I. INTRODUCTION

The trend of the electric power demand increases continuously. The main cause of this increasing consumption is from the rapid growth of the country in terms of urbanization and industrialization. The increasing demand of the electricity and continuing rise of the oil price have caused the Electricity Generating Authority of Thailand (EGAT) to accelerate its electricity production, and simultaneously, consider a cheaper energy source. Lignite, as revealed by a large scale exploration, has its reserves in Thailand in a quantity that makes its utilization for power generation feasible. From an environmental viewpoint, the operation of lignite-fired power plants are known to alter the quality and balance of the environment. The lignite composes of several elements including oxygen (O), silicon (Si), aluminium (Al), potassium (K), titanium (Ti), magnesium (Mg), calcium (Ca), sodium (Na), barium (Ba), manganese (Mn), chlorine (Cl), bromine (Br), iodine (I), molybdenum (Mo), arsenic (As), antimony (Sb), selenium (Se), indium (In), cerium (Ce), mercury (Hg), tungsten (W), iridium (Ir), gold (Au), silver (Ag), copper (Cu), Zinc (Zn), nickel (Ni), cobalt (Co), iron (Fe), vanadium (V), chromium (Cr), scandium (Sc), thorium (Th), halfnium (Hf) and the others. When lignite is burnt, the trace elements are transferred to bottom ash, fly and gases, and are discharged to the environment. Thus, the process of lignite combustion creates air pollution problem due to the trace elements, originally associate with lignite and highly enriched in the fly ash which is emitted into the atmosphere with the flue gas stream.

The area of concern in this study is Mae Moh Project area, since most lignite consumed in Thailand is used at the Mae Moh Project. Moreover, the use of lignite-fired boilers for the generation of electricity in this area will continue to increase in the future.

1.1 Mae Moh Project

1.1.1 Location

The Mae Moh Project is situated in the center of the Mae Moh Basin which is located in Amphoe Mae Moh and about 25 km east of Changwat Lampang in the northern Thailand (see Figure 1). The Basin is relatively flat at the center with elevations between 300 m to 360 m Mean Sea Level (MSL), rimmed by mountains with elevation of approximately 700 m to 900 m MSL. The Basin has an elongated shape, approximately 17 km in length and 9 km in width, with total area about 150 km^2. The Basin lies with its long axis in the north-south direction, and is surrounded by Doi Kiew Lom at the north, Doi Pha Hom at the south, Doi Chang at the east and Doi Lhong at the west.

1.1.2 Project description

The Mae Moh Project comprises three main processes as follows:

1.1.2.1 Mining process

Preliminary exploration is carried out both by geological and drilling method to investigate soil and rock structure including proven reserve estimation. The lignite ore is removed from the sub-surface by open-cast mining method by which the overburden is removed by 11.5-m^3 electric-power shovels and hauled by 85-ton rear dump trucks to outside dumping area having total volume of 1,000 million m^3, about 2 km on the east side of the pit. For the hard shale overburden, explosive (ammonium-nitrate-fuel oil) is utilized to break up the ground before using the shovel. The lignite is excavated by 3.24-m^3 electric-power shovels and transferred to hauling equipments. The lignite demand for the existing three 75 MW Units is 1,603 million tons per annum (19). According to EGAT's plan, the power plants with a total capacity of 1,725 MW will consume about 12 million tons of lignite annually.(19)

