

REPUBLIC of TURKEY
MINISTRY of ENVIRONMENT

UNI-MAR ENERJİ YATIRIMLARI A.Ş.
MARMARA EREĞLİSİ NATURAL GAS COMBINED CYCLE
B.O.T. POWER PLANT

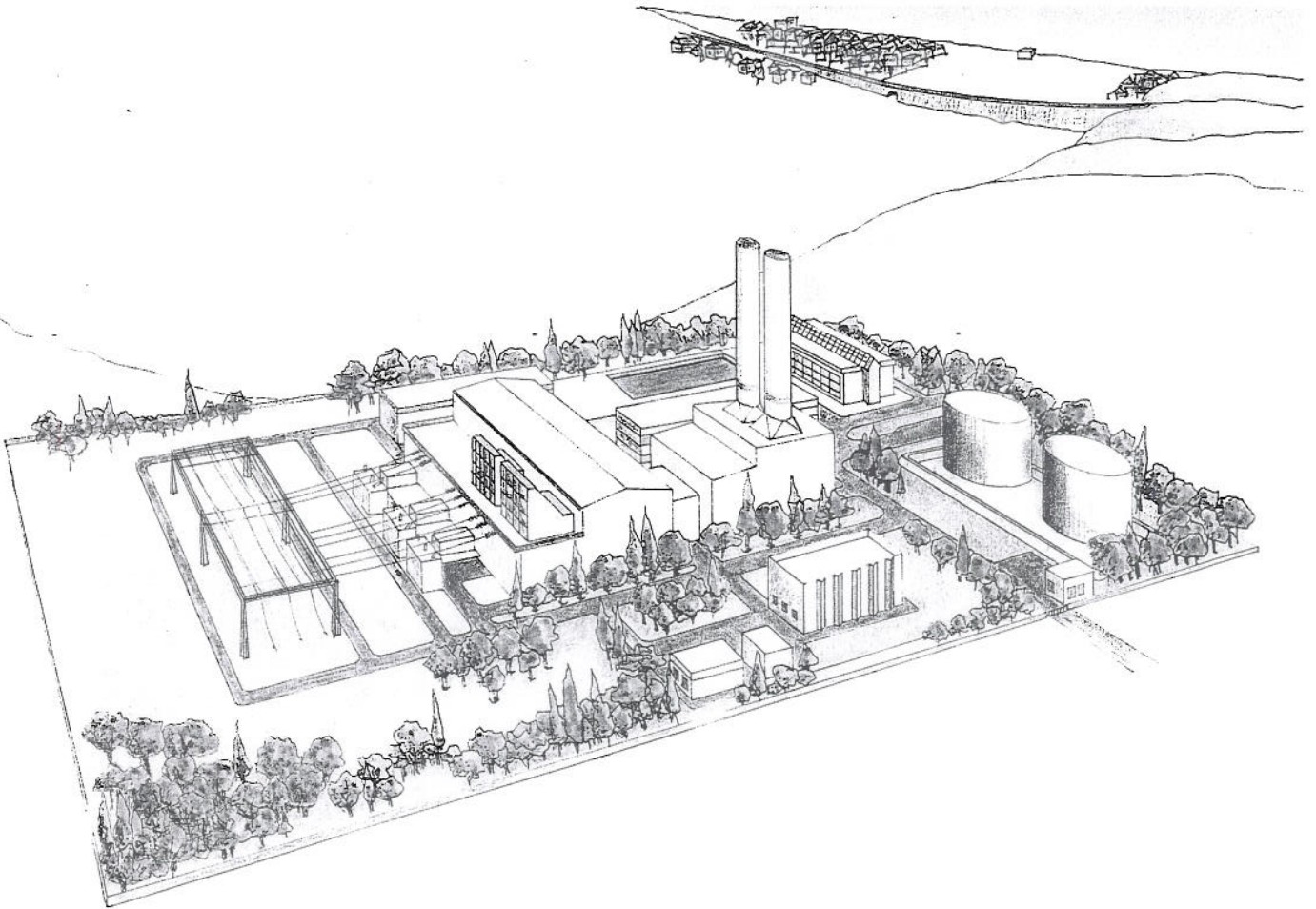
ENVIRONMENTAL IMPACT ASSESSMENT
FINAL REPORT

İSTANBUL TECHNICAL UNIVERSITY
FACULTY OF CIVIL ENGINEERING, DEPARTMENT OF
ENVIRONMENTAL ENGINEERING
İSTANBUL, AUGUST 1994

REPUBLIC of TURKEY
MINISTRY of ENVIRONMENT

UNI-MAR ENERJİ YATIRIMLARI A.Ş.
MARMARA EREĞLİSİ NATURAL GAS COMBINED CYCLE
B.O.T. POWER PLANT

ENVIRONMENTAL IMPACT ASSESSMENT
FINAL REPORT



İSTANBUL TECHNICAL UNIVERSITY
FACULTY OF CIVIL ENGINEERING, DEPARTMENT OF
ENVIRONMENTAL ENGINEERING
İSTANBUL, AUGUST 1994

**REPUBLIC of TURKEY
MINISTRY of ENVIRONMENT**

**UNI-MAR ENERJİ YATIRIMLARI A.Ş.
MARMARA EREĞLİSİ NATURAL GAS COMBINED CYCLE
B.O.T. POWER PLANT**

**ENVIRONMENTAL IMPACT ASSESSMENT
FINAL REPORT**

Project Owner :

UNIT INTERNATIONAL S.A.
AVENUE LOUISE 240 - 1050 Brussels
Tel : 32/2/511 81 42 (5 line)
Fax : 32/2/511 98 82
for
UNI-MAR ENERJİ YATIRIMLARI A.Ş.
Marmara Ereğlisi / Turkey

Prepared by :

İSTANBUL TECHNICAL UNIVERSITY
Faculty of Civil Engineering
Department of Environmental Eng.,
80626 Ayazağa-İstanbul/Turkey
Tel :0212/285 37 85 - 285 37 94
Fax :0212/285 37 76

Project Title :

**UNI-MAR MARMARA EREĞLİSİ NATURAL GAS
COMBINED CYCLE B.O.T. POWER PLANT**

Project Location :

Sultanköy/Marmara Ereğlisi of Tekirdağ Province/Turkey
Date : August, 1994

ABSTRACT

The growth of population and industrialization during recent years has resulted in a rapid increase in the energy demand of Turkey. The energy consumption is 1100 kWh/cap. day. This is half the value of the global average and one fifth of the European Community average. Taking into consideration the population growth, industrialization and elevation of living standards, it is expected that the energy demand in the year 2010 will be 450 billion kWh. Therefore, in 15-20 years time, 5 times the current capacity will be needed. This demand can be met using thermal and hydraulic power, nuclear energy, hydrogen energy, solar energy and wind energy. Due to the substantial negative environmental impacts associated with coal power plants, the long construction periods and high investment costs for hydro electrical power plants, the considerable reaction of the public to nuclear energy the high investment and operation costs of hydrogen energy, and the view that solar and wind energy are inefficient in the current economical conditions, natural gas fired power plants are considered favorable.

The Turkish government has enacted the required legislation to allow the private section to take part in power production to help meet the demand for energy supply in Turkey. The 480MW Natural Gas Combined Cycle Power Plant to be realized under Build-Operate-Transfer model by UNI-MAR Enerji Yatırımları A.Ş. is proposed in the line with the provisions of Law 3096 which permits private sector companies to construct and operate power plants.

The major project documents : Implementation Agreement, Gas Sales Agreement, Energy Sales Agreement and Fund Payment Agreement have been negotiated and concluded during the course of 1993 with the Ministry of Energy and Natural Resources (MENR), the Turkish Gas and Petroleum Pipeline Company (BOTAŞ), the Turkish Electricity Authority (TEK), and the Electrical Energy Fund (EEF).

The Project will be realized in Marmara Ereglisi, in the vicinity of the BOTAŞ LNG Terminal.

This report is prepared according to the format in the "Environmental Impact Assessment Regulation" published on 7 February 1993 in Official Gazette No 21489. In the Report, the Project is described, the aim is clarified, the site location is explained and economical and social dimensions of the Project are evaluated. The current status and the existing statistical data on the Project Site and vicinity were evaluated and, when necessary, complementary surveys, investigations and measurements were carried out at the project site to obtain more information on the environmental characteristics. The impacts of the Project on the environment, precautions that should be taken during construction and operation, and the consequence of either closing the Plant at the end of the operating period or continuing its operation thereafter are evaluated and necessary measures are proposed.

LEGAL FRAMEWORK AND THE APPROVAL PROCEDURE OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT

Environmental Impact Assessment Regulation which was published in Official Gazette No 21489 dated 7 February 1993 is based on Environmental Law No 2872, Article 10. This regulation includes the format and the approval procedure of the EIA report. Thermal power plants with generation capacity above 300MW are subject to EIA report according to Appendix I (paragraph 2a) of the Regulation. The proposed power plant is further considered in the frame of Appendix II (paragraph 4):

This EIA report is prepared in accordance with above mentioned legislation. The format of the report is taken from Appendix V of the Regulation which is identical with the one issued to the Owners by the Ministry of Environment letter No B. 19.0.CED.012 00 02/00496 7489 dated 01/11/1993.

EIA report approval procedure diagram and a list of Laws, Regulations, Communiqués and official documents which are referred in this EIA report is given in Annex A.

CONTENTS

ABSTRACT

EIA LEGAL FRAMEWORK AND APPROVAL SCHEDULE

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXES

CHAPTER I The definition and the aim of the Project

CHAPTER II The Location of the place selected for the Project

II.1. Selection of the activity location II.1

II.2. Location of the Project activity units II.3

CHAPTER III Economic and Social Dimensions of the Project

III.1. Investment program and financial resources of the Project III.1

III.2. Time-table for the Project III.2

III.3. Cost-benefit analysis of the Project III.4

III.4. Other economic, social and infrastructure activities which are not within the frame of the Project but are designed by the owner of the Project or other firms in relation with the Project III.5

III.5. Other economic, social and infrastructure activities which are not within the frame of the Project but are expected to be undertaken by the owner of the Project or other firms in relation with the Project III.6

CHAPTER IV Environmental Characteristics of the Location Selected for the Project

IV.1. Characteristics of the physical and biological environment and the use of the natural resources IV.1

IV.1.1. Meteorological and climatic characteristics IV.1

IV.1.2. Geological characteristics IV.2

IV.1.3. Hydro-geological characteristics	IV.5
IV.1.4. Characteristics of the soil and its usage	IV.6
IV.1.5. Agricultural areas	IV.7
IV.1.6. Hydro-geological characteristics	IV.8
IV.1.6.1. Rivers and lakes	IV.8
IV.1.6.2. Characteristics of the marine environment	IV.8
IV.1.6.2.1. Previous studies carried out on Marmara Sea and Turkish straits prior to the Project	IV.8
IV.1.6.2.2. Regional characteristics and marine investigations carried out in the vicinity of the Project Site	IV.16
IV.1.7. Existing and planned utilization of surface water resources	IV.29
IV.1.8. Species living in seas or in-land water resources such as lakes, fishing weirs, rivers	IV.29
IV.1.9. Thermal and geo-thermal water resources	IV.30
IV.1.10. Protected areas	IV.30
IV.1.11. Forest areas	IV.30
IV.1.12. Flora and fauna	IV.30
IV.1.13. Stockbreeding	IV.31
IV.1.14. Mines and fossil fuel resources	IV.32
IV.1.15. Areas with high landscape value and recreational areas	IV.32
IV.1.16. Lands under control and responsibility of authorized governmental agencies	IV.32
IV.1.17. Existing pollution load of the area	IV.32
IV.2. Characteristics of socio-economic environment	IV.35
IV.2.1. Economic characteristics	IV.35

IV.2.2. Population	IV.35
IV.2.3. Local social infrastructure services	IV.37
IV.2.3.1. Educational infrastructure	IV.37
IV.2.3.2. Health infrastructure	IV.38
IV.2.4. Urban and rural land utilization	IV.38
IV.2.5. Income	IV.38
IV.2.6. Unemployment	IV.38
IV.2.7. Health	IV.38

CHAPTER V. Impacts of the Project on environment and measures will be taken

V.1. Activities during land preparation, construction and installation stages, impacts on physical and biological environment and measures to be taken	V.1
V.1.1. Location and amount of excavation works, materials and explosives which will be used during excavation in land preparation stage	V.1
V.1.2. Where excavation waste such as soil, stone, sand, etc. will be transported and for which purposes they will be used	V.1
V.1.3. Where and on how much area will filling and construction on piles be made in water medium and the material that will be used	V.1
V.1.4. Works which will be performed to ensure ground safety	V.2
V.1.5. How and where flood prevention and drainage activities will be carried out	V.3
V.1.6. Transportation, storage and utilization of flammable, explosive, dangerous and toxic materials which will be used during land preparation and construction stages; tools and machines which will be employed for this purpose	V.4
V.1.7. Activities spreading dust such as crushing, grinding, transportation and storage during construction stage	V.4

V.1.8. Excavation, dredging activities, etc. which will be performed for any purpose in water environments within the Project area; where and how such activities will be carried out; size of the area which will be affected, amount of stone, sand, pebble and similar materials which will be excavated as a result of these activities and where they will be transported and for what purposes they will be used	V.5
V.1.9. Transportation infrastructure plan of the Project, activities related with the construction of this infrastructure; materials, chemicals, tools, machines which will be used; dust-emitting mechanical, activities such as crushing, grinding, transportation and storage	V.7
V.1.10. Plan of water supply the Project, activities related with the construction of this system, materials which will be used for these, activities; amount of water which will be supplied from resources and amount of process water; boiler and/or cooling water, drinking and consumption water and other utilization of water	V.9
V.1.11. Amount and characteristics of waste water within the frame of the Project, amount and characteristics of cooling water, plans of discharge systems, activities related to construction and installation of these systems, characteristics of the treatment units in the system, sewerage system, how and where water will be discharged	V.10
V.1.12. Electrification plan of the Project, activities which will be carried out and materials which will be used for the implementation of this plan; locations and capacities of energy transmission lines and transformers	V.13
V.1.13. Types; minimum calorific values sulfur, ash, nitrogen, volatile substance contents; humidity rates of fuels which will be used during all stages from land preparation to commissioning of all units; fuel consumption amounts, combustion systems where such fuels will be used for measurement	V.14
V.1.14. Types and amounts of waste water which will be produced as a result of activities which will be carried out during all stages from land preparation to commissioning of all units; recipient environments where such water will be discharged	V.14
V.1.15. Types and amounts of solid waste which will be produced as a result activities which will be carried out during all stages from land preparation to commissioning of all units or due to works which will be performed for excavation in water environments; where such waste will be transported and for which purposes they will be used	V.14

V.1.16. Sources and levels of vibration and noise to occur as a result of the activities which will be carried out during all stages from land preparation to commissioning of all activity units	V.15
V.1.17. Types and quantities of trees which will be cut down for land preparation and land gaining requirements for construction area, plant species which will be destroyed and size of the area where such activities will be carried out	V.17
V.1.18. Size of agricultural land which will be destroyed for land preparation and land gaining required for construction area; their land utilization capabilities and types of agricultural products	V.17
V.1.19. Where and how the accommodation and other technical/social infrastructure needs of the personnel who will work in activities during all stages from land preparation to commissioning of the activity units of the Project, will be satisfied	V.17
V.1.20. Activities posing risk and dangers for human health and environment which will be carried out during all stages from land preparation to commissioning of units	V.17
V.1.21. The amount of the area where land arrangement will be made for creating landscape elements or for other purposes in the Project area (afforestation, green area arrangements, etc.) and tree species which will be selected	V.18
V.2. Activities in the operation phase of the Project, impacts on the physical and biological environment, and the measures which will be taken	V.19
V.2.1. Characteristics of all the units of the Project, activities which will be realized in these units, their capacities, the services which will be provided by other units rather than activity units	V.19
V.2.2. Hazardous, toxic, explosive and flammable materials which will be used at the activity units during production, and their transportation and storage	V.20
V.2.3. Characteristics and the quantity of the machinery, equipment, instruments and tools which will be used at the activity units.	V.21
V.2.4. Goods and / or services which will be produced at the activity units, production amount of final products and semi-finished products, to where, how and in what amount they will be marketed; where, how and in what amount they will be marketed; where, how and to how many population these services will be offered	V.22

V.2.5. Production methods and technologies which will be used at the activity units, flow-chart of production	V.23
V.2.6. The manner of transport of the raw materials, auxiliary materials, finished materials and the personnel. The mode of transport and vehicles, their quantities and capacities	V.24
V.2.7. For which processes and in what amount of water will be used at the activity units, the physical, chemical and bacteriological characteristics of the waste water generated after the process; the materials will be disposed at the waste water treatment plants	V.26
V.2.8. The quantity of boiler water and / or cooling water to be used at the activity units, after what type of process these wastes will be given to the recipient environment and how, and the characteristics of the water will be discharged.	V.27
V.2.9. The materials which will contaminate the waste water will be generated after use of the drinking water and the water used for other purposes, the treatment which will be used for treating such waste water will be discharged to the recipient environments, the receiving environments and the method of discharge	V.27
V.2.10. Fuel types which will be used at the activity units and other units, quantities and chemical analysis thereof, the units at which the fuel will be consumed and the quantities thereof, the combustion systems, emissions, instruments and systems will be used for measurement	V.29
V.2.11. The quantity and characteristics of the solid waste which will be generated by each unit during operation of the activity, methods of storing, piling and disposal, how and where such solid waste will be transported, or for which purposes they will be recycled or where they will be sold	V.33
V.2.12. Sources of vibration and noise which will be generated during operation of the activity, and the levels thereof	V.34
V.2.13. Kind of radioactive wastes	V.35
V.2.14. Where and how the accommodation and other technical/social infrastructure needs of the personnel who will work in the activities during all stages from the land preparation to commissioning of the activity units of the Project	V.35
V.2.15. Risky or hazardous activities of the Project in the phase of operation, with respect to human health and the environment	V.35

V.2.16. Land arrangements for creating landscape elements or for other purposes in the Project area	V.35
V.2.17. Heat loss emissions	V.36
V.3. Effects of the Project on the socio-economic environment	V.36
V.4. The effects of the Project on the environment; general assessment and the precautions	V.40
V.4.1. Geological status and soil characteristics	V.40
V.4.2. Hydrology	V.40
V.4.3. Water quality	V.41
V.4.4 Air quality	V.43
V.4.5. Noise effects and the precautions	V.45
CHAPTER VI The effects which may occur or continue after the enterprise is terminated, and the measures will be taken for these effects	
VI.1. Recreation activities	VI.1
VI.2. Reclamation of land	VI.1
VI.3. Impacts on available water resources	VI.1
VI.4. Possible emissions	VI.1
CHAPTER VII Alternatives of the Project	
Alternatives of the Project	VII.1
CHAPTER VIII Conclusions	
VIII.1. Air pollution control	VIII.1
VIII.2. Water pollution control	VIII.4
VIII.3. Noise pollution control	VIII.5
VIII.4. Recreation	VIII.6

VIII.5. Solid wastes	VIII.6
VIII.6. Hazardous and toxic wastes	VIII.6
VIII.7. Monitoring Procedures	VIII.6
VIII.8 Public health, security and Health Protection Belt	VIII.7
VIII.9. Land utilization	VIII.8
VIII.10. Other impacts	VIII.8

REFERENCES

ANNEXES

LIST OF PREPARERS

SIGNATURE OF PREPARERS

ACKNOWLEDGMENTS

LIST OF TABLES

NO		PAGE
Table I.1 .	Energy Production Capacities according to Fuel Types Used, 1992	I.3
Table I.2.	Energy Demand Projection for Turkey by TEK	I.3
Table II.2.1.	The Area Covered by the Units	II.8
Table IV.1.1.1.	Ambient and Sea Water Temperatures in the Region	IV.2
Table IV.1.1.2.	Analysis of 22 year period Wind Data obtained from Tekirdag Meteorological Station	IV.2
Table IV.1.3.1	Ground water Levels in Boring Wells.	IV.6
Table IV.1.3.2.	Analysis Results of the Samples taken from the Boring Wells	IV.6
Table IV.1.4.1.	Characteristics of the Agricultural Land in the Region	IV.7
Table IV.1.5.1.	Information about the Agricultural Land in Marmara Ereğlisi and Sultanköy	IV.7
Table IV.1.5.2.	Agriculture in the Region	IV.8
Table IV.1.6.2.1.	Pollution loads from Izmit and Istanbul	IV.12
Table IV.1.6.2.2.	Phases that Crude oil go through and its Duration	IV.12
Table IV.1.6.2.3.	Primary Production and Chlorophyll-a Variations in the Marmara Sea	IV.16
Table IV.1.6.2.4.	Hg Concentrations in Various Marine Medium (ng/l)	IV.16
Table IV.1.6.2.5.	Analysis Methods used in Marine Investigations	IV.18
Table IV.1.6.2.6.	Current Velocity Results Measured with Drogues	IV.18

Table IV.1.6.2.7.	Current Velocities in the vicinity of Marmara Ereğlisi BOTAS Facilities	IV.19
Table IV.1.6.2.8.	Wave Characteristics of the Marmara Sea	IV.19
Table IV.1.6.2.9.	Results of the Chemical Analysis on Sea Water Samples (18.2.1994)	IV.20
Table IV.1.6.2.10.	Results of the Chemical Analysis of the Sea Water Samples (27.2.1994)	IV.21
Table IV.1.6.2.11.	Bottom Sludge and Characteristics in Marmara Ereğlisi Coasts (28.2.1994)	IV.21
Table IV.1.6.2.12.	Fauna and Flora (27.2.1994)	IV.23
Table IV.1.6.2.13.	Plankton Species	IV.24
Table IV.1.6.2.14.	Plankton Species and individual numbers at m^{-3} (Vertical net)	IV.24
Table IV.1.6.2.15.	Plankton Species and Individual Numbers at m^{-3} (Horizontal net)	IV.25
Table IV.1.6.2.16.	Plankton Quantities in Samples around Marmara Ereğlisi	IV.25
Table IV.1.6.2.17.	Plankton Quantities in Samples taken from South Marmara	IV.26
Table IV.1.6.2.18.	Chlorophyll-a Analysis Results	IV.26
Table IV.1.8.1.	Local Catch Fish	IV.30
Table IV.1.17.	Frequency Analysis (Hz/dB)	IV.33
Table IV.2.1.1.	Economical Sectors in Marmara Ereğlisi	IV.35
Table IV.2.2.1.	Population at the Immediate Vicinity of the UNI-MAR Power Plant	IV.36
Table IV.2.2.2.	Population Information on Tekirdağ	IV.36
Table IV.2.2.3.	Population Change in Marmara Ereğlisi	IV.37
Table IV.2.2.4.	Age Pyramid for the Province of Tekirdağ	IV.37

Table IV.2.3.1.	Marmara Ereglisi District Centrum Educational Status	IV.38
Table V.1.11.1.	Quantity and Quality of the Waste Water Generated in the Power Plant	V.13
Table V.1.15.1.	Description Solid Waste which will be generate during Excavation and Construction and Way of Disposal	V.15
Table V.1.16.1.	Construction Equipment and Machinery Upper Noise Limits according to Noise Control Regulation.	V.16
Table V.1.16.2.	Upper limits for tolerable noise according to Noise Control Regulations	V.16
Table V.2.10.1.	Characteristics of Natural Gas to be used in the Plant	V.29
Table V.2.11.2.	TÜPRAS-400 Product Specifications	V.30
Table V.2.11.3.	Exhaust gas composition for base load operation on natural gas and emergency fuel TÜPRAS 400	V.31
Table V.2.10.4.	Estimated Emissions	V.33
Table V.2.12.1.	Sources of Noise and Expected Levels at the Power Plant	V.34
Table V.3.1.	Environmental Cost-Benefit matrix	V.38
Table V.4.1.	Matrix of Potential Environmental Effects during Construction	V.39
Table V.4.2.	Matrix of Potential Environmental Effects During Operation	V.39
Table V.4.4.1	Comparison of Fuel Emissions and Limit Values given in the Regulation	V.44
Table VIII.1.1	Comparison of Fuel Emissions and Limit Values given in the Regulation	VIII.2
Table VIII.1.2.	Results of the Air Quality Model	VIII.3
Table VIII.1.3.	Air Pollutants and Limit Values	VIII.4

LIST OF FIGURES

NO		PAGE
Figure II.1.1.	Location of Marmara Ereglisi in the Region	II.1
Figure II.1.2.	Alternative Site Locations and the Site Chosen	II.2
Figure II.1.3.	Existing Urban Plan of Marmara Ereglisi	II.4
Figure II.1.4.	Location of UNI-MAR Power Plant	II.5
Figure II.2.1.	Site Areas A, B and C.	II.6
Figure II.2.2.	Site Layout.	II.7
Figure IV.1.6.2.1.1.	Marmara Sea Hydrography	IV.9
Figure IV.1.6.2.1.2.	Average Water Exchange in the Marmara Sea...	IV.11
Figure IV.1.6.2.1.3.	Vertical Variations in Dissolved Oxygen in Marmara Sea...	IV.14
Figure IV.1.6.2.1.4.	Average Dissolved Oxygen Concentration in the Marmara Sea and the Turkish Straits	IV.15
Figure IV.1.6.2.1.5.	Variation of Dissolved Oxygen with Depth in the North Entrance of the Bosphorous	IV.15
Figure IV.1.6.2.2.1.	Fish Larvas Research Area	IV.27
Figure IV.1.6.2.2.2.	Location of the Research Stations for Fish Larvas	IV.28
Figure IV.1.17.1.	Location of Sound Measurements	IV.34
Figure V.1.5.1	Drainage Area	V.3

Figure V.1.8.1.	Water Intake and Discharge Layout	V.6
Figure V.1.9.1.	Roads of The Region	V.7
Figure V.1.9.2.	T" Junction for Connection of Site Access Road to D110 Highway.	V.8
Figure V.1.10.1.	Water Cooling Systems Flowchart	V.12
Figure V.2.5.1.	Flow Chart of the Operation	V.25
Figure V.4.5.1.	Noise Levels and Isobar Curves	V.47
Figure VII.1.	Comparison of CO ₂ Emissions according to Fuel Types used in Power Plants	VII.4

LIST OF ANNEXES

NO	DESCRIPTION
ANNEX A	List of Laws, Regulations, Communiqués and Official Documents and Approval Procedure of EIA Report
ANNEX II.1.1.	MENR Letter for Site Approval
ANNEX II.2.1.	Site Layout and Description of the Units
ANNEX III.2.1.	Construction Time Schedule
ANNEX III.4.1.	MENR Letter for 380 KV Connection to National Grid
ANNEX IV.1.1.-3.	Meteorological Data
ANNEX IV.1.2.1.-12.	Location of the Soil Investigations, Geotechnical Sections, Laboratory Test results
ANNEX IV.1.2.13.	Consent of MENR for Seismic Criteria
ANNEX IV.1.2.14.	Geological Maps
ANNEX IV.1.3.1.	Seismotectonic Map and PGA graph.
ANNEX IV.1.4.1.	Soil Classification Report for the Project Site
ANNEX IV.1.6.1-12.	Oceanographic Measurements and Investigations
ANNEX IV.1.7.	Consent of (DSI) for the Project Site
ANNEX IV.1.10.1.	Archaeological Sites at Marmara Ereğlisi
ANNEX IV.1.10.2.	Consent of the Ministry of Culture for the Project Site
ANNEX IV.1.11.1.	Consent of the Ministry of Forestry for the Project Site
ANNEX IV.1.15.1.	Consent of the Ministry of Tourism for the Project Site
ANNEX V.1.3.1.	Design for Sea Water Cooling System, Intake and Discharge Facilities
ANNEX V.1.16.1.	List of Construction Machinery and Equipment
ANNEX V.2.10.1.	Measurement Procedure for Emission Compliance

ANNEX V.4.3.1	Requirement of the Ministry of Agriculture for Thermal Discharge and Chlorination
ANNEX V.4.3.2	Thermal Discharge and Dispersion Model
ANNEX V.4.4.	Air Quality Model
ANNEX V.4.5.	Noise Prediction Calculation
ANNEX VIII.1.	Cumulative Impact of UNI-MAR AS and TRAKYA AS Power Plants Thermal Discharges
ANNEX VIII.2.	Cumulative Impact of UNI-MAR AS and TRAKYA AS Power Plants on the Air Quality
ANNEX VIII.5.1.	Protocol between UNI-MAR AS and Marmara Ereglisi Municipality

CHAPTER I

The Definition and the Aim of the Project

Definition of the Project

The Marmara Ereğlisi B.O.T. Power Plant Project will be realized by an international consortium led by Unit International S.A., Brussels-Belgium under the Build-Operate-Transfer model. The 480 M.W. Natural Gas Fired Combined Cycle Power Plant will be constructed and operated in accordance with Law No. 3096 which permits private sector companies to construct and operate power plants. Further to the Feasibility Study submitted to the Ministry of Energy and Natural Resources (MENR), Unit International S.A. has obtained the authorization on April 22, 1993. The relevant Turkish authorities and Unit International S.A. have signed the following agreements: the Implementation Agreement with Ministry of Energy and Natural Resources ("MENR") on June 18, 1993, the Energy Sales Agreement with Turkish Electricity Authority ("TEK") on August 24, 1993, the Natural Gas Sales Agreement with Turkish Gas and Petroleum Pipeline Company ("BOTAS") on July 2, 1993 and the Fund Payment Agreement with Electrical Energy Fund ("EEF") on August 9, 1993.

The proposed Power Plant will use the natural gas provided by BOTAS as primary fuel and generate about 3,600,000,000 kWh energy which will be delivered totally to TEK. The Owners aim to provide additional generation capacity for the immediate future needs in Turkey through an environmentally friendly power plant such as those extensively implemented by the developed countries where great attention is paid to environmental issues (such as France, United Kingdom, United States of America, Japan, Germany, Belgium, etc..)

The proposed Power Plant shall occupy approximately 14 hectares and shall consist of 2 gas turbines and associated heat recovery steam generators attached to them and one steam turbine, water treatment plant, electric switchyard, oil storage tanks, several other tanks, pumps and approximately 1200 m. sea water cooling pipes between the pump house at the shore and the Power Plant. The tallest structure on the site will be the two exhaust stacks which will extend about 65 meters above the ground level.

Electricity shall be produced using combined cycle technology. In a combined cycle plant, waste heat from the gas turbine exhausts is recovered, converted to steam to drive a steam turbine generator to produce electricity in addition to those from GT units. Combined cycle plants are more efficient than the simple cycle plants built in the past, where waste heat was released to the atmosphere.

The heart of the Marmara Ereglisi Combined Cycle Power Plant will be two gas turbines. In a gas turbine, compressed air is mixed with natural gas and burned in combustion chambers. Rapidly expanding hot exhaust gases drive a turbine as they exit the combustion chamber. The turbine drives the generator which produces electricity. Since Marmara Ereglisi Power Plant will use combined cycle technology, hot gases leaving the gas turbine will enter the heat recovery steam generator where exhaust gases will be used to produce steam. This steam energy will then be converted to mechanical energy through steam turbine driving its own generator to produce electrical energy. Exhaust gases having lower enthalpy will be discharged to the atmosphere through two approximately 65 meter high stacks at a temperature of approximately 101 °C.

The proposed Power Plant shall be able to operate continuously on base load. Operation and maintenance staff recruitment will be around 50 people. Fourteen staff, responsible for management, administration, engineering and maintenance, will work a regular 40-hour workweek. The remaining staff will be shift workers operating the proposed Power Plant around-the-clock. There will always be at least two operators at the proposed Power Plant at any given time.

The "clean" energy produced at the Power Plant will be delivered to Turkish Electricity Authority (TEK), through the 380 kV substation. Amount of energy expected and imported will be registered with proper measuring meters at relevant outgoing feeders in accordance with Energy Sales Agreement (ESA).

Market or service area of the Project, its importance and necessity within this area with respect to the economic and social aspects of the country, region and/or province

The Power Plant will use mostly natural gas and the energy produced will be used to meet the energy demand of Turkey. The economical and social importance of the plant is briefly explained below.

The energy demand all around the world, especially in the developing countries, is increasing rapidly. On the other hand, natural resources consumption has negative effects on the environment, which in turn creates ground for serious discussions. Today, Turkey uses wood, coal, petrol, natural gas, hydraulic and geothermal sources to meet the energy demand. New energy sources like nuclear energy, wind energy and bio-energy are to be employed to close the gap between supply and demand in the future.

For the time being, electrical power is generated in plants which are run on thermal or hydraulic power. Types of fuel used are lignite, coal, natural gas, diesel and geothermal energy. Dams, natural lakes and rivers are used for hydraulic power.

Types of fuel planned to be used in new projects designed in 1992 are given in Table I.1. As can be seen from the table lignite is the most commonly used fuel with a share of 36.9 %, followed by hydraulic energy with 32.7 %, natural gas with 18 % and fuel-oil with 9 %.

The shares of other fuel types are negligible. Energy productions of these plants are also given in Table I.1.

Total actual energy production capacity for the year 1992 is given as 93470 GWh (= 93.5 Billion kWh).

Total energy production for 1992 was 67.3 Billion kWh. The capacity will reach 106.2 Billion kWh by the end of 1994 (TEK, 1993).

Table I.1 . Energy Production Capacities According to Fuel Types Used, 1992

Fuel Type	Lignite	Hydraulic	Natural Gas	Fuel-oil	Coal	Diesel	Geothermal	Total
Consumption Percentage	36.9	32.7	18.0	9.0	2.2	1.1	0.1	100
Capacity MW	5450.5	8378.7	2591.7	1531.3	352.6	393.8	15.0	18713.6
Energy Production GWh	34484.0	30592.5	16811.0	8393.5	2082.0	1017.0	90.0	93470.0

GWh : Giga Watt-Hour -10⁹ Watt-Hour

The energy demand is presumed to increase by 8 %. Expected energy demand values are given in Table I.2.

Table I.2. Energy Demand Projection for Turkey by TEK

Year	1995	2000	2005	2010
Energy Demand Billion kWh	90	130	190	270

These are the projections of TEK. But in rapidly developing countries the energy demand can be more than the projected amount. It is believed that in 2000 Turkey's energy demand will reach the global average and in 2010, it will reach the European average.

By the year 2000 approximately 64 Billion kWh should be added to the present energy production. This goal can be achieved by using the following sources.

- * Thermal Power Plants (Coal, Lignite, Oil and Natural Gas)
- * Hydro-electrical power plants
- * Nuclear power plants
- * Solar and wind energy
- * Bio-energy
- * Geothermal energy

Coal

49 % of the coal consumed is used in the steel industry, 22 % in other industries, 15 % for heating and the rest for other purposes. Coal is imported in Turkey because of production shortage.

Lignite

Lignite mines are mostly situated at Afsin-Elbistan, Mugla, Soma, Tuncbilek, Seyitomer. The lignite consumed in the power plants has low calorific value like 1100 kcal/kg. More lignite fired power plants are not likely to be built in Turkey whereas their actual number is sufficient and local lignite coals have low calorific value. Since exhaust gases are important pollutants and disposal of ash is a problem, these plants are not looked upon with favor. There is also the problem of radiation from trace radioactive elements found in coal when lignite fired power plants are concerned.

Oil

Since Turkey does not have rich oil resources, power plants run by oil are not economical. Also, power plants that run on fuel have obvious negative effects on the environment.

Hydro-electrical Energy

Turkey's economical hydro-electrical potential is projected to be 122 billion kWh. For the time being 32.7 billion kWh is generated which means that only 1/4 of the potential is being used. Disadvantages of hydro-electrical power plants are long implementation periods, high investment costs and vast areas occupied when dams are concerned.

Solar Energy

Solar energy is either used, directly or indirectly in power production or in thermal activities. In direct application, solar energy is utilized by photovoltaic cycle in solar batteries. In indirect application, thermal energy is turned into power using various technologies. Since commercial production of solar energy has not been satisfactorily developed yet, it is not likely to take a part in Turkey's power production in the near future.

Wind Energy

Many studies are carried out around the world to make use of wind energy. The USA and Denmark are advanced in this field. In 1990, 2500 GWh of power was produced with 1557 MW installed capacity in the USA and 744 GWh of power was produced with 412 MW installed capacity in Denmark. In Turkey, Marmara, Aegean and East Anatolian regions are prospective regions for this energy according to wind speed and wind power recordings of Turkish Meteorological Institute. However, neither wind energy nor solar energy can meet the immediate power demand of Turkey.

Nuclear Energy

Today, nuclear energy is an important energy source all around the world. There is no nuclear energy production in Turkey. However, site investigations were made in Silifke-Akkuyu and Sinop. A site was selected at Akkuyu located 45 km. to the west of Silifke in 1976 for the first nuclear power plant of Turkey, and the necessary license was obtained from the Nuclear Energy Commission of the Prime Ministry. From that date on, detailed geology, earthquake, soil, hydrology, oceanography and meteorology investigations have been made and the project basics have been determined but the project could not be implemented.

Natural Gas

Natural gas can be found in various parts of Turkey. The production is 200-250 million m³ which is not a considerable quantity. In 1987, with the commencement of natural gas importation from Russia, residences, some industries and Hamidabat, Ambarli Power plants started using this fuel. In 1991 the amount of natural gas imported from Russia by BOTAS was 4 billion m³/year. As shown in Table I.1. the capacity of natural gas power plants in Turkey is 2591 MW as of 1992. Natural gas is preferred because it is a clean energy source.

As a result, energy production using natural gas appears to be the only solution to the meet energy demand of Turkey in the short term. The establishment of the BOTAS LNG Terminal and the importing of natural gas from Algeria, are clear indications of the government's goals in this respect. This 480 MW plant * will play an important role in meeting our country's energy demand.

*The proposed UNI-MAR Combined Cycle Power Plant will have an installed technical capacity of 480 MW. UNI-MAR A.S. is contractually obliged to provide 458.69 MW available power to TEK. The Company will be subject to a penalty in the event this power is not delivered. Therefore, BOTAS is obliged to provide an amount of natural gas adequate to generate 458.69 MW. As a result 458.69 MW is the installed output contractually guaranteed by the Company.

CHAPTER II

The Location of the place selected for the project

II.1. Selection of the Activity Location

The Project consists of a 480 MW Natural Gas Fired Combined Cycle Power Plant to be located near the coast of the Marmara Sea, in the vicinity of the BOTAS LNG Terminal at Marmara Ereğlisi, approximately 100 km to the west of Istanbul. (Figure II.1.1).



Figure II.1.1. Location of Marmara Ereğlisi in the Region

The Project is being developed in line with the Turkish Government's Energy Policy. The Plant size and choice of location is determined on the basis of information and suggestions made by the Ministry of Energy and Natural Resources, the State Planning Organization, the Turkish Electricity Authority and the Turkish Gas and Petroleum Pipeline Company.

The following has been taken into consideration for selection of the proposed Power Plant:

- Increasing the generation capacity of Turkish network in this region.
- The energy needs of Marmara region and Turkey's existing transmission system.
- Availability of natural gas supply and long term demand for natural gas systems in Turkey.

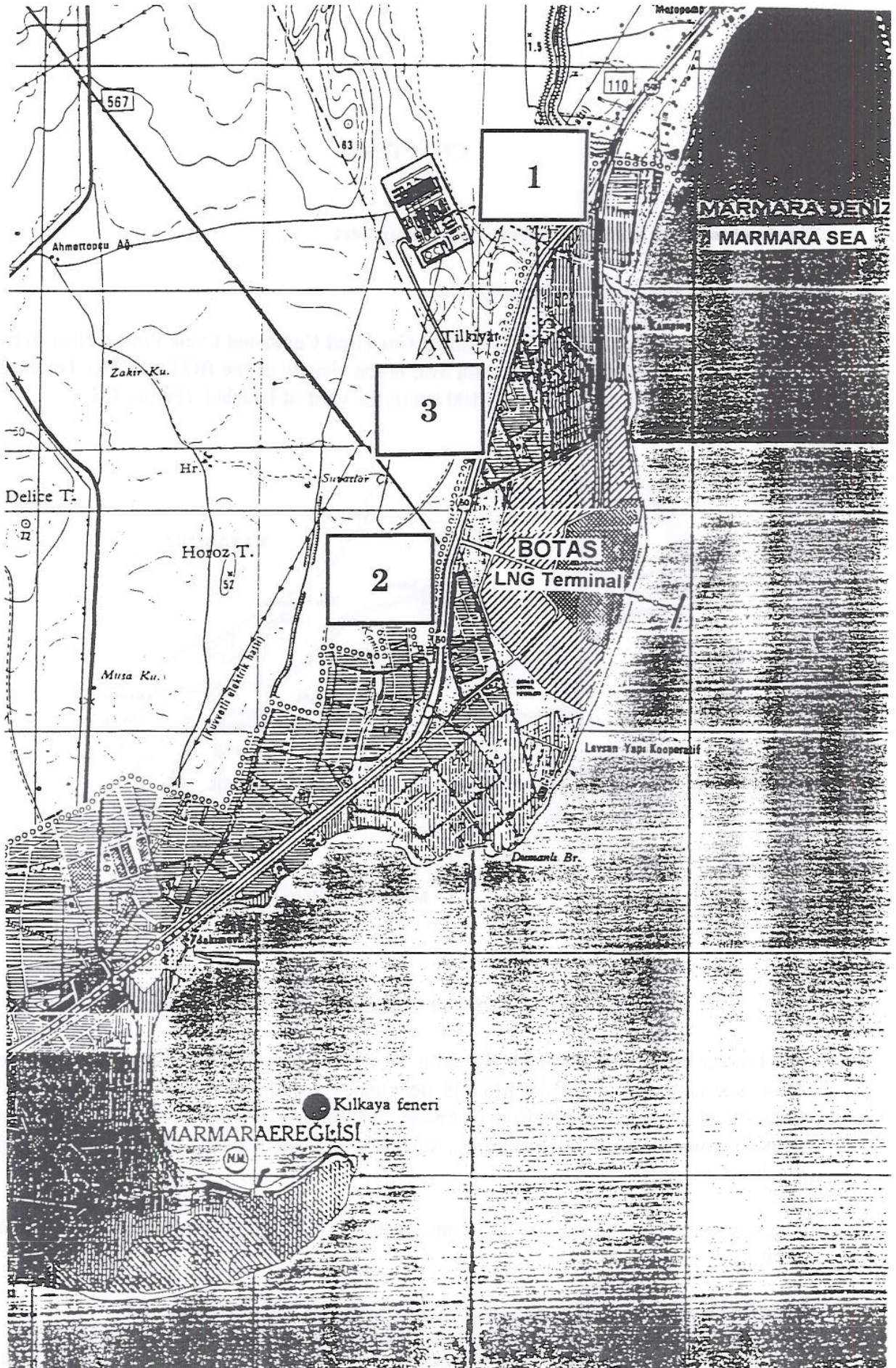


Figure II.1.2. Alternative Site Locations and the Site Chosen

- Existing natural gas pipeline and the LNG Terminal and storage capacity at Marmara Ereğlisi,
- Development Strategy and Foreign Investment Policy objectives of Turkey.

A site report has been prepared following the visits made by technical experts of the Consortium. Three possible fields shown in Figure II.1.2. were chosen as alternative site locations. These have been listed in the order of priority and the approval of the Ministry of Energy and Natural Resources has been requested. The Ministry and the Turkish Electricity Authority have approved the site location, declaring no adverse claims (Annex II.1.1.)

The exact positioning of the Power Plant area has been determined after detailed soil investigations and earthquake studies by the Consortium as south-west of the field number 1. (Figure II.1.2.)

The selected site is approximately 900 m away from the sea shore. Connection will be made to Tekirdag-Istanbul D 110 highway by means of an (approximately 1 km long) access road. The location of the Site is reasonably distant from the extensively populated and permanently occupied areas and existing BOTAS facilities so that requirements of the Environmental Regulations are satisfied. The topography of the land is such that it naturally conceals the Power Plant from view when traveling on the D 110 highway.

An approved Environmental Order Plan or a Local Urban Plan for the Site location does not exist. However, the Project-Site neighbors the existing Urban Plan of the Marmara Ereğlisi Municipality and is considered within its approaching zone. Consortium will prepare a local urban plan for approval of the Municipality. A health protection zone will be shown on the new local urban plan according to Regulation for Non-Hygienic Facilities. The existing Urban Plan of Marmara Ereğlisi is seen in Figure II.1.3. and the location of the plant with respect to Urban Plan is given in Figure II.1.4.

II.2. Location of the Project Activity Units

Arrangement of the buildings and technical units are shown on the Site Layout (Figure II.2.2.) and covered areas as well as number of floors are given in Table II.2.1. Descriptive information and preliminary drawings can be found in Annex II.2.1.

The proposed Power Plant will consist of one main ("A") and two auxiliary ("B" and "C") areas as shown in Figure II.2.1.

Area "A" (Power Plant)

Located in the hilly region west of the D 110 highway and being the Power Plant's main area comprising all the main activities for the power production.

Area "B" (Cooling Water Pipes with Cooling Water Pump house)

Being the "on-shore" part of the cooling water system comprising the cooling water pipe routing from "A" to the shore line including the C.W. pump house located on the shore.

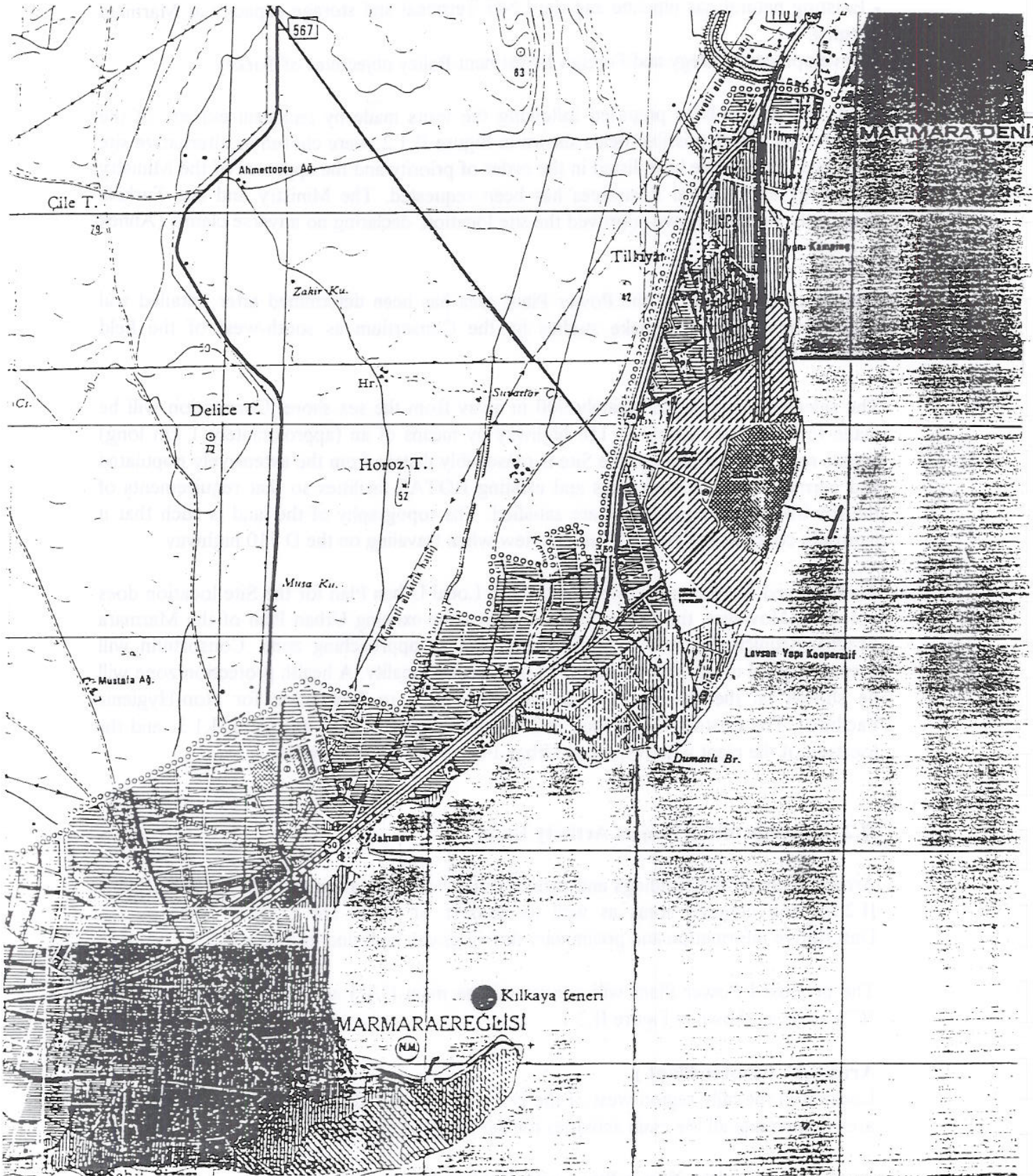


Figure II 1 3 Existing Urban Plan of Marmara Ereğlisi



Figure II.1.4. Location of the UNI-MAR Power Plant in relation with Boundaries of the Existing Urban Plan

Area "C" (Cooling Water Intake and Outlet)

Being the "off shore" part of the cooling water system comprising the cooling water intake and outlet pipes and structures in the sea.

Site layout and other plans and sections of the activity units are given in Annex II.2.1.

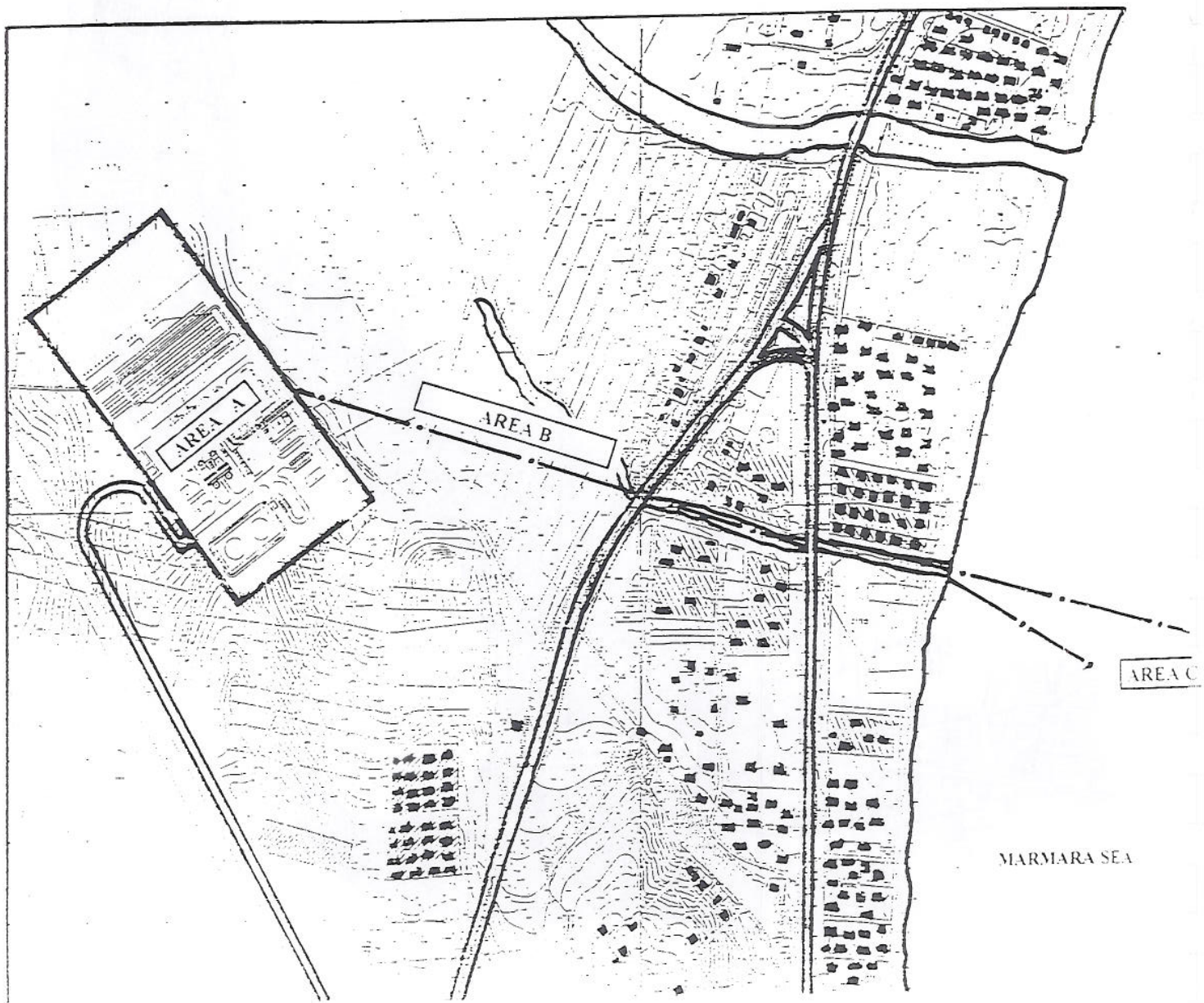
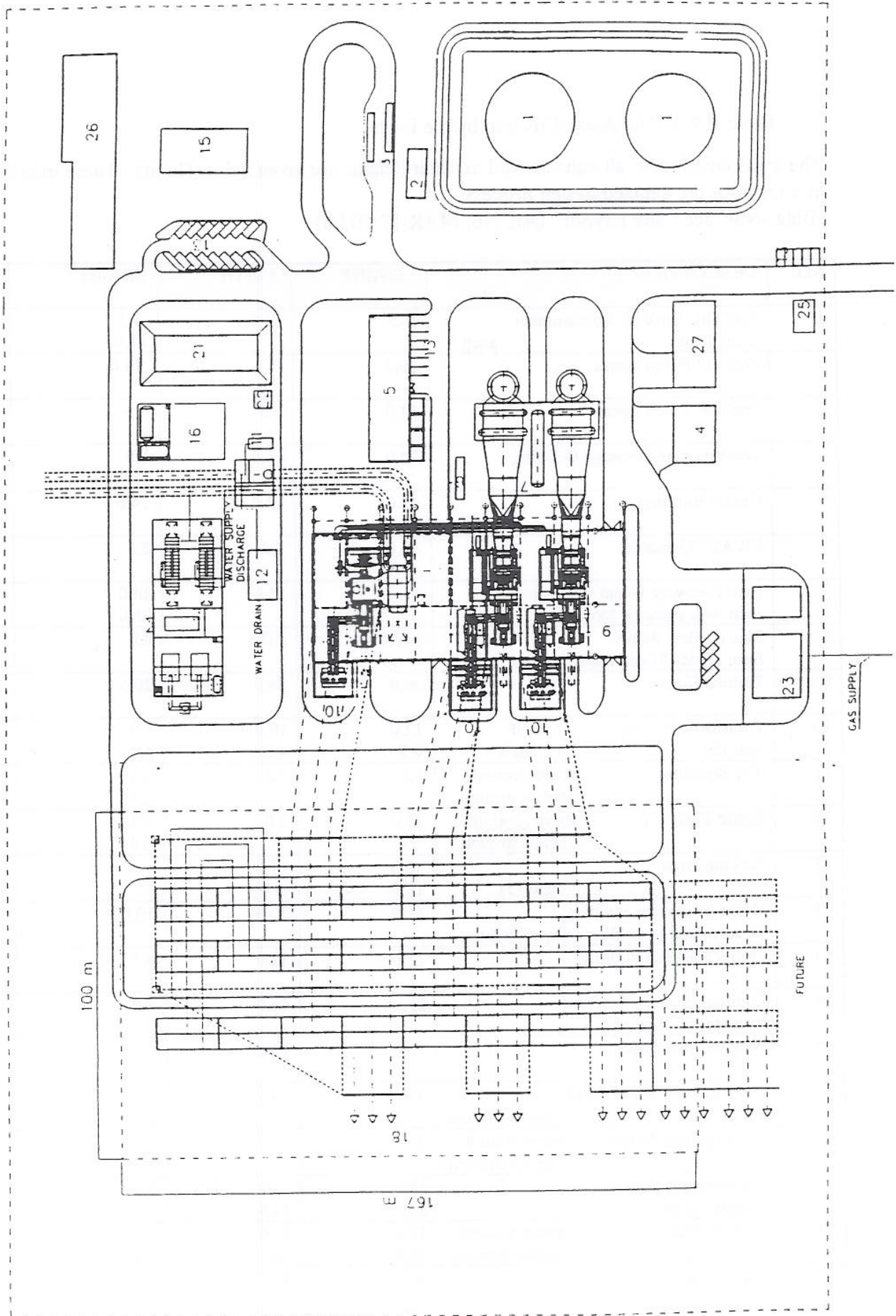


Figure II.2.1. Site Areas A, B and C.



UNI-MAR Enerji Yatırımları AS
 480 MW Combined Cycle Power plant SITE LAYOUT
 DRG. No. MAR/17/002
 Figure II.2.2. Site Layout

Table II.2.1. The Areas Covered by the Units

The areas covered by all units, as well as, their heights are given below (In m). These may change as a result of the detailed design process:

(Bldg.-Nos. acc "Site Layout" Drg. No. MAR/17/002 b)

NO.	DESCRIPTION	LENGHT	WIDTH	HEIGHT	FLOORS
1	Fuel Oil Tanks & Containment 2 Oil Tanks each	NO.	55,0	3,5 21,0	
2	Fuel Oil Pump House	19,2	8,5	16,0	1
3	Fuel Oil Truck Apron	14,0	2,0	-	
4	Workshop and Storage Building	20,0	15,0	6,0	1
5	Contol Building	42,0	12,0	14,0	3
6	SWAS - Container	12,0	2,5	2,5	1
7	Heat Recovery Steam Generator (2) each with stack on top	45,0	25,0	20,0 65,0	
8	Pipe & Elec. Racks from (7) to (8) and other	100,0	2,0	8,0	
9	Turbine House	90,0	36,0	20,5	1
10	Transformers (3X).....each near (5).....each	12,0 4,5	10,0 4,0	7,0 3,0	
11	Oil Separator.....above groundbelow ground	5,5	3,2	0,3 2,7	
12	Septic Tankabove groundbelow ground	15,0	8,0	0,3 2,7	
13	Parking Areanear (5)	30,0 18,0	15,0 5,0		
14	Water Treatment Building Desalination Unit, Black Start Facilities	51,0	20,0	10,0	1
15	Owner's Admin Building	25,0	12,0	4,5	1
16	Demineralisation Unit and Compressor Station	25,0	16,0	7,0	1
18	Outdoor Switchyard	167,0	100,0	-	
21	Fire Fighting Water Pondbelow ground	35,0	15,0	- 2,0	
22	Fire Fighting Pumph.....above groundbelow ground	35,0	15,0	4,0 2	1 (1)
23	Gas reducing station outdoor areas	18,0 8,0	14,0 14,0	7,0 -	1
24	Cooling Water.....above ground Pumphouse.....below ground	14,0 39,9	11,0 10,4	10,2 8,0	1
25	Gate House	6,0	4,7	2,5	1
26	Admin. Bldg. with Canteen, First Aid. Ch.Lab., Change - Shower	60,0	12,0	4,5	1
27	Fire Brigade	22,0	10,0	6,0	1



View of the Project Site from D'110 Istanbul-Tekirdag Highway

III.2. Time-Table for the Project is given below;

TIME TABLE
FOR
MARMARA EREGLISI CCGT POWER PLANT

PHASE I

APRIL 93

PHASE II

OCTOBER 94

PHASE III

DECEMBER 97

PHASE IV

PHASE I

- Preparation of the Feasibility Study including conceptual engineering environmental, economic and business analyses
- Submission of the Feasibility Study to Ministry of Energy and Natural Resources.
- Approval of the Feasibility Study by the Ministry of Energy and Natural Resources.

PHASE II

- Completion of contracts (IC, ESA, GSA, EFA) with related Turkish Authorities.
- Subsurface Investigation, land survey, water study, and other site related issues.
- Obtention of the necessary permits and approvals including Environmental Impact Assessment.
- Finalization of the Engineering and Procurement Contract.
- Finalization of the Operation and Maintenance Contract.
- Formation of the Joint Venture Company in Turkey.
- Land Expropriation.
- Obtention of UTFT Guarantee and Incentive Certificate
- Financial Closing.

PHASE III

- Detailed Engineering
- Procurement
- Construction (Detail is given in Annex III 2.1.)
- Start-up and Commissioning.

PHASE IV

- Full Operation.

III.3. Cost-Benefit Analysis of the Project

The Project presented by the Sponsors supports the development and energy policy objectives and foreign investment policy of Turkey. The scope and methodology of the proposal is in line with the Turkish legislation and has been guided by information and requests received from the officials of the MENR, TEK, BOTAS, SPO and UTFT (General Directorate for Foreign Investment).

Turkish energy policy is to provide cheap, secure, and good quality energy to all users at the right time in order to support healthy economic and social development of the country. For this purpose, all local and imported energy resources are expected to be used, and all local and foreign, private and public investment and finance possibilities are expected to be utilized in order to supply the required energy to meet primary and secondary energy demands in an economical and secure way.

As quoted in the " 1993 Program " prepared by State Planning Organization, Projections based on actual and programmed Power Plant capacities indicate a deficit in supply and demand balance during the second half of the 1990's.

Despite the importance given to the development of local resources in energy production, low quality and reserve limitations will sustain the demand for and share of imported high quality energy sources within total consumption in the medium and long term. In this context natural gas utilization will be widened to meet a part of the new energy demand of the energy and industrial sectors, instead of lignite and petroleum products. Environmental concerns will be taken into account in the economic evaluation of energy production, transmission, transformation and utilization.

Hydro and lignite coal reserves have traditionally been Turkey's primary fuels for power generation. These major power generation sources are abundantly located in the eastern regions of the country whereas the existing and growing power demand is in the industrially developed and densely populated western and northwestern areas (industry and housing sectors represent 80 percent of the total electricity consumption). Therefore, electricity will continue to be transmitted in Turkey from east to west and associated transmission line power losses, voltage and frequency fluctuations will remain significant, requiring additional investment for compensation.

During recent years, natural gas has been playing an increasingly important role in power generation at the expense of lignite and fuel-oil. This trend favoring gas is driven both by environmental concerns and the availability of economical sources of natural gas after the opening of Russian pipeline.

As natural gas is the cleanest burning fuel, its usage provides both economic and social benefits to Turkey by reducing the environmental impact of industrialization. The clean burning nature of natural gas also reduces operating and maintenance costs.

The general economic growth and industrial development of Turkey has been directly linked to a rapidly increasing use of energy. Securing the supply of inexpensive and good quality energy input to maintain industrial competitiveness both for local and export production is one of the prime objectives of Turkey. Minimizing the cost of adding new power generating capacity, and maximizing the benefits that can be derived by local industry as well as the general public has been taken into account in the choice of plant size and technology.

The Marmara region, being one of the most industrially developed and densely populated areas of Turkey, necessitates an additional generating capacity to meet the region's rapidly increasing demand for electrical energy.

In order to secure the electricity supply to respond to rapidly increasing electricity demand in the Marmara region, and to improve the quality and efficiency of the electricity, construction of large scale power generation plants in the region are deemed necessary. Consequently, 2500 additional power generation capacity is planned to be installed in the Marmara region in the second half of 1990 s.

Turkey's liberal foreign capital policy encourages foreign enterprises to invest in such large scale and important infrastructure projects with convenient financing models, such as the Built Operate Transfer (B.O.T.).

With the aim of opening the electrical energy market to the private sector, Law no 3096 was enacted on 4.12.1984 in order to set forth the provisions for the generation, transmission, distribution and trading of electricity by local and foreign private capital companies.

Considering the above mentioned energy policy objectives, electricity demand projections, environmental considerations, and foreign capital policy of Turkey, a natural gas fired Combined Cycle Power Plant to be located at Marmara Ereğlisi region is suggestible.

III.4. Other economic, social and infrastructure activities which are not within the frame of the Project but are designed by the owner of the Project or other firms in relation with the Project

Connection of the proposed Power Plant to BOTAS pipeline for gas supply and to TEK network for the import of the produced energy, requires design and construction of additional infrastructure which is not in the scope of the Project but secured in the major Project documents.

Existing buried 24" natural gas pipeline is running parallel to the southwest border of the Power Plant at 150 m. distance. Design of the connection pipe to existing pipeline will be made by the Owners according to BOTAS standards.

380 kW substation of the Power Plant will be interconnected three other substations of Turkish 380 kW network. The overhead lines associated with these interconnections will be designed by TEK as per their initial planning (See Annex III.4.1.)

III.5. Other economic, social and infrastructure activities which are not within the frame of the Project but are expected to be undertaken by the owner of the Project or other firms in relation with the Project

Procurement of the materials and the construction of the connection pipe to existing BOTAS natural gas pipeline will be made by Owners and transferred to BOTAS for operation and maintenance. This buried pipeline will be constructed according to BOTAS safety standards. Construction of the pipe will be made in right-of-way that will be provided by BOTAS includes a 12 m wide safety strip.

There will be three outgoing lines from the plant's substation. Constituting 3X954 MCM with max. angle of departure of 30 degrees. plant connection to the TEK system will be at the first take over tower from which approximately 20 km long transmission lines will be constructed with line towers at proper intervals for interconnection to Ikitelli, Hamitabat, Istanbul 5.

CHAPTER IV

Environmental Characteristics of the Location Selected for the Project

IV.1. Characteristics of the Physical and Biological Environment and the Use of the Natural Resources

IV.1.1. Meteorological and Climatic Characteristics

In the Tekirdağ-Marmara Ereglisi region, the climate is similar to an Aegean climate. There is considerable precipitation in Spring and Winter. The precipitation is usually in the form of rain and, occasionally, snow. In Summer there is very little rain and the temperature can rise up to 38°C. There is a high rate of evaporation but the weather is rarely cloudy. In a 50-year period (1931-1980) of surveillance the total annual precipitation is found to be 587.63 mm. (See annex IV.1.1.1. DMI, 1984) In another publication of the General Directorate of State Meteorological Institution, the average and extreme values for a period of 30 years is given as 590.5 mm. and 877.2 mm. (See Annex IV.1.1.2. DMI, 1974). Consequently, the evaporation in the region is more than precipitation. The lowest, average, and highest temperatures between 1931-1980 are 13.5°C, 13.7°C, 37.6°C, respectively.

The annual average temperature is 14 °C. The average seasonal temperature is 22°C in Summer and 6,5°C in Winter. The monthly changes in ambient and sea water temperatures are given in Table IV.1.1.1.

Intensity-Duration-Frequency curves of precipitation for Tekirdag are given in Annex IV.1.1.3. (D.M.I., 1987). These curves show that 5-minute, 10-minute and 15-minute rains that might occur every 10 years are 14.3, 17.7 and 26 mm/min. respectively.

Distribution of wind velocity, number of occurrence and number of percentage according to directions for a period of 22 years are given in Table IV.1.1.2. (D.M.I., 1974). As can be seen from the table, the prevailing directions are NE, NW and SE. Winds in the NE-E-S sector are critical when waves and currents are concerned. The strongest wind velocity recorded in the region is 28.9 m/sec. (NW). Wave climate projections depending on wind data are given in Section IV.1.6.

Table IV.1.1.1. Ambient and Sea Water Temperatures in the Region

Month	Ambient Temperature	Sea Water Temperature
January	5°C	9°C
February	6°C	7°C
March	7°C	8°C
April	12°C	11°C
May	16°C	15°C
June	21°C	20°C
July	23°C	23°C
August	23°C	23°C
September	20°C	21°C
October	16°C	17°C
November	12°C	14°C
December	8°C	11°C

Table IV.1.1.2. Analysis of 22 year period wind data obtained from Tekirdag Meteorological station (from D.M.I.-1974)

Direction	Average Wind Velocity (m/sec) and Number of Occurrence	Percentage of Occurrence (%)	Maximum Wind Velocity (m/sec)
N	4.1-1691	12	-
NE	4.1-3569	26	25
E	2.7-950	7	-
SE	2.4-1921	14	-
S	3.5-1296	9	27.0
SW	4.0-739	5	28.6
W	3.2-600	4	-
NW	3.6-2990	23	28.9

IV.1.2. Geological Characteristics

The subsoil of the Power Plant area has been investigated by a detailed study of aerial photographs, by continuous cored borings, trenches, dutch cone and standard penetration tests, seismic cross hole and refraction measurements as well as by laboratory tests with undisturbed and disturbed samples from the different rock and soil strata.

The location of the subsoil investigations is shown on the layout given in Annex IV.1.2.1; in addition to the aerial photo study and the physical site investigations, a geological mapping of the outcrops of rock in the Site vicinity has been performed.

General Geology

The Power Plant area is located within the region of the Thrace Basin which is built up by rock from Tertiary and Quarternary age. In this basin, the sedimentation of sandstone and siltstone commenced in the Palaeocene-Eocene (mainly Eocene) and ended in the Upper Miocene. The outcropping rock in the Site area - a succession of carbonatic bound sandstone as well of siltstone and claystone - originates from the "Osmancik" formation, a stratum of the Upper Oligocene. This rock developed in a fluvio - maritime environment being located next to the coast and which temporarily dried out. This is verified by minor strata of brown coal as well as by the lime content of the sandstone.

At the beginning of the Pliocene another period of sedimentation started, but the Pliocene sediments are overlying the older strata more or less discordantly. A longer period of erosion commenced which was only interrupted by the locally limited Pliocene "Ergene" formation. However, in the region of the investigated area, Pliocene sediments are not yet present as a result of former erosion or due to a lack of their sedimentation.

In the Miocene age, the rock has been folded and a series of saddle and hollow structures developed. In the Site vicinity two directions folding at different ages can be distinguished: one folding of the basin with folding axes directed to the North-Northeast and a second folding directed towards the West-Northwest. The stress and strain of the rock resulting from these to folding processes led to the formation of clefts and faults with facilitated erosion.

With the beginning of the Pleistocene and the connected sea-level subsidence the present valleys in the Power Plant area started to carve. The sea-level rose again at the end of the Pleistocene and thus a strong sedimentation occurred starting with a transgression conglomerate via carbonatic marine clays and sands which are rich in fossils. The rapidity of this sea-level increase is demonstrated by the fact that fluviatile sediments are totally missing except few relics at the bedrock top in several borings in areas (B) and (C).

Site Geology

From topographic and geotechnical point of view, the Site area may be subdivided into three different zones with special subsoil conditions:

Area A: Power Plant Area

The subsoil of the hilly Power Plant area West of the flat plane of the Kınıklı Stream and the silted river bed of "Kuru Dere" is formed by alternating sand and siltstones of the Oligocene "Osmancık" formation. The rock consists of medium to thick layers with thin interbedded claystone layers; being located on the South-Eastern flat flank of a folding zone, the rock is slightly dipping towards the South-West and is quite undisturbed containing only few open seams and owning a well strength and bearing capacity. The upmost 2 to 5 m thick zone of the rock is in-situ weathered to sand or stiff to hard clay. The underground water table is located in approx. 2.5 m depth ($\pm$ sea level) on the North-Eastern boundary to the valley and is slightly increasing towards the South-West

with increasing elevation of the hills.

A typical cross-section through the Site area with the distribution of the weathered rock and the sandstone and siltstone is shown in Annex IV.1.2.2. (legend for the rock and the soil profiles: see Annex IV.1.2.3. and IV.1.2.4.

Area B + C : Cooling Water System

The cooling water pipes are crossing the a.m. boundary of the valley and run parallel to "Kuru Dere" towards the Marmara Sea. Towards the "Kuru Dere" the rock surface is dropping down to approx. 20 m. below surface as a continuation of the North-eastern hill slopes and further down to 30 to 35 m below surface due to a NNE-striking fault with a vertical displacement of 10 to 15m. The erosion valley is filled by an up to 35 m thick sequence of Holocene soft clays and loose to medium dense sands. This zone is continuing along the offshore cooling water inlet and outlet system several hundred meters into the Marmara Sea.

A synoptic geotechnical section along the cooling water system is shown in Annex IV.1.2.5.

Average Soil Mechanics Properties

Typical grain size distributions of the different layers are shown in Annexes IV.1.2.6.-11; the average soil mechanical properties of the explored strata are summarized in Annex IV.1.2.12.

The named strata are following:

Holocene (area B and C):

- stratum no. 3: marine and brackish sands, silts and clays
- stratum no. 4: upper marine sands
- stratum no. 5: upper marine clay
- stratum no. 6: lower marine sands
- stratum no. 7: lower marine clay
- stratum no. 8: carbonatic stiff clay

Oligocene (area A):

- stratum no. 11a: weathered rock
- stratum no. 11b: silt- and claystone
- stratum no. 11c: sandstone

Strata no.9 and 10 have only minor importance due to their poor existence at the basis of the Holocene sediments in area B and C; thus differentiated soil mechanical properties can be omitted.

IV.1.2.a. Seismological Characteristics

The seismic conditions of the Marmara-Ereglisi region are determined by the active East-West striking North Anatolian Fault Zone crossing the Marmara Sea and passing approx. 10 kms South of Marmara-Ereglisi. A moderate seismicity has been observed in the past century within the Marmara Sea; the strongest earthquake happened in 1912 near Mürefte/Sarköy with a magnitude of approx. 7.2, located approx. 80 kms West of the Power Plant Site. Except for an historical earthquake (1766, 25 kms Southeast of the Site) no stronger earthquakes than Magnitude $M = 5.7$ happened within the surrounding area with a radius of 50 kms.

A detailed evaluation of the seismicity with the safe assumption that all observed earthquakes may happen at the boundary of the seismotectonic province next to the Site (Annex IV.1.2.a.1.) leads to the following seismic design data for a required return period of 200 years:

Site Intensity	$I(s) = 8-8.5$
Peak Ground Acceleration	$PGA = 220-300 \text{ cm/s}^2$

On the basis of the Turkish "Specification for Structures to Be Built in Disaster Areas" (1975) in combination with the US Uniform building code section 2312 (1988) the seismic zone coefficient has been determined to $C_0 = 0.14$ as a basic value for the seismic design of the Power Plant structures. As this coefficient is higher than the maximum coefficient according to the 1975 Turkish Regulations, a new seismic zone had to be defined. Seismic Criteria prepared for the Project Site has been approved by MENR (Annex IV.1.2.1.)

The soil class is II for the Power Plant area and IV for the cooling water structures. The design will be performed by dynamic procedure for special structures or by quasi-static procedure with lateral force definition $F = C_0 \cdot K \cdot S \cdot I \cdot W$. (K =structural coefficient, S =spectral coefficient, I = building importance factor, W = total weight) for simple structures according to the above mentioned Regulations.

IV.1.3. Hydro-geological Characteristics

General Hydro-geology

Hydro-geological Characteristics at the Project Site

Underground water level is observed in the borings which was made during geotechnical investigations at the Power Plant area and cooling water pipes area. Underground water levels in borings are given in Table IV.1.3.1. (See Annex IV.1.2.1. for locations of the borings). As can be followed from this Table, underground water elevations are 5 m, around the hilly area and 2-2.5 m, below the soil surface near the bed of Kınıklı Stream. The analysis results of the samples from B1 and A3 wells are given in Table IV.1.3.2. Exiting underground water in the region is polluted significantly especially with the respect to $\text{NO}_3\text{-N}$ and special treatment is required for drinking. This pollution is

probably originated from the fertilizers and septic tank leakage. In addition to this, a particular amount of salinisation is present in B1 well. This indicates uncontrolled usage of underground waters and saline water intrusion in the region. Summer houses in the region supply their water from their own wells. Underground water table decreases during summer and this increases the risk of salinisation. Underground waters near the surface are not appropriate for drinking due to high $\text{NO}_3\text{-N}$ content.

Because of the underground water present in the Project Site, care should be given to the drainage system during construction of the Plant.

