EXECUTIVE SUMMARY

OF

THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

REHABILITATION OF AFŞİN-ELBİSTAN A THERMAL POWER PLANT

(09 December 2005)
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1 Introduction

Within the framework of the "Preparation of Energy Liberalization Project" assisted by the World Bank, Republic of Turkey has applied a portion of a grant provided from Japan Policy and Human Resources Development (PHRD) fund for the procurement of the consultant services for the EIA study of the "Rehabilitation of Afsin-Elbistan A Thermal Power Plant and Construction of Flue Gas Desulfurization (FGD) Unit". The International Bank for Reconstruction and Development (IBRD) is the administrator of this grant.

Concerning the environmental assessment of the rehabilitation project, the project is classified as "Category A" by the World Bank and the Environmental Impact Assessment (EIA) procedure was applied. The EIA study and the procedure has also been carried out according to both requirements of the current EIA Regulation of Turkish Government (Official Gazette, No: 25318, 16.12.2003) and the Environmental Assessment Policies and Procedures of the World Bank (OP/BP/GP 4.01 Environmental Assessment). According to Turkish EIA Regulation, this project is included in Article 25 b that states extra ordinary conditions for EIA procedure to be applied to the projects which are not subjected to EIA Regulation officially, but subjected to international funding mechanisms. Therefore, a unique EIA Report had been prepared for both Turkish Legislation and World Bank Policies.

The chief objectives of the EIA were to: (a) determine if, based upon estimates of air quality impacts, the overall program for rehabilitation and FGD installation for the Afsin-Elbistan A Thermal Power Plant could be sequenced in time: first with a rehabilitation project (Phase I) to be followed by an FGD installation project (Phase II), if so, (b) determine impacts of the rehabilitation project and FGD project and necessary mitigating actions. To determine if the FGD project (Phase II) could be derogated, the EIA work scope included a comparative analysis of air quality with respect to Turkish ambient air quality standards for SO₂ from current AETPP operation and resulting air quality after the Phase I rehabilitation is completed. Thus, the EIA served as a decision document for Turkish government officials to determine if the FGD investment was an immediate priority or could be developed at a later date.

This EIA study has been conducted by CINAR Mühendislik Müşavirlik ve Proje Hizmetleri Ltd. Şti. and KEMA International B.V. and this report has been prepared in accordance with the contract with EÜAŞ.

Aim of the EIA study is to meet both the requirements of the Turkish EIA Legislation and World Bank for a "Category A" Environmental Assessment study (OP 4.01 Annex B Content of an EA Category A Report). For this purpose, EIA has been prepared according to the special EIA format regarding the requirements of the World Bank and Turkish Ministry of Environment and Forestry.

This EIA was prepared using both field surveys and desktop studies (literature survey, calculation, assessments and modeling).
1.1 Major Conclusions

The EIA procedure yielded the following major conclusions:

- The rehabilitation of the ESPs on the main stack and the Bruden stacks is essential to address the dust and particulate emission problems.
- The AEAPP operating at full load after rehabilitation/upgrade without an FGD unit will meet both the long-term and short-term air quality standards for SO₂.
- The AEAPP operating at full load will not meet Turkish SO₂ emission standards. However, in evaluating the EIA, the Ministry of Environment and Forestry (MOEF) has recognized that plant performance after rehabilitation does not affect compliance with Turkish air quality standards for SO₂ in the plant vicinity and therefore, has confirmed that it will provide a derogation period in which to install an FGD in accordance with an Amendment to the “Regulation on Control of Air Pollution Caused by Industrial Sources” (RCAP) to be issued shortly.
- The rehabilitation of the plant will improve the plant’s environmental compliance with Turkish dust emission standards. Dust emissions have been identified, during public consultations as a major environmental issue among local groups.

2 Project Description

Afgin-Elbistan A Thermal Power Plant (AEATPP) is located between Çoğulhan and Alemdar Towns of Afgin District of Kahramanmaras Province. It was established by TEK during 1984-1987. It has 1355 MWe capacity with its four units and it is one of the most important power plants in Turkey.

AEATPP is a conventional thermal power plant utilizing low quality lignite from Kışlaköy Region. Lignite is sent to the storage area by conveyors having a capacity of 1 million tons. Lignite extracted from the different layers of the mine (having several thermal calorific values) is blended here and the lignite that has 1050 kcal/kg average value is conveyed to the power plant. The power plant consumes 3000 ton fuel per hour.

Steam temperature and pressure in the boiler are 535°C and 197.5 kg/cm² respectively and each boiler produces 1020 ton/h steam. Voltage is 21 kV at the outlet of generator that is then amplified to 380 kV in order to connect energy to the grid.

Process water is supplied from Ceyhan River Spring in Elbistan. Ash produced from is conveyed back to open mining site by ash conveyors and filled to the vacancies formed by extraction of coal. These areas are then covered by topsoil and landscaped.

The plant was designed to burn the low quality lignite with high moisture easily without using supplementary fuel. The system developed for such lignites is to first dry the lignite to increase its calorific value.

AEATPP is designed for an annual electricity production of 8,800,000,000 kWh. However, there have been a loss/decrease in capacity and reliability of the plant due to equipment wear and some unscheduled shutdowns. Average efficiency has decreased below the
design efficiency. Therefore, General Directorate of Electricity Generation Corporation (EUAŞ) decided that the rehabilitation of the plant is required.

Aşşin-Elbistan A Thermal Power Plant Rehabilitation and FGD Project will be sequenced into two phases: the first phase includes rehabilitation of the plant and the second phase will be construction of a Flue Gas Desulfurization (FGD) plant.

The first phase of the program to be financed by the World Bank is rehabilitation of AEATPP. It will include maintenance, repair, rehabilitation and modernization of mainly boiler, turbine and electrostatic precipitators. In the second phase, the FGD unit to be retrofitted to AEATPP will be similar to FGD unit in the AEBTPP, and based on wet limestone process.

