous for radioactive contamination are the emergency situations.

This is the example of the Wynskeeil accident in England. On 8th of October 1957 in reactor No. 1 the temperature rose sharply, the operators failed to control the process. The grid melts and the fuel starts to run out and burn. The chimney of the reactor begins to mimic radioactive smoke and pollute the environment. Workers from the plant receive a 150-fold higher dose of radiation above the permissible, and the area nearby - more than ten times higher. The radioactive clouds hang over North England, Scotland and part of northern Europe. On the 4th day after the accident, the fire was extinguished. Fortunately, during the accident, there are no deaths. Contamination of the pastures, and hence the cow's milk with radioactive iodine, is responsible for throwing huge amounts of milk into the ocean. Radiological Protection Council data show that in the 30-year period in England 33 people died and died as a result of exposure.

As in most such cases, the UK authorities for political reasons do not reveal the causes and nature of the Wynskeeel accident. This was done only after 30 years.

The accident at Three Mile Island - USA, which took place on March 29, 1979, was also huge. Despite the significant damage to the reactor core, the integrity of its protective shell was not impaired, and the radioactive discharge and pollution of the atmosphere and inside the emergency station proves to be very small. The temperature of the accident in different parts of the upper half of the core reaches 2800 ° C. The transfer and deposition of fission products in the TM -2 sheath are limited by inert gases and only very small quantities of the product fall into the atmosphere, although more than 20% iodine and more than 50% cesium have been ejected initially. Subsequently, these radioisotopes are found in the lower layers of the atmosphere. After thorough analysis of the causes and extent of the accident, valuable lessons have been learned about the construction and technical safety of the reactors.

The biggest accident at the NPP is in Chernobyl, Ukraine. On April 26, 1986, the Chernobyl NPP's 4th bloc collapsed, causing severe consequences for the country, its neighbors and almost all European countries.

The Fukushima I nuclear accident in Japan is a radiation incident of the highest seventh grade on the international scale for nuclear events.

The power plant owned by the Tokyo Electric Company (TEPCO) has 6 power units with water-jet reactors and is the world's largest nuclear power plant.

It was triggered by the earthquake and the tsunami that followed in early March 2011. The Japanese official authorities said it was a localized accident, but it subsequently turned out that as a result of the weekend accident on the US west coast they measured an increased level of radioactive background. In May 2011, even in the southern hemisphere of the Earth, there are radioactive isotopes and an increased background background that is the result of the Fukushima NPP disaster.

On July 5, 2012, the Japanese and world media reported that a report by the special parliamentary committee said that "The Fukushima-1 accident was not a natural but a technogenic disaster. The nuclear power plant was not prepared for either a strong earthquake or a tsunami. " The Commission blames the operator, the TEPKO company, and the government's nuclear services.

In the earthquake, blocks 1 - 3 are self-extinguished, and the back-up power generators that supply the electronic control system and water pumps to cool the fuel rods are included. This is necessary because after stopping the chain reaction, the fuel rods continue to emit a large amount of heat due to the natural radioactive decay.

The power plant is protected by a breakwater with a height designed to contain a tidal wave up to 5.7 meters high, but the tsunami that hits the shore about 40 minutes later is about 14-15 meters high. Wave floods the plant, damages the power and electronics in the units and interrupts the external power supply to the plant. The earthquake disruptions prevent rapid external intervention in the affected area.

This conclusion differs from the conclusion of the TEPKO's internal investigation at the end of 2011 that the main cause of the accident was the tsunami wave whose height of 15 meters exceeded the forecasts of seismologists.

Some of the most catastrophic nuclear incidents are those we have never heard of. When we think of a nuclear disaster, we usually think of Chernobyl and Fukushima or Hiroshima and Nagasaki.

No matter how devastating they may be, during the Cold War the warring powers are conducting nuclear experiments, the results of which were the same, if not worse, consequences of the nuclear incidents and detonations that dominate the history books.

Between 1946 and 1958, the US carried out 23 nuclear tests on the remote Pacific Bokini Atoll. Among these attempts is Castle Bravo, which the United States carried out in 1954, and is the most powerful nuclear device the country has ever detonated. It is 1000 times more powerful than the bombs placed over Hiroshima and Nagasaki, and causes radioactive particles to reach as far as Australia, India and Japan.

After Castle Bravo, the inhabitants of neighboring atolls had to be evacuated, but that was not enough to be safe. After detonations, atol residents reported an increase in cancer and infant with disabilities. Forced emigration is a critical moment in US nuclear tests, although it is debatable how much Americans have been concerned about the local population. Residents of the Bikini atoll are sent to neighboring atolls, but they are not adapted to such a large population and people are starving.

Moreover, despite the assurance that the locals will be able to return to their homes after military attempts, these attempts make the atoll unfit for habitation. Pollution of water and soil makes fishing and farming impossible there. To date, radiation levels there are too high for safe habitation.