IV.1.4.Characteristics of the Soil and Its Usage

The Project Site is situated on mostly "IIIrd and IVth Class Agricultural Land" (See annex IV.1.4.1.). The natural habitat of the region is grass and currently grain and sunflower agriculture is made. The basic characteristics of the agricultural land of the region is given in Table IV.1.4.1.

Table IV.1.3.1 Underground water levels in Boring Wells

Boring No.	Boring Depth (m)	Underground water level (m)
A1	15	3.90
A2	20	5.50
A4	15	4.00
A6	15	3.60
A7	15.3	5.50
B1	25	2.30
B2	30	2.50
B3	40	1.05

Table IV.1.3.2. Analysis Results of the Samples taken from the Boring Wells

Parameter	Well No. A3	Well No. B1
pH	7.2	7.5
Conductivity ($\mu\text{mho/cm}$)	900	2650
TDS (mg/l)	550	1700
SO_4^{2-} (mg/l)	80	500
$\text{NH}_3\text{-N}$ (mg/l)	0.65	0.55
$\text{NO}_2\text{-N}$ (mg/l)	0.026	0.13
$\text{NO}_3\text{-N}$ (mg/l)	6.0	27.5
Cl^- (mg/l)	110	350

IV.1.5. Agricultural Areas

The region of Marmara Ereglisi is seen as a land for industrial agriculture. The information about the land close to the project area is given in Table IV.1.5.1. There are 360 farming families in Marmara Ereglisi and 160 in Sultanköy. The land to be occupied by the Power Plant is evaluated as "IIIrd and IVth Class Agricultural Land" by the Ministry Agriculture and Forestry.

Table IV.1.4.1. Characteristics of the Agricultural Land in the Region

Parameter	Content
pH	7.4 -7.6
Water Quantity, %	53 - 55
Phosphorous (P_2O_5), kg/0.1he	6.71
Potassium (K_2O), kg/0.1he	Rich
Organic matter, %	1.15 -1.40

Table IV.1.5.1. Information about the Agricultural Land in Marmara Ereglisi and Sultanköy

Location	Agricultural Land (hectare)	Non-agricultural Land (hectare)	Total (hectare)
Marmara Ereglisi	6378	243	6621
Sultanköy	1139	39	1178
Total	7517	282	7799

Agriculture in the region is totally dry, the land is not left to fallow and modern methods are employed.

The agricultural products are mostly cereals, watermelons and sunflowers. (See Table IV.1.5.2.) 1/20 of the wheat production of Turkey is harvested in Tekirdag. Consequently, Marmara Ereglisi has an important place in the total cereal production. Also, the productivity per unit area is above that of the average of Turkey.

300 gr. of pesticides and herbicides and 50-65 kg. of artificial fertilizers are used per 0.1 hectare.

Table IV.1.5.2. Agriculture in the Region

Product	Marmara Ereglisi (hectare)	Sultanköy (hectare)	Productivity (kg/hectare)
Wheat	2.300	300	5.000 - 6.000
Rye	300	50	-
Sunflower	400	200	2.000 - 2.500
Watermelons	500	50	20.000 - 25.000
Fruit -Vegetables	4	1	-

IV.1.6. Hydro-geological Characteristics

IV.1.6.1. Rivers and Lakes

There are no lakes or important rivers in the region. Only Kınıklı Stream is close to the Project Site. The stream is dry 8-9 months in a year and its flowrate depends on the precipitation. There are no lakes, estuaries or wetlands in the region.

IV.1.6.2. Characteristics of the Marine Environment

Cooling water for the Plant will be taken from the Marmara Sea and the thermal discharge will be also made to the same medium. Therefore, it is important to describe the current status of the Marmara Sea. For this purpose, general characteristics of the system formed by Marmara Sea and Turkish Straits are summarized systematically and then results of the investigations carried out around the Marmara Ereglisi coastal line are given.

IV. 1.6.2.1. Previous Studies carried out on Marmara Sea and Turkish Straits

A. Characteristics of Marmara Sea and Turkish Straits

A.1. Geographical and Hydrographical Characteristics

The Marmara Sea is an internal sea which connects the Black Sea to the Mediterranean. Urbanization, industrialization, intense sea traffic and connection to the Black Sea makes Marmara Sea most vulnerable to pollution. 25 % of the population and 60 % of the industry of Turkey is situated in this region.

Marmara Sea is connected to the Black Sea and the Aegean Sea via two narrow, shallow and long gateways namely Bosphorous and Dardanelles. To the North of the Marmara Sea there are three cavities lying in the East-West direction with a depth exceeding 1000 m. To the South of Izmit Bay-Marmara Island line there is continental shelf with an average depth of 100 m. (Figure IV.1.6.2.1.1.). Total surface of the Marmara Sea is

11500 km² and its total volume is 3378 km³. The Bosphorous is one of the most narrow gateways of the world with a width of 0.7 -3.5 km., length of 31 km. and an average depth of 35 m. The Bosphorous is connected to the Marmara Sea by an abrupt passage from a 40-70 m. deep shallow triangular region to the cavity to the East of the Marmara basin. In the Black Sea connection, there is a 10 km long channel. As a continuation of the Bosphorous, this channel first extends 8 km to the NE and then to the NW. Its depth is 75-80 m. and its width is 500-1000 m. (Ünlüata et al., 1990).

The Dardanelles which connect the Marmara Sea to the Aegean Sea is 62 km. long, 1.2-7 km. wide and 55 m. of average depth. The connection point is wider (> 7 km.) and deeper (70-80 m.).

B. Oceanographic and Hydrodynamic Characteristics

The most important characteristic of the Marmara Sea is a sharp and continuous saline layer (halocline) at 20-25 m. of depth. Saline water (38.5‰) from the Mediterranean and less saline water from the Black Sea (18 ‰) form a distinctive density separation layer. The most inclusive and systematic study on Marmara and Turkish Straits was realized in 1986-87 (Özsoy et al., 1988). The results of this study are summarized below.

. Changes in Temperature-Depth

The lowest and highest temperatures at the upper layer are 8°C (in February-March) and 24°C (in August). Upper layer temperatures of the Marmara and Black Sea are almost equal. At the bottom layer of the Marmara Sea the temperature is uniform and about 14.5°C.

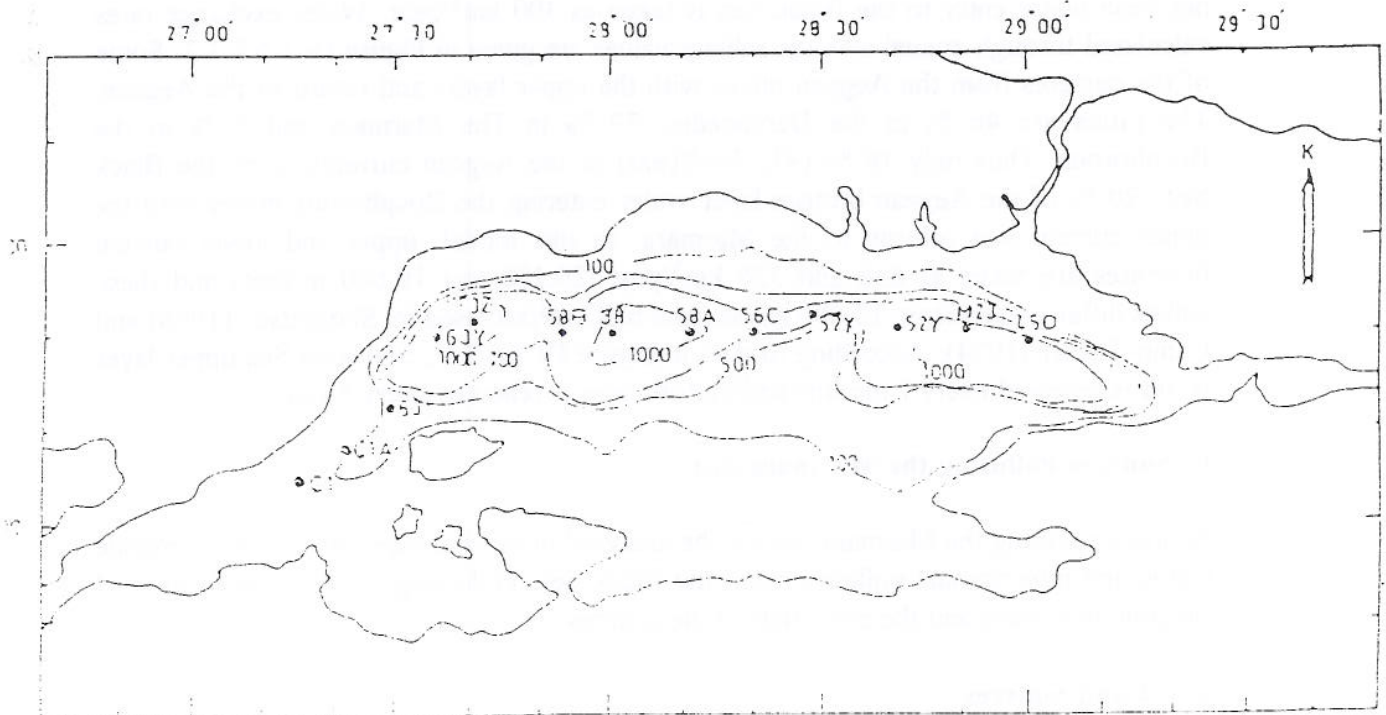


Figure IV.1.6.2.1.1. Marmara Sea Hydrography

. Changes in Salinity-Depth

In Marmara Sea, salinity in the upper layer is 30 ‰ in Winter and 24 ‰ in Summer. The upper layer salinity which is about 18 ‰ in the entrance of the Bosphorous rises to 20-22 ‰ in the Marmara Sea entrance as a result of vertical diffusion. The same phenomenon applies to the Dardanelles and salinity rises to 32 ‰. Bottom layer salinity in the Marmara Sea is about 38.5 ‰. Along the direction of flow in the Bosphorous and Dardanelles, a drop in the level of salinity can be observed. This can only be explained by vertical diffusion.

. Changes in Density- Depth

In upper layer of the Marmara Sea The oceanographic density (σ_t) varies between 15-23.5 but the density of the bottom layer remains at about 28.5 (Özsoy et al., 1988). The seasonal density variations in the Bosphorous and Dardanelles occur in tighter periods than Marmara. Because the density of the bottom current from the Dardanelles to the Marmara Sea is more than the density of the bottom layer in the Marmara Sea, the bottom layers in the Marmara Sea are refreshed.

. Hydrodynamic Characteristics

In the Marmara Sea and Turkish Straits, two layer medium assumption and the average water exchange between the upper and lower layers can be illustrated by a box model created using water and salinity rates as the basis. (Özsoy et al., 1988). In the model the net fresh water entry to the Black Sea is taken as 300 km³/year. Water exchange rates calculated through annual average salinity values are given in Figure IV.1.6.2.1.2. Some of the currents from the Aegean mixes with the upper layers and return to the Aegean. The ratios are 48 % in the Dardanelles, 29 % in The Marmara and 5 % in the Bosphorous. Thus only 18 % (312 km³/year) of the Aegean currents reach the Black Sea. ~20 % of the Aegean bottom layer water entering the Bosphorous mixes with the upper current and returns to the Marmara. In this model, upper and lower current flowrates are taken as 636 and 336 km³/year (20.100 and 10.600 m³/sec) and these values differ greatly from 12.680 m³/sec and 6183 m³/sec used by Skopintsev (1968) and Camp-Tekser (1974). According to data in Figure IV.1.6.2.1., Marmara Sea upper layer water is renewed every 3 months and bottom layer is renewed every 5 years.

C. Sources Polluting the Marmara Sea

Sources polluting the Marmara Sea can be analyzed in three groups: land sources, marine traffic and international pollution from the Black Sea. Following is a brief evaluation of the pollutant loads and the potentials of the sources.

C.1. Land Sources

Pollution load from the land comes from the domestic and industrial wastes from Istanbul, Izmit, Tekirdag and Silivri, as well as pollution from the agricultural areas

carried to the sea by rivers.

Most of the pollution comes from Istanbul and Izmit. Assumptions for domestic and industrial pollutant loads from these two centers for 1990 are given in Table IV.1.6.2.1. (Orhon, 1990)

There are pre-treatment systems in most of the important industries in Istanbul and Izmit. Therefore, it can be assumed that the current pollution loads are 50% less, staying on the safe side. The major problem in these two centers is getting the central treatment plants to function as soon as possible. In Tekirdag, Erdek, Silivri, Sarköy and Gemlik, the wastewater are discharged to the bottom of the sea after a mechanical treatment. The most important stream reaching to Marmara is Nilüfer stream that carries the domestic and industrial wastewater of the Bursa region to the Marmara Sea. There is no solid data concerning the agricultural pollution. Though, it is known that considerable amount of nutrients and agricultural chemicals are carried to the sea.

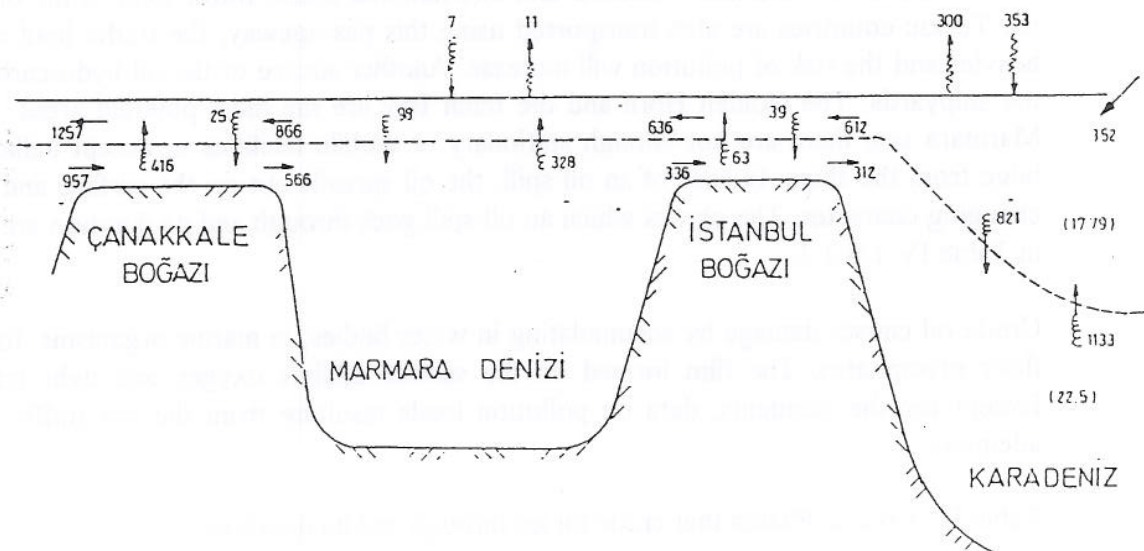


Figure IV.1.6.2.1.2. Average water exchange in the Marmara Sea and the Turkish straits for the average salinity between 1986-1987

C.2. International Pollution Coming From the Black Sea

The Black Sea is polluted immensely by the waters of the Danube and Dinyeper. As a result of this a considerable amount of pollution load is transported to the Marmara Sea by the upper currents of the Bosphorous. According to (Uslu et al.,1991) the organic load from the Black Sea to the Marmara is equivalent to 2930 t TOC/day (~4030 t BOI₅/day). This is about 4030/330=12 times greater than the load coming from Istanbul in 1990. Consequently, there is a serious pollution load coming from Europe to the Marmara via the Black Sea.

Table IV.1.6.2.1. Pollution loads from Izmit and Istanbul (for 1990)

Source of pollution		Flow rate (m ³ /day)	BOD ₅ [*] (t/day)	Nitrogen (t/day)	Phosphorous (t/day)
Izmit	Domestic	164600	49.4	9.9	2.5
	Industrial	164595	85.6	6.9	2.9
	Total	329195	135	16.8	5.4
Istanbul	Domestic	1.080.000	223	39	7
	Industrial	220.000	107	16	2
	Total	1.300.000	330	55	9

* Biochemical Oxygen Demand

C.3. Pollution Resulting From Sea Traffic

Marmara Sea carries a heavy internal and international transit traffic load. If the oil from the Turkic countries are also transported using this passageway, the traffic load will be heavier and the risk of pollution will increase. Another source of the oil hydrocarbons is the shipyards. The Golden Horn and the Izmit Bay are the most polluted areas. In the Marmara sea, there are not enough stationary or mobile facilities to accept ballast and bilge from the ships. In case of an oil spill, the oil spreads out on the surface and starts changing character. The phases which an oil spill goes through and its duration are given in Table IV.1.6.2.2.

Crude oil causes damage by accumulating in water bodies, in marine organisms, fish and floor precipitates. The film formed on the surface inhibits oxygen and light transfer. Except for the accidents, data on pollution loads resulting from the sea traffic is not adequate.

Table IV.1.6.2.2. Phases that crude oil go through and its duration

Phases	Duration (day)	Percentage (%)
Evaporation	1-10	25
Dissolving	1-10	5
Photochemical degradation	10-100	5
Microbiological degradation	50-500	30
Suspension-precipitation	100-1000	15
Oil residue	1000	20

D. Dimensions of the Existing Pollution

D.1. Dissolved Oxygen in the Marmara

One typical characteristic of the Marmara Sea is the continuous depletion of oxygen below the halocline layer. Oxygen depletion in the deep waters of the Marmara for a period of 30 years (1954-1983) is given in Figure IV.1.6.2.1.3. Bosphorous upper layer water coming from the Black Sea and Dardanelles bottom layer water from the Aegean are saturated. On the other hand oxygen saturation in the deep waters of the Marmara is critical and about 20-30%. The variation of dissolved oxygen concentrations in deep waters of the Marmara and Turkish Straits are given in Figure IV.1.6.2.1.4. (Orhon 1991). As can be seen from the figure, D.O. concentration in the West of Marmara show variations with the years; whereas, in the middle parts the concentration is 1.5-2.0 mg/l. One other interesting data comes from the investigations made between 1963-1986 in the Black Sea entrance of the Bosphorous. As shown in Figure IV.1.6.2.5., in the first 50 m. D.O. concentrations reduced to 6 mg/l from 10 mg/l. The most important reason is the pollution in the Black Sea. Since this will affect the pollution in the Marmara, pollution load from Europe is very important.

D.2. Nutrient Level and Primary Productivity

Taking 30 m. of depth as the border line, the upper and lower volumes of the Marmara Sea are 345 and 3033 km³ (Uslu et al., 1991). The phosphorous concentrations in the upper and lower volumes are 0.3 and 0.8-1.2 (1.0) µmol/l and the average (NO₂ + NO₃) nitrogen concentrations are 2 µmol N/l and 10 µmol N/l. (Özsoy et al., 1988). The total average and bottom layer organic carbon concentrations are given as 1.88 mgC/l and 0.59 mgC/l in the latest studies. In a study completed by METU, the Primary Productivity and Chlorophyll-a concentrations vary within a year as in Table IV.1.6.2.3.

Primary Productivity in the Marmara Sea is 84 t C/km²-year and in the Black Sea approximately 100 t C/km²-year. Since the surface area of the Marmara is 11500km², primary productivity will be 84x11.500 x 966.000 t C/year. Total organic carbon equivalent of Istanbul's domestic and industrial wastewater pollution load is 120.450 t BOD₅/year (87600 t C/year) and it is 1/11 of the primary production mentioned above. Taking the stoichiometric constants for algae production by photosynthesis into consideration, primary productivity quantities resulting from N and P loads coming from Istanbul are calculated as $3.86 \times 10^6 \text{ mol N/day} \times (106/16) = 9.33 \times 10^9 \text{ mol C/year}$ (=112.000 ton C/year) for nitrogen and $0.30 \times 10^6 \times 365 \text{ mol C/day} (106/1) = 11.61 \times 10^9 \text{ mol C/year}$ (=139.000 t C/year) for phosphorous. Nitrogen/phosphorous ratios for Istanbul wastewater and the upper layer of the Marmara Sea are;

$$(N/P)_{\text{Ist}} = 3.86 \times 10^6 / 0.3 \times 10^6 = 12.87 < 16$$

$$(N/P)_{\text{mar}} = 2.0 / 0.3 \times 6.67 < 16$$

Therefore, it can be concluded that the inhibiting nutrient of algae production in the Marmara is nitrogen (Uslu et al. , 1991). Organic carbon coming from the Black Sea via the upper current of the Bosphorous is $1.380.100 \text{ tC/year}$ and this is $1.380.100/87.600 = 16$ times more than Istanbul's organic carbon load for 1990. Consequently, removing carbonaceous matter from the wastewater does not mean much in eutrophication control.

D.3. Heavy Metal Pollution

Except for intensely polluted areas like Izmit and Gemlik Bays and the Golden Horn, the Hg concentration in the Marmara is quite low. In the measurements carried out by Bastürk et al.(1986) throughout 1985, Hg concentrations in the upper and lower sections of the Marmara Sea are 16 and 24 ng/l respectively, which are very low. A comparison of Hg concentrations in Marmara and other seas are given in Table IV.1.6.2.4.

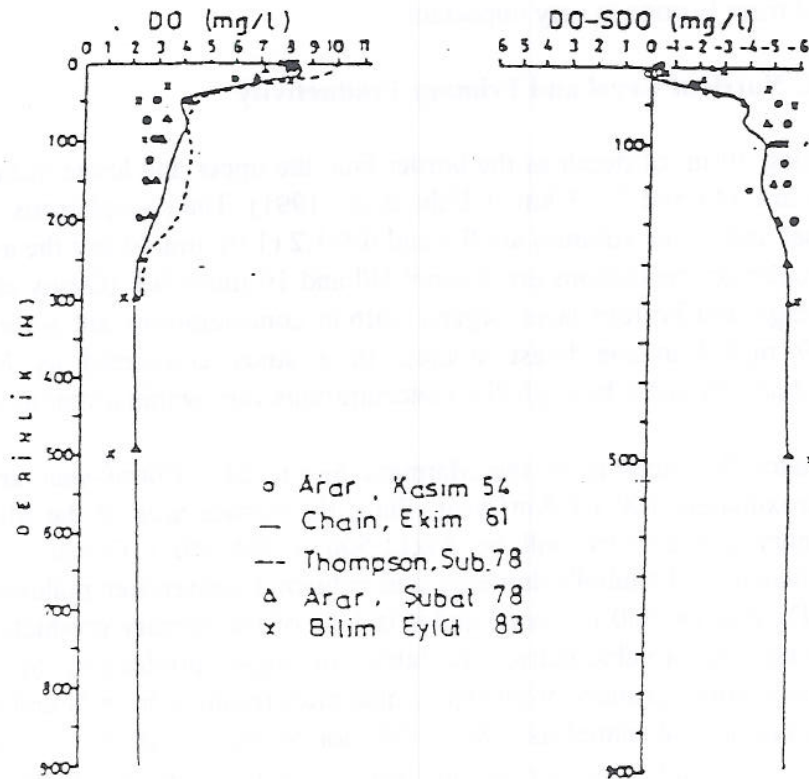


Figure IV.1.6.2.1.3. Vertical Variations in Dissolved Oxygen in Marmara Sea for November 1954 to September 1983 (Yilmaz et al. 1990)

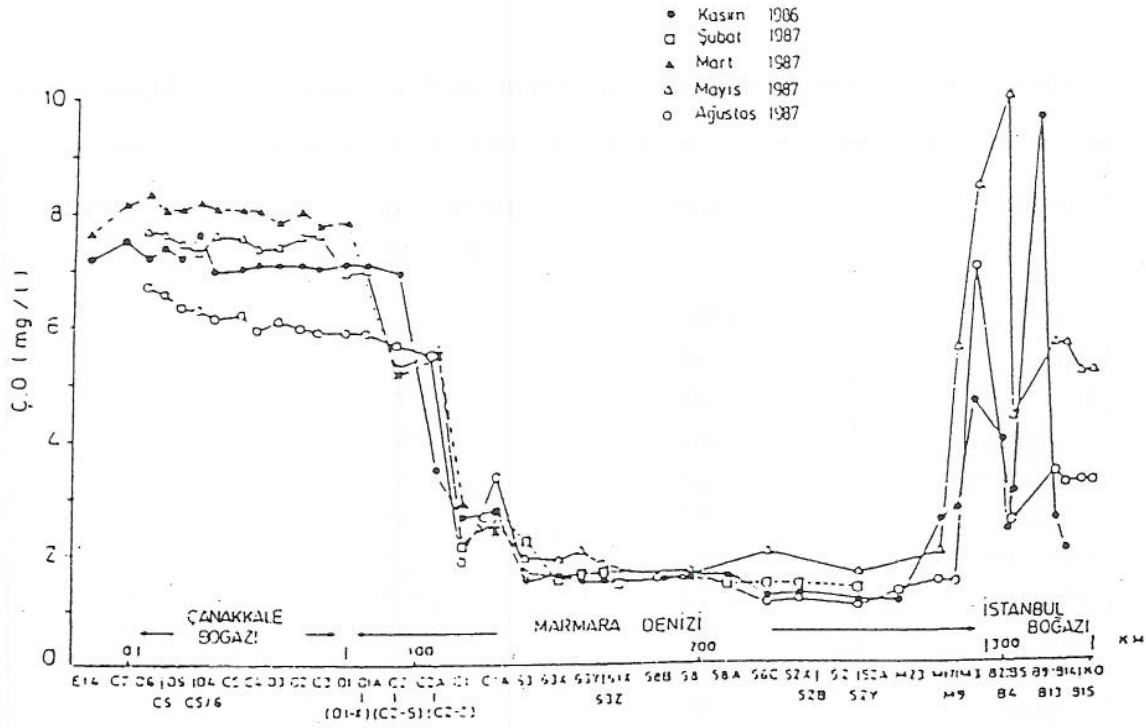


Figure IV.1.6.2.1.4. Average Dissolved Oxygen Concentration Variations in the bottom layer of the Marmara Sea and the Turkish Straits

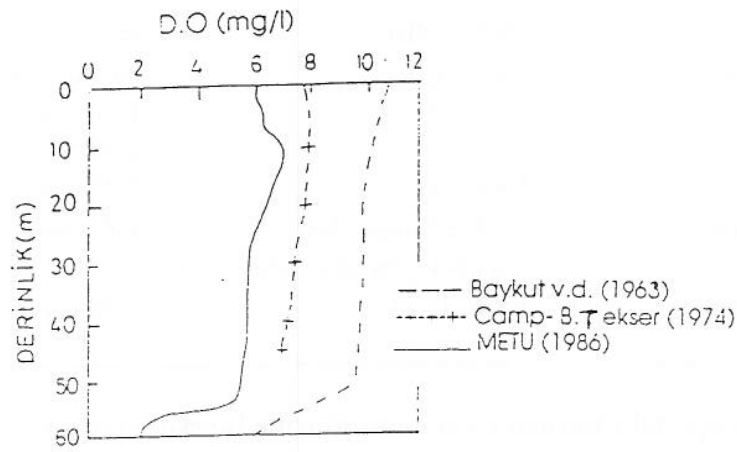


Figure IV.6.2.1.5. Variation of Dissolved Oxygen with Depth in the North Entrance of the Bosphorous (Öztürk, et al. 1991).

Table IV.1.6.2.3. Primary Production and Chlorophyll-a Variations in the Marmara Sea

Months	Year	Primary Productivity (gc/m ² -month)	Chlorophyll-a (µg/l)
March	1986	11.35	2.50
April	1986	6.53	1.31
July	1986	3.72	0.62
September	1986	3.80	0.81
November	1986	4.62	1.73
January	1987	3.85	1.84
February	1987	6.08	2.21
May	1987	16.90	3.83
June	1987	3.95	0.75
July	1987	4.90	0.87
August	1987	4.73	1.11

Table IV.1.6.2.4. Hg Concentrations in Various Marine Medium (ng/l)

Name	Hg	Source
Turkey's Mediterranean Coasts	15(8-25)	Aydogdu, T.(19682)
Israel Coasts	60(10-180)	Roth et al (1977)
Adriatic Sea	70(10-210)	Kosta et al (1978)
North Atlantic	35(12-84)	Kulebakina and Kozlova (1985)
Bosphorous	19(3-34)	IMS-METU (1986)
Marmara Sea	16(4-27)upper layer 24(14-41) bottom layer	IMS-METU(1986)
Minamata Bay	1600-3600	Berhand and Zettera (1975)

IV. 1.6.2.2. Regional Characteristics and Marine Investigations carried out in the Vicinity of the Project Site

a. Station Locations

In order to investigate the oceanographic, benthic, pelagic, ecological and water quality characteristics of the Marmara Sea as the receiving medium and to determine the sea floor topography and geo-technical characteristics of the coastal line in Sultanköy Region, seven stations (S4, S5 S6 S61, S7, S8, S9), were established. In these stations, two rounds of investigations were carried out by I.T.Ü. on 18.02.1994 and 27.02.1994.

Investigation area and station locations are given in Annex IV.1.6.1 and the station coordinates are given in Annex IV.1.6.2 and Annex IV.1.6.3.

b. Sampling and Analysis Methods

Bottom sludge samples were obtained by grab in stations 5 and 9. in order to determine the geo-technical characteristics of the sea floor. These samples were analyzed in the geo-technology Laboratory of I.T.Ü. and granulometric status, consistency limits, shear stress, dry and wet specific weights were determined. In addition to these, metal (Zn, Pb, Cd, Fe, Mn) and organic matter (VSS) analysis were made.

Flora and fauna on the sea floor was also investigated and species were determined.

Vertical and horizontal nets were used to take plankton samples and determine the plankton mass and species in the receiving medium. Chlorophyll-a was also measured. In the first round, the variations of oceanographic parameters (temperature, conductivity, salinity, oceanographic density and dissolved oxygen) with depth were made using YSI-3800 Model and automatic system with Sea-Bird probe was used in the second round. Calibration measurements were also made using the Winkler Method in every station at the surface, middle section and bottom for controlling D.O. measurements. Current measurements were made using Hydro-Product mobile current sampler and drogues. Water samples were taken by automatic systems to analyze the water quality characteristics. BOD₅ and total coliform were measured in surface water samples. BOI₅, PO₄-P, Total P, NH₃-N, NO₃-N, NO₂-N and Organic N were measured in samples taken from -5 m. and - 10 m. Standard Methods for Examination of Water and Wastewater (AWWA, APHA and WPCF, 1985) and EPA standards were followed in chemical and biochemical analysis as much as possible. Experimental analysis methods are given in Table IV.1.6.2.5. Marine investigations were made with ARAR, the research boat of the Istanbul University Marine Sciences Institute.

C. Evaluation of the Studies

Two rounds of investigations to determine receiving medium characteristics in spring-summer were carried out by I.T.Ü. Environmental Engineering Department on 18.02.1994 and 27.02.1994 in Marmara Ereglisi, Sultanköy region.

c.1. Current Status

Current velocities and directions were measured in the seven different stations at various depths. Hydro Product mobile current meter and rogue buoys were used.

The results of the measurements by mobile apparatus are given in Annexes IV.1.6.4 and IV.1.6.5. Drogue trajectories and average current velocities at the surface, -5 m. and -15 m. around station 6 are given in Annexes IV.1.6.5 and IV.1.6.7. When the results are analyzed, the considerable difference in current directions in a short time interval can be observed. Although, the main direction of the currents is from the Bosphorous to the Dardanelles, the opposite direction was observed in the first round. This probably results

Table IV.1.6.2.5. Analysis Methods used in Marine Investigations

Parameter	Method	Source
Organism	a) Bottom Sludge Analysis Macroscopic and Microscopic Analysis	Carpbell et al (1982) Parenzan (1970) Rield (1983)
Metals Fe, Mn, Cu	Atomic Absorption Spectrophotometer	AWWA, APHA, WPCF (1992) AWWA, APHA, WPCF (1989)
VSS	Gravimetric	AWWA, APHA, WPCF (1989)
pH BOI ₅ PO ₄ -P Light Permeability NH ₃ -N NO ₂ ⁻ NO ₃ ⁻ -N Org.N Total P Chlorophyll ^a Plankton T.Coli	b) Sea water analysis pH meter D.O. demand measurement Colorimetric Secci Disc Indophenol Col. Colorimetric Cd-Reduction and Colorimetric Persulphate Oxidation and Cd Reduc. Alkaline Persulphate Oxidation and Colorimetric Spectrophotometric Qualitative, quantitative Membrane Filter	" " " " Murpy and Riley (1962) Methods of Seawater Analysis/ed.by K.Grasshoff/83 AWWA,APHA,WPCF-1992
Velocity, Side Velocity, Trajectory Temperature Conductivity Salinity O.Density CO ₂	c) Current Hydro-product+Current Sampler Drogues d) Oceanographic Parameters YSI-3800 and Sea-Bird Automatic Measurement Systems	

from the wind. On the other hand, at -20 m., the main direction is towards Dardanelles and parallel to the coast. The current velocities vary between 0.05-0.18 m/sec. in the first and second round. The results are given in Table IV.1.6.2.6.

Current measurements were made in the region by Aegean University Marine Sciences Institute and Temel Harita A.S. for BOTAS LNG Terminal during February 1990 - January 1991. These are given in Table IV.1.6.2.7. and they support the latest data obtained

In 90 % of the time, the currents are towards the Dardanelles and parallel to the coast. The velocity near the surface varies between 0.05 and 0.4 m/sec and generally it is more than 0.1 m/sec.

Table IV.1.6.2.6. Current Velocity Results Measured With Drogues

Measurement Depth(m)	Current Velocity (m/sec) and Direction	
	18.02.1994	27.02.1994
-1m (Surface)	0.06 - NW	0.15 - S
-5m	0.03 - N	0.08 - S
-15m	0.03 - N	0.01 - SE

c.2. Wave Climate

According to the observations made during February 1990- January 1991 prepared by Dokuz Eylül University, Marine Sciences Institute and Temel Harita A.Ş., maximum

wave height and period are less than 1.75 m. and 5 sec. respectively. In the Wave Atlas prepared by Hydrography and Oceanography Department of Turkey, is given in Table IV.1.6.2.8. According to the data in this atlas, the maximum wave height observed in Marmara is 3.3 m. In Tekirdag Wastewater Marine Discharge Plant Project design wave height and period, suggested by SMB method in SE and NE, directions, are $H_s=4$ m. and $T_s=7$ sec. respectively.

Table IV.1.6.2.7. Current Velocities in the vicinity of Marmara Ereglisi BOTAS Facilities (Temel Aras- 9 Eylül Univ. Marine Sic.Inst.1991)

Measurement Depth (m)	Current Velocity (m/sec) and direction									
	2/90	3/90	4/90	5/90	6/90	7/90	8/90	9/90	10/90	11/90
Surface	0.30-S	0.07-S 0.14-N								
-3		0.07-N	0.05-S 0.40-S	0.30-S 0.18-N	0.23-S 0.05-N	0.30-S	0.09-S 0.23-S	0.23-S	0.40-S 0.03-N	0.4-S 0.3-S
-11	0.07-S 0.16-S	0.05-S 0.17-N								

c.3. Hydrographic Status

The topography of the sea floor between Sultanköy and BOTAS LNG Terminal show a little different structure. There is a wide beach on the Sultanköy coast and the sea is shallow. 20 m. of depth is reached at about 350 m.(Annex IV.16.18.) The average sea floor slope between the coast and -20 m. of depth is 6%. Between 20 to 50 m. depth the slope is 4.4 %. In front of BOTAS the beach disappears and the sea deepens starting from the coast and reaches -20 m. at 70 m. away from the coast. Because of the wide beach, care should be given to the sediment movements during cooling water water intake and thermal discharge diffuser.

Table IV.1.6.2.8. Wave Characteristics of the Marmara Sea (Wave Atlas)

H: cm T: sec	Winter	Spring	Summer	August
H_{10}^*	200			
T_{10}	5			
H_s	240			
T_5	5			
H_{max}	330	150	150	240

* 90 percentile wave height

c.4. Oceanographic Properties of the Sea Water

Within the scope of the project, in a total of 7 oceanographic observation stations, two series of measurements were made to determine oceanographic parameters. Starting at the surface and moving every 2 m., temperature, salinity, conductivity, and

oceanographic density were measured at every station. These results are given in Tables (1-12) in Annexes IV.1.6.8. and IV.1.6.9.

Although the oceanographic measurements were made in February when complete diffusion is at its best, because of the two layer current in the Marmara a pycnocline has been observed starting at -20 m. This can be observed better at the long period measurements made in 1986-1987 in this region (Annex IV.1.6.10). The surface water temperature variations are given in Annex IV.1.6.11. (METU, DMI 1974)

When the Salinity -Depth graphs prepared by METU Marine Sciences Institute in 1986-87 in the Marmara and Turkish Straits are analyzed a Halocline layer is observed at -20 to -30 m. depths. Therefore, it can be concluded that starting with - 30m. the Mediterranean Water is seen. In the upper 20 m. the Black Sea Water is located. In summer, upper layer salinity is 24-26‰ and bottom layer salinity is about 38 ‰. Temperatures in the same season are 10 °C for the upper layer and 15°C in the bottom layer. Seasonal variations in temperature and salinity for the upper layer of the Marmara and the Turkish Straits are given in Annexes IV.1.6.11 and IV.1.6.12. (IMS-METU, 1988)

c.5. Measuring Water Quality Parameters

Along with oceanographic parameters obtained in the receiving medium, pH, dissolved oxygen, total Coliform, BOD₅, Ammonia nitrogen, organic nitrogen, nitrate and nitrite nitrogen, total phosphorous and light penetration parameters were analyzed in water medium. The analysis results of the samples taken from various depths by automatic sampler are given in Table IV.1.6.2.9. and IV.1.6.2.10.

Table IV.1.6.2.9. Results of the Chemical Analysis on Sea Water Samples (18.2.1994)

Station No	Depth (m)	pH	D.O. mg/l	BOI ₅ mg/l	Total Coliform number/l	NH ₃ -N µm/l	Tot.P µm/l
4	0.2	8.38	9.5	<5			
	5	8.42	9.9				
	10	8.42	10.0				
5	0.2	8.30	9.5	<5			
	5	8.39	9.7				
	10	8.40	9.9				
6	0.2	8.31	9.5	<5	0	0.8	0.75
	5	8.39	10.0			0.5	0.75
	10	8.40	10.0			0.4	0.70
7	0.2	8.42	9.5	<5			
	5	8.42	10.0				
	10	8.40	10.0				
8	0.2	8.35	9.5	<5			
	5	8.40	10.0				
	10	8.42	10.0				
	0.2	8.35	9.5	<5	10	0.5	0.65
	5	8.40	10.0			0.5	0.75

c.6. Pollution in the Bottom Sludge

The results of the organic matter and heavy metal experiments carried out on bottom sludge are given in Table IV.1.6.2.11. Geotechnical characteristics of the floor are given in section c.8.

c.7. Benthic and Pelagic Status

In order to investigate the flora, fauna and pelagic status of the Marmara Ereglisi coast, Algerian (Beam Troll) and benthic sampling (10 min. period) have been carried out at 10 m. and 30 m. depths. Fauna and flora samples obtained were put in formaldehyde solution. According to laboratory analysis, samples were grouped and species determined (Table IV.1.6.2.12). Also, using a standard net with 60 μm -diameter pores, vertical and horizontal plankton sampling were made. 4-5% formaldehyde was used and qualitative and quantitative analysis were made. Qualitative results are given in Table IV.1.6.2.13 and quantitative results are given in Table IV.1.6.2.14 and IV.1.6.2.15. All samples are given in volumetric terms and number in m^3 was counted by Sedwick-Rater camera.

Table IV.1.6.2.10. Results of the Chemical Analysis of the Seawater samples(27.2.1994)

Station No	Depth (m)	pH	D.O. mg/l	T.Coliform number/l	NO ₂ -N $\mu\text{m/l}$	NO ₃ -N $\mu\text{m/l}$	NH ₃ -N $\mu\text{m/l}$	Org.N $\mu\text{m/l}$	Tot.P $\mu\text{m/l}$
4	0.2	8.39	9.7						
	5	8.40	10.0						
	10	8.42	10.0						
5	0.2	8.35	9.7	0	<0.02	0.1	0.4	5.73	0.95
	5	8.40	10.0		<0.02	<0.05	0.4	6.21	0.94
	10	8.42	10.0		<0.02	0.08	0.4	5.75	0.78
6	0.2	8.32	9.5						
	5	8.40	9.9						
	10	8.40	10.0						
7	0.2	8.42	9.6	10			<0.3		0.90
	5	8.42	10.0				0.4		0.95
	10	8.40	10.0				0.7		0.90
8	0.2	8.36	9.7						
	5	8.41	10.0						
	10	8.43	10.0						
9	0.2	8.36	9.6	0			0.5		0.75
	5	8.41	10.0				0.5		0.75

Table IV.1.6.2.11. Bottom sludge and characteristics in Marmara Ereglisi coast (27.2.1994).

Station No	Zn ¹	Pb ¹	Cd ¹	Fe ¹	Mn ¹	Cu ¹	Volatile Organic Matter ²
5	72	14	1.8	8000	100	13	25.00
9	90	22	5.0	4500	140	8	36.99

1. mg/kg dry weight

2. gr/kg dry weight

Benthic Evaluation

Zn, Pb, Cd, Fe, Mn, Cu and volatile organic matter analysis of the bottom sludge were made. The results determined on dry mass basis are given Table IV.1.6.2.11. The Fe concentration is noteworthy. This could be explained with the iron profile residues which were left on the sea floor after boring works. Volatile organic matter changes within the range of 2.5-9 % as dry mass percentage. Even though the investigation was made at the end of the season using Beam Troll, sufficient amount of organisms were obtained. The results are similar to Marmara Sea's coastal benthic structure which is given in Table IV.1.6.16 (February 1991). The results of the study carried out by the same unit in February-August 1992 in South Marmara are given in Table IV.1.6.17. South Marmara is more suitable to fishery than Marmara Ereglisi. This can be explained by contamination which is decreasing from North to South.

Pelagic Evaluation

All oceanographic parameter results are about seasonal averages. While the chlorophyll-a concentration was 1.6 mg/m³ (ave.) in 18.01.1994, it increased to 3.2 mg/m³ (ave.) in 27.01.1994 when the weather was warmer (Table IV.1.6.2.18). This meets the seasonal value for the Marmara Sea.

As can be seen from the results, because winter 1993 was warm and the nutrients in the medium were surplus, number of individuals per m³ is high. Moreover, presence of some Dinoflagellate species and the number of individuals reflect this problem of the Marmara Sea. Marmara Ereglisi is one of the less polluted regions of the Marmara. On the other hand, plankton studies show that because of the current system, the dense pollution in the northern regions of the Marmara effect this region too. In the investigations carried out in three different stations, vertical plankton results were similar but horizontal results show considerable differences. Therefore, horizontal sampling can be used for qualitative evaluation. In addition, the 60 µm diameter pore apparatus cannot filter a 100% water column. As a result, the vertical results can be evaluated from a quantitative point of view.

When Zooplankton is qualitatively and quantitatively evaluated, number of species and number of individuals in a m³ are poor because of the season. Therefore, the results cannot be assessed.

Biotic Structure of the Marmara Sea

Marmara Sea is richer than the Black Sea when deep and migrating fish are concerned. Fishery in Marmara makes up 11.7% of Turkey's total sea products. Migrating fish like blue fish, tunny fish, sardine, horse mackerel and shrimps and sand mussels enrich this sea. Number of fish species in the Marmara sea is 200. In a study by Artüz, et al. it is indicated that, of the 21 species of fish caught in the Marmara between 1970-1976, number of species above the average weight have decreased from 14 kg to 5 kg. The reason is believed to be pollution. According to the authors, a strong statistical correlation exists between the species index and the pollution index. ($r=0.96$).

Table IV.1.6.2.12 Fauna and Flora (27.2.1994)

FAUNA	STATION NO	
	13	14
Polychaeta		
<i>Serpula vermicularis</i>	+	+
Anthozoa		
<i>Caryophyllia smithi</i>		+
<i>Veretillum cynomorium</i>		+
Bivalvia		
<i>Ostrea edulis</i>	+	
<i>Mytilus galloprovincialis</i>	+	
<i>Chamellea gallina</i>	+	
<i>Sphaerocardium poucicostatum</i>	+	
Gastropoda		
<i>Hinia reticulata</i>	+	
<i>Gourmya vulgata</i>	+	+
<i>Murex brandaris</i>		+
Asteroidea		
<i>Marthasterias glacialis</i>	+	+
Echinoidea		
<i>Schizaster canaliferus</i>		+
Decapoda		
<i>Palaemon adspersus</i>	+	
<i>Macropipus depurator</i>	+	+
VERTEBRATA		
Pleuronectidae		
<i>Buglossidium luteum</i>	+	
Scorpaenidae		
<i>Scorpaena scrofa</i>	+	+
Serranidae		
<i>Serranus hepatus</i>		+
Gobiidae		
<i>Proterorhinus marmoratus</i>	+	+
Rajidae		
<i>Raja naevus</i>		+
FLORA		
Chlorophyceae		
<i>Codium tomentosum</i>	+	+
<i>Ulva lactuca</i>	+	+
Phaeophyceae		
<i>Cystoseira barbata</i>	+	+
Rhodophyceae		
<i>Ceramium rubrum</i>	+	+
<i>Hypnea musciformis</i>	+	+
<i>Laurencia obtusa</i>	+	+

Table IV.1.6.2.13. Plankton Species

<u>DIATOMA SPECIES</u>	<u>DINOFLAGELLAT SPECIES</u>	<u>ZOOPLANKTON</u>
<i>Chaetoceros spp.</i> <i>Coscinodiscus spp.</i> <i>Dithyllum brightwell</i> <i>Nitzschia closterium</i> <i>Nitzschis seriata</i> <i>Rhizosolenia hebetata</i> <i>Rhizosolenis sp.</i> <i>Skeletonema costatum</i> <i>Thalassiosira spp.</i>	<i>Ceratium furca</i> <i>Ceratium fusus</i> <i>Ceratium tripos</i> <i>Dinophysis caudata</i> <i>Noctiluca scintillans</i> <i>Prorocentrum micans</i>	<i>Rediolaria sp.</i> <i>Cirriped larva.</i>

Moreover, sword fish and mackerel are almost extinct. The same thing applies to lobster. Extreme and disorganized fishery also leads to extinction. Studies carried put in other seas support this hypothesis.

Table IV.1.6.2.14 Plankton Species and individual numbers at m³ (Vertical net)

SPECIES	St. 5	St. 8	St. 11
PHYTOPLANKTON			
<i>Ceratium furca</i>	29080		43180
<i>Ceratium fusus</i>	29080	66314	41805
<i>Ceratium tripos</i>			16997
<i>Chaetoceros spp.</i>	1861284	1823623	755669
<i>Coscinodiscus sp.</i>	87247	165784	
<i>Dictyotha fibula</i>	87247	232097	159407
<i>Dinophysis caudata</i>			16997
<i>Dithyllum brightwellii</i>	1832202	2519915	885269
<i>Melosira sp.</i>			
<i>Nitzschia closterium</i>	145412	132627	
<i>Nitzschia seriata</i>	174495		
<i>Noctiluca scintillans</i>		33157	24808
<i>Prorocentrum micans</i>	116330	66314	58802
<i>Rhizosolenia hebetata</i>	13348899	18899364	9328041
<i>Skeletonema costatum</i>	3548073	3116737	1215644
<i>Thalassiosira spp.</i>	203578	132627	255889
ZOOPLANKTON			
<i>Cirriped larva.</i>	29080		

Table IV.1.6.2.15. Plankton Species and Individual Numbers at m³ (Horizontal net)

SPECIES	St. 13	St. 14
PHYTOPLANKTON		
<i>Ceratium furca</i>		17411
<i>Ceratium fusus</i>		3482
<i>Chaetoceros spp.</i>		52232
<i>Coscinodiscus sp.</i>	5083	3482
<i>Dictyotha fibula</i>	25417	13929
<i>Dithyllum brightwellii</i>	432083	376071
<i>Melosira sp.</i>		6964
<i>Nitzschia closterium</i>	15250	10446
<i>Noctiluca scintillans</i>	5083	3482
<i>Prorocentrum micans</i>	30500	38304
<i>Rhizosolenia hebetata</i>	2506083	2064910
<i>Skeletonema costatum</i>	213500	198482
<i>Thalassiosira spp.</i>	5083	6964
ZOOPLANKTON		
<i>Radiolaria sp.</i>		3482

Marmara comes fourth after the Black Sea when number of species are concerned and it is placed just after the Black Sea in productivity. As benthos, its composition is similar to Black Sea and the Mediterranean. The phytobenthos structure in the Marmara consists of red alga (Rhodophyceae), green alga (Chlorophyceae) and black alga (Phaeophyceae).

Table IV.1.6.2.16. Plankton Quantities in Samples /Marmara Ereglisi (Area: 37000 m²)

Depth	Species	Quantity (Tons)
21 m	<i>Merluccius merluccius</i>	1.40
	<i>Trigla lucerna</i>	0.28
	<i>Trigla lyra</i>	0.81
77 m	<i>M. Merluccius</i>	0.55
	<i>T. Iyra</i>	0.51

Table IV.1.6.2.17 Plankton Quantities in Samples taken from South Marmara

SPECIES	FEBRUARY 1992 (Tons)	AUGUST 1992 (Tons)
<i>M. Merluccius</i>	41471.5	1585.2
<i>T. Lucerna</i>	304.4	308.3
<i>T. Lyra</i>	252.3	248.4
<i>M. Barbatius</i>	316.8	249.3
<i>Solea sp</i>	38.5	19.6
<i>Arnoglossus sp</i>	84.9	150.7
<i>P. Maxina</i>	20.3	34.7
<i>P. Flesus</i>	0	7.9
<i>M. Merlangus</i>	150.2	114.4

Table IV.1.6.2.18. Chlorophyll-a Analysis Results

Date	Station No	Depth (m)	Chlorophyll-a mg/m ³
18.2.1994	9	0.2	1.60
		5	1.57
18.2.1994	61	0.2	1.60
		5	1.62
		10	1.60
27.2.1994	5	0.2	3.20
		5	3.95
		10	2.73

Fish Eggs and Larvae

The fish eggs and larvae distribution and quantity in the North Marmara Sea Region, including Marmara Ereğlisi was surveyed for a PhD. thesis (Yöksek, 1993) prepared in the Istanbul University Marine Sciences and Administration Institute

Location of the research area is shown in Figure IV.1.6.1. and locations of the stations are shown in Figure IV.1.6.2.

The results obtained from the Marmara Ereğlisi region are given below:

1. In this 86m-deep station eggs and Larvae of 17 species were specified during the research period. Density of 4 species in April, at which time the research period starts, is 3.5/10m³. In May, because of temperature rise, the number of species increases to 11.
2. The density of *D. annularis*, *S. japonicus* and *Blennius sp.* eggs and larvae is 21.2/10m³. In September the density starts to decrease and it is 1.1/10m³. By October the density is 0.9/10m³. In November (temperature 13.8-14.5°C, salinity

%027.2-38.3, Dissolved oxygen 1.0-9.2 mg/l and pH 8.0-8.4), *S.sparattus* is the dominant species laying eggs and larvae. In vertical sampling the egg density is 41.1/10m³ and in horizontal sampling the value increases to 1282/10m³. This shows that in the surface area the egg density is more.

In station no.27 (40° 59 20 N-28° 02 30E), at 55m of depth eggs and larvae of 25 species were identified. In April, (temperature 8.8-14.0°C, salinity &0 26.0-38.0, dissolved oxygen 1.34-9.6 mg/l and pH 8.3-8.7) density of 5 species of eggs and larvae was 0.5/10m³. In May, as the number of species laying eggs increased, the density of eggs and larvae also increased to 33.4/10m³. In June when the surface temperature is 22.5°C and dissolved oxygen is 0.7-8.6 mg/l, although the number of species laying eggs is the same the eggs and larvae density drops to 18.5/10m³ and decreasing continues throughout August (6/10m³, September 4.4/10m³, October 0.05/10m³).

S.sparattus is first seen in November (temperature 13.8-14.5°C, salinity %027.7-38.2, Dissolved oxygen 0.9-9.1 mg/l and pH 8.0-8.4) with a vertical density of 17.6/10m³ and horizontal density of 2000/10m³. In February when the surface water temperature is lowest (average 5.5°C) *S.sparattus* has a dense distribution (252.1/m³) and this species continues to lay eggs until the end of March.

In station no.28 (41° 02 30" N-28" 02 30 E) at 20m of depth eggs and larvae of 22 species were identified. In April, density of 4 species of eggs and larvae was 2.9/10m³; whereas, the number of species increased to 7 and the density of eggs and larvae also increased to 8.6/10m³. In June, when the temperature is 15.2-23.1°C, salinity is %023.2-23.8 and pH is 8.4, eggs and larvae density of *E.encrasicolus*, *M.merluccius*, *M.merlangius*, *S.hepatus*, *T.trachurus*, *D.annularis*, *U.scaber*, *S.japonicus*, *Arnoglossus* sp. *P.flesus*, *S.lascaris* and

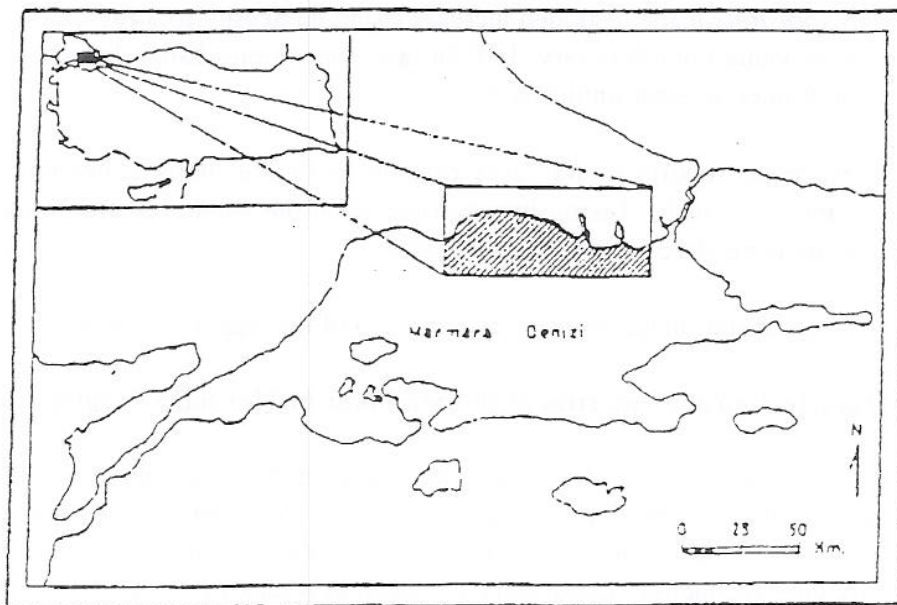


Figure IV.1.6.1. Location of the Research Area for Fish Eggs and Larvae (Yukse,1993)

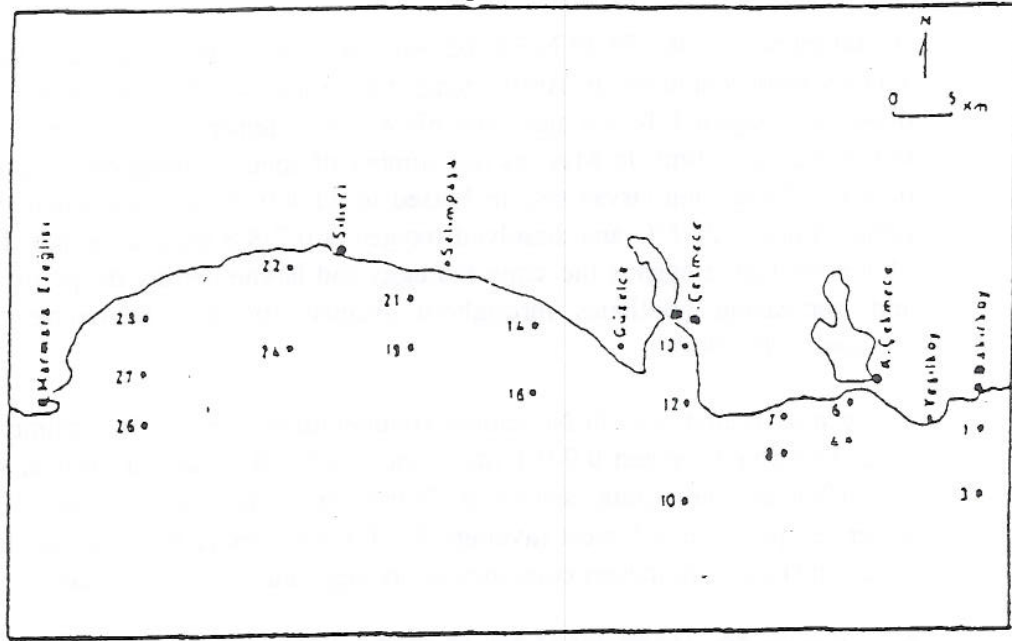


Figure IV.1.6.2.2. Location of the Stations (Yuksek, 1993)

S. vulgaris were 60.1/10m³. In August, number of species is 4 and density is 6/10m³. Starting with September eggs and larvae density rapidly drops to 0.3/10m³, and in October no species were identified. In November (temperature 13.7-14.4°C, salinity ‰25.5-34.8, Dissolved oxygen 3.5-9.7 mg/l and pH 8.1-8.4) *S. sparattus* made a sudden increase rising its density to 3491.4/10 m³ and kept this high value until February. In February, this species had a density of 498/10m³ and continued to exist until March.

Since no reports of this area exist prior to the thesis concerned, a comparison cannot be made. Taking into consideration the whole research area, 34.4% of the eggs were alive and 65.6% were dead.

Around station numbers 26 and 28, 50% of the eggs were alive.

c.8. Geo-technical Properties of the Sea Floor in Marmara Ereglisi Coast

Along the coastal lines, where the water intake and diffuser pipes will be placed, sieve analysis of the disturbed soil samples, soil type, consistency limits and specific weight analysis were made. The results of the studies carried out in I.T.Ü. Civil Engineering Faculty Geo-technology Laboratory are given in Annex IV.1.6.13.

Results of the Consistency Limits Analysis carried out on a number of disturbed soil samples are given below:

Gravel	%	1-30
Sand	%	23-80
Silt-Clay	%	6-54

The structure is alluvionic and the soil type is sand to sand with silt (SM-SC).

Results of the consistency experiments carried out on the under-sieve (No. 40) of the disturbed soil samples are

Water content	%	54-82
Liquid limit	%	36-47
Plastic limit	%	21-28
Plasticity index	%	15-19

According to these results, the water content of the soil is high and its strength is low. Behavior of the soil will be always controlled taking into consideration the pressure on the foundation, type and dimensions of the foundation.

Sheet piling will be used when necessary to protect the pits opened to lay cooling water pipes. Sand-gravel beds will be used to prevent rises and falls on the sea floor resulting from excavation.

IV.1.7. Existing and Planned Utilization of Surface Water Resources

State Hydrological Works General Directorate (D.S.I.) is planning to construct two reservoirs on the Kinikli Stream, approximately 11 km North-West from the Project Site. Consent of D.S.I. on the Project Site in relation with Kınıklı Stream is given in Annex IV.1.7.1.

Information on local fishing and living species in the sea is given in Chapter IV.1.8.1.

The sea shore is used for recreation purposes, mostly by the residents of the summer houses. UNI-MAR A.S. expropriation plan includes approximately 15 000 m³ land at the sea shore, which is presently not occupied. This area will be preserved by the Company as a beach for public use during operation period of the Plant. Dense housing as will not be permitted.

IV.1.8. Species living in seas or in-land water resources such as lakes, fishing weirs, rivers

There exists no species in the region which are under protection by International Laws and Regulations. Turkish Aquatic Products Law (No. 1380) and Cost Guard Law (No. 2692) are related with reproduction, nutrition, sheltering and living medium of the fish species. Additionally, there are Decisions based on recommendations of the experts for the measures to be taken to protect the species with economical value. The types and quantities of local catch fish caught near the bottom of the sea in Marmara Ereglisi are given in Table IV.1.8.1.

Table IV.1.8.1 Local Catch Fish

Species	Quantity (tons/year)
Sole (<i>Solea sp.</i>)	5
Swallow (<i>Triglia sp.</i>)	1-2
Dab (<i>Pleuronectes sp.</i>)	2
Whiting (<i>Gadus euxinus</i>)	10
Surmullet (<i>Mullus surmuletus</i>)	1

Pelagic fishing is also done by the local fishermen. Bonito, Blue Fish, Gilt-head bream, Medium Sized Blue Fish, Horse Mackerel, Sardines, Mullet, Garpiki are the most common species. There is no data concerning the amounts of these fish. During January, February and March, sand mussels are collected and sold to a private company. The amount is believed to be 100 tons/year. Rock mussels are also collected but the amount is negligible. In the recent years, oysters were also collected. Demersal fishes live in the benthic and they are ventrally flat. Their bodies are thick, hard, spiny or without spines, gelatinous. Pelagic fishes are partly or totally laterally flat. They move quickly and feed on phytoplankton and zooplankton.

IV.1.9. Thermal and geo-thermal Water Resources

There are no known thermal and geo-thermal water resources in the region.

IV.1.10. Protected Areas

The Project Site is not located in National Parks, Nature Parks, Wetlands, Natural Monuments, Nature Protection Areas, Biogenetical Reserve Areas, Biosphere Reserves, Natural sites and monuments nor Special Environment Protection Areas and Special Protection Areas. (See Annexes IV.1.7.1., IV.1.10.2., IV.1.11.1., IV.1.15.1.)

Within the borders of the Marmara Ereglisi Municipality, the first degree archeological sites are found close to the town center. The area between Kamara Stream and Baglar Stream is third degree archeological site. (Annex IV.1.10.1)

Summer houses settlement is of importance in the region due to proximity to Istanbul. There are about 120 vacation sites in Marmara Ereglisi, 25 of them being in Sultanköy.

IV.1.11. Forest Areas

There is no considerable forestal area. Bushes and small groups of plants are found. See Annex IV.1.11.1. for the consent of Ministry of Forestry.

IV.1.12. Flora and Fauna

Mid-and South Inner Thrace is a wide steppe without any forests. There are sporadic bushes and unimportant forest remains that can be cut. Although this region is mostly formed of steppes, this is not natural but anthropogenic. The region is divided into two forest growing groups: Hacidag-Malkara group and Tekirdag-Seymen-Silivri group.

The forests in Hacidag-Malkara group were devastated through cutting and grazing. The forestal species are *Quercus* (Oak) and *Carpinus* (Eastern Hornbeam). In addition, *Pinus Bruttia* can also be seen. Tekirdag-Seymen-Silivri group is also deeply devastated. In the remaining parts of this group, forestal remains have turned into bushes and the region is becoming a pasture. Two of the areas concerned is Haciveli grove to the North of Tekirdag and Twin Peaks to the North of Canta. Tüylü Mese and Karaçali are the species of these parts.

In addition to these, annual, biannual and multiannual, flowering (in April, May and September) species exist, generally growing in ruins, road sides, river beds and bushes: *Hyoscyamus niger* L., *Centranthus ruber* DC., *Taraxacum officinale* Wigg, *Anemone pavonina* Lam, *Ranunculus repens* L.

According to the data obtained, the region is not host to extinct species. Plant biotops in narrow areas and some fauna, especially sparrows, with this flora can be observed.

During September-October and May, Karabildircin (*Coturnix coturnix*) is hunted. Also, the region welcomes migrating birds occasionally. Among these ducks species like Yesilbas (*Anas platyrhynchos*), Elmabas (*Anthya malia*), Kilkuyruk (*Anas acuta*), Mikirdak (Camurca) (*Limosa limosa*) and Marti (Alacali) (*Larus sp.*) are hunted from November to February. There are no flora or fauna that is protected by national or international laws and regulations. There are no scare or extinct species. In order to protect the wildlife, hunting duration, hunting limits and protected species are specified in accordance with the Land Hunting Law (Law No. 3167) is used (Annex A, line 24).

The following species are also observed:

Emys orbicularis L. in still and flowing waters and coastal lines, *Mauremys caspia* Gmelin in fresh waters, *Ophisarus apodus* Pallas in shrubbery and stony places and *Lacerta Taurica* Pallas in open areas, low and sparse vegetation, stony and sandy regions (Muthar, 1973). *Coluber caspius* in stony river sides, mountain slopes, fields and marshes and *Salamandra salamandra* L. in high humid forests or in tree groups can be observed.

IV.1.13. Stockbreeding

Commercial stockbreeding is not common in Marmara Ereglisi or Sultanköy. The farmers feed stock for their own needs. There are 1250 cattle, 280 sheep and goats. Figures for poultry are not available.

There is no cultural fishery in Tekirdag.

IV.1.14. Mines and fossil fuel resources

There are no known mines or fossil fuel resources with economical value in the region.

IV.1.15. Areas with high landscape value and recreational areas

The region has a recreational importance, especially because it is close to Istanbul. The beach in Sultanköy is an important recreation area. See Annex IV.1.15.1 for the consent of the Ministry of Tourism on the Project Site.

Lands under control and responsibility of authorized governmental agencies

Following are the lands at the surroundings of the Project Site and under control of governmental agencies;

- Military Fuel Oil Storage Area in Marmara Ereglisi Centrum,
- Military recreation facility 4 km. to the West of Marmara Ereglisi,
- BOTAS LNG Terminal at 4 km to the North East of Marmara Ereglisi Centrum.

IV.1.17. Existing pollution load of the area

Air Quality

In order to assess the air quality at the Power Plant area, particulate matter, sulfur dioxide and nitrogen dioxide measurements have been made (27.02.1994). The measurements took place near close to, 20m. towards the Project Site. During the measurements, there was a light wind towards South. The weather was slightly cloudy and the ambient temperature was 17°C.

The results show that, sulphur dioxide and nitrogen dioxide levels were about 3.0 µg/m³. The level of particulate matter was 150 µg/m³. According to these results the air quality in the region is fine when sulfur dioxide and nitrogen dioxide parameters are concerned. The results obtained are below the Short Term Limiting Values stated in the Air Quality Control Regulation (Annex A, line 14). The particulate matter result is equal to the 150 µg/m³ stated as the maximum 24-hour limiting value for Winter given in the Air quality Control Regulation. The value for 1-hour is not given in the same Regulation.

Water Quality

At the community, there is not a sanitary sewer system. The domestic wastewater is collected in partly perforated septic tanks. The septage is removed periodically by scavengers and are disposed on lands selected by the Municipality. Thus, the pollution of coastal waters is quite negligible as there is not any direct sewer connection to coastal area. However, there is a serious risk of underground water pollution. The coastal water is suitable for recreational purposes. On the other hand, during the summer months, there arises a coastal water pollution due to the increase in population. The pollution level has

not been determined by any sufficient epidemiological data so far. The pollution risk from the proposed plant will be quite low, so it can be assumed to be negligible. The plant consists of its own wastewater treatment plant.

The groundwater samples collected from the drilling wells present near the plant area, indicate that the NH_3 , NO_2 and NO_3 parameters an indicator of pollution of domestic and agricultural waste waters, are significantly high (Table IV.1.3.2.).

It can be stated that, the groundwater especially near the soil surface is highly polluted.

The only river basin at the district is Kinikli Stream which is usually dry in most of the year. The river receives water only by rain at rainy periods. At present, the downstream of the river is closed. The collected water is usually used by various construction companies. As the river is usually dry, any active biological life is not detected.

Noise Level

Measurements were made at 7 various sampling stations, in order to determine the present noise levels at the Project Site and background noise level is determined as 38 dBA in average. The main source of noise pollution is the nearby D110 highway. According to the frequency analyses the basic noise source is the low frequency noise generated by tyres of the vehicles.

Background noise level measurement was made in accordance with IEE Standards using 1" condenser microphone, Sound level meter DAWE type 1400 H, Oktave filter set DAWE type 1464 A and acoustic calibrator DAWE type 1418 B. TS 2606 of Turkish Standards Institute was followed for the measurement methods.

Sound level measurements were made during 10 minute recording as "A" weight sound level (dBA). Frequency Analysis is given in Table IV.1.17. See Figure IV.1.17.1 for location of sound measurements.

Table V.1.17. Frequency Analysis (Hz/dB)

Location no.	Leq dBA	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
1	38	48	38	33	31	31	31	28	24
2	36	54	51	40	36	33	31	29	24
3	48	65	58	54	45	46	44	45	30
4	36	46	45	40	33	34	33	30	25
5	37	43	42	36	32	32	32	29	24
6	37	45	43	37	32	32	32	29	25
7	38	53	49	39	31	32	32	30	25



Figure IV.1.17.1 Location of Sound Measurements

IV.2. Characteristics of Socio-Economic Environment

The information in this section is taken from Provincial and Regional Statistics by State Institute of Statistics of the Prime Ministry, Republic of Turkey.

IV.2.1. Economic characteristics

The economy in Marmara Ereglisi is mostly dependent on agriculture. The sectors in the region are given in Table IV.2.1.1. The Chamber of Commerce and Industry in the region has 250 members and the number of members is expected to reach 350 in near future. 50 % of the members are involved in commerce and 50 % in industry.

Table IV.2.1.1 Economical Sectors in Marmara Ereglisi

Sector	Percentage
Agriculture	% 70
Commerce	% 10
Industry	% 10
Fishing	% 10

The industrial facilities in the region are:

1. Türk Petrol Storing Facilities
2. Military Fuel Oil Storing Facilities
3. Asphalt and Bitumen Storage Facilities of the Department of Roads and Highways
4. Derkon Leather Ready-to Ware Factory (320 workers)
5. Paksan Steel Goods Factory (150 workers)
6. Türkmen Velvet Factory (Closed)
7. BOTAS LNG Import Terminal

1/20 of the total wheat production of Turkey takes place in Tekirdag. Sunflower and watermelon agriculture is also economically important.

The annual income per capita is assumed to be 10-12 million TL.

IV.2.2. Population

Actual Population at the Immediate Vicinity of the UNI-MAR Power Plant

The population has been examined at the immediate vicinity of the Power plant which will be constructed at approximately, 1 km SouthWest of Sultanköy village, 900 m West of the Marmara sea shore and 2 km NorthWest of the BOTAS LNG Terminal at Marmara Ereglisi.

Presently, total 40 houses are observed in the area of 78,5 hectare which is covered by a 500 m diameter circle with center where the Gas Turbines of the proposed Power Plant will be placed. Location of the existing houses according to the Power Plant area and their population is explained in Table IV.2.2.1.

Table IV.2.2.1. Population at the immediate vicinity of the Power Plant

House Group	Location	Population	Use
4 houses	within expropriation limits	20	Summer (rarely winter)
3 houses	500 m NorthWest	12	Summer-winter
30 houses (64 units)	350 m South	0*	Summer
3 houses	400 m Southeast	15	Summer-winter

* Under construction

Actual population at the examined area is 47-50 corresponding a density of 0.63 person/hectare. Additional maximum 300 person could be expected upon completion of 30 houses which are now under construction, so the density may reach 4.46 person/hectare. Low population rate at this spot and the positions of the existing houses had been an important criteria for final site selection for the UNI-MAR Power Plant.

Information on Tekirdag is given in Table IV.2.2.2.

Population in Marmara Ereglisi

Population changes in various villages of Marmara Ereglisi are given in Table IV.2.2.3.

Until 1983, the growth rates in Marmara Ereglisi and Sultanköy were 2% and 1%. Starting in 1985, when Marmara Ereglisi became a district, the growth rates increased to 17% and 29%. The age pyramid for the province of Tekirdag is given in Table IV.2.2.4. Census of population is for 1985.

Table IV.2.2.2. Population Information on Tekirdag

Total Population	468 842 people
Population of Province and District Centurms	258 940 people
Sub-district and village population	209 902 people
Total Annual Growth Rate	%o 30.40
Growth Rate of Province and District Centrum	%o 43.22
Growth Rate of Sub-districts and villages	%o 15.65
Area	6 218 km ²
Population Density	75 people/km ²

Table IV.2.2.3. Population change in Marmara Ereglisi

Place	Population (1935), person	Population (1985), person	Population (1990), person
Marmara Ereglisi	1433	2943	5387
Çesmeli	505	420	665
Sultanköy	625	698	1715
Türkmenler	548	453	443
Yakuplu	517	471	426
Yeni Çiftlik	1439	2282	3730
Total	5067	7267	12366

IV.2.3. Local Social Infrastructure Services

IV.2.3.1. Educational Infrastructure

The rate of literacy in the region is 98%. Information on the schools in the district centrum is given in Table IV.2.3.1. In Sultanköy, the the existing school consists of four classrooms, three of which are currently used. Three teachers conduct a combined education. One classroom is empty.

Table IV.2.2.4. Age Pyramid for the Province of Tekirdag (1985)

AGE GROUP	MALE	FEMALE
0 - 4	17 737	17 113
5 - 9	19 844	18 743
10 - 14	19 207	18 016
15 - 19	20 823	18 213
20 - 24	38 796	18 036
25 - 29	19 854	16 706
30 - 34	17 018	13 947
35 - 39	12 086	10 813
40 - 44	9 157	8 166
45 - 49	8 957	8 262
50 - 54	9 484	8 960
55 - 59	8 431	8 244
60 - 64	6 229	6 028
65 - 69	3 341	3 688
70 - 74	3 079	3 363
75 - 79	1 999	2 579
80 - 84	929	1 614
85 +	470	1 074
UNKNOWN	625	350

Table IV.2.3.1. Marmara Ereğlisi District Centrum Educational Status

School	Number of Teachers	Number of Students
Primary School	27	750
High School	9	90

IV.2.3.2. Health Infrastructure

There are two health centers in the region, one in district centrum and the other in Yeniçiftlik. Six practitioners, four nurses and three midwives work in the district centrum; whereas, three practitioners and two nurses work in Yeniçiftlik. One midwife is employed in each health center in Sultanköy and Yakuplu.

There are no dentists within the district. Only pharmacies serve in the centrum. In the district there is one ambulance which belongs to the Municipality.

There are neither Governmental nor Social Insurance Institution hospitals in the district. The patients are transferred to the Tekirdag and Çorlu to Government or Social Security Institution hospitals by the health centers when necessary.

IV.2.4. Urban and Rural Land Utilization

The nearest harbour to the region is the Tekirdag Harbour. The housing is scattered. Emlak Bankasi has invested in a 3000 residence project. An industrial site in the district centrum is also planned.

Summer houses occupy the shores very densely. Majority of the houses were constructed as co-operative houses owners often live in Istanbul and Tekirdag. Population increases during weekends, summer and school holidays.

IV.2.5. Income

The annual average income in the region is 10-12 million TL. per person.

IV.2.6. Unemployment

The unemployment rate in the region is 7%.

IV.2.7. Health

There are no endemic diseases in the region.

CHAPTER V

Impacts of the Project on environment and measures will be taken

V.1. Activities during land preparation, construction and installation stages, impacts on physical and biological environment and measures to be taken

V.1.1. Location and amount of excavation works, materials and explosives which will be used during excavation in land preparation stage

Excavations will be made at Power Plant area (Area A) and cooling water pipes route (Area B) , for natural gas pipe connection, and access road construction as shown on Figure II.2.1.

Excavations and backfilling for buildings, structures and roads are estimated 350 000 m³. Heavy construction machinery will be employed as for excavation and backfilling activities as listed on Annex V.1.16.1. Sheet piling and temporary delowering of ground water will be necessary at " Area B ". Dynamite may be used for rock blasting. Safety measures will be taken during blasting according to "Communiqué for the precautions to be taken at the works and facilities where the flammable, explosives, dangerous or harmful materials utilized" (Annex A, line 1). Some 150,000 m³ of this excavated material has been foreseen to be used in the switchyard area (Area A), for backfilling.