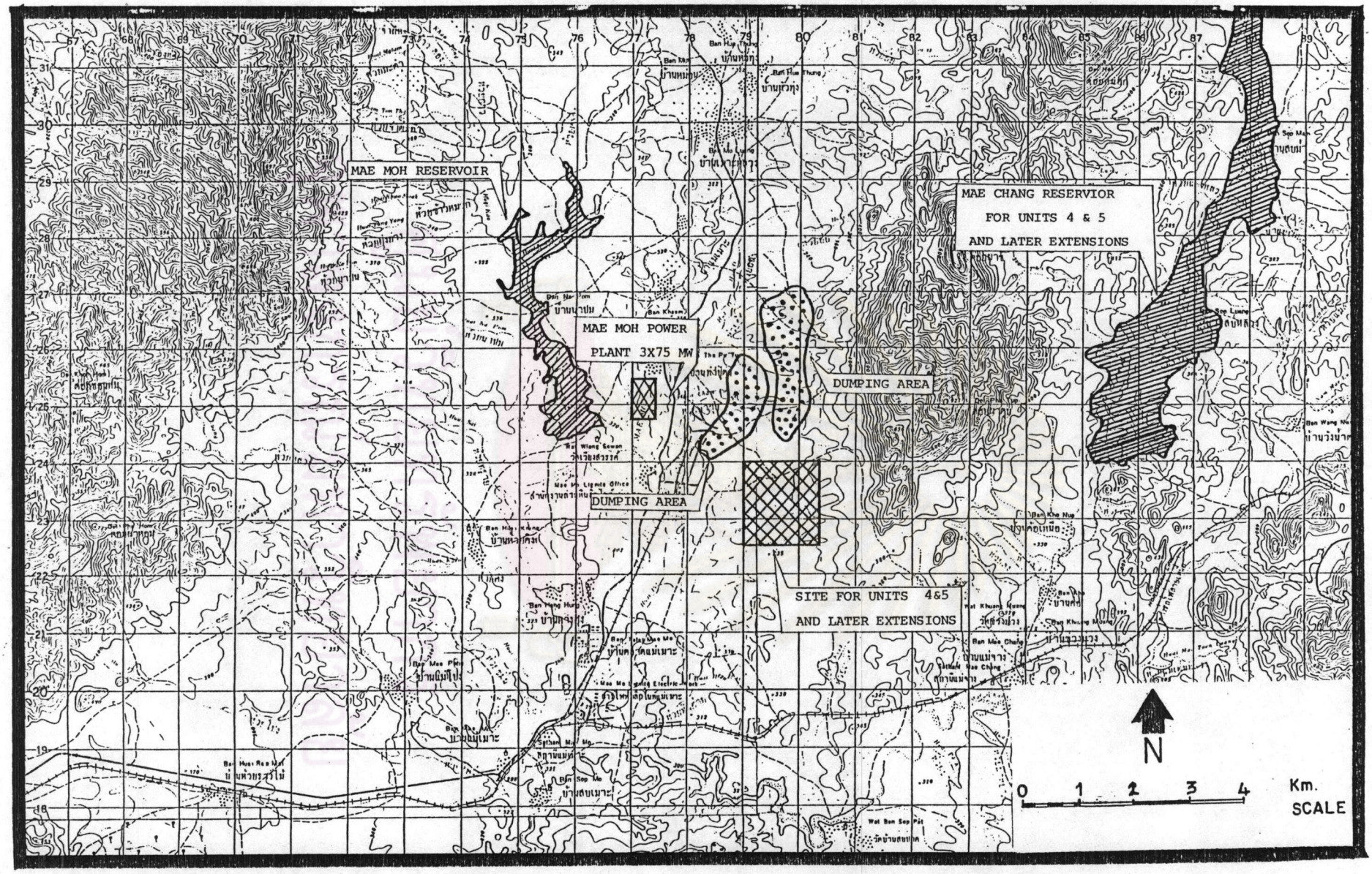

Figure 1 Location of Mae Moh Basin

1.1.2.2 Material handling process

The 35-ton rear-dump trucks are utilized as pit hauling equipments to transport lignite to a primary mobile crusher unit. The lignite is crushed to smaller than 30 cm and loaded on 1-m width conveyor belt which can convey the lignite at about 500 tons per hour through a distance of 2 km to a stripper and stacker unit. These units function as a transfer point where the lignite is conveyed either to the 30,000-ton lignite stockpile, 8 m height and located near the power plants, or a feeder which feeds the lignite to a secondary crusher unit. The fine-crushed lignite is ready to be transported to a burner unit.