3 Purpose Of The Project

The aims of the World Bank project for AEATPP are as follows:

- Improvement of plant reliability/availability,
- Improvement of the efficiency of the plant,
- Extension of the operating life of the plant, and
- Reduction of dust emission levels to fulfill Turkish Environmental Regulations.

3.1 Importance and Necessity of the Project

The energy-environment review carried out by the World Bank and the Government of Turkey (GoT) concluded that rehabilitation of existing power plants is economically and environmentally justified. The GoT has identified rehabilitation of all existing thermal power plants and retrofitting FGD units during the next five years as a high priority of its energy strategy. Aşşin-Elbistan A Power Plant is at the top of the rehabilitation list because it has experienced the most significant deterioration in its performance and reliability. Coupled with the need to improve its environmental performance, rehabilitation is the most cost effective option.

The GoT has also recognized that retrofitting FGD systems on all their thermal power stations is required both to improve environmental performance in the energy sector and as one of the conditions of the EU Acquis for the energy sector.

The limit values for SO₂ emissions given in the Regulation on Industrial Air Pollution Control cannot be achieved in some of the existing thermal power plants and the construction of FGD system is required. In spite of this requirement, these thermal power plants, including Aşşin-Elbistan A Power Plant, could not be retrofitted with the FGD system because of the substantial investment requirements. These plants are very important to provide the security of energy supply and they are in operation although the requirements of the Environmental Legislation can not be met.

Therefore, the derogation for a reasonable transition period is required to make necessary investments. As it is known, Turkey is a candidate country for EU membership and the
studies have been carried out for the harmonization of EU environmental legislation including the EU Large Combustion Plants (LCP) Directive. It is expected that the EU will grant derogations for its' existing thermal power plants, since the EU has provided such derogations for both its' newer members such as Poland and for candidate members such as Romania.

Within this context, the Ministry of Energy and Natural Resources (MENR) have been informed about the legislative situation of these thermal power plants to achieve the emission limit values specified in the Regulation on Industrial Air Pollution Control and necessity of the derogation providing a transition period for PM and SO₂ emissions up to 2010 and 2015, respectively. MENR has requested from the Ministry of Environment and Forestry (MoEF) provision of derogation for a transition period to achieve the SO₂ emission limit values for the existing lignite-fired power plants and the undersecretary level meetings have been carried out. Within the high-level negotiations, MENR and MoEF agreed on the importance of the derogation. MENR has recently received an official letter from MoEF related to the draft derogation item for providing the 5 year-transition period to meet the emission limit values on the condition that to achieve the air quality standards given in the Regulation on Protection of Air Quality. Within this framework, the amendment of the Regulation covering the derogation is expected. In this case of obtaining the derogation, it will be possible to realize the rehabilitation of Afşin-Elbistan A Power Plant without the construction of FGD plant at the first stage and to construct the FGD system on the second stage at the point in time specified in the derogation.

3.1.1 Improvement of Environmental Performance

The Turkish Air Quality Legislation could be summarized in two different Regulations such as Regulation on Air Quality Protection which states the short term and long term ground level concentration limits to be observed in a defined impact area and secondly The Regulation on Industrial Air Pollution Control that defines the limits for stack gas emissions for various industries. In this section the focus will be emissions levels specified in the above Regulation.

The main air pollutants of the power plant, which require further control, are particulates and sulfur dioxide (SO₂). NOx-emissions are in the 400-500 mg/Nm³ range, which is in compliance with the Turkish Environmental Regulations.

Particulates from the Bruden filters are in the 1,200-8,000 mg/Nm³ range while the electrostatic precipitators (ESPs) downstream of the boiler have similar performance (420 mg/Nm³ to 6,000 mg/Nm³) which is above the current regulatory limit value of 100 mg/Nm³. Bruden (vapor) filters are used to separate vapour and coal dust. The moisture content in the coal is evaporated by flue gas heating process in the mills. After mills, 1/3 of coal dust together with 2/3 of gas leaving mills goes to the bruden filters where coal dust is collected and fed to the boiler and steam is exhausted to the atmosphere by vapor fans. SO₂ is not controlled resulting in stack emission levels of 2,000 to 15,000 mg/Nm³.
depending on the sulfur content of the coal where the regulatory stack gas SO₂ emission limit value in Turkey is 1000 mg/Nm³. Therefore an FGD unit will be required as part of the second phase of the program.

Main goals of the project are to improve reliability and efficiency of the AEATPP and extend life of the plant to ensure security of energy supply and consequently decrease emissions of the plant below the limits of Regulation on Industrial Air Pollution Control and to decrease negative impacts on environment.

The total investment for the rehabilitation project is estimated to be approximately 440 million USD, and the FGD retrofit system is about 220 million USD. Investment costs are explained in detail in Section IV.2.5.

4 Location Of The Project

Afsin-Elbistan A Thermal Power Plant is located within the Kahramanmaras Province of Turkey. Location of AEATPP is 14 km far from Afsin District and 30 km from Elbistan District. The nearest settlement places to the AEATPP is Cogulhan Town, 500 meters away from the plant, and Alemdar Town that is about 1 km far from the plant.

AEATPP is located to the 2.5 km east of existing AEBTPP. Location of power plant is 154 km north of Kahramanmaras Province.

Project will affect primarily Cogulhan Town, Afsin District, and Kahramanmaras Province.

5 Baseline Environmental Characteristics of the Project Area

In this section the Baseline environmental characteristic data that were obtained as a result of literature and field surveys. The baseline environmental measurement results will be presented in the following sections.

5.1 Meteorological Characteristics

Afsin District is located at the intersection of Mediterranean, Central Anatolia and Eastern Anatolia. Although the terrestrial climate dominates, characteristics of these three regions could be observed in this region. Dry and arid weather dominates in the summer while cold and snowy weather dominates in the winter. Most of the rains are formed during spring and autumn.

5.2 Geology and Geomorphological Characteristics

There are no special geological and geomorphological features and no negative effect of the activity on the geology.