V.1.2. Where excavation waste such as soil, stone, sand, etc. will be transported and for which purposes they will be used

Excess material from excavation of the buildings, structures and roads is estimated as 150 000 m³. This will be dumped and leveled at the filling areas determined by the Municipality. Granular material of about 25 000 m³ has been foreseen to be transported by dump-trucks from operating quarries in the areas for use as back filling material in required areas of construction.

Any excavated soil, stone, sand, etc. obtained from the excavation works shall firstly be stored in an appropriate place at the job site for the purpose of being reused in the construction works and any surplus of inappropriate material shall be removed from the Site and shall be dumped at areas permitted by relevant authorities for these purposes.

V.1.3. Where and on how much area will filling and construction on piles be made in water medium and the material that will be used

The Project does not include any filling works in water environments for land gaining or other purposes but the piling works to ensure ground safety of the marine structures. Marine structures include, a sea water inlet pipe of 500 m and a water intake, a sea water discharge pipe of 160 m and a multi-port diffuser of approximately 160 m long. Location of these structures is shown on Figure II.2.1. as construction " Area C ".

The intake cooling water pipe will be buried and founded on piling structures in dredged ditches. The discharge pipe will partly be buried and founded on piles in dredged ditches. The multi-port diffuser will be installed above sea ground level and founded on piling structures.

Design and dimensions of the marine structures are shown in Annex V.1.3.1.

V.1.4. Works which will be performed to ensure ground safety

Area A Power Plant Area

The Power Plant will be founded on flat foundations immediately in the moderate rock and above the underground water table. The central area (gas and steam turbine) with a planned zero level of approx. + 10 m a.s.l. shall be located on a flat ridge to be excavated. At the western boundary slopes with a height up to 20 m arise with an average slope inclination of 1:1.5 (vertical: horizontal) in the top soils and the weathered rock or with an inclination of 1:0.6 (vertical : horizontal) in the non-weathered rock. At the rock surface, an approx. 3.5 m broad berm shall be arranged containing a well-dimensioned out drain for surfacial dewatering.

For excavation of the solid sandstone with compressive strength up to 1000 kg/cm^2 blasting may become necessary. To avoid unnecessary disturbance of the rock pre splitting method has to be applied.

The excavated sandstone and siltstone may be used as filling material in the switch yard area and for the temporary site facilities and storage areas. Parts of the switch yard and other structures will also be founded on flat foundations on this well compacted fill.

The agricultural soil shall be separated before further excavation and filling. This may be used for final fill of Plant areas to be recultivated or other filling purpose in the parts of the Northeastern plane.

Area B+C: Cooling Water System

As the soft clays and the loose to medium dense sands of the up to 35 m thick Holocene sediments are found to be not stable in case of the design earthquake (liquefaction and cyclic mobility) the on shore and off shore cooling water pipes and structures shall be founded on piling systems. The piles have to be founded in the bedrock up to 35 m depth. The steel piles may be driven or vibrated but considering the existing houses between the new road to Tekirdag and the shore the piles will be bored or jacked in this area to avoid harmful vibration and the settlements of the houses.

For excavation of the 5 m deep cooling water pipe trace, local temporary underground water lowering may be required. The temporary excavation and site road requires an approx. 15 m. broad strip of land on both sides of the trace axis. For crossing the existing roads sheeted excavation pits have to be performed which temporarily narrow the roads.

V.1.5. How and where flood prevention and drainage activities will be carried out

The system will consist of concrete pipes during operation and during construction. Rain water collected from roofs will be drained and reacquainted. The area covered by the plant will be 11.3 ha. The area served by the drainage system is approximately 37.5 ha. (see Figure V.1.5.1.). The coverage of the ground in the drainage area can be considered to be 30 % concrete and 70 % earth; outside the drainage area, totally earth. Therefore, the concrete and earth sections of the drainage area are:

Concrete area = 3.4 ha
Earth area = 7.9 ha

Runoff coefficients for concrete and earth surfaces are 0.9 and 0.2 respectively. 10-minute-period rains that may occur once in every 5 or 10 years have been considered and storm flow rates calculated as follows.

$Q_5 = 25 \text{ m}^3/\text{sec}$
 $Q_{10} = 33 \text{ m}^3/\text{sec}$

(2.5) ^{??}
(3.3) ^{??} ~~incorrect~~ (USE TEKIROVA DATA)

In this case, the rain water flow rate in the drainage area for 10-minute-period rains which occur every 10 years is increased by 16%. The rain water collected will be directed to Kınıklı Stream in accordance with the topography of the Site.

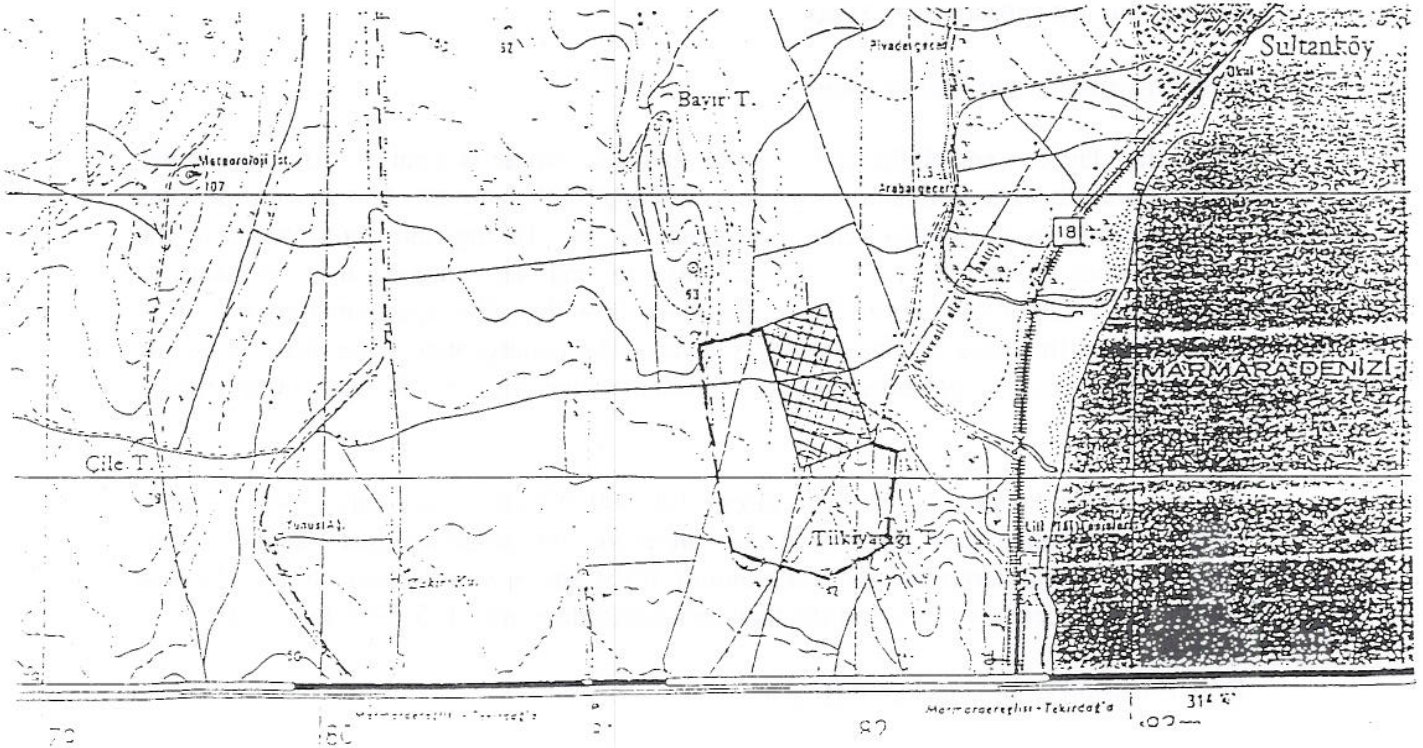


Figure V.1.5.1. Drainage Area

V.1.6. Transportation, storage and utilization of flammable, explosive, dangerous and toxic materials which will be used during land preparation and construction stages; tools and machines which will be employed for this purpose

Dynamite may be used for rock blasting. Estimated quantity is 1kg per ton of the material to be excavated. Dynamite will be transported to Site on the " just in time " basis, at the quantity needed for one day's work. Dynamo-type activator, batteries, ignition cord will be used by trained workers for activation of dynamite.

Radioactive material may be used in testing devices for seam weld on pipes, during erection. Such work will be carried out by specialized companies and certified workers. The isotopes used are low radiation type and transported in lead containment.

There will be one fuel apron surrounded by screens to serve the construction machinery.

Paints and thinners to be used during construction as flammable material. Products of Turkish Machinery and Chemical Industry (MKE) or equivalent will be utilized. Safety measures will be taken during transportation, storage and blasting according to Communiqué for dangerous and harmful materials (Annex A, line 1 and line 10). List of machines and equipment is given in Annex V.1.16.1.

V.1.7. Activities spreading dust such as crushing, grinding, transportation and storage during construction stage

Dust Emission during Construction:

When the clay content of the soil is 30 % and the climate is semi-dry, during regular construction, the emission factor is given as 297 kg/1000m²-month. This amount denotes dust emission with particle size less than 30 m. Taking into consideration the characteristics of the Project region (humidity rate and clay content), it is necessary to modify the value of this factor. The soil studies show that after approximately 0.5 m. of vegetation earth, come silt and sand-clay layers. The underground water level is mostly 2.5 m. Therefore, the emission factor is chosen within the 75-150 kg/1000m²-.month range.

The area of the Project Site is 14 hectares (140 000 m²) including roads, Cooling Water pipeline and natural gas pipeline areas. Therefore, the resulting dust emissions vary between 5250 kg/month and 10500 kg/month. If the Site is watered twice a day, the dust emission is reduced by 50 % and the final emission values are 2125-5250 kg/month.

Dust Emission from Uncovered Roads:

Depending on the soil characteristics, rain, vehicle weight, number of wheels and velocity, dust emission from the roads vary within the range of 0.2 - 10 kg/vehicle/km. For the Project Site, the emission factor is 10 kg/vehicle/km (USEPA AP 42). 350 000 m³ of excavation is deduced for the Project Site. Therefore the total dust emission is 8750 kg / km.

If the excavation volume is taken as 350 000 m³, the emission will be 8750 kg/km. Dust

emission is reduced by 80 % when the roads are watered. The result, in this case, is 1750 kg/km.

Aggregate Works and Storage:

The emission factor given for aggregate loading and emptying are given as 0.003-2.4 kg/ton (USEPA AP 42). For the Project Site, this is taken as 0.05 kg/ton. In case of 350 000 m³ of excavation 17 500 kg of dust will be emitted. 50 % of the emission will settle around the location where aggregate works are carried out.

Emission factor for wind erosion during storage is given as 0.5 - 8.8 kg/day hectare (USEPA AP 42). For the Project, the factor is taken as 2 kg/hectare. The surface area for the material to be stored have a surface area of approximately 2 hectares. Accordingly, the dust emissions are reduced to be 4 kg/day.

V.1.8. Excavation, dredging activities, etc. which will be performed for any purpose in water environments within the Project area; where and how such activities will be carried out; size of the area which will be affected, amount of stone, sand, pebble and similar materials which will be excavated as a result of these activities and where they will be transported and for what purposes they will be used

Main cooling water pipes will be installed in the "Kuru Dere" bed near the plant.

Cooling water intake line will be between the coast and -10 m. deep point; thermal outlet line will be between the coast and -11 m. deep point (Figure V.1.8.1 and Annex V.1.3.4). The length of the cooling water intake line in the sea will be approx. 500 m., the length of the thermal outlet line including the diffuser will be approximately. 310 m. The diameters of both concrete pipes will be 2500 mm. and they will be laid separately in separate trenches.

The thickness of the gravel above the pipe crown will be minimum of 80 cm. The pipes will be supported by piles to control soil subsidence. The excavation depth can be taken as 4.0 m.

The safe trench width is: $B_t = 5.6$ m. The cross sectional area of the trench based on the trench sidewall slope of 1 (vertical) : 2 (horizontal) $A = 38$ m²

This value can be reduced to $A = 22$ m² provided that the stability of the trench is maintained by sheet piling. Therefore, taking into consideration that 75 % of the pipeline will be within trenches, the quantity of the excavation at the worst case is:

$$V_t = 20.000 \text{ m}^3$$

The approximate quantity of the excavated material which will be used as backfilling material is $V_d = 16800$ m³ (%84). The surplus of the excavated material of $V = 3200$ m³ will be spread on the trench.

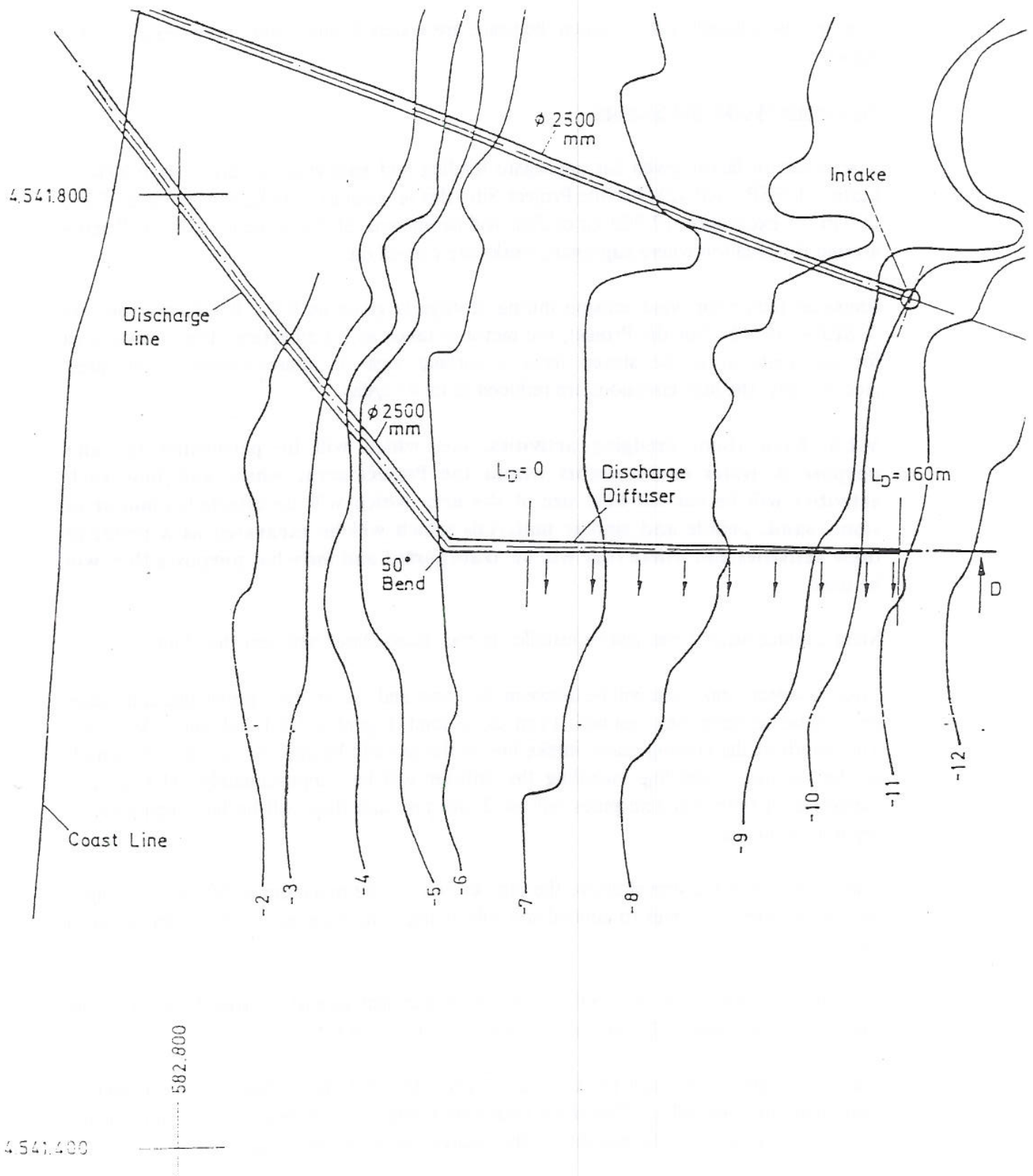


Figure V.1.8.1. Water Intake and Discharge Layout

V.1.9. Transportation infrastructure plan of the Project, activities related with the construction of this infrastructure; materials, chemicals, tools, machines which will be used; dust-emitting mechanical activities such as crushing, grinding, transportation and storage

a. General Status

Marmara Ereğlisi Natural Gas Fired Combined Cycle Plant can be reached via D110 highway (See map, Figure V.1.9.1.). This highway is 2 x 3.50 m. wide and open to traffic in both directions. There are ditches to both sides of the road. The surface is asphalt and the geometrical and physical condition of the road is generally good.

There is only one small harbour in Marmara Ereğlisi and it can only be of limited service. Marmara Ereğlisi cannot be reached via railroad. There is a military airport in Çorlu.

The traffic on the D110 highway is quite busy. During Summer the traffic increases due to summer residential areas extending on the coast of the Marmara Sea.

The average daily traffic load on the D110 highway for 1992 is given below. Observations were made near Marmara Ereğlisi.

Automobiles	:3542/day
Buses	:423
Trucks	:1363
Trailers	:65
Total	:5393

The major changes in the traffic density occur in summer months during the vacation period. Number of automobiles which use this highway in Summer is 2-3 times more than the yearly average.



Figure V.1.9.1. Roads of the Region

No important changes occur in the heavy vehicle density. The rate of change in June and September are relatively less. D 110 will be used during construction of the UNI-MAR Power Plant in order to reach the Site from Tekirdag direction as well as direction of Istanbul. Frequency of truck traffic will be high as 2000 trucks in during excavation, site preparation and access road construction. Heavy machinery (turbines, transformers etc.) will be transported from Tekirdag harbor however this is not a frequent operation.

b. Site Access Road

A new access road will be constructed by UNI-MAR A.S., at industrial standards to reach the Power Plant area from D110 Istanbul-Tekirdag highway. Location of the junction on D110 has been recommended by Turkish Highway Authorities with considerations of existing and future traffic load of D110 and safe approaching distances. The route of the access road will be detailed by the urban planners and engineers to maximum 6% slope. Road will be ~1000 m. long and 8 m. wide with two lanes and proper drainage. Access road will be included into future local urban plan for the approval of the Municipality.

D 110 junction will be at ~600 m. distance from the BOTAS junction in route from Istanbul. "T" junction design will satisfy all necessary safety measures and traffic requirements with appropriate turning angles, signs, traffic lights, raised aisles, etc. (Figure V.1.9.2). This road will also provide access to BOTAS as well as reaching BOTAS metering station and pipeline for their maintenance and operation purposes. Civil works for the road construction includes excavation, filling, compaction, concreting, drainage channels, asphalt pavement, electrical works installation of the traffic signs and lights. Necessary concrete structures will be constructed where the access road passes over the existing BOTAS pipeline and safety measures will be taken. Heavy construction machinery will be employed for certain period of time as listed in Annex V.1.16.1. Explosives may also be used for rock blasting. Excavation and filling during construction of the road, will increase dust emission and noise levels which are examined in Chapters V.1.7 (dust) and V.1.16 (noise). There will be no crushing, grinding activities at the Site. Granular material will be procured from commercial sources and transported to Site by dumper trucks only when necessary.

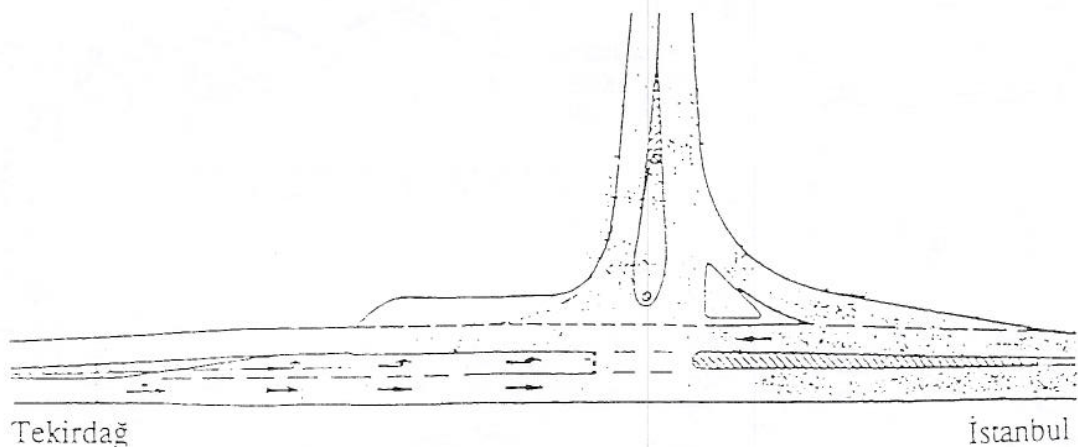


Figure V.1.9.2. "T" Junction for Connection of Site Access Road to D110 Highway

V.1.10. Plan of water supply the Project, activities related with the construction of this system, materials which will be used for these activities; amount of water which will be supplied from resources and amount of process water; boiler and/or cooling water, drinking and consumption water and other utilization of water

Only source of the water to be used as cooling/process water and for domestic purposes is the sea water of 31 000 m³/h.

This quantity will be consumed as below:

Open Cooling system	: 29 900 m ³ /h
Desalination Plant	: 1100 m ³ /h

Desalination Plant produce 105 m³/h of potable out of 1100 m³/h water which will be used for:

Potable and consumption water	: 15 m ³ /h
Make-up for steam system	: 20 m ³ /intermittent
Water for NO _x Control	: 70 m ³ /h in case of fuel oil operation

Sea water will be taken from the Marmara Sea by means of a water intake structure and concrete pipes of 2500 mm diameter and discharged by separate line of concrete pipes. Considering geophysical properties of the Seabed together with the seismic criteria all marine structures will be supported by piles which will be driven into the rockbed under the seabed.

Both intake and discharge pipes will partly be buried into the seabed. Therefore dredging and back filling will be made at these areas.

At the sea shore a pump house will be constructed on piles. Main part of the pump house will be under the ground and there will be a concrete housing on the surface level in consideration of environmental issues. Amounts of water for various purposes are shown in detail on the flow diagram of the water supply system (See Table V.1.10.1.).

Water Supply Plan During Construction:

Water will be needed for domestic use, cleaning purpose, rinsing against dust propagation and cooling of tools during drilling in variable amounts according to work schedule and construction phases. During early construction phase (excavation and piling works), water will be transported by road tankers or recovered from wells or taken from the river. 200 tons above underground water storage tank(s) will be provided at Site for standby purpose. Drinking water will be purchased from local suppliers.

Desalination plant will be installed right after early construction and mobilization phase. Temporary piping will be laid down, between the shore and the Site.

V.1.11. Amount and characteristics of waste water within the frame of the Project, amount and characteristics of cooling water, plans of discharge systems, activities related to construction and installation of these systems, characteristics of the treatment units in the system, sewerage system, how and where water will be discharged

The following types of waste waters will be generated by the Plant.

- Domestic waste water
- Waste water from the desalination plant and demineralization plant (intermittent)
- Blow down of HRSGs (intermittent) via drainwater pit in cooling water return
- Waste waters from HRSG and GT off line cleaning (intermittent)
- Waste water from the oil separator (intermittent)
- Rain water

Cooling Water and Process Water quantities and chemical consumption are given in Table V.1.11.1.

a) Domestic Waste water

The number of daily personnel in operation, maintenance, administration and other units is around 50. Domestic waste water of the personnel and cafeteria will be collected with a separate pipeline, treated in a activated sludge process-package plant, disinfected and then used to water green land and/or given to the thermal discharge line. The effluent from the package treatment will meet the Water Quality Control Discharge Limits. An oil trap will be installed for the waste water from the cafeteria and thus oil will be prevented from entering the package treatment. Characteristics of the package type waste water treatment plant is given below:

Water consumption	: 250 l/day/capita
Max. population to be served	: 100
Organic Load	: 60 g/BOD ₅ /day/capita
Treatment efficiency	: 90-95%

Stages of the process:

- Coarse screening
- Aeration
- Sedimentation
- Pressurized Sand Filtration
- Disinfecting

Civil works for the treatment plant include construction of waste water supply pipe, piping for transporting the plant effluent, excavations, landfills, concrete works and finishing works.

During construction and erection stage 400- 600 people will be employed at the Site, and domestic waste water will be collected from temporary Site facilities i.e. cafeteria,

canteen, WC's, showers, and will be discharged to approximately 250 m³ capacity septic tank that will be constructed within the Site boundaries. Septic tank will regularly be emptied by the scavengers in co-operation with the Municipality. Civil works include, excavation, concrete works and piping works and removal, backfilling, landscaping works, when package treatment goes into operation.

b) Rain Water

Rain water collected on the Project Site will be given to Kınıklı Stream via a separate pipeline. Rain water from outside the Site will be collected and directed away from the Site by storm water diversion channel and discharge network.

c) Desalination Plant Waste water

The desalination plant capacity is 1100 m³/h. Approximately 1000 m³/h of water with increased salinity will leave this plant. This will be returned to the Marmara Sea through the thermal discharge line. Waste water resulting from the cleansing of desalination plant by acid will be neutralized and given to the thermal discharge line. Desalination plant effluent water characteristics are given in Table V.1.11.1.

d) Boiler Blow-Downs

Amount of water reduction because of boiler blow-downs will be about the same as make up water. Estimated 20 m³ once a week of distilled water will be discharged through the thermal discharge line. There are no pollutants within this water which will cause ecological damage in the receiving medium.

e) Waste water From Gas Turbine Compressor Cleaning

Waste water with high suspended solids concentrations will be generated when HRSG's and the compressors providing the gas turbines with air are off line cleaned. This waste water will be discharged to the sea through the thermal line.

Quantity and quality of chemicals in the cooling water, desalination, demineralization and domestic waste waters and waste water coming from the package treatment are given in Table V.1.11.1.

WATER COOLING SYSTEM FLOWCHART

V.12

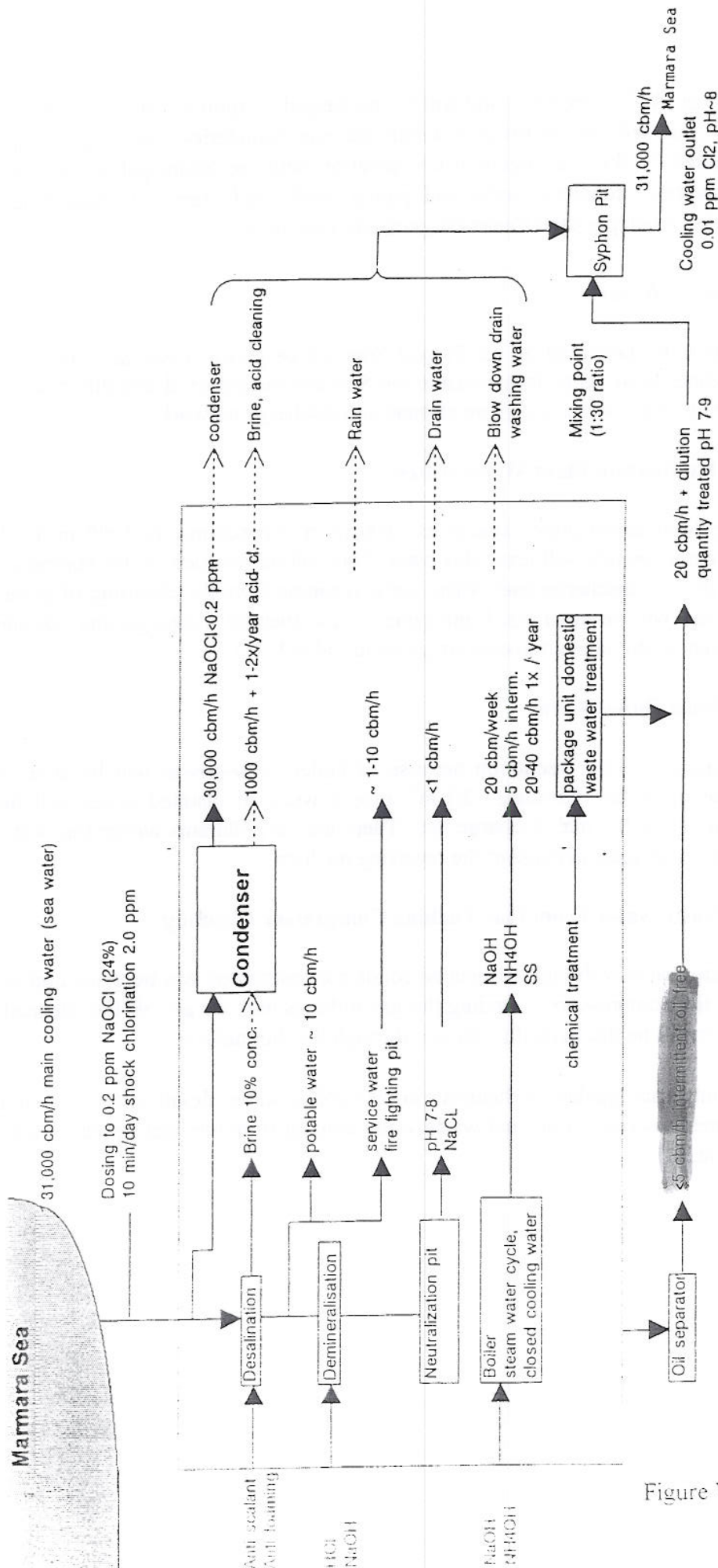


Figure V.1.1.1.1

Table V.1.11.1. Quantity and quality of the waste waters generated and remarks:

System	Chemicals	8000 hours gas operation(a)	10 days fuel oil operation(a)	total consumption per year(a)	remarks
Main cooling water $Q = 31000 \text{ m}^3/\text{hour}$	NaOCl [%24] (for controlling biological growth)	450 t/year $= 360 \text{ m}^3/\text{year}$ $\sim 52 \text{ m}^3 \text{ CL}_2/\text{year}$	15 t/year $= 12 \text{ m}^3/\text{year}$	465 t/year $= 375 \text{ m}^3/\text{year}$	a
Desalination plant	Anti-Scaling[100%] Belgard EV Anti-Foaming[100%] Belite M8 Acid Cleaning HCl[30%]	750 kg/year 100 kg/year included in demineralization plant	90 kg/year 12 kg/year included in demineralization plant	850 kg/year 120 kg/year included in demineralization plant	b,c
Demineralization water	HCl [%30] NaOH [%50]	150 t/year 100 t/year	20 t/year 12 t/year	170 t/year 115 t/year	b,c
Water steam cycle $Q = 20 \text{ m}^3/\text{week}$	NH ₄ OH [%30] NaOH [%50]	5 t/year 5 t/year	150 kg/year 150 kg/year	5.5 t/year 5.5 t/year	d
Closed Cooling Water	NaOH	included in demineralization plant			d

a: 0.2 ppm continuous dosing level, 2 ppm shock chlorination 10 min/day
b: will be discharged to the Marmara Sea after it has been neutralized (pH=7)
c: values just for information, they can change when supplier is chosen.
d: only in case of emptying the systems

V.1.12. Electrification plan of the Project, activities which will be carried out and materials which will be used for the implementation of this plan; locations and capacities of energy transmission lines and transformers

Electrical Energy generated by GT and ST generator units in the Plant shall be delivered to double + transfer bushbar system of Plant's 380 kV switchyard via step-up transformers. Step-up transformers shall be able to reach a 230 MVA capacity by forced cooling system. Auxiliary consumption requirement of the Plant will be met by 2 transformers of 15.75/6.6 kV 20 MVA capacity. 2 emergency steam turbine generator sets each having 3.5 MW rating to serve for black start and emergency conditions.

There will be three outgoing feeders at Plant's switchyard for which the connection to 380 kV network shall be realized at first tower. Two spare spaces will be reserved for the future extension at Plant's switchyard.

Electricity during construction will be provided through TEK transformer station located at BOTAS Terminal. There will be diesel generator sets at the Site. Energy consumption estimated as 1 megawatts and may reach up to 2 megawatts at peak consumption.

V.1.13. Types; minimum calorific values sulfur, ash, nitrogen, volatile substance contents; humidity rates of fuels which will be used during all stages from land preparation to commissioning of all units; fuel consumption amounts, combustion systems where such fuels will be used for measurement

During construction approximately 350 tons of TÜPRAS-400 automotive diesel will be used by construction machines and trucks operating at the Site. Fuel oil will be transported to the Site by road tankers on daily need basis. One fuel oil apron will be prepared in separate fence at the Site for refilling of the Site machinery. Traveling lorries will refill at commercial petrol stations. The specification of the fuel is given in Table V.2.10.2.

V.1.14. Types and amounts of waste water which will be produced as a result of activities which will be carried out during all stages from land preparation to commissioning of all units; recipient environments where such water will be discharged

Domestic waste water will be generated by the workers and personnel during construction period. Number of workers will change in accordance with the nature of the activities at various stages. Waste water will be collected in a septic tank of 250 m³ capacity in consideration of peak number of workers within the temporary Site facilities area. The septic tank will be disinfected and emptied by the contractor in compliance with the instructions of the Municipality.

It is the intention to install the desalination plant as soon as possible in order to make use of the water obtained.

As long as this plant is not available water will be brought to the Site by road tankers or recovered from wells or taken from the river. For easy commissioning of the desalination plant, a temporary connection will be installed to the sea.

During early construction phase water will be used for ;

- human use
- cleaning
- prevention of dust propagation during excavations and on temporary roads.
- cooling of tools during drilling

As soon as the desalination plant is installed, it will supply the plant for final construction works, commissioning and subsequent operation.

V.1.15. Types and amounts of solid waste which will be produced as a result activities which will be carried out during all stages from land preparation to commissioning of all units or due to works which will be performed for excavation in water environments; where such waste will be transported and for which purposes they will be used

Solid waste that will possibly be produced during excavation and construction (duration 27 months) at the Power Plant area and in the sea are listed (Table V.1.15.1).

Table V.1.15.1. Description Solids Waste which will be generated during Excavation and Construction and Way of Disposal

Type	Quantity	Way of Disposal
Debris, (after cleaning works)	10 tons/month	Will be disposed to Municipality garbage area.
Garbage (domestic waste)	30 tons/month	Will be disposed to Municipality garbage area.
Packing material (during erection)	30 tons total	Will be carried in the containers back to factory for reuse.
Large size solid waste (ruined machinery etc.)	few pieces	Will be sold after storage at the site
Dried mud (during drilling works)	5000 m ³	Will be dumped into filling areas shown by the Municipality
Hazardous waste (battery, paint, etc.)	1000 kg	Will be collected in leakage-proof containers at site by the contractor and moved by the Municipality
Metal waste (scrap material, remaining construction material)	100 tons	Will be collected and sold by the contractor

The solid wastes generated will be recycled whenever possible in accordance with the Solid Wastes Legislation and suggestions of the Marmara Ereğlisi Municipality. When recycling is not possible the solid wastes will be disposed. Industrial and hazardous solid wastes generated will be disposed according to the suggestions and directives of the Ministry of Environment and cooperation with the Municipality.

V.1.16. Sources and levels of vibration and noise to occur as a result of the activities which will be carried out during all stages from land preparation to commissioning of all activity units

Noise from construction equipment and machinery during activities will propagate the surrounding area. The level of noise will diminish as it travels to the receiver primarily due to absorption of noise by the atmosphere and due to the spreading of the noise energy over a larger area. Noise level are predicted at the nearest residences located approximately 500 m distance from the site will be 45-65 dBA. The present noise levels have been observed on the Project Site as continuous equivalent noise level of 38 dBA.

List of the machinery and equipment that will be used during the construction is given in Annex V.1.16.1 The list includes the earth moving equipment like excavators, loader, material handling machines like cranes, stationary machines like pumps, generators and

others; carpentry shop, vibrators are shown. The upper limits of noise levels are given in the Noise Control Regulation, for construction machinery. The upper noise limits given in Noise Control Regulation are given in Table V.1.16.1.

Equipment and Machinery used will change according to the construction schedule given in Annex III.2.1. At the early stage of the construction piling and sheet piling will be made and dynamite will be used for rock blasting which creates impact noise. The upper limit for impact noise is 140 dBA according to Regulation.

Other limits are given on Table V.1.16.2. When it is not possible to meet the noise limits, these activities will be announced to local community and they will be informed about how long it will go on.

Table V.1.16.1. Construction Equipment and Machinery Upper Noise Limits according to Noise Control Regulation.

Construction Equipment & Machinery	Noise Level Leq(dBA)
Loader (60 - 67 kW)	110
Bulldozer (100 - 450 kW)	120
Excavator (45 - 80 kW)	105
Concrete Crusher, Air Tool(36 kg.)	110
Crane	105
Compactor (2 - 75 kW)	110
Concrete Batching Plant	115
Concrete Pump	115
Grader	120
Rock Drilling Machine	125
Compressor	115
Tractor	120
Wheel Loader	115
Electrical Motors (300 Hg,1200 rev / min)	105
Pump (300 Hp,1600 rev/min)	120

Table V.1.16.2 Upper limits for tolerable noise according to Noise Control Regulations

Duration of noise reception(hour/day)	Max. noise level (dBA)
7,5	80
4	90
2	95
1	100
0,5	105
0,25	110
1/8	115

V.1.17. Types and quantities of trees which will be cut down for land preparation and land gaining requirements for construction area, plant species which will be destroyed and size of the area where such activities will be carried out

There are no trees on the Project Site.

V.1.18. Size of agricultural land which will be destroyed for land preparation and land gaining required for construction area; their land utilization capabilities and types of agricultural products

The Project Site is approximately 14 ha. including the access road. Most of the land used for the Project is "IVth class Agricultural Land" (88 200 m²). The soil profile is shallow, weak structure, slope is deep and land utilization capability is IV because of moderate erosion. Land is with less slope, has middle depth, weak structure, slow permeability and moderate erosion, therefore land utilization capability is IIIrd class.

There are 4 houses at site area. The natural habitat of the land is grass. Currently and grain fields are found at the proximity of the site. Presently, these fields are in transformation into smaller parcels, as shown on private plan studies prepared by their landlords.

Power Plant will be located at skirts of the hills mostly on IVth class soil. Approximately 8 hectares will be covered by the site roads and parking, buildings, turbine hall, switchyard and tank farm, all at above ground. Landscaping criteria of the Project includes measures to incorporate the built-up areas into surroundings.

There will be buried auxiliaries of the Plant such as cooling water pipeline at the alluvium soil at North, close to D 110 highway and natural gas pipeline at the backside (South) of the Power Plant, however, surface character of the soil will brought back original after the construction works.

V.1.19. Where and how the accommodation and other technical/social infrastructure needs of the personnel who will work in activities during all stages from land preparation to commissioning of the activity units of the Project, will be satisfied

Site facilities include cafeteria, canteen, toilets, dressing rooms and showers to serve average 400 and at the peak 600 personnel during construction. Logging facilities and social services are not envisaged because most of the workers will be employed from local sources. Accommodation for technical and administrative personnel will be provided at rented houses at the vicinity. Personnel will be transported by the bus services of the contractor.

V.1.20. Activities posing risk and dangers for human health and environment which will be carried out during all stages from land preparation to commissioning of units

The activities which will create an environmental discomfort are: excavation and piling works, transportation of excess material and concrete foundation works (will be performed at early stages of the construction). Erection and commissioning is rather less disturbing.

Measures which will be taken to reduce discomfort and risk to public health are discussed in related Chapters.

Construction is, by its very nature, a dangerous activity involving working at heights, heavy and rotating machinery, working near hot surfaces and in confined spaces, etc. All necessary safety measures will be taken, regulations will be followed and training will be given by the contractor under supervision of safety engineer.

V.1.21. The amount of the area where land arrangement will be made for creating landscape elements or for other purposes in the Project area (afforestation, green area arrangements, etc.) and tree species which will be selected

After the construction, the surroundings of the Project will be re-organized and plantation will be made in accordance with the environment.

The Project area covers approximately 120 000 m² of which 80 000 m² will be occupied by paved or covered areas including in site roads, parking area, electrical switchyard and buildings. Approximately 40 000 m² will be rearranged after construction according to detailed landscaping design. Existing landscape at the Project Site does not include any trees or grass as man made landscaping elements but green and brown color fields. These fields are actually being in transformation by the effect of single houses along the D 110 highway and a group of co-operative houses both are at approximately 400 m distant from the Project Site.

Landscaping works for the Power Plant includes the following;

- Rearranging cuts and fills on the existing landform which will be done to some extent, during site preparation.
- Rehabilitation of the top soil that could well accommodate to the micro climatic conditions and existing species of the region.
- Planting of flora to adapt and also improve visual quality of the surrounding land from different view points.
- Use of bushes and trees as green fence around the site in order to provide a viewshed.
- Arrangement of basic visual elements (form, line, color and texture) of the Power Plant, in order to minimize the visual changes at the existing landscape.
- Green landscaping elements will also be considered to absorb dust that is carried by the wind and may effect instruments at the Power Plant.

The natural format of the land will be damaged during construction but it will be reorganized upon the completion of the Project.

V.2. Activities in the Operation Phase of the Project, Impacts on the Physical and Biological Environment, and the measures which will be taken

V.2.1. Characteristics of all the units of the Project, activities which will be realized in these units, their capacities, the services which will be provided by other units rather than activity units

The chosen optimized installed net capacity of approximately 480 MW shall be accomplished by ABB combined cycle designated as KA 13E-2 consisting of the following main components.

- 2 Gas Turbogroups GT 13E2

Proposed GT units of 160 MW class represents the latest development of ABB's GT 13 series. An important feature of GT 13E2 is the use of single annular combustor which uses 72 double-cone EV low-NO_x burners. In comparison to silo combustor type units it has better output and efficiency. These units have a 35.7 % simple efficiency at ISO conditions when burning natural gas.

- 2 Heat Recovery Steam Generators and Water/Steam Cycle

The hot gas flow from each of the gas turbines will be guided to its related HRSG for recovering heat energy from hot gasses by generating steam which is then used in the common steam turbine for additional power production. Each HRSG has HP and LP stages; economizer, evaporator and drum associated with each pressure stage. Natural circulation type HRSG incorporates also a condensate pre-heater. Exhaust gasses leave HRSG stack at 523 kg/s rate of 101 °C.

- Steam Turbine Unit and Condenser

The ST as proposed will be two casing design, with a single-flow high pressure section and a double-flow low pressure sections. A sea water cooled tube-type heat exchanger condenser the steam flow leaving the LP-turbine sections.

- GT and ST Generators

Gas turbine and steam turbine driven generators are 2 pole, 3-phase synchronous generators with fully encapsulated internal cooling system. The four heat exchangers for cooling the generator cooling air are located in the bottom half of the stator housing. Each generator has 210 MVA capacity and output voltage of 15.75 kV. A brushless excitation system will be utilized providing low maintenance during operation.

- HV-Switchyard

380 kV switchyard will be designed as double bushbar + transfer scheme 3 out going feeders will establish an interconnection to TEK' s 380 kV interconnected system. Two additional feeders shall be reserved for future requirements.

- Fuel Systems

Two GT's will be operated on natural gas as the main fuel, and with light distillate as stand-by but only in case of interruption of the fuel gas supply. A natural gas treatment and pressure reducing station involving a measuring station shall be installed according to BOTAS requirements. A fuel oil tank farm having 20 000 m³ capacity will be installed to keep GT's operating continuously over a period of 10 days.

- Main and Auxiliary Cooling Systems

Cooling water for the ST condenser main cooling system and for the closed auxiliary cooling water will be derived from a single once-through sea water system.

- Water Treatment and Demineralization Plant

Water shall be used for provision of potable water, make-up water for water-steam system and injection for NO_x control. Raw water shall be extracted from Marmara Sea. The water desalination plant operates on evaporation basis. The required thermal energy will be generated by auxiliary boilers.

- Fire Fighting System

Plant will be equipped with a comprehensive fire fighting system consisting of a water fire fighting system with electric motor and diesel driven fire water pumps and CO₂ flooding systems. An extensive fire detection and alarm system will be installed at critical parts of the Plant.

- Waste water treatment plant

Activated Sludge is employed as the treatment process of domestic waste water. The epoxy or NeutraRust coated steel construction package plant utilizing blower and fine-bubble diffusers as aeration means has covered top with access manholes to prevent odor and fly nuisance.

V.2.2. Hazardous, toxic, explosive and flammable materials which will be used at the activity units during production, and their transportation and storage

Transportation of Chemicals

The chemical HCl is a strong acid, NaOH is a strong base and NaOCl is a strong base with a strong oxidizing effect and harmful (caustic) to eyes, skin and mucous membranes.

They will be delivered in bigger quantities (order of tons) and have to be transported in safety cars (e.g. road tank car). NH₄OH is also a strong base and harmful to eyes, skin and mucous membranes. It will be delivered in security tanks of certain size (order of 1 m³) so that permanent presence of sufficient amount of ammonia is given.

Anti-Scaling and Anti-Foaming reagents are delivered in smaller quantities in drums with trucks signed as chemical transport.

Storage on Plant

HCl and NaOH will be stored in tanks of PPHD as described for example in the specifications of the water treatment plant. NaOCl can be stored either in rubber coated carbon steel tanks or tanks of glass fiber strengthened plastics. NH_4OH , the anti-scaling and anti-foaming reagents are stored in their own safety tanks. All tanks are surrounded by a wall, coated with an acid or caustic resistant painting, high enough to prevent leak of the chemicals into the environment in the case of a burst of the tank. From there the chemicals can be piped after neutralization to the waste water line. All filling stations will be equipped with safety showers and eye baths for emergency cases.

Regulation for Transportation and Storage of Dangerous and Harmful substances will be followed. (Annex A, line 10)

V.2.3. Characteristics and the quantity of the machinery, equipment, instruments and tools which will be used at the activity units.

- 2 x GT - Generator Set
 - including Fuel gas block
 - Fuel oil block
 - Lube oil tank
 - Internal and external pipework
 - Main shut off valves for fuel gas and fuel oil
 - GT insulation
 - Blow off silencer
- 2 x Sound proof enclosure including ventilation and CO_2 fire fighting system
- GT-generator internal cooling system
 - incl. 2 x Generator cooler
 - 2 x Lube oil cooler
 - Intermediate cooler
 - Connecting pipework
- 2 x Air intake system
 - incl. Air intake filter (two stage filter)
 - Air intake silencer
 - Air intake duct
 - Insulation
 - Expansion joint
- 2 x Exhaust System
 - incl. Exhaust duct
 - Insulation
 - Expansion joint

- 2 x HRSG
incl. Exhaust Silencer, stack 65 m.
- Fuel gas system with its accessories
- Fuel oil system with its accessories
- Cooling system with its accessories
- Steam condensate system with its accessories
- Compressed air system with its accessories
- Drain system with its accessories
- ST-generator set
incl. Condenser
Lube oil tank
Connecting pipework
- 1 x Machine house crane 85/20 tons
- 3 x Generator Crane 3.2 tons
- Fire fighting pumps including pipework
- Heating ventilation of buildings
- Water treatment plant with desalination and emergency power facility and all accessories
- Process instrumentation and control
- Equipment for HV-switchyard

V.2.4. Goods and / or services which will be produced at the activity units, production amount of final products and semi-finished products, to where, how and in what amount they will be marketed; where, how and in what amount they will be marketed; where, how and to how many population these services will be offered.

Plant will contribute a 480 MW additional capacity to national network. Annual generation capacity of the Plant shall be approximately 3.6 billion kWh. Three feeders which will be installed in plant's switchyard shall be connected to TEK's 380 kV Hamitabat, Ikitelli and Istanbul 5 substations via overhead lines which are to be built by TEK. Measurement of electrical energy to be dispatched to TEK system with unidirectional active power meters having accuracy class of 0.5. Two groups of meters

shall be utilized to measure power flow in either direction, namely to TEK or Plant. The energy dispatched to TEK's interconnected network shall meet the requirements of national system in addition to local region.

The Plant has no by-products and it does not need side industries.

V.2.5. Production methods and technologies which will be used at the activity units, flow-chart of production

The proposed Power Plant shall occupy approximately 14 hectare and shall consist of 2 gas Turbines and associated waste heat recovery boiler attached to them and one steam turbine, water treatment plant, electric switchyard, oil storage tanks, several other tanks, pumps and approximately 900 m. sea water cooling pipes between the pump house at the shore and the Power Plant. The tallest structure on the Site will be the two exhaust stacks which will extend about 65 meters above the ground level.

Electricity shall be produced using combined cycle technology. In a Combined Cycle Plant, waste heat from the gas turbine exhausts is recovered, converted to steam to drive a steam turbine generator to generate electricity in addition to those from GT units. Combined Cycle Plants are more efficient than the Simple Cycle Plants built in the past, where waste heat was released to the atmosphere.

The heart of the Marmara Ereğlisi Combined Cycle Power Plant will be two gas turbines. In a gas turbine, compressed air is mixed with natural gas and burned in combustion chambers. Rapidly expanding hot exhaust gases drive a turbine as they exit the combustion chamber. The turbine drives the generator which produces electricity. Since Marmara Ereğlisi Power Plant will use Combined Cycle technology, hot gases leaving the gas turbine will enter the heat recovery steam generator where exhaust gases will be used to produce steam. This steam energy will then be converted to mechanical energy through steam turbine driving its own generator to produce electrical energy. Cooled Exhaust gases having lower enthalpy will be discharged to the atmosphere through approximately 65 meter high stacks.

The proposed Power Plant shall be able to operate continuously. Operation and maintenance staff recruitment will be around 50 people. Fourteen staff, responsible for management, administration, engineering and maintenance, will work a regular 40-hour workweek. The remaining staff will be shift workers operating the proposed Power Plant around-the-clock. There will always be at least two operators at the proposed Power Plant at any given time.

Electricity generated at the Power Plant will be exported to TEK at the utility delivery point. Electricity will be dispatched at 380 kV level with 3 feeders of utility's interconnected grid. Amount of energy expected and imported will be registered with proper measuring meters at relevant outgoing feeders in accordance with ESA agreement.

Flow chart of the operation is given on Figure V.2.5.1.

V.2.6. The manner of transport of the raw materials, auxiliary materials, finished materials and the personnel, the mode of transport and vehicles, their quantities and capacities

The transportation system of the region consists mainly of asphalt roads. D-110 highway connects Marmara Ereglisi to Tekirdag city centrum which is 40 km. to the West. D-110 is also connected to D-100 which runs to the east. In order to reach Istanbul, D-100 highway or TEM highway can be used as well.

Modern transportation network connects Marmara Ereglisi to all regions of the country.

Power Plant does not need any raw materials . Auxiliary materials such as chemicals for water treatment plant and spare parts for the machinery will be transported by closed containers from Istanbul via D 110.

Natural gas as primary fuel of the Power Plant will directly be supplied from existing BOTAS pipeline. Emergency fuel will be fuel oil will be transported by road tankers and stored at site in $2 \times 10.000 \text{ m}^3$ tanks. Regulation will be followed during transportation and storage of fuel oil (Annex A, line 1).

Transportation of 50 personnel will be made by service bus and company cars.

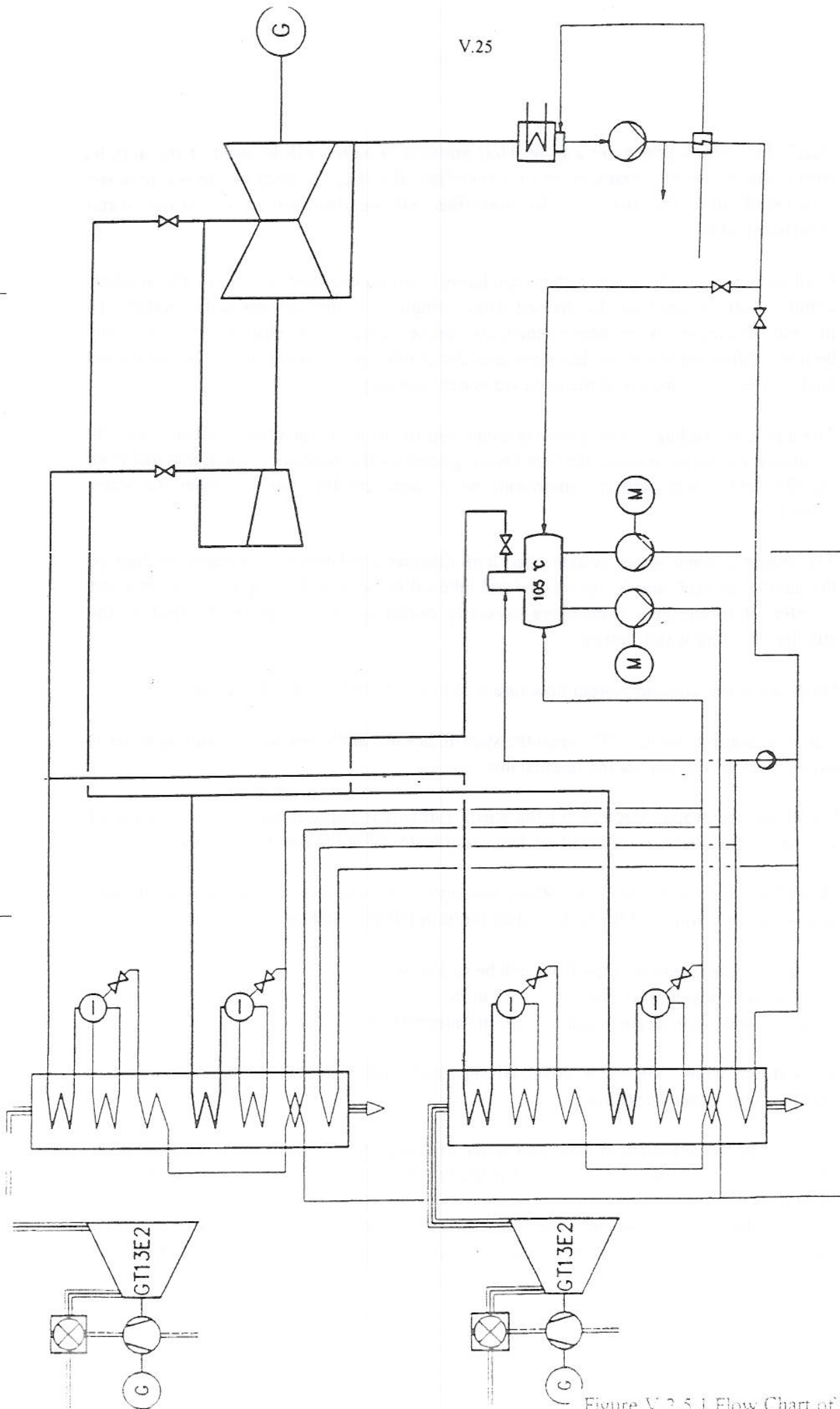


Figure V.2.5.1 Flow Chart of the Operation

V.2.7. For which processes and in what amount of water will be used at the activity units, the physical, chemical and bacteriological characteristics of the waste water generated after the process; the materials will be disposed at the waste water treatment plants

Cooling water for the steam turbine condenser main cooling system and for the auxiliary cooling water system will be derived from a single once-through sea water system. To prevent sea animals from entering the water intake, screens and chlorination systems will be used. After the sea water has been used for cooling the turbines, it will be discharged back to the sea by means of the main sea water cooling pumps.

The auxiliary cooling water system is connected to the main sea water system. Two 100 % auxiliary coolers transfer the heat losses, gained by the auxiliary cooling systems from the different power station components which need cooling, into the main sea water system.

The closed cooling water system filled with demineralized water. It accepts the heat of the auxiliaries (GT and ST generator and lube oil coolers, fuel pump coolers, etc.) and transfers it to the heat exchangers (auxiliary coolers), which transfer the heat to the auxiliary cooling water system.

Open sea water cooling system flow rate is : $Q_{cool} = 31\,000\text{ m}^3/\text{h} \gg 8.6\text{ m}^3/\text{sec}$

The temperature rise is 10°C within the system, but not in the sea water. Cooling water is cycled back to the sea via the thermal line.

Demineralised water required for the steam turbines is approximately 20 m^3 estimated per week. This water is obtained by deionizing water from the desalination plant.

When fuel oil is to be used in the Plant, deionized water requirement increases to $70\text{ m}^3/\text{h}$ and water injection used for NO_x control for both HRSG's will be $70\text{ m}^3/\text{h}$.

The water consumption in the Plant will be as follows:

Potable and consumption water : $15\text{ m}^3/\text{h}$

Make-up water for steam system : $20\text{ m}^3/\text{intermittent}$

Blow-down from HRSG is collected separately and returned to the discharge line together with other waste waters.

Capacity of the desalination plant and water treatment plant is designed to be $1100\text{ m}^3/\text{h}$. Water from the Marmara Sea will be treated to produce potable water. The desalination plant uses the distillation process to produce fresh water. $1000\text{ m}^3/\text{h}$ of the $1100\text{ m}^3/\text{h}$ of water intake to the desalination will be returned back to the sea with increased salinity. The rest ($105\text{ m}^3/\text{h}$) will be consumed as potable service and demineralized water in the Plant.

V.2.8. The quantity of boiler water and / or cooling water to be used at the activity units, after what type of process these wastes will be given to the recipient environment and how, and the characteristics of the water will be discharged.

Raw water for the Boiler and Process Cooling is extracted from the Marmara Sea and treated in the water treatment and desalination plant.

A) BOILER Water

Quantity of water in the water steam cycle is approximately 300 tons. The water/steam cycle comprises 3 separate drain systems;

- boiler drains and blow down
- clean drain condensate
- turbine internal drains

The drain water will be first collected at proper drain tanks, treated and discharged to the cooling water return line.

B) COOLING Water

Cooling water comprises two circuits, one being main condenser cooling circuit and the other one closed cooling system. In main cooling system 31 000 m³/h of sea water circulates. Closed cooling system comprises demineralized water circulating through several heat Combined Cycle Power Plant. Warmed demineralized water in closed cooling system is cooled down in the heat exchanger.

The wastes from closed cooling water system and steam water cycle are negligible small (0.0 168 %) and are directed to sea water discharge line.

Water Pollution Control Regulation will be followed for design and discharge criteria. Characteristics of the water to be discharged is given in Chapter V.1.11.

A Thermal Discharge and Dispersion Model is given in Annex V.1.3.2 and design of the cooling water intake and discharge facilities is explained in Annex V.1.3.1.

V.2.9. The materials which will contaminate the waste water will be generated after use of the drinking water and the water used for other purposes, the treatment which will be used for treating such waste water will be discharged to the recipient environments, the receiving environments and the method of discharge

Treatment plant is designed to produce 15 m³/h of potable water out sea water for daily use in the Plant.

Domestic waste water generated in the Plant will be treated by a package treatment plant. Activated Sludge is employed as the treatment process. Package Plant utilizing blower and fine-bubble diffusers as aeration means has covered top with access manholes

to prevent odor and fly nuisance. The treatment plant effluent is used for irrigation purposes or could be given to sewage network of the Municipality which is now under planning. The excess activated sludge will be stored at solid waste storage areas of the Municipality.

The treatment plant influent is domestic wastewater which includes no industrial effluent and storm water. The following values constitutes the design basis:

Water consumption	:250 l/day/capita max.
Population to be served	:100
Organic Load	:60 gm. BOD ₅ /day/capita

The plant effluent will satisfy the limits specified in Table 21.1 of The Environmental Law and Associated Regulations No. 2872, as follows:

BOD ₅	:	45 mg/l
COD	:	120 mg/l
TSS	:	45 mg/l
pH	:	6-9

V.2.10. Fuel types which will be used at the activity units and other units, quantities and chemical analysis thereof, the units at which the fuel will be consumed and the quantities thereof, the combustion systems, emissions, instruments and systems will be used for measurement

Primary fuel is natural gas which is provided by BOTAS pipeline and ignited in gas turbines without storage. Annual gas consumption will be approximately 541 Million kg or 693 million Nm³ / year (based on 7900-8000 hours of operation per year). Emergency fuel is TUPRAS 400 of which consumption will depend on times of non-availability of natural gas. Fuel oil will be transported by road tankers and stored in 2 x 10.000 m³ tanks within the site boundaries. Characteristics of the natural gas are given in Table V.2.10.1 as supplied by BOTAS on 11.7.1994.

Table V.2.10.1 Characteristics of Natural Gas to be used in the Plant

Chemical Composition		Mol Percentage
Methane	(C ₁)	Min 83.0
Ethane	(C ₂)	Max 11.0
Propane	(C ₃)	Max 3.15
Butane	(C ₄)	Max 2.00
Pentane and other heavy	(C ₅)	Max 1.00
Hydrocarbons		
Carbondioxide	(CO ₂)	Max 3.00
Oxygen	(O ₂)	Max 0.02
Nitrogen	(N ₂)	Max 5.00
Sulfur		Concentration (mg/m ³)
Hydrogen Sulfur	(H ₂ S)	Max 5.1
Mercaptan Sulfur		Max 15.3
Total Sulfur		Max 102.0

Upper Calorific Value

Max 10 427 Kcal/m³

Min 8 750 KCal/m³

m³: volume of 1 m³ gas at 15°C and 1.01325 Bar absolute pressure

Characteristics of fuel oil is given in Table V.2.10.2 .

Table V.2.10.2. TÜRKİYE PETROLLERİ RAFINERİLERİ A.Ş.
PRODUCT SPECIFICATIONS (CODE No TUPRAS-400 AUTOMOTIVE DIESEL
(*)

CHARACTERISTICS	GUARANTEE		METHOD
Color, ASTM	3.0	Max.	ASTM D 1500
Density at 15°C, kg/l	0.820-0.850		ASTM D 1298
Flash Point, °C (°F)	51.7 (125)	Min.	ASTM D 93
Pour Point, °C (°F)			ASTM D 97
Winter Grade(a)	-6.7 (20)	Max.	
Summer Grade (b)	-3.9 (25)	Max.	
Distill., Evap. Basis °C (°F) 90% End Point	357 (675) 355 (725)	Max. Max.	ASTM D 86
Sulfur, wt%	0.7	Max.	ASTM D 129 or IP 336
Carbon Residue, Romsbottom (on 10% Residuum), wt %	0.2	Max.	ASTM D 524
Viscosity, SSU at 37.8°C (100°F)	34.45		ASTM D 88
Corrosion, Copper Strip 3h at 50°C(122°F)	No 3 Strip or better		ASTM D 130
Ash, wt%	0.01	Max.	ASTM D 482
Cetane Index, Calculated	50	Min.	ASTM D 976
Sediment and Water, vol. %	0.03	Max.	ASTM D 2709

(a) From 1st of October to 30th of April (b) From 1st of May to 30th of September

(*) This product is produced in Izmit, Izmir and O. Anadolu Refineries. Issued: October 1987(1)

Exhaust gas composition is given in Table V.2.11.3.

Site Conditions:

Ambient temperature	14.1 °C
Ambient pressure	1.016 bar
Rel. humidity	75 %
cos ϕ	0.80

Table V.2.10.3. Exhaust gas composition for base load operation on natural gas and emergency fuel TÜPRAS 400

Composition	Natural gas	Fuel oil TÜPRAS 400
O ₂ (Volume - %)	13,88	13,01
N ₂ (Volume - %)	74,78	72,89
CO ₂ (Volume - %)	3,18	4,67
H ₂ O (Volume - %)	7,21	8,50
Ar (Volume - %)	0,94	0,92
SO ₂ (Volume - %)	0,0000	0,006
NO _x (vppm)	25	80
CO (mg / mN ₃)	25	25
Particles (mg / mN)	3	13

SO₂ concentration depends directly on sulfur content of the fuel. Above mentioned values relate to the given sulphur contents in the gas of 0,0 % and in the TÜPRAS 400 of 0.7 % (weight).

EXHAUST STACK

Height	: 65.0 m.
Inner diameter	: 6.1 m.
Exhaust gas mass flow	: 523 kg/s
Temperature	: 101°C
Density of exhaust gas	: 1.27 kg/cm

UNI-MAR Combined Cycle Power Plant will function on full-time basis but would be shut down for servicing for less than 800 hours per year or less than 8% of the total hours in a year.

Fuel for full time operation is natural gas which will be provided by BOTAS. UNI-MAR Enerji Yatırımları A.Ş. is an " uninterrupted buyer " of BOTAS as per the Gas Sales Agreement. In fact, the Plant will always burn natural gas unless gas supplies becomes unavailable. If there are any cut-backs or if BOTAS goes under maintenance in a different time than the Plant, fuel oil will be used as back up supply. Storage tanks will be anyhow, designed for 10 days of consumption.

Combustion System and Air Emissions

There will be two sources of the air contaminant emissions at the Power Plant: the exhaust from the combined cycle gas turbines and the oil storage tank. Emissions from the turbine exhaust stacks will be minimized by the control at combustion chambers of the turbines.

ABB KW, Germany made gas turbines incorporated in the Power Plant are equipped with highly advanced EV-Burners (Environment Protection-Burners), allowing for an NO_x emission of max. 25 ppm (180 mg/m³ in dry exhaust gases with 3% Oxygen excess) when burning natural gas.

NO_x Control System

The NO_x control system used in UNI-MAR Combined Cycle Power Plant, is dry burning system that was developed by ABB as a result of researches started in 1987. This system provides the lowest NO_x levels while increasing the efficiency.

In the past, NO_x control was basically made by water or steam injection on the flame during combustion. This wet burning system had the following disadvantages;

- NO_x level of 25-150 ppm
- Loss in efficiency
- High cost
- High CO emissions
- Huge amount of water consumption
- High maintenance costs

The problems caused by wet burning system had been gradually eliminated by ABB. Below, the development steps of technology and the emission levels achieved at every step are outlined;

- Diffusion flame system: 200-250 ppm
- Wet burning system : 25-150 ppm
- Lean premix method : 40 ppm

Finally, dry combustion system with low-NO_x burners (25 ppm for natural gas and 80 ppm when fuel oil used) has been developed. These burners being the product of latest technology of ABB, are named as EV-Burners (Environment Protection - Burners).

EV-Burners helped to decrease formation of NO_x by use of smaller burning chambers. with low flame temperature and short flame. Excellent gas-air mixture was achieved with ABB Vortex design in EV-Burners. Thus, not only low levels are achieved but also the other pollutants are limited and the efficiency is increased.

Design of the combustion system also includes use of fuel oil. No_x emissions will be max. 80 ppm (500 mg/m³ in dry exhaust gases, with 3% Oxygen excess) achieved through water injection in the combustion chamber. Maximum operation is 22 kg/sec for fuel oil . The temperature of gases emitted from the stack will be about 101° C. Gaseous emissions will not be visible. The oil storage tanks will be painted white to minimize heating by the sun and consequent evaporative emissions. Evaporative emissions of volatile organic compound (VOC) from the oil tank, at approximately 23 kg per year, which is an negligible quantity.

The emissions from the exhaust stack are well below the limits of Turkish Regulations for air quality control as explained in Chapter VIII.1.

Emissions calculations are made on guaranteed figures (in dry exhaust gases with 3% Oxygen excess) of the manufacturer and outlined in Table V.2.10.4.

Table V.2.10.4. Estimated Emissions

Pollutant	Natural Gas		Distilled Fuel Oil (TÜPRAS 400)	
	Emissions		Emissions	
	mg/m ³	kg/h	mg/m ³	kg/h
NO _x	180	60	500	188.5
CO	65	28.7	60	25.4
Particulate Matter	7.5	3.5	30	14.4
SO ₂	10	8.8	1230	390

In order to comply with monitoring requirement by the Regulations, parameters of NO_x, CO for natural gas operation and the parameters of NO_x, CO and SO₂ will continuously be monitored by the operator with approved monitoring equipment installed at the Plant. Hydrocarbons may also be included into this monitoring program. Measurement procedure that will be followed during Test and Operation is given in Annex IV.2.10.1

Compared with plants using coal or fuel oil, NO_x produced per MWh is less than half in plants using natural gas.

On operation with fuel oil, SO_x emissions are unavoidable. The amount of emitted pollutants depends on the content of sulfur in the fuel oil and the operating time with such fuel.

CO₂ production is also unavoidable when using fossil fuels. However, Combined Cycle Plant produces approximately 30 % less than a fuel oil fired steam plant and around 50 % less than a coal fired one.

Annex V.4.4.2. includes an Air Quality Model based on the basic Gaussian plume formulas for calculations of "Surface Concentration of Pollutants from Point Sources" and Ground-level Concentration Distribution from the Power Plant.

V.2.11. The quantity and characteristics of the solid waste which will be generated by each unit during operation of the activity, methods of storing, piling and disposal, how and where such solid waste will be transported, or for which purposes they will be recycled or where they will be sold

No solid wastes are generated in the Plant except domestic solid wastes during operation. All solid wastes will be disposed of in the Marmara Ereglisi Municipality dump areas.

V.2.12. Sources of vibration and noise which will be generated during operation of the activity, and the levels thereof

Noise Sources:

The gas turbines, heat recovery boilers, the steam turbine and all the normal auxiliaries operating at any capacity from 10% to 100 %, are the sources for sound emission individually and in combination.

The primary operational noise at the Power Plant is listed in Table V.2.12.1. These noise levels are the estimations at various units of the Power Plant are based on measurements from a similar power plant. All noise levels have been adjusted to the level received at a distance of 30 meters for easy comparison.

The machine hall housing the gas and steam turbines is not considered to be a working area. Only short time intermittent visits (less than one hour) to the machine hall will be required for visual checks during normal operation.

Noise receptors:

The closest residents, are located along the D 110 highway. These are group of 30 houses under construction. at a distance of about 350m North from the turbine inlet on the South side of the Project Site. Other residents (10 separate houses) are located again along D 110, at 500 to 800m SouthWest from the Project Site.

Four houses within the boundary of the Site are included into expropriation plan and will not be occupied, therefore are not considered as noise receptors. The summer houses are densely located between D 110 and the sea shore, however these are well away (about 700m SouthWest) from the noise sources.

Table V.2.12.1. Sources of Noise and Expected Levels at the Power Plant

Unit	Noise Level at 30 m dBA
HRSG Stack with Silencer	65
HRSG Walls	70
Turbine Intake with Silencer	67
Turbine	65
Transformers	59

Method of Analysis

The applicable noise limit for UNI-MAR Marmara Ereglisi Power Plant is 45 dBA according to the Noise Pollution Control Regulations because the buildings (noise receptors) located at 60 m. to the urban settlements. 45 dBA limit is calculated by adding 15 dBA to 40 dBA of basic criteria, so 55 dBA limit is found to be applicable during day time. Noise level limit during night is less 15 dBA. Therefore 45 dBA limit is consequently applicable for the Power Plant in operation 24 hours/day.

The noise levels expected at 1.5 m above ground for the UNI-MAR Power Plant are given in isobar curves Figure V.4.5.1.

Isobar curves vary according to positioning of the turbogroups. Noise level for the buildings at approximately 435 m. North direction is calculated 45 dBA.

Annex V.1.5.1 includes a comprehensive Noise Prediction Calculations, based on 92 different single source (figures 1 and 2) at the Plant. This computer model added all single impact results in the total sound emission level. Later, sound pressure level isobar curves plotted according to the values at 1419 emission points (figure 10)

V.2.13. Kind of Radioactive Wastes

No radioactive waste will be generated at the proposed Power Plant.

V.2.14. Where and how the accommodation and other technical/social infrastructure needs of the personnel who will work in the activities during all stages from the land preparation to commissioning of the activity units of the project will be satisfied

The housing will be provided in city centers of Marmara Ereğlisi, Tekirdağ and Çorlu. All other technical/infrastructure needs can be provided from the places mentioned above.

V.2.15. Risky or hazardous activities of the Project in the phase of operation, with respect to human health and the environment

The following are the areas that special safety measures will be taken during operation;

- High voltage switchgear 380 kV will be protected according to relevant IEC standards, as well as, TEK requirements.
- Step up transformers will be surrounded by cages for touch protection.
- Leaking transformer oil will be collected in pits beneath and passed thorough an oil separator.
- Protection against danger from battery acids and other chemicals will be by means of wearing eye protection and provision of eye rinsing devices.
- Electrical switchgear rooms will be locked and only accessible to trained people. Equipment will be placed in metal clad for touch protection.
- Natural gas reducing station will have fire protection, warning signs, prohibition of smoking alarms when leakage is discovered by detectors, sparkless tools for maintenance, fence to allow access to authorized people only.
- Chemicals will be stored in rooms with locks only accessible to authorized people.
- Periodic inspections done by Company will ensure the health and safety of the employees and the environment, using international practice and in accordance with all relevant Turkish Legislation.

V.2.16. Land arrangements for creating landscape elements or for other purposes in the project area

Existing topography at the Project area will be slightly changed by excavations in order to place the foundations on favorable rock surface. Once the foundation works are completed excavated areas will be refilled and leveled. Later top soil recovered during excavation will be laid down according to landscaping and Site arrangement plan.

The landscaping criteria, as explained in Chapter V.1.2.1. previously, includes rearranging the Project Site to be in harmony with the surroundings.

Proposed Power Plant will bring an additional quality to the environment with the help of plantation of trees, bushes, flower beds and evergreen grass.

V.2.17. Heat Loss Emissions

The heat losses to be ejected to the environment from the cold end of the thermodynamic cycle (the condenser) are influenced by the overall efficiency of the cycle. The advantages of the Combined Cycle over the conventional steam plants is that the heat losses are only one third of the conventional ones. Therefore, the impact of thermal loading from the discharged cooling water is considerably less per generated kWh than would be caused by other types of plants.

V.3. Effects of the project on the socio-economic environment

a) Environmental cost- benefit analysis

Environmental cost-benefit matrix is given in Table V.3.1.

b) Income increases expected from the project, employment opportunities will be created, population movements, migrations, education, health, culture, other social and technical infrastructure services and changes in utilization patterns of these services, etc.

There will be no immediate rise in the average income of the region. However, input to the local economy is expected because of the employment opportunities that the Plant will offer. Greater input will take place during construction. The actual benefit on the country basis will be seen when the Plant starts producing electricity.

The company will be an important tax payer in the Tekirdag province.

400-600 people during construction and 50 people during operation will be employed. Therefore there will be no considerable increases in the population. The land on which the Power Plant and its annexes are to be located will be expropriated. It would be appropriate if priority were given to the ex-owners of this land in employing workers and personnel. The needs of these workers and personnel will increase the demand for locally produced goods and services which will in return increase the income of the local people who provide such goods and services.

The present health infrastructure of the region is not adequate. It is probable that there will be health service problem during construction and operation. Transformation of the existing health center into a hospital and opening a Social Security Institution Clinic seems necessary. The concerned authorities should be informed in this respect. Upgrading of the health service facilities, due to the increased demand, will be at benefit of all residents in the region.

The educational infrastructure of the region is adequate. 840 students are currently enrolled in schools in Sultanköy and Marmara Ereglisi and one classroom is empty. Families of most of the workers will not come to the region. Therefore, the extra load they will bring to the educational infrastructure is negligible. 50 people will work during plant operation. In this case, if there is one student per employee, the extra load will be $50/840=0.06$; if there are two students per employee, the extra load will be $2 \times 50/840=0.12$. This load can be met by the present educational institutions. This point has also been confirmed by the Directorate of the National Education in Marmara Ereglisi. Other than that, there is also the possibility of the personnel accommodating in Tekirdag, Çorlu or even Istanbul and sending their children to school there. This will also decrease the extra load.