In December 1950, President Truman established New County, a Nevada site for the sole purpose of conducting nuclear trials. Ultimately, US governments are testing a total of 928 nuclear bombs, mostly underground, although many people report seeing clouds in the shape of a sponge from overground tests in the Las Vegas area.

Field workers called a particularly heavy bomb "Dirty Harry" because of the huge number of nuclear particle deposits after her detonation. Residents reported that the explosion made the sky "beautifully red" and left a "metallic taste in the air." Another explosion called Sedan has left an incredibly large crater and has infected more US residents than any other experience in the history of the country.

Today the polygon is open to visitors, but some things remain secret because visitors can not wear cameras and mobile phones, perhaps because there are still trials there.

In October 1961, the USSR detonated King's Bomb - the most powerful man-made explosive device in human history. It is detonated on Cape Suoyi on the North Island, off the coast of Northwestern Russia. The mushroom cloud was huge - seven times taller than Mount Everest. "King Bomb" was three times more powerful than Castle Bravo and 1570 times more powerful than the bombs placed over Japan by the Americans.

Although the USSR is trying to modify the bomb so that radioactive deposits do not have such an enormous impact on the environment, it destroys all buildings in the North and interrupts radio communications for an hour.

France conducted nuclear attempts at two atolls in French Polynesia from 1966 to 1996 despite the protests by the Polynesian Territorial Assembly. The first test bomb sucks all of the water from the atoll lagoon and the atoll itself starts to "die dead fish," says

Greenpeace. The bomb scatters radioactive particles to Peru and New Zealand.

2.2. Characteristics of uranium mining

Many specialists believe that the liquidation of uranium mining in Bulgaria in 1991. was carried out hastily, as a result of which in a number of areas there were no complete technical solutions for this activity [12].

The monitoring of the environmental status of the MOEW in the vicinity of former uranium mines includes the field radiometric measurements and laboratory analysis of soils, waste products in tailing ponds and landfills, bottom sludge, underground and surface run-off. Radiological parameters of soils, bottom sludge and waste materials are assessed by analyzing samples from the EEA for the control of potential pollutants [13]. The water samples are analyzed radiochemically with respect to the indicators laid down in BDS 2823 "Drinking Water" - total beta radioactivity, uranium content and radium content [14].

With the entry into force of Decree of the Council of Ministers № 74 / 27.03.1998 on eradication of the consequences of the mining and processing of uranium raw materials, Ecoinengineering -RM EOOD is responsible for organizing and controlling the activities related to the technical liquidation, the technical and biological reclamation, water management and the conduct of complex environmental monitoring of environmental components. Despite the existence of a legal basis, monitoring networks are not built and operated at all sites, as recommended by the Chairman of the Energy Committee "Instruction for Organization of System for Monitoring, Design, Construction and Operation of Environmental Surveillance Networks Influenced by uranium industry regions "[15].

Under the Phare Program "Complex Program for Cleaning and Monitoring of the Areas Affected by Uranium Production and Processing in Buhovo", in March 1999 a Local System for Basic Environmental Monitoring in the Buhovo - Yana Region (LBMM) . The system consists of two monitoring containers located in Buhovo and Yana, two reception centers - in Rare Metals EOOD, Buhovo and in the EEA - MOEW, as well as a information board for continuous informing the public, installed at the Buhovo cultural home .

LMPMM aims to continuously monitor environmental performance before rehabilitation activities, over time and long-term after completion of restoration work in the area. The monitoring containers are equipped with measuring equipment for continuous control of total dust, radiological parameters: gamma radiation dose rate, radon concentration in ground air, meteor parameters: wind direction and wind speed, temperature and humidity of the ground air, atmospheric pressure and rainfall [16].

The results obtained and their comparison with the applicable normative documents give grounds for some general assessments and conclusions.

- in the settlements located close to the former uranium production areas studied and the adjacent agricultural areas, the concentration of natural radionuclides in the soil and the level of the radiation background are not altered.
- Following the liquidation of uranium mines, access to some of them is not sufficiently limited.
- Places where the radiation background is several times higher than the natural background should be restricted by population access, despite the minor radiation risk.
- Liquidation procedures should be completed in the "Grazovitsa" loading ramp and the soil should be deactivated on a limited area [17].

A concrete wall should be erected around the embankment of uranium ore at the Rivers of Nevi, in the village of Dobralak, avoiding scattering and inappropriate use of the ore.

The results of the surveys were also provided to the relevant municipalities in order to inform the local public and to limit the phenomena of radio-phobia or frivolity by the people in the mentioned areas. Besides, the assessments carried out more broadly will contribute to the conduct of an adequate economic policy in the surveyed regions.

