WORKING LEVELS IN THE COAL FIRED POWER PLANT IN CROATIA

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INTRODUCTION

The exposure from man-made natural sources is called *technologicaly enhanced natural radiation* - TENR (1). One of the first sources of uranium and thorium which was detected not being connected with the nuclear industry, was found during energy production using fossil fuels. As the combustion of coal increases, so will the magnitude of environmental and human health hazards associated with trace elements and radionuclides mobilized by the coal fuel cycle. The large fraction of coal ash that does not find commercial application is usually dumped in the vicinity of the coal fired power plant (CFPP). The coal ash may contain enhanced levels of the natural radionuclides in the uranium and thorium series, especially fly ash. Among the decay products are the radon isotopes, ^{222}Rn, ^{220}Rn and ^{219}Rn, which are noble gases and thereby pose special problems in assessing the radiological hazard of fly ash. For that reason, investigations of the hazards were undertaken in the CFPP in Croatia, because the anthracite coal used for combustion has an average 10% sulphur and a variation of uranium.

EXPERIMENTAL PROCEDURES

In the seventies the uranium content in coal was between 500-1200 $Bqkg^{-1}$ (2). After 1980 it declined to an average 250 $Bqkg^{-1}$ due to opening of an different vein in the coal mine. This requested a thorough monitoring programme which included measurements of activity concentration of radionuclides in coal and ash samples, and measurements of working levels (WL).

WL is defined as any combination of short-lived radon daughters in one liter of air that will result in the emission of 1.3×10^5 MeV of potential alpha energy. Under conditions of secular equilibrium 3.7 $kBqm^{-3}$ (100 $pCiL^{-1}$) of ^{222}Rn produces 1 WL (3).

WLs were measured as "grab samples" using method developed by Scott (4).

RESULTS AND DISCUSSION

In the CFPP seven locations have been chosen, because of long-time occupational exposure, and five on-site in places with natural air flow. All WL values are an arithmetic mean of three measurements.

Tables 1 and 2 summarize the estimated WL values, together with occupancy time limit.

Table 1. WL OF OCCUPATIONALLY EXPOSED PERSONS INSIDE THE CFPP

Work place	mWL (1977)	Occupancy time limit	mWL (1983)	Occupancy time limit
Conveyour belt (coal)	8.0	42 h/week* unlimited	7.0	42 h/week unlimited
Conveyour belt (coal)	15.0	24-42 h/week	6.0	42 h/week unlimited
Below the automatic control (ash hooper)	80.0	21 h/week	12.0	24-42 h/week
Below the automatic control (ash hooper)	60.0	42 h/week	12.0	24-42 h/week
Waste pile fresh	80.0	21 h/week	-	-
Waste pile old	-	-	60.0	42 h/week
Bottom ash	80.0	21 h/week	20.0	24-42 h/week

* 42 h/week was taken as the occupancy time limit to comply with the US general population standards, since the workers in the CFPP were never considered as people occupationally exposed to radiation.

Table 2. WL ON-SITE IN PLACES WITH NATURAL AIR FLOW

Work place	mWL (1977)	Occupancy time limit	mWL (1983)	Occupancy time limit
Area around the steam generator building	6.0	unlimited	6.0	unlimited
Under the stack	5.0	unlimited	6.0	unlimited
Near the furnice	5.0	unlimited	6.0	unlimited
Office building (500 m from the CFPP)	3.0	unlimited	-	-
10 km fom the CFPP	3.0	unlimited	6.0	unlimited

The WLs have shown great variations between two measurements, depending on the radioactivity of the coal and combustion products present at the time of the measurements in the CFPP. The highest WL was besides the bottom ash and fresh waste pile, where even an occupancy time limit should be considered.

Table 3 summarizes the estimated WL values measured in 1990.

Table 3. WL MEASURED ON-SITE AND OFF-SITE CFPP IN 1990.

Location	mWL
Coal storehouse	6.0
Below the automatic control (ash hooper)	11.0
Area around the steam generator building	6.0
Slag and ash pile	6.0
Štrmac	6.0
Vozilići	5.0
Stepčići	5.0
Luka Plomin	4.0
Rabac	3.0

As we expected, the highest values were obtained on-site of the CFPP.

Locations 5 - 9 were at different directions and distances from the CFPP, chosen in dependency on wind-rose (Table 4).

Table 4. ALTITUDES, DISTANCES AND DIRECTIONS FROM THE CFPP

Location	Altitude (m)	Distance (km)	Direction
Štrmac	120	3	SW
Vozilići	100	5	NW
Stepčići	80	2	W
Luka Plomin	10	1	SE
Rabac	0	20	S

The most interesting case is the location Štrmac, where a hamlet was built on a ninety years old tailing site, where already the third generation of same families are dweling in the same houses. At the location Rabac, which is at the sea shore, the WL is slightly lower, due to the lower ^{226}Ra content of the sea.

CONCLUSION

This paper introduces WL measurements in the industry where TENR is present. The CFPP is a specific case with the apperance of natural radioactivity which was very similar to open pit uranium mining. The appearence of places with an increase of natural radioactivity in non-nuclear industries have left the legislator, at present without a ready solution in Croatia, how to systematize occupationally exposed workers, especially after the Chernobyl accident, when the public become sensitive to radiation of any origin.

REFERENCES

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