Table V.3.1. Environmental Cost-Benefit Analysis

Utilization of the environment before the Activity	Probable changes during Construction and Commissioning	Probable changes during Operation
LAND USE At the location of the Power Plant the land is utilized as non-irrigated agricultural land of mostly 4th class. Power plant covers 14 ha including access road and CW pipeline area. Estimated income is 8 million TL/ha. There are 4 houses which are used during weekends by the owners.	Before construction, the land and the 4 houses will be expropriated by the MERNR. Landlords will receive cash in advance, the totals determined by the price evaluation committee and paid by the company. The Power Plant area (A+B area) is out of the Urban Plan of the Municipality. Only buried CW pipes and a pump house (C area) will be located in planned area. Therefore no significant plan modification required but a new local urban plan will be prepared for Municipality approval.	Presence of a Power Plant at this location may cause a change in land use. Many commercial service facilities may come to the area such as restaurants, groceries, fresh food, repair and cleaning services and logging of these as well as Power Plant personnel and their dependents.
VALUE OF LAND AND HOUSES Land price differs in a range of 50 000-100 000 TL/M² at Power Plant area (A+B areas) and 200 000-300 000 TL/M² for planned area (C area). Value of duplex or two storey house on 400 M² plot at planned seaside area is about 600 000 TL. While it has more value before BOTAS PIG Terminal had been constructed. These summer houses have already lost their value because they are bordering with BOTAS hazard zone. The future visual impact of huge LNG tankers might be the other reason for value degradation.	Construction activities may create and uncertainty on prices of the fields neighboring the Power Plant area so the sales will be effected, however, a sudden decrease on the land value is not expected, according to speculation experience in Turkey. Construction for CW pipes may cause incremental decrease on prices of the houses at the seaside. Sales of the houses may slow down however, renting price will certainly increase because of sudden demand for logging 600 workers personnel and visitors.	Increase on land value will happen during operation period because the Power Plant will vitalize local economy by attracting commercial and service facilities nearby. Sale prices of the houses at the seaside may gradually increase however, speculative increase may not happen as expected by the first investors because these houses will serve permanent occupation rather than seasonal use as before. Annual average for rent income may again reach investors original expectations from seasonal income.
TAX REVENUES Tax revenue is an important tool to improve the environment if used for the purpose. In the region where the Power Plant will be located following are the current tax revenues - Agricultural tax (collected by the government) - Real property tax (determined by the Municipality and collected by the government office) - VAT (limited to daily shopping of the residents which increases during summer)	Tax revenues of the government will change in type and amount with an considerable increase in comparison with existing amounts for below reasons: - JV Company will be established at Marmara Ereğlisi so corporate tax will be paid to the Tekirdag province. - Income tax of up to 600 construction personnel will be paid. - VAT will increase because of local purchases - Real property tax will increase - Tax revenue of the Municipality will also increase in relation with their services.	JV company operates the plant for 20 years and pays: - Corporate tax - Income tax for personnel - VAT for goods and services purchased by the company - All above taxes will also be paid by other companies and independents who gives service to new environmental changes - Property taxes will also increase due to increasing property values, their sales or rent.
TOURISM OR RECREATION FACILITIES AND ACTIVITIES At the location of UNİ-MAR Power Plant there is no tourism or recreation facilities are present. Summer houses are found at the sea shore of Sultanköy. Some are still under construction whereas others occupied mainly during vacations. Marmara Ereğlisi is not an international tourism center of Turkey, but has seasonal visitors from closer cities i.e. Istanbul and Tekirdag. There are two motels and modest restaurants at the town center. Available water and sewage network services are poor. Entertainment centers, recreational facilities, holiday clubs, animation, cinema, theater, sport centers are not found. Festivals or sportive competitions are not known.	New restaurants, and facilities needed for the Turkish and foreign personnel and visitors of the Power Plant. For the first summer during construction, the habitual life at the summer houses close to BOTAS will be effected due to the construction of the marine structures.	Continuous operation the of Power Plant will gradually upgrade local services and facilities such as: - drinking water supply - bank and PTT - hotels, restaurants - shops - school and kindergarten - transportation - repair and maintenance services - recreational areas, parks and as a result of this change quality of the life at the region will change positively, and attract investors for the recreational facilities which will serve larger community.

Table V.4.1. Matrix of Potential Environmental Effects During Construction

Environmental Elements Effectuated	Plant Buildings and Auxiliary Units	Water Supply and Thermal Discharge
Geology and soil	Erosion to a certain extent during construction	Erosion to a certain extent
Hydrology	A gradual increase in the surface run-off	No effects
Water Quality	No effects	Increased turbidity
Land and Sea Ecology	All cultivation will be removed from the Project Site	Vegetation and animals on the sea floor will be effected
Land Usage	Converted to industrial use within the plant's boundaries	Restriction on fishing and anchoring
History and Ecology	No effects	No effects
Socio-economical Status and Local Services	500 people will be employed. Increase in local services and housing demands.	100 people will be employed. Increase in local services and housing demands.
Public Health and Security	Job related accidents	Job related accidents
Transportation and Traffic	Truck traffic will increase considerably.	Sea Traffic and marine structures will be restricted.
Energy Production and Consumption	No production. Approx. 1MW consumption.	No production.
Air Pollution	Dust emission	No effect
Noise	Temporary increase during construction well below limits	Sound level increase during construction well below limits
Aesthetics	Appearance of the plant Site will be changed	Appearance of the plant Site will be changed
Recreation	Significant for the pump house area and slight on the hill side.	Significant effect

Table V.4.2. Matrix of Potential Environmental Effects During Operation

Environmental Elements Effectuated	Plant Buildings and Auxiliary Units	Water Supply and Thermal Discharge
Geology and soil	No effect	No effect
Hydrology	A trivial increase in the surface run-off due to rain	No effects
Water Quality	No effects	Permissible increases in temperature and chlorine concentrations
Land and Sea Ecology	No considerable effects	Sea ecology will change.
Land Usage	Converted to industrial use within the plant's boundaries	Restriction on fishing and anchoring
History and Ecology	No effects	No effects
Socio-economical Status and Local Services	47 people will be employed.	3 people will be employed.
Public Health and Security	Low level of risk of spills from chemicals stored on the Site	No adverse effects
Transportation and Traffic	Minor effect due to truck traffic	Sea Traffic and marine structures will be restricted.
Energy Production and Consumption	480 MW energy will be produced in the first stage	Trivial energy consumption for water supply.
Air Pollution	Exhaust gas emissions will be met during operation	No effect
Noise	Well below limits	Well below limits
Aesthetics	Appearance of the plant Site will be changed	No important effect
Recreation	No important effects	No important effects

V.4. The Effects of the Project on the Environment, General Assessment and the Precautions

In this section, the effects of the Project on the environment are described. Effects on the environment during construction and operation are summarized in Table V.4.1. and Table V.4.2. The effects analyzed in this Chapter, result from the main equipments and auxiliary systems of UNI-MAR Natural Gas Combined Cycle Plant unless indicated otherwise. Effects resulting from other buildings or activities are of secondary concern.

V.4.1. Geological Status and Soil Characteristics

(a) Studies made

Site Geology and soil characteristics have been determined by the investigations carried out at the Project Site.

(b) Effects and Precautions

Effects

- (1) Effect of the Project on geological resources in the region
- (2) Disturbance of the stability of the top soil.

Precautions

- (1) There are no known geological formations or mineral resources of importance on the Site. The region is mostly open to summer residences. The Site is classified as IVth and IIIrd class agricultural land. Mostly, cereals, sun flowers and water melons are grown on this land. No precautions are necessary.
- (2) To minimize the soil erosion risk, grass and trees will be planted. Moreover, precautions will be taken against rain water.

V.4.2. Hydrology

(a) Studies

Hydrological data is taken from the General Directorate of State Meteorological Station in Tekirdag (D.M.I., 1974). Hydrological and meteorological data are given in Chapter IV.1.

(b) Effects and Precautions

Effects

- (1) Buildings on the construction site might effect the surface run-off constant and infiltration velocity

(2) There is a risk that the pollutants (oils) from the Project Site might mix with surface waters.

(3) The implementation of the Project will increase the surface water pollution.

Precautions

(1) For the first two effects the following precautions are appropriate: Rain water drainage system and oil traps and systems to collect oily pollutants around the fuel oil storage tanks.

(2) For protection against floods, storm water diversion channels and levees will be constructed. Excavations and filling will be made during dry periods as far as possible. Fuel oil tanks will stand on oil proof concrete tables at ground level.

V.4.3. Water Quality

(a) Wastes, Receiving Medium and Legislation

Cooling water will be taken from the sea. Intake location will be at -10 m. The temperature rise of the cooling water will be 10 °C. It will be discharged via a thermal discharge line to the sea by means of a diffuser between -5 m. and -11 m. Waste water from desalination and demineralization plants and the oil separator will be also discharged via the thermal discharge line. The temperature rise in summer should not exceed +1°C and +2 °C in winter, spring and autumn, at the end of primary dilution and the maximum temperature of the discharge should not exceed 35 °C, according to Water Quality Control Regulations (See Annex A, line 16).

According to the Aquatic Products Legislation, residual chlorine concentration for surface waters should not exceed 0.01 mg/l where water products are concerned. (Annex A, line 11 and 13; Annex V.4.3.1.).

(b) Effects on the Environment and Precautions

Effects

(1) Temperature rise in the receiving medium will increase the metabolic activities of the sea organisms. Consequently, species vulnerable to high temperatures will leave their places to less vulnerable species and a different growth will be observed around the discharge location.

2) If the plant is temporarily or permanently closed down, the species adapted to the previous temperature will be adversely affected. This is more dangerous than the effects of the temperature rise.

(3) Because of the temperature rise, dissolved oxygen concentration will be relatively decreased.

(4) Temperature rise for the coastal waters is considered beneficial for water sports.

(5) The most important impact of the Power Plants with sea water cooling system on the receiving medium comes from cooling water. Plankton, crustacea, fish eggs and larvae and shelled creatures in the cooling water from the sea can be harmed because of the temperature rise reaching up to 10°C, turbulence and sheer stress.

To minimize this effect the velocity of the water inlet was kept low at UNI-MAR Power Plant and the construction was equipped with screens. Since fish eggs and larvae are very small (~500µm), nothing can be done to prevent them from entering, the cooling water line. In order to quantitatively evaluate the effect of cooling water intake on the fish and/or mussel population, the width of the band forming the cooling water is calculated as (for 8m³/sec).

$$W = \frac{8\text{m}^3/\text{sec}}{10\text{m} \times 0.1\text{m}/\text{sec}} = 8\text{m}.$$

The rich coastal band of fish eggs and larvae is more than 20km, even with this value 8km band effected by the water intake forms 4/10 000 of the whole.

Plankton, crustacea, fish eggs, larva and shelled creatures which are taken in with the cooling water will be seriously effected because of the chlorination, temperature rise, turbulence in the pumping stations, etc.

(6) Chlorination at the thermal discharge line structure will effect the plankton and fish larva at the first mixing point.

Precautions

(1) Thermal Discharge line is designed not to exceed a temperature rise of +1 °C in summer and +2 °C in winter, spring, autumn. Thermal Discharge Model is given in Annex V.4.3.2. The temperature rise in summer will be 0.53 °C and during the rest of the year 0.45 °C.

(2) Even in summer months the temperature rise will not exceed 35 °C because the water will be taken from a colder environment of 10 °C.

(3) The entrance of the cooling water line is designed to keep plankton and fish out.

(4) Precautions will be taken so that the residual chlorine at the end of primary dilution will not exceed 0.01 mg/l. The diffuser has been designed to satisfy a primary dilution of 19.

(5) Pre treatment will be used for the domestic waste water and waste waster from the oil separator that are given to the thermal discharge line.

V.4.4 Air Quality

Air quality was examined in two stages. Firstly, existing air quality in the region has been investigated, later, the extra pollution load that the Plant might bring to this region was determined. Assessments were made for the stages of Construction, Operation and Close-down.

Impacts during Construction

During implementation, the most important impact on the air quality will be dust emission. This will be caused by excavations, transportation, storage and re-transportation due to land arrangements of excavation material. In addition to the work done at the Power Plant area, similar work will be done between the BOTAS LNG Terminal and the Plant during construction of natural gas pipe line, energy transmission line and cooling water pipe lines. Additional to dust emissions from un-paved service road during transportation of construction materials and equipment transportation on the highway will also contribute to the dust emission.

Exhaust gases will be generated by the machinery and equipment during excavation and construction. There will be evaporation of hydrocarbons from the fuel storage tanks installed at the Site. Fuel emissions will result from heating systems of the temporary site facilities

Organic and inorganic pollutants will result from cutting, welding, painting of the metal parts.

Precautions during Construction

Of all the activities mentioned above, the ones generating dust have priority. To reduce dust emissions, watering is suggested. 80 % of reduction can be expected when periodical watering is applied during excavation, transportation and storage. Moreover, pulverization can also be applied to the solutes containing binding chemical matter. Watering is the most popular method to control the dust emission.

Dust and gas emissions from explosives which will be used during excavation and exhaust gases from construction machines are rather low and will not effect the ambient air quality of the region. Timely maintenance and regular check of the machinery and equipment is recommended for mitigation of other emissions.

Impacts during Operation

Components of the exhaust gases generated during use of natural gas and TUPRAS 400 (in case of emergency) in the gas turbines are mainly nitrogen oxides, carbon monoxide, particulate matter, sulfur oxides and hydrocarbons.

Effects of the pollutants in the exhaust gas are summarized below.

Particulate Matter: The particulate matter consist of liquid and solid particles of 0.0002μ - 500μ . Particulate matter cause a decrease in the visibility. Depending on concentration and time, they damage in the respiratory system and the vegetation.

Carbon Monoxide: Carbon monoxide is colorless and tasteless. Depending on concentration and time, it is harmful to human and animal health.

Nitrogen Dioxide: Being the most important one in the family of nitrogen oxides, nitrogen dioxide, together with humidity in the atmosphere, results in acid rains and corrosion. In addition to these, it decreases the visibility, damages the respiratory system and causes photochemical reactions and formation of oxidants.

Sulfur Dioxide: Depending on time and concentration, sulfur dioxide is harmful to human and animal health, historical and natural monuments. The greatest damage is to human and animal respiratory systems.

Above mentioned pollutants cause cumulative impact when found together.

Precautions during Operation

The main fuel of the Plant is natural gas. The mathematical model (Annex V.4.4.2.1.) developed for this Project shows that the emissions of natural gas at ground level are below the limit values given in the Air Pollution Control Regulation (See Table V.4.4.1.). The height of the stack is acceptable according to limits of mentioned in the same Regulations (Annex A, line 14).

TÜPRAS 400 will be used in case of emergency. The emission levels for unstable atmospheric conditions and with consideration of 0.7% sulfur content in the fuel were calculated by the model and the results were found close to the Regulation limits. On the other hand, since TÜPRAS 400 will be used for limited period of time per year, the estimated emission levels are tolerable. No extra precautions are necessary when the Plant is operated as described in the Project.

Table V.4.4.1. Comparison of fuel emissions and limit values given in the Air Pollution Control Regulation (in dry exhaust gases with 3% Oxygen excess)

Pollutant	Natural Gas			TUPRAS 400		
	Emissions		Limits in Regulation	Emissions		Limits in Regulation
	mg/m ³	Kg/hr		mg/m ³	Kg/hr	
NO _x	180	60	500	500	188.5	800
CO	6.5	28.7	100	60	25.4	175
Particulate Matter	7.5	3.5	10	60	14.4	70
SO ₂	10	8.8	60	1230	390	1700

Close-down

The economical life-time of the Plant can be extended up to 30-40 years by means of continuous maintenance and renewals. At the end of its economical life, the Plant will be dismantled, machinery and equipment will be removed and the Site will be reorganized. During these activities, dust emissions are inevitable.

V.4.5. Noise Effects and the Precautions

The Power Plant consists of a pair of gas turbines and one steam turbine. Noise arising from turbines and from other sources are evaluated in a co-ordinate system. The equivalent noise levels from all of the sources are calculated by the manufacturer, according to ANSI Standards and, thus the equivalent noise curves are determined, (Figure V.4.5.1., Annex V.4.5.) In the calculations, use of silencers at the compressor and at the other similar accessories are considered. Any noise discrepancies are also taken into account. The noise emission level is predicted by using theoretical equations to calculate the combined effect of noise emissions from 92 different sources. By this method, it is possible to optimize each noise source in an acoustic manner.

Effects

The distribution of equivalent noise curves depend on the location of the turbines. The total noise level within the Plant area is determined by the model. This value is around 45 dBA at a district 450-500 meters away from the Plant area. This value is equal to the limit taking place in the Noise Pollution Control Regulation, given for night hours at district settlements.

The various values gathered from different parts of the Plant units are below 80 dBA, thus, this situation fits the limits given in the Regulations. In the Regulations, the maximum tolerable noise for employees in a shift is also 80 dBA. (Annex A, line 15).

Precautions

The following sound protection measures are taken in the Power Plant for sound attenuation;

Turbogroups and Machine Hall Building

- Gas turbogroups covered with mineral wool and equipped with sound proof enclosures made of a metal frame where sound absorbing cassettes will be installed.
- Steam turbogroup covered with mineral wool.
- Machine hall equipped with sound absorbing cladding.
- Silencer provided at air intake and at exhaust gas side, made of perforated metal sheets stuffed with mineral wool.
- Ventilation equipped with silencers.

Pumps and auxiliary equipment

- Pumps will be covered by a sound proof enclosure where required.
- Ventilation systems will have silencers where required.
- Non-technical buildings will have passive noise protection (glazing, etc.) where required to meet noise level limits.

Basically, active measures will be taken against noise propagation from the source of noise i.e. provision of sound absorbing material (mineral wool) or sound proof enclosures. Passive measures will be taken where necessary to avoid undue sound pressure levels within effected areas or rooms. Generally we state that measures will be taken to meet noise limits as given by the Regulation.

During the start-up public announcement should be made for the people living in the neighborhood for the dates and duration of sudden sound impacts.

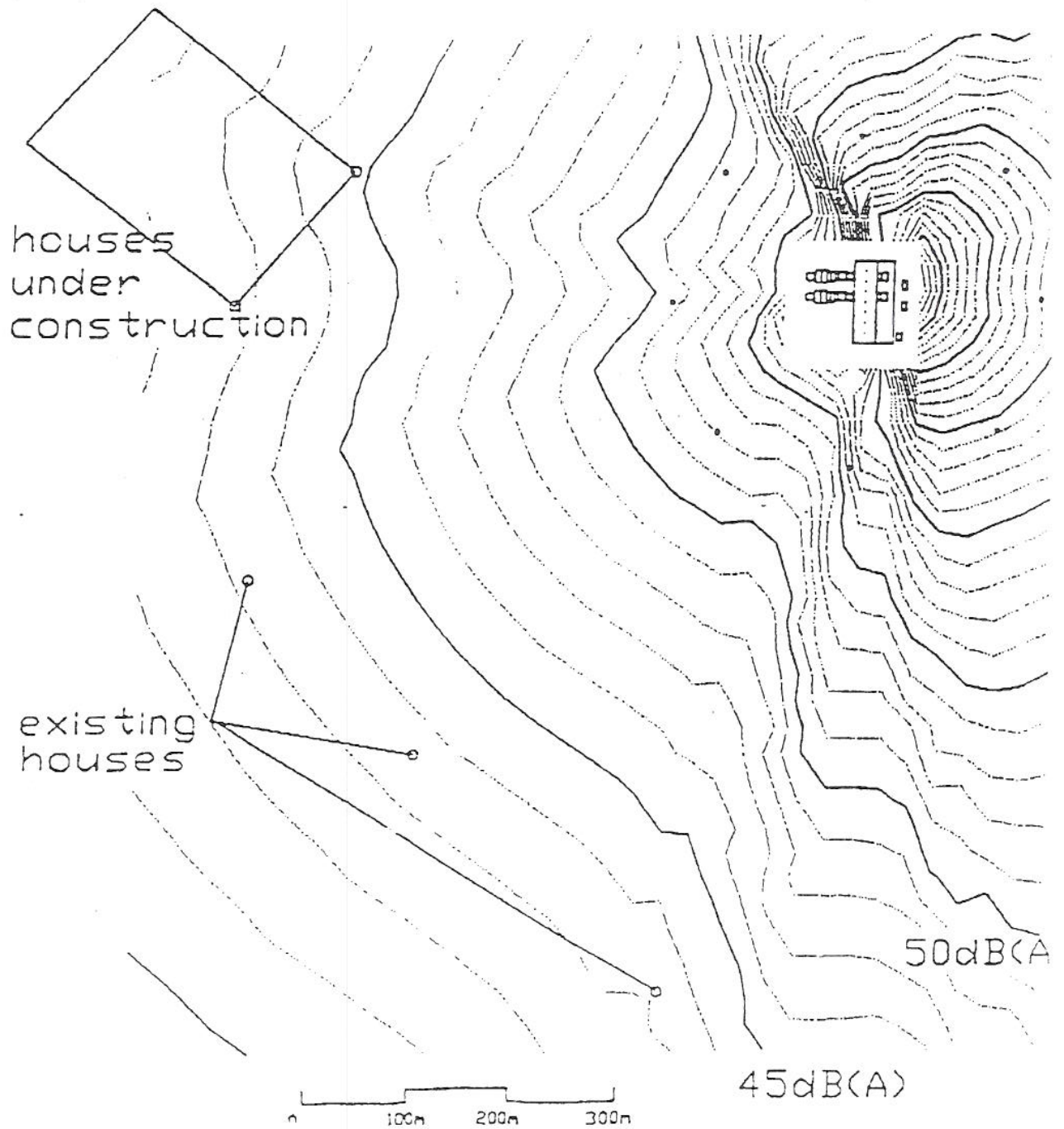


Figure V.4.5.1. Noise Level and Isobar Curves

CHAPTER VI

The effects which may occur or continue after the enterprise is terminated, and the measures will be taken for these effects:

VI.1. Recreation activities

The proposed Power Plant will be transferred to MENR after operation period of 20 years in accordance with Implementation Agreement. However, economical life of such power plants can be extended up to 30-40 years with continuous maintenance and renewals. MENR, Treasury and Municipality will propose for the future use of the Power Plant area after its economical life.

The Power Plant could be transformed to an industrial museum in the scope of recreational arrangement, as it is often made in developed countries. Otherwise, it will be removed partly or completely and the recovered area will be used for other purposes.

VI.2. Reclamation of land

When so decided, the Power Plant will be removed partly or completely after its economical life. The land will be rearranged with excavation, filling debris removal and landscaping works. Sea water cooling pipes will also be removed and piles will be left in the ground.

Land reclamation works will be carried out at Power Plant area of 120 000 m² and at the cooling pipes route of some 15 000 m². The access road of the Power Plant will remain, since it will be part of urban plan of the Municipality from the beginning.

VI.3. Impacts on available water resources

The Plant would have no impacts on the water resources after it has been closed down.

VI.4. Possible emissions

If the Plant is to demolished after it is closed down, dust could be generated. Necessary precautions should be taken to avoid formation and spreading of dust.

CHAPTER VII

Alternatives of the Project

Although a considerable amount of Turkey's energy demand will be met by it, the UNIMAR Natural Gas Combined Cycle Plant, will not meet all of Turkey's Energy demand. For this reason, other energy sources should also be considered. The following energy resources and systems could potentially be utilized to satisfy the immediate energy need of Turkey:

- * Energy Saving (commercial, urban areas and industry)
- * Renewable resources (hydroelectric, geothermal, wind and solar)
- * Combined Cycle Plant
- * Gas Turbines
- * Nuclear Energy Stations
- * Thermal Power Plants

Energy Saving

Considering the current economical growth rate, Turkey's energy gap cannot be closed merely by energy saving. Although energy saving is the cheapest energy source, it does not satisfy the demand unless combined with energy production from other sources.

Renewable resources

Renewable energy resources, with the exception of hydroelectric energy, have never been adequate to meet the energy demand. Hydroelectric power plants, however, have disadvantages such as high initial investment cost, long construction periods, the need for large reservoir areas, and negative impacts on the natural river eco-system. Therefore, hydroelectric energy can only be considered as an alternative for middle or long term energy planning. Moreover, energy planning depending solely on hydroelectric power plants as an energy source would carry with it serious risks for Turkey. Consequently, energy resources other than hydroelectric energy must be considered from the viewpoint of operating reliability.

Gas Turbines and Combined Cycle Plants

It is widely accepted that gas turbines and natural gas combined cycle power plants have minimum negative effects on the environment. The energy produced in such systems is the cleanest energy after renewable energy. Where air emissions are concerned, they have superiority to thermal power plants (Figure VII.1.). Due to the short construction and erection periods associated with gas fired and combined cycle plants, they can be put into operation in a relatively short time. Such plants are compact and occupy smaller sites.

When compared to "Simple Gas Turbines", a "Combined Cycle Natural Gas Fired Power Plant" (CCPP) has the following advantages:

In CCPP technology hot exhaust gases (~500 °C) generated from the gas turbines are not released to the atmosphere but are circulated in waste heat recovery boilers in order to produce steam to operate the steam turbine. This technology helps to reduce exhaust gas temperature significantly (to ~101°C) and to increase the efficiency to 50% which is much greater than simple cycle gas turbine efficiency of 27%. This highly efficient technology has made Natural Gas CCPPs become considered an environmentally friendly system.

The burning system of the gas turbines requires special technology, because it is here that NO_x emissions, the most important emissions of natural gas power plants, are controlled. The Proposed Power Plant is equipped with modern technology EV-Burners (Environment Protection Burners) which keep NO_x emissions below a level of 25 ppm.

In cases where the alternate fuel fuel oil is used, low emission distilled (diesel) fuel oil can be utilized instead of heavy fuel oil in order to reduce exhaust gas emissions. Another technological capability is to provide NO_x control system when burning fuel oil. However, using the NO_x control system will cause an efficiency loss in the gas turbines to arise to a certain extent. The proposed Power Plant is capable of achieving low NO_x emissions (80 ppm) during fuel oil use by means of water injection into the combustion chamber.

Various alternatives are available for procuring the boiler / process water. It may be obtained from surface water (i.e. river, lake), from wells, from the Municipality network or from seawater (by means of desalination). Because the availability of surface and underground water sources as well as the capacity of local network in this region is very limited, necessary water for this power plant will be taken from the sea. A desalination plant will be installed for this purpose.

An environmentally friendly technology with low NO_x emissions has been selected for this Project, considering that natural gas power plants would be the solution for immediate energy supply.

Nuclear Energy Stations

Nuclear energy stations pose serious accident and pollution risks. Moreover, it is almost impossible to build and operate nuclear power plants in the short term.

Thermal Power Plants

The risks of air pollution and radioactive pollution associated with the present coal, lignite or heavy fuel burning thermal power plants are high. Such thermal power plants may seriously threaten the environment. Also because construction and implementation periods of thermal power plants are long, they can only be considered as alternatives to meet medium term needs.

As a result, Combined Cycle Power Plants are the most suitable alternative to overcome the immediate energy shortage of Turkey. It is expected that the UNI-MAR Combined Cycle Power Plant will play an important role in closing this energy gap.

Site Selection Criteria and Alternatives

The location of this B.O.T. Power Plant has been mutually determined by the State Planning Organization, MENR, TEK and BOTAS and within the Turkish Government's energy policy. In addition to this basic principle the below subjects were borne in mind.

Aesthetic harmony, foundation stability, staying outside of valuable agricultural fields as far as is possible, being situated as far as possible from inhabited settlements, proximity to the existing BOTAS LNG terminal and the TEK high voltage network, transportation access, etc...

Three alternative sites complying with the above criteria were proposed to MENR and preference was made for Site No.1 (Figure II.1.2.). Evaluation of alternatives are below:

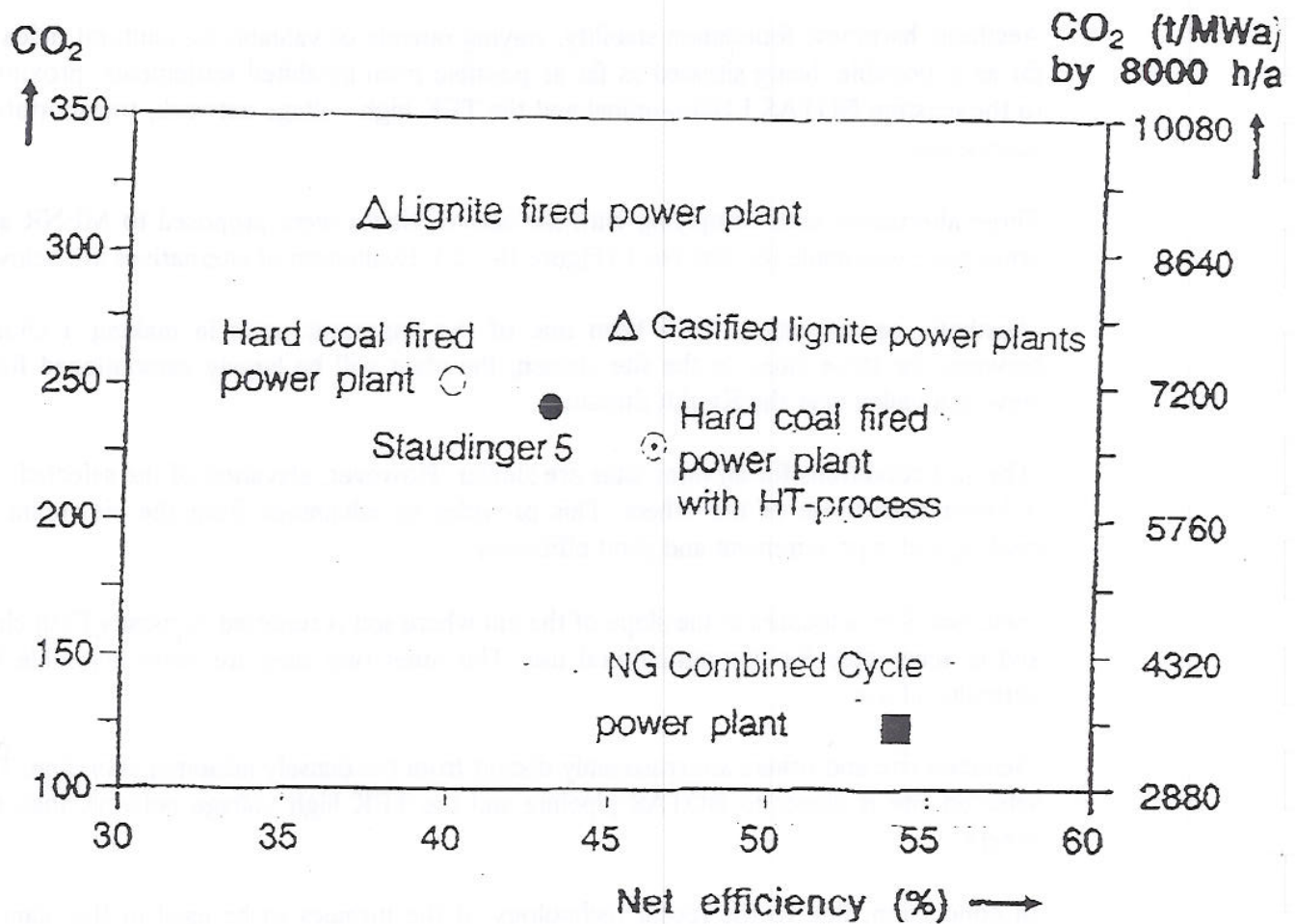
- Aesthetic considerations have been one of the important point in making a choice between the three sites. In the site chosen, the plant will be largely camouflaged from view in a valley near the Kınıklı Stream.

- The soil conditions for all three sites are similar. However, elevation of the selected site is lower than those of the others. This provides an advantage from the viewpoint of cooling water procurement and plant efficiency.

- Selected Site is located at the slope of the hill where soil is reported as mostly IVth class and is acceptable for non-agricultural use. The other two sites are more favorable for agricultural use.

- Selected site and others are reasonably distant from the densely inhabited shoreline. The selected site is closer to BOTAS pipeline and the TEK high voltage network than the others.

In conclusion, due to the recent technology of the turbines to be used in the planned UNI-MAR combined cycle plant to be constructed at Marmara Ereglisi, the high efficiency of energy generation, the low exhaust gas emissions achieved through NO_x control, and the favorable site selection, the most proper alternative is seen to be chosen.



CO₂-Emission when preparation electrical power out of fossil fuels

GMDT
A 43 036

Figure VII.1. Comparison of CO₂ Emissions for Different Power Plants

CHAPTER VIII

Conclusions

The proposed Natural Gas Combined Cycle Power Plant in Marmara Ereglisi by UNIMAR Enerji Yatırımları A.Ş. is among the activities listed in Annex 1 of the Environmental Impact Assessment Regulations of the Ministry of Environment. This EIA report has been prepared in accordance with the format of the aforementioned Regulations. The Laws, Regulations, Communiqués and the official document taken into account in assessment of the environmental impacts of the proposed Project are listed in Annex A.

In this Chapter a brief summary of the explanations, significant environmental impacts and the degree of the success of the precautions to avoid the negative impacts of the Project and the comparison of the alternatives are presented.

The proposed Natural Gas Power Plant is of a Combined Cycle type which involves the technologies limiting NO_x emissions to maximum of 25ppm (180mg/m^3). The hot exhaust gasses ($\sim 500^\circ\text{C}$) are recirculated through the boilers which results in the reduced exhaust gas temperatures ($\sim 101^\circ\text{C}$) and substantial increase in the efficiency.

According to the Gas Sales Agreement with BOTAS, the main fuel of the Plant will be natural gas. However, fuel oil may be used temporarily if natural gas supply is cut off for whatever reason. The injection of water into the combustion chamber is incorporated into the technology in order to keep the NO_x emissions below 80ppm (500mg/m^3) for the periods during which fuel oil is used. Fuel oil tanks with capacity of 10 days supply will be provided in the Project Site.

Environmental impacts and the measures to avoid the negative impacts are presented below.

VIII.I Air Pollution Control

The assessment of the proposed Power Plant in terms of the "Air Pollution Control Regulations" are briefly presented below:

a. Stack Height

The proposed 65m stack complies with Article 8 of the Regulations (Annex A, Line 14).

b. Discharge Velocity of Exhaust Gases

Discharge velocity of the exhaust gases (14m/sec) is well above the minimum required value of 6m/sec that is given in article 8 of the Regulations.

c. Pollutant Emissions

Dust emissions to be generated during erection is discussed in Chapter V.1.7. and is not given in this Chapter. Exhaust gas emission when using natural gas is given below.

NO_x emissions of 180mg/m³ is far below the limit of 500mg/m³ permitted by the Regulations. This has been achieved by advances in turbine design.

CO emissions calculated from the committed limits of the proposed Project is about 65/m³ whereas the permitted limit in the Regulations is 100mg/m³.

Limit value for the particulate matter is given as 10mg/m³ in the Regulations whereas emission value of the proposed Project is 7.5mg/m³. TÜPRAS 400 which will be used in case of an emergency will emit the following particulate matter: Cadmium (Cd), Vanadium (V), Barium (Ba), Antimony (Sb), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), Aluminum (Al), Chromium (Cr), Arsenic (As), etc. These metals are below the limits given in Regulations, Article 7 (Annex A, line 14).

When burning natural gas, gaseous pollutants in the hydrocarbon group emitted will be Hexane, Butane, Pentane, Heptane, Octane, Nonane and Cyclopentane, Cyclohexane, Benzene, Toluene, Xylene. The emission standards in the Article 7 of the Regulations are met.

Similarly the calculated SO₂ concentration of the exhaust gas is 10mg/m³ which is again well below the SO₂ limits of the Regulations (60mg/m³).

The main fuel of the Plant is natural gas. In case of emergency, TUPRAS 400 (or its equivalent) will be used.

The comparison of the emissions with the limit values of the Air Pollution Control Regulations are given in Table VIII.1.1. for both natural gas and TÜPRAS 400. The limits of the Regulations are met for both fuels.

Table VIII.1. Comparison of fuel emissions and limit values given in the Air Pollution Control Regulation.

Pollutant	Natural Gas			TUPRAS 400		
	Emissions		Limits in Regulation	Emissions		Limits in Regulation
	mg/m ³	Kg/hr	mg/m ³	mg/m ³	Kg/hr	mg/m ³
NO _x	180	60	500	500	188.5	800
CO	6.5	28.7	100	60	25.4	175
Particulate Matter	7.5	3.5	10	60	14.4	70
SO ₂	10	8.8	60	1230	390	1700

In order to comply with monitoring requirement by the Regulations (Articles 34 and 35 Sections 4.1 and 4.2) parameters of NO_x, CO for natural gas operation and the

parameters of NO_x , CO and SO will continuously be monitored.

Authority in charge may require ambient air quality monitoring in the vicinity of the Plant in accordance with Article 38 and Appendix 2 of the Regulations which includes the data on monitoring network, methods, number and frequency of the measurements.

The parameters of NO_2 for natural gas operation and the parameters of NO_2 and SO_2 for fuel oil operation need to be monitored in ambient air to comply with the aforementioned monitoring requirements of the Regulations.

Ground Concentrations of the Pollutants

The ground and surface concentrations predicted for several scenarios and atmospheric stability conditions are below the levels permitted in article 6 of the Regulations even under the most unfavorable conditions (Table VIII.1.2.).

Table VIII. 1.2. Model Results

Fuel	Pollutant	Atm.stability	Plume Height (m)	Model estimation ($\mu\text{g}/\text{m}^3$)
Natural gas	NO_2	Unstable	35	12.8
Natural gas	NO_2	Unstable	314	2.82
Natural gas	NO_2	Neutral	35	<1
Natural gas	NO_2	Neutral	314	<1
TÜPRAS 400	NO_2	Unstable	35	42
TÜPRAS 400	NO_2	Unstable	314	9.2
TÜPRAS 400	SO_2	Unstable	35	109.5
TÜPRAS 400	SO_2	Unstable	314	24.1
TÜPRAS 400	SO_2	Neutral	35	35.8
TÜPRAS 400	SO_2	Neutral	314	<1

Upon the request of the EIA Committee formed by the Ministry of Environment, the cumulative effects if a second natural gas power plant would constructed in the vicinity of UNI-MAR Power Plant, are analyzed using the same model. Predicted air pollutants from two Power Plants are also below the limits of the Regulations (Annex VIII.1.1).

Table VIII.1.3. Air Pollutants and Limit Values

Pollutant	Unit	Long Term Limit Values"	Short term Limit Values""
Sulfur Dioxide (SO ₂)			
Sulfur Trioxide (SO ₃) included			
a) General	µg/m ³	150	400(900)
b) Industrial Regions	µg/m ³	250	400(900)
Carbon Monoxide (CO)	µg/m ³	10000	30000
Nitrogen Dioxide (NO ₂)	µg/m ³	100	300
Nitrogen Monoxide (NO)	µg/m ³	200	600
Chlorine (Cl ₂)	µg/m ³	100	300
Hydrocarbons (HC)	µg/m ³	-	140(280)
Suspended particulate matter (PM) (10 micron and smaller particles)			
a) General	µg/m ³	150	300
b) Industrial Regions	µg/m ³	200	400
Cadmium (CA) and compounds in PM	µg/m ³	0.04	-
Precipitating dust (incl. particles bigger than 10 microns)			
a) General	mg/m ² -day	350	650
b) Industrial Regions	mg/m ³ -day	450	800
Cadmium and Compounds in precipitating dust	µg/m ² -day	7.5	-

" Long Term Limit Values : Arithmetic average of all of the limits which should not be exceeded.

"" Short Term Limit Values : Maximum daily averages or statistically all measurement results in order of magnitude, values which should not exceed 95% of the values.

VIII.2. Water Pollution Control

The important aqueous wastes generated at the proposed site are

- Cooling Water (Thermal Discharge)
- Brine and Regeneration Wastes
- Domestic wastewater

Sea water temperature has significant impacts on the marine organisms and marine ecology. The effluent temperature will comply with the thermal discharge standard in the Water Pollution Control Regulations (Annex A, line 16). The proposed diffuser design achieves the limits set for the incremental temperature rise (max. 1°C in winter and 2°C in summer).

Upon request of EIA review and evaluation committee formed by the Ministry of Environment, the "Thermal Discharge and Dispersion Model" (Annex V.4.3.2.) was

modified and applied, in order to predict the cumulative effects that could occur in case of a second combined cycle power plant would be constructed at the vicinity of UNI-MAR Power Plant. Due to its location, impact of UNI-MAR discharge after 2nd dilution, was included into the temperature increase resulted in sea water surface after 1st dilution of the second Plant and cumulative effects were examined on the Model. Results showed that the cumulative effects would be below the thermal discharge limits stated in the Regulations (Annex VIII.2.1).

The residual free chlorine in the discharged effluent has an important effect on the aquatic organisms. Considering that, free residual chlorine concentration of the UNI-MAR thermal discharge is kept below 0.2 ppm which satisfies the limit of 0.5 ppm given in the Aquatic Products Regulations. Diffuser design and the chlorine concentration levels of the thermal discharge are adequate to comply with the standards of 0.01 ppm in the marine environment following the initial dilution.

The total discharge of heavy metals (Cu, Cr, Pt, Mn, etc.) which occurs only during the operation with fuel oil and off line cleaning of HRSGs is given as about 12kg/year. The estimated total heavy metal concentration in sea water is about 0.0002 mg/l which is well below the limits set in the Regulations of the Aquatic Products.

Brine and regeneration wastes are discharged after neutralization together with the cooling water and they do not have any significant effect on the sea water quality due to the high number of dilution.

Domestic wastewater will be treated in a package treatment plant in compliance with the levels indicated in the Water Pollution Control and Aquatic Products Regulations. After disinfecting, treated water will either be used for irrigation or given to the thermal discharge line during winter.

Rain water will be collected by separate channels and given to surface waters. Surface drainage from the fuel oil storage area will pass through a separator and will be discharged only after the removal of oil.

A water quality monitoring system will be set up to monitor the parameters given in the discharge permit in accordance with the "Sampling and Analysis Methods Communiqué of the Water Pollution Control Regulations" of the Ministry of Environment.

Necessary prevention and control measures will be taken to prevent oily wastewater and chemical leakage mixing with the ground water.

VIII.3. Noise Pollution Control

Noise pollution is an important impact. Noise control features are incorporated into the project design and necessary measures will be taken during operation in order to comply with the limits of the Noise Pollution Control Regulations of the Ministry of Environment. Noise level is decreased to 45 dBA at residential areas 450m away from the noise source.

VII I.4. Recreation

The coast between BOTAS and Sultanköy is used for water sports during summer. Between the D110 Highway and the coast, dense housing consisting of second residences (summer houses) exist. UNI-MAR Natural Gas Combined Cycle Plant will not adversely affect the water sports.

VIII.5. Solid Wastes

Solid wastes and sludge which will be generated in the Plant will be disposed at the Marmara Ereğlisi Municipality solid wastes storage area as per the protocol signed between the Owner of the Project and the Municipality (Annex VIII.5.1).

Solid wastes generated during construction and operation will be stored temporarily at the Site and solid wastes will be transported to landfills as indicated by the Municipality of Marmara Ereğlisi. All actions concerning solid wastes will be directed according to the Solid Wastes Control Regulation and Solid Waste Storing Area Management Directive and all obligations foreseen by this legislation will be undertaken. (Annex A, Line 14 and 23.). Stabilized biological activated sludge will be taken to the drying beds and at certain intervals will be disposed with the dried sludge.

VIII.6. Hazardous and Toxic Wastes

Related legislation will be followed for the transportation, storage and application of harmful wastes to be used and stored during construction and operation. In the storage areas, necessary precautions will be taken to prevent spreading and percolation to the ground water.

VIII.7. Monitoring Procedures

The Plant will be controlled through various monitoring programs during operation as required by the authorities. Information concerning these monitoring procedures are summarized below which were already given in the previous Chapters.

Water Pollution Monitoring

The effects of the discharged water on the receiving medium will be monitored according to Water Pollution Control Regulation and Aquatic Products Law and Regulations (Annex A, Line 11 and 13). The period, frequency and number of monitoring is determined according to the legislation.

Domestic wastewater treatment plant effluent will be monitored according to the Water Pollution Control Regulation (Annex A, Line 16) and a discharge permission is given. Inspections are made by the permit authorities and the cost for the monitoring is paid by the Operator.

Air Pollution Monitoring

Impact of the Power Plant on ambient air quality is monitored in two stages according to the Regulation (Annex A, line 14).

The pollutants at the source are examined during the emission permit application. NO_x, SO_x, CO and HC will be continuously measured with the instruments in the Plant and the records will be kept as required by the Regulation.

Ministry of Environment as the concerned authority might ask the measurement of NO₂ and SO₂ in order to monitor ambient air quality. The measurement system is determined by the authority according to criteria given in Article 38 and Appendix 2 of the Regulation.

VIII.8. Public Health, Security and Health Protection Belt

The "Communiqué for the precautions to be taken at the works and facilities where the flammable, explosive, dangerous or hazardous materials utilized" (Annex A, line 10 and in particular the general directives of this Communiqué will be followed for design, construction and operation of the Plant.

All energy transmission lines will be constructed as indicated in the legislation. Cable and pipe networks will be clearly marked and it will be possible to control any leaks at any time. In case of emergency, stop valves on the pipelines feeding the Plant will automatically be turned off and inflow of all gas and liquid will be stopped. Automatic excess pressure air valves will be installed to prevent the pipes from bursting in case of pressure increase. Leakage will be collected in the security drainage dikes and will be disposed of in case of an accident. Required personnel and equipment will be ready for fire fighting and health service at the Power Plant area.

There will be a Health Protection Belt around the Plant according to Non-hygienic Facilities Regulation. Combined Cycle Plant will cover an area 20 hectares (400m.x 500m.) The ground of the Plant is located beyond the existing urban plan boundaries but within the approaching zone of this plan where agricultural activities and a few houses without construction permits are observed. The width of a health protection belt is recommended below according to future usage of the area and the negative effects of the Plant to the environment.

Noise

The maximum noise limit for traffic, is given as 45 dB(A) in the Noise Control Regulation, section III Article 12 in case the Plant is within the residential settlement. In the same Regulation, 2nd paragraph of Article 12 (Table 4) it is stated that for industrial plants noise limit, for continuous noise is 65 dB (A) during the day (06.00-22.00) and 55 dB(A) for night (22.00-06.00). Therefore, the width of the health protection belt is set according to 55 dB (A) limit value.

The width of the belt at the West of the Plant Site can be taken as 150m. To the South, the Plant Site extends for 220m from the noise source at which point the level drops to 50 dB(A); therefore there is no need for an extra belt. Again there is no need for a health protection belt at the North of the Site where the Site extends for 250m from the source and this area will be occupied by future TEK transmission lines.

Air Pollution

Air pollution that might be caused by the Plant is analyzed using different scenarios and using a model. In the prevalent wind direction, 1x1 km grid cell, NO_x and SO₂ concentrations were higher than the other grids. On the other hand, in this grid which also includes the source, the concentrations are well below the limits of the Regulation. Therefore, according to the model there is no need for extra belt outside the Site boundaries. But this condition should be verified by future monitoring programs.

VIII.9. Land Utilization

Most of the Project Site is IVth class agricultural land and the rest is IIIrd class. A dense housing can be observed between the D110 Highway and the coast. This housing expands very fast and consists of second residences (summer houses). Operation of the BOTAS LNG Terminal will add an industrial character to this region and land utilization will change to a certain extent, accordingly.

VIII.10. Other Impacts

Preservation of Wild Life Flora and Fauna

Wild life, flora and fauna will be effected slightly by the impacts (noise, dust) of the excavation activities, specially if carried out during migration periods. Operation of the Power Plant will not cause the said effects whereas noise will be less and landscaping will help to mitigate the effects.

Preservation of Cultural Monuments and Works of Art

No historical, cultural or archaeological findings were depicted at the Project Site. Marmara Ereglisi town and vicinity is classified as first and third archaeological sites. Projects site is 2km away from the boundary of the third degree archaeological site. Necessary precautions have been taken by the Plant designer to protect the region from negative effects, especially in terms of air pollution.

Preservation of the Coast

Main and auxiliary part of the Project remain outside the Coast Preservation Belt. Only the part of buried sea water cooling pipes and the pump house are in the Coast Preservation Belt as permitted by the Law.

Alternatives of the Project

This Project is developed in accordance with the energy production policy of the Republic of Turkey. Basic decisions for the financial model, location and the type of the Plant were taken by the government.

A detailed comparison within the alternatives of the Power Plant is made in Chapter VII and the proposed action is found most proper alternative.

UNI-MAR Natural Gas Combined Cycle Power Plant achieve high efficiency with low impact of the environment where its technology and site selection are concerned.

Protection from Flood

The Project Site is outside of the Kınıklı Stream's flooding area. Rainwater coming from the Project Site will not cause a flood risk. Rainwater coming from the field Northwest of the Project Site will be diverted by use of the open channels.

Aesthetics

In order to minimize impacts on the aesthetics of the region the Plant will be located in the slopes of the Tilkiyatağı hill at the West of the D110 highway. The Plant will be in harmony with its surroundings after the completion of landscape works and plantation.

No significant impact is expected on the existing local services such as health, education and transport. However, there will be a considerable increase for the truck traffic during construction. No endemic animals and plants and wetland exist in the area. Production or utilization of pesticides are not needed in the Project. Most of the identified impacts are considered as insignificant. Substantial impacts were prevented by incorporating environmental protection features into the Project design and operation plan.

REFERENCES

ANNEXES

REFERENCES

- Türkiye üretim-Tüketim İncelenmesi 1993-1997, TEK Genel Müdürlüğü, APK-357 Kod No. 10/1-200, Eylül 1993, Ankara.
- 1991 Enerji Raporu Dünya Enerji Konseyi Türk Milli Komitesi, Ocak 1993, Ankara.
- Yılmaz, A., Baştur, Ö. et al (1990). Marmara Denizi ve Boğazlar Sisteminin Su Dinamiği ve Çevresel Karakteristiği, İstanbul Çevre Sorunları Sempozyumu, Tebliğler Kitabı.
- Özsoy, E., Oğuz, T., Latif, M.A., Ünlüata, Ü., Sur, H.İ., Beşiktepe, Ş., (1988). Physical Oceanography of The Turkish Straits, Second Annual Report, Volume I., METU-IMS.
- Shopintsev, B.A., (1968). Some Reduction and Oxidation Processes in the Black Sea, Oceanology, Vol. 8, No. 3, pp: 328-341.
- Camp-Tekser (1974). Revision of Master Plan for Sewerage of İstanbul.
- Orhon, D., (1991). İstanbul'un Çevre Sorunları ve Çözüm Yolları. İstanbul ticaret Odası Yayın No. 1991/11.
- Uslu, O., Orhon, D., Ünlüata, Ü., Filibeli, A., (1991). Factors Affecting Pollution Control Strategies Along The Coastal Zone of İstanbul. Umweltschutz-Stuttgerter Berichte Zur Abfallwirtschaft, Band. 49.
- Öztürk, İ., Eroğlu, V., Akkoyunlu, A., (1992). Marine Outfall Applications on The Turkish Coastal of The Black Sea. Water Science and Technology Vol. 25, No. 9, pp 203-210.
- Aydoğdu, T., (1982). A Study of Mercury in Three Benthic Species of the Eastern Mediterranean. Msc Thesis, IMS-METU, Erdemli, İçel.
- Bernhard, M. and Zattera, A., (1975). Major Pollution in the Marine Environment, in Pearson E. A. and E.D.F. Frangigane (eds). Marine Pollution and Marine Waste Disposal, 195-300, Pergamon Press, Oxford.
- IMS-METU (1986). İstanbul Kanalizasyon Projesi Atıksu Sistemlerinin İşletme Öncesi ve Sonrası İzlenmesi, Deniz Çalışmaları Bulgu Raporu.
- Kosta, L., Ravmik, V. et al (1978). Some Trace Elements in the Waters, Marine Organisms and Sediments of the Adriatic by Neutron Activation Analysis, J. Radiat. Chem., Vol. 44, pp 317-322.

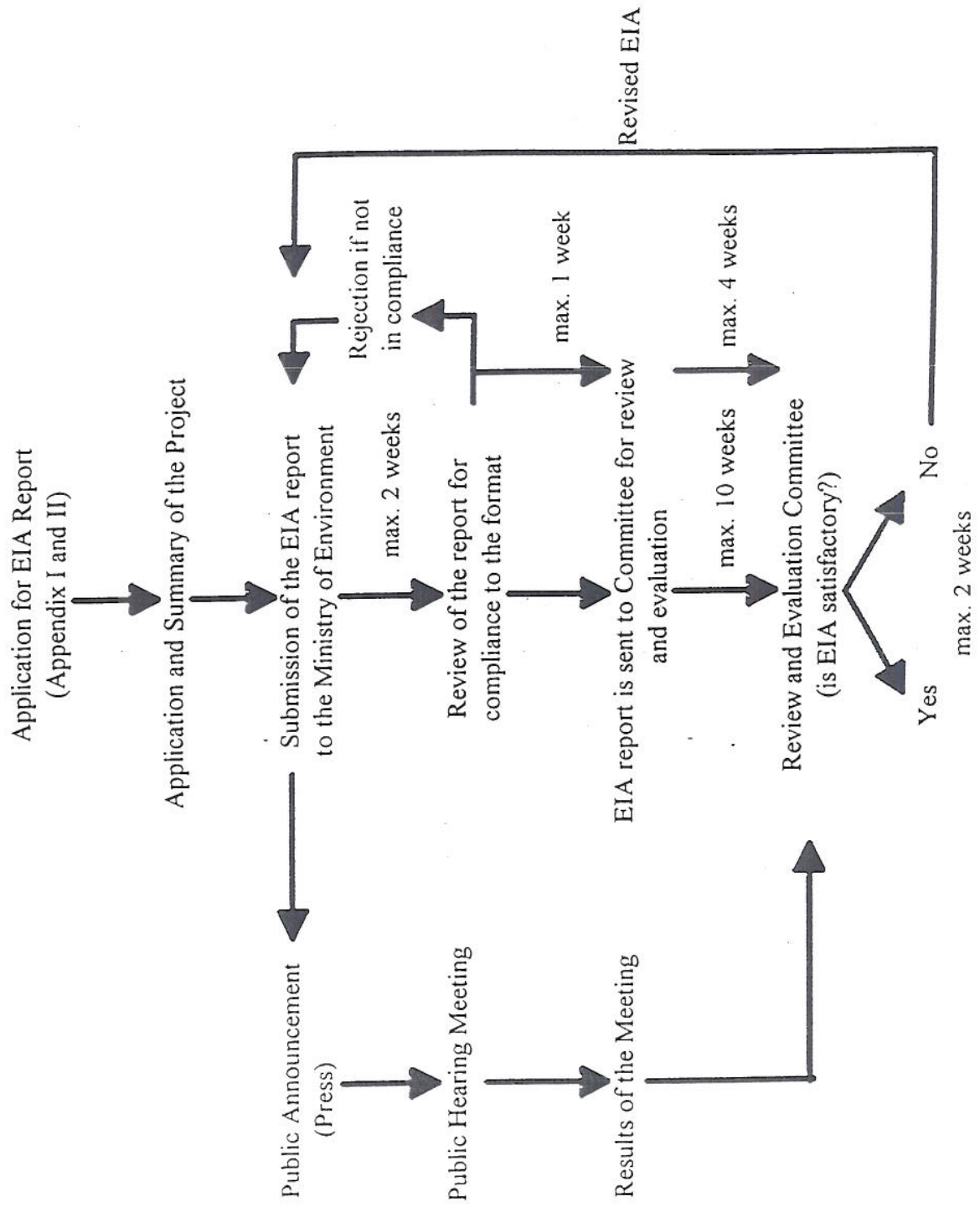
- Kulebakina, L.G. and Kozlova, S.I. (1985). Distribution of Dissolved and Suspended Forms of Mercury in the 0-400 m layer of the Atlantic Ocean and the Mediterranean Sea, *Oceanology*, Vol. 25, pp 191-195.
- Campbell, A.C., Gorringe, R., Nicholls, J. (1982). *The Mediterranean Sea*. The Hamlyn Publishing Ltd.
- Parazan, P. (1970). *Corta d'identita'della Canchiglie del Mediteraneo Vol. I. Bios Taras-Taranto*.
- Rield, R. (1983). *Fauna and Flora des Mittelmeers*.
- AWWA, APHA and WPCF (1985). *Standart Methods For The Examination of Water and Wastewater*.
- Murpy, J. and Riley, J.P. (1962). *Anal. Chim. Acta* 27:31.
- Grasshoff, K. (1983). *Methods of Seawater Analysis*.
- Seyir Hidrografi ve Oşinografi Dairesi Başkanlığı (1985). *Rüzgar, Deniz, Ölüdeniz ve Dalga Atlası*.
- DMİ Genel Müdürlüğü (1971). *Ortalama ve Ekstrem Kıymetler Meteoroloji Yıllığı*.
- EPA (1979). *Chemistry Laboratory Manual For Bottom Sediments*, U.S. EPA-905/4-79-014.
- Temel Araştırma, 9 Eylül Üniversitesi (1991). *Wave, Current and Meteorological Measurements For LNG Terminal Near*.
- Marmara Ereğlisi. *Technical Data Report*.
- Artüz, İ. (1990). *Historical Development and Dimensions of Pollution in the Sea of Marmara and Turkish Straits*. *Proceedings of Special Symposium on Environmental Problems of İstanbul*, Organized by Environmental Protection Council (in Turkish).
- USEPA AP 42 *Compliation of Air Pollutant Emission Factors*.
- USA-EPA *Noise Pollution Control Regulations*
- Dünü Bugünü ile Marmara Ereğlisi (1994). (İlçe Belediyesi Tanıtım Kitabı), Yatkın Ofset Matbaacılık.

ANNEXES

**LIST OF LAWS, REGULATIONS, COMMUNIQUÉS AND OFFICIAL DOCUMENTS
REFERRED IN ASSESSMENT OF THE ENVIRONMENTAL IMPACTS**

LINE NO	TITLE	DATE AND/OR NUMBER
1	Communiqué for the non-monopoly explosives, hunting material i.e. Their production, import, transportation, storage, sale, use, disposal and inspection.	87/12028 No. Cabinet Decision.
2	Law for General Hygiene	24/4/1930 No: 1593
3	Regulation for non-hygienic facilities	19/04/1968 No. 12852
4	Law for Shore Protection	4/4/1990 No. 3621
5	Regulation for application of Shore Protection Law	1/8/1990 No.20594
6	Urban Law	3/5/1985 No.3194
7	Typical Urban Regulation for the municipalities which are not included into Law No:3030 for Administration of Metropol municipalities.	2/11/1985 No: 18916
8	Urban regulation for unplanned areas which are in or out of the approaching zones of the municipalities.	2/11/1985 No:18916
9	Decision for the grouping the facilities which cause air pollution, in respect to type of their activities.	26/5/1991/20882 No.91/1551
10	Communiqué for the precautions to be taken at the works and facilities where the flammable, explosives, dangerous or hazardous materials utilized	17/11/1973 No:7/7551
11	Aquatic Products Law	9/8/1983 No:1380
12	Environmental Law	9/8/1993 No: 2872
13	Aquatic Products Regulations	1973
14	Air Pollution Control Regulations	1986
15	Noise Pollution Control Regulations	1986
16	Water Pollution Control Regulations	1988
17	Solid Wastes Control Regulations	1991
18	Hazardous Substances Communiqué in Water, Water Pollution Control Regulation	1989
19	Administrative Methods Communiqué in Water, Water Pollution Control Regulations	1989
20	Technical Methods Communiqué in Water, Water Pollution Control Regulations	1991
21	Sampling and Analyses Methods Communiqué in Water, Water Pollution Control Regulations	1991
22	Regulation for hazardous chemical and products	1993
23	Directive of Ministry of Environment for Management of the Solid Waste Storage Areas	1993
24	Decision of the 1993-1994 Hunting Season Central Committee of the Ministry of Forestry	19/7/1993 No: 21642

APPROVAL PROCEDURE FOR EIA REPORT



MINISTRY OF ENERGY AND NATURAL RESOURCES
General Directorate of Energy Works

Number: B-15-O-EGM.0.00.00.00.-2382
Subject : Plant Site

13670

ANKARA
02/11/1993

Ref: a)Your letter dated 23.9.1993 and No. 01/1029
b)Your letter dated 1.10.1993 and No. 01/1040
c)Our letter dated 17.11.1993 and No. B.15.0.ADB.0.00.00.00.2035

From the three alternatives that have expalined in your letter (a) concerning the site area of the Natural Gas Fired Plant, you advise that the technical team of your consortium determined the site area number 1 is the most favorable site and you want to start the start of soil investigation works at this site.

Our Ministry does not seem any draw-backs for choosing any of the three areas, providing that all responsibilities for topographical, geological, environmental, meteorological studies and population, ownership issues and permits remains with your consortium, as stated in our letter ref (c) and implementation agreement dated 18/06/1993.

It is our Ministry's duty that providing support for the necessary permits applications to the government authorities.based on the documents that will be prepared as requirement of the related legislation.

Signed.
For the Minister

Muammer Isikoglu
Deputy of Under Secretary

T. C.
ENERJİ VE TABİİ KAYNAKLAR BAKANLIĞI

Enerji İşleri Genel Müdürlüğü

Sayı B.15.0.EGM.0.00.00.00. -2382

Ankara

Konu Marmara Ereğlisi Doğalgaz
Santral Sahası

13670

- 2 KASIM 1993

MİMAG İNŞAAT VE TİCARET A.Ş.
İzci Sokak No:18

06700-ANKARA

- İLGİ: a)23.9.1993 tarih ve 01/1029 sayılı yazınız.
b)1.10.1993 tarih ve 01/1040 sayılı yazınız.
c)17 Eylül 1993 tarih ve B.15.0.EGB.0.00.00.00.2035 sayılı yazımız.

3096 sayılı Kanun'un 4.maddesine göre Marmara Ereğlisinde şirketinizde ortak olduğu bir konsorsiyum tarafından tesis edilip işletilecek olan 500 MW kurulu gücündeki Marmara Ereğlisi Doğalgaz santralı tesis sahası olarak Şirketiniz tarafından ilgi (a) yazınızda belirlenen 3 alternatif sahadan 1 nolu sahanın Konsorsiyum teknik heyetince en uygun yer olarak görüldüğünü ve sözkonusu sahada zemin etüdü için gerekli sondajlara başlanmasının istendiğini belirten ilgi (b) de kayıtlı yazınız incelenmiştir.

İlgi (c) de kayıtlı yazımızda da belirtildiği üzere santral yeri olarak belirlenen sahada topografik, Jeolojik, çevresel, meteorolojik vb. özellikler ve yerleşim, nüfus, mülkiyet konuları ile ilgili konsorsiyumunuz tarafından yapılacak çalışmalar ve tesis için alınması gerekli izinler konusunda 18 Haziran 1993 tarihinde paraflanan Uygulama Anlaşmasında da yer aldığı şekilde her türlü sorumluluk konsorsiyumunuzda olmak üzere belirlenen sahalardan herhangi birinin seçiminde Bakanlığımızca sakınca görülmemektedir.

Bakanlığımızın bu konuda yapılacak araştırma çalışmaları ve sonuçları ile alınması gerekli izinlere yönelik yükümlülüğü, şirket tarafından ilgili mevzuatın gereklerine uygun olarak hazırlanacak dökümanlara dayalı izin başvuruları konusunda Devlet birimleri nezdinde girişimde ve yardımda bulunmaktadır.

Bilgilerinizi rica ederim.

BAKAN ADINA

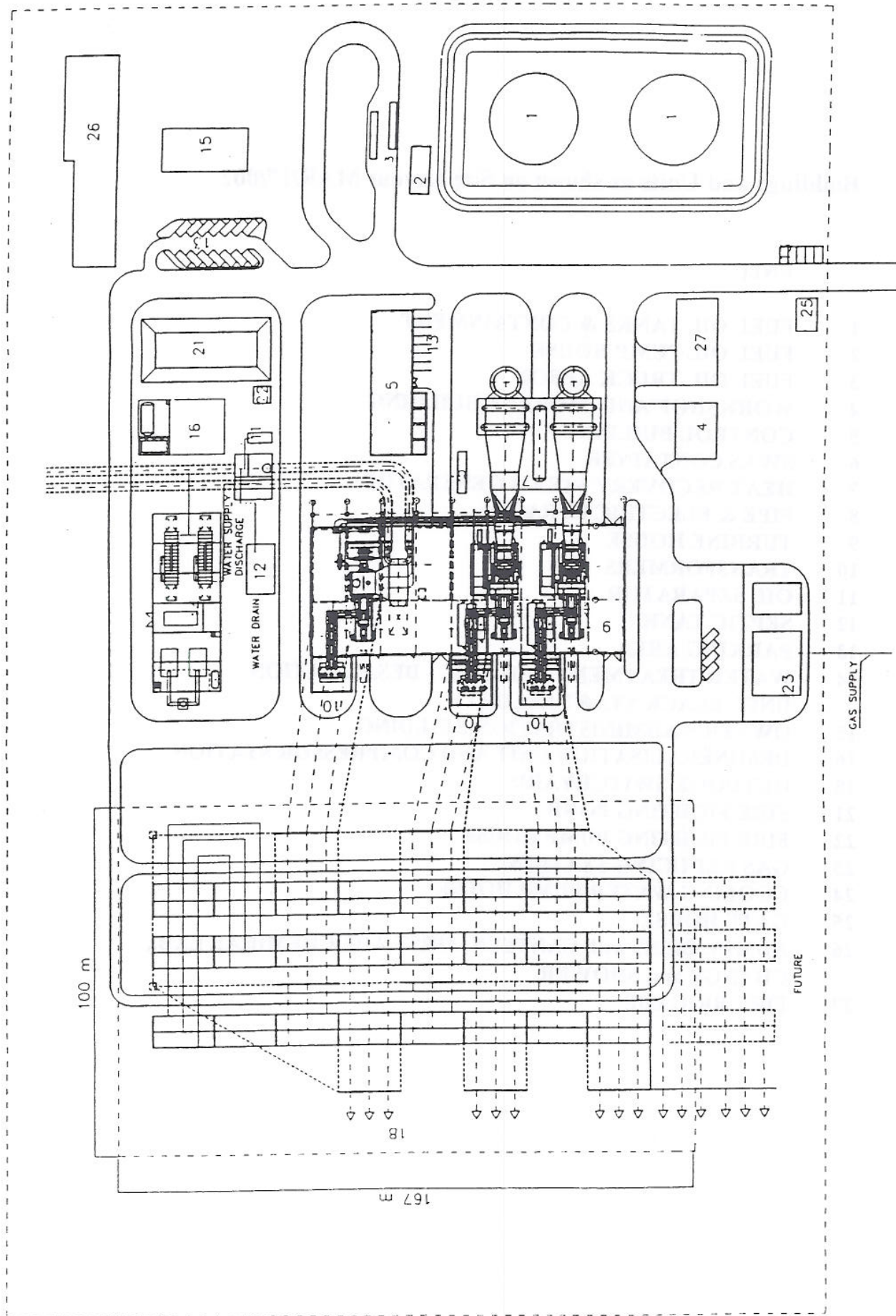


Muammer İSKOĞLU
Müsteşar Yardımcısı

Buildings and Units as shown on Site Layout MAR/17/002

UNIT

- 1 FUEL OIL TANKS & CONTAINMENT**
- 2 FUEL OIL PUMP HOUSE**
- 3 FUEL OIL TRUCK APRON**
- 4 WORKSHOP AND STORAGE BUILDING**
- 5 CONTROL BUILDING**
- 6 SWAS CONTAINER**
- 7 HEAT RECOVERY STEAM GENERATOR**
- 8 PIPE & ELECTRICAL RACK**
- 9 TURBINE HOUSE**
- 10 TRANSFORMERS**
- 11 OIL SEPARATOR**
- 12 SEPTIC TANK**
- 13 PARKING AREA**
- 14 WATER TREATMENT BUILDING, DESALINATION
UNIT, BLACK START FACILITY**
- 15 OWNER'S ADMINISTRATION BUILDING**
- 16 DEMINERALISATION UNIT AND COMPRESSOR STATION**
- 18 OUTDOOR SWITCHYARD**
- 21 FIRE FIGHTING POND**
- 22 FIRE FIGHTING PUMP HOUSE**
- 23 GAS REDUCING STATION**
- 24 COOLING WATER PUMP HOUSE**
- 25 GATE HOUSE**
- 26 ADMIN. BLDG with CANTEEN, FIRST AID, CHEMICAL LAB.,
CHANGE and SHOWER**
- 27 FIRE BRIGADE**



UNI-MAR Enerji Yatırımları AS
 480 MW Combined Cycle Power plant SITE LAYOUT
 DRG. No. MAR/17/002
 ABB Kraftwerke AG

Turbine Hall

Arrangement, dimensions and type of structure are shown on ABB - drawings Nr. GKW G 520 832 and Nr. GKW G 610 548

The design of the building follows in general the ABB standard design for Turbine Halls

The carcass structure above ground floor level is of structural steelwork. The basement including its ceiling at ground floor level is of watertight reinforced concrete.

The roof and external walls consist of double leaf insulated aluminium sheeting above +1.0 m and of precast concrete panels finish below +1.0 m. Required sound attenuation will be observed. 6.0 m high prec. concr. panels shall be provided, where walls are facing transformer yards.

The cabinets which house the circuit breaker, grounding cubicle and excitation transformer are formed by containers

The ground floor slab will be of RCC with metallic hardener floor finish, underlaid with rubble soling. Cable ducts be covered by removable precast concrete slabs.

Ext. Cage ladders to be provided to both roofs.

Doors and gates shall be double plate flush shutter type, the main gates will be folding sliding type.

Artificial lighting will be provided

HRSG and HRSG Aux. Equipment

Arrangement and approximate dimensions of the Heat Recovery Steam Generators System are shown on ABB - drawing No. GKW G 520 832.

The ABB design provides steam generators of the outdoor installation type. So no building is to be provided and the Civil Works are limited to the foundations and ancillary works at ground level. All structures above ground level, i. e. steel structure, platforms, stairways etc. are part of the mechanical supply of the Steam Generators.

Besides the reinforced concrete foundations, ducts, pits, a reinforced concrete slab at ground level is provided below the outlines of the steam generators. The free areas between these are finished with RCC paving. Details for floor slab and foundations are the same as descr. for Turbine-House.

All elements of the stacks above ground level are part of the mechanical supply of the stacks. So the Civil Works are limited to the foundations and to ancillary works at ground level.

The stack foundations are square, octagonal or circular reinforced concrete blocks of the required diameter and thickness. The top side is shaped following the stack requirements, as outlined on the drawing.

Between the stacks and Turbin House, wide shallow reinforced concrete ducts are provided below the exhaust pipes and exhaust silencers. The foundations of exhaust silencers are incorporated within the bottom of these ducts. The free areas between the stack foundations and exhaust pipe ducts are finished with RCC paving.

Workshop and Storage Building

This is a single storey building of the approximate dimensions LxWxH = 15x20x6m. The carcass structure above ground floor is of RCC framework with masonry walls.

The roof consists of heavy duty insulation with foam concrete on cast in situ reinforced concrete slab with permanent metal shuttering. Metal shuttering to be painted from the underside.

Internal walls will be masonry walls, all walls and ceilings shall be plastered and painted.

Sanitary room are provided with all fittings, water supply and dewatering. All finishes to be provided as described under Control-, Administration- and Switchgear Building.

A light overhead crane runway is provided, also an access gate, emergency doors, industrial type windows and ventilation louvres.

Fuel Oil Tanks and Containment

Arrangement of fuel Oil Tanks and Containment is shown on ABB drawing MAR/17/002.

The respective Civil Works comprise the ring foundations under the tank outline, the finish to the area under the tanks with bitumen sand layer on compacted gravel, the bund dyke to the tankyard and the oil proof sealing tot the tank yard ground area and dyke sides as shown on ABB drawing GKW G 530 463.

Regarding the seismic conditins the above tank foundation might be modified, i. e. a raft foundation will be provided (for safe foundation system during earthquake) instead of the ring foundation.

Fuel Oil Pump House

Distillate oil is provided optionally as standby fuel. The Fuel Oil Pump house houses the respective unloading and forwarding pumps., see draw. GKW G 530 464.

It is a single storey building. The structure is of reinforced concrete, the walls are of brickwork.

Roof is of RCC with heavy duty insulation.

Steeldoors and industrial type windows are foreseen.

The building is equipped with hoist beams under the roof and with an access gate. On the ground floor slab, pedestals for the pumps are provided. Below, a cable duct and oil retention pits are provided.

Pipe and Cable Racks

Arrangement and horizontal dimensions are shown on ABB-dwg. No. MAR/17/002.

All Structural steelwork such as building structures including floor and intermediate platforms, walkways, gratings and chequered plates with cut-outs for crossings, bordering profiles, railings, stairs and ladders supporting structures like pipe bridges, road crossings, sleepers, supply and erection including foundation works are part of the civil works.

Transformer Yards

One great Transformer is provided to each one of the three Turbine/Generator sets.

The Transformer Yards consist of transformer foundations, oil collection pits and enclosures, see GKW G 520 832 and GKW G 610 548.

The transformer foundations consist of reinforced concrete foundation slabs at deep level and of reinforced concrete walls up to ± 0 m plant level which support the transformer rails.

The oil collection pits consist of concrete bottom slabs (above the transformer foundation slabs) and of walls of varying thickness up to ± 0 m plant level. Pits are covered by grating with about 20cm gravel topping.

Blast walls are provided where transformers are adjacent to buildings or to each other.

Control-, Administration- and Switchgear Building

Arrangement, dimensions and type of structure are shown on ABB-drawing GKW G 610 540.

Details for basement slab and foundations are the same as described for Turbine Hall.

The carcass structure above ground floor is of RCC Framework with masonry walls. The cable basement is of watertight reinforced concrete.

The intermediate floors as well as the roof consist of cast in situ reinforced concrete.

A heavy duty insulation is foreseen on the r. e. roof.

Internal walls will be in brick masonry, perfect party wall quality for staircase area, with both side plaster and paint.

Sanitary rooms are provided at least at two floors, with all fittings, water supply and dewatering, terrazzo tiling on floors and tiling on walls.

All finishing works will be provided as follows:

- Control room, Computer room and Switchgear rooms will have removable. double flooring with PVC topping.
- Suspended ceilings to be provided in Control room, Computer room, Offices, Toilets and Corridors. Battery room shall have acid resistant tiling on floor and walls.
- All the floors to be concrete carborundum tiles, resp. terrazzo tiles.
- All ceilings to be painted. Doors and windows in the entrance area to be aluminium, doors to technical rooms to be steel doors, doors to nontechnical rooms to be wooden doors. Aluminium partition walls with glazing.

Fuel Truck Apron

The fuel truck apron consists of a paved area. This area will be made out of r.c. with a small surrounding curb and oil collecting channels. The channels are covered with grating and will collect and direct any oil leakages to the oily water system.

Gas Pressure Reducing and Metering Station

The Gas pressure reducing and metering station will be built according to "BOTAS" specifications.

Cooling Water Pump House

Arrangement, dimensions and type of structure are shown on ABB drawing MAR/17/004. The structure is of reinforced concrete, the roof consists of heavy duty insulation with foam concrete on r. c. roof slab, the walls are of brickwork, both sides plastered and painted. The floor finish consists of granolithic screed. R. C. roof slab to be performed by precast elements, underside to be painted.

A light overhead crane runway is provided, also an access gate, emergency doors, industrial type windows and ventilation louvres.

Doors to be steel doors as described as for Turbine House, gate to be supplied as rolling shutter door. External cage ladder is provided.

Fire Fighting Pond

Location is shown on ABB-drawing No. MAR/17/002. The Pond is at approximate dimensions of $L \times W \times D = 40 \times 15 \times 2\text{m}$. The structure consists of watertight reinforced concrete. It will be finally sized based on Fire Officer's requirements.

Water treatment Plant Building

Arrangement, dimensions and type of structure are shown on ABB drawing.

The structure of the Building is of reinforced concrete. The walls are of brickwork, plastered and painted. All finishes as described for Control Building. Details for foundations and basement slab are the same as described for Turbine House.