5.3 Surface and Ground waters
The Elbistan and Göksun plains are groundwater catchment areas around the project area. The direction of groundwater flow in the project area is from northwest and northeast to south towards Hurman Creek. The largest river in the project area is Hurman Creek.

5.4 Soil Characteristics

Soils of the region mainly composed of Alluvial, Colluvial, Brown and Red Brown Soils. Most of the soils have heavy, neutral, less alkaline structure and very rich in lime. Soil of the region has no problem in view of permeability and salinity.

Afşin District, where AEATPP is located, is approximately 41% agricultural fields, 39% meadow and pasture lands, 9% forest, 10% others and 1% residential areas.

AEATPP is located on, alluvial, colluvial and forest soil group and the capability class of the soil is Class I. Erosion degree is “less erosion”.

The soil of the region, where AEATPP is located, has very high lime content and alkaline structure. Therefore they have low acidification sensitivity.

The existing soil sample analysis and literature study shows that the soils of the region and agricultural areas have alkaline character. Therefore, soils of the region show the ability to neutralize SO2 deposition.

It is observed during the site surveys around the AEATPP that fly ash from the power plant deposits on the ground, especially in Çoğulhan Town, which is the nearest settlement to the power plant. During the public meeting, local farmers stated that the agricultural products have been affected by the dust emitted from the AEATPP.

Farmers of the region interviewed by EIA group experts indicated that there has been a difference in vegetable production compared to before and after commencement of power plant’s activity, also, drying of the plants was observed. In addition, most of the complaints were focused on settleable dust problem. These statements are based on farmers own opinions and observations. However, there is no scientific study or statistical data justifying complaints or observations.

5.5 Water Resources and Usage

The main water sources of Afşin and Elbistan Districts are Hurman stream, which is a branch of Ceyhan River, Göksun Stream and Mağara Gözu Stream. There has been irrigated agriculture in the plain side. Hurman stream, passing through the Afşin Plain, is the most important stream of Afşin District. Ceyhan River springs from the Pinarbaşı Locality, which is located in 3 km east of Elbistan.

The drinking water of Afşin District is supplied from Çobanpınarı Spring. This spring is 5 km west of Afşin District and 22 km far from AEATPP. Drinking and potable water source of Elbistan District is Ceyhan Spring that is southeast of the Elbistan District. The flow rate of the Ceyhan Spring is 5-7 m³/s. Based on information from Elbistan Municipality, existing water supply of the Municipality is 0.35 m³/s and the future demand will be about 0.6 m³/s. After second phase of the project, AEATPP will require 1.5 m³/s water. Therefore, water supply of the AEATPP will not have a drawback. The drinking water demands of Çoğulhan...
and Alemdar Towns are supplied by drinking water network that uses groundwater sources.

5.6 Flora and Fauna

The project area is located in the B6 square of Gridding System. "Flora of Turkey and East Aegean Islands" publication of Davis is the reference document for the detection of the flora species collected from the region. In addition, the field survey study has been supported by the review of same publication. Flora inventory prepared as a result of the land and literature study is given by EIA Report.

Fauna species around the Afsin-Elbistan A Thermal Power Plant and impact area are detailed in EIA Report. Family of each species, Turkish name, habitat, IUCN category, Red Data Book category and whether they are in Bern Convention Appendix-2 (fauna species strictly protected) or Appendix-3 (protected fauna species) lists are determined and given in related table. (-) sign indicates that the species are not given in Appendix-2 and Appendix-3 of Bern Agreement.

Furthermore, publication on official gazette dated 20 July 2005 and numbered 25881 by the Ministry of Environment and Forestry, General Directorate of Protection of Nature and National Parks, “2005-2006 Hunting Period Central Hunting Commission’s Decisions” Annex-1 (wild animals protected by Ministry of Environment and Forestry), Annex-2 (hunting animals protected by Central Hunting Commission), Annex-3 (hunting animals that are permitted to be hunted at specific times by Central Hunting Commission) lists are stated at the related tables.

During the field surveys it was monitored that because of the operation of the AETPP fauna species have already been moved to appropriate biotops since there were habitat losses occurred and the human activity around the power plant has been increased much. The surrounding of the power plant does not constitute a special living and breeding habitat for the fauna species. In addition, since the existing power plant is very close to residential areas, no significant faunal activities were observed. Planned project will not have an effect of additional habitat loss for the fauna species. By the rehabilitation of power plant, the ambient air quality will be improved with respect to dust and that would have a positive affect on the terrestrial fauna.

5.7 Lignite Sources

Afsin-Elbistan lignite reserve located in Kahramanmaras covers an area of almost 100 km² in Afsin and Elbistan Districts. This region has proven ore deposits of 3.4 billion tones. Reserve is on the economical open mining facility, considering the 3/1 m³/ton decopage/coal ratio about 1.7 billion tons of this total reserve have operatable capacity. The reserve under consideration is used as three sectors named Çöllolar, Kışlaköy and Afsin şectors. The coal has been used in Afsin-Elbistan Thermal Power Plants.

6 Baseline Environmental Studies Conducted in the Region
Site surveys have been conducted to determine existing baseline environmental conditions for Afşin-Elbistan A Thermal Power Plant Rehabilitation Project area and its close vicinity between 2nd of February and 5th of April 2005. These environmental surveys covered the noise measurements, surface and groundwater sampling, air quality survey and soil pollution sampling.

The scope of the work conducted in this region is the determination of the existing pollution level of the area. The air quality monitoring was conducted during two 60 day periods for a total duration of approximately four months while the other sampling and monitoring works were only conducted once. In addition to those studies there were no other previous baseline studies conducted in the region. Therefore, there were no previous data showing the environmental situation of the region before the power plant was put into operation and hence it is not possible to compare the existing situation with the previous one, so that the exact level of impact of the power plant on the environmental conditions of the area could not be determined. The findings of the analysis could only be compared and discussed with the regulations and with each other.