The problem with the content of uranium and alpha particles in the drinking water of Haskovo, Parvomay and Velingrad from April 2017 was highlighted here. Then increased uranium content was found in four wells of the nine supplying cities of Haskovo. Survey data from September 2016, but only in the public domain came out this year. Specific values for the overriding meanings have not yet come out officially, but there is a number of over-norms mentioned. Similar data are available for other settlements. In immediate proximity to these settlements there were uranium mines, which are no longer functioning but not preserved according to the requirements of the Bulgarian and international legislation. Money for mine closure has been absorbed, and work has not been done to the best of its quality. So rainwater and underground rivers flow through the former mines safely and extract radioactive isotopes and particles.

Regardless of the reasons for the increased content of uranium, it is inadmissible to silence the truth in pursuit of purely economic or political ends and thus to put people from different regions of the country at risk for their lives.

2.3.Characterisation of radiation from other activities

Air crews and passengers traveling on high-flying airplanes, i. at high heights, can also receive increased cosmic exposure. Its intensity depends on the duration of the flight, the solar activity, the latitude, etc.

Often electronic and luminous devices, research apparatus, watches, toys and others contain radium - 226, strontium - 90, tritium, etc., which contribute to the increase in the human radioactive dose. In modern life and production, many of the apparatuses, machines, utensils, and articles of use contain radioactive materials and imitate radiation in their use.

For example, uranium is used in dentistry as a glaze of ceramics, this element as well as fertilizer add firmness to materials used in dentistry. Radioactive materials have entered the industry and bust at a violent pace after the Second World War.

The peaceful atom enters the medical procedures, especially in well-developed countries, where the population is significantly more exposed to radioactive exposure. Research laboratories and some industries emit radioactive waste, which can be a source of pollution if the purity and safety guidelines for handling such substances are not strictly observed [18].

Already at the beginning of the 20th century, under the influence of information on the stimulating action of radioactive radiation on plant development, the interest in radioactivity increased and various preparations and fertilizers containing radioactive elements were placed on the market. Interestingly, even after the end of World War II and the atomic bombing over Hiroshima and Nagasaki, the interest in radioactive substances such as fertilizers has also increased and increased in some countries such as the United States, Canada, Denmark where a large number of vascular and Polish experiments to test the effect of radioactive substances on field, vegetable and other crops.

Many scientists and specialists have convincingly demonstrated as a result of numerous vascular and field trials that increasing crop yields can be achieved by developing new agro-technical methods and technologies and applying many other substances, fertilizers and activities instead of use radioactive substances that hinder the risk of increasing the radioactive background of the soil and the environment [19].

It has been shown that certain quantities of radioactive substances are introduced into soil with mineral fertilizers that may pose a risk to human health. According to agrochemists and fertilizer specialists, the potassium element - 40 (0.012% of the permanent isotopic composition of natural potassium in whatever minerals, salts, substances) is always introduced into the soil - is not a threat to the living organisms.

Phosphorous fertilizers are also known as uranium and radium, but as traces of only theoretical significance as dangerous components. It has been found that the amounts of uranium and radium in phosphorites from different sources are different. Grounds for concern are the results of checks on the accumulation of uranium and radium in greenhouse soils where mineral fertilizers are applied at very high levels. It was found that in these soils, compared to neighboring normally fertilized fields, the uranium content increased by 75% and the radius by 10-70%, for a 5-10 year intensive use of greenhouses. The uranium and radium content of superphosphate and phosphorus is 10 and 50 times higher than soil content. According to the calculations for the introduction of optimal doses of phosphorous fertilizers, there is no practical danger of reaching uranium and radium limit values in the near future, but adherence to optimal fertilization standards with phosphorous fertilizers is mandatory. The results of the agrochemical and biochemical studies did not show an increase in the concentration of uranium, radium and thorium in the country's greenhouse soils.

From the point of view of environmental and food security, it is necessary to periodically monitor the radiation status of intensively fertilized soils with phosphorus [20].

Fertilizers and agrochemistry specialists argue that there is a real danger of using phosphors in the construction or chemical melioration of salted soils with the radioactive elements contained therein. The analyzes show that phosphorus does not differ significantly in the content of radioactive elements from the soil into which it is introduced. Batch phosphogies with higher radioactivity are encountered, but it is always lower than the superphosphate radioactivity. According to some hypotheses, the technological operations for the production of phosphorous fertilizers in which the phosphogypsum is a waste do not include the phosphorus-containing radioactive elements and, regardless of the fact, this product is administered at a dose of 20-30 tonnes per hectare of phosphogypsum at Soil melioration This product is not capable of enriching soils with radioactive elements. However, during meliorative activities, specialists should refrain from very high doses of phosphogypsum, although they may be introduced into the soil once, as some of its properties may deteriorate.

3.Conclusions:

1. The formation of radioactive contamination and its behavior is of interest for both preventive measures and after a nuclear or nuclear accident at the NPP.
2. Radioactive contamination in a radiological or nuclear accident will be determined by a wide range of factors that determine the contamination of tropospheric air, soil, water, plants and the overall environment.
3. Optimized control of radioactive contamination following an accident contributes to the proper organization of evacuation rescue operations as well as to the decontamination of contaminated areas and food products.

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