At groundfloor level, catchpits with acid/lye resisting lining are provided under tanks, furthermore a control room and a laboratory and Storage room are arranged. Part of the building has a second floor, where switchgears and compressors are arranged.

An access gate and several trolley girders are provided.

Outside the building tanks are installed above ground on top of catchpits resp. a neutralisation pit. The pits are watertight RCC constructions with acid/lye resisting lining.

Oil Separator

Arrangement is shown on ABB drawing No. MAR/17/002, approximate dimensions and structure of the oil separator is shown on ABB-drawing GKW G 530 461.
The complete structure will be built below ground and consists of watertight reinforced concrete.

Septic Tank

Arrangement is shown on ABB drawing MAR/17/002. The complete structure will be built below ground consisting of watertight reinforced concrete and sized based on occupancy.

Gate House

This gate house is sized for 2 persons and will include washroom/toilet, kitchen and wall mounted AC unit.

Dimensions are approx. 4,0m x 6,0m x 2.8m.

The structure is a RCC framework with infilled masonry.
Finishing as per Control Building.

LEGEND

CONDENSER PAK

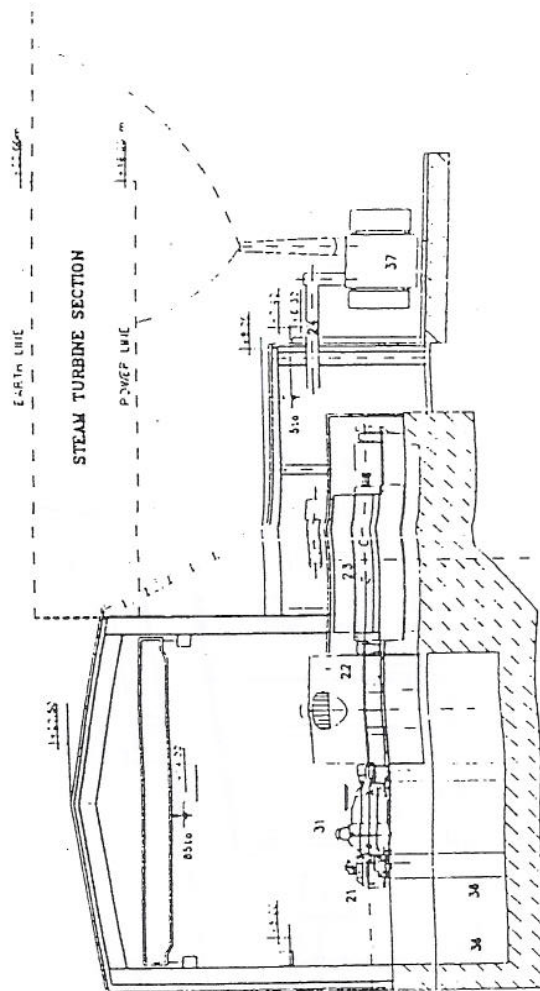
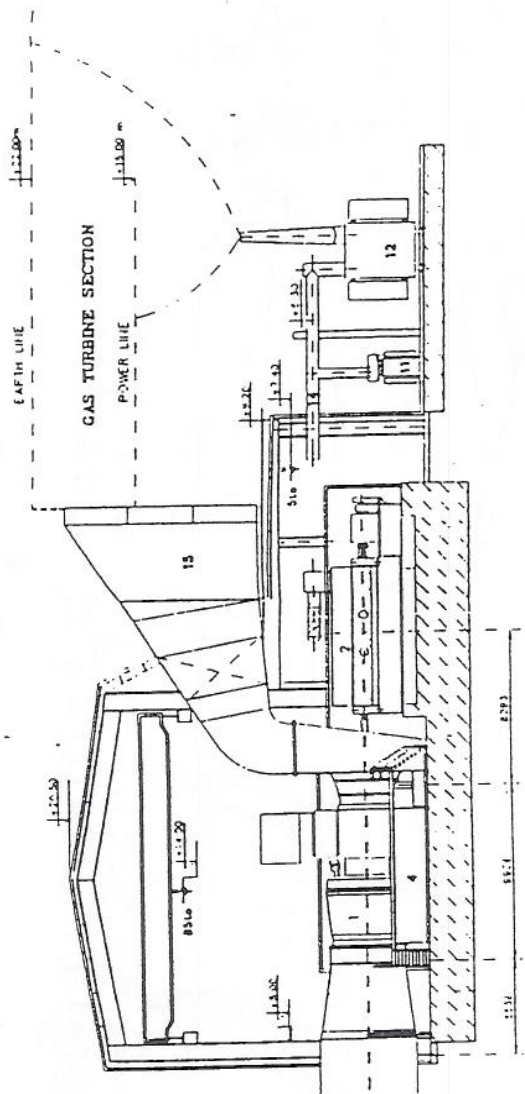
- 1 GAS PUMP
- 2 GENERATOR
- 3 COMPRESSOR
- 4 FUEL IN BLOCK
- 5 FUEL IN BLOCK
- 6 STEERING WHEEL
- 7 STEERING WHEEL
- 8 BATTERY WHEEL
- 9 GENERATOR BELT WHEEL
- 10 GENERATOR BELT WHEEL
- 11 GENERATOR BELT WHEEL
- 12 GENERATOR BELT WHEEL
- 13 GENERATOR BELT WHEEL
- 14 GENERATOR BELT WHEEL
- 15 GENERATOR BELT WHEEL
- 16 GENERATOR BELT WHEEL
- 17 GENERATOR BELT WHEEL
- 18 GENERATOR BELT WHEEL
- 19 GENERATOR BELT WHEEL
- 20 GENERATOR BELT WHEEL

STEAM TURBINE PAK

- 21 STEAM TURBINE
- 22 STEAM TURBINE
- 23 STEAM TURBINE
- 24 STEAM TURBINE
- 25 STEAM TURBINE
- 26 STEAM TURBINE
- 27 STEAM TURBINE
- 28 STEAM TURBINE
- 29 STEAM TURBINE
- 30 STEAM TURBINE
- 31 STEAM TURBINE
- 32 STEAM TURBINE
- 33 STEAM TURBINE
- 34 STEAM TURBINE
- 35 STEAM TURBINE
- 36 STEAM TURBINE
- 37 STEAM TURBINE
- 38 STEAM TURBINE
- 39 STEAM TURBINE
- 40 STEAM TURBINE
- 41 STEAM TURBINE
- 42 STEAM TURBINE

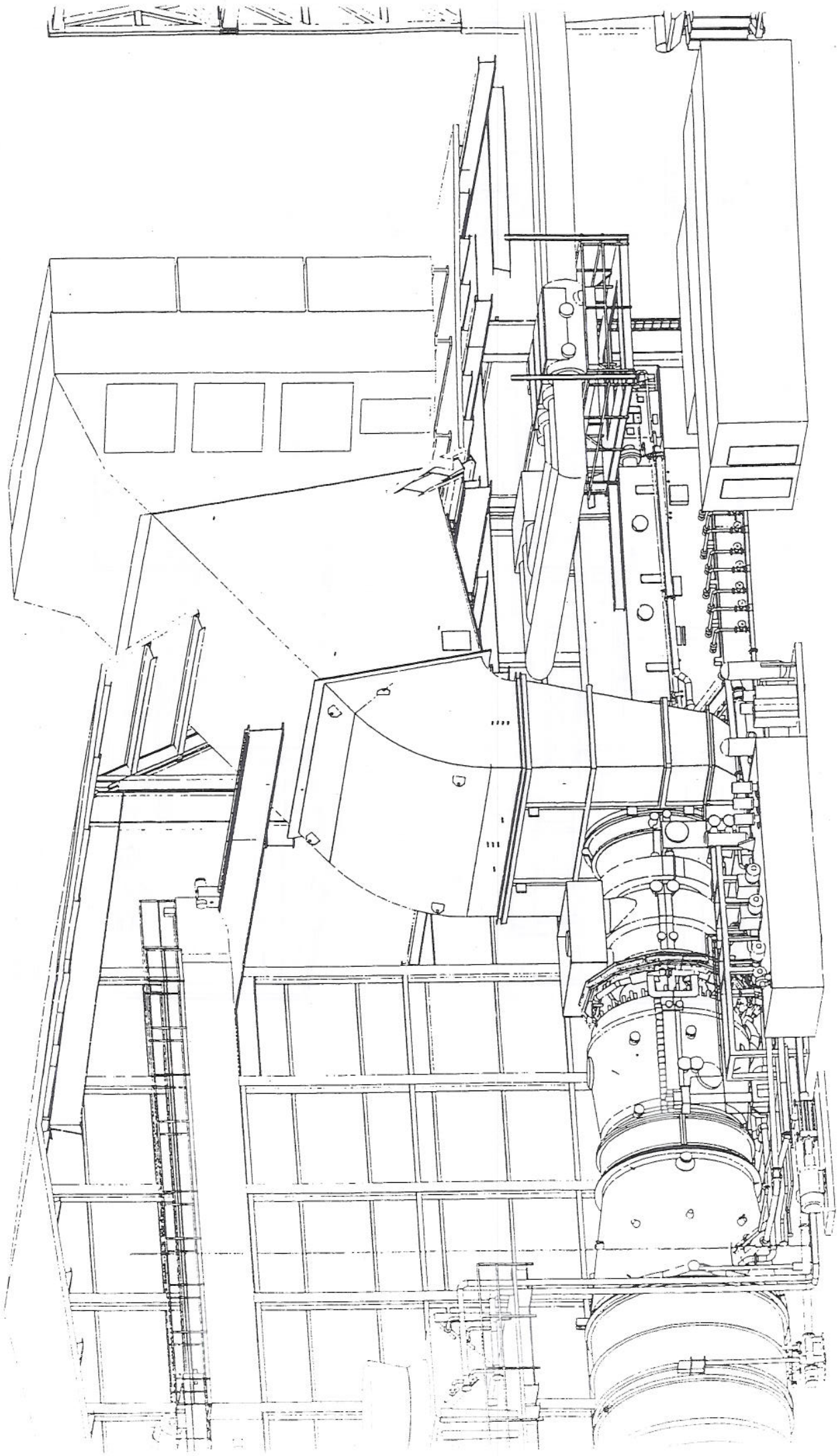
WATER PAK

- 43 WATER PUMP
- 44 WATER PUMP
- 45 WATER PUMP
- 46 WATER PUMP
- 47 WATER PUMP
- 48 WATER PUMP
- 49 WATER PUMP
- 50 WATER PUMP
- 51 WATER PUMP
- 52 WATER PUMP
- 53 WATER PUMP
- 54 WATER PUMP
- 55 WATER PUMP
- 56 WATER PUMP
- 57 WATER PUMP
- 58 WATER PUMP
- 59 WATER PUMP
- 60 WATER PUMP
- 61 WATER PUMP
- 62 WATER PUMP



500 HP STEAM SECTION
MAR 1964

NO.	DESCRIPTION	QTY.	UNIT	PRICE	TOTAL
1	STEAM TURBINE	1	EA	100.00	100.00
2	STEAM TURBINE	1	EA	100.00	100.00
3	STEAM TURBINE	1	EA	100.00	100.00
4	STEAM TURBINE	1	EA	100.00	100.00
5	STEAM TURBINE	1	EA	100.00	100.00
6	STEAM TURBINE	1	EA	100.00	100.00
7	STEAM TURBINE	1	EA	100.00	100.00
8	STEAM TURBINE	1	EA	100.00	100.00
9	STEAM TURBINE	1	EA	100.00	100.00
10	STEAM TURBINE	1	EA	100.00	100.00
11	STEAM TURBINE	1	EA	100.00	100.00
12	STEAM TURBINE	1	EA	100.00	100.00
13	STEAM TURBINE	1	EA	100.00	100.00
14	STEAM TURBINE	1	EA	100.00	100.00
15	STEAM TURBINE	1	EA	100.00	100.00
16	STEAM TURBINE	1	EA	100.00	100.00
17	STEAM TURBINE	1	EA	100.00	100.00
18	STEAM TURBINE	1	EA	100.00	100.00
19	STEAM TURBINE	1	EA	100.00	100.00
20	STEAM TURBINE	1	EA	100.00	100.00
21	STEAM TURBINE	1	EA	100.00	100.00
22	STEAM TURBINE	1	EA	100.00	100.00
23	STEAM TURBINE	1	EA	100.00	100.00
24	STEAM TURBINE	1	EA	100.00	100.00
25	STEAM TURBINE	1	EA	100.00	100.00
26	STEAM TURBINE	1	EA	100.00	100.00
27	STEAM TURBINE	1	EA	100.00	100.00
28	STEAM TURBINE	1	EA	100.00	100.00
29	STEAM TURBINE	1	EA	100.00	100.00
30	STEAM TURBINE	1	EA	100.00	100.00
31	STEAM TURBINE	1	EA	100.00	100.00
32	STEAM TURBINE	1	EA	100.00	100.00
33	STEAM TURBINE	1	EA	100.00	100.00
34	STEAM TURBINE	1	EA	100.00	100.00
35	STEAM TURBINE	1	EA	100.00	100.00
36	STEAM TURBINE	1	EA	100.00	100.00
37	STEAM TURBINE	1	EA	100.00	100.00
38	STEAM TURBINE	1	EA	100.00	100.00
39	STEAM TURBINE	1	EA	100.00	100.00
40	STEAM TURBINE	1	EA	100.00	100.00
41	STEAM TURBINE	1	EA	100.00	100.00
42	STEAM TURBINE	1	EA	100.00	100.00
43	STEAM TURBINE	1	EA	100.00	100.00
44	STEAM TURBINE	1	EA	100.00	100.00
45	STEAM TURBINE	1	EA	100.00	100.00
46	STEAM TURBINE	1	EA	100.00	100.00
47	STEAM TURBINE	1	EA	100.00	100.00
48	STEAM TURBINE	1	EA	100.00	100.00
49	STEAM TURBINE	1	EA	100.00	100.00
50	STEAM TURBINE	1	EA	100.00	100.00
51	STEAM TURBINE	1	EA	100.00	100.00
52	STEAM TURBINE	1	EA	100.00	100.00
53	STEAM TURBINE	1	EA	100.00	100.00
54	STEAM TURBINE	1	EA	100.00	100.00
55	STEAM TURBINE	1	EA	100.00	100.00
56	STEAM TURBINE	1	EA	100.00	100.00
57	STEAM TURBINE	1	EA	100.00	100.00
58	STEAM TURBINE	1	EA	100.00	100.00
59	STEAM TURBINE	1	EA	100.00	100.00
60	STEAM TURBINE	1	EA	100.00	100.00
61	STEAM TURBINE	1	EA	100.00	100.00
62	STEAM TURBINE	1	EA	100.00	100.00



Gas Turbogroup 13E2

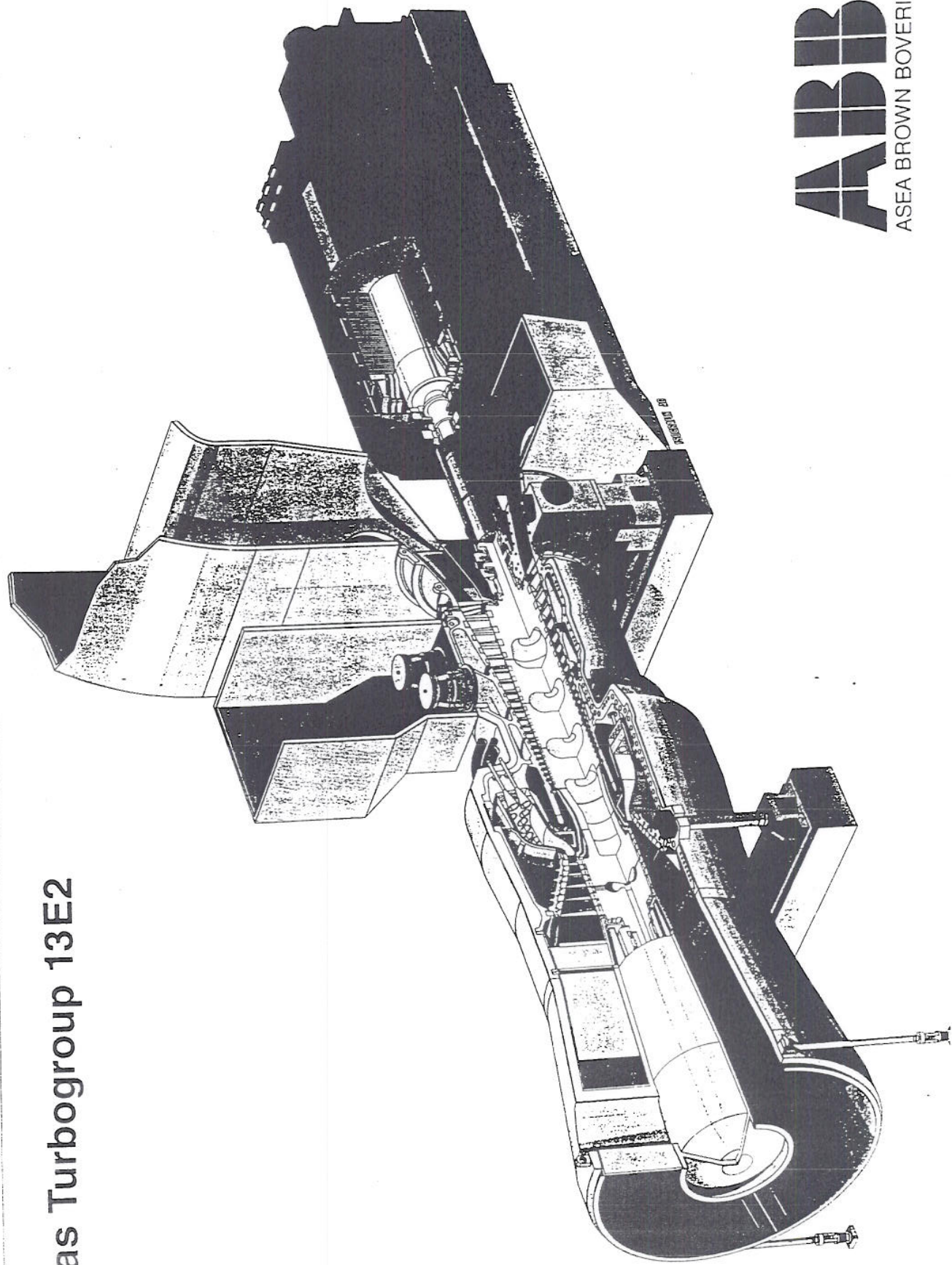
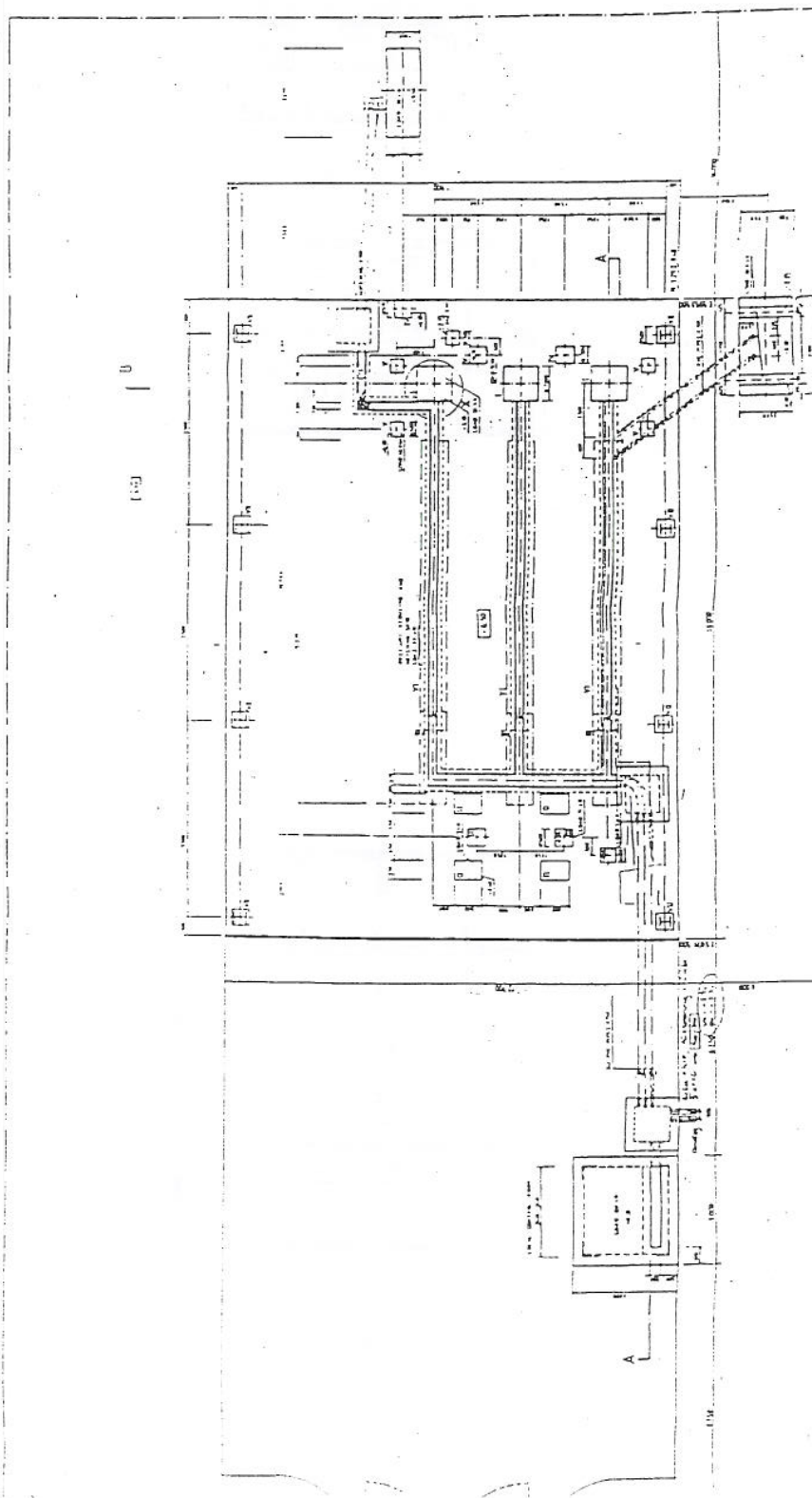
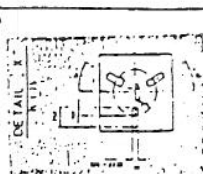
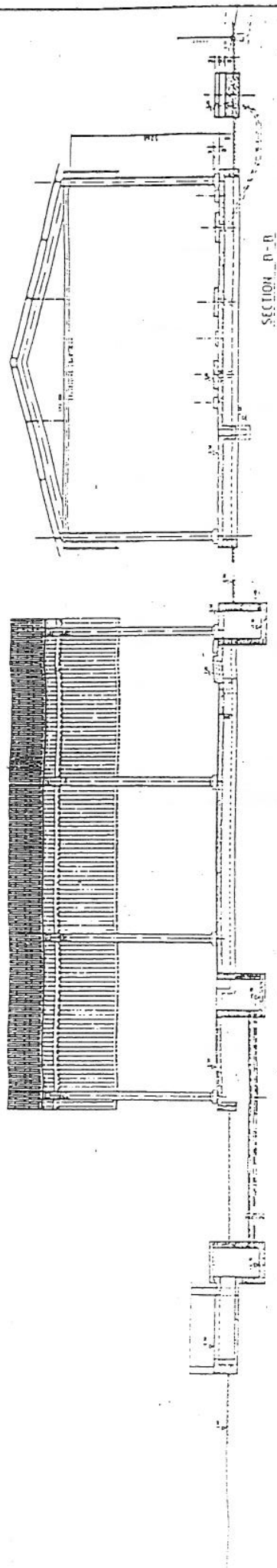
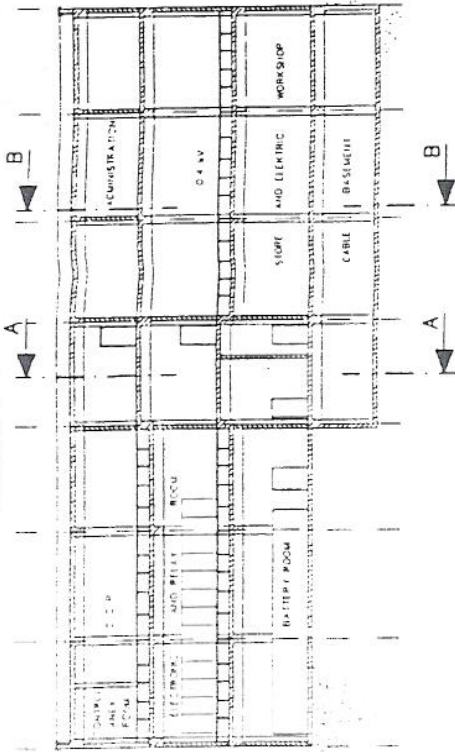


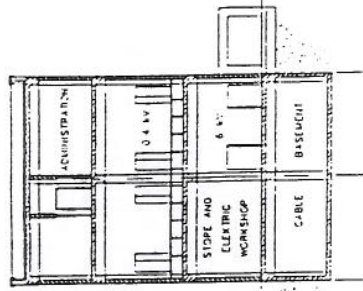
ABB
ASEA BROWN BOVERI

[illegible]

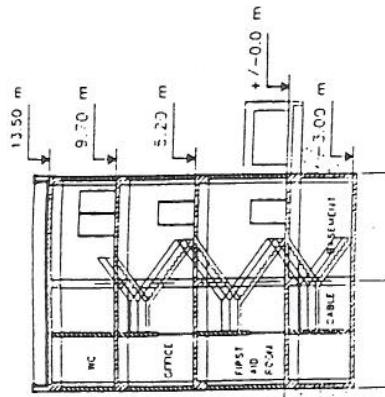
SECTION C-C



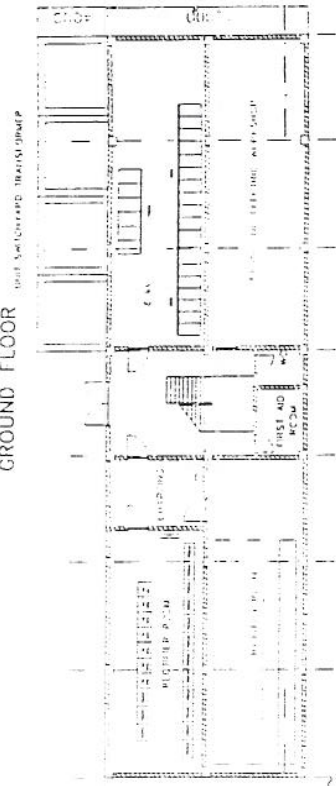
SECTION B-B



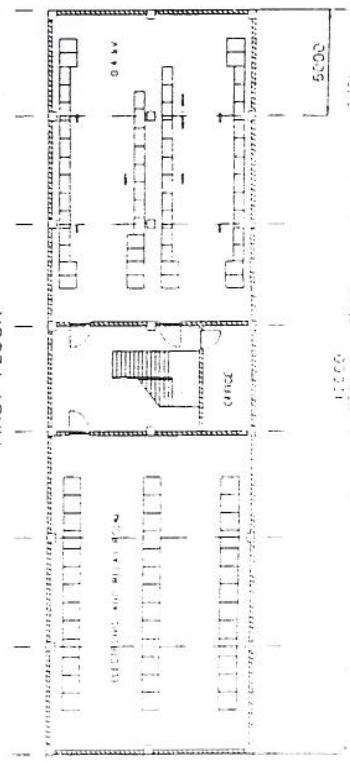
SECTION A-A



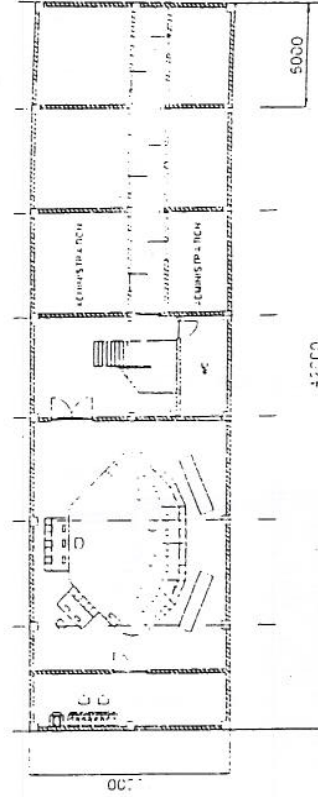
GROUND FLOOR



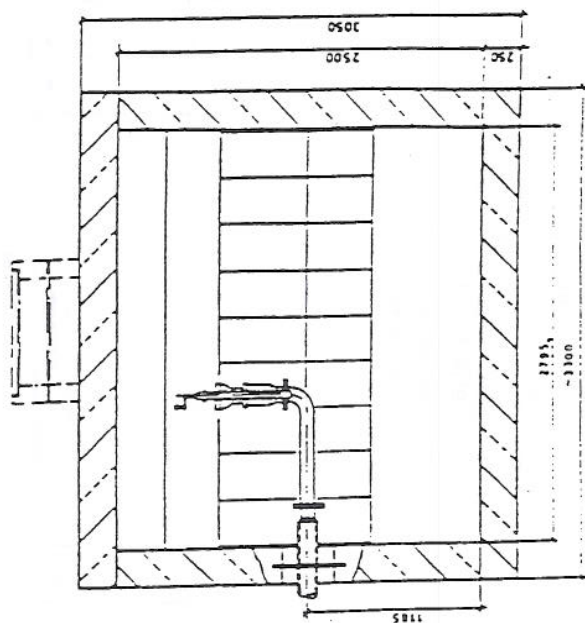
FIRST FLOOR



SECOND FLOOR



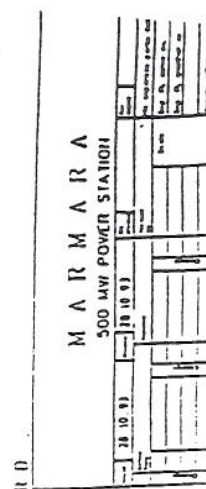
NO. 1000 10000
MARRA
UNIT

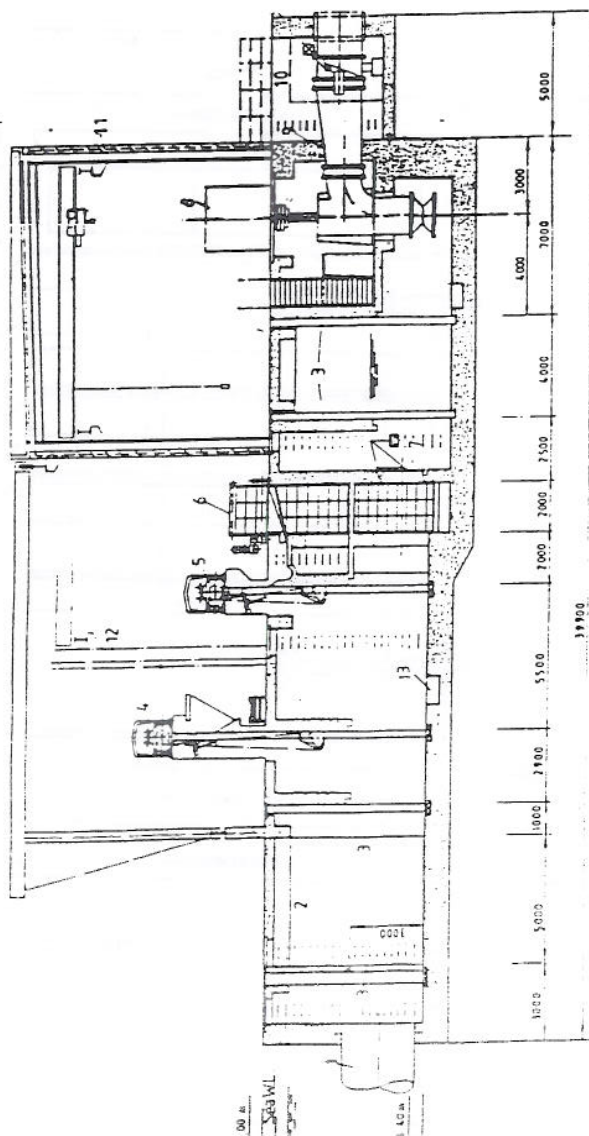


Technical drawing of a vertical pump assembly, showing a cross-section of the main body and a detailed view of the pump assembly at the bottom. The main body is a vertical cylinder with a flange at the top and a flange at the bottom. The pump assembly at the bottom consists of a pump housing, a pump shaft, and a pump impeller. The drawing includes dimensions: 96 C. at the top and 96 C. at the bottom. A label 'Pump assembly' points to the pump assembly at the bottom.

Schnitt A-A

reference drawing





1	Cooling water intake
2	Distributing chamber
3	Isolating gates
4	Coarse bar screen
5	Fine bar screen
6	Band screen
7	Emergency discharge gate
8	Cooling water pump
9	Piping fixpoint
10	Valve pit
11	Housing structure
12	Max. housing structure
13	Settle outlet
14	Chlorination plant
15	Drain container

[illegible]

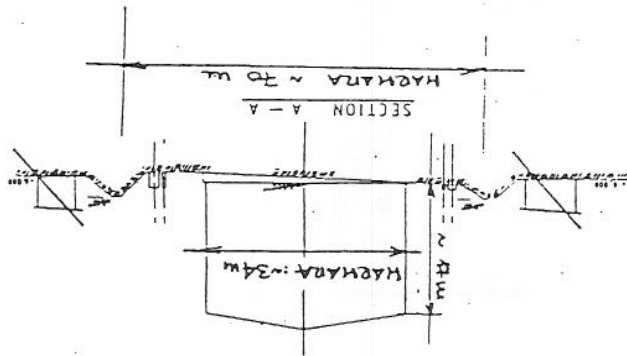
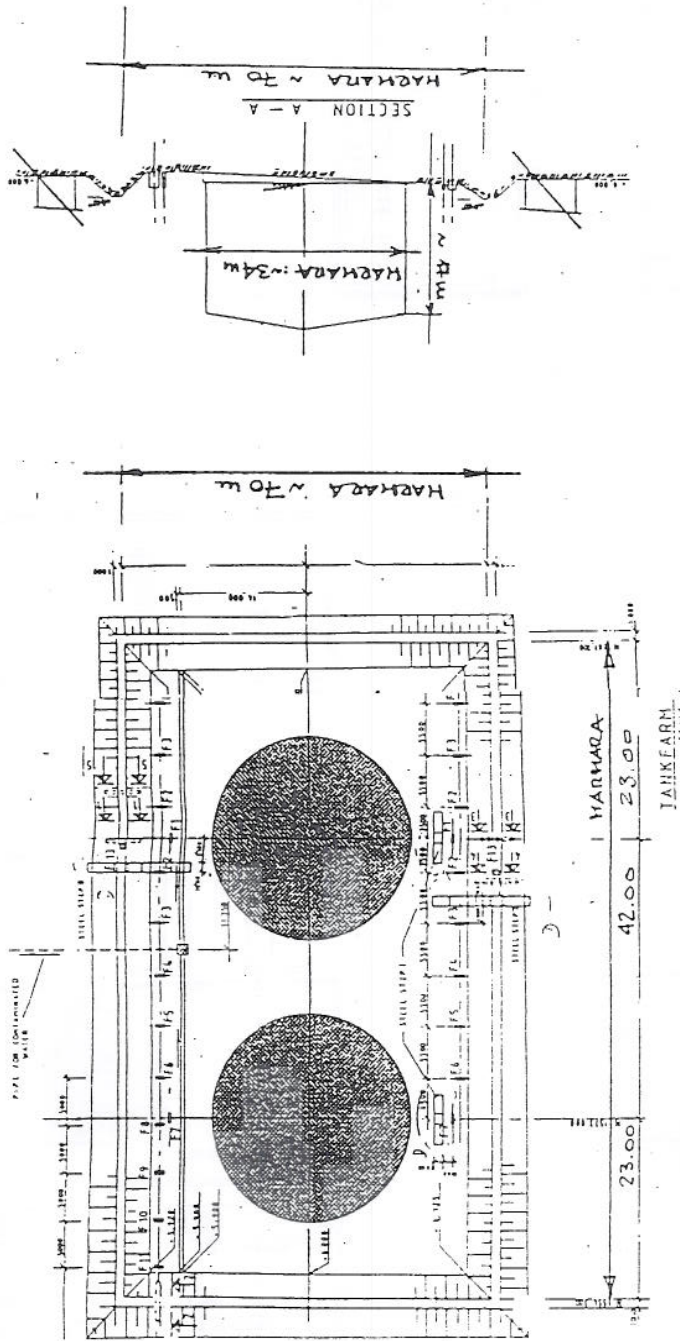
UNIMAR A.S.

MARMARA EREGLISI
480 MW COMBINED CYCLE POWER PLANT

DRG. No. MAR/17/004

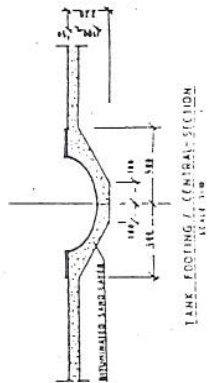
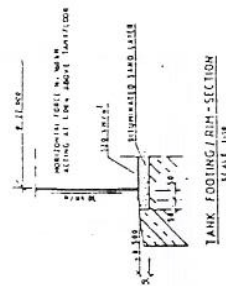
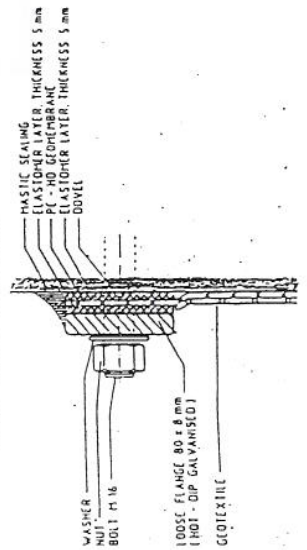
SCHAEFER 1.03,94

REF. NO.	DATE	NAME	DOC. TYPE	FILE
				A3

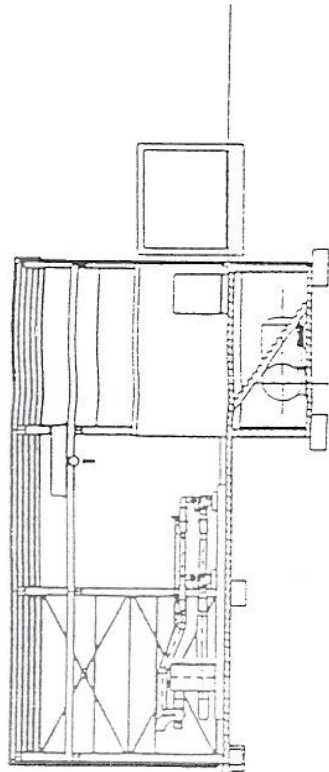


DETAIL "C"

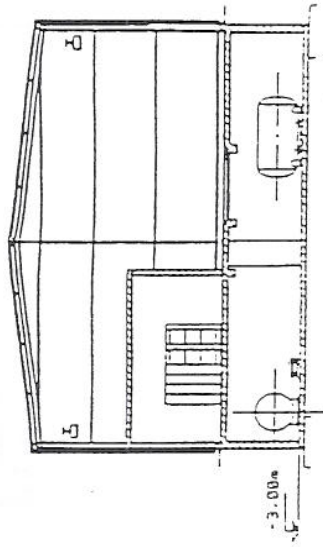
FIXING ELEMENT DETAIL LOOSE FLANGE CONNECTION



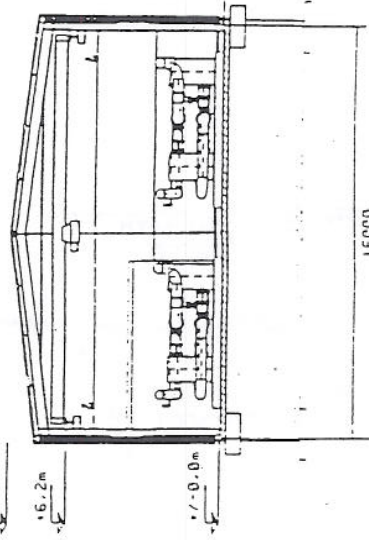
Section I - I



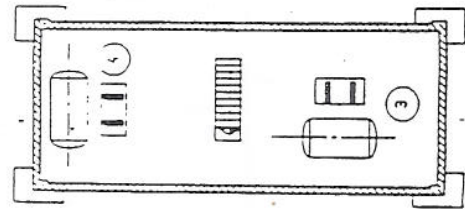
Section A - A



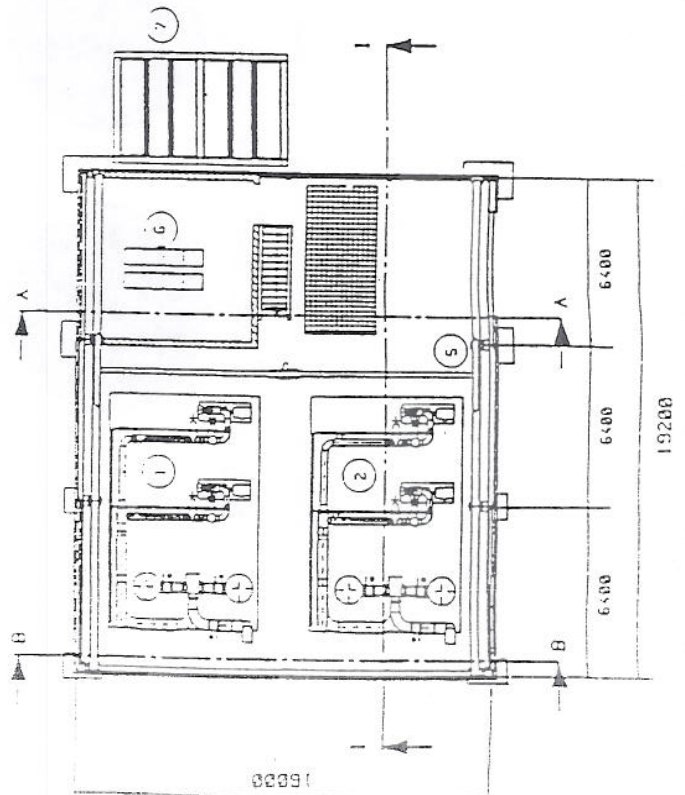
Section B - B



Elevation -3.00 m



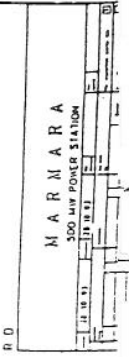
Elevation 0.00 m



reference drawing

Legend

- 1 - 180 Supply Pumps Boiler
- 2 - 180 Supply Pumps Boiler
- 3 - Condensate Tank and Pumps
- 4 - Condensate Tank and Pumps
- 5 - Solenoid
- 6 - Solenoid
- 7 - Transformer

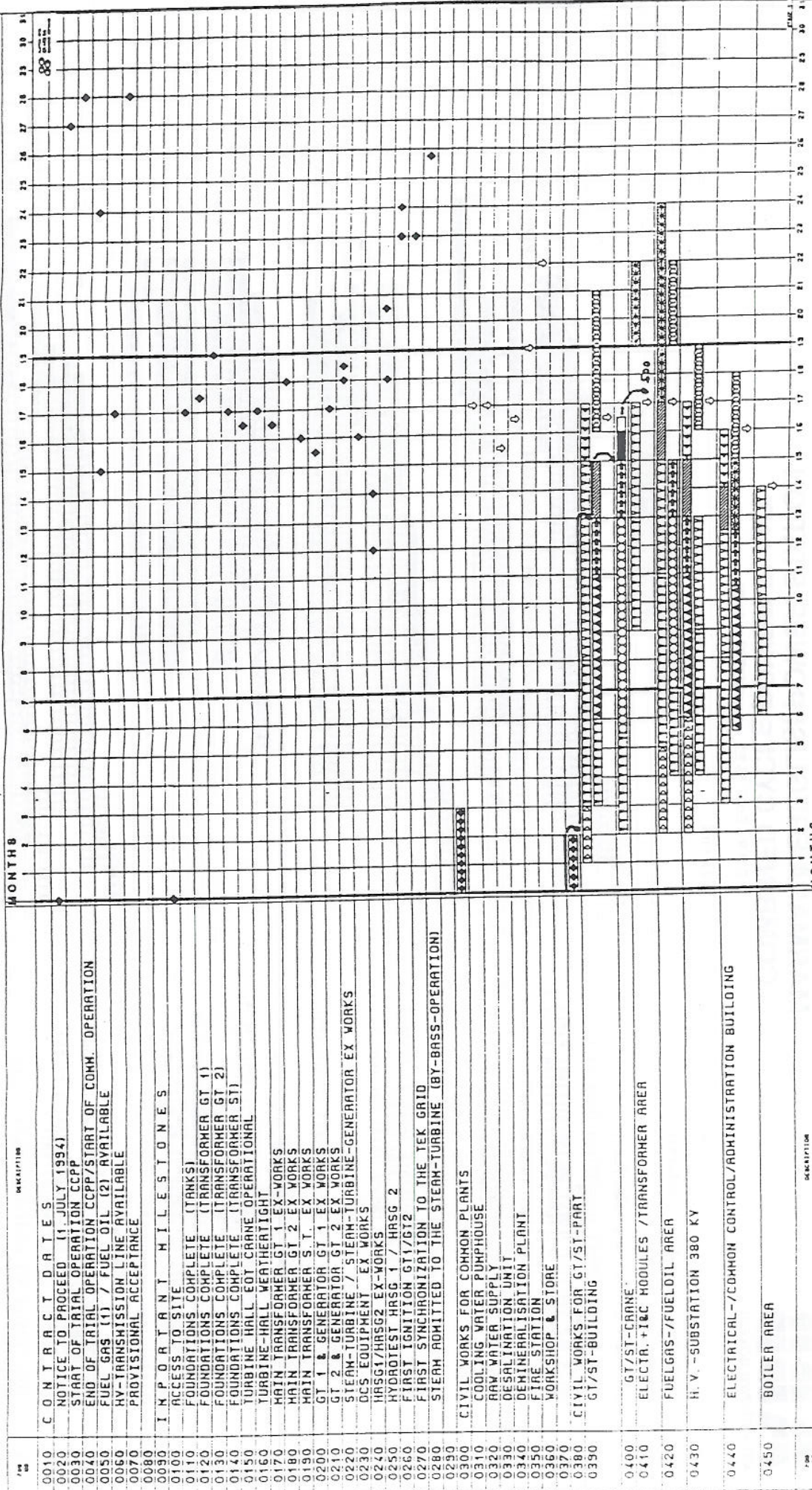


ANNEX III.2.1.

CONSTRUCTION TIME SCHEDULE

MARMARA EREGLISI POWER STATION COMBINED CYCLE POWER PLANT

CCPP : 2xGT 13 E2 + 2xWHRSTG + 1xST



NO	DESCRIPTION	NO	DESCRIPTION
0100	NOTICE TO PROCEED (1 JULY 1994)	11	STEELSTRUCTURE MANUFACTURING
0200	START OF TRIAL OPERATION CCPP	12	STEELSTRUCTURE ERECTION
0300	END OF TRIAL OPERATION CCPP/START OF COMM. OPERATION	13	STEELSTRUCTURE CLADDING
0400	FUEL GAS (1) / FUEL OIL (2) AVAILABLE	14	ROOFING/CLADDING
0500	HV-TRANSMISSION LINE AVAILABLE	15	FINISHING WORKS
0600	PROVISIONAL ACCEPTANCE	16	FINISHING WORKS
0700		17	ERECTION
0800		18	ERECTION
0900		19	ERECTION
1000	ACCESS TO SITE	20	ERECTION
1100	FOUNDATIONS COMPLETE (TANKS)	21	ERECTION
1200	FOUNDATIONS COMPLETE (TRANSFORMER GT 1)	22	ERECTION
1300	FOUNDATIONS COMPLETE (TRANSFORMER GT 2)	23	ERECTION
1400	FOUNDATIONS COMPLETE (TRANSFORMER ST)	24	ERECTION
1500	TURBINE HALL EOT CRANE OPERATIONAL	25	ERECTION
1600	TURBINE-HALL WEATHERTIGHT	26	ERECTION
1700	MAIN TRANSFORMER GT 1 EX-WORKS	27	ERECTION
1800	MAIN TRANSFORMER GT 2 EX-WORKS	28	ERECTION
1900	MAIN TRANSFORMER S.T. EX-WORKS	29	ERECTION
2000	GT 1 & GENERATOR GT 1 EX-WORKS	30	ERECTION
2100	GT 2 & GENERATOR GT 2 EX-WORKS	31	ERECTION
2200	STEAM-TURBINE / STEAM-TURBINE-GENERATOR EX-WORKS	32	ERECTION
2300	CCS EQUIPMENT EX-WORKS	33	ERECTION
2400	HRS/G1/HRS/G2 EX-WORKS	34	ERECTION
2500	HYDROTEST HRS/G 1 / HRS/G 2		
2600	FIRST IGNITION GT1/GT2		
2700	FIRST SYNCHRONIZATION TO THE TEK GRID		
2800	STEAM ADMITTED TO THE STEAM-TURBINE (BY-BASS-OPERATION)		
2900			
3000	CIVIL WORKS FOR COMMON PLANTS		
3100	COOLING WATER PUMPHOUSE		
3200	RAW WATER SUPPLY		
3300	DESALINATION UNIT		
3400	DEMINERALISATION PLANT		
3500	FIRE STATION		
3600	WORKSHOP & STORE		
3700			
3800	CIVIL WORKS FOR GT/ST-PART		
3900	GT/ST-BUILDING		
4000	GT/ST-CRANE		
4100	ELECTR. + IEC MODULES / TRANSFORMER AREA		
4200	FUELGAS-/FUELOIL AREA		
4300	H. V. -SUBSTATION 380 KV		
4400	ELECTRICAL-/COMMON CONTROL/ADMINISTRATION BUILDING		
4500	BOILER AREA		

REVISIONS

NO	DESCRIPTION	DATE
1	REV A	02.01.94

LEGEND

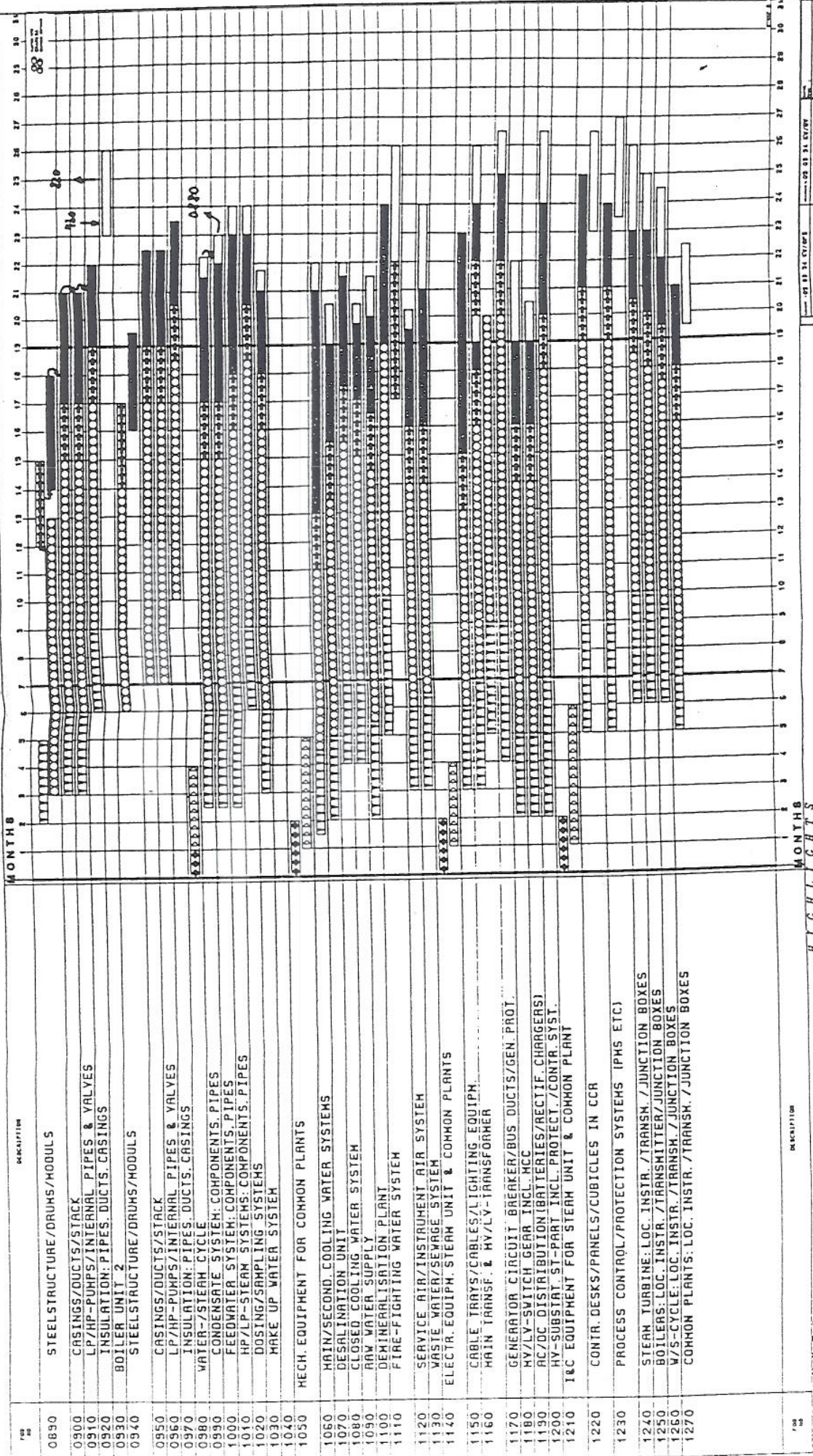
01	CONCEPT DESIGN/ENGINEERING
02	BASIC DESIGN/ENGINEERING
03	Detailed Design/ENGINEERING
04	FABRICATION/MANUFACTURING
05	TRANSPORTATION/SHIPMENT
06	ERECTOR WORKS/ERECTION
07	FINISHING WORKS
08	OPERATION

KEY

01	CONCEPT DESIGN/ENGINEERING
02	BASIC DESIGN/ENGINEERING
03	Detailed Design/ENGINEERING
04	FABRICATION/MANUFACTURING
05	TRANSPORTATION/SHIPMENT
06	ERECTOR WORKS/ERECTION
07	FINISHING WORKS
08	OPERATION

MARMARA EREGLISI POWER STATION COMBINED CYCLE POWER PLANT

C C P P : 2xGT 13 E2 + 2xWHRSTG + 1xST



LEGEND

01 CONCEPT DESIGN/ENGINEERING

02 BASIC DESIGN/ENGINEERING

03 DETAILED DESIGN/ENGINEERING

04 FABRICATION/CONSTRUCTION

05 CIVIL WORKS (GENERAL)

06 EXCAVATION/CONCRETE

11 STEELSTRUCTURE MANUFACTURING

12 STEELSTRUCTURE ERECTION

13 STEELSTRUCTURE FINISHING

14 FINISHING WORKS

15 ERECTION

16 COMMISSIONING

17 RELIABILITY-TRIAL RUN

ABB

WHENEVER ORDERED, IT IS THE POLICY OF ABB TO DELIVER THE EQUIPMENT IN THE MOST RELIABLE AND ECONOMICAL MANNER.

ABB 10083

MINISTRY OF ENERGY AND NATURAL RESOURCES
General Directorate of Energy Works

Number: B-15-O-EGM.0.00.00.03/680-2
Subject : Plants connection to National Grid

3822

ANKARA
28/03/1994

The BASIC SINGLE-LINE diagram and SINGLE-LINE information which is sent by TEK, for the natural gas combined cycle power plant to be constructed at Marmara Ereglisi by your company, are attached to our letter.

For the Minister

Dr.Mustafa Turhan
General Manager.

T.C.
ENERJİ VE TABİİ KAYNAKLAR BAKANLIĞI
Enerji İşleri Genel Müdürlüğü

Sayı B.15.O.EGM.O.OO.OO.03-680/2 — 313

Ankara

Konu Marmara Ereğlisi Santralının
Ulusal Sisteme Bağlantısı

3822

28 MART 1994

MİMAĞ İNŞAAT VE TİCARET A.Ş.
İzci Sok. No:18

06700/ANKARA

İLGİ: 17.1.1994 tarih B.15.2.TEK.O.20.OO.04.OTD/002-104-2289 sayılı TEK yazısı.

Firmanızca Marmara Ereğlisi'nde yapılacak doğalgaz kombine çevrim santrali ile ilgili TEK'in gönderdiği Prensip TEK-HAT Diagramı ve TEK-HAT Durum Bilgisi yazımız ekinde gönderilmektedir.

Gereğini rica ederim.

BAKAN ADINA

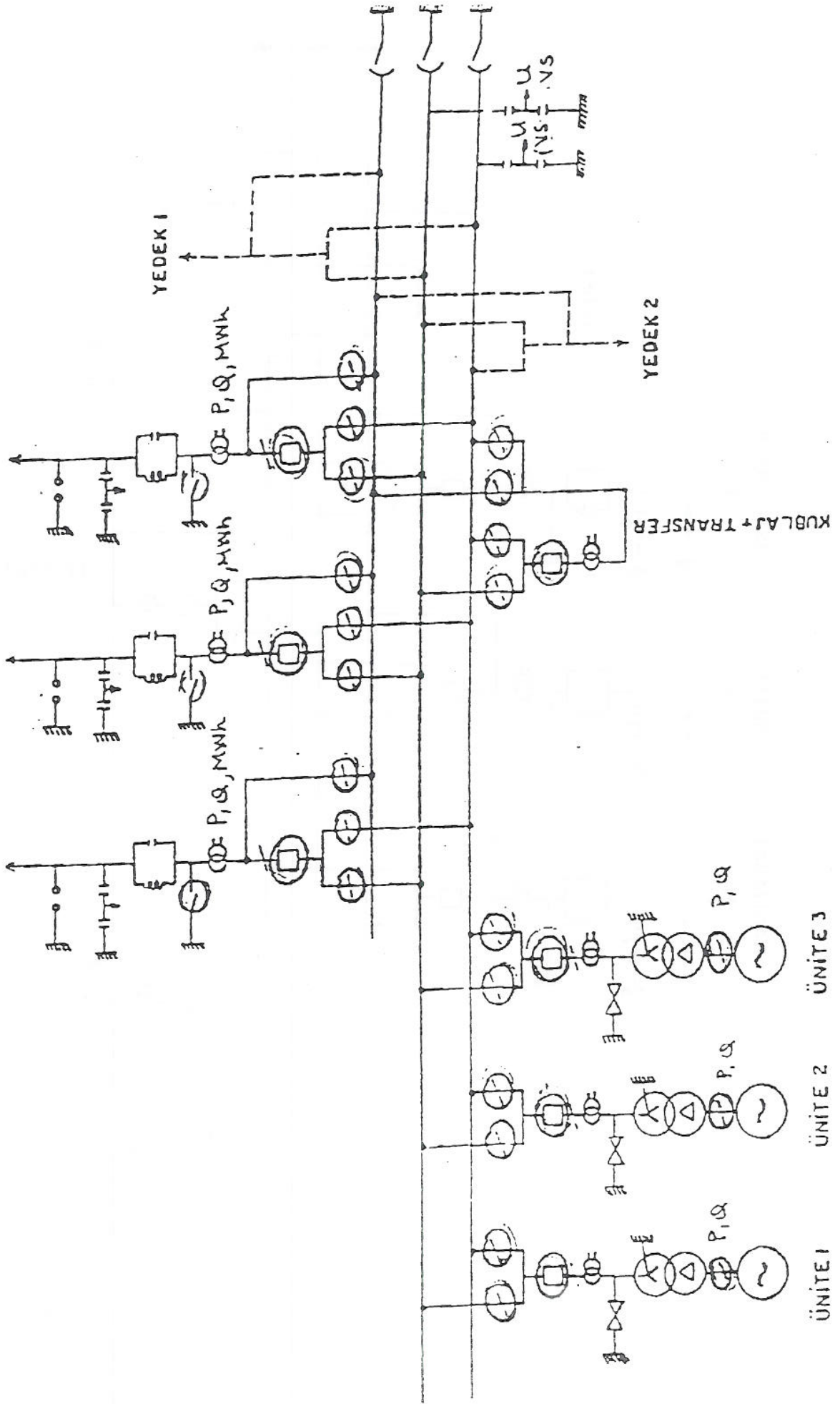
Dr. Mustafa TURHAN
Genel Müdür

EK:1-TEK-HAT Diagramı (1 sayfa)
2-TEK-HAT Durum Bilgisi (3 sayfa)

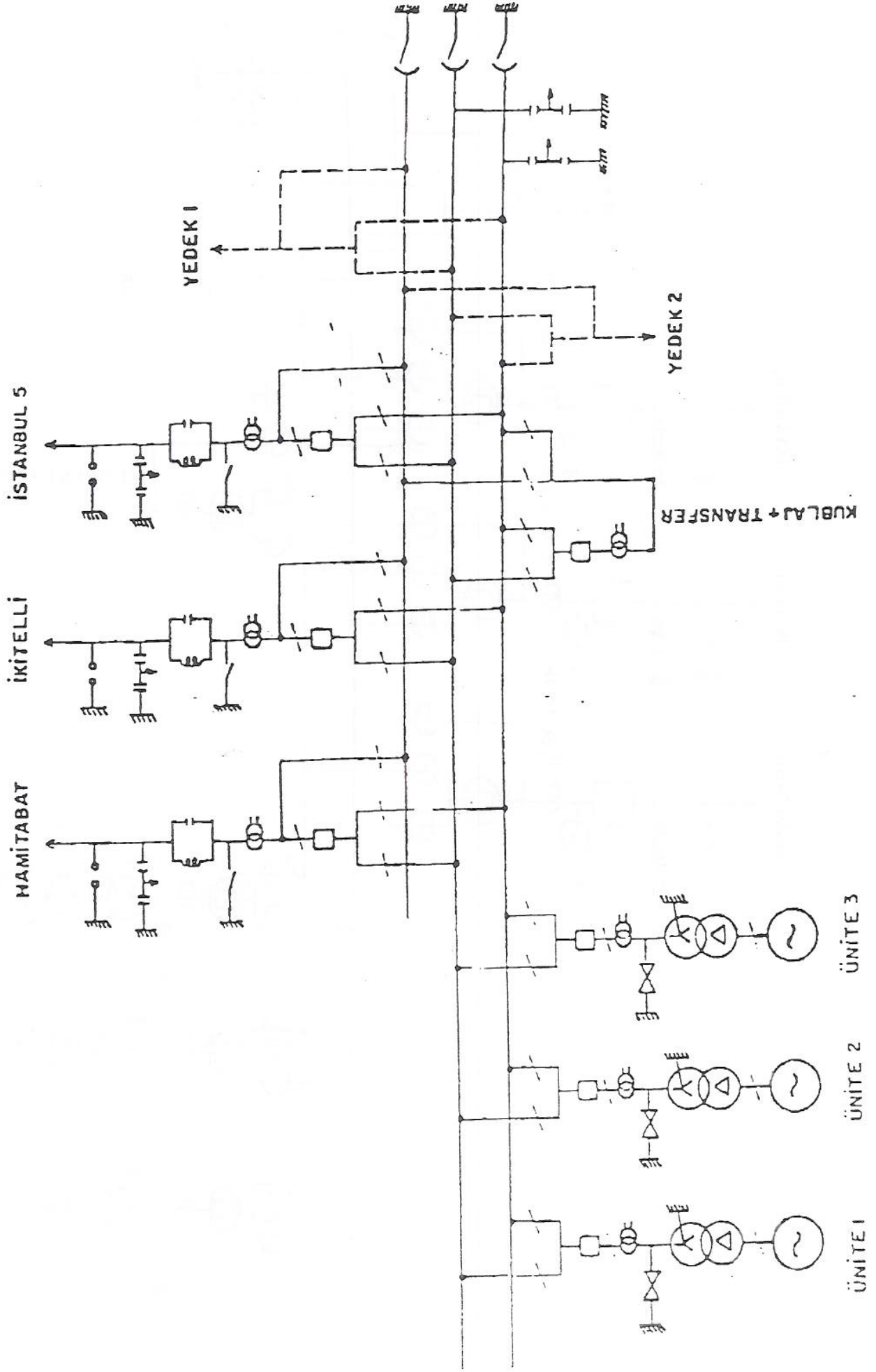
[illegible]

R. C. C. 1 ASAPAZARI			DATA COLLECTION										Data Utilization										
Substation : M.EREGLISI													National Dispatching.					Regional Dispatching					
YEARS			Measurements					Signals					Computer					Synoptic Panel					
Volt	Name	Y	Nb	P	Q	U	DIV	TCA	CB	DS	ES	VS	TM	TS	CB	DS	VS	TM	TS	CB	DS	ES	VS
380	COUPLING+TRANSFER	C+T	1	0	0	0	0	0	1	4	0	0	0	5	1	0	0	0	5	1	4	0	0
380	BUSEBAR	BB	2	0	0	2	0	0	0	0	0	2	2	2	0	0	2	2	2	0	0	0	2
380	MMAYYABAY	LT	1	1	1	0	0	1	1	3	1	0	3	3	1	0	0	3	3	1	3	1	0
380	IKIVELLI	LT	1	1	1	0	0	1	1	3	1	0	3	3	1	0	0	3	3	1	3	1	0
380	ISTANBUL 5	LT	1	1	1	0	0	1	1	3	1	0	3	3	1	0	0	3	3	1	3	1	0
380	GENERATOR UNIT.	GR	3	0	0	0	0	0	3	6	0	0	0	9	3	0	0	0	9	3	6	0	0
15	GENERATOR UNIT.	GR	3	3	3	0	0	0	0	3	0	0	6	3	0	0	0	6	3	0	3	0	0
TOTAL				6	6	2	0	3	7	22	3	2	17	34	7	0	2	17	34	7	22	3	2

HAMİTABAT İKİTELLİ İSTANBUL 5



III-K-51



ANNEX IV.1.1.

**METEOROLOGICAL DATA
TEKİRDAĞ REGION**

İSTASYONUN ADI: YEKİNDAG		ORTALAMA SICAKLIK										RAŞAT SORESİ: 1939-1900 (42)	
OCAK	SURAT	MART	NİSAN	MAYIS	HATİRAN	TEMMUZ	AGUSTOS	EYLÜL	EKİM	KASIM	ARALIK	RAŞAT SORESİ: 1939-1900 (42)	ARALIK
GÜNLER													
1	6.4	5.5	10.4	13.8	19.5	22.5	23.9	21.4	17.7	13.3	9.6		
2	5.5	5.4	9.3	14.0	19.3	22.4	23.8	21.1	17.8	12.9	9.1		
3	4.4	5.3	9.2	14.3	19.4	22.1	23.8	21.5	17.8	13.0	8.7		
4	4.9	5.2	9.4	14.6	19.2	22.1	23.8	21.2	17.0	13.1	8.3		
5	4.0	5.2	9.9	14.5	18.8	22.5	23.4	21.1	16.6	13.4	7.9		
6	4.5	5.7	10.2	14.5	18.8	22.9	23.8	21.1	16.4	13.3	7.8		
7	5.2	6.0	9.9	14.0	19.2	23.2	23.8	20.6	15.9	12.8	8.5		
8	5.0	6.0	10.2	15.3	19.4	23.0	24.0	20.8	16.2	12.7	8.7		
9	4.3	5.8	10.4	15.1	19.4	23.0	24.1	20.6	16.4	12.2	8.3		
10	4.6	5.4	10.2	14.8	20.5	23.0	24.1	20.3	16.3	12.4	7.6		
1.10 GÜN :	5.0	5.5	9.9	14.6	19.4	22.7	23.9	21.0	16.8	12.9	8.4		
11	4.6	5.6	10.2	14.8	21.2	23.3	24.0	20.5	15.7	12.2	8.4		
12	4.4	5.5	10.0	15.4	21.1	23.6	23.8	20.4	15.4	12.6	8.4		
13	4.0	5.8	10.6	15.7	21.2	23.5	23.9	20.0	14.8	12.6	7.9		
14	3.6	6.5	10.6	15.9	21.4	23.5	23.5	19.9	15.3	12.4	7.1		
15	4.3	6.6	10.5	16.0	20.9	23.7	23.6	19.6	15.5	12.5	6.5		
16	4.4	6.3	10.3	16.3	21.1	24.0	23.5	19.8	15.3	12.3	6.5		
17	4.1	6.0	10.9	17.1	21.1	24.4	23.6	19.7	15.2	11.7	6.4		
18	3.7	6.1	11.6	16.8	21.1	24.1	23.4	19.5	15.2	11.5	6.5		
19	3.7	6.4	11.1	17.3	21.3	23.9	23.4	19.5	14.3	10.7	6.4		
20	3.7	6.5	11.4	18.1	21.3	24.0	23.3	19.5	13.8	10.5	6.0		
2.10 GÜN :	4.1	6.1	10.7	16.3	21.2	23.8	23.6	19.8	15.1	11.9	6.9		
21	3.7	6.6	11.4	18.0	21.7	23.9	23.2	18.9	14.2	9.4	6.1		
22	3.4	7.4	11.8	18.0	21.6	23.8	23.1	18.6	14.7	9.4	5.6		
23	3.5	7.3	12.2	18.3	21.8	23.8	22.9	18.6	14.1	9.0	5.6		
24	4.1	7.4	12.3	18.0	22.0	23.7	22.8	18.4	13.8	9.1	6.5		
25	4.6	7.6	12.5	17.7	22.2	23.8	22.8	18.0	13.3	9.0	6.5		
26	4.0	7.9	12.3	17.8	22.6	23.6	22.6	18.1	13.8	8.5	6.2		
27	3.5	8.0	12.1	18.4	22.2	23.6	22.5	18.1	14.1	8.6	6.1		
28	3.2	9.4	12.6	18.6	22.5	23.5	22.1	18.1	14.0	8.8	5.8		
29	3.8	9.7	13.0	18.7	22.5	23.6	22.0	17.5	13.6	8.9	5.4		
30	4.0	9.8	13.5	19.0	22.8	23.4	21.7	17.5	14.2	9.2	6.3		
31	4.4	10.1	13.5	19.1	22.8	23.8	21.9	17.5	14.0	9.2	6.7		
3.10 GÜN :	3.8	8.3	12.4	18.3	22.2	23.7	22.5	18.2	14.0	9.0	6.2		
AYLIK ORT :	4.3	6.6	11.0	16.4	20.9	23.4	23.3	19.7	15.3	11.3	7.2		
YILLIK ORTALAMA DEĞER :	13.7												

İSTASYON ADI:TEKİRÇAĞ
İSTASYON YÜKSEKLİĞİ: 4 M

ENLEM DERECESİ:40 59
BOYLAP DERECESİ:27 33
RASAT SÜRESİ:1939-1980 (42)

HETFOROLOJİK ELEMANIN ADI	A Y L A R											
	1	2	3	4	5	6	7	8	9	10	11	12
ORTALAMA SICAKLIK	4.3	5.2	6.7	11.0	16.7	20.9	23.4	23.3	19.7	15.2	11.3	7.1
ORTALAMA SICAKLIĞIN>5.0 OLUŞU GÜNLER SAYISI	13.0	14.5	20.2	28.1	30.7	30.0	31.0	31.0	30.0	30.9	27.6	21.3
ORTALAMA SICAKLIĞIN>10.0 OLUŞU GÜNLER SAYISI	3.5	4.1	6.3	19.1	30.5	30.0	31.0	31.0	30.0	29.0	20.1	8.6
EN YÜKSEK SICAKLIK	21.5	22.7	20.2	34.3	33.0	34.0	37.6	37.2	34.0	32.0	27.9	21.6
EN YÜKSEK SICAKLIĞIN TARİHİ	3.71	19.57	31.52	3.52	24.45	20.58	17.40	15.45	13.65	16.74	15.61	8.40
EN YÜKSEK SICAKLIĞIN>30.0 OLUŞU GÜNLER SAYISI	0.0	0.0	0.0	0.0	0.0	0.3	1.5	4.5	5.4	0.7	0.0	0.0
EN YÜKSEK SICAKLIĞIN>25.0 OLUŞU GÜNLER SAYISI	0.0	0.0	0.1	0.3	2.7	14.8	20.3	28.5	11.2	1.4	0.0	0.0
EN YÜKSEK SICAKLIĞIN<0 OLUŞU GÜNLER SAYISI	1.9	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
EN DÜŞÜK SICAKLIK	-13.5	-13.3	-9.0	-1.0	2.7	5.2	12.6	11.0	3.7	-0.2	-8.4	-11.6
EN DÜŞÜK SICAKLIĞIN TARİHİ	3.42	5.50	3.40	6.43	3.44	4.39	26.60	20.49	30.70	27.46	28.41	30.41
EN DÜŞÜK SICAKLIĞIN<0 OLUŞU GÜNLER SAYISI	10.1	7.0	4.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.3	5.0
EN DÜŞÜK SICAKLIĞIN<-1.0 OLUŞU GÜNLER SAYISI	0.0	5.7	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	3.6
EN DÜŞÜK SICAKLIĞIN<-2.0 OLUŞU GÜNLER SAYISI	6.3	4.2	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.5
EN DÜŞÜK SICAKLIĞIN<-3.0 OLUŞU GÜNLER SAYISI	4.9	3.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.9
EN DÜŞÜK SICAKLIĞIN<-4.0 OLUŞU GÜNLER SAYISI	3.7	2.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3
EN DÜŞÜK SICAKLIĞIN<-5.0 OLUŞU GÜNLER SAYISI	3.0	1.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9
EN DÜŞÜK SICAKLIĞIN<-10.0 OLUŞU GÜNLER SAYISI	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
EN DÜŞÜK SICAKLIĞIN>10.0 OLUŞU GÜNLER SAYISI	0.7	0.9	1.3	7.7	26.0	29.9	31.0	31.0	29.3	22.7	12.4	3.3
EN DÜŞÜK SICAKLIĞIN>20.0 OLUŞU GÜNLER SAYISI	0.0	0.0	0.0	0.0	0.2	1.9	0.2	7.5	1.3	0.0	0.0	21.1

İSTASYON ADI: TEKİRDAĞ
İSTASYON YÜKSEKLİĞİ: 4 M

ENLEM DEREJESİ: 40 59
BOYLAM DEREJESİ: 27 33
RASAT SÜRESİ: 1931-1980 (50)

METEOROLOJİK ELEMANIN ADI

A Y L A R

	1	2	3	4	5	6	7	8	9	10	11	12	YILLIK
ORTALAMA YAĞIŞ MİKTARI (MM.)	71.8	52.5	53.0	41.4	37.2	37.4	20.1	12.2	29.3	57.5	81.2	85.3	579.7
YAĞIŞIN > 0.1 OLDUĞU GÜNLER SAYISI	12.8	10.3	10.3	8.7	7.7	6.4	3.5	2.3	4.1	7.4	9.4	12.1	95.1
YAĞIŞIN = 0.0 OLDUĞU GÜNLER SAYISI	1.5	1.4	1.0	0.7	0.8	0.6	0.4	0.4	0.5	0.7	1.1	1.1	10.1
YAĞIŞIN > 0.1-5.0 OLDUĞU GÜNLER SAYISI	8.1	6.7	6.8	6.2	5.3	4.0	2.2	1.6	2.4	4.6	5.3	7.0	60.3
YAĞIŞIN > 5.1-10.0 OLDUĞU GÜNLER SAYISI	2.3	2.1	1.7	1.3	1.2	1.1	0.7	0.3	0.6	1.2	1.6	2.4	16.6
YAĞIŞIN > 10.1-15.0 OLDUĞU GÜNLER SAYISI	1.2	0.8	0.9	0.7	0.7	0.7	0.3	0.2	0.4	0.5	0.8	1.0	8.0
YAĞIŞIN > 15.1-20.0 OLDUĞU GÜNLER SAYISI	0.5	0.3	0.4	0.3	0.2	0.3	0.1	0.1	0.2	0.3	0.4	0.8	3.8
YAĞIŞIN > 20.1-25.0 OLDUĞU GÜNLER SAYISI	0.3	0.1	0.2	0.1	0.2	0.2	0.1	0.0	0.2	0.3	0.4	0.3	2.4
YAĞIŞIN > 25.1-30.0 OLDUĞU GÜNLER SAYISI	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	1.3
YAĞIŞIN > 30.1-35.0 OLDUĞU GÜNLER SAYISI	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.1	1.0
YAĞIŞIN > 35.1-40.0 OLDUĞU GÜNLER SAYISI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.5
YAĞIŞIN > 40.1-50.0 OLDUĞU GÜNLER SAYISI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.5
YAĞIŞIN > 50.1-75.0 OLDUĞU GÜNLER SAYISI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.5
YAĞIŞIN > 75.1-100.0 OLDUĞU GÜNLER SAYISI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.5
YAĞIŞIN > 100.1 OLDUĞU GÜNLER SAYISI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
GÜNLÜK EN ÇOK YAĞIŞ MİKTARI	65.0	53.7	50.5	46.6	36.1	50.3	57.0	60.1	76.8	79.2	78.0	86.0	86.0
GÜNLÜK EN ÇOK YAĞIŞIN TARİFİ (GÜN VE YIL)	15.46	24.46	13.39	0.40	14.79	7.75	29.59	23.76	26.42	5.56	5.56	11.21	11.12.31

CRIALAHA YAĞIŞ

İSTASYON ADI : TEKİRDAĞ RASAT SÜRESİ : 501 1931 - 1980

GÜNLER	OCAK	ŞUBAT	MART	HAZİRAN	MAYIS	TEMMUZ	AĞUSTOS	EYLÜL	Ekim	KASIM	ARALIK
1	2.07	2.88	1.58	0.67	0.72	1.05	0.46	0.11	0.19	1.26	2.50
2	2.84	2.40	1.30	1.60	1.25	0.73	1.04	0.35	1.51	2.55	1.51
3	2.76	2.60	2.98	1.94	1.50	1.32	0.74	0.41	1.09	1.64	3.27
4	2.06	1.70	1.43	1.09	1.54	1.42	1.73	0.09	1.85	1.76	2.32
5	2.25	0.43	1.79	1.08	0.55	2.22	0.97	1.17	1.71	2.56	2.72
6	3.03	1.25	1.94	1.21	0.36	1.96	0.50	0.02	0.84	1.98	2.09
7	1.95	2.02	1.91	2.47	1.04	2.38	1.07	0.01	2.01	1.65	1.87
8	2.78	1.74	2.15	1.81	1.25	0.87	0.75	0.00	1.34	1.22	2.40
9	2.56	1.46	1.81	0.77	1.02	0.95	0.76	0.14	2.63	2.63	3.16
10	3.42	1.00	1.63	1.39	1.60	1.52	0.49	0.10	1.13	4.05	2.05
1-10 GÜN TOP. :	25.71	17.49	18.51	14.02	11.32	14.44	8.51	2.40	14.30	21.34	23.91
11	1.90	3.28	2.05	1.24	1.00	1.06	0.81	1.63	3.21	4.08	3.42
12	2.48	2.75	2.47	1.60	1.59	1.45	0.48	0.44	0.70	1.08	2.52
13	1.68	2.29	2.88	2.30	2.06	1.75	0.89	0.56	1.28	2.91	3.09
14	2.61	1.47	1.84	0.84	1.90	0.79	1.00	0.25	2.44	0.98	3.70
15	3.15	2.47	3.05	1.83	2.03	0.72	0.27	0.10	0.98	0.67	3.23
16	1.47	2.08	2.30	3.47	1.33	0.88	0.25	1.07	2.04	4.51	2.40
17	2.06	1.09	2.41	2.93	1.45	0.71	0.21	0.73	1.01	3.06	2.81
18	2.35	2.47	1.84	1.52	1.28	0.45	0.07	0.19	1.09	2.23	1.30
19	2.50	1.35	1.38	1.92	0.97	0.95	0.19	0.69	2.97	2.48	4.34
20	3.85	0.95	0.50	1.78	1.04	0.84	0.81	0.77	4.37	3.67	2.64
2-10 GÜN TOP. :	24.05	21.01	20.71	15.42	14.64	5.85	4.98	6.42	20.09	25.67	29.46
21	3.85	0.95	0.50	1.78	1.04	0.84	0.81	0.77	4.37	3.67	2.64
22	1.77	0.90	1.77	0.29	1.79	1.99	0.39	0.32	2.52	3.16	2.21
23	1.11	1.31	2.56	0.74	0.29	2.21	0.57	0.94	1.31	3.70	2.26
24	0.75	2.19	2.03	0.70	1.41	0.90	0.61	1.49	2.84	4.92	2.91
25	0.89	3.17	1.16	0.64	0.80	1.15	0.65	1.38	1.51	3.26	1.44
26	3.33	1.71	0.61	1.26	1.32	1.75	1.36	2.04	2.17	4.15	3.67
27	2.49	1.48	1.17	1.30	1.05	0.63	0.44	1.39	0.80	3.09	3.25
28	2.13	2.27	1.73	0.83	0.72	1.01	0.23	2.73	1.92	3.48	5.66
29	1.52	0.08	0.75	0.46	1.97	2.25	1.92	2.03	2.56	3.11	4.20
30	2.06	*****	1.00	0.77	1.04	0.35	0.14	1.17	1.80	1.63	3.00
31	2.18	*****	1.29	*****	0.62	*****	0.74	*****	1.34	*****	2.49
3-10 GÜN TOP. :	22.07	14.05	14.57	8.75	12.04	13.10	7.87	14.26	23.14	34.18	33.72
AYLIK TOPLAM :	71.83	52.54	53.79	42.21	38.01	37.38	21.36	29.86	57.53	81.19	87.08
YILLIK TOPLAM :	587.63										

Rasat Süresi 1930-1970
Yükselik (H) : 4 m.