6.1 Noise Measurements

Noise survey was conducted between 4th and 13th of February 2005. Purpose of the survey is to collect the baseline data regarding the background noise levels in the vicinity of the Afşin-Elbistan A Thermal Power Plant. For this purpose 12 hours continuous noise measurements were conducted at totally 7 points.

Baseline noise measurement results were compared with the World Bank standards and standards stated in Turkish Regulation on Assessment and Management of Environmental Noise.

The $L_{eq}$ values measured around the Afşin Elbistan A Thermal Power Plant were in compliance with the maximum allowable values given by Turkish Regulation on Assessment and Management of Environmental Noise and the World Bank Limits.

6.2 Surface and Groundwater Sampling Studies

Water samples were taken from groundwater wells and surface water to determine the baseline physical and chemical characteristics of the water resources of the Project site within the context of surface and groundwater quality survey on 15th of February 2005.

Surface and ground water samples were taken around the Afşin-Elbistan A Thermal Power Plant at totally 6 points which are expected to be affected from project activities. Two of the wells were selected around the ash deposit area to determine the characteristics of the groundwater according to the parameters stated at "Regulation on Hazardous Waste" Annex11-A Table.

Samples were analyzed to determine the water classification for pH, DO, Conductivity, TDS, Total Hardness, COD, BOD, NO₃, NO₂⁻N, F, Cl, CN, Zn, Cu, Fe, SO₄, PO₄-P, Mg, As. Samples taken from ash deposit area were also analyzed according to the parameters stated at the Table of Regulation on Hazardous Waste Control Regulation Annex11-A. Quality of the water resources is determined in compliance with the Regulation on Water.
Pollution Control. Most of the parameters for the surface and groundwater samples show Class 1 and 2 properties. According to the Regulation, Class 1 is the highest quality water and the Class 2 is the slightly polluted water that are both explained in Section 3.2.9.2 of EIA Report.

The water samples taken at two boreholes in the ash deposit area were analyzed according to the Regulation on Turkish Hazardous Waste Control Annex 11A. Parameters analyzed in groundwater samples taken from the ash deposit area are below the limit values of hazardous waste. So that the existing facilities does not have a negative influence on the existing water quality of the surrounding water sources.

6.3 Baseline Soil Contamination Survey

Baseline soil contamination survey was conducted in February 2005. The focus of this survey was the collection and subsequent analysis of the soil samples from the thermal power plant and its surrounding to determine the baseline soil conditions. Totally 10 soil samples were taken for the soil efficiency analysis (texture, salinity, pH, lime, phosphorus, potassium, organic matter), cation exchange capacity and chemical analysis (TOC, Total Nitrogen). 2 of the soil samples were taken from the ash deposit area to be analyzed according to the parameters stated at Regulation on Hazardous Waste Control Annex 11A.

6.4 Baseline Air Quality Survey

Baseline air quality measurements were conducted for Afsin-Elbistan A Thermal Power Plant rehabilitation area and its close vicinity between 2nd of February and 5th of April 2005 and between 18th of May and 17th of July 2005 to establish current levels of air quality and to calibrate the air quality model that would subsequently be used to estimate the change of air quality due to the activities for the Afsin-Elbistan A Thermal Power Plant Rehabilitation Project. Measurements were conducted at 10 locations. 2 measurements were performed at the dominant wind directions on the nearest sensitive receptors to the Afsin-Elbistan A Thermal Power Plant along the long term dominant wind directions, and remaining 8 measurements were conducted at locations in project impact area as specified in Turkish Regulation on Industrial Air Pollution Control (Item 40 a-1). During each monitoring period, at each location, three samples were taken, each representing a twenty day average.

The overall measurement results for 120 days were compared with the long term (LT) limit values stated in the Regulation on Air Quality Protection article 6. The definition of ST limit value is stated in the regulation as the value that should not be exceeded by the 95% of all the measurement results of the daily average values. Since only twenty day averages were available with the diffusion tube measurements, the ST or daily average values were estimated by air quality modeling. The ISCST3 model developed by the USEPA and which has been adopted as the international standard for multiple point sources modeling of air quality impacts from tall stack emissions was used to estimate ST values of air.
quality parameters (dust, SO₂, and NOₓ). The definition of LT is stated in the regulation as the value that should not be exceeded by the arithmetical average of all measurement results. The ST limit values stated in the regulation are the daily average values that should not be exceeded 95 per cent of the year.

The pollutants that were the focus of this air quality survey are PM₁₀, HF, HCl, NOₓ and SO₂. Fractions of the suspended particulate matters with aerodynamic diameters less than 10 micrometers (PM₁₀) are of main concern because of their strong correlation with human health effects. In this survey, existing ambient PM₁₀ levels were surveyed at ten sampling points in the vicinity of the existing Afsīn-Elbistan A Thermal Power Plant. On the other hand settleable particulate matter having higher aerodynamic diameters, have importance for visual nuisance and plant life since these particulates cover the leaves of the plants and inhibits the photosynthesis.

Particulate matter (PM), NOₓ and SO₂ are three of the primary air pollutants of combustion. Therefore at ten sampling points in the vicinity of the existing Afsīn-Elbistan A Thermal Power Plant site also were selected for NOₓ and SO₂ analysis. The passive diffusion tubes were used for these pollutants. Ten sampling points in the vicinity of the existing Afsīn-Elbistan A Thermal Power Plant site were also selected for HF and HCl analysis.

The PM₁₀ measurement period was continuous at each location for 6 days.

In addition the existence of particulate matter problem around Afsīn-Elbistan A Thermal Power Plant is obvious with the field observations. The particulate matter is classified as settleable (large particulates) and PM₁₀. In this project usually settleable large particulate problem is significant which is also supported by the field observations. The public complaints about the particulate problem is also very much. The settleable dust problem should be solved by the installation of appropriate control mechanisms such as ESPs. The measurements were based on the measurement of PM₁₀ since it has a health hazard risk. This measurement results should be accepted as a reference for future.

Measured nitrogen oxide concentrations were below the long term limit values.