1.1.2.3 Lignite burning process

The fine-crushed lignite from the crusher is conveyed to a unit of the power plants and released into the bunker above the coal feeder. The lignite from the feeder unit is released into a pulverizer unit where the lignite is ground into powder then fired in a burner unit. Heat resulting from the burning lignite is utilized for producing steam which inturn propells turbines and generators. The electricity from the turbine generators is distributed to substation units. The solid waste from the burning lignite is loaded by the rear-dump truck to the ash dumping area having total volume of 100 million m^3, about 2 km east of the Mae Moh Lignite-Fired Power Plant Units 1-3.(64)

The overall plan for the power plant project with ultimate capacity of 1,725 MW includes up to ten generating units. At present, there are three 75-MW plants which are already in operation (see Figure 2). Four additional 150 MW. units are under construction. The other three units are planned. The power plant units 1 to 3 have been equiped with electrostatic precipitators connecting to 80-m high stacks for collecting particulates with efficiency of 96 percents and 99 percents for units 1 to 2 and unit 3, respectively.(65)

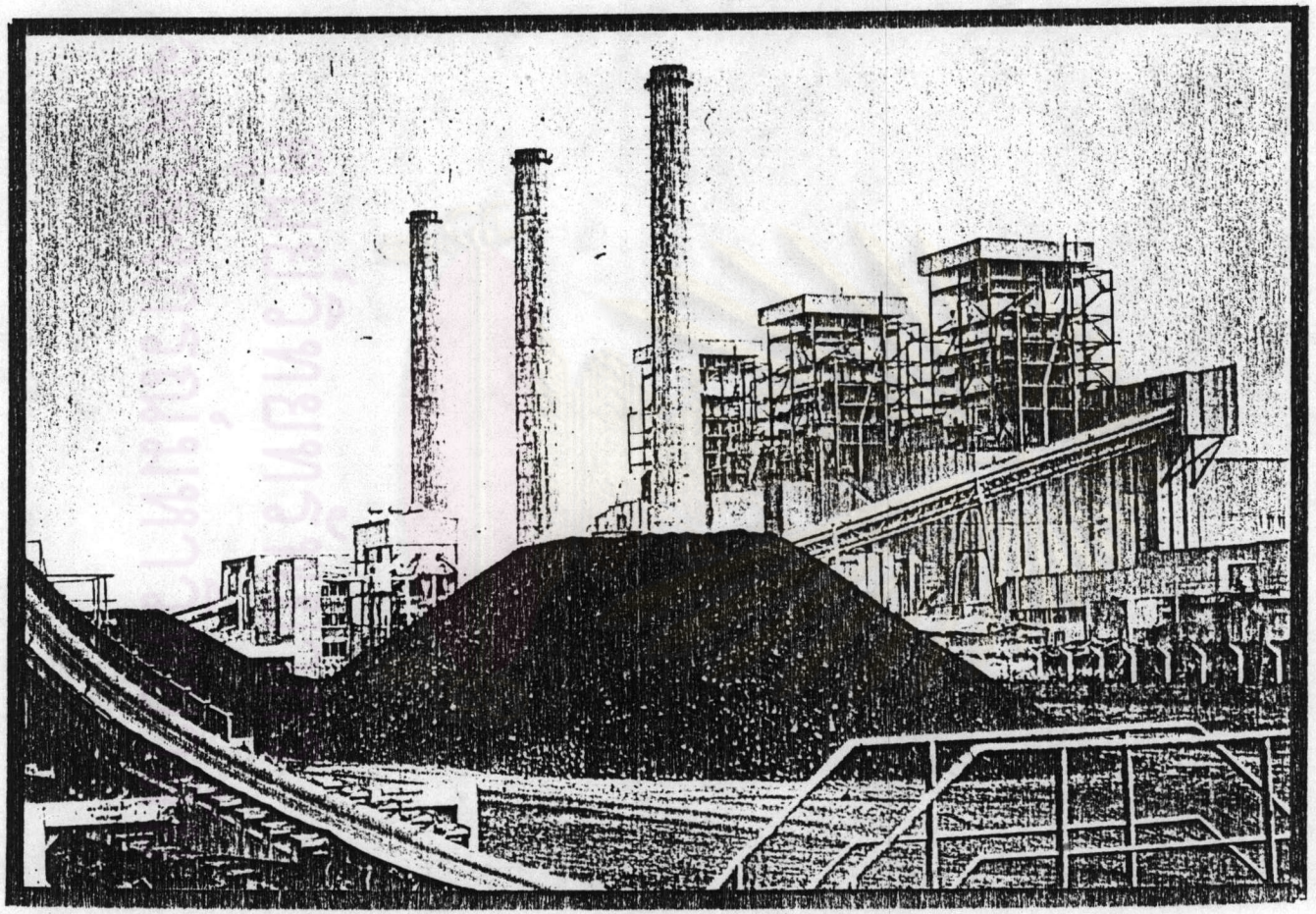

Figure 2 Mae Moh Lignite-Fired Power Plant Units 1 to 3

1.2 Emission source in the project area

There are many sources of pollutant emission in the project area as described below.

1.2.1 Mae Moh mining activities

Fugitive dust is generated by the lignite mining activities such as drilling, blasting, loading, hauling, dumping, conveying, crushing and stockpiling. Additionally, the fugitive dust emission is also generated by road maintenance graders, semi-mobile crushers, truck operations and the open-pit. The emitted fugitive dust generally consists of various particle sizes. Some settle to the ground quickly while other particles may be transported up to many kilometers from the mining site. Thus the mining generally contributes to a significant increase of the fugitive dust level. In 1982, it was estimated that the process of waste rock removal and disposal generated over 30 percents of the total dust emission.(64) Moreover, the process of lignite mining and handling produced the dust emission about 6 percents of the annual total dust emissions. (64)

1.2.2 Lignite-Fired Power Plant Units 1 to 3

