Chapter 1

INTRODUCTION

1.1 Background

Coal has been classified by the Keystone Coal Industry Manual into numerous types including lignite.[1] It is used as fuel in power plant for generating electricity in many countries. Like other fossil fuels and other materials found in nature, coal contains trace amounts of the naturally occurring radioactive materials which volatilize during the combustion process at high temperature (1200-1800 °c) and then at lower temperature, partially condense on the different ash fractions. After the combustion, small amounts of these radionuclides as well as other nonradioactive trace elements follow the fly ash, released from the power plant, through the stack into the atmosphere and disperse over the large areas in the vicinity.

Regarding the radiation exposure to man from radionuclides in coal and fly ash, three main radioactive elements: uranium-238 (U-238), thorium-232 (Th-232), and potassium-40 (K-40) are of importance. These also include their decay products. The U-235 and its decay products has tended to be ignored because of the small portion of U-235 in natural uranium, though a recent assessment[2] suggests that this may not be justified. The average specific activities of U-238, Th-232 and K-40 in coal and fly ash in some countries are shown in Table 1.1.

Table 1.1 Specific Activity of U-238, Th-232 and K-40 (Bq/kg) in Coal in Some Countries.

		U-238 (Bq/kg)	Th-232 (Bq/kg)	K-40 (Bq/kg)
Worldwide[3-6]	Coal	20	20	50
(typical	range)	10-600	10-200	37-440
	Fly ash	240	130	265
U.K.[7]	Coal	14.5	12.5	150
Australia[8]	Coal	9-47	17-29	23-140
	Fly ash	64-114	57-130	170-615
India[9]	Coal	18.5-40.7	29.6-66.6	77.7-388.5
	Fly ash	70.3-110.0	118.4-177.6	181.3-521.7

However, coal or lignite with higher concentrations of uranium, thorium and potassium have been reported as being used as fuel in particular plant in some countries.[3,6,10] Much higher concentration have even been found in coal-mine samples from some uraniferous coal seam.[5]

It has been concluded in most studies[10-13] that all the decay products of both the U-238 and Th-232 series are generally in secular equilibrium with their parents in coal.

In fly ash resulting from the combustion process, the increase in specific activity of radioactive materials depends primarily on its inorganic component known as its ash content. Beck et. al.[5] reported that for coal with ash content between 10-15 %, a mean concentration

factor is about 7-10. In the other study,[13] it was concluded that the concentration of radioactive material typically ranges from 5 to 20 times the values for coal. However lower grade coals and lignites with ash contents of more than 20 % are reported to be used routinely in some countries.[9]

The radiological impact of radionuclides released from coal fired power plant has been evaluated in many studies[3,5,10,13-27] and found to be negligible compared to the dose received from the same naturally occurring radionuclides due to normal environmental radiation exposure. For a coal fired power plant normalized to 1,000 MWe and at a distance of 500 m away from the plant, the maximum individual annual radiation doses to lung and bone were 0.01 to 0.42 mSv and 0.4 to 3.8 mSv respectively. The annual collection doses are 0.42 to 2.4 person-Sv

In Thailand, lignite has been used in thermal power plant for electricity generation since 1973. It is expected that in 1992, the annual consumption of lignite will go beyond 32 megaton.[28] This will result in the dispersal of more than 90,000 tons of fly ash per year.

1.2 Objectives

1.2.1 To determine the specific activities of some natural radionuclides in lignite samples with different ash contents by using gamma spectrometry.

1.2.2 To determine the specific activities of some natural radionuclides in lignites and corresponding bottom ashes and fly ashes by using gamma spectrometry.

1.2.3 To estimate the enrichment factors of some radionulides in lignite ashes.

1.3 Scope of The Research

The research was concerned with the study and determination of natural radionuclides in lignite, bottom ash and fly ash samples from Mae Moh Operation Mine and Mae Moh Power Station (unit 4-11) of the Electricity Generation Authority of Thailand (EGAT). The method used was gamma spectrometry with hyper pure germanium detector.