SO₂ was first measured at 10 sampling points around Afsīn-Elbistan A Thermal Power Plant between 2nd of February and 5th of April 2005. Second phase SO₂ measurement was conducted at the same sampling points around Afsīn-Elbistan A Thermal Power Plant between 18th of May and 17th of July 2005. Slight decrease was observed in SO₂ concentrations during the last period measurements. Afsīn Elbistan A Thermal Power Plant was not operated between 3rd and 13th of July 2005 according to the capacity report which may explain the difference.

As a result of the analysis conducted, the results of the ambient SO₂ measurements indicate that the Afsin-Elbistan A Thermal Power Plant as it currently operates (at reduced capacity) and after it will be rehabilitated and operated at full capacity are in compliance with the Turkish ST and LT air quality standards. First phase air quality measurements conducted during the winter period (February, March and early April), second phase air quality measurements conducted during spring-summer period (May, June and July) and
the results of continuous SO$_2$ measurement station of EUAŞ reflecting reduced capacity operation of the plant show that both the short term and long term SO$_2$ concentrations are in compliance with the regulation. Furthermore, the modeling results for the plant operating at full capacity after rehabilitation will also be in compliance with Turkish air quality regulations.
Construction Period Environmental Impacts and the Mitigation Measures Emissions

The rehabilitation project (first phase) will involve removal and/or replacement of obsolete plant components. Land preparation, excavation and construction works will be involved for the second phase of the project for the foundation of FGD unit. The material excavated during land preparation will be used as fill material and the excess material will be carried to internal storage area by the trucks.

The main source of emissions to the atmosphere during construction is dust. Emissions during the construction of a building can be associated with land clearing, drilling and blasting, ground excavation, cut and fill operations and construction of a particular facility itself. Dust emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A large portion of the emissions can also result from equipment traffic over temporary roads at the construction site.

Potential impacts associated with dust emissions during the land preparation and the construction phase will be minimized by the following mitigation methods;

- Stockpiles of material will be done in such a manner so as not expose them to wind by covering them with suitable sheet material.
- The access road will be water sprinkled to prevent dust formation.
- Particular attention will be paid to dust suppression on the working width or at construction sites when working within dry weather conditions.
- Vehicles delivering dusty construction materials to the site or removing spoil will be limited at speed and covered.

The excavation works during construction of the project will be conducted in accordance with "Regulation on Excavation Soil, Construction and Ruins Control" published by 18.03.2004 dated and 25406 numbered Official Gazette.

Total emission amount from the working machines were calculated and the emission value is below the 1.5 kg/h limit value stated by Article 40 of Regulation on Industrial Air Pollution Control. The vehicles will regularly be maintained and the vehicles will not be left running unless needed.

6.5 Water and Wastewater

During the construction works of the project, water will be consumed for domestic purposes and water spraying for dust prevention. Water demand of the AEATPP is currently supplied from Ceyhan River Spring. During the rehabilitation of AEATPP and the construction of FGD unit, required water will also be supplied from the same source.

During the construction activities at the first and second phase of the project, the chief source of wastewater will be from domestic wastewater of the workers. The wastewater produced will be conveyed to existing domestic wastewater treatment plant of the power plant. The capacity of the treatment plant will meet the wastewater load of the personnel
during construction phase as the plant was designed for operation phase of the power plant.

6.6 Solid Wastes

Solid wastes generated during the construction activities will include domestic solid wastes from the personnel, medical wastes, and oily wastes, hazardous wastes such as used batteries, bitumen, cables, copper, fire-fighting foam, adhesives, general chemicals, acids, oil rags and absorbents, solvents, contaminated soils, insulation, paint sludge, used oil and paint cans and drums etc. and package wastes.

Domestic wastes will be collected at black bags separated from medical, hazardous dangerous and package wastes. Separately collected domestic wastes will be transported to temporary waste storage center or container by special vehicles and they will be stored separately. Domestic wastes will not be mixed with any hazardous waste and/or medical waste during the collection.

All operations related with storage, transportation and disposal of domestic solid wastes will be carried out in accordance with “Regulation on Solid Waste Control” published on 14.03.1991 dated and 20814 numbered Official Gazette.

For the existing situation, solid wastes of AEATPP are taken by private firm for disposal. Solid wastes produced during the construction works will also be disposed by the same company.

Waste collection containers will be located in the project area. Recyclable wastes (paper, plastic etc.) and irreversible organic wastes (food wastes) will be stored in different closed containers.

Paper, cardboards, plastics and metal package wastes will be segregated according to their type and collected by blue bags. Collection, transportation, storage and disposal of package wastes will be in accordance with Regulation on Package and Packaging Wastes issued on 30.07.2004 dated and 25538 numbered Official Gazette.

If any hazardous waste including heavy metals and chemical wastes is formed during the construction phase, storage and disposal of these wastes will be conducted in compliance with Regulation on Hazardous Control Regulation issued on 14.03.2005 dated and 25755 numbered Official Gazette.

Regulation on Waste Batteries and Accumulators Control came into force by 31.08.2004 dated and 25569 numbered Official Gazette will be complied.

The medical wastes produced at the medical center of the power plant will be collected at red bags and containers and they will be disposed in compliance with Regulation on Medical Waste Control.

Waste oil will be disposed in compliance with Regulation on Waste Oil Control came into force by 21.01.2004 dated and 25353 numbered Official Gazette.
6.7 Noise

During the construction of both phases of the project noise is expected from trucks, dozer, mixer, excavator, compressor, and grader. The potential for noise will be minimized by restricting construction works to those hours permitted by the relevant working hours.

The noises from the vehicles used for the construction will not exceed the standard noise levels and the limits of Regulation on Assessment and Management of Environmental Noise will be met.

According to the calculations, noise level is below 70 dBA at 150 m distance from the construction site. Nearest residential area is located 600 m far away from the AEATPP location therefore noise levels would not expected to be excessive to have negative impact on the community.

The Contractor will supply the personnel protective equipment such as ear guards.