Enlem (ϕ) : 40° 59' E
Boylam (λ) : 27° 29' E

Meteorolojik Elemanlar	Rasat süresi	A Y L A R												Y
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Mahallî ortalama ekvül basınç (mb)	30	1017.0	1016.3	1017.0	1014.7	1013.9	1013.4	1012.5	1012.8	1016.4	1018.6	1017.9	1017.1	
• en yüksek • • • •	30	1039.8	1044.6	1039.7	1030.5	1030.0	1027.5	1023.9	1027.5	1031.7	1032.3	1040.8	1046.4	
• en düşük • • • •	30	981.0	987.7	990.3	985.6	994.1	997.6	999.4	997.1	1000.3	996.5	991.9	986.4	
Saat 07 ⁰⁰ deki ortalama sıcaklık (°C)	30	3.2	3.7	5.0	9.8	15.2	19.7	21.9	21.6	17.9	13.5	10.3	6.2	
• 14 ⁰⁰ • • • •	30	5.8	7.2	8.8	13.7	18.6	23.2	26.2	26.8	23.0	18.3	13.9	9.7	
• 21 ⁰⁰ • • • •	30	4.1	5.0	6.5	11.3	16.2	20.3	22.8	23.2	19.1	14.7	11.2	7.0	
Ortalama sıcaklık °C	30	4.3	5.2	6.7	11.5	16.6	20.9	23.4	23.5	19.7	15.3	11.4	7.3	
Ort. sıcak. ≥ 5.0 °C old. ort. gün sayı.	15	15.0	15.3	20.9	29.5	31.0	30.0	31.0	31.0	30.0	31.0	28.3	22.3	
• • ≥ 10.0 °C • • • •	15	4.1	4.5	6.5	21.5	30.9	30.0	31.0	31.0	29.9	30.0	21.9	10.8	
Ortalama yüksek sıcaklık °C	30	7.3	8.7	10.4	15.4	20.3	24.9	27.8	28.1	24.0	19.2	14.9	10.3	
• düşük • • • •	30	1.5	2.2	3.6	7.9	12.6	16.4	18.7	19.0	16.0	12.0	8.9	4.5	
En yüksek sıcaklık günü	30	13.952	19.960	31.952	3.952	24.945	28.958	17.940	15.945	13.963	30.966	15.961	8.940	17
En düşük sıcaklık günü	30	18.9	22.2	28.1	34.3	33.8	34.0	37.6	37.2	34.0	29.5	27.9	21.6	
Yük. sic. ≥ 30.0 °C old. ort. gün sayı.	30	-	-	-	0.0	0.3	1.4	5.2	6.1	0.8	-	-	-	
• • ≥ 25.0 °C • • • •	30	-	-	0.1	0.4	3.2	14.7	28.0	29.0	11.8	1.2	0.1	-	
• • ≥ 20.0 °C • • • •	30	-	0.4	1.5	4.5	16.2	28.9	31.0	31.0	28.6	13.3	2.9	0.3	
• • ≤ -0.1 °C • • • •	30	2.5	1.2	0.2	-	-	-	-	-	-	-	-	0.8	
Günlük en yüksek sıcaklık farkı °C	30	18.8	17.0	19.5	17.4	17.1	15.7	15.1	15.0	16.4	15.9	15.2	15.6	
En düşük sıcaklık günü	30	3.942	5.950	3.940	6.943	3.944	4.939	26.960	20.949	30.970	27.946	28.941	30.941	3
En düşük sıcaklık °C	30	-13.5	-13.5	-9.0	-1.0	2.7	9.2	12.6	11.0	3.7	-0.2	-6.9	-10.9	
Düş. sic. ≤ -0.1 °C old. ort. gün sayı.	30	10.7	7.5	4.9	0.2	-	-	-	-	-	0.0	1.2	5.0	
• • ≤ -3.0 °C • • • •	30	5.7	3.5	1.1	-	-	-	-	-	-	-	0.3	1.9	
• • ≤ -5.0 °C • • • •	30	3.5	1.9	0.4	-	-	-	-	-	-	-	0.1	0.9	
• • ≤ -10.0 °C • • • •	30	0.7	0.2	-	-	-	-	-	-	-	-	-	0.0	
• • ≤ -15.0 °C • • • •	30	-	-	-	-	-	-	-	-	-	-	-	-	
• • ≤ -20.0 °C • • • •	30	-	-	-	-	-	-	-	-	-	-	-	-	
• • ≥ 20.0 °C • • • •	30	-	-	-	0.2	1.9	8.8	10.5	1.7	-	-	-	-	
• • ≥ 15.0 °C • • • •	30	-	-	0.0	0.4	6.3	22.5	30.3	29.8	20.4	5.7	1.2	-	
• • ≥ 10.0 °C • • • •	30	1.0	1.0	1.3	8.2	23.7	30.0	31.0	31.0	29.4	23.6	13.9	4.0	
• • ≥ 5.0 °C • • • •	30	8.4	7.5	10.8	24.2	30.9	30.0	31.0	31.0	30.0	30.2	24.5	14.2	
Toprak üstü düşük sıcaklık ortalaması °C	12	1.6	1.6	2.2	6.3	11.0	14.4	17.1	17.4	14.8	10.6	7.2	3.7	
Toprak üstü en düşük sıcaklığı °C	12	-13.2	-13.1	-7.0	-2.9	3.0	8.0	10.8	9.5	2.5	1.2	-7.0	-13.3	
Top. üs. düş. sic. ≤ -0.1 °C old. ort. gün sayı.	7	11.6	9.1	9.1	1.0	-	-	-	-	-	-	2.3	6.1	
• • • ≤ -3.0 °C • • • •	7	5.7	4.7	1.1	-	-	-	-	-	-	-	0.4	1.3	
• • • ≤ -5.0 °C • • • •	7	2.7	3.1	0.1	-	-	-	-	-	-	-	0.1	0.4	
• • • ≤ -10.0 °C • • • •	7	1.0	0.6	-	-	-	-	-	-	-	-	-	0.3	
Ortalama buhar basıncı (mb)	31	7.2	7.4	7.8	10.1	14.1	17.3	18.9	19.1	16.5	13.4	11.5	9.0	
Saat 07 ⁰⁰ deki ortalama nisbi nem %	31	84	53	83	81	79	74	72	74	78	82	86	86	
• 14 ⁰⁰ • • • •	31	77	73	70	68	70	65	59	57	61	67	74	77	
• 21 ⁰⁰ • • • •	31	82	81	78	74	75	70	66	67	72	78	83	84	
Ortalama nisbi nem %	31	81	79	77	74	74	70	66	66	71	76	81	82	
En düşük nisbi nem %	31	30	28	10	13	15	20	21	21	16	26	25	34	
Saat 07 ⁰⁰ deki ort. bulutluluk (0—10)	31	7.8	7.5	7.2	6.3	5.6	3.6	2.2	2.1	3.8	5.9	7.3	7.8	
• 14 ⁰⁰ • • • • (0—10)	31	7.9	7.5	7.3	6.2	5.6	4.4	3.0	2.9	4.1	5.8	7.3	7.8	
• 21 ⁰⁰ • • • • (0—10)	31	7.0	6.4	5.9	4.9	4.1	3.6	1.6	1.4	2.0	4.1	5.8	6.6	
Ortalama bulutluluk (0—10)	31	7.6	7.1	6.8	5.8	5.2	3.9	2.2	2.1	3.3	5.3	6.8	7.3	
Ortalama esik günler sayısı (0.0—1.9)	31	2.0	2.1	2.6	4.6	4.8	9.5	17.4	18.1	12.0	5.2	2.3	1.8	
• bulutlu • • • (2.0—8.0)	31	12.2	13.0	15.2	16.6	20.0	17.7	12.5	11.8	15.8	18.6	15.4	14.2	
• kapalı • • • (8.1—10.0)	31	16.7	13.2	13.2	8.7	6.2	2.8	1.1	1.1	2.2	7.2	12.3	15.0	

TEKİRDAĞ

Rasat Süresi 1930-1970

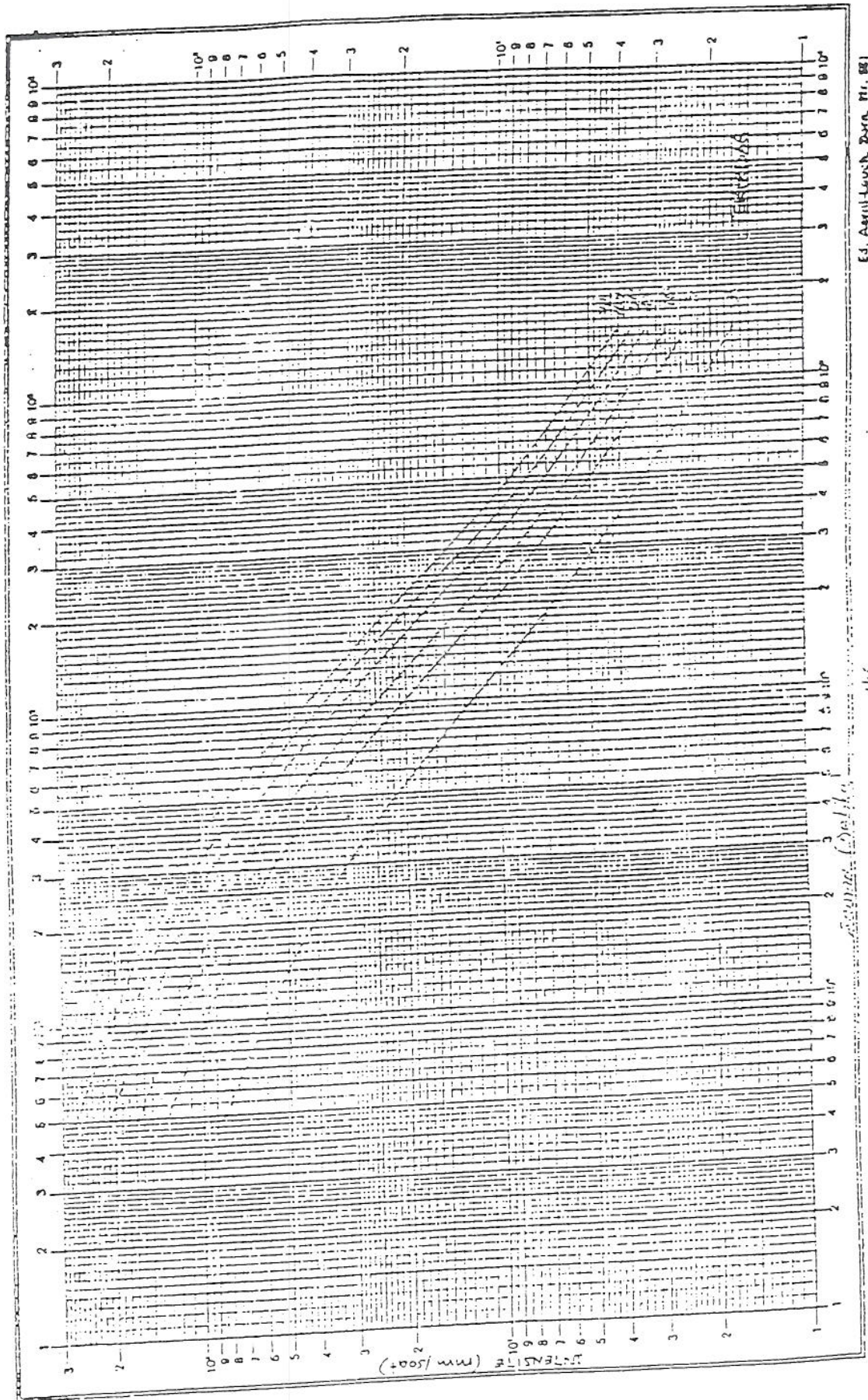
Yükseklik (H) : 4 m.

Enlem (φ) : 40° 59' E.

Boylam (λ) : 27° 29' E

Meteorolojik Elemanlar	Rasat süresi	A Y L A R												Y
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Ortalama buharlaşma (mm) (Wüld)	16	30.7	33.6	46.8	59.6	73.1	93.6	138.2	147.9	104.5	71.3	44.2	33.9	
Günlük en çok buharlaşma (mm) (Wüld)	16	4.9	5.9	15.0	8.2	13.8	10.5	11.9	10.9	10.5	10.0	5.8	4.8	
Saat 07 ⁰⁰ deki ortalama yağış miktarı (mm)	30	34.9	22.5	26.9	16.3	9.6	9.7	4.1	2.9	8.5	23.4	36.2	40.5	
• 14 ⁰⁰ • • • • •	30	21.0	17.7	16.9	12.9	12.6	10.8	6.0	3.7	9.7	11.5	21.6	26.0	
• 21 ⁰⁰ • • • • •	30	25.2	13.3	14.0	10.7	14.7	17.2	9.1	3.7	9.6	16.0	26.5	27.4	
Ortalama yağış miktarı (mm)	40	71.8	57.7	56.0	43.1	35.7	37.5	19.2	9.2	29.8	52.2	82.6	95.8	
Günlük en çok yağış miktarı (mm)	40	65.8	53.7	50.5	50.7	32.5	53.9	57.0	48.3	76.8	79.2	78.0	86.0	
Yağış $\geq$ 0.1 mm. old. günler sayısı	40	12.5	10.2	10.0	8.4	7.3	6.2	3.1	1.6	3.7	7.0	9.3	12.4	
• $\geq$ 10.0 • • • • •	40	2.5	1.7	1.9	1.4	1.2	1.4	0.5	0.4	1.0	1.5	2.6	3.1	
• $\geq$ 50.0 • • • • •	6	-	-	-	-	-	-	-	-	-	-	0.2	-	
Ortalama kar yağışlı günler sayısı	15	2.3	1.1	0.9	-	-	-	-	-	-	-	-	0.8	
• karla örtülü günler sayısı	40	3.0	2.5	0.8	-	-	-	-	-	-	-	0.1	1.2	
En yüksek kar örtüsü kalınlığı (cm)	40	25	19	16	-	-	-	-	-	-	-	19	20	
Ortalama sisli günler sayısı	40	1.0	1.0	0.7	0.4	0.4	0.0	-	-	0.1	0.6	0.9	0.6	
• dolulu • • • • •	40	0.1	0.0	0.1	0.1	0.1	0.1	0.0	-	0.0	0.0	-	0.1	
• kırağılı • • • • •	40	3.5	3.5	3.7	0.4	-	-	-	-	-	0.0	0.6	2.2	
• orajlı • • • • •	40	0.6	0.4	0.6	0.8	2.4	3.5	1.5	0.9	1.1	1.0	1.3	0.8	
Saat 07 ⁰⁰ deki ort. rüzgâr hızı (m/sec)	31	3.7	3.2	2.9	2.1	1.8	2.2	2.7	2.8	2.8	3.0	2.8	3.5	
• 14 ⁰⁰ • • • • •	31	4.4	4.1	4.0	3.4	3.1	3.1	3.8	4.1	4.0	4.1	3.8	4.1	
• 21 ⁰⁰ • • • • •	31	3.4	3.1	2.9	2.2	1.8	1.8	2.1	2.3	2.4	2.6	2.8	3.3	
Ortalama rüzgâr hızı (m/sec)	31	3.8	3.5	3.3	2.6	2.3	2.5	2.9	3.1	3.1	3.2	3.1	3.6	
En hızlı rüzgâr yönü ve hızı (m/sec)	30 SSW 28.3 NNW 28.9 SW 28.6 SW 26.5 S 25.7 NNE 25.0 NNE 20.4 NNW 23.9 NNE 19.0 SW 19.6 S 27.0 SSW 24.6 NNW													
Ort. fırtınalı gün. sayı. (17.2 $\geq$ m/sec)	30	1.2	0.8	1.0	0.7	0.6	0.5	0.1	0.1	0.3	0.3	0.8	1.0	
Ort. kuv. rüzg. gün. sayı. (10.8 — 17.1 m/sec)	30	4.6	3.7	3.8	3.0	2.1	2.3	3.6	2.6	3.0	3.6	2.9	4.7	35
N rüzg. ort. hızı ve esme sayısı toplamı	22	5.9-183	5.2-143	4.3-140	3.0-88	3.2-66	2.8-137	3.5-147	3.4-147	3.5-189	4.3-183	4.4-120	4.8-148	4.1-1
NNE • • • • •	22	6.2-136	6.2-122	5.2-135	4.8-107	4.0-76	4.0-100	4.5-168	4.4-169	4.8-160	5.5-179	4.6-104	5.5-109	5.0-1
NE • • • • •	22	4.8-226	4.1-219	4.5-354	3.4-218	3.6-247	3.9-228	1.6-419	4.1-459	3.9-198	4.5-366	3.7-244	4.3-191	4.1-35
ENE • • • • •	22	4.6-70	3.4-58	3.7-94	3.7-75	3.0-58	4.3-77	4.0-62	4.5-88	5.1-54	4.5-57	4.0-57	4.2-60	4.1-*
E • • • • •	22	3.0-69	2.9-67	2.4-82	2.2-107	2.4-118	2.5-65	2.7-87	3.1-74	3.2-53	3.1-67	2.7-84	2.8-77	2.7-
ESE • • • • •	22	3.5-43	2.6-32	3.3-42	2.6-49	2.4-53	2.7-44	3.3-30	3.6-42	2.6-24	2.8-24	2.5-38	2.4-33	2.9-
SE • • • • •	22	2.6-105	2.4-115	2.4-168	2.4-212	2.2-287	2.4-198	2.5-165	2.6-158	2.6-136	2.3-138	2.4-127	2.6-112	2.4-10
SSE • • • • •	22	4.1-43	4.1-56	3.6-51	3.3-77	2.7-87	3.0-109	3.1-105	3.2-116	3.2-94	3.3-64	4.1-86	2.7-47	3.4-
S • • • • •	22	4.3-104	3.8-92	3.4-73	2.9-102	3.2-110	3.2-127	3.0-144	3.4-113	2.9-109	3.3-88	3.9-103	4.6-131	3.5-1
SSW • • • • •	22	3.5-28	4.9-39	4.2-21	5.5-31	3.3-16	4.8-20	2.6-9	3.9-5	4.0-10	4.0-15	5.4-41	4.7-55	4.6-2
SW • • • • •	22	4.1-77	4.3-112	5.6-71	4.8-56	4.5-55	3.4-34	4.1-13	2.4-21	3.0-31	3.0-57	3.5-87	3.4-125	4.0-
W • • • • •	22	4.3-28	4.3-24	4.1-33	5.1-45	4.1-34	3.1-19	2.2-14	2.7-10	2.8-10	3.8-17	3.3-24	3.3-25	3.9-
WNW • • • • •	22	3.0-63	3.5-67	4.0-50	3.6-75	3.0-46	2.6-51	2.6-25	2.4-23	2.7-26	2.6-45	3.8-62	3.1-67	3.2-
NW • • • • •	22	3.4-138	3.8-110	2.7-94	3.2-90	2.7-83	2.8-94	2.8-82	2.7-88	2.9-104	3.1-122	3.0-156	3.4-143	3.1-1
NNW • • • • •	22	4.3-334	4.1-250	4.0-231	3.4-171	2.8-177	3.4-259	3.3-202	3.0-226	3.4-236	3.3-278	3.2-295	4.1-331	3.6-2
Ortalama toprak sıcaklığı °C (5 cm)	25	4.5	5.8	7.8	14.2	20.9	26.0	28.8	28.2	23.1	16.9	11.7	6.9	1
En düşük • • • °C (5 cm)	25	-7.0	-5.9	-2.2	1.5	5.9	13.7	17.2	14.9	9.4	3.6	-4.0	-4.0	-
Ortalama • • • °C (10 cm)	13	5.2	6.2	8.7	14.5	21.3	25.7	28.6	28.5	23.0	17.2	13.0	8.1	1
En düşük • • • °C (10 cm)	13	-5.0	-2.4	0.3	2.3	9.0	14.6	18.4	15.8	12.0	7.1	2.1	1.1	-
Ortalama • • • °C (20 cm)	13	5.1	5.7	8.0	13.5	20.2	24.8	27.6	27.5	22.5	15.9	12.7	7.9	1
En düşük • • • °C (20 cm)	13	-4.6	-0.9	1.0	4.5	10.2	14.8	18.4	17.4	13.6	8.3	3.9	1.1	-4
Ortalama • • • °C (50 cm)	30	7.1	6.9	8.4	12.9	18.6	23.3	26.3	26.8	21.6	18.6	14.1	9.8	1
En düşük • • • °C (50 cm)	30	2.6	2.4	2.0	5.6	12.3	15.1	18.4	17.3	16.6	13.4	6.3	3.5	
Ortalama • • • °C (100 cm)	11	9.9	9.1	9.9	12.6	16.9	20.8	24.3	25.0	23.3	19.8	16.8	13.1	16
En düşük • • • °C (100 cm)	11	6.9	6.2	7.1	9.8	13.2	17.3	20.9	23.0	19.3	17.0	13.7	8.3	

70000000



Ed. Aerial Launch Data, H. 881

4/16

Teilung } 1-100 u. 1-10000
Logar. Division }
Taschen } 21.1 mm
Uhr } 21.1 mm

ANNEX IV.1.2.1.-12

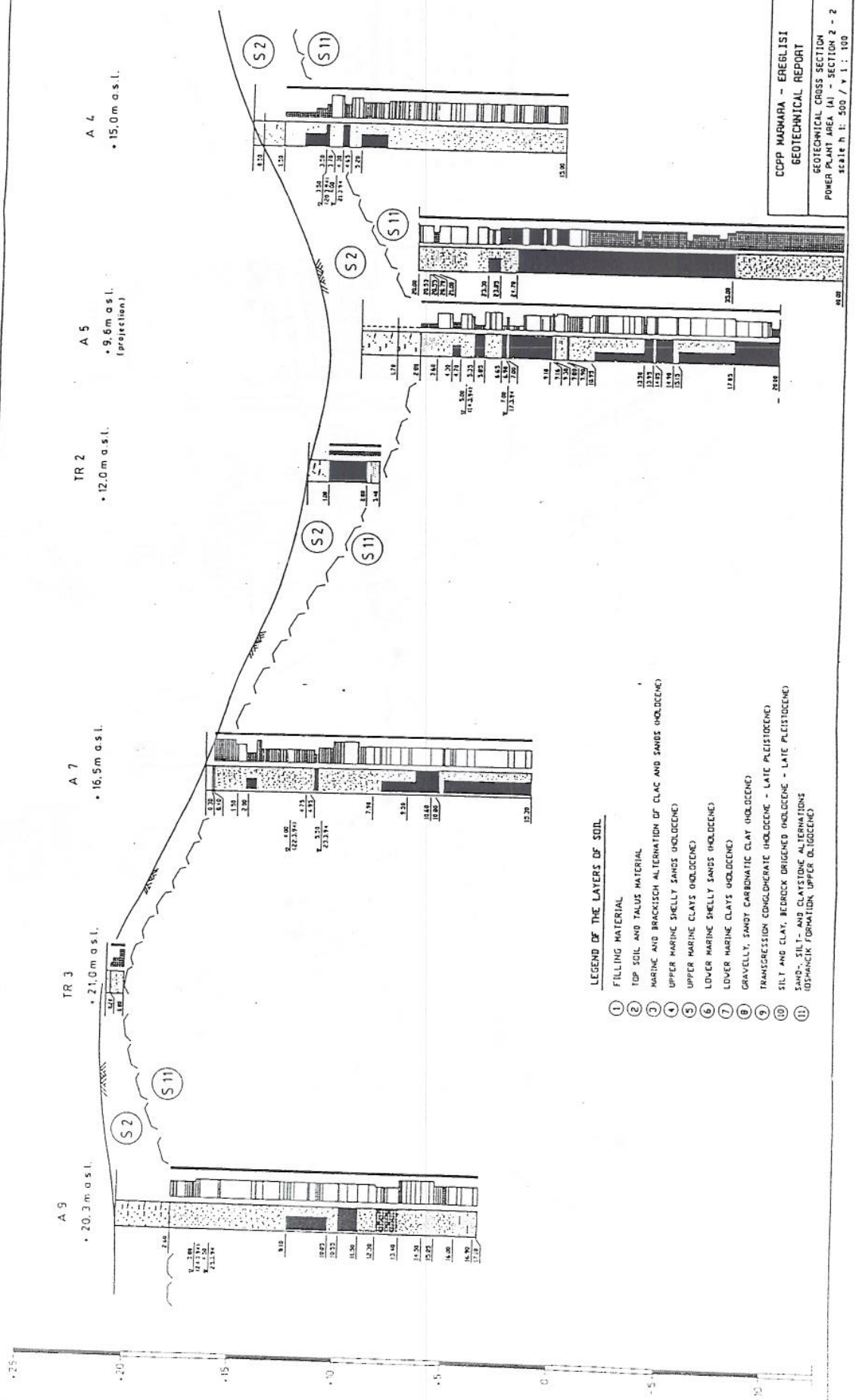
**GEOTECHNICAL STUDIES
at the
PROJECT SITE**

ANNEX IV.1.2.1.

- INVESTIGATIONS 1991**
- ◆ A1...A9 : borings power station (except A8)
 - ◆ B1...B3 : borings cooling water pipes
 - ◆ C1...C6 : borings CW-pipes offshore
 - ◆ TR1...TR4 : trenches
 - ◆ CPT1...CPT11 : Dutch cone penetration test
 - ◆ A50, B30 : borings for cross-hole measurements
 - ◆ RL...RL4 : refraction lines
- OTHER INVESTIGATIONS 1993**
- ◆ T1...T0 : borings TEKSAN 1993



ANNEX IV.1.2.2.



COPP MARGARA - EREGLISI
GEOTECHNICAL REPORT

74030 / 18
APRIL 1994

GEOTECHNICAL CROSS SECTION
POWER PLANT AREA (A) - SECTION 2 - 2
scale h: 500 / v 1: 100

marks of the soil
DIN 4023

short. short.
as

ANNEX IV.1.2.3

	topsoil	Mu				UP (undisturbed sample)
	filling material	A				UP (undisturbed sample tested)
	talos material	Lx				GP (disturbed sample)
	gravel	G	g			GP (disturbed sample tested)
	coarse grained gravel	gG	gg			mushy
	medium grained gravel	mG	mg			soft
	fine grained gravel	fG	fg			stiff
	sand	S	s			medium solid
	coarse grained sand	gS	gs			solid
	medium grained sand	mS	ms			3,5 (1.10.88) groundwaterlevel at 1.10.1990 in 3,5m under surface by drilling
	fine grained sand	fS	fs			3,6 12.3.87 groundwaterlevel in plezometer or after drilling
	silt	U	u			
	clay	C	c			
	cobbles	X	x			
	boulder	Y	y			
	rock	Z				
	rock wethered	Zv				

Standard-Penetration-Test

61 closed cons
61 hits je
15cm depth

25 open cons
25 hits
je 15 cm

CCPP MARMARA - EREGLISI
GEOTECHNICAL REPORT

74030 / 15

APRIL 1994

SUBSOIL PROFILES
LEGEND FOR SOIL PROFILES

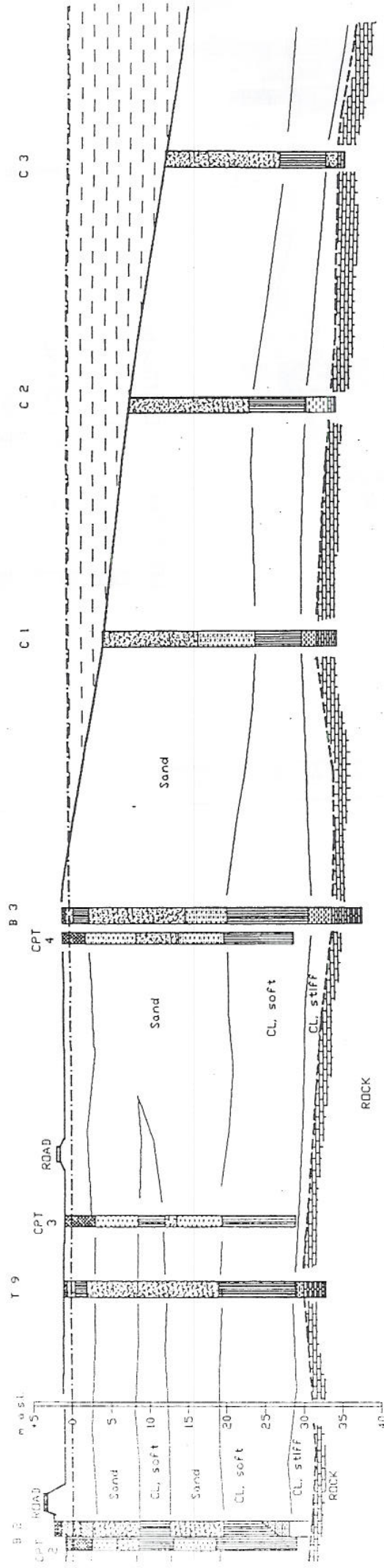
GEO - BÜRO FÜR
GEOTECHNIK ROMBERG GbR
RÖNTGENSTR.18 64291 DARMST.

CCPP MARMARA - EREGLISI GEOTECHNICAL REPORT		74030 / 16 APRIL 1994	
SUBSOIL PROFILES LEGEND FOR ROCK PROFILES		GEO - BÜRO FÜR GEOTECHNIK ROMBERG GM RÖNTGENSTR.18 64291 DARMST.	

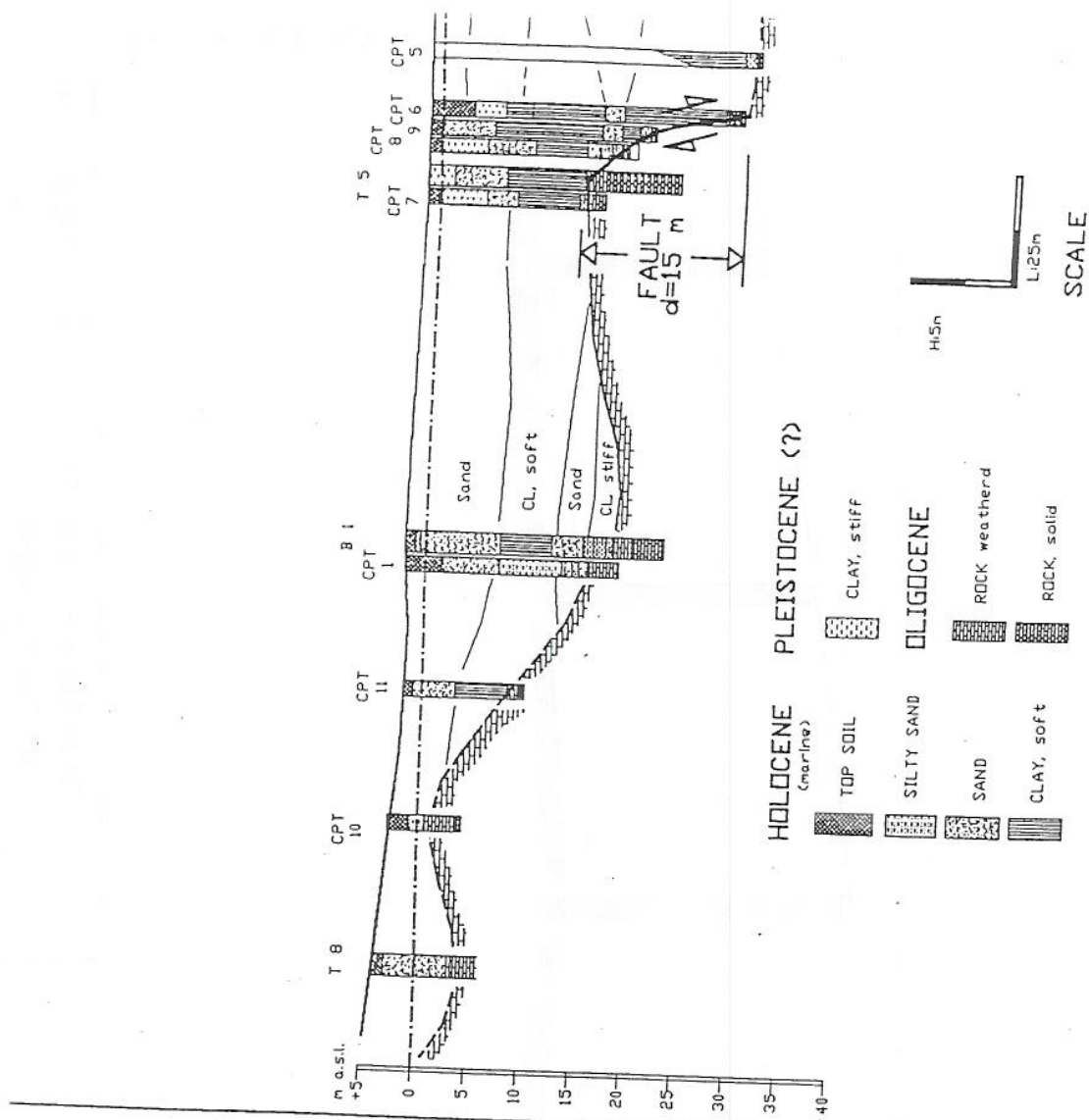
LITHOLOGICAL REPRESENTATION		REPRESENTATION OF SAMPLES AND GROUNDWATER DATA SEE ENCLOSURE 74030/15	
SANDSTONE, FINE GRAINED	SILTSTONE		
SANDSTONE, MEDIUM GRAINED	CLAYSTONE		
SANDSTONE, COARSE GRAINED	SANDSTONE / CLAYSTONE ALTERNATION WITH 30 % CLAYSTONE		
SANDSTONE, FINE GRAINED WITH CLAYSTONE INTERCALATIONS	SANDSTONE / CLAYSTONE ALTERNATION WITH 70 % CLAYSTONE		
SANDSTONE, MEDIUM GRAINED WITH CLAYSTONE INTERCALATIONS	BROWN COAL		

STRENGTH REPRESENTATION		REPRESENTATION OF BEDDING PLANES		JOINT REPRESENTATION	
	VERY HIGH HIGH MEDIUM LOW VERY LOW WEATHERED TO SOIL		SINGULAR BEDDING PLANES DIST. OF BEDDING BETWEEN 15 AND 30 cm DIST. OF BEDDING BETWEEN 6 AND 15 cm DIST. OF BEDDING LESS THAN 6 cm DIST. OF BEDDING NOT DETERMINABLE		NO JOINTS 1 TO 3 PER m 3 TO 10 PER m MORE THAN 10 PER m

LITHOLOGICAL REPRESENTATION		REPRESENTATION OF BEDDING PLANES		JOINT REPRESENTATION	
	VERY HIGH HIGH MEDIUM LOW VERY LOW WEATHERED TO SOIL		SINGULAR BEDDING PLANES DIST. OF BEDDING BETWEEN 15 AND 30 cm DIST. OF BEDDING BETWEEN 6 AND 15 cm DIST. OF BEDDING LESS THAN 6 cm DIST. OF BEDDING NOT DETERMINABLE		NO JOINTS 1 TO 3 PER m 3 TO 10 PER m MORE THAN 10 PER m



CCPP MARMARA - EREGLISI GEOTECHNICAL REPORT	74030 / 24 APRIL 1994 GEO - BÜRO FÜR GEOTECHNIK ROMBERG GMBH
COOLING WATER SYSTEM SYNOPTIC GEOTECHNICAL SECTION	COOLING WATER SYSTEM SYNOPTIC GEOTECHNICAL SECTION



LAYER	w_n	γ_n	γ_s	LL	PL	PI	lc	c'	ρ'	c_u	ρ_u	pc	N30	Dr	kf
	%	kN/m ³		%	%	%	-	kN/m ²		kN/m ²		kN/m ²	-	-	m/s
3	74 - 80	15.4 - 16.5	26.8	33 - 35	14 - 23	12 - 20	(0)			10		2 - 6			
4	19 - 20	18.3 - 18.5	26.7 - 26.9					20	32 - 39			30 - 120	10 - 20	0.3 - 0.5	1.10-5 - 3.10-5
5	40 - 72	15.3 - 17.5	26.4 - 26.9	44 - 84	16 - 38	28 - 50	0.12 - 0.45	0 - 10	19	10 - 25	0 - 9	2 - 4	1 - 2		
6	18 - 23	17.5 - 19	26.5 - 26.6					10 - 30	28 - 37			100 - 250	20 - 35	0.5 - 0.66	
7	22 - 66	16.5 - 20	26.0 - 26.8	30 - 88	14 - 27	13 - 61	0.33 - 1.00	10 - 30	19 - 24	25 - 35	0 - 10	2 - 8	5 - 15		
8	28 - 27	17.1 - 20.5	26.6	26 - 46	13 - 23	12 - 31	0.50 - 1.03			20 - 50	0				
11 a	8 - 18	18 - 21	26.5 - 26.7	30 - 50	14 - 22	16 - 28	0.94 - 1.05	20 - 30	28 - 32			q_u			
11 b	2 - 18	24 - 27	26.4 - 27.2									5000 - 90000			
11 c	2 - 18	22 - 26	26.4 - 27.2	42 - 55	22 - 25	20 - 30	1.10 - 1.23								

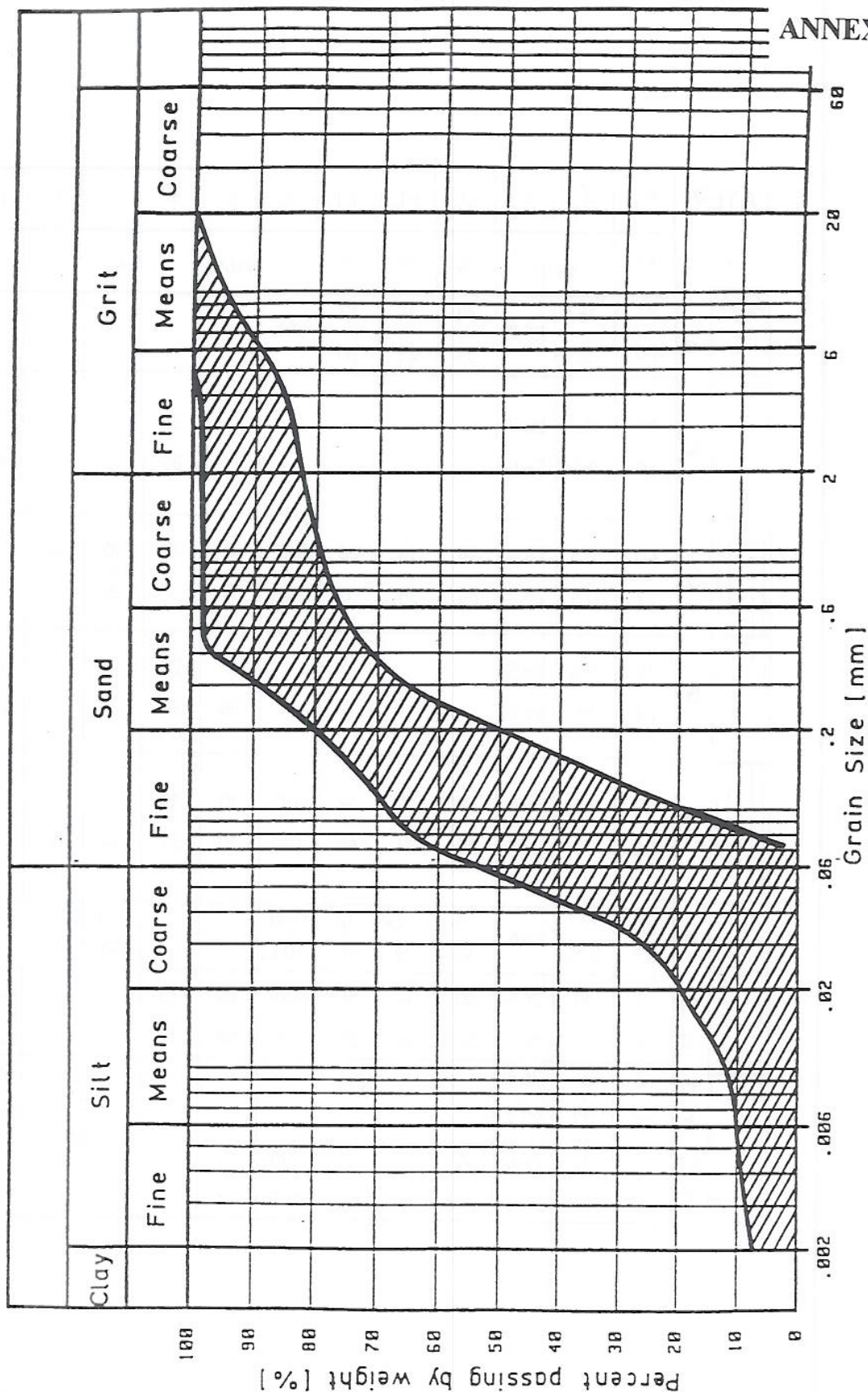
CCPP MARMARA - EREGLISI
GEOTECHNICAL REPORT

74030 / 28

APRIL 1994

LABORATORY TESTING
SUMMARY

GEO - BÜRO FÜR
GEOTECHNIK ROMBERG GM
RÖNTGENSTR. 18 64291 DARMST



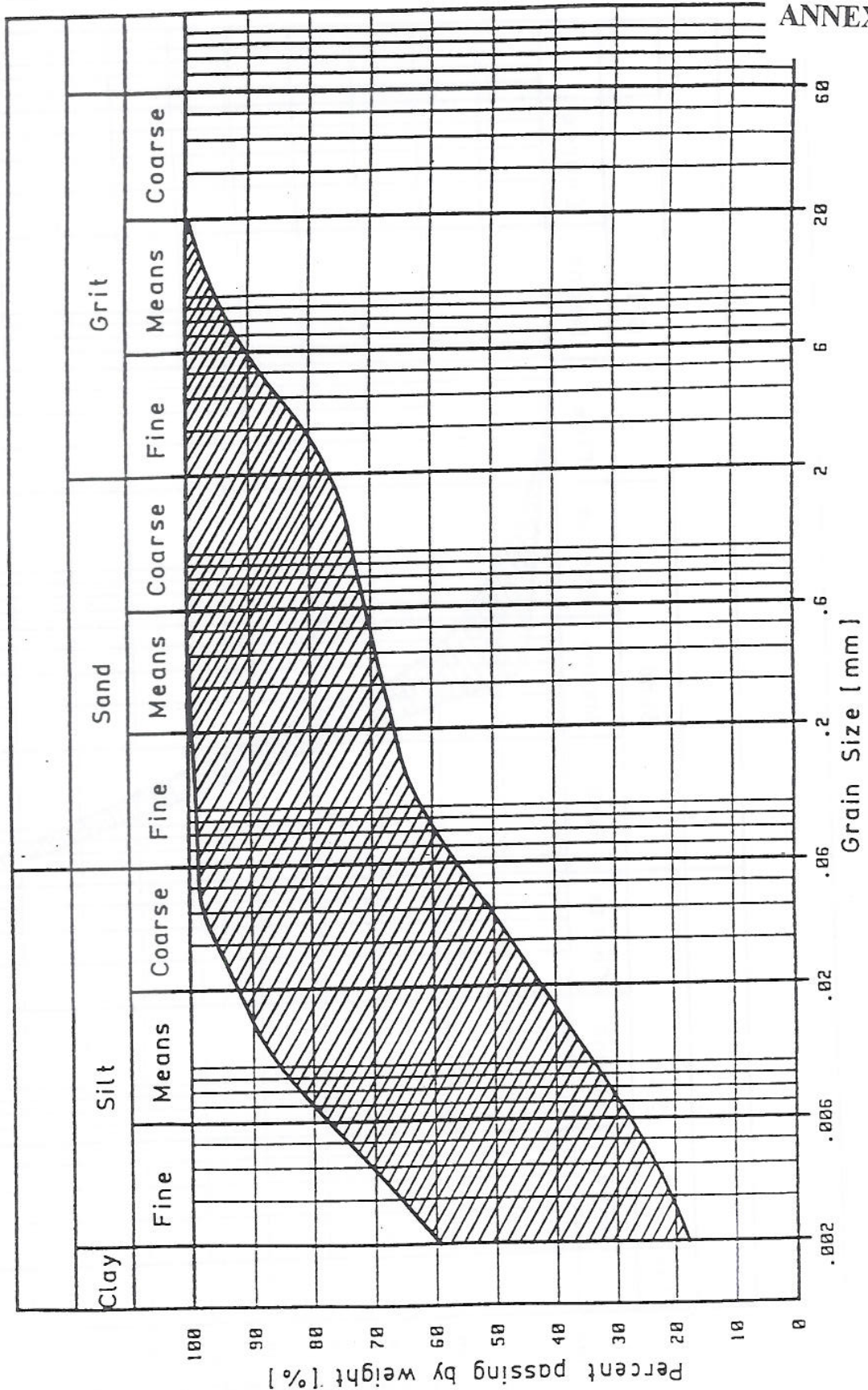
CCPP MARMARA - EREGLISI
GEOTECHNICAL REPORT

74030 / 38

JUNE 1994

LABORATORY TEST RESULTS
LAYER NO. 4
GRAIN RANGE

GEO - BÜRO FÜR
GEOTECHNIK ROMBERG GMBH
RÖNTGENSTR.18 64291 DARMSTADT



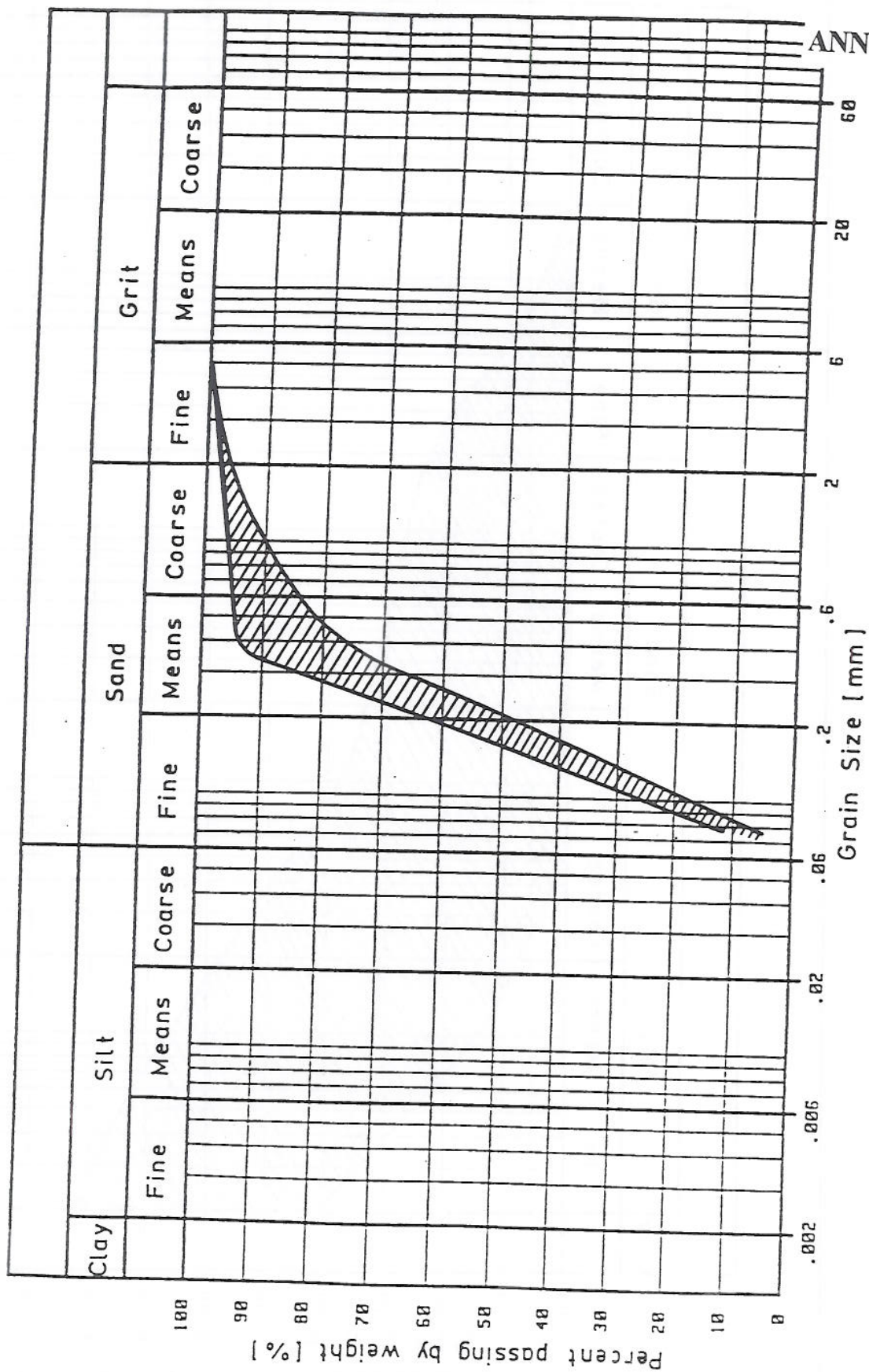
CCPP MARMARA - EREGLISI
GEOTECHNICAL REPORT

LABORATORY TEST RESULTS
LAYER NO. 5
GRAIN RANGE

74030 / 42

JUNE 1994

GEO - BÜRO FÜR
GEOTECHNIK ROMBERG GMBH
RÖNTGENSTR. 18 64291 DARMSTADT



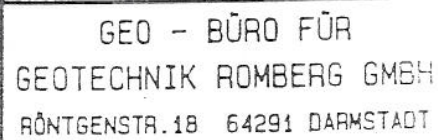
CCPP MARMARA - EREGLISI
GEOTECHNICAL REPORT

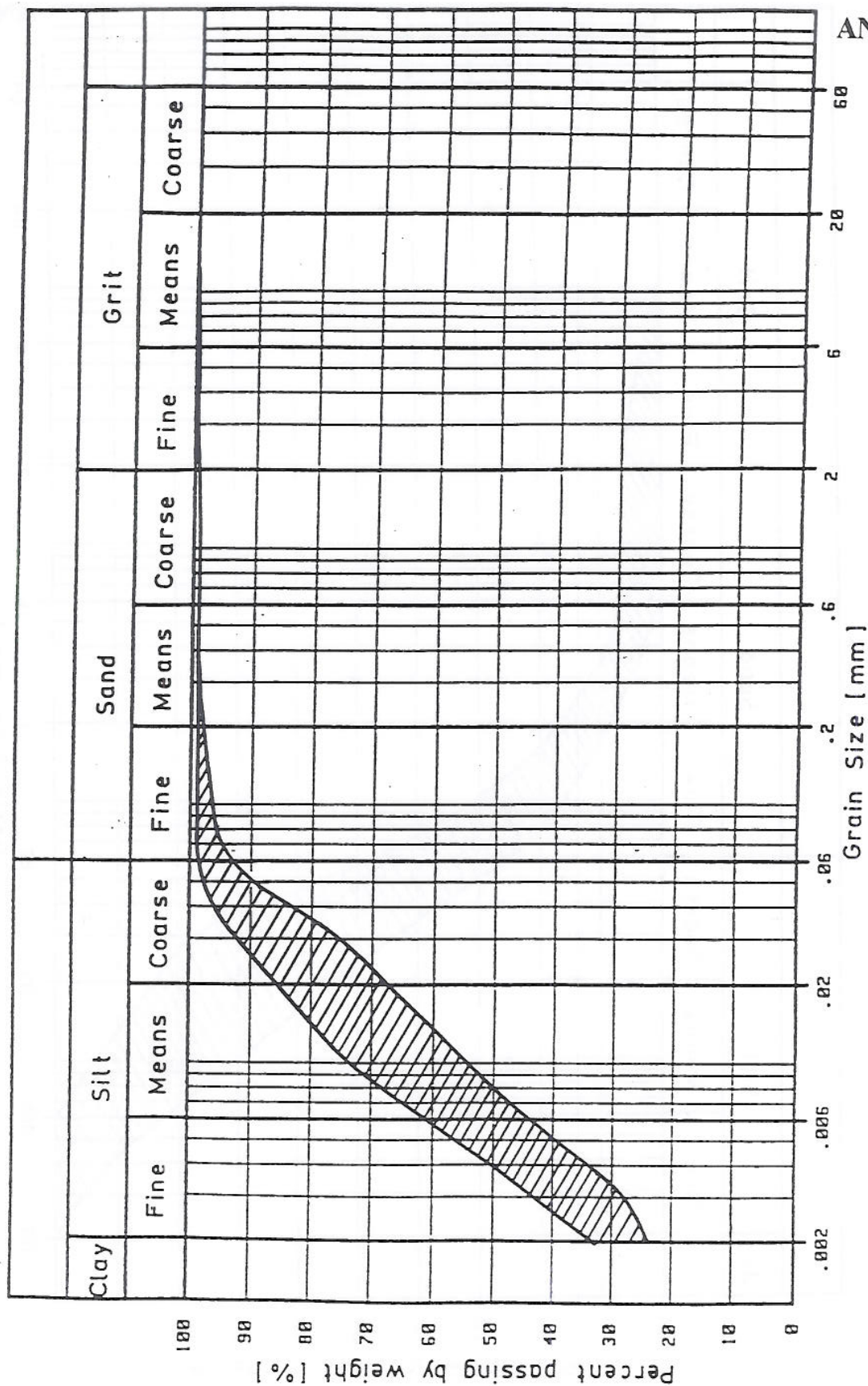
74030 / 46

JUNE 1994

LABORATORY TEST RESULTS
LAYER NO. 6
GRAIN RANGE

GEO - BÜRO FÜR
GEOTECHNIK ROMBERG GMBH
RÖNTGENSTR. 18 64294 DACHSTADT





Layer No. 11a
(weathered Siltstone)
(6-8 m)

CCPP MARMARA - EREGLISI
GEOTECHNICAL REPORT

74030 / 54

JUNE 1994

LABORATORY TEST RESULTS
LAYER NO. 11a
GRAIN RANGE

GEO - BÜRO FÜR
GEOTECHNIK ROMBERG GMBH
RÖNTGENSTR. 18 64291 DARMSTADT

LAYER	w_n	γ_n	γ_s	LL	PL	PI	lc	c'	p'	c_u	p_u	p_c	N30	Dr	kf
	%	kN/m^3		%	%	%	-	kN/m^2		kN/m^2		kN/m^2	-	-	m/s
3	74 80	15.4 16.5	26.8	33 35	14 23	12 20	(0)			10		2 6			
4	19 20	18.3 18.5	26.7 26.9					20	32 39			30 120	10 20	0.3 0.5	1.10-5 3.10-5
5	40 72	15.3 17.5	26.4 26.9	44 84	16 38	28 50	0.12 0.45	0 10	19	10 25	0 9	2 4	1 2		
6	18 23	17.5 19	26.5 26.6					10 30	28 37			100 250	20 35	0.5 0.66	
7	22 66	16.5 20	26.0 26.8	30 88	14 27	13 61	0.33 1.00	10 30	19 24	25 35	0 10	2 8	5 15		
8	28 27	17.1 20.5	26.6	26 46	13 23	12 31	0.50 1.03			20 50	0				
11 a	8 18	18 21	26.5 26.7	30 50	14 22	16 28	0.94 1.05	20 30	28 32			q_u			
11 b	2 18	24 27	26.4 27.2									1000 10000			
11 c	2 18	22 26	26.4 27.2	42 55	22 25	20 30	1.10 1.23					18000 43000			

CCPP MARMARA - EREGLISI
GEOTECHNICAL REPORT

74030 / 58

APRIL 1994

LABORATORY TESTING
SUMMARY

GEO - BÜRO FÜR
GEOTECHNIK ROMBERG GM
RÖNTGENSTR. 18 64291 DARMST

MINISTRY OF ENERGY AND NATURAL RESOURCES

Number: B-15-O-EGM.0.04.00.01/680-2
Subject : M. Ereglisi seismic report.

ANKARA
18/04/1994

UNI-MAR ENERJİ YATIRIMLARI A.Ş.
İRAN CAD. No: 2/1
06700 KAVAKLIDERE-ANKARA

Ref: Your letter dated 15.03.1994 , No. 877/94-SB

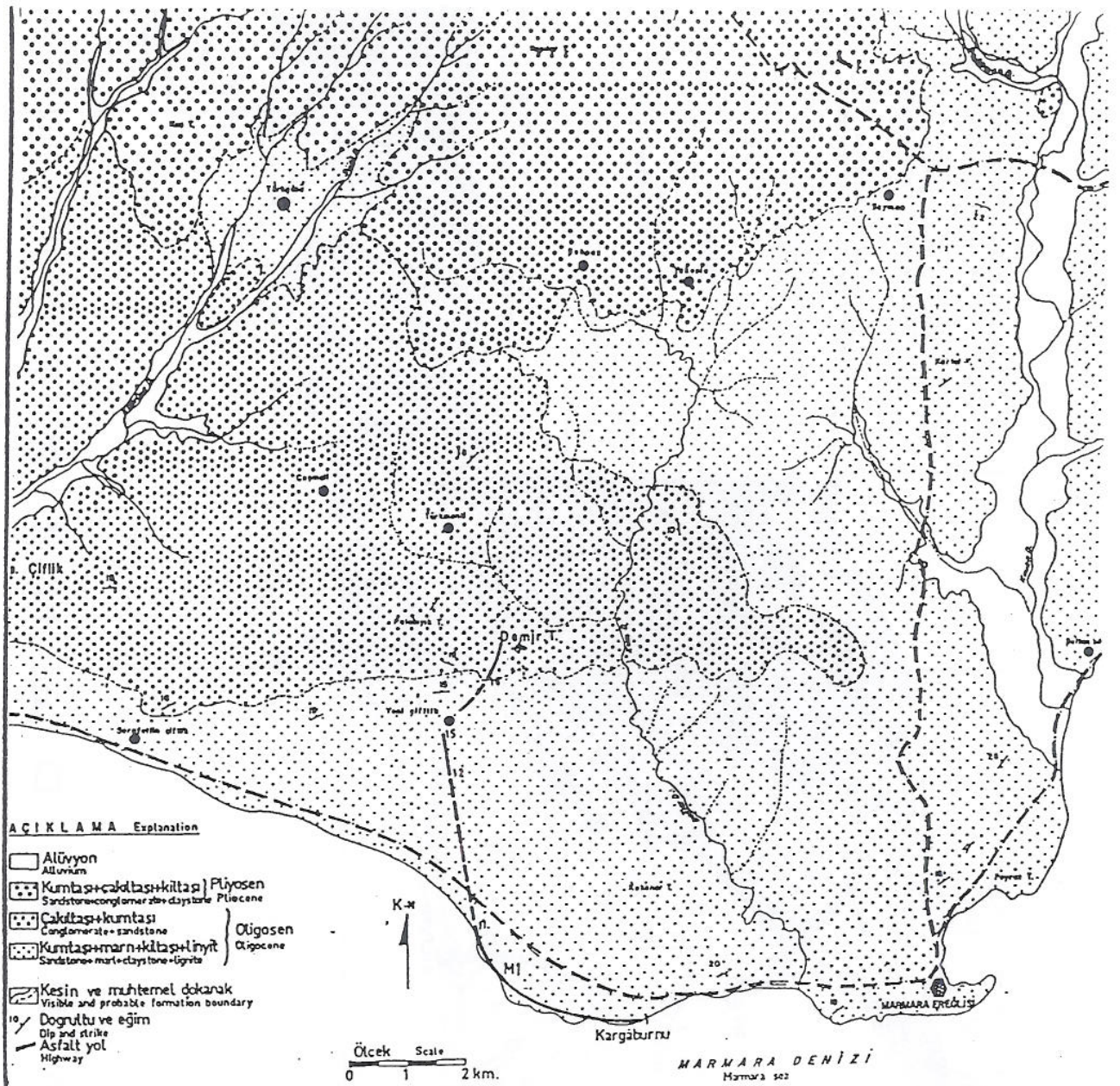
The seismic report that you have prepared and submitted along with to your ref. letter, for the power plant site at Marmara Ereglisi, was examined and approved in principal.

According to the contract conditions, all technical and design responsibilities of the plant including the ground safety works belong to your company for the power plant which will be constructed at Marmara Ereglisi and operated by your company, as per the law 3096 item 4.

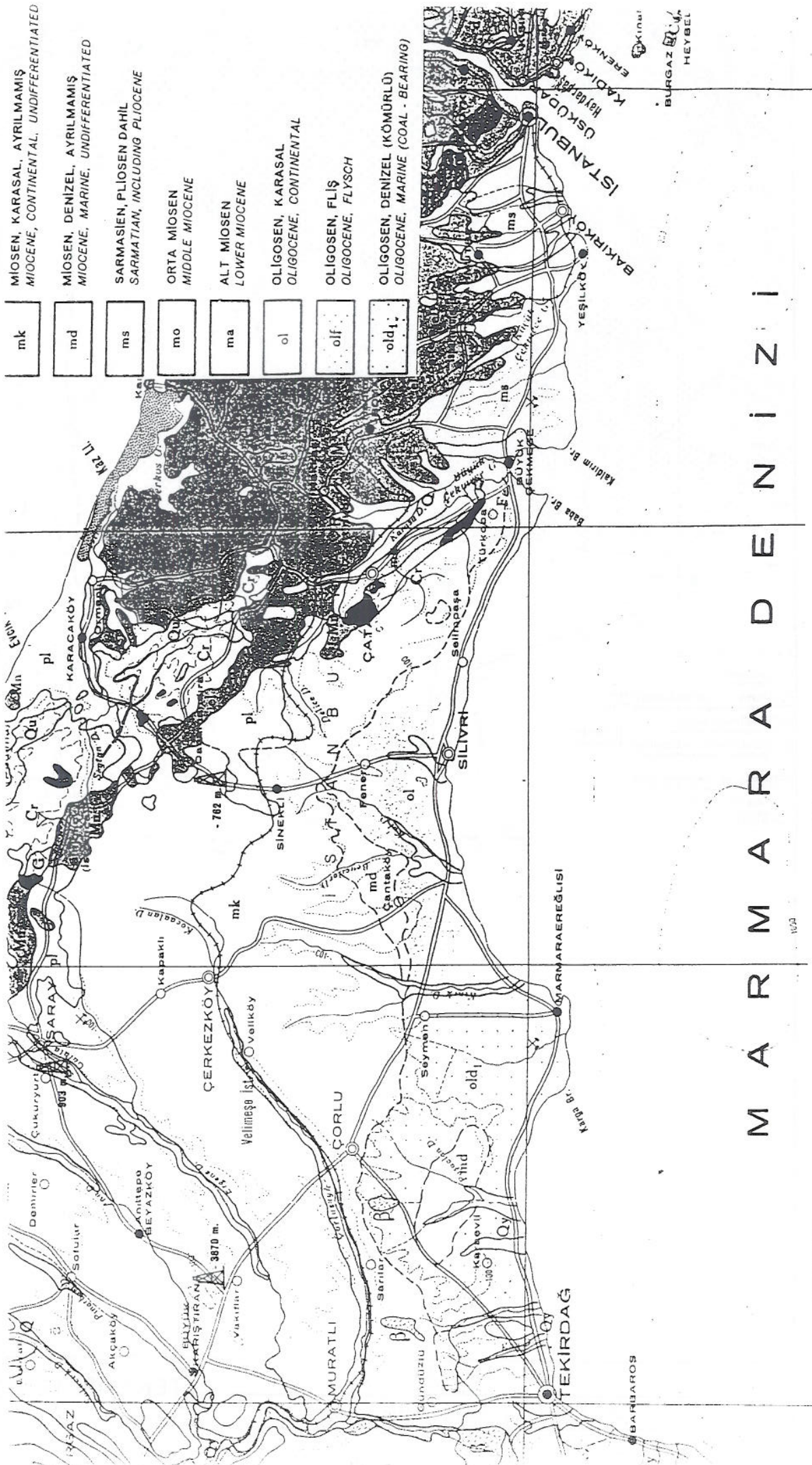
Please be informed.

Signed
For the Minister

Dr.Mustafa Turhan
General Manager.



