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TECHNOLOGICALLY ENHANCED NATURAL RADIOACTIVITY AROUND THE COAL FIRED POWER PLANT

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Abstract

In some situations the exposure to natural radiation sources is enhanced as a result to technological developments. Burning of coal is one source of enhanced radiation exposure to naturally occurring elements, particularly radium, thorium and uranium. Most of the radioactive substances are concentrated in the ash and slag, which are heavy and drop to the bottom of a furnace. Lighter fly ash is carried up the chimney and into the atmosphere. The bottom ash and slag are usually deposited in a waste pile, from where some activity may leach into aquifers or be dispersed by wind.

The main pathways through which the populations living around coal fired power plants are exposed to enhanced levels of natural radionuclides are inhalation and ingestion of the activity discharged into the atmosphere. For this reason, extensive investigations have been under way for several years in the coal fired power plant in Croatia, which uses an anthracite coal with a higher than usual uranium content.

Introduction

This paper presents the summary of results of gammaspectrometric measurements of natural radioactivity around coal fired power plant (CFPP) located in Plomin bay at peninsula Istria in northern part of Adriatic coast. Figure 1. gives the map of Plomin bay with the site of coal fired power plant.

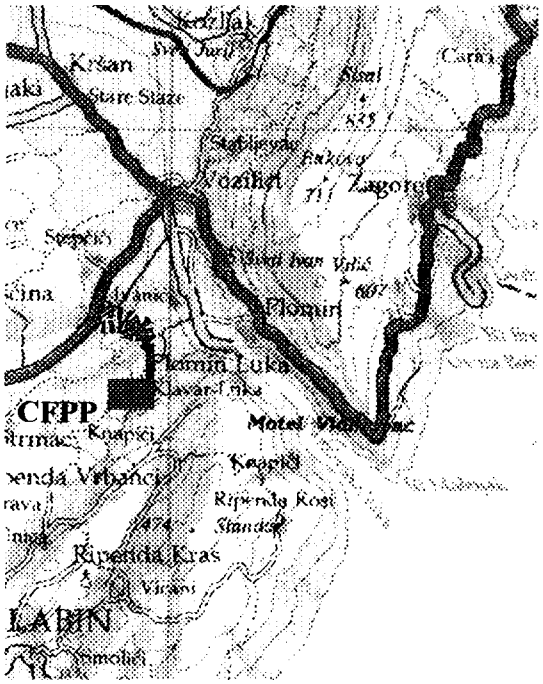

Figure 1. The map of Plomin bay with the site of coal fired power plant (CFPP)

Coal has widely contributed to electrical power generation. In Croatia, coal is playing an important role in meeting her energy needs. Coal like any other geological material found in nature, contains tracer quantities of naturally occurring pre-mordial nuclides. The most important burden to the environment from coal combustion from CFPP are the atmospheric pollution. The main pollutants are SO_2, NO, NO_x, CO. Beside the inactive contaminants, the coal also contains tracer quantities of the naturally occurring radionuclides.

Its direct combustion or conversion to other forms of fuels resulted in the concentration of non-combustible mineral matters, which include most of the radionuclides in the ash or gaseous residues. The release of some of these residues to the environment, either through the stack or from the waste storage areas results in the distribution of these natural radionuclides from deep inside the earth (where the impact on humanity is nil), to locations, where it can enhance the ambient radiation field resulting in higher population exposures [1,2]. For that reason, extensive investigations have been under way for several years in the CFPP in Croatia, which uses an anthracite coal with a higher than usual uranium content.

Methods

Air samples for determination of total alpha activity were collected on Schneider-Poelman filters with the aid of an air pump, which sampler was held 1m above the surface. At the same sampling stations, the fallout samples were collected. One litre from the monthly sample was evaporated to dryness for determination of total alpha activity. Determination of total alpha activity was performed by using a surface barrier Si detector and 1 K channel analysing system [3,4].

To obtain the monthly mean concentrations of gamma emitters in surface air, the airborne particles were collected on glass fiber filters (with a nominal collection efficiency of 99.9 % for 0.3 μm particles) by means of a high-volume air sampler at a flow rate of 2000 m^3 in 24 hours. The activities of natural radionuclides were measured by use of HPGe(Li) ORTEC detector (resolution 1.78 keV on 1.33 MeV ^{60}Co, relative efficiency 16.8%) jointed to 4 K channel analysing system and connected on line with the computer [3,4].

Radiation surveys of the working area inside the CFPP were made with a Victoreen Thyac III gamma-beta survey meter, with a detector held one meter above the surface. Later on a network of TL dosimeters was organized.

Results and discussion

Monthly mean values of total alpha activities in surface air showed fluctuations through the year depending on meteorological parameters. The maximum value was obtained in winter (2.4 E-5 Bqm^{-3}) at the location 1.5 km far from CFPP, in direction southeast by east. The lowest values were in summer (less than 3.0 E-6 Bqm^{-3}, with the maximum of 2.4 E-6 Bqm^{-3}).

The maximum value of total alpha activity was determined in monthly fallout sample from September (2.7 E+1 Bqm^{-3}), what was in direct connection with the amount of rain.

Specific activities of ^{238}U, ^{226}Ra and ^{40}K in surface air samples are presented in Table 1.

Table 1.
Specific Activities in Surface Air (Bqm^{-3})

	^{238}U	^{226}Ra	^{40}K
Around CFPP	4.0 E-6	2.8 E-7	6.2 E-7
Northern Hemisphere [5]	2.6 E-8	3.0 E-9	3.1 E-5

It is obvious that the activity levels around the CFPP exceed the values in Northern Hemisphere by factors of hundred.

The external level of natural radiation around working places at the time of measurement varied from 13 to

39 $nCkg^{-1}h^{-1}$. The highest value was 129 $nCkg^{-1}h^{-1}$, obtained on one occasion under the ash hopper. The background of the surrounding countryside showed fluctuations between 1 - 2 $nCkg^{-1}h^{-1}$.

More recently some of the measurements were repeated, and all the results have shown decreased contamination. The reason for that probably is use of the coal with low concentration of uranium. The old waste pile has been covered with 0.5 m thick level of soil and grass was sawed on, so that is another reason for decreased contamination at surrounding area.

Conclusion

In conclusion it can be pointed out that covering the waste pile with soil was good solution for reducing radioactive contamination in the environment and to keep the possible risk to the surrounding population under permanent control. However, it is necessary to control the radioactivity of coal used for combustion, slag and ashes deposited on new waste pile.

Radiological health hazards due to coal fuel cycle is only a small fraction of the total environmental background radiation. Even through the radiation received by the population due to coal fuel cycle is very small, continuous operation of the power plant with coal as a fuel will result in the cumulative exposure. So a continuous watch on this source of enhanced exposure should be kept for health monitoring purpose.

References

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