Personnel employed for the construction works will be accommodated in the existing guesthouse of the power plant, Çoğulhan Town and/or houses in the Afspın District. Therefore whole technical/social infrastructure needs of the personnel working for the construction activities will be supplied from AEATPP, Çoğulhan Town and/or Afspın District.

6.8 Health and Safety

During the construction phase of the project, the risks posed to human health are possible industrial accidents resulting from the construction works requiring use of heavy construction equipment.

In order to minimize these risks,

- Qualified personnel will be employed for the construction equipments and all personnel will be trained for health and safety issues,
- Working shift of workers for construction activities will be limited,
- Personnel protection equipment such as eyeglasses, gloves, hard heads and safety belts will be supplied,
- Personnel will be monitored to assure they use protection equipment.
- Continuous health center will be established on project area and health centre and health staff will be ready for the incidents on site,
- The measures will be taken for fire fighting.

Work Health and Safety Regulation came into force by 09.12.2003 date and 25311 numbered Official Gazette and Worker Health and Worker Safety Rule will be complied.
7 Environmental Impacts during Operation Phase of the Project and Necessary Mitigation Measures

7.1 Water Consumption

All of the water required for process (feed water, cooling water and domestic water) demand of AEATPP is supplied from Ceyhan Spring in Elbistan. Water is pumped to the power plant by four pumps each has 1800 m³/h capacity and two steel pipelines have been used for this purpose. Each line has 1 meter diameter and 30 km length. Incoming water is demineralized before it is used in the process.

Maximum water consumption of the AEATPP is about 4300 t/h. Raw water line currently feeding the AEATPP has a capacity of 7200 m³/h and the current maximum demand of AEATPP is 4300 t/h. When the FGD is retrofitted at AEATPP it will require 1000 t/h water supply. Therefore, the current source, namely Ceyhan Spring is enough for both the water demand of process and FGD of AEATPP.

7.2 Wastewater

In AEATPP, some of the wastewater is reused and some part is discharged. The wastewater to be discharged is treated at sewage or ash water treatment plants and then discharged to Çogulhan River in compliance with discharge standards.

7.3 Air Quality Impacts and Air Quality Dispersion Modeling

The stack gas emission report of TUBITAK-MAM prepared at the year 2000, for SO₂ and PM concentrations of the power plant were used to estimate the source strength.

The calculations are carried out with a US-EPA regulatory model ISCST3 that is a well known model and is the standard for most international studies. It is a satisfactory model for dispersion calculations. The model is especially designed for tall stacks.

For the purpose of this project the short term version has been applied, since hour-by-hour meteorology data is available and it is generally recognized that detailed modeling with hour-by-hour meteorology will result in more precise calculations. It is especially suitable for the Afsin-Elbistan A Thermal Power Plant. The model accepts hourly meteorological data records to define the conditions for plume rise, transport, diffusion, and deposition. The model estimates the concentration or deposition value for each source and receptor combination for each hour of input meteorology, and calculates both yearly averaged and short term (daily) averages.

For the dispersion of the emissions from power plant, modeling was applied for both the existing situation of the power plant and 3 different scenarios. First case is according to the existing situation of power plant, second case is the no FGD and PM emissions are limited to 100 mg/Nm³ by ESPs, Third case is the FGD option and 100 mg/ Nm³ PM concentration, the fourth case is FGD option an 50 mg/Nm³ PM concentration is limited by ESP. For each case, the contribution of AEBTPP was also taken into account.

Dispersion calculations are carried out, using the following elements:
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- emission data,
- surface parameters,
- meteorological data, and
- dispersion model.

Hourly observations of three years data were used to calculate the daily and annual average concentrations for existing and future situation around power plant.

7.3.1 Modeling Results for Existing Situation

7.3.1.1. SO₂

In all situations the contributions of all components have been calculated. To these concentrations contributing to the background concentration should be accounted. In the existing situation, the maximum yearly concentration is 65 µg/Nm³ and at 1 km north of the power plant. In the middle of Coğulhan the yearly contribution is about 40 µg/m³. This is lower than the long term Turkish limit values of 150µg/Nm³. The highest daily value is 1214 µg/Nm³. However, over 95 per cent of the calculated SO₂ values calculated for the year were within the limit value of 400 µg/Nm³. Therefore the modeling indicates that the current plant operation is in full compliance with the Turkish air quality standard for short term limits. This was further verified by continuous measurement results for ambient air quality that was available in the area which also demonstrated compliance with the ST air quality standard for SO₂.

7.3.1.2. NOx

The maximum annual average concentration is 11.7 µg/Nm³ at 1 km north of the plant. In Coğulhan the yearly average contribution is about 8 µg/Nm³. The highest daily value lies 1km west-southwest of the plant with a value of 236 µg/Nm³. All values are below the Turkish limit values.

7.3.1.3. Dust

The maximum yearly concentration is 119 µg/Nm³ at 750 m north of the power plant. In the middle of Coğulhan the yearly contribution is about 80 µg/Nm³. This is lower than the long term Turkish limit values of 150 µg/Nm³. The highest daily value is 2427 µg/Nm³.

7.3.2 Comparison between Measured and Calculated with Modeling of SO₂ Values throughout the Winter and Summer Period

Measured and calculated ground level concentrations by the air quality dispersion model reflect SO₂ and PM₁₀ levels that are in compliance with the Turkish regulation.

Measurement points and average measured concentrations are stated in the EIA Report. Measured data (winter period) is compared with modeling value. The measured values compare very well with the model results except for the measuring points HK 5, HK 7 and HK 10. In the comparison that 7 out of 10 measuring points are in the same magnitude indicates that the model is calculating in the right order.

Average concentrations are getting less of the three measuring period when comparing with measured value and modeled value during the summer period. Measured and
modeled values for the points HK 2, HK 4, HK 8, HK 9 and HK 10 are quite compatible. HK1 is placed in a hilly region, where the accuracy in the calculation is low.

The highest measured value is 49.7 μg/m³ in HK 1, near the village Alemdar. This is below the Turkish long term SO₂ limit values of 150 μg/Nm³.