Sekil - 2 / Fig - 2



M A R M A R A D E N İ Z İ

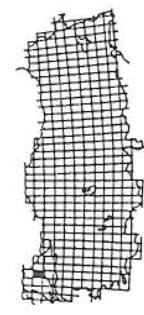
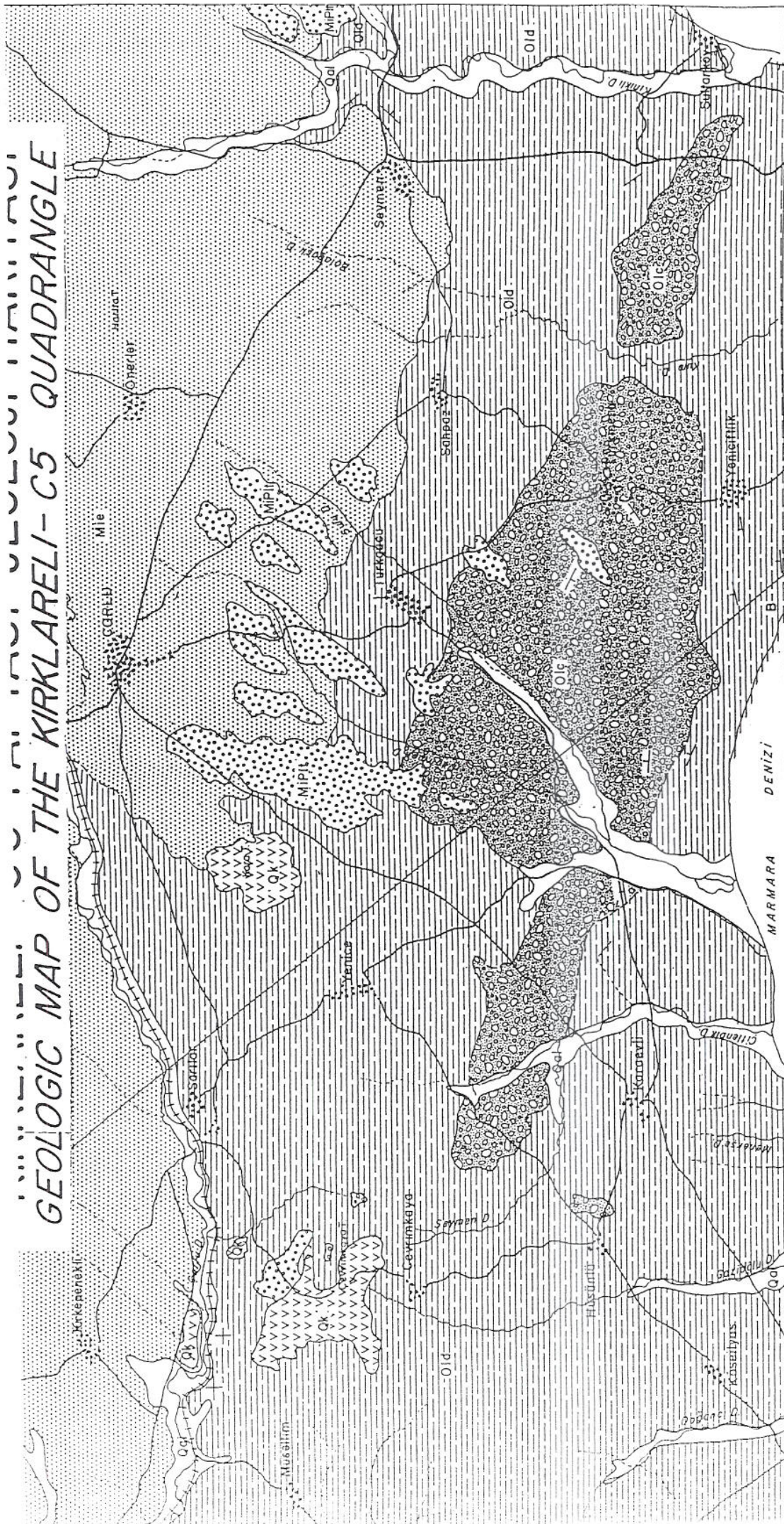
- mk MIOSEN, KARASAL, AYRILMAMIŞ
MIOCENE, CONTINENTAL, UNDIFFERENTIATED
- md MIOSEN, DENİZEL, AYRILMAMIŞ
MIOCENE, MARINE, UNDIFFERENTIATED
- ms SARMASİEN, PLOSEN DAHL
SARMATIAN, INCLUDING PLOCIENE
- mo ORTA MIOSEN
MIDDLE MIOCENE
- ma ALT MIOSEN
LOWER MIOCENE
- ol OLIGOSEN, KARASAL
OLIGOCENE, CONTINENTAL
- olf OLIGOSEN, FLİŞ
OLIGOCENE, FLYSCH
- oldi OLIGOSEN, DENİZEL (KÖMÜRLÜ)
OLIGOCENE, MARINE (COAL - BEARING)

- EOSEN - OLIGOSEN FLİŞ
EOCENE - OLIGOCENE FLYSCH
- EOSEN, AYRILMAMIŞ
EOCENE, UNDIFFERENTIATED
- EOSEN FLİŞ

- plQ PLIO - KUATERNER
PLIO - QUATERNARY
- n NEOJEN, KARASAL, AYRILMAMIŞ
NEOGENE, CONTINENTAL, UNDIFFERENTIATED
- ndr NEOJEN, KISMEN DENİZEL, KISMEN KARASAL (KÖMÜRLÜ)
NEOGENE, PARTIALLY MARINE, PARTIALLY CONTINENTAL (COAL - BEARING)

- Q KUATERNER, KARASAL, AYRILMAMIŞ
QUATERNARY, CONTINENTAL, UNDIFFERENTIATED
- Qd KUATERNER, DENİZEL, AYRILMAMIŞ
QUATERNARY MARINE, UNDIFFERENTIATED
- Qn HOLOSEN, YENİ ALÜVYON
HOLOSENE, NEW ALLUVIUM

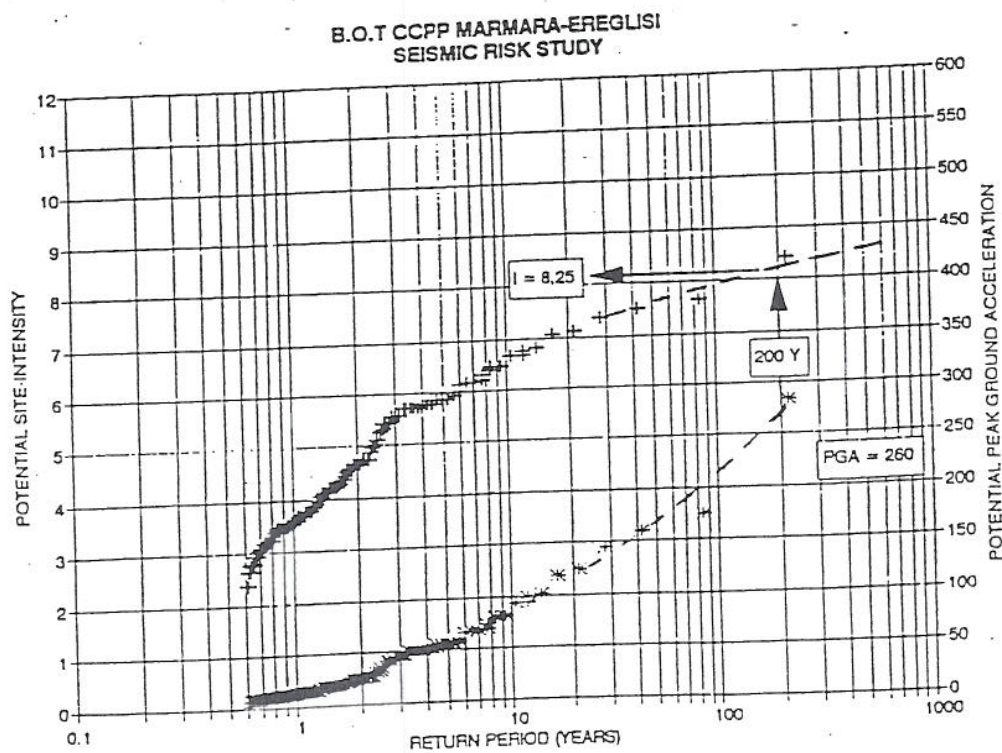
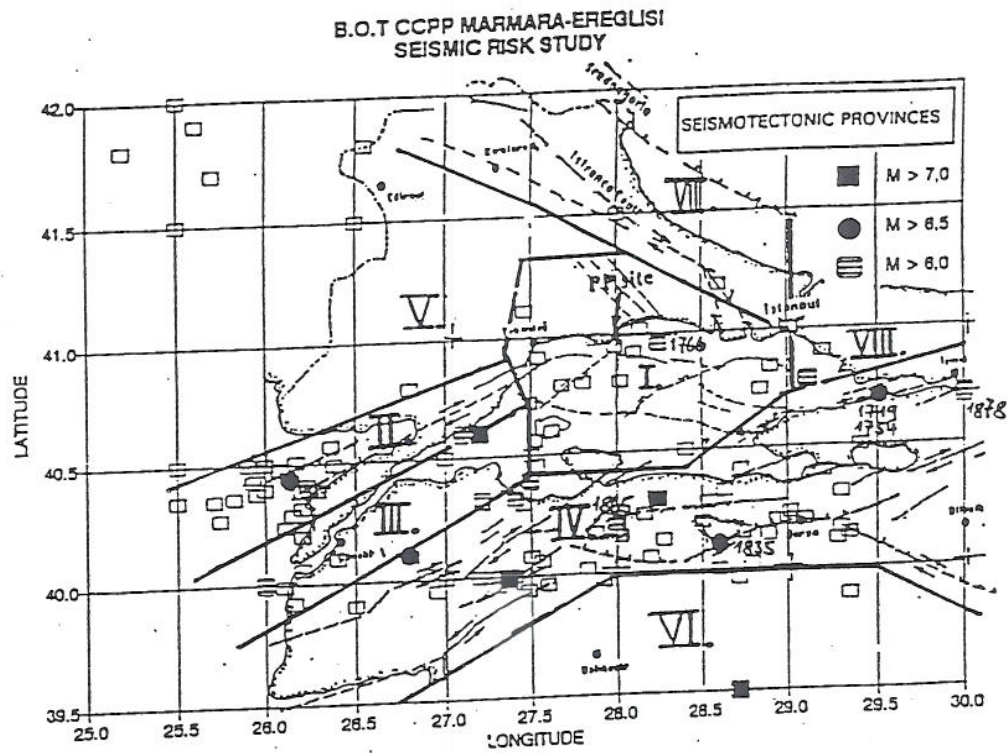
GEOLOGIC MAP OF THE KIRKLARELI-C5 QUADRANGLE



ÖLÇEK: 1/100 000
SCALE

HARITA BİRLİMLERİNİN AÇIKLAMASI
DESCRIPTION OF MAP UNITS

- | | | | | | |
|--|-------------------|--|----------------------|--|------------------|
| | Quaternary (Qal) | | Eocene (Eoc) | | Pliocene (Plc) |
| | Miocene (Mio) | | Oligocene (Olig) | | Paleocene (Palc) |
| | Cretaceous (Cret) | | Jurassic (Jur) | | Triassic (Tri) |
| | Permian (Perm) | | Carboniferous (Carb) | | Devonian (Dev) |
| | Silurian (Sil) | | Ordovician (Ord) | | Cambrian (Camb) |
- Other symbols: Fault, Unconformity, Tectonic zone, Volcanic zone, Marine zone, Freshwater zone, Salt water zone, Shallow water zone, Deep water zone, Tidal zone, Non-tidal zone, Estuarine zone, Bays and gulfs, Straits and channels, Rivers and streams, Lakes and ponds, Wetlands, Forests, Agriculture, Urban areas, Rural areas, Mountains, Hills, Plateaus, Valleys, Plains, Coasts, Beaches, Dunes, Sandbars, Shoals, Banks, Bars, Mouths, Deltas, Estuaries, Lagoons, Marshes, Swamps, Bogs, Fens, Peatlands, Wetlands, Forests, Agriculture, Urban areas, Rural areas, Mountains, Hills, Plateaus, Valleys, Plains, Coasts, Beaches, Dunes, Sandbars, Shoals, Banks, Bars, Mouths, Deltas, Estuaries, Lagoons, Marshes, Swamps, Bogs, Fens, Peatlands.



ANNEX IV.1.4.1.

SOIL CLASSIFICATION REPORT
for the
PROJECT SITE

ANNEX IV.1.4.1

Republic of Turkey
PRIME MINISTRY
GENERAL DIRECTORATE of RURAL SERVICES
Planning and Project Office

No : B 021KHZ O 10 00 05 / 194-6181
Subject : Land use for non-agricultural purpose

26/07/1994

UNI-MAR ENERJİ YATIRIMLARI A.Ş.
Iran Cad 2/1
Kavaklıdere / ANKARA

Ref a) Our letter dated 1.4.1994 and No 194-2770
b) UNI-MAR Enerji Yatırımları A.Ş. letter dated 27.6.1994
c) Regional Dir. of Rur. Serv. letter dated 13.7.1994 and No B 021KHZ 1.18.00
031.10642-118-2137

In reference with your letter (b), it is understood that, total 263 720 m² land located at Tekirdag-Marmara Ereglisi-Sultankoy which will be expropriated for UNI-MAR Combined Cycle Power Plant site and its access road and the cooling water pipeline route, as being reported by the ref. (c) letter, is composed of;

- rain-dependent-agricultural use land of 8200 m² II. (second class), 98 920 m² III. (third class), 126 000 m² IV. (fourth class), 18 400 m² and,
- cession use land of IV. (fourth class) and,
- riverbed use land of 7 400 m² VIII. (eighth class), and,
- shore sand use land of 4 800 m² VIII. (eighth class)

In accordance with the items 7 and 8 Regulation for Use of Agricultural Lands for Non-agricultural Purpose, above mentioned land is approved for non-agricultural purpose.

For your kind information and action.

Ahmet AYHAN
Asst. General Manager

Attach: Report (2 copies)

Distribution:

For Information:

Governor of Tekirdag

(Directorate of Public Works and Settlements)

For Action:

1)18. Regional Directorate of Rural
affairs/ISTANBUL

2)UNIT INTERNATIONAL S.A.
Iran Cad 2/1 / ANKARA

T. C.

BAŞBAKANLIK

KÖY HİZMETLERİ GENEL MÜDÜRLÜĞÜ
Etüt ve Proje Dairesi Başkanlığı

Sayı : B021KHZ0100005/194 - 6181

Konu : Tarım dışı amaçlı 37659
arazi kullanımı.

26/...7/1994

UNI-MAR ENERJİ YATIRIMLARI A.Ş.

İran Cad. No:2/2 06700

Kavaklıdere/ANKARA

İLCİ: a) 1.4.1994 tarih ve 194-2770 sayılı yazımız.

b) Uni-Mar Enerji Yatırımları A.Ş.'nin 28.6.1994 tarihli yazısı.

c) Köy Hiz.18.Bl.Md.nün 13.7.1994 tarih ve B.02.KHZ.2.1.18.00.031.10642-118-2137 sayılı yazısı.

İlgi (b) yazı ile Uni-Mar Enerji Yatırımları A.Ş. tarafından yapılmakta olan 500 MW kurulu gücünde Doğalgaz Kombine Çevrim Elektrik Santral sahasının Devlet Karayolu ile irtibatını temin edecek bağlantı yolu ve soğutma suyu güzergahının kamulaştırılmasının yapılabilmesi için Tekirdağ-Marmara Ereğlisi-Sultanköy mevkiinde bulunan toplam 263 720 m2 alan için yazılan ilgi (c) yazı eki toprak etüt raporundan sahanın yağıza bağlı tarımda kullanılan 8200 m2-si II.(ikinci), 98920 m2-si III.(üçüncü), 126000 m2-si IV.(dördüncü), terk kullanımlı 18400 m2-si IV.(dördüncü), ırmak yatağı kullanımlı 7400 m2 VIII.(sekizinci), sahil kumu kullanımlı 4800 m2-sinin de VIII.(sekizinci) sınıf arazilerden meydana geldiği anlaşılmıştır.

Tarım Alanlarını Tarım Dışı Gaye ile Kullanılmasına Dair Yönetmeliğin 7. ve 8. maddesine göre, yukarıda özellikleri belirtilen arazilerin tarım dışı amaçla kullanılması uygun görülmüştür.

Bilginizi ve gereğini rica ederim.



Ahmet AYHAN

Genel Müdür Yardımcısı

EKİ: Rapor (2 Adet)

DAĞITIM :

Gereği için :

Tekirdağ Valiliğine
(Bay. ve İsk.Müd.Şü)

Bilgi için :

1) Köy Hiz.18.Bl.Md.ne/İSTANBUL

2) Uni-Mar Enerji Yatırımları A.Ş.

İran Cad. No:2/2 06700

Kavaklıdere/ANKARA

SOIL CLASSIFICATION REPORT for 263 720 m² LAND at TEKIRDAG MARMARA EREGLISI SULTANKOY

1-GENERAL INFORMATION

1.1. Location of the Ground and its Area: Examined land located at Tekirdag, Marmara Ereglisi, Sultankoy. Total surface area of the land is approximately 263 720 m² according to planimetric measurements.

1.2. Type of the Map and its Scale: 1/ 2000 scale Site Layout of the Power plant and 1/ 2000 scale Expropriation Plan were used during studies at the site and 1/ 2000 scale Expropriation Plan was used for studies at the office.

1.3. Purpose of the Study: Unit International S.A. plans to construct a 500 MW B.O.T. Power Plant over the subject ground.

2- SOIL and LAND CHARACTERISTICS

Examined area composed of zonal and alluvial soil and river bed and shore sand
Zonal Soil: Soil has a profile of medium depth (70-80 cm) and shallow (40-45 cm). Upper soil contains (SCL-SL-LS) Silty clay "L", sandy "L" and "L" sand. Lower soil contains (SCL-vfSL-SL-LS) sandy silty "L"; very fine sandy L, sandy "L" and, "L" sand. Permeability is slow for fine structure soil, average for medium structure soil and fast for rough structure soil, their is drainage is good. Their slopes are; low (% 2-4), moderate (%7-8) and steep (% 13-16). Erosion is less-to-medium. Topography is undulated, slightly waved and waved, physiography is high, slope and skirt land.

Alluvial Soil: Soil has a deep profile (120-130 cm). Upper soil contains (CL-SL-LS) clay "L", sandy "L" and "L" sand. Lower soil contains (SCL-vfSL-SL-LS) sandy silty "L"; very fine sandy L, sandy "L" and, "L" sand. Permeability is slow for fine structure soil, average for medium structure soil and fast for rough structure soil, their is drainage is poor. Ground water is found at 100-110 cm depth. They are almost plain (%1-2 slope). Effected by slight erosion. Topography is plain, physiography is in a ground land position.

River bed: is party running along the Cooling Water Route

Shore sands: is found where the Pump Station area meets the Marmara Sea.

3- LAND USE, AGRICULTURE and PRODUCE

233 120 m² out of the 263 720 m² Examined area, is used as dry-agriculture land. Wheat and sunflower is produced in rotation with average and low yield. The land composed of 18 400 m² cession land, 7 400 m² river bed, 4 800 m² shore Sand-dunes.

4- SOIL CLASSIFICATION

A) Natural Gas Power Plant Area

a) Due to medium deep soil profile, medium soil structure, average permeability, moderate slope and medium erosion, the land utilization class is (III) three, area: 40 400m²

b) Due to medium deep soil profile, fine soil structure, less permeability, moderate slope and medium erosion, the land utilization class is (IIIe) three, area: 24 600m²

c) Due to shallow soil profile, fine soil structure, slow permeability, steep slope and medium erosion, the land utilization class is (IVe) four, area: 126 000m²

TEKİRDAĞ İLİ MARMARA EREĞLİSİ İLÇESİ SULTANKÖY MEVKİİNDE BULUNAN 263 720 m² YÜZÖLÇÜMLÜ ARAZİNİN PLANLAMA TOPRAK ETÜT (PTE) RAPORU

1- GENEL BİLGİLER

1.1. Arazinin Mvkii ve Alanı : Etüt sahası Tekirdağ-Marmara Ereğlisi İlçesi, Sultanköy mevkiinde bulunmaktadır. Sahanın toplam alanı yapılan planimetrik ölçüme göre yaklaşık olarak 263 720 m² dir.

1.2. Harita Cinsi ve Ölçeği : Etüt çalışmalarında 1/2000 ölçekli Santral Fizik Yerleştirme Planı ile Kamulaştırma Planı kullanılmış olup, Büro çalışmalarında 1/2000 ölçekli Kamulaştırma Planı kullanılmıştır.

1.3. Etüdün Aracı : Etüt sahası üzerinde Unit International S.A. tarafından İşlet-Devret modeli ile 500 MW güçta Doğal Gaz Kombine Çevrim Elektrik Santrali kurulmak istenmektedir.

2- TOPRAK VE ARAZİ ÖZELLİKLERİ

Etüt sahası zonal ve alüvyal topraklar ile ırmak yatağı ve sahil kumullarında meydana gelmiştir.

Zonal Topraklar : Orta derin (70-80 cm) ve sığ (40-45 cm) toprak profiline sahiptir. Üst toprak bünyesi (SCL-SL-LS) kumlu killi tın, kumlu tın ve tınlı kumdur. Alt toprak bünyesi (SCL-vfSL-SL-LS) kumlu killi tın, çok ince kumlu tın, kumlu t. ve tınlı kumdur. Geçirgenlik ince bünyeli arazilerde yavaş, orta bünyeli arazilerde orta, kaba bünyeli arazilerde hızlı olup, drenajları iyidir. Hafif (% 2-4), orta (% 7-8) ve dik (% 13-16) meyilli arazilerdir. Hafif ve orta derecede erozyona sahiptir. Topoğrafya ondüzlü, hafif dalgalı ve dalgalı, fizyografya yüksek, yamaç ve etek arazisi pozisyonundadır.

Alüvyal Topraklar : Derin (120-130 cm) toprak profiline sahiptir. Üst toprak bünyesi (CL-SL-LS) killi tın, kumlu tın ve tınlı kumdur. Alt toprak bünyesi (SCL-vfSL-S) kumlu killi tın, çok ince kumlu tın ve kumdur. Geçirgenlikleri ince bünyeli arazilerde yavaş, orta bünyeli arazilerde orta, kaba bünyeli arazilerde hızlıdır. Drenajları kıfayetsizdir. 100-110 cm de taban suyu mevcuttur. Hemon hemen düz (% 1-2) meyilli arazilerdir. Hafif erozyon etkisi altındadır. Topoğrafya düz düze yakın, fizyografya taban arazi pozisyonundadır.

İrmak Yatağı : Sogutma suyu boru güzergahının bir kısmı boyunca yer almaktadır.

Sahil Kumulları : Pompa İstasyonunun Marmara Denizi ile birleştiği sınırda yer almaktadır.

3- ARAZİ KULLANMA ŞEKLİ, ÜRÜN ÇEŞİDİ VE VERİM

Etüt sahasının toplam alanı 263 720 m² olup, bunun 233 120 m² lik kısmı kuru tarım arazisi olarak kullanılmaktadır. Mınavebeli olarak buğday ve ayçiçeği yetiştirilmekte olup, verimleri orta ve düşüktür. Sahanın 18 400 m² lik kısmı terk arazi, 7400 m² lik kısmı ırmak yatağı, 4800 m² lik kısmı sahil kumullarından meydana gelmiştir.

4- ARAZİ SINIFLAMASI

A) Doğal Gaz Santral Sahası

a) Orta derin toprak profili, orta bünye, orta geçirgenlik, orta meyil ve orta erozyondan dolayı arazi kullanma kabiliyet sınıfı (III e) üstür. Alanı 40 400 m² dir.

b) Orta derin toprak profili, ince bünye, yavaş geçirgenlik, orta meyil ve orta

B) Site Access Road:

a) Due to medium deep soil profile, rough soil structure, fast permeability, slight slope and slight erosion, the land utilization class is (III) three, area: 12 560m²

b) Due to medium deep soil profile, medium soil structure, average permeability, moderate slope and medium erosion, the land utilization class is (IIIe) three, area: 21 360m²

C) Cooling Water Pipes Route:

a) Due to deep soil profile, medium soil structure, average permeability, almost no-slope, slight erosion and the insufficient drainage, the land utilization class is (IIw) two, area: 3 600m²

b) Due to deep soil profile, fine soil structure, slow permeability, almost no-slope and slight erosion and insufficient drainage, the land utilization class is (II) two, area: 4 600m²

c) River bed: The land utilization class is (VIII) eight, area: 7 400m²

D) Pump Station

b) Due to deep soil profile, rough soil structure, fast permeability, almost no-slope and slight erosion and insufficient drainage, the land utilization class is (IV) four, area: 18 400m²

c) Shore Sand: The land utilization class is (VIII) eight, area: 4 800m².

5-CONCLUSION and RECOMMENDATIONS

1. Examined area is not within our irrigation and development project scheme.

2. Total surface of the examined area is 263 720 m², of which, 8 200m² is (II.) second class, 98 920m² is (III.) third class, 144 400m² (IV.) fourth class, 12 000m² (VIII.) eighth class land.

3. The ground of the Natural Gas Power Plant is total 191 000m², of which 65 000m² (III.) third class, 126 000m² (IV.) fourth class land.

4. Total area covered by the site access road is 33 920m² and composed of (III.) third class land.

5. Total area covered by the Cooling Water Pipes Route is 15 600m², of which 8 200m² (II.) second class, 7 400m² (VIII.) eighth class. Cooling water pipes will be embedded.

6. Total area covered by the Pump Station is 23 000m², of which 18 400m² (IV.) fourth class, 4 800m² (VIII.) eighth class.

6-ANNEXES

1. (PTE) Map 1/2000 scale

2. Legend

Ahmet ATALIK
Agricultural Engineer

Approved
01/07/1994
A.Yilmaz ISIK

crozyondan dolayı arazi kullanma kabiliyet sınıfı (III c) içtür. Alanı 24 600.

c) Sığ toprak profili, ince bünye, yavaş geçirgenlik, dik meyil ve orta erozyon
dan dolayı arazi kullanma kabiliyet sınıfı (IV es) dördüncü. Alanı 126 000 m² dir.

B) Bağlantı Yolu

a) Orta derin toprak profili, kaba bünye, hızlı geçirgenlik, hafif meyil ve fif erozyondan dolayı arazi kullanma kabiliyet sınıfı (III s) uçtur. Alanı 12 m² dir.

b) Orta derin toprak profili, orta bünye, orta geçirgenlik, orta meyil ve o
crozyondan dolayı arazi kullanma kabiliyet sınıfı (III e) Uçtur. Alanı 21 360

C/ Soğutma Suyu Boru Güzerajları

a) Derin toprak profili, orta bünye, orta geçirgenlik, hemen hemen düz meyli, hafif erozyon ve kısıyetsiz drenajdan dolayı arazi kullanma kabiliyet sınıfı (I) ikidir. Alanı 3600 m² dir.

b) Derin toprak profili, ince blünye, yavaş geçirgenlik, hemen hemen düz mey: hafif erozyon ve kifayetsiz drenajdan dolayı arazi kullanıma kabiliyet sınıfı sekizdir. Alanı 4600 m² dir.

e) İrmak Yatağı : Arazi kullanma kabiliyet sınıfı (VIII) sekizdir. Alanı 7400 r

D1 Pompa Istasyon

a) Derin toprak profili, kaba bünye, hızlı geçirgenlik, hemen hemen düz mey. hafif erozyon ve kifayetsiz drenajdan dolayı arazi kullanma kabiliyet sınıfı I. dördttür. Alanı 18400 m² dir.

b) Sahil Kumulu : Arazi kullanma kabiliyet sınıfı (VIII) sekizdir. Alanı 48 m² dir.

5- SONUÇ VE ÖNERİLER

1. Eğitim sahası sulama ve geliştirme projemiz içinde değildir.

2. Etüt. sahasının toplam alanı 263 720 m² olup, bunun 8200 m² lik kısmı (II) ikinci sınıf, 98 920 m² lik kısmı (III) üçüncü sınıf, 144 400 m² lik kısmı (IV) dördüncü sınıf, 12 200 m² lik kısmı (VIII) sekizinci sınıf arazilerden meydana gelmiştir.

3. Doğal gaz santral sahasının toplam alanı 191 000 m² olup, bunun 65 000 m² kısmı (III) üçüncü sınıf, 126 000 m² lik kısmı (IV) dördüncü sınıf arazilerden oluşmaktadır.

4. Bağlantı yolunun toplam alanı 33 920 m² olup, tamamı (III) üçüncü sınıf zillerden meydana gelmiştir.

5. Soğutma suyu boru güzergahı toplam alanı 15 600 m² olup, bunun 8200 m² I. kısım (III) ikinci sınıf, 7400 m² II. kısım (VIII) sekizinci sınıf arazilerden oluşmaktadır. Soğutma suyu boruları yeraltına dönecektir.

6. Pompa İstasyonunun toplam alanı 23 200 m² olup, bunun 18 400 m² lik kısmı (IV) dördüncü sınıf, 4800 m² lik kısmı (VIII) sekizinci sınıf arazilerden meydana gelmiştir.

6- EKLER

1. 1/2000 ölçekli (PTE) Haritası

2. Lejant

Ahmet ATALIK
Ziraat Mühendisi

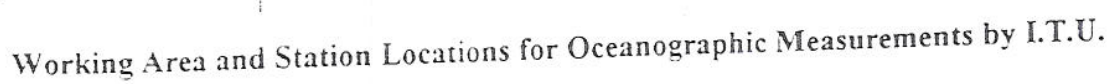
TASDİK OLUNUR

0/ 141924

Handwritten signature: *A. J. ...*

**OCEANOGRAPHIC MEASUREMENTS
and
INVESTIGATIONS**

İTÜ FACULTY of CIVIL ENGINEERING
Department of
ENVIRONMENTAL ENGINEERING



Annex.IV.16.2 Coordinates of the Stations(18.02.1994)

Saat Varış Kalkış	Mevkin	İstasyon No	Derinlik	YÖN	Rüzgar KUVVET	Deniz	Gök	B. Basınç	H. Sic
1412-1425	41° 00' 30 N 28° 00' 20 E	4	20	Sakin	Sakin	SWELL/2	bc	1026	14°C
1430-1445	41° 00' 30 N 28° 00' 80 E	5	18	ENE	2	2	bc	1025	14°C
1455-1502	41° 00' 30 N 27° 59' 45 E	61	14	ENE	2	2	bc	1024/2	14°C
1510-1525	41° 00' 90 N 28° 00' 60 E	7	19	ENE	2	2	bc	1024	14°C
1530-1540	41° 00' 92 N 28° 00' 20 E	8	14	NE	1	SWELL/2	bc	1023/2	14°C
1543-1552	41° 00' 95 N 27° 59' 80 E	9	08	Sakin	Sakin	SWELL/2	bc	1023/2	14°C

Annex.IV.16.3 Coordinates of the Stations(27.02.1994)

Saat Vang Kalkı	Mevki	İstasyon No	Derinlik	YÖN	Rüzgar KUVVET	Deniz	Gök	B Basınç	H Sic
1215-1222	41° 00' 26 N 28° 00' 20 E	4	20	Sakin	Sakin	-	b/m	1025/2	15°C
1227-1239	41° 00' 26 N 27° 59' 80 E	5	19	Sakin	Sakin	-	b/m	1025	16°C
1245-1250	41° 00' 30 N 27° 59' 43 E	61	14	Sakin	Sakin	-	b/m	1025	16°C
1300-1308	41° 00' 90 N 28° 00' 60 E	7	18	Sakin	Sakin	-	b/m	1025	16°C
1318-1324	40° 00' 90 N 28° 00' 18 E	8	15	SW	2	1	b/m	1024/2	15°C
1331-1337	41° 00' 95 N 27° 59' 80 E	9	09	SW	2	1	b/m	1024	15°C
1347-1405	41° 00' 90 N 27° 59' 75 E 41° 00' 60 N 27° 59' 53 E	13	10	S	2	1	b	1023/2	15°C
1418-1438	40° 59' 60 N 27° 59' 90 E 40° 59' 00 N 27° 59' 40 E	14	31	S	1	1	b	1023	15°C

Current measurements made on 18.02.1994

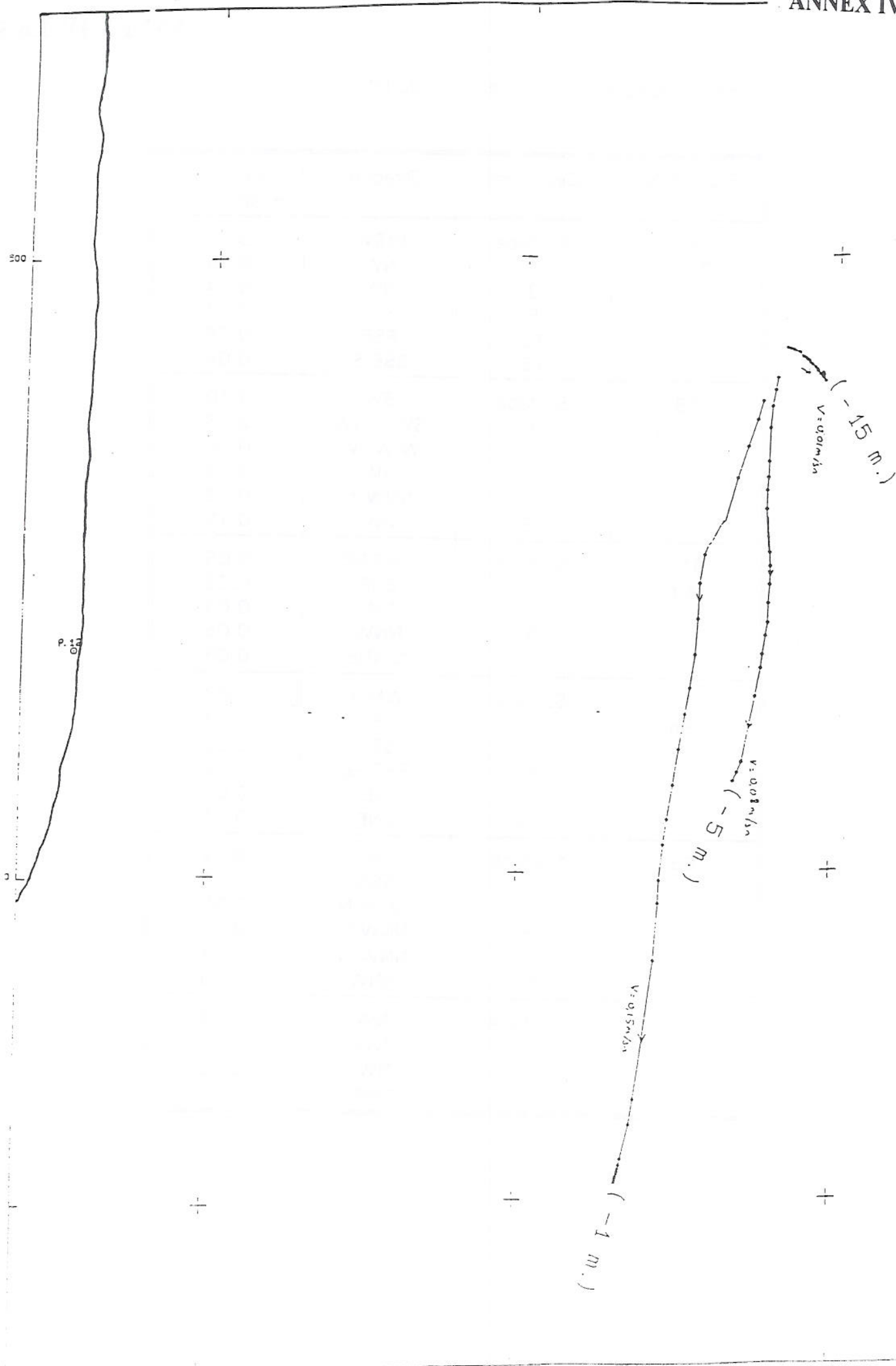
Station No	Depth (m)	Direction	Velocity (m/sn)
4A (20 m)	Surface	NW	0.07
	1	N	0.04
	3	W	0.07
	5	WSW	0.07
	10	SW	0.10
	15	SSW-SW	0.12
5A	Surface	S	0.18
	1	SW	0.07
	3	SW-WSW	0.05
	5	WNW-NW	0.05
	10	WNW-NW	0.07
	15	WSW	0.12
61A	Surface	NE-E	0.11
	1	E	0.05
	3	ESE-SE	0.05
	5	SSE-S	0.01
7A (19 m)	Surface	E-SE	0.09
	1	SSE-S	0.05
	3	SSW-SW	0.05
	5	SW-WSW	0.06
	10	SSW-SW	0.11
	15	S-SSW	0.17
8A (14 m)	Surface	W	0.06
	1	WNW-NW	0.06
	3	WNW-NW	0.08
	5	NW	0.11
	10	NW	0.17
9A (8 m)	Surface	W	0.10
	1	NW-NNW	0.09
	3	NW	0.12
	5	NW	0.14



ANNEX IV.1.6.5.

Current measurements made on 27.02.1994

Station No	Depth (m)	Direction	Velocity (m/sn)
4B (20 m)	Surface	WSW	0.10
	1	NW	0.05
	3	NW	0.04
	5	W	0.02
	10	SSE	0.06
	15	SSE-S	0.06
5B (19 m)	Surface	SW	0.10
	1	SW-WSW	0.13
	3	W-WNW	0.15
	5	NW	0.13
	10	NNW-N	0.12
	15	NNW	0.15
61B (14 m)	Surface	NE-ENE	0.05
	1	ENE	0.02
	3	NW	0.05
	5	NNW	0.05
	10	N-NNE	0.08
7B (18m)	Surface	WNW	0.08
	1	S	0.03
	3	SSE	0.05
	5	ESE-SE	0.02
	10	NE	0.03
	15	ENE	0.01
8B (15m)	Surface	S	0.02
	1	SSN	0.04
	3	NNW-N	0.05
	5	NNW-N	0.02
	10	NNW-N	0.11
	13	NNW	0.19
9B (8 m)	Surface	NW	0.09
	1	NW	0.13
	3	NNW-N	0.16
	5	NNW	0.10



Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 4 -Depth 20m) 18.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density ρ_t (kg/m ³)
Surface	7.443	28.187	2.936	22.002
2	7.476	28.156	2.935	21.973
4	7.496	28.169	2.938	21.981
6	7.351	28.164	2.927	21.995
8	7.281	28.171	2.922	22.011
10	7.252	28.176	2.921	22.017
12	7.261	28.181	2.921	22.019
14	11.361	32.011	3.639	24.421
16	14.394	38.149	4.571	28.538
17	14.507	38.261	4.595	28.599

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 5 -Depth 18m) 18.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density ρ_t (kg/m ³)
Yüzey	8.112	28.151	2.984	21.886
2	7.485	28.154	2.936	21.971
4	7.429	28.172	2.933	21.992
6	7.312	28.194	2.927	22.024
8	7.245	28.189	2.921	22.039
10	7.245	28.177	2.919	22.019
12	7.473	28.184	2.938	21.995
14	13.311	36.616	4.297	27.582
16	14.314	38.218	4.569	28.609
17	14.411	38.299	4.585	28.651

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 61 -Depth 14m) 18.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density ρ_t (kg/m ³)
Yüzey	7.641	28.153	2.957	21.951
2	7.667	28.121	2.947	21.921
4	7.671	28.159	2.951	21.949
6	7.615	28.117	2.942	21.925
8	7.291	28.198	2.924	22.016
10	7.246	28.181	2.921	22.022
12	7.231	28.176	2.919	22.021
14	7.344	28.081	2.919	21.932

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 7 -Depth 18m) 18.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density ρ_t (kg/m ³)
Yüzey	7.533	28.317	2.961	22.135
2	7.671	28.172	2.952	21.961
4	7.453	28.185	2.936	21.999
6	7.334	28.172	2.926	22.004
8	7.298	28.168	2.923	22.006
10	7.352	28.227	2.929	22.052
12	7.345	28.195	2.929	22.021
14	11.331	36.222	4.058	27.667
16	13.639	37.401	4.413	28.122
18	14.496	38.308	4.599	28.639

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 8 -Depth 14 m) 18.02.1994

Depth (m)	Temperat ure °C	Salinity ‰	Conducti vity Siem/m	Density s_t (kg/m ³)
Yüzey	7.501	28.161	2.938	21.974
2	7.629	28.179	2.949	21.971
4	7.352	28.223	2.932	22.042
6	7.291	28.201	2.926	22.032
8	7.271	28.186	2.926	22.023
10	7.259	28.184	2.922	22.023
12	7.271	28.179	2.922	22.017
13	7.299	28.184	2.925	22.018

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 9 -Depth 9 m) 18.02.1994

Depth (m)	Temperat ure °C	Salinity ‰	Conducti vity Siem/m	Density s_t (kg/m ³)
Yüzey	7.493	28.131	2.934	21.951
2	7.585	28.141	2.942	21.947
4	7.611	28.128	2.943	21.934
6	7.526	28.131	2.937	21.948
7	7.491	28.119	2.933	21.943

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 4 -Depth 20m) 27.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density ρ_t (kg/m ³)
Yüzey	8.465	28.441	3.039	22.064
2	8.471	28.422	3.037	22.045
4	8.457	28.433	3.038	22.059
6	8.305	28.636	3.045	22.239
8	8.295	28.639	3.045	22.243
10	8.261	28.658	3.044	22.263
12	8.343	28.827	3.067	22.384
14	8.201	29.099	3.082	22.617
16	8.363	29.249	3.109	22.711
18	8.719	29.603	3.172	22.937
20	8.989	29.862	3.219	23.099

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 5 -Depth 19m) 27.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density ρ_t (kg/m ³)
Yüzey	8.336	27.967	2.983	21.711
2	8.341	27.969	2.984	21.712
4	8.349	27.937	2.931	21.686
6	8.489	28.444	3.041	22.063
8	8.507	28.445	3.043	22.061
10	8.484	28.534	3.051	22.134
12	8.461	28.595	3.054	22.185
14	8.388	28.761	3.064	22.326
16	8.334	29.034	3.086	22.547
18	8.712	29.511	3.163	22.866

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 61 -Depth 14 m) 27.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density s_t (kg/m ³)
Yüzey	8.421	27.944	2.987	21.681
2	8.411	27.941	2.986	21.681
4	8.375	27.966	2.986	21.705
6	8.483	28.367	3.033	22.004
8	8.496	28.401	3.038	22.027
10	8.486	28.519	3.048	22.122
12	8.471	28.652	3.061	22.229
14	8.487	28.953	3.091	22.462

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 7 -Depth 18m) 27.02.1994

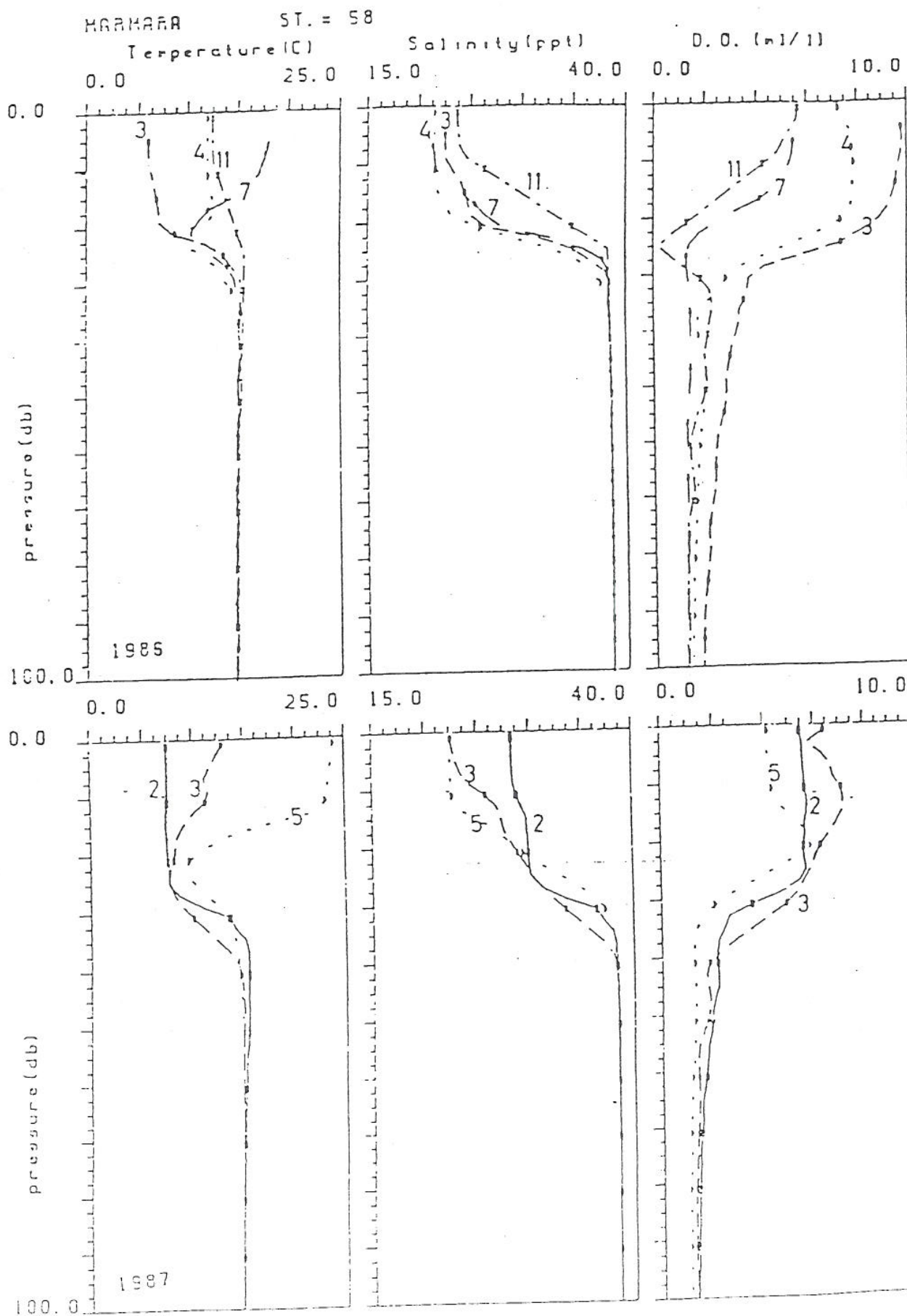
Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density s_t (kg/m ³)
Yüzey	8.489	28.326	3.031	21.971
2	8.397	28.294	3.019	21.959
4	8.428	28.415	3.034	22.049
6	8.504	28.461	3.044	22.074
8	8.466	28.414	3.037	22.043
10	8.449	28.603	3.054	22.193
12	7.345	28.195	2.929	22.021
14	11.331	36.222	4.058	27.667
16	13.639	37.401	4.413	28.122
18	14.496	38.308	4.599	28.639

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 8 -Depth 15m) 27.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density ρ_t (kg/m ³)
Yüzey	8.455	27.929	2.988	21.665
2	8.419	28.182	3.011	21.968
4	8.405	28.186	3.011	21.873
6	8.407	28.246	3.016	21.921
8	8.495	28.491	3.046	22.099
10	8.491	28.515	3.049	22.119
12	8.289	28.238	3.054	22.321
14	8.389	28.986	3.086	22.502

Sea Water Data obtained in Marmara Ereğlisi by ITU Environmental Engineering Personell (Station 9 -Depth 8 m) 27.02.1994

Depth (m)	Temperature °C	Salinity ‰	Conductivity Siem/m	Density ρ_t (kg/m ³)
Yüzey	8.487	27.963	2.994	21.687
2	8.475	27.959	2.293	21.686
4	8.476	27.958	2.993	21.685
6	8.469	27.974	2.994	21.698
7	8.441	28.313	3.026	21.973



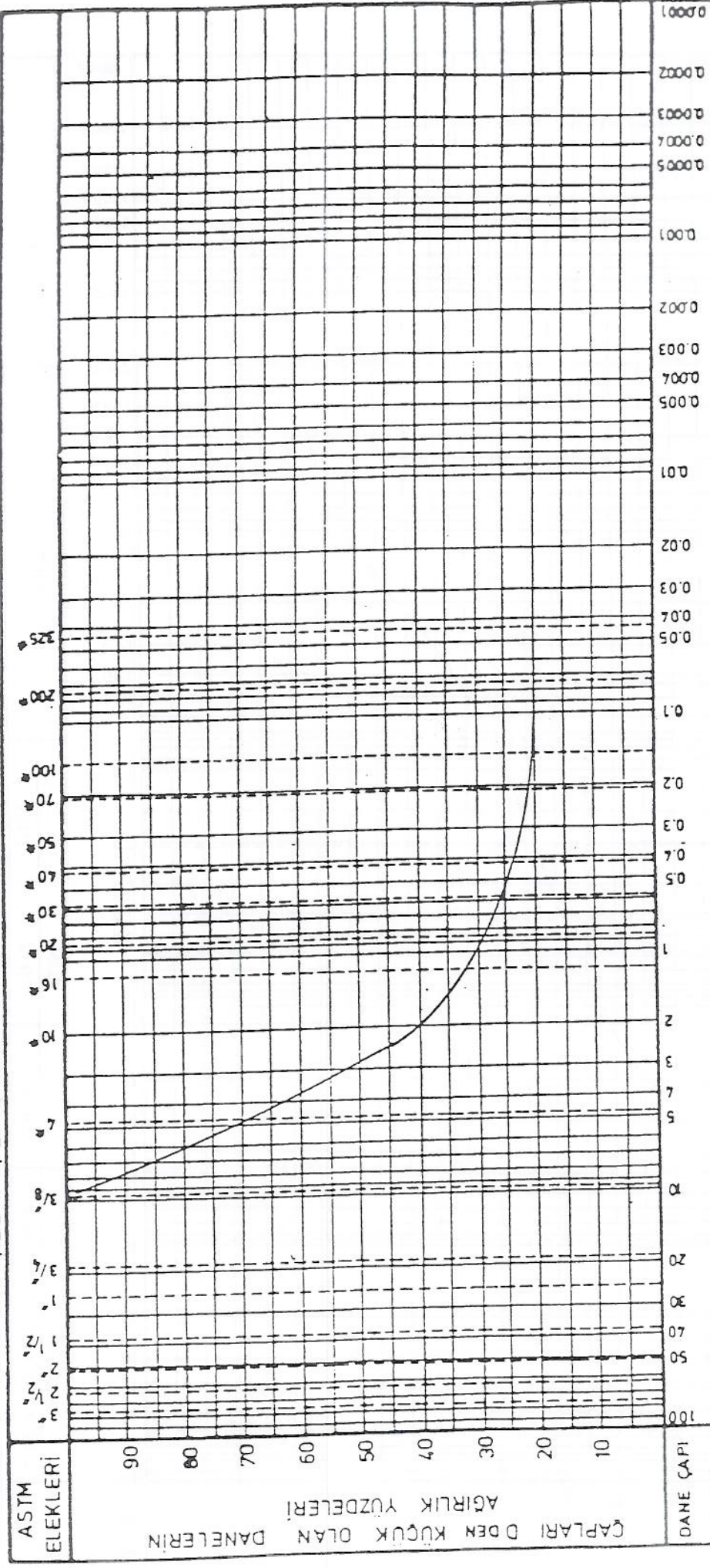
DENİZ SUYU SICAKLIKLARI
MARMARA BÖLGESİ

İstasyon Adı :	Meteorolojik Gözetim	Gözlem Tarihi	A Y L A R												
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yıllık
ÇANAKKALE	Ort.	19	9.2	8.4	8.5	10.9	15.4	19.8	22.7	23.6	21.8	18.3	15.0	11.9	13.3
	En Yüksek.	21	13.8	15.3	12.8	16.0	19.5	23.2	23.9	23.6	24.9	22.5	19.0	16.0	23.9
	En Düş.	21	0.3	0.6	5.0	7.5	11.0	16.2	19.3	21.0	17.2	14.4	9.8	6.8	0.3
FLORYA	Ort.	30	8.2	7.4	8.2	11.0	15.4	20.1	22.6	23.2	20.9	17.3	14.0	10.4	14.9
	En Yüksek.	30	16.8	14.2	19.6	19.9	23.5	27.0	28.3	28.0	24.8	24.0	23.0	17.2	31.8
	En Düş.	31	0.1	0.5	3.2	1.8	2.3	14.0	16.0	18.8	12.7	9.1	5.3	0.2	0.1
KUMKÖY	Ort.	16	7.3	6.0	6.0	9.2	14.1	19.6	22.5	23.2	21.3	17.9	14.2	10.3	14.3
	En Yüksek.	20	15.0	10.1	9.9	15.0	20.1	24.8	26.2	26.3	23.3	21.8	18.5	13.0	26.3
	En Düş.	20	2.8	1.0	1.2	3.8	7.0	14.0	15.0	10.5	15.0	11.9	8.0	5.4	1.0
TEKİRDAĞ	Ort.	3	8.6	6.7	7.3	10.6	17.1	20.6	22.8	23.7	21.8	17.7	14.3	10.8	13.1
	En Yüksek.	5	10.5	9.5	9.7	17.6	22.0	23.0	25.4	25.9	24.2	21.6	19.6	13.3	23.9
	En Düş.	5	4.6	5.0	6.0	6.7	10.8	17.6	20.5	21.5	19.3	14.3	11.7	8.9	4.6
YASSIADA	Ort.	10	9.9	8.1	7.8	10.1	13.2	17.9	20.8	22.1	20.4	18.0	15.7	12.0	14.6
	En Yüksek.	10	12.8	10.4	11.0	14.1	17.5	21.5	24.7	26.2	24.3	23.0	19.2	16.2	26.2
	En Düş.	10	6.9	3.8	5.7	7.4	8.7	11.4	17.7	17.8	17.0	13.5	7.2	8.0	3.8

GRANÜLOMETRİ EĞRİSİ.

DENEY TARİHİ: Mart 94

NUMUNENİN GELDİĞİ YER: Marmara Ereğlisi Enerji Üretim Tesisi
PROJENİN İSMİ: Ged Çalışması



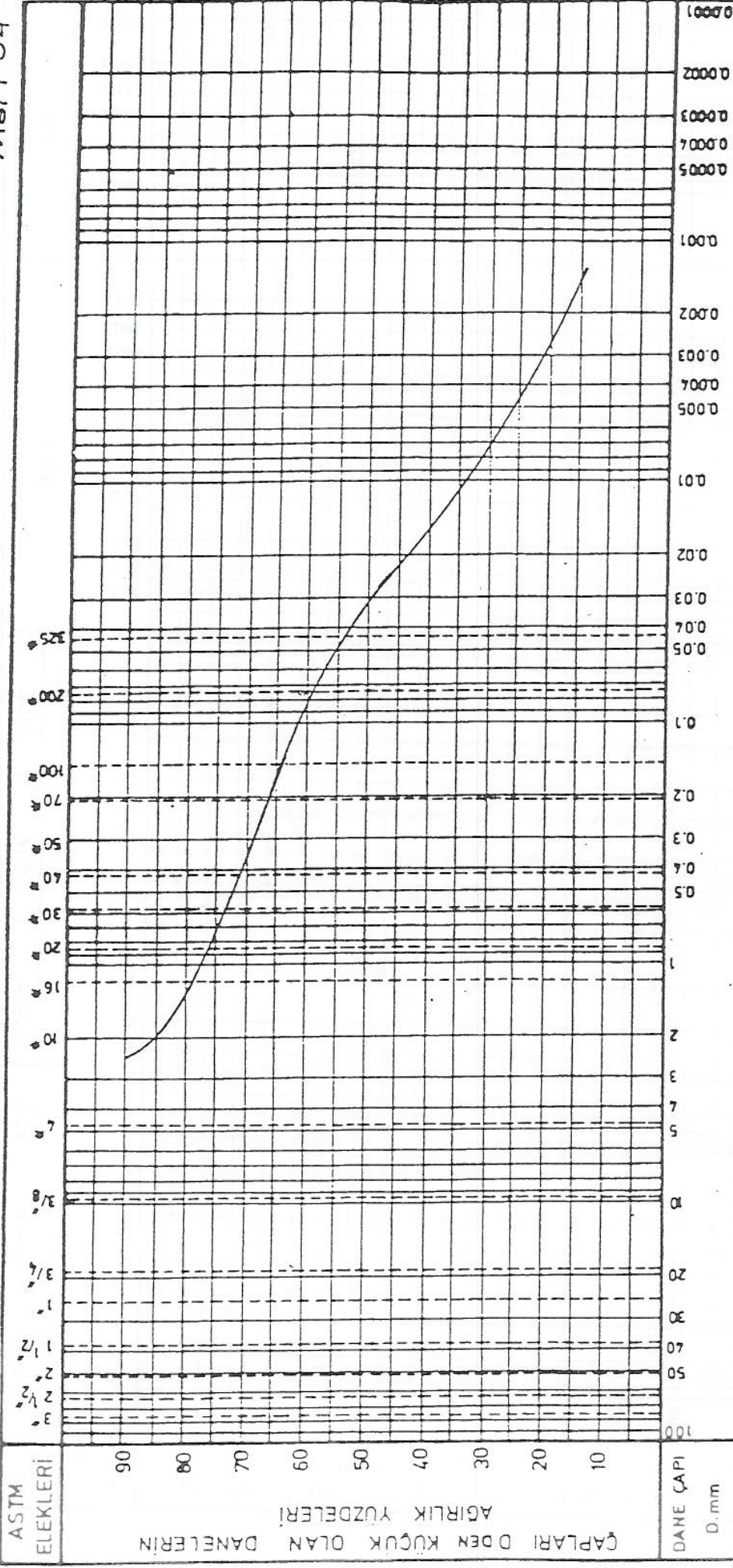
ZEMİN	ÇAKIL			KUM			SILT			KİL		
	KABA	ORTA	İNCE	KABA	ORTA	İNCE	D ₆₀	D ₃₀	C _u	C _c		
SONDAJ NO:	DERİNLİK - in			ZEMİN CİNSİ.			KİL %	D ₆₀	D ₃₀	C _u	C _c	
1	18.00			SM-SC			20					

Ru

GRANÜLOMETRİ EĞRİSİ.

NUMUNENİN GELDİĞİ YER: Marmara Ereglisi Enerji Üretim Tesisi
 PROJENİN İSMİ: Çed Çalışması

DENEY TARİHİ: Mart 94

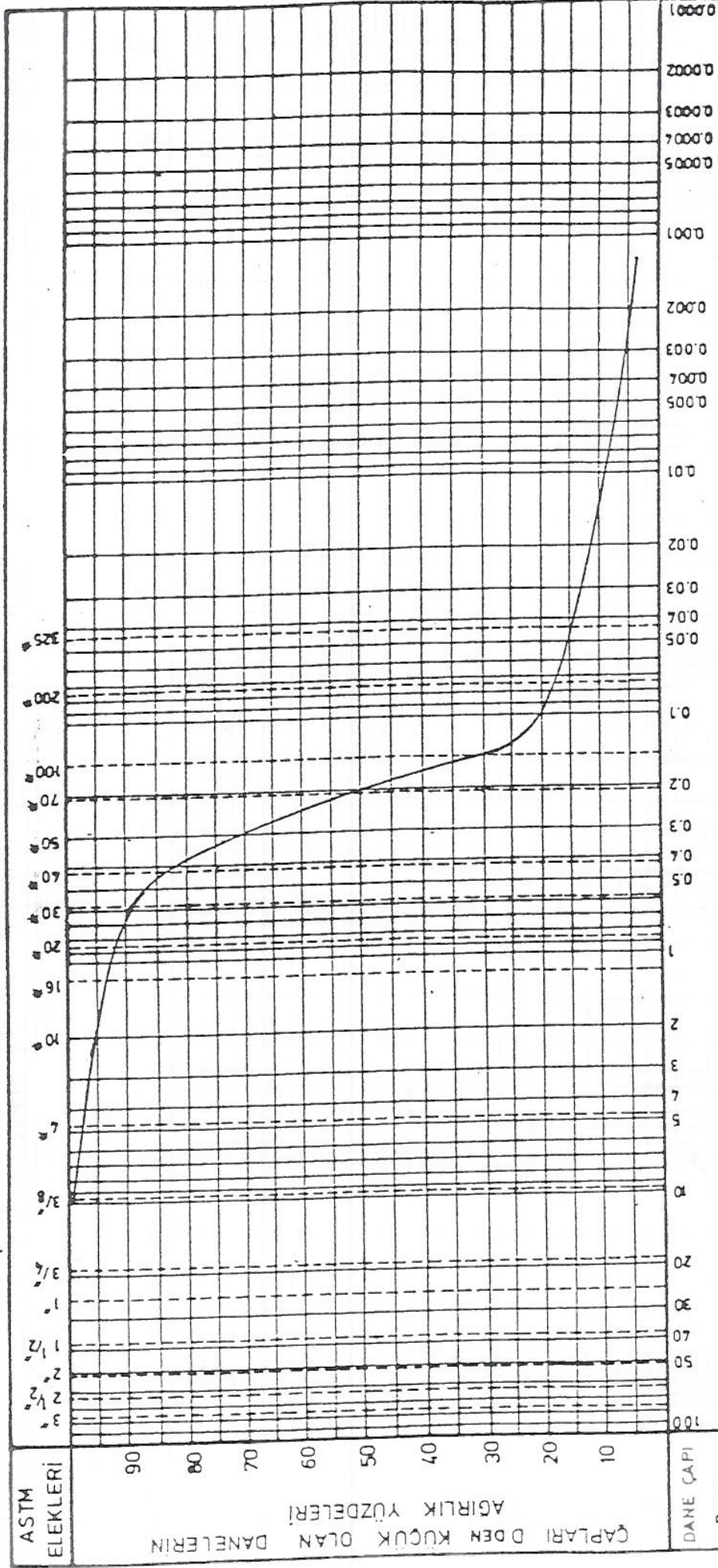


ZEMİN	ÇAKIL			KUM			SILT			KİL				
	KABA	ORTA	İNCE	KABA	ORTA	İNCE	D ₆₀	D ₃₀	D ₁₀	C _u	C _c			
SONDAJ NO:	DERİNLİK - in			ZEMİN CİNSİ.			KİL %	SILT %	KİL %	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
3	32,00			—			41	42	17					

GRANÜLOMETRİ EĞRİSİ.

NUMUNENİN GELDİĞİ YER: Marmara Ereğlisi Enerji Üretim Tesisi
PROJENİN İSMİ: Çed Çalışması

DENEY TARİHİ: Mart 94



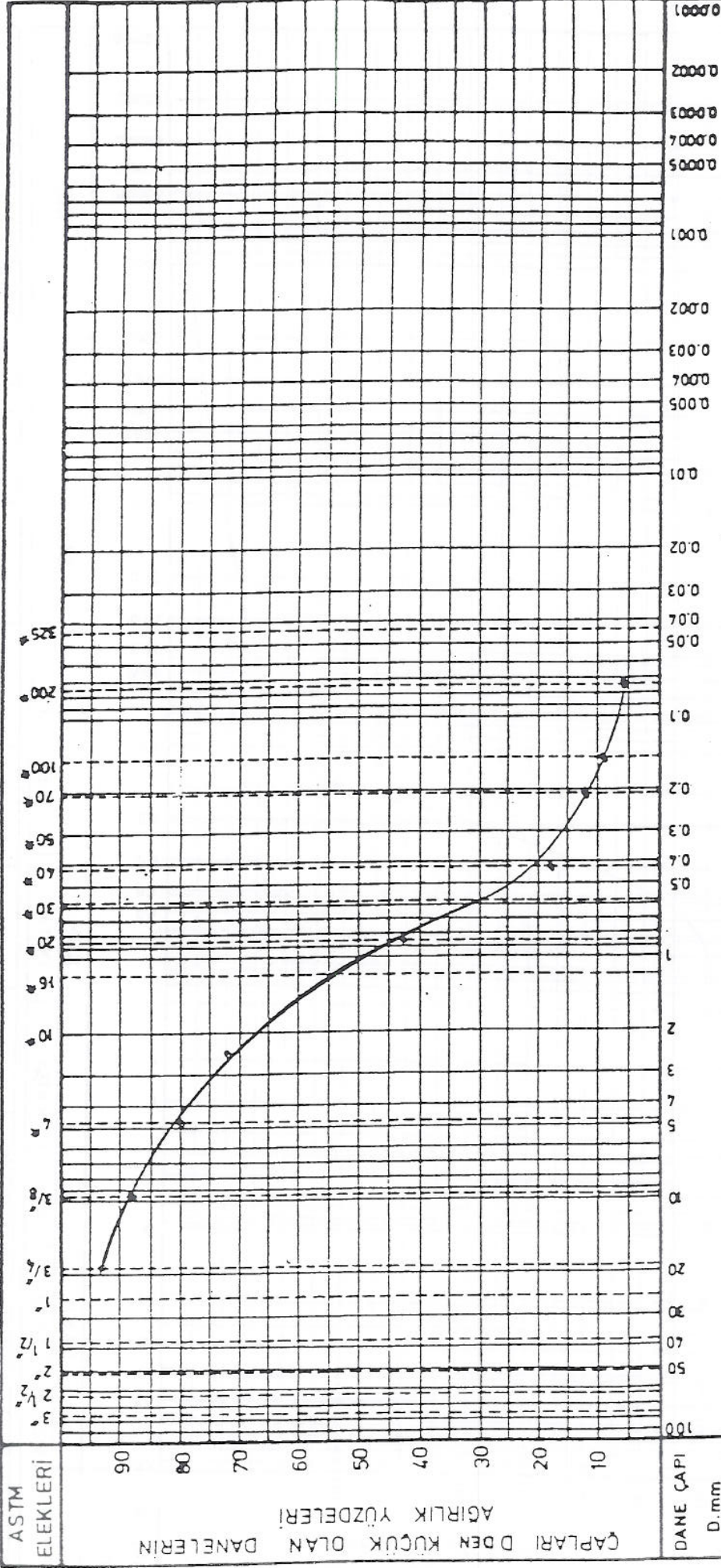
ZEMİN	ÇAKIL			KUM			SILT			KİL		
	KABA	ORTA	İNCE	KABA	ORTA	İNCE	D ₆₀	D ₃₀	D ₁₀	C _u	C _c	
SONDAJ NO:	ZEMİN CİNSİ:			ÇAKIL %	KUM %	SILT %	KİL %	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
5	18,00			2	80	14	4					

Ru
B3

GRANÜLOMETRİ EGRİSİ.

NUMUNENİN GELDİĞİ YER: Marmara Ereğlisi Enerji Üretim Tesisi
 PROJENİN İSMİ: Çed Çalınması

DENEY TARİHİ: Mart 94



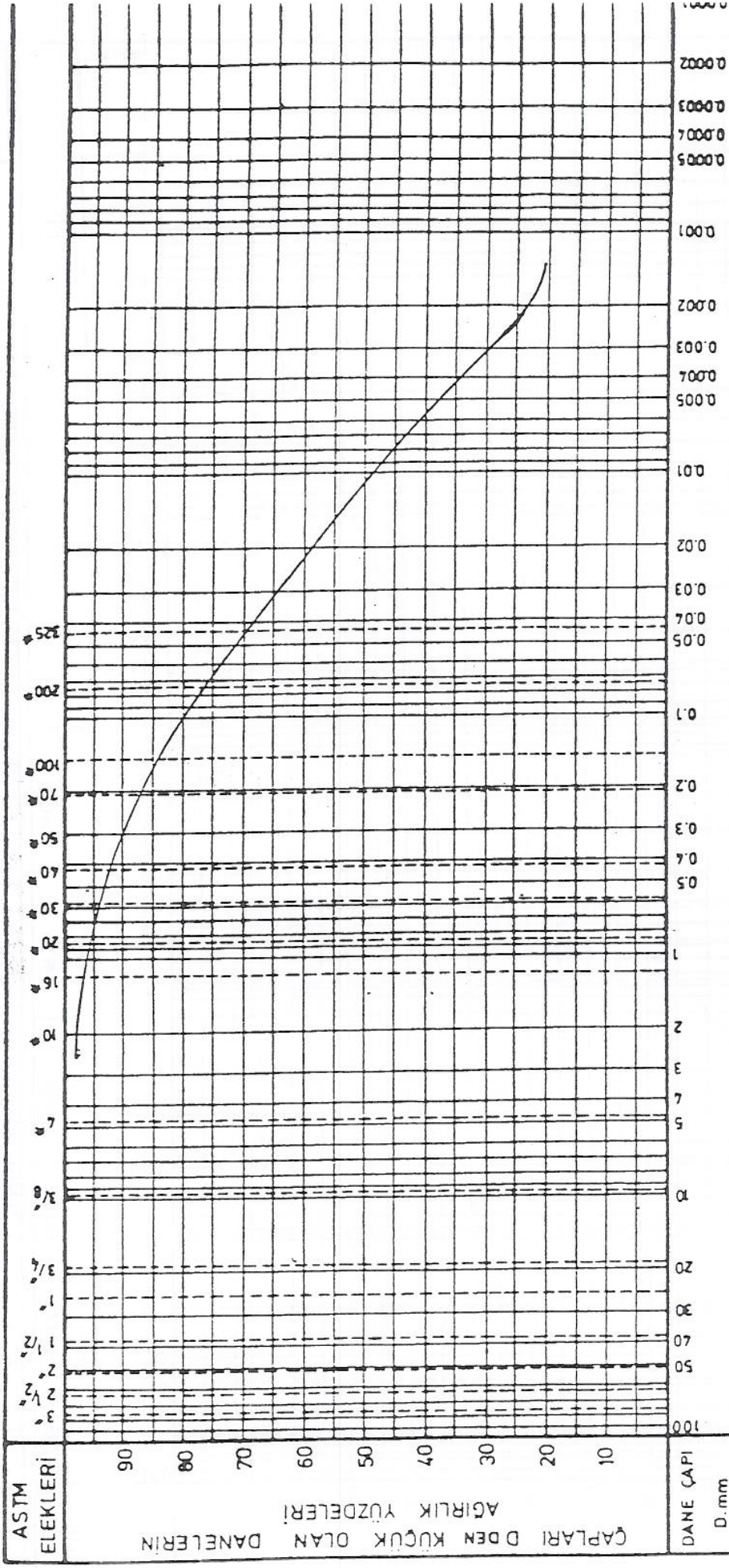
ZEMİN	ÇAKIL			KUM			SILT			KİL					
	KABA	ORTA	İNCE	KABA	ORTA	İNCE	D ₆₀	D ₃₀	D ₁₀	C _u	C _c				
SONDAJ NO:	DERİNLİK - m			ZEMİN CİNSİ.			ÇAKIL %	KUM %	SILT %	KİL %	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
9	8,00			SW/SM			19	75.		6					
				SW/SC											

REB

GRANÜLOMETRİ EĞRİSİ.

NUMUNENİN GELDİĞİ YER: Marmara Ereğlisi Enerji Üretim Tesisi
PROJENİN İSMİ: Çed Gölmesi

DENEY TARİHİ: Mart 94

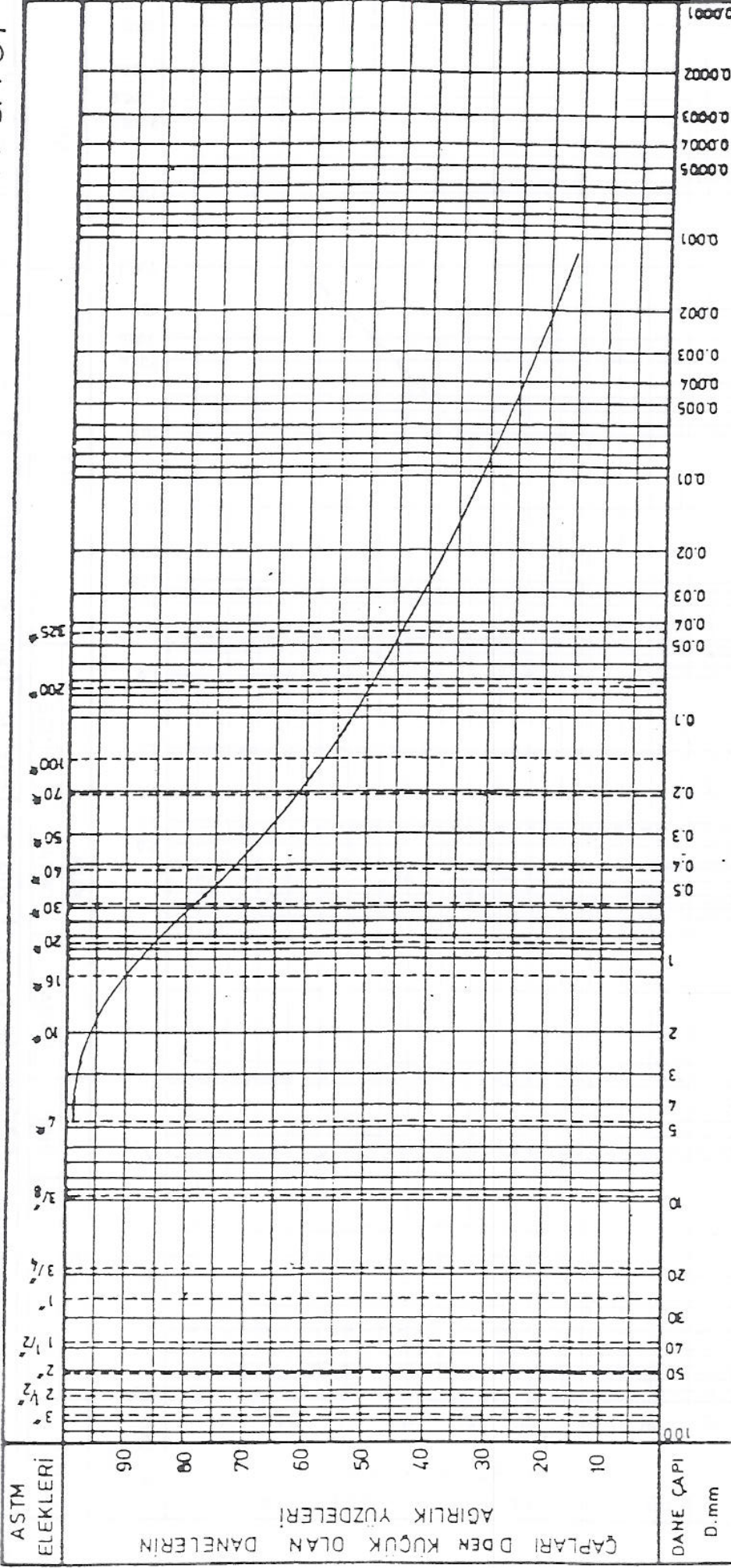


ZEMİN	ÇAKIL			KUM			SILT			KİL		
	KABA	ORTA	İNCE	KABA	ORTA	İNCE	D ₆₀	D ₃₀	D ₁₀	C _u	C _c	
SONDAJ NO:	DERİNLİK - 10			ZEMİN CİNSİ.			ÇAKIL %	KUM %	SILT %	KİL %		
10	43,00			—			23	54	23			

Rüç

GRANÜLOMETRİ EĞRİSİ.

NUMUNENİN GELDİĞİ YER: Marmara Ereğlisi Enerji Üretim Tesisi
 PROJENİN İSMİ: Ged Gölmesi
 DENEY TARİHİ: Mart 94



ZEMİN	ÇAKIL			KUM			SILT				KİL				
	KABA	ORTA	İNCE	KABA	ORTA	İNCE									
SONDAJ NO:	DERİNLİK - m			ZEMİN CİNSİ.			ÇAKIL %	KUM %	SILT %	KİL %	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
12	25,00			SM-SC			1	50	29	20					

Revizyonlar

ANNEX IV.1.7.1

Republic of Turkey
MINISTRY OF PUBLIC WORKS
STATE HYDRAULICAL WORKS
GENERAL DIRECTORATE
Planning and Project Office

No : B 09 1 DSI O 10 00 00 / 563.59 / 2836
Subject : Combined Cycle Power Plant Project

ANKARA
08/07/1994

UNIT INTERNATIONAL S.A.
Iran Cad 2/1
Kavaklidere / ANKARA

Ref : UNI-MAR Enerji Yatirimlari A.S. letter dated 27.6.1994

The project site of the Natural Gas Power Plant which is planned to be constructed at Marmara Ereglisi, has been reviewed and the following has been determined by DSI General Directorate.

The subject site is not in the scope of the irrigation project of DSI and is not subject to flood.

Please be informed.

For General Director
Huseyin YAVUZ
Head Of Department

Distribution:

- Governor of Tekirdag
(Directorate of Public Works)
TEKIRDAG
- UNIT INTERNATIONAL S.A.
Iran Cad 2/1 Kavaklidere / ANKARA
- DSI XI.Region Directorate/ EDIRNE

BAYINDIRLIK VE İSKÂN BAKANLIĞI
DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ
Etüd ve Plan Dairesi Başkanlığı

A N K A R A

/ /

0 8 TEMMUZ 1994

Sayı : B 09 1 DSİ 0 10 00 00 / 563.59 /
2836

Konu : Doğalgaz kombine çevrim enerji
santrali pro.

UNIT INTERNATIONAL S.A
İran Caddesi 2/1
Kavaklıdere/ANKARA

İLGİ; UNI-MAR Enerji Yatırımları A.Ş.nin 27.6.1994 tarihli dilekçesi ;

Tekirdağ ili Marmara Ereğlisinde kurulmak istenilen doğalgaz kombine çevrim enerji santrali tesislerinin ekli krokide işaretli yerine ilişkin ilgi dilekçe ile talep edilen DSİ Genel Müdürlüğü tespitleri aşağıda belirtilmiştir.

Söz konusu arazinin DSİ sulama projeleri kapsamına girmediği ve taşkına maruz olmadığı belirlenmiştir.

Bilginizi arz ve rica ederim.

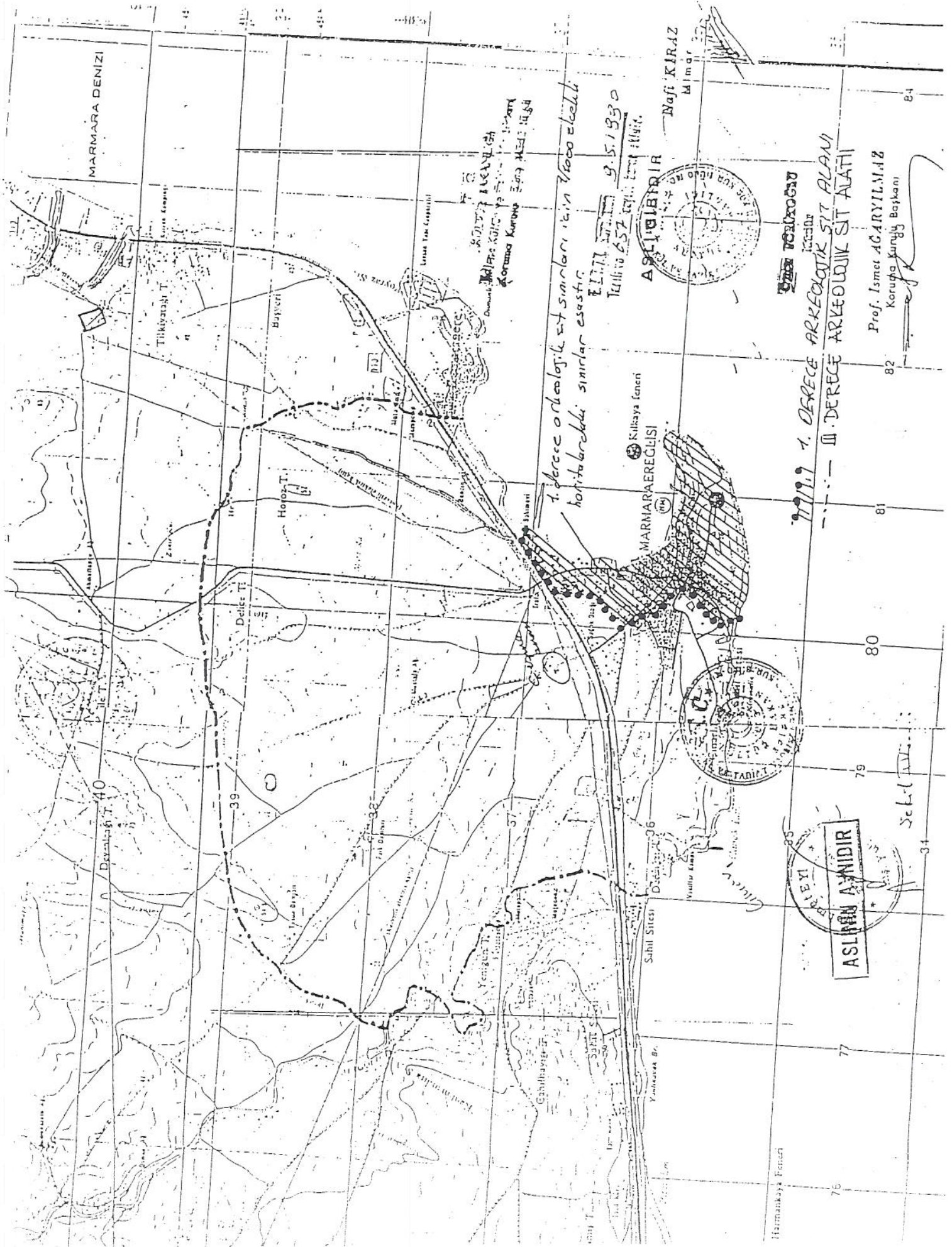


Hüseyin YAVUZ
Genel Müdür a.
Daire Başkanı

EKİ: Dilekçe ve Kroki

DAĞITIM:

- Tekirdağ Valiliği
(Bayındırlık ve İskan Müdürlüğü)
TEKİRDAĞ
- UNIT INTERNATIONAL S.A. İran
Caddesi 2 / 1
Kavaklıdere/ANKARA
- DSİ XI. Bölge Müdürlüğü/ EDİRNE



ANNEX IV.1.10.2

Republic of Turkey
MINISTRY OF CULTURE
EDIRNE
NATURAL and CULTURAL TREASURES
PRESERVATION COUNCIL DIRECTORATE

No : E.K.T.V.K.K. 59.08.203/628
Subject : Marmara Ereglisi
Combined Cycle Power Plant

EDIRNE
28/07/1994

To : Governor of Tekirdag (Directorate of Culture)

Ref : a) UNI-MAR Enerji Yatirimlari A.S. letter
dated 27.6.1994 and No L-940627-014
b) Tekirdag Governor (Directorate of Culture) letter
dated 22.7.1994 and No B.16.0.PER.4.59.00.00.720/1172

Natural Gas Power Plant which is planned to be realised at Tekirdag province, Marmara Ereglisi - Sultankoy, is not located within the boundaries of archaeological site, and no cultural treasure was encountered during surface survey according to the report of the Museum dated 22.7.1994 as enclosure of ref (b), so there is no drawbacks for the construction of the said power plant when the Law No 2863 for Preservation of Natural and Cultural Treasures considered.