Boiler exhaust gases are the pollutants emitted from the lignite-fired power plant. The pollutants that have been identified in the boiler exhaust consists of particulate matters, sulfur dioxide, nitrogen oxides, carbon monoxide hydrocarbon, heavy metals and radionuclides. Although the exhaust emission comprises only small percentage of the total particulate produced because of the high collection efficiency of the electrostatic precipitators, this pollutant emission is significant in light of the large quantity of lignite burned to produce the electricity. The total particulates emission from the power plant units 1 to 3 had been estimated at about 200 grams per second or about 63 percents of the annual total dust emission in 1982.(64)

In this thesis, some potentially hazardous heavy metals, such

as cadmium, copper, lead, manganese, nickel and zinc in airborne particulates in the Mae Moh Project area were investigated. These heavy metals are very important for four reasons as described below.

Firstly, these heavy metals are common air pollutants in the coal-fired power plant area.

Secondly, these heavy metals or/and their compounds are considerable significant in term of environmental health because of their toxicity to human beings, animals and plants, and may be the most harmful pollutants since they are not biodegradable and often have a long systemic effects.

Thirdly, these heavy metals in airborne particulates are progressively removed from the atmosphere by wet and dry deposition processes causing contamination of other environmental media.

Fourthly, the EGAT has planned to expand the full production capacity of the power plant from 225 MW at the present to 1,725 MW in the future.

In order to assess the pollutant effects on man and the environment resulting from the Mae Moh Project and its expansion, the determination of these heavy metals are necessary.

1.3 Objective of the study

The objectives of this study are

1.3.1 To determine the contents of cadmium, copper, lead, manganese, nickel and zinc in the lignite and the laterite soil by using atomic absorption spectrophotometric techniques.

1.3.2 To investigate the quantity of these heavy metals in airborne particulates in the Mae Moh Basin, within the radius of 2 km around the Mae Moh Power Plant Units 1 to 3.

1.3.3 To determine the relationship between each heavy metal and the airborne particulates.