7.3.3 Rehabilitation Scenarios

7.3.3.1. Base scenario

The base scenario is the rehabilitation of the power plant without FGD. ESPs will be installed in this option. All of the stacks of the power plant will operate, the dust emission will be reduced to 100mg/Nm³. Ambient dust and SO₂ levels will be in compliance with the ST and LT limits of the regulation.

7.3.3.2. Alternative 1 with FGD

In this scenario a FGD is installed and will reduce the SO₂ emission concentration to 1000mg/Nm³. The dust emission will be reduced to 100mg/Nm³. All ST and LT levels of PM₁₀ and SO₂ comply with Turkish air quality limits.

7.3.3.3. Alternative 2 with FGD

In this scenario a FGD is installed and will reduce the SO₂ emission concentration to 1000mg/Nm³. The dust emission concentration will be reduced to 50mg/Nm³. In this alternative there is no difference in the local SO₂ contribution. The local dust contribution concentration will be reduced by a factor of two.

7.3.4 Dispersion Calculations

Using the ISCST3 model, the dispersion calculations are carried out for SO₂, PM₁₀ and NOₓ.

For PM₁₀, NOₓ and SO₂ there are both long term and short term averaged limit values are given in Turkish Regulation to be checked. Long term average values calculated by the model are average concentrations calculated over separate atmospheric classes and averaged over at least one year. Since the one year period is not representative, 3 years period is used in modeling studies. Considering the average of 3 years concentrations, it will be the most representative value for future.

As a result of the modeling scenarios, it was determined that without an FGD, after the rehabilitation, operation of the Afsin-Elbistan A Thermal Power Plant would comply with Turkish ambient air quality regulations.

7.4 Ash and Gypsum Disposal

Ash and slag produced by combustion in the power plant have been carried by ash transportation system. Ash is first removed by the ESPs and then it is conveyed to mining area by ash conveyors and buried there by filling the empty area caused by the coal extraction.

The ashes of AEATPP were analyzed according to parameters of Regulation on Hazardous Waste Control Annex 11-A and it was observed that ash is not in the hazardous waste classification stated in the regulation in force.
At the second phase of the project, the gypsum from FGD unit will be mixed with ash and then the mixture will be conveyed to the disposal at the mining area. Amount of gypsum produced will be about 5,750 millions ton per year including sludge and ash. The water amount in the gypsum will supply the moisture needs of the mixture to be conveyed. The disposal of the mixture will be the same as the method stated above. Recycling of the gypsum is not possible in this region. Ash and gypsum mixture will be disposed at the mining area. Gypsum and waste ash from the power plant will be watered to prevent blowing.

The ashes of existing AEATPP were analyzed by Middle East Technical University Environmental Engineering Department according to parameters of Regulation on Hazardous Waste Control Annex 11-A and the results are presented in the report of "Research Project of Middle East Technical University on Storage of Thermal Power Plants Ashes of TEAS According to the Regulation on Hazardous Waste Control (Project Code No: 98.03.11.28)". The results were compared with the Regulation on Hazardous Waste Control Annex 11-A and all parameters between the limit values and or in the defined range, therefore the ashes can be land filled.

The cover of the disposal site will be afforested as current condition.

### 7.5 Other Solid Wastes

Disposal of sludge produced from wastewater treatment plant of power plant will be carried out according to the Regulation on Solid Waste Control and regulation on Soil Pollution Control dated 31.05.2005.

Domestic solid wastes will also be produced during the operation period of the AEATPP. Existing domestic waste production rate of power plant is 146.000 kg per year. Solid wastes are collected by a private firm and they are disposed. After the first and second phases of the project, same procedure will continue, no change in the amount of solid waste is expected and the disposal method will remain the same if no additional employment will be necessary.

### 7.6 Noise

Noise originates from workplace sites with high-powered equipment such as the steam turbine, generator, and substations. The noise from these sources may exceed 85 decibel acoustic (dBA) in the production area. The personnel working at these places should use ear protection equipment. The impact of noise will be negligible beyond 500 m from the site.

### 7.7 Soil Acidification

General sensitivity classification of soil properties shows that soil samples of the project area are not sensitive to acid deposition. Furthermore, sensitivity to alkaline cation loss, sensivity to dissolved "AI" and general sensivity is "L" Category (low sensivity).
In conclusion, the project will not expected to have a negative impact on regional soil quality.

### 7.8 Impacts of the Project on Existing Agricultural Areas and Agricultural Products

The negative physical and chemical impacts on the soil and agricultural products should be prevented. Within the scope of the first phase, rehabilitation project, of AEATPP, the electrofilters will be rehabilitated and ash will not be discharged on the soil and agricultural areas.

In addition to that, at the second phase of the project FGD unit will be installed and the FGD retrofit will decrease the ground level concentration of $SO_2$ emissions below the limits of the Turkish Regulation.

### 7.9 Impacts on Groundwater and Surface Water and Mitigation Measures

Both sewage and ash water treatment plant will be in use during the operation of the AEATPP. Therefore there will not be any discharge from the plant to the receiving water bodies without treatment. Discharge parameters will be in compliance with the limits of Water Pollution Control Regulation published on Official Gazette dated 31st of December 2004 and numbered 25687.

At the second phase of the project, gypsum produced at the FGD unit will be disposed by discharging into the mining area where lignite is recovered completely. Low solubility of ash and gypsum decreases the pollution risk. Dissolution and negative effect on groundwater is not expected. Since the gypsum sludge is alkaline it tends to immobilize heavy metals, preventing their leaching and subsequent migration to groundwaters.

Groundwater quality around the AEATPP will be monitored regularly during the operation of the project.

### 7.10 Occupational Health and Safety

One of the expected health effects of the existing plant is the air pollution level resulting from the power plant. Results of stack gas measurements conducted by TÜBİTAK MAM in 2000 show that dust and $SO_2$ emissions exceeds the limits of Regulation on Air Pollution Control due to the failure ESP and lack of FGD unit. Therefore EUAS has planned the rehabilitation of AEATPP and FGD retrofit.

Emissions will be under the limits of the Regulation on Industrial Air Pollution Control currently in use.

Industrial accidents may be another risk that is normally seen at all industrial plants. Personnel will be trained on Occupational Health and Safety Rules in order to guarantee safety at plant. Details are given by EMP in the Annex 1A of the EIA report.

Waste management will properly be applied in the plant. All wastes will be collected and disposed in accordance with Regulation on Water Pollution Control, Regulation on
Industrial Air Pollution Control, Regulation on Hazardous Wastes Control and Regulation on Hazardous Chemicals.

Medical wastes produced from medical center of power plant will be disposed in compliance with the Regulation on Medical Waste Control published by Official Gazette dated 20.05.1993 and numbered 21586.

Fire fighting system will always be present, tested and in service in the plant.

8 **Environmental Management Plant (EMP)**

An Environmental Management Plan reflecting the main environmental issues to be addressed in both Phase I (Rehabilitation) and Phase II (FGD installation) of the program has been prepared.

EMP establishes a framework for the identification of environmental protection, mitigation, monitoring measures to be taken during both construction and operation phase of the project. EMP consists of mainly seven chapters, as Project Description, Mitigation Plan, Monitoring Plan, Institutional Strengthening, Schedule, Institutional Arrangements, and Public Consultation.

EMP clearly indicates the environmental monitoring to be applied during the both first and second phases of the project.

9 **Public Meetings and Disclosure**

Public meeting for the project was held in Çoğulhan Town, which is the nearest settlement to AEATPP, in 17th of March 2005. Participants of the meeting were local people, Mayors of Çoğulhan Town, Afsin District, Elbistan District, NGOs from Kahramanmaraş, authorities from A and B Power Plants, media, Regional Chamber of Agriculture representatives, representatives of Ministry of Environment and Forest, representatives of Kahramanmaraş Provincial Directorate of Environment and Forest, representatives from General Directorate of EUAŞ, and representatives of EIA Consultants, Çinar Engineering. Date of the meeting was determined by the Ministry of Environment and Forestry. Place of the meeting was determined by Kahramanmaraş Provincial Organization of Environment and Forestry.

Public meeting was announced to the people by the following methods ten days before the meeting:

- Announcement in a national gazette,
- Announcement in the local gazette in Afsin and Elbistan Districts,
- Announcement on website of Çınar Engineering (www.cinarmuhendislik.com),
- Announcement at Afsin, Elbistan Districts Municipalities,
- Announcement at the Provincial Organization of Kahramanmaraş Environment and Forestry for informing their official directorates, NGOs and media,
Announcement of the public directly from the office of ÇINAR rented in Çoğulhan for a duration of one month and the public opinion on the project were obtained by written complaints at this office.

Distribution of brochures before meeting.

During the meeting a power point presentation was given to the public for explanation of the phases of the project and existing situation with photographs.

The complaints of the public on the existing emissions from the plant, was especially focused on dust deposition. Health problem and damage on agricultural products are also mentioned by the participants and local residents. Another subject they mentioned is the employment. Recruitment at the both AEATPP and AEBTPP is their common request.

The draft EIA report was made available for the public and NGOs at the Municipalities of Çoğulhan Town, Afşin and Elbistan Districts, Kahramanmaraş Provincial Directorate of Environment and Forestry , Management offices of AEATPP and AEBTPP and the contact office of ÇINAR in Çoğulhan. Availability of draft EIA report for review of interested parties for duration of 15 days starting from the 15th of August 2005 was announced by Kahramanmaraş Provincial Directorate of Environment and Forestry and local newspapers. Both Turkish and English summary of the EIA Report was also announced to people at the web site of Çınar Mühendislik Müşavirlik ve Proje Hizmetleri Ltd.Şti. (www.cinarmuhendislik.com).

The comments of the public and NGO's on the draft EIA and their statements at public meeting were incorporated in the EIA Report. A general complaint of the public is the air pollutant emissions of the existing power plant. People believe that the rehabilitation project and FGD installation project on the second stage will decrease the emissions from the power plant and they present their thanks to EÜAŞ.

The copies of EIA Report were distributed to the official institutions after the EIA Report was accepted by the Ministry of Environment and Forestry as a final document.

10 Impacts of the Project on Socio-Economic Environment and Environmental Cost Benefit Analysis

As it is stated in the report, the failures caused decrease in the production capacity of the AEATPP. Its production is very low compared to its design capacity. The rehabilitation is inevitable because AEATPP has very important role in the economical use of the lignite reserves and reverse as energy in Afşin-Elbistan Region and this power plant is the first power plant of the region. The rehabilitation will decrease the production cost.

Environmental performance of the existing power plant has also been decreased due to the failures in the plant especially on ESPs. PM and SO2 emissions of the power plant exceeds the limit values of Regulation on Industrial Air Pollution Control. By this project, ESP rehabilitation and FGD retrofit will provide lower emissions; SO2 and PM concentrations will decrease the emission limit values of the regulation. Therefore,
negative impacts on human health, agricultural products and other living organisms will be minimized.

11 Project Alternatives

Rehabilitation of the existing power plant on the first phase and construction of FGD unit on the second phase has no other alternative.

At the second phase, the most appropriate areas will be preferred for the location of FGD unit and its buildings. From the technological point of view, the planned system for the FGD, is wet-limestone process which is the most efficient system.

12 Conclusion

Main goals of the Project are to improve reliability and efficiency of the AEATPP and extend the life of the plant and to decrease emissions of the plant below the limits of Regulation on Industrial Air Pollution Control and to decrease the negative impacts on environment. Therefore the project aims to decrease the negative impacts of the project on the environment.

Rehabilitation of AEATPP at the first phase and installation of FGD unit at the second phase will guarantee reliability and efficiency of the plant, it will also extend the life of the plant and it will increase environmental performance of the plant which is one of the most important power plants of Turkey.