Please be informed.

Omer YORUKOGLU
Director of Preservation Council

Distribution:

- Governor of Tekirdag
(Directorate of Culture)
- UNI-MAR Enerji Yatirimlari A.S.
Iran Cad 2/1 Kavaklidere / ANKARA

T. C.
KÜLTÜR BAKANLIĞI
EDİRNE KÜLTÜR ve TABİAT VARLIKLARINI
KORUMA KURULU MÜDÜRLÜĞÜ

SAYI : E.K.T.V.K.K. 59.08.203/628
KONU : Marmara Ereğlisi, Doğalgaz
çevrim enerji santrali.

EDİRNE
15.8.1994

TEKİRDAĞ VALİLİĞİ'NE
(Kültür Müdürlüğü)

- İLGİ : a) UNI-MAR Enerji Yatırımları A.Ş.'nin 27.6.1994 gün ve L-940627-014 sayılı yazısı.
b) Tekirdağ Valiliği (Kültür Müdürlüğü)'nin 22.7.1994 gün ve B.16.0.PER. 4.59.00.00.720/1172 sayılı yazısı.

Tekirdağ ili, Marmara Ereğlisi ilçesi, Sultanköy Mevkiinde yapılmak istenen Doğalgaz çevrim santralının, Marmara Ereğlisi Arkeolojik sit sınırları içinde kalmaması ve ilgi(b) yazı eki 22.7.1994 tarihli Müze raporunda da yapılar yüzey araştırmasında her hangi bir kültür varlığına rastlanmadığından, 2863 ve 3386 sayılı Kültür ve Tabiat Varlıklarını Koruma Kanunu açısından yapılmasında bir sakınca bulunmamaktadır.

Bilgilerinize arz ederim.

DAĞITIM :

Gereği :

- Tekirdağ Valiliği'ne
(Kültür Müdürlüğü)
- UNI-MAR Enerji Yatırımları A.Ş.
İRAN Caddesi 2/1-Kavaklıdere/ANKARA

Ömer YÖRÜKOĞLU
Koruma Kurulu Müdürü

ANNEX IV.1.10.2

Date of the Report : 22.7.1994
Subject of the Report : Marmara Ereglisi Sultankoy
Natural Gas Combined Cycle Power Plant

REPORT

(for Directorate of the Tekirdag Museum)

Edirne Preservation Council for Natural and Cultural Treasures letter dated 12.7.1994 and No 5/2 explains that UNI-MAR Enerji Yatirimlari A.S. wishes to realise a Natural Gas Combined Cycle Power Plant Project at Marmara Ereglisi-Sultankoy location and the Council requests that the project site be surveyed for historical and cultural site classification.

The mentioned area has been surveyed by ourselves by necessary investigations at site. Power Plant Site is located at the west of the alluvial plane filled by the Kinikli Stream and north of the Tilkiyatagi hill. The Site is at 4 km distance to Marmara Ereglisi and beyond the borders of the Marmara Ereglisi (Archaeological) Site which was determined by the decision of E.K.T.V.K.K (Edirne Natural and Cultural Treasures Preservation Council) dated 9.5.1990 and No 657.

No fragment that could be an evidence of any geological, anthropological, prehistoric, archaeological and art history was found during our surface survey. Therefore, an opinion was reached that, the power plant proposed to be constructed at this site, would not cause any inconvenience in respect to Laws No 2863 and 3386 for Preservation of Natural and Cultural Treasures.

Please be informed.

Onder OZTURK
Researcher

M.Akif Isin
Archaeologist
Director of Museum

Rapor Konusu: M. Ereğlisi Sultanköy doğalgaz çevrim santrali
Rapor Tarihi: 22.7.1994

R A P O R
(Tekirdağ Müzesi Müdürlüğüne)

Edirne Kültür ve Tabiat Varlıklarını Koruma Kurulunun 12.7.1994gün 5/2 sayılı yazılarında ilimiz Marmara Ereğlisi ilçesi Sultanköy mevkiinde Oni-mar Enerji Yatırımları A.Ş. tarafından doğalgaz kombine çevrim enerji santrali projesi gerçekleştirilmek istendiği belirtilerek santral sahasının tarihi ve arkeolojik sit açısından incelenmesi istenmektedir.

Söz konusu yer 21.7.1994 tarihinde tarafımızdan yerine gidilerek gerekli incelemeler yapılmıştır. Santral alanı Kınık deresi alüvyonlarının doldurduğu ovanın batı yamaçlarında Tilkidağı tepenin kuzeyindedir. Marmara Ereğlisi'ne 4km. mesafede ve E.K.T.V.K.Kca 9.5.1990 gün 657 sayılı kararı ile belirlenen Marmara Ereğlisi sit alanı sınırlarının dışında kalmaktadır.

Kurulmak istenen santral proje sahasında yaptığımız yüzey araştırması sonucunda tarih öncesi ve tarihi devirlere ait jeoloji, antropoloji, prehistoriya, arkeoloji ve sanat tarihi açılarından belge niteliği taşıyabilecek herhangi bir fragmana rastlanmamıştır. Dolayısıyla burada kurulmak istenen doğalgaz çevrim santrali inşaatının 2863 ve 3386 sayılı Kültür ve tabiat varlıkları koruma kanunları açısından engel nitelikler taşımayacağı kanaatine varılmıştır.

Bilgilerinize arz ederiz.

Önder Öztürk
Araştırmacı

M. Akif İşin
Arkeolojik
Müze Müdürü

ANNEX IV.1.11.1

**Republic of Turkey
MINISTRY OF FORESTRY
Presidency of Research and Coordination Council
Research and Environmental Affairs Office**

No : ACD.2-CED.4-1223
Subject : 500 MW Combined Cycle Power Plant

28/07/1994

UNIT INTERNATIONAL S.A.
Iran Cad. No:2/1
Kavaklidere 06700 ANKARA

Ref : Your Letter dated 27.6.1994 and No L-940627-011

Your ref. request for the 500 MW Natural Gas Power Plant project which will be realized at Marmara Ereğlisi, has been reviewed.

The mentioned site is not found within the forestry areas.

Please be informed.

For the Minister

Hasan TURAN
President of the Council

T.C.
ORMAN BAKANLIĞI

Araştırma Planlama ve Koordinasyon Kurulu Başkanlığı
Araştırma ve Çevre Dairesi Başkanlığı

Sayı : AÇD.2-ÇED.4-1223

28/07/1994

Konu : 500 MW Doğalgaz Kombine
Çevrim Enerji Santrali

UNIT INTERNATIONAL S.A.
İran Caddesi 2/1
Kavaklıdere 06700 ANKARA

İLGİ: 27.6.1994 tarih ve L-94062/-011 sayılı dilekçeniz.

Marmara Ereğli'sinde gerçekleştirmeyi planladığınız 500 MW Doğalgaz Kombine Çevrim Enerji Santrali Projesine ilişkin ilgede kayıtlı dilekçeniz incelenmiştir.

Sözkonusu proje sahası orman rejimine giren alanlar içerisinde yer almamaktadır.

Bilgilerinizi rica ederim.


Hasan TURAN
Bakan-a.
Kurul Başkanı

ANNEX IV.1.15.1

**Republic of Turkey
MINISTRY OF TROUISM
General Directorate of Investments**

No : PL. Dai. Bsk/ 591040002
Subject : Tekirdag-Marmara Ereglisi
Combined Cycle Power Plant
1461-3255-15396

ANKARA
7 July 1994

UNIT INTERNATIONAL S.A.
(Uni-Mar Enerji Yatirimlari A.S.)
Iran Cad. No:2/1
Kavaklidere 06700 ANKARA

Ref : Your Letter dated 27.6.1994 and No L-940627-013

In your ref. letter, you request our consent after evaluation of the project site of 500 MW Natural Gas Power Plant which will be realized at Tekirdag, Marmara Ereglisi.

The mentioned site is not found within the Trouism sites and centers boundaries which had been declared by the Law No 2634 and the a/m request is not found inconvenient by our Ministry providing that, application be made in accordance with legislation in force.

Please be informed.

For the Minister

Gurkan ERTAS
Investments
Deputy Gen. Mngr.

T. C.
TURİZM BAKANLIĞI
Yatırımlar Genel Müdürlüğü

ANKARA

Sayı : PL.Dai.Bşk/591040002.....
Konu : Tekirdağ-Marmara Ereğlisi
Doğalgaz Kombine çevrim
enerji santrali hk.

7 TEMMUZ 1994

1461-3255 -15396

UNIT INTERNATIONAL S.A'NA
(Unı-Mar Enerji Yatırımları A.Ş.)
İran Cad. No:2/1
Kavaklıdere 06700 ANKARA

İLGİ: 27.6.1994 gün ve L-940627-013 sayılı yazınız.

İlgi yazı ile; Tekirdağ İli, Marmara Ereğlisinde gerçekleştirelecek olan 500 MW. Doğalgaz Kombine Çevrim Enerji Santrali proje sahasının turizm açısından değerlendirilerek görüşümüz sorulmaktadır.

Söz konusu alan; 2634 sayılı Yasa uyarınca ilan edilen turizm alan ve merkezleri içinde yer almamakta olup, yürürlükteki mevzuat çerçevesinde uygulama yapılmak koşuluyla anılan talep Bakanlığımızca sakıncalı görülmemektedir.

Bilgilerini ve gereğini rica ederim.

BAKAN ADINA



Gürkan ERTAŞ
Yatırımlar Genel Müdür V.

ANNEX V.1.3.1.

**SEA WATER COOLING SYSTEM
INTAKE and DISCHARGE FACILITIES
DESIGN**

PROJECT MARMARA UNIT

Design Engineering for Cooling Water Intake and Cooling Water Outlet (Discharge) Facilities

ref.: - Design of 1994/02/01

- Meeting with ITU in Istanbul on 1994/04/29

- Draft of the EIA-Report, April 1994

The design of the cooling water intake as a bell-mouth intake at about - 10 m (sea level = ± 0 m) as documented in the design of 1994/02/01 is the final design and accepted in the EIA-Report.

The design of the cooling water outlet (discharge) as a normal outlet building (see design of 1994/02/01) following article 31 of the "Regulations Related to the Turkish Environment Law" seems to the EIA experts not to be adequate to the limits, that in summer the difference of water temperature at the surface level should not be more than $+ 1^{\circ}\text{C}$ (in winter: $+ 2^{\circ}\text{C}$). On the other hand the articles in the "Regulations Related to the Turkish Environment Law" give no clear decision that cooling water could not be treated as "Industrial waste water" (see article 31 of the Regulations).

The experts of the EIA-Study anticipate cooling water discharge as a diffuser construction (see draft of the EIA-Report). The knowledge about diffusers for cooling water disposals is well based after many advanced cases and well concentrated in the summarized contribution by G.H. Jirka, "Multiport Diffusers for Heat Disposal: A Summary" (Journal of the American Society of Civil Engineers, Hydraulics Division, Vol. 108, 1982, HY 12, pp. 1425-1468). From there, it is appropriate to carry out the cooling water discharge as a staged line diffuser (see also the draft of the EIA-Report).

In the actual case the following present values are assumed:

- difference of recircled cooling water temperature compared with sea water temperature: $\Delta T = + 10^{\circ}\text{C}$
- flow rate of cooling water: $Q_0 = 8 \text{ m}^3/\text{s}$
- port elevation (HD) of the single nozzles (see also EIA-Report): 5 m under sea level
- mean time (95% ambient flow velocity: $v_a = 0,1 \text{ m/s}$.

With these conditions and in consideration of the summarized experience about diffusers (see G.H. Jirka above and K. Cederwall "Buoyant Slot Jets into Stagnant or Flowing Environments", Report No. KH-R-25, 1971, California Institute of Technology, USA) the following design values will lead to the adequate application in the present case:

- length of the stage diffuser: $L_D = 160 \text{ m}$
- distance of single pipe nozzles: $l = 2,0 \text{ m}$
- diameter of single pipe nozzles: $d = 0,25 \text{ m}$
- initial dilution: $S_1 = 10$
- number of nozzles: $n = 81$
- ejected velocity at the nozzles: $v_e \approx 2 \text{ m/s}$

Interaction takes place between the single jets coming out of the stage diffuser to realize the mixing of discharge water ($T^\circ\text{C} = T_0 - 10^\circ\text{C}$) with the ambient water ($T_0^\circ\text{C}$). The momentum flux ratio will be:

$$\frac{v_a^2}{v_e^2} \cdot \frac{H \cdot L_D}{n \cdot \frac{\pi d^2}{4}} = 0,5.$$

The source Froude number with $\Delta\rho = \rho_e - \rho_a$ (suffixes (e) for ejection fluid and (a) for ambient fluid) is:

$$\frac{v_a^3}{\Delta\rho} \cdot \frac{L_D}{g \cdot v_e \cdot n \cdot \frac{\pi d^2}{4}} = 0,67.$$

Both values after K. Cederwall will lead to a small deflected surface wedge of the mixing plume. After G.H. Jirka the minimum first dilution S_1 will be

$$S_1 = 0,67 \left(\frac{1-H}{\frac{\pi d^2}{4}} \right)^{1/2} = 9,57.$$

The value $S_1 = 10$ given in the present design above, leads to a mixing on the safe side and, in the light of a stability criterium by G.H. Jirka to a stable near field.

With the design values given above the mathematical model on the basis given by K. Cederwall and also by G.H. Jirka, which is ready for a run in the ITU (see draft of the EIA-Report, annex, Thermal Discharge and Dispersion Model) the avoidance for less than $\Delta T = +1^\circ\text{C}$ in the surface level could be proven.

The output of the discharge stage diffuser should be a line source with the length $L_D = 160$ m and an ejection velocity $v_e = 2.0$ m/s. To secure these conditions the diffuser pipe is designed as a step by step reduced diffuser pipe diameter, starting with $D_0 = 2.5$ m and ending with $D_E = 0.4$ m (Fig. 2).

The top view of the discharge line is shown in Fig. 1. The 50° bend is able to reach the situation that the diffuser is located perpendicular to the ambient flow direction and far enough from the intake facility. The height of the axis of the diffuser pipe has to be 5.0 m below the sea level. The port nozzles are located in distances of $l = 2.0$ m along the diffuser pipe and directed parallel to the sea bottom (Fig. 3).

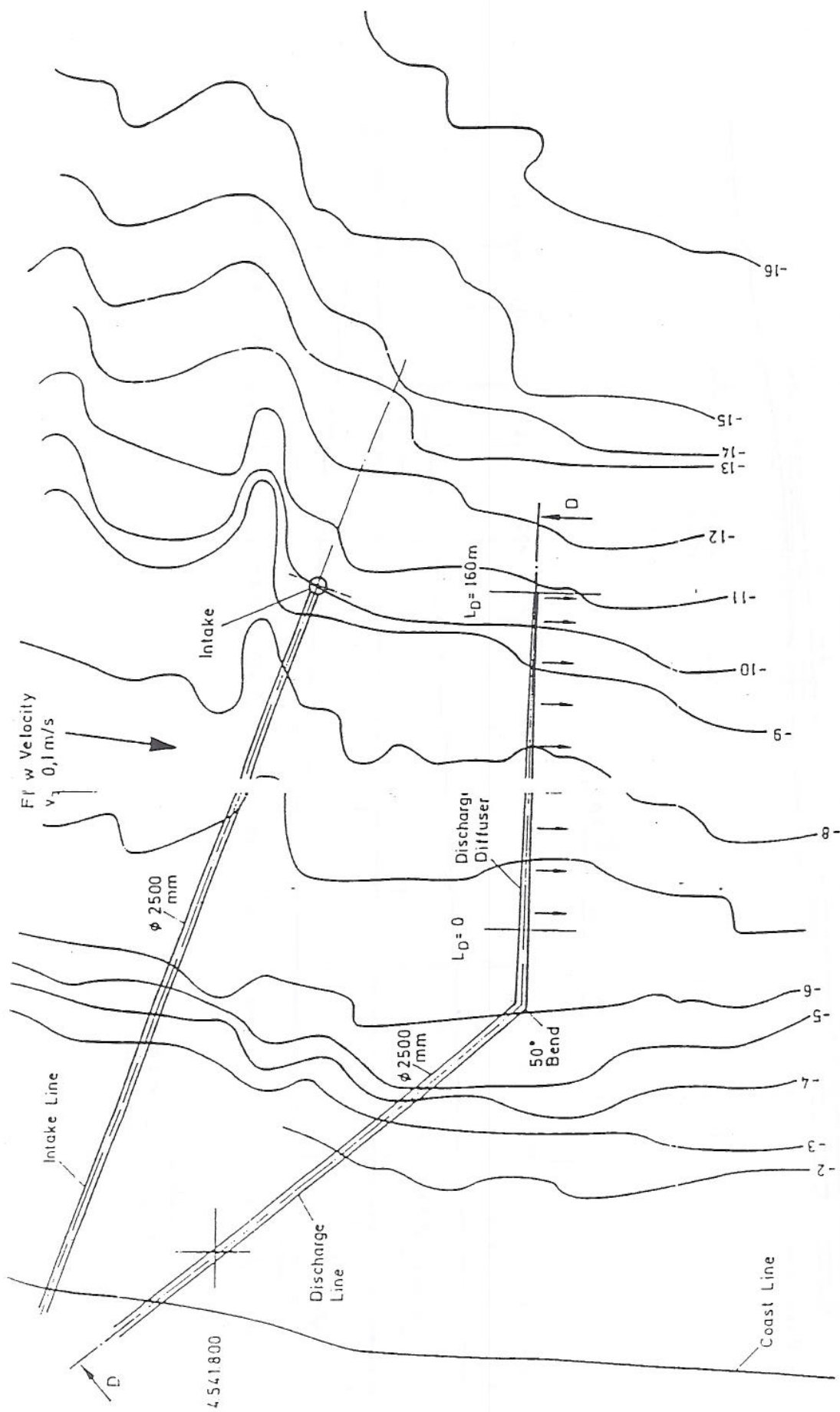


(A. Richter)

Reduction of Diffuser Pipe Diameter

from length [m]	to length [m]	Δl [m]	ϕ [mm]
0	11	11	2450
11	21	10	2350
21	29	8	2300
29	41	12	2200
41	53	12	2100
53	63	10	2000
63	73	10	1900
73	83	10	1800
83	97	14	1650
97	107	10	1500
107	119	12	1350
119	127	8	1200
127	137	10	1050
137	145	8	850
145	151	6	700
151	160,5	9,5	400

Reduction of the diffuser pipe diameter (see Fig. 2) means a constructive approximation on pipe velocity within the diffuser as a value of almost 1,6 m/s. Transition from one pipe diameter to the other is to be built by a conical section with a length of 0,5 m (see Fig. 3).



Scale: 1:2000

582.800

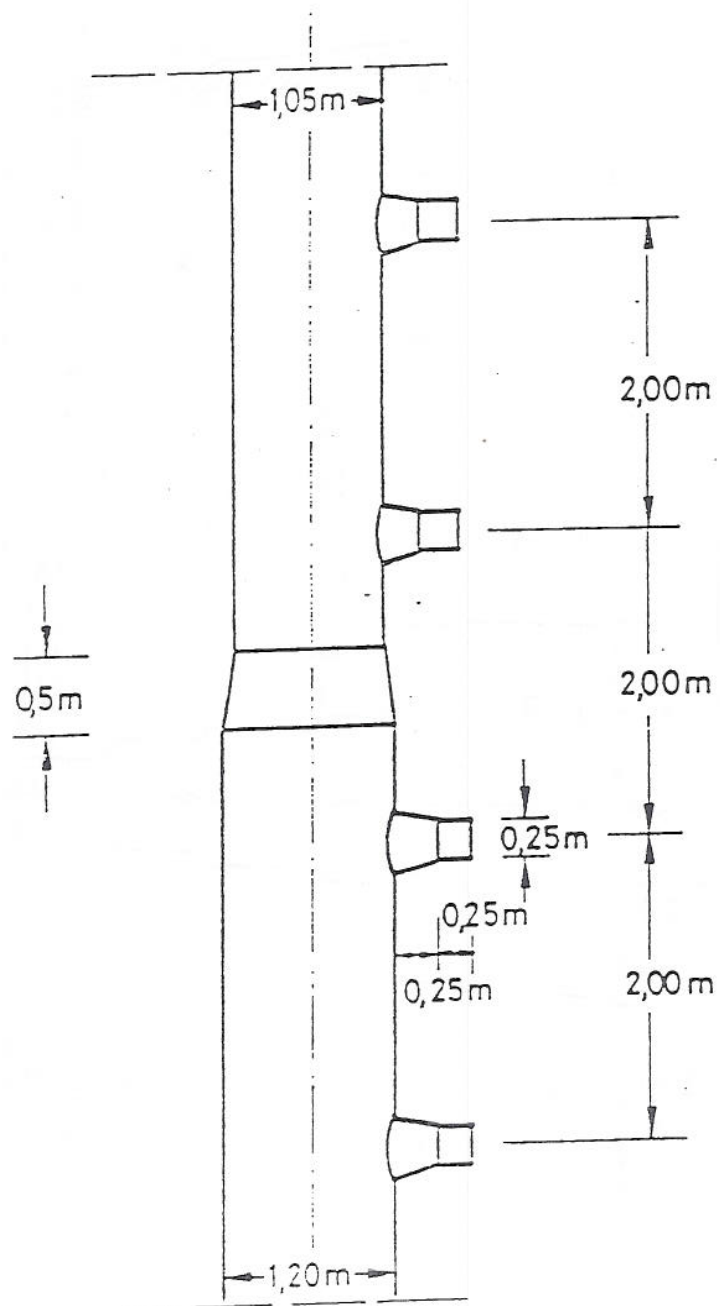
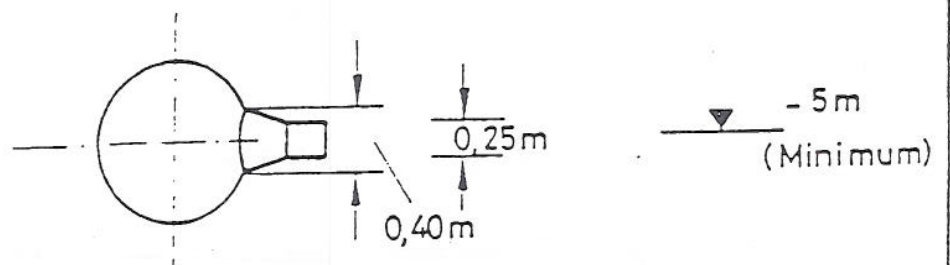
4.541400

Intake and Discharge Diffuser
Plan View

9401

1

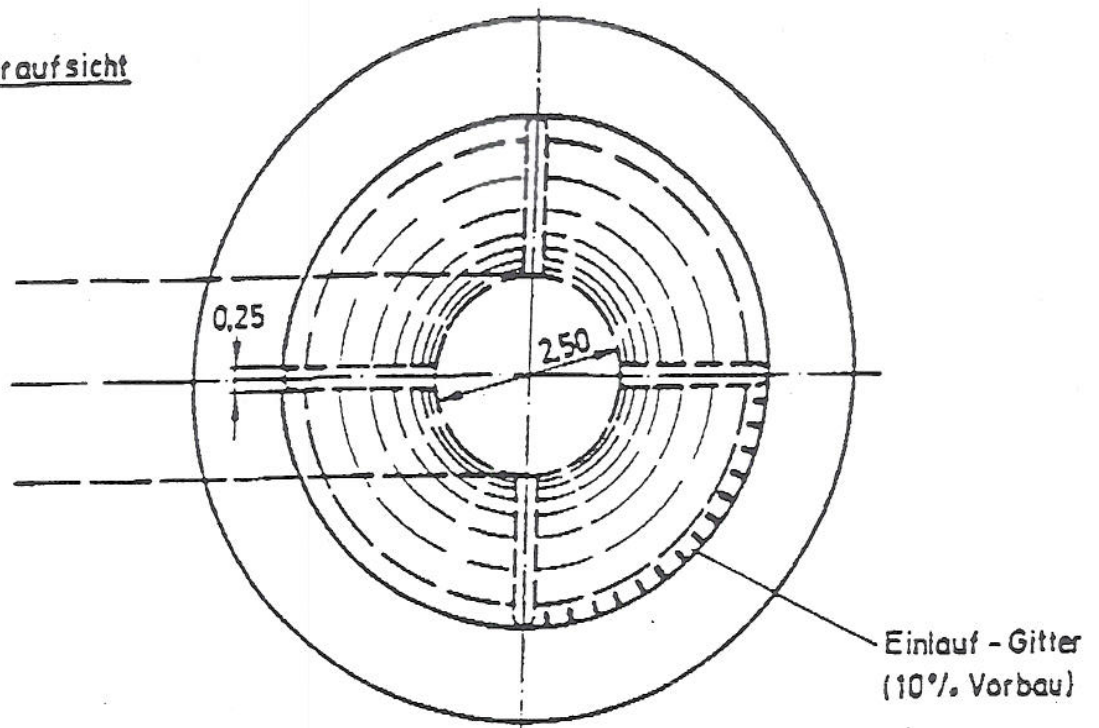
Detail Nozzle and Pipe Reduction



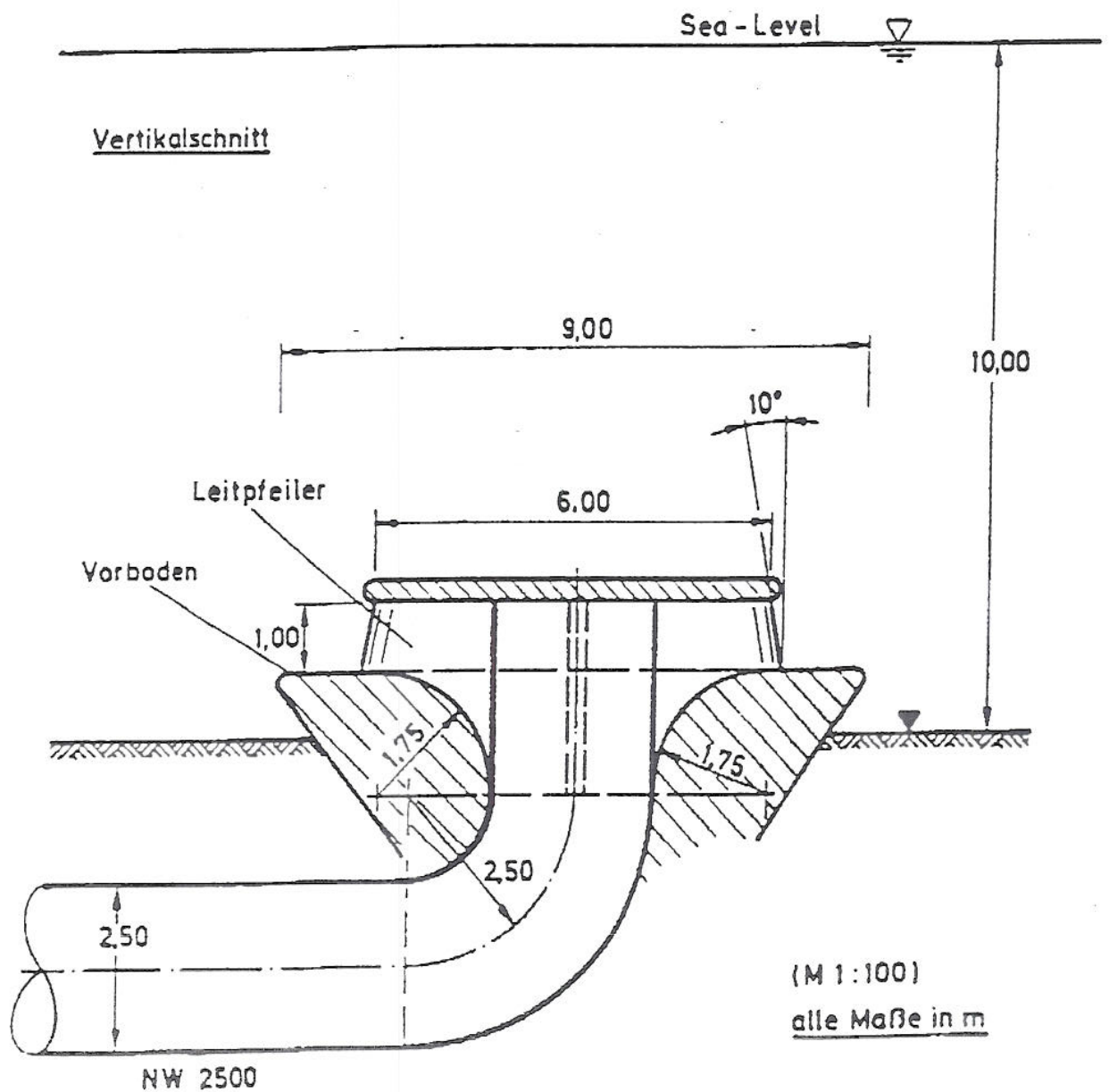
Scale: 1 : 50

Detail Nozzle

Draufsicht



Vertikalschnitt



WATER INTAKE Top View and Section

ANNEX V.2.10.1.

**MEASUREMENT PROCEDURE
for
EMISSION COMPLIANCE**

1. Introduction

The field testing procedure for emission compliance described in the following sections, applies to the specific conditions of a cogeneration power plant with steam or water injection for wet NOx-control.

Emissions considered for the compliance test are:

- Nitrogenoxides NOx (NO, NO₂)
- Carbon monoxide CO
- Unburned hydrocarbons UHC
- Carbon dioxide CO₂
- Oxygen O₂

SO₂ emission numbers, originated from the Sulphur content of the burned fuel will be calculated, because the SO₂ standards are to meet by selection of fuels with a limited Sulphur content.

Other source emissions, such as particulate matter, methane, reactive organics and ammonia will be tested, depending on the particular requirements of the permit to operate

Additionally, ambient conditions

- barometric pressure,
- temperature,
- rel. humidity

are recorded.

Documentation of turbine operating conditions will be performed and will include as a minimum :

- power output
- fuel consumption
- analysis of the fuel
- steam or water injection rate
- compressor discharge
- exhaust gas temperature

Emission testing will be conducted while running engine performance test. Within this time at least 2 * one-hour test runs at the required load points are executed. The water-to-fuel ratio schedule, necessary to demonstrate NOx emission compliance, will be optimized during commissioning phase.

The test procedures are in accordance with significant aspects of "40 CFR part 60/Subpart GG/App.A", "VDI-Richtlinien" and "CIMAC - exhaust emission measurements".

(1) Sampling probe:

In absence of significant flue gas stratification, a multi-hole sampling probe (stainless steel 316 or equivalent), which allows integrated sampling, is used for gas extraction. The distribution of the holes is such, that equal areas are covered. Slight stratifications do not effect the results, if the emission numbers are adjusted to 15% O₂ or expressed as specific emissions.

(2) Calibration valves:

(8)

Three-way valves assemblies are used to direct the sample - or calibration gas to the analyzers. One heated assembly is located directly downstream the probe and filter to check the whole system, particularly regarding material interferences, influence of the moisture trap and for leaks. It is also capable of blocking the sample gas flow and introducing filtered ambient air when the measurement system is in the stand-by mode.

(3) Heated sampling line:

(11)

A teflon or stainless steel (type 316 or equivalent) sampling line is used to transport the gases to the analyzers. The gas sample in the "heated section" (11) is maintained at approx. 180° C in order to prevent condensation of moisture and UHC with higher boiling points.

(4) Filter:

Particles are removed by a heated glass fiber filter, upstream the calibration valve assembly.

(5) Sampling pump:

(6)

A nonreactive, leak-free and heated (approx. 180° C) pump is used to push the gas sample through the system at a flow rate of approx. 10 l/min, which is sufficient to provide the analyzers with the required gas quantity and to ensure short residence time of the gas in the sampling system. Furthermore an overflow and pressure regulating system (6) is used to ensure a reduced gas flow through the water trap for reliable water condensation at the required temperature.

(9) Moisture trap:

A moisture trap, designed to reduce the dew point of the gas sample to < 3° C is installed for the determination of CO, O₂ and CO₂ and NO_x (on "dry basis").

(10) Analyzers:

The concentration of different gases are determined with continuously working analyzers.

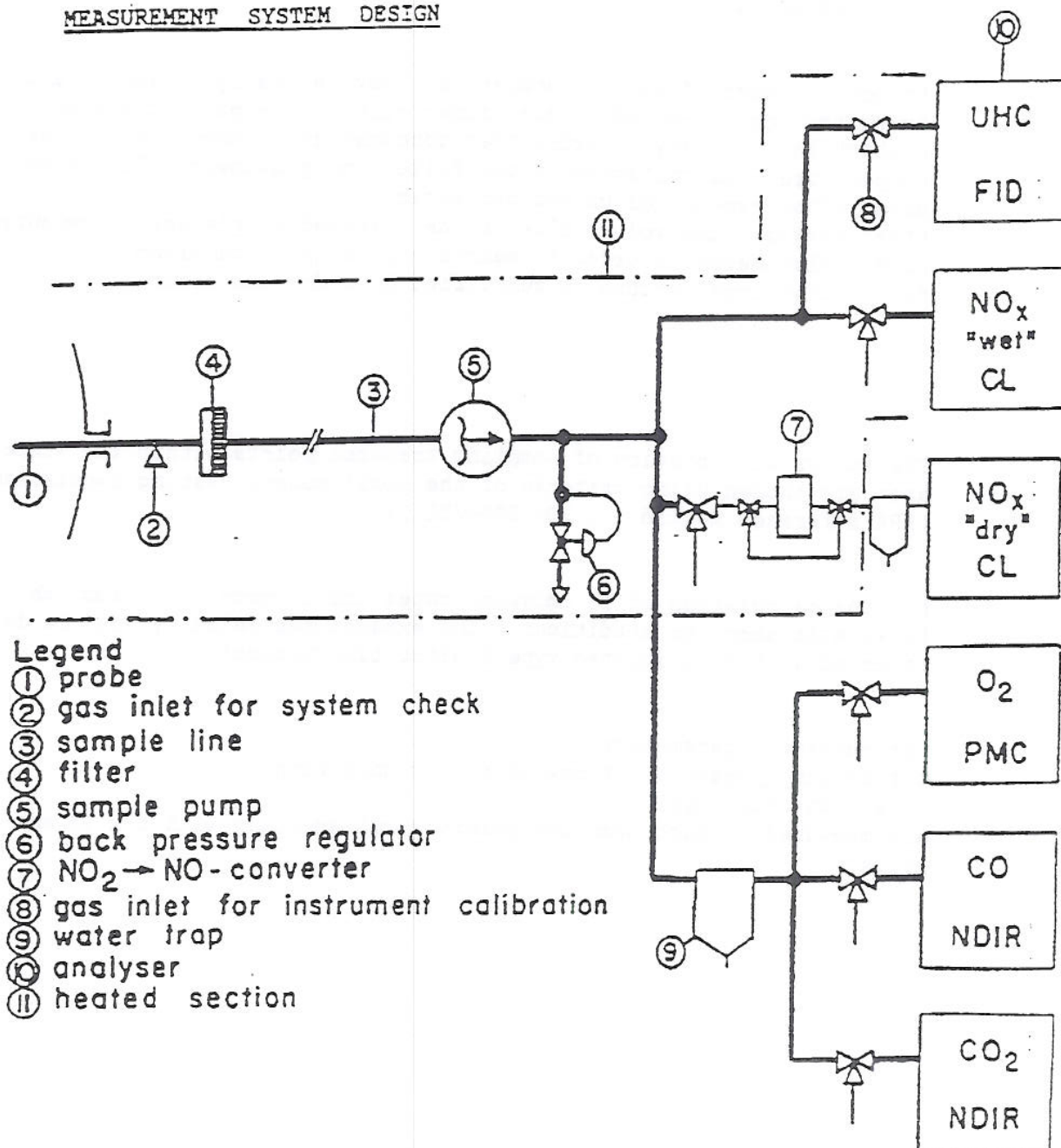
2. MEASUREMENT SYSTEM

2.1 Monitoring of gaseous emissions

The equipment required to extract, transport and analyze the gas sample constitute the "measurement system". A scheme of the measurement system is shown in Figure 1, the essential components are described below.

Fig. 1

MEASUREMENT SYSTEM DESIGN



2.2 PARTICULATE MATTER (PM)

Depending on the particular source testing procedures in different states, 2 methods are employed, which differ mainly in the position and temperature of the PM - collecting filter :

- a.) filter in-stack , with temperatures corresponding to the stack temperature (EPA method 17, VDI 2066/Bl.2/Bl.3)
- b.) filter out-stack , with a temperature maintained at 120°C (EPA method 5)

At both methods, flue gas samples are isokinetically extracted and drawn through pre-weighted glass fiber filter. The particulate matter - which includes any material that condense at or above the filter temperature - is collected on the filter and gravimetrically determined after removal of uncombined water.

After drying , the volume flow of the filtered sample gas is measured with a flow meter in order to maintain isokinetic sampling conditions. The total volume is quantified by a dry gas meter.

The number and location of sampling traverse points within the stack area are chosen using criteria of the local source testing regulations (EPA reference method 1 , VDI 2066/Bl.1).

For the calculation of PM emission rates and in order to establish isokinetic sampling conditions , the exhaust gas velocity will be determined with a calibrated type S pitot tube assembly.

The necessary parameters :

- o flue gas -pressure, -temperature, -composition
 - o velocity head (Δp)
- are measured at each sampling points simultaneously with the PM analysis.

MINISTRY OF AGRICULTURE AND RURAL AFFAIRS
General Directorate of Protection and Control

Number: CKHD-53-73

Subject : Marmara Ereglisi, Natural Gas
 Power Plant

ANKARA

05180 22/03/94

UNI-MAR ENERJI YATIRIMLARI A.S.
Izci Sok. No:18, 06700 G.Osmanpasa / ANKARA

Ref: Your Letter Dated 11.03.1994

Explaining cooling of the 500 MW BOT CCPP to be constructed and operated by your consortium will be done by sea water, you ask from our Ministry that, the permissible temperature difference between sea water that will be taken from and given to the sea, as well as the permissible Chlorine quantity (mg/l) to be used in cooling water.

All sea water of the Istanbul city, Marmara Sea and Bosphourus are announced to be aquatic products' production area, in Official Gazettes No. 18496 dated 21/8/1984 and No. 19481 dated 8/6/1987. Aquatic products law No. 1380 item 20 prohibits discharge of harmful substances to the waters. Regulation of Aquatic Products item 11 gives the list of harmful substances that prohibited to be discharged to the waters. Regulation Appendix -5 List , Title: Physical Properties explains ;, Wastes that increase the temperature of the river more than 2°C/day, or the temperature of the sea, lake, reservoir that it joins, more than 0.5 °C, can not be discharged to the aquatic products production areas.

Below please find the chlorine limits for the receiving mediums and the in the wastes, as stated in our legislation;:

Receiving Medium	Tolerated quantity (mg/l)	Waste water /Upper limits (mg/l)
Chlorine	170	Free Chlorine (CL2) 0.5
Chlorine (free)	0.01	
Chlorophenolls	0.02	
Monochlorophenolls		
O-Chlorophenol	0.015	
P-Chlorophenol	0.06	
M-Chlorophenol	0.06	

T.C
TARIM ve KÖYİŞLERİ BAKANLIĞI
Koruma ve Kontrol Genel Müdürlüğü

Sayı:ÇKHD-53-73
Konu;Marmara Ereğlisi Doğalgaz
Santrali

A N K A R A

21.03.94 03100

MIMAG İNŞAAT VE TİCARET ANONİM ŞİRKETİNE
İzci Sok.No:18 06700 Gaziosmanpaşa/ANKARA

İlgi:11.03.1994 tarihli yazınız.

Tekirdağ İli,Marmara Ereğlisinde,şirketinizinde ortak olduğu Konsorsiyum tarafından Yap-İşlet-Devret modeli çerçevesinde tesis edilip işletilecek olan 500 MW kurulu gücündeki Doğal Gaz Kombine Çevrim Santralinin soğutulmasının deniz suyu ile yapılacağı belirtilerek,denizden alınacak su ile verilecek su arasındaki sıcaklık farkı ile sözkonusu tesiste soğutma suyunda kullanabilecek klor miktarı(mg/l) Bakanlığımızdan istenmektedir.

İstanbul İlinin tüm karasuları,Marmara Denizi ve İstanbul Boğazı 21 Ağustos 1984 tarih ve 18496 sayılı Resmi Gazetede ve 8.6.1987 tarih ve 19481 sayılı Resmi Gazetede Su Ürünleri üreme ve istihsal yeri ilan edilmiştir.1380 sayılı Su Ürünleri kanununun 20 inci maddesi sulara zararlı madde dökülmesi yasağını getirmektedir.Su ürünleri yönetmeliğinin 11 inci maddesinde sulara dökülmesi yasak olan zararlı maddeler yer almaktadır.Yönetmeliğin Ek-5 sayılı listesinde yer alan fiziksel özellikler başlığı altındaki sıcaklık maddesinde; yılın herhangi bir ayında döküntü veya akıntı olarak karıştığı akarsuyun sıcaklığını bir günde 3°C den,döküldüğü deniz,Göl ve rezervuarın sıcaklığını 2°C den,bir saatte 0.5°C den fazla değişikliğe uğratan atıkların su ürünleri istihsal sahalarına dökülemez demektedir.

Mevzuatımızda alıcı ve atık sulardaki klor limit değerleri ise aşağıdaki şekildedir.

These quantities have importance for the aquatic product are and the protection of and continuation of the aquatic products. Item 36; para d of law No 3288 related to law no 1380, explains penalties for industries cause pollution.

Please be informed.

Signed
For the Minister
Dr. Ismail MERT
General Manager

Alıcı Ortam	Kabul Edilen (tolere) Değeri mg/l	Atık Su	Üst Sınırlar mg/l
-Clorur	170 mg/l	-Serbest Klor(Cl)	0.5 mg/l
-clor(serbest)	0.01 mg/l		
-Chlorphenoller	0.02 mg/l		
Monochlorphenoller:			
O-Chlorphenol	0.015 mg/l		
P-Chlorphenol	0.06 mg/l		
M-Chlorphenol	0.06 mg/l		

Bu değerler su ürünleri üreme ve istihsal sahaları ile su ürünlerinin korunması ve devamlılığının sağlanması açısından önem taşımaktadır. 1380 sayılı Su Ürünleri kanununa değişiklik getiren 3288 sayılı kanunun 36. maddesinin d bendinde cezai hükümler yer almakta olup kirleticiliği tespit edilen sanayi kuruluşları hakkında kanuni işlem yapılmaktadır.

Bilgilerinizi rica ederim.


Dr. İsmail MERT
Bakan a.
Genel Müdür Yardımcısı

ANNEX V.4.3.2.

**THERMAL DISCHARGE
and
DISPERSION MODEL**

THERMAL DISCHARGE AND DISPERSION MODEL

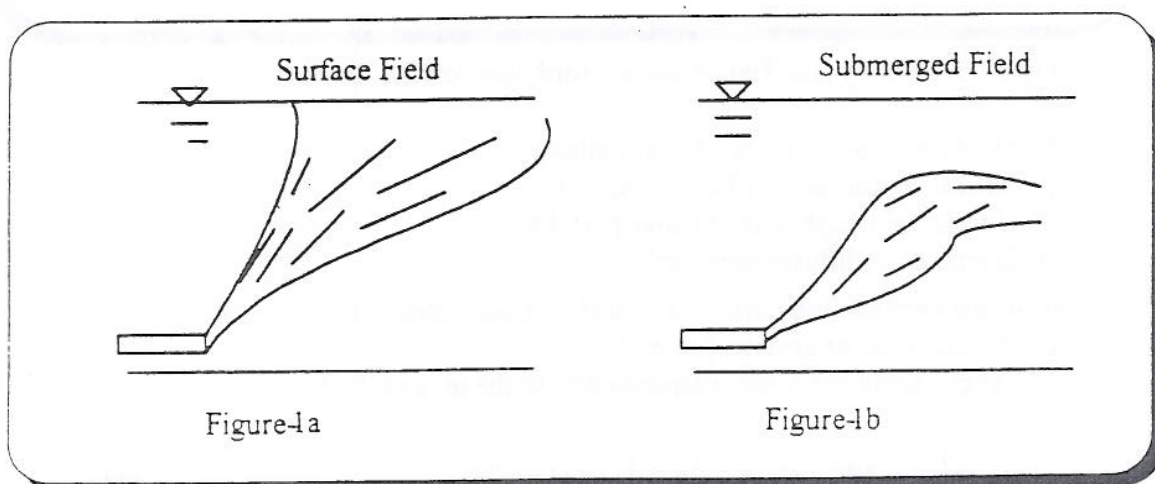
Analysis of the Thermal Model (THERMOD) from the Dilution Point of View

In marine discharge projects, the design is made either according to the primary dilution or total dilution. The important types of dilution are primary dilution (S_1), which takes place between the diffuser port and the level that wastewater field is formed, secondary dilution (S_2), which is horizontal and a result of turbulence diffusion and longitudinal dispersion, tertiary dilution, S_3 , in which the concentration of the biodegradable matter decreases. In thermal discharge projects, because the temperature difference on the receiving media surface is important, temperatures obtained by studying primary and secondary dilutions are taken into consideration during design. Since sea water is used as cooling water, it is assumed that there are no biodegradable pollutants and therefore, tertiary dilution is neglected.

According to the Water Pollution Control Regulation, the temperature difference in the receiving media upon thermal discharge should not exceed 2°C in winter and 1°C in summer. Therefore a model is necessary to obtain these temperature changes. The THERMOD model prepared in İ.T.Ü. Environmental Engineering Department makes it possible to draw equivalent temperature curves showing the temperature differences on the surface.

Wastewater Field Types

Density varies with temperature and salinity. In this type of discharge, density differences will be observed because of the differences in temperature and salinity of wastewater and receiving media. Therefore, the wastewater may spread in the receiving media in various ways. The water jet rises with its own velocity and longitudinal dispersion; the density changes because of salinity and temperature. If the sea water density is greater than the jet's density, thermally discharged water will rise to the surface (Figure-1a). If the sea water density is less than the jet's density, the jet will rise up to the level in which the sea water density will be greater and it will spread at this level, forming a submerged field (Figure-1b).



PRIMARY DILUTION

Many studies have been carried on primary dilution and formulation has been made in the best way possible.

Theoretical methods given are supported by experimental studies..

Cederwall Equations

The quantitative definition of turbulent jet mixing in homogenous water media is given by Abraham (1),(2) and Cederwall. Cederwall's practical methods are given below:

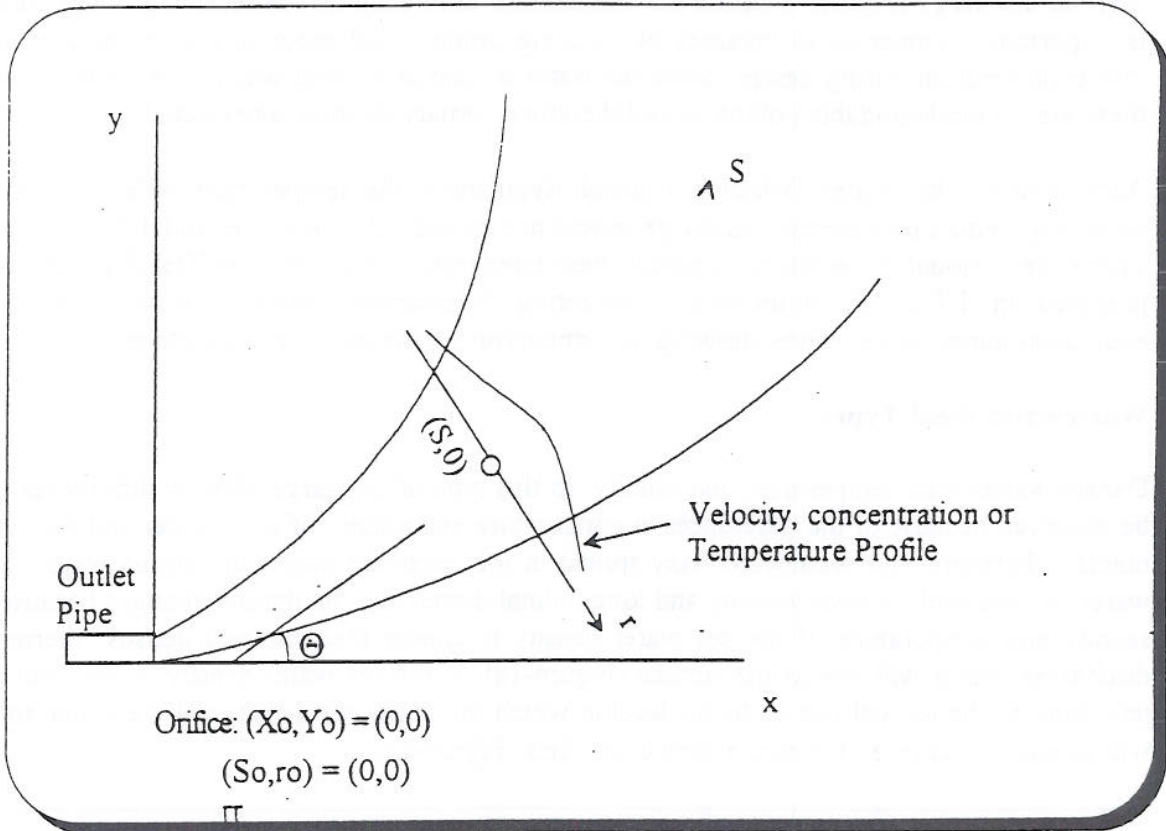


Figure 2 Velocity and Temperature Distribution on the Jet Axis

S : Dilution of wastewater [dimensionless]

Y_0 : Vertical length from diffuser port, [m]

x : Horizontal length from diffuser port, [m]

D : Diameter of diffuser port, [m]

Θ : Angle between the horizontal and the jet axis, [degrees]

g : Acceleration of gravity, [m/s²]

r : Length along the x-axis perpendicular to the jet axis, [m]

$$\frac{Y_0}{D} < 0.89F \rightarrow S_m = 0.54.F.Y_0^{0.44}(D.F)^{-0.44} \quad (1)$$

$$\frac{Y_0}{D} \geq 0.89F \rightarrow S_m = 0.54.F.(0.38Y.D^{-1}.F^{-1} + 0.68)^{1.67} \quad (2)$$

Continuity Equation

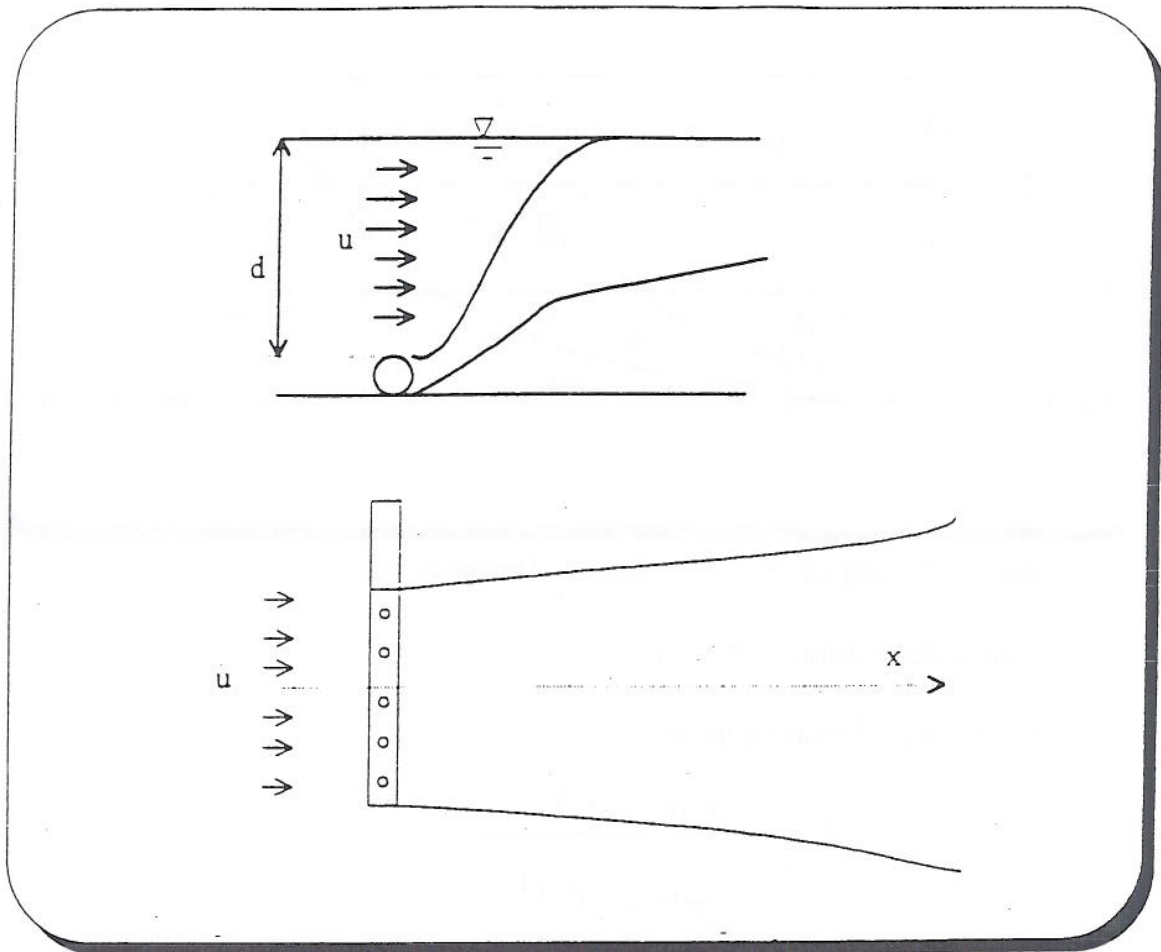


Figure-3: Current Propagation According to Primary and Secondary Dilution

A simplified equation to calculate primary dilution which occurs as a result of currents is

$$(S_1 - 1) \cdot Q = b \cdot d \cdot u \quad (3)$$

$$S_1 = (b \cdot d \cdot u + 1) \cdot Q^{-1} \quad (4)$$

b: Diffuser length (Perpendicular to the Current), [m]

d: Thickness of wastewater field, [m]

u: Current velocity, [m/sn]

Q: Discharge flowrate [m³/sn]

Dilution Equations for the Stratified Environment

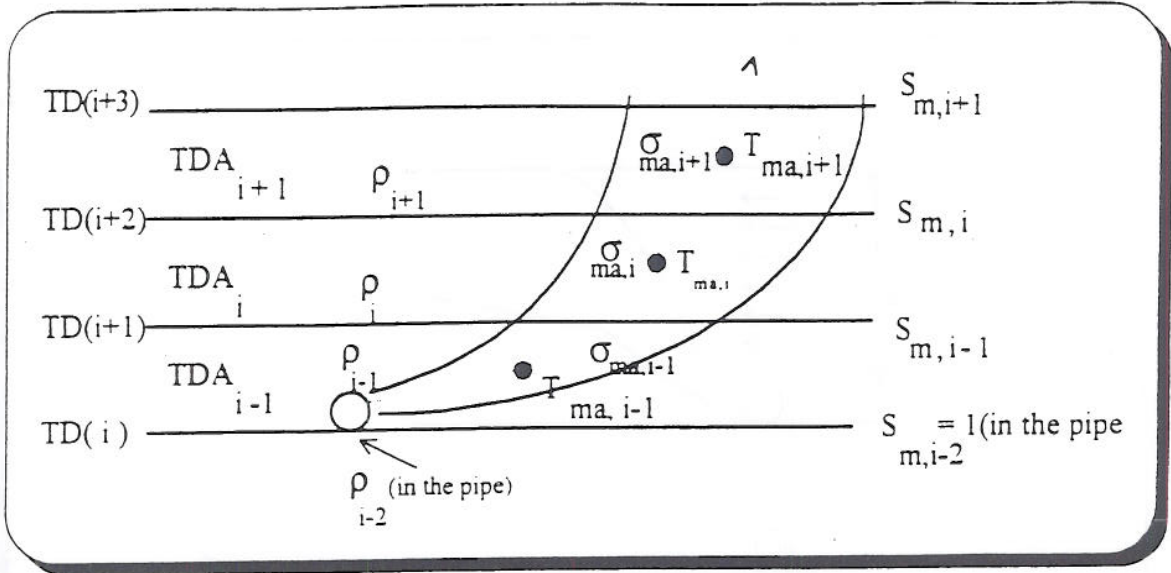


Figure-4: Primary Dilution in the Thermal Discharge Model

$$\text{Oceanographic density } (\sigma_i) = \rho_i - 1000 \quad (5)$$

Calculation of Froude's number;

$$F_i = \frac{V_j(i * \rho_0)^{0.5}}{\left[g.D \sum_{j=1}^i (\rho_{aj} - \rho_0) \right]^{0.5}} \quad (6)$$

The average dilution (S_{ma}) can be calculated from the S_m obtained from the Cederwall Equations.

$$S_{ma} = 2 \cdot S_m \quad (7)$$

Calculation of oceanographic density on the jet axis for (i)th layer ;

$$\sigma_{m,i} = \frac{\sigma_{m,i-1} + (S_{m,i} * S_{m,i-1}^{-1} - 1)\sigma_{a,i}}{S_{m,i} * S_{m,i-1}^{-1}} \quad (8)$$

Calculation of average oceanographic density on the jet axis for the (i)th layer:

$$\sigma_{ma,i} = \frac{\sigma_{ma,i-1} + (S_{ma,i} * S_{ma,i-1}^{-1} - 1)\sigma_{a,i}}{S_{ma,i} * S_{ma,i-1}^{-1}} \quad (9)$$

When the continuity equation to calculate average sea water temperatures related to the primary dilution is written, an equation similar to the oceanographic density equation appears;

$$T_{ma,i} = \frac{T_{ma,i-1} + (S_{ma,i} * S_{ma,i-1}^{-1} - 1)TDA_i}{S_{ma,i} * S_{ma,i-1}^{-1}} \quad (10)$$

- TD(i) : Sea water temperature in the (i-1)th layer , [°C]
- TD(i+1) : Sea water temperature in the (i)th layer, [°C]
- TDA_i : Average sea water temperatures in (i -1)th and (i)th layers, [°C]
- T_{ma,i} : Average sea water temperature , related to dilution, after mixing [°C]
- ρ_i : Sea water density in (i)th layer, [kg/m³]
- ρ_{aj} : Average sea water density in section j starting from diffuser port level
- ρ₀ : Density of discharged water, [kg/m³]
- (σ_{mi}) : Oceanographic density of jet axis in the (i)th layer, [kg/m³]
- (σ_{ai}) : Average of oceanographic densities in (i)th and (i+1)th layers, [kg/m³]
- (σ_{ma,i}) : Average density resulting from mixing in the (i)th layer, [kg/m³]
- S_{mi} : Dilution on the jet axis, [dimensionless]
- S_{ma,i} : Average dilution in the jet, [dimensionless]
- V_j : Outlet velocity of discharged water from diffuser, [m/sn]
- F_i : Densimetric Froude's number, [dimensionless]

SECONDARY DILUTION

After the discharged water reaches the surface or the level at which it will stay, it moves with the currents. Further mixing and dilution takes place between the sea and the wastewater field as a result of the natural turbulence in the sea. Dilution through diffusion with turbulence is called secondary dilution.

Thermal Discharge and Dispersion Model (THERMOD), gives the equations containing the functions which are solved by Eddy and Brooks. An original sub-program is designed to simulate the erf function in the calculation of the turbulence diffusion. The assumptions used in these equations are given in Figure 5.

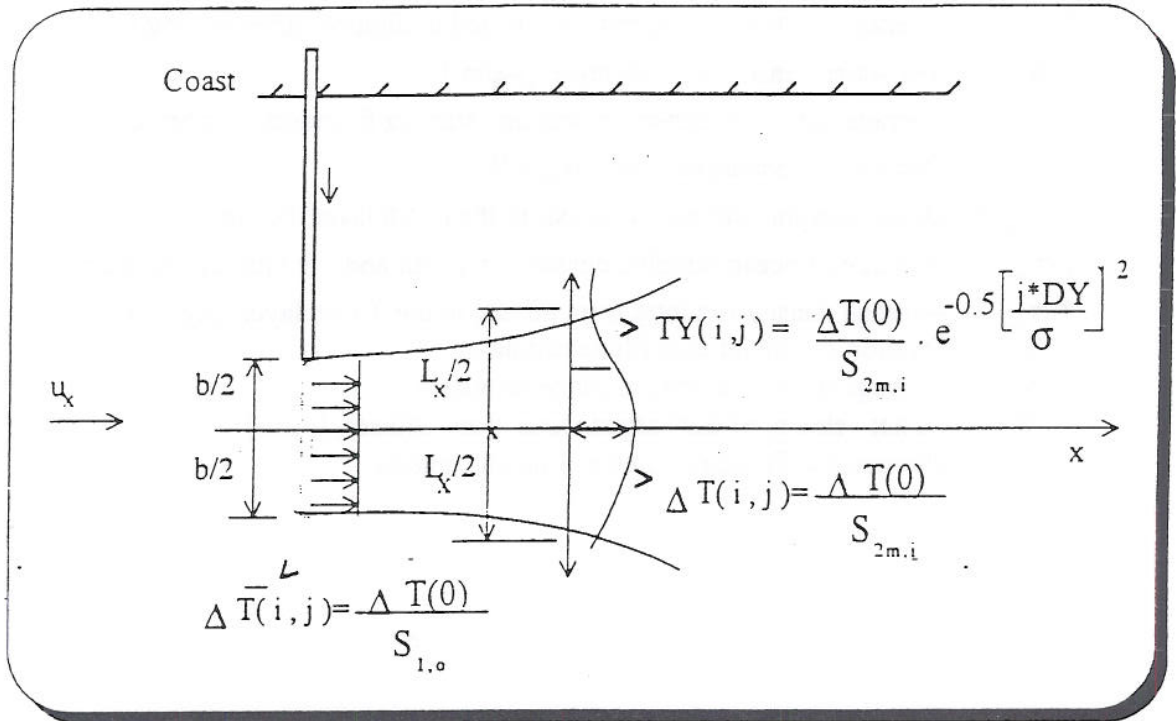


Figure-5: Secondary Dilution Approach in Thermal Discharge and Dispersion Model

The standard deviation, s , of the $TY(i, j)$ distribution is

$$\sigma = \frac{L_x}{2\sqrt{3}} \quad (11)$$

Width of the wastewater field, L_x , for a specific value of x is

$$L_x = b \cdot \left(1 + \frac{2}{3} * \frac{x}{b}\right)^{3/2} \quad (12)$$

Constant b can be calculated from equation (14).

$$\beta = \frac{12 \cdot \varepsilon}{u_x \cdot b} \quad (13)$$

$$\varepsilon = 4.53 \cdot 10^{-4} \cdot b^{4/3} \quad (14)$$

The secondary dilution, ($S_{2,i}$), can be calculated from an equation solved by Brooks.

$$S_{2m,i} = \frac{1}{\text{erf} \frac{1}{\sqrt{1 + \frac{2}{3} \beta \frac{x}{b}}}} \quad (15)$$

If the temperature differences during the horizontal motion of the wastewater field on the x-axis are given as $TY(i, j)$, taking $DY = L_x/10$ and with the help of equation (16)

$$TY(i, j) = \Delta \bar{T}(i, j) \cdot e^{-0.5[(y \cdot DY)/\sigma]^2} \quad (16)$$

difference distributions can be obtained. Temperature on the sea surface, T_{DENIZ} is known; therefore temperature distribution during the horizontal motion of the wastewater field along the x-axis [$TS2(i, j)$] can be calculated.

$$TS2(i, j) = T_{DENIZ} + \Delta \bar{T}(i, j) \cdot e^{-0.5[(y \cdot DY)/\sigma]^2} \quad (17)$$

Temperature differences on the x-axis are

$$\Delta \bar{T}(i, j) = \frac{\Delta T(0)}{S_{2m,i}} \quad (18)$$

- L_x : Wastewater field width for a specific value of x, [m]
 b : Field width at $v_x=0$ (effective diffuser length perpendicular to the current), [m]
 β : Dimensionless constant
 e : Turbulence diffusion constant at $x=0$
 $S_{2m,i}$: Secondary dilution on the x-axis in (i)th layer
 u_x : Current velocity, [m/sn]
 $\Delta T(i, j)$: Axis temperature on the x-axis, [$^{\circ}\text{C}$]
 $TY(i, j)$: Temperature distribution during the wastewater field's horizontal motion on the x-axis
 TD : Sea water temperature prior to discharge, [$^{\circ}\text{C}$]

As a result, $TY(i, j)$ temperature distribution values are written in "OUT.DAT" with the x, y, $TY(i, j)$ format. and the data on surface temperature distribution are carried out of the program as ASCII. As input data sea temperature and salinity values are read from VERWIN.DAT and VERSUM.DAT. In Table 1, the results of the model's winter data (VERWIN2.DAT) are given. According to output from the OUT.DAT equivalent temperature curves are drawn by SURFER package program and given in Figure 6 and Figure 7.

Sea water salinity and temperature data used in the program are given in Table-2 and Table-3. In the model, *current velocity* is taken as *0.1 m/sec*.

Table-2 : Variation of Salinity and Temperature with Depth for February
(Discharge depth: 5 m.)

Depth	Salinity	Temperature
Surface	28.422	8.471
1	28.432	8.468
2	28.441	8.465
3	28.437	8.461
4	28.433	8.457
5	28.535	8.381

Table-3 : Variaton of Salinity and Temperature with Depth (Discharge depth: 5 m.)

Depth	Salinity	Temperature
Surface	21.744	21.92
1	21.841	21.53
2	21.937	21.14
3	22.034	20.75
4	22.215	20.74
5	22.397	20.73

References

- [1]. ABRAHAM, G., Jet Diffusion in Stagnant Ambient Water , Delft Hydraulics Laboratory, Publication no. 29 (1963).
- [2]. ABRAHAM, G., Horizontal Jets in Stagnant Fluid of Other Density, ASCE HY 4 (1965).
- [3]. CEDERWALL, K., Hydraulics of Marine Waste Water Disposal, Hydraulics Division, Chalmers Institute of Technology, Gothenburg Sweden Report 42 (1968).

WINTER SEASON

Effluent Temperature (°C) :20
 Effluent Salinity (‰) : 25.658
 Diameter of Discharge Line Pipe (m) :2.5
 Port Diameter (m) : .25
 Tickness of Mixing Layer (m) : 1
 Discharge Depth (m) : 5
 Discharge flowrate (m³/sec) : 8
 Number of Ports : 81

NO	DEPTH.	TEMPE.	SALN.	AV. DENS	AX. DIL	AX. DENS	AV.DIL	AV. DENS	AV. TEMP
1	5	8.381	28.535	22.1407	5.2387	21.2931	10.4774	21.7169	9.5243
2	4	8.457	28.433	22.0970	7.1167	21.5053	14.2334	21.8172	9.2432
3	3	8.461	28.437	22.0995	8.5102	21.6026	17.0203	21.8634	9.1155
4	2	8.465	28.441	22.0971	9.6609	21.6615	19.3217	21.8913	9.0382
5	1	8.468	28.432	22.0892	11.7943	21.7388	23.5887	21.9271	8.9353

Length of Diffuser Pipe (m) : 160
 Angle Between The Current and The Diffuser (°) : 90
 Current Velocity (m/sec) : .1
 Distance of Temperature Curves from the Diffuser : 1000m

T (100	0) = 8.931919	T (200	0) = 8.901343
T (100	78) = 8.927142	T (200	78) = 8.896884
T (100	156) = 8.913109	T (200	156) = 8.88378
T (100	234) = 8.890672	T (200	234) = 8.862832
T (100	313) = 8.861159	T (200	313) = 8.835278
T (100	391) = 8.826244	T (200	391) = 8.802678
T (100	469) = 8.787785	T (200	469) = 8.76677
T (100	548) = 8.747664	T (200	548) = 8.729311
T (100	626) = 8.707644	T (200	626) = 8.691945
T (100	704) = 8.669238	T (200	704) = 8.656088
T (100	782) = 8.633642	T (200	782) = 8.622853
T (100	861) = 8.601686	T (200	861) = 8.593018
T (100	939) = 8.573845	T (200	939) = 8.567022

$T(300 \quad 0) = 8.858131$
 $T(300 \quad 78) = 8.854119$
 $T(300 \quad 156) = 8.842332$
 $T(300 \quad 234) = 8.823487$
 $T(300 \quad 313) = 8.798699$
 $T(300 \quad 391) = 8.769374$
 $T(300 \quad 469) = 8.737071$
 $T(300 \quad 548) = 8.703374$
 $T(300 \quad 626) = 8.66976$
 $T(300 \quad 704) = 8.637503$
 $T(300 \quad 782) = 8.607605$
 $T(300 \quad 861) = 8.580766$
 $T(300 \quad 939) = 8.557381$

$T(400 \quad 0) = 8.816672$
 $T(400 \quad 78) = 8.81309$
 $T(400 \quad 156) = 8.802566$
 $T(400 \quad 234) = 8.785738$
 $T(400 \quad 313) = 8.763605$
 $T(400 \quad 391) = 8.73742$
 $T(400 \quad 469) = 8.708577$
 $T(400 \quad 548) = 8.678488$
 $T(400 \quad 626) = 8.648474$
 $T(400 \quad 704) = 8.619672$
 $T(400 \quad 782) = 8.592976$
 $T(400 \quad 861) = 8.56901$
 $T(400 \quad 939) = 8.54813$

$T(500 \quad 0) = 8.780346$
 $T(500 \quad 78) = 8.777141$
 $T(500 \quad 156) = 8.767721$
 $T(500 \quad 234) = 8.752663$
 $T(500 \quad 313) = 8.732856$
 $T(500 \quad 391) = 8.709422$
 $T(500 \quad 469) = 8.68361$
 $T(500 \quad 548) = 8.656683$
 $T(500 \quad 626) = 8.629824$
 $T(500 \quad 704) = 8.604048$
 $T(500 \quad 782) = 8.580157$
 $T(500 \quad 861) = 8.55871$
 $T(500 \quad 939) = 8.540024$

$T(600 \quad 0) = 8.749252$
 $T(600 \quad 78) = 8.746369$
 $T(600 \quad 156) = 8.737897$
 $T(600 \quad 234) = 8.724352$
 $T(600 \quad 313) = 8.706536$
 $T(600 \quad 391) = 8.685458$
 $T(600 \quad 469) = 8.66224$
 $T(600 \quad 548) = 8.63802$
 $T(600 \quad 626) = 8.613859$
 $T(600 \quad 704) = 8.590675$
 $T(600 \quad 782) = 8.569186$
 $T(600 \quad 861) = 8.549894$
 $T(600 \quad 939) = 8.533087$

$T(700 \quad 0) = 8.722725$
 $T(700 \quad 78) = 8.720117$
 $T(700 \quad 156) = 8.712452$
 $T(700 \quad 234) = 8.700198$
 $T(700 \quad 313) = 8.68408$
 $T(700 \quad 391) = 8.665011$
 $T(700 \quad 469) = 8.644008$
 $T(700 \quad 548) = 8.622096$
 $T(700 \quad 626) = 8.60024$
 $T(700 \quad 704) = 8.579266$
 $T(700 \quad 782) = 8.559825$
 $T(700 \quad 861) = 8.542373$
 $T(700 \quad 939) = 8.527167$

$T(800 \quad 0) = 8.700007$
 $T(800 \quad 78) = 8.697635$
 $T(800 \quad 156) = 8.690661$
 $T(800 \quad 234) = 8.679514$
 $T(800 \quad 313) = 8.664851$
 $T(800 \quad 391) = 8.647503$
 $T(800 \quad 469) = 8.628394$
 $T(800 \quad 548) = 8.60846$
 $T(800 \quad 626) = 8.588576$
 $T(800 \quad 704) = 8.569495$
 $T(800 \quad 782) = 8.551809$
 $T(800 \quad 861) = 8.535932$
 $T(800 \quad 939) = 8.522099$

$T(900 \quad 0) = 8.680436$
 $T(900 \quad 78) = 8.678266$
 $T(900 \quad 156) = 8.671889$
 $T(900 \quad 234) = 8.661694$
 $T(900 \quad 313) = 8.648284$
 $T(900 \quad 391) = 8.632419$
 $T(900 \quad 469) = 8.614944$
 $T(900 \quad 548) = 8.596713$
 $T(900 \quad 626) = 8.578528$
 $T(900 \quad 704) = 8.561077$
 $T(900 \quad 782) = 8.544903$
 $T(900 \quad 861) = 8.530382$
 $T(900 \quad 939) = 8.517732$

$T(1000 \quad 0) = 8.663461$
 $T(1000 \quad 78) = 8.661466$
 $T(1000 \quad 156) = 8.655606$
 $T(1000 \quad 234) = 8.646237$
 $T(1000 \quad 313) = 8.633914$
 $T(1000 \quad 391) = 8.619335$
 $T(1000 \quad 469) = 8.603276$
 $T(1000 \quad 548) = 8.586523$
 $T(1000 \quad 626) = 8.569813$
 $T(1000 \quad 704) = 8.553776$
 $T(1000 \quad 782) = 8.538913$
 $T(1000 \quad 861) = 8.525569$
 $T(1000 \quad 939) = 8.513944$

SUMMER SEASON

Effluent Temperature (°C) :30
Effluent Salinity (%) : 22.9
Diameter of Discharge Line Pipe (m) :2.5
Port Diameter (m) : .25
Tickness of Mixing Layer (m) : 1
Discharge Depth (m) : 5
Discharge flowrate (m3/sec) : 8
Number of Ports : 81

NO	DEPTH.	TEMPE.	SALN.	AV. DENS	AX. DIL	AX. DENS	AV.DIL	AV. DENS	AV. TEMP
1	5	20.730	22.397	14.9858	6.3241	14.6291	12.6481	14.8075	21.4675
2	4	20.740	22.215	14.8464	8.6549	14.6876	17.3099	14.8180	21.2729

!!!!!!.....SUBMERGED FIELD IS FOUND BEYOND THIS DEPTH.....!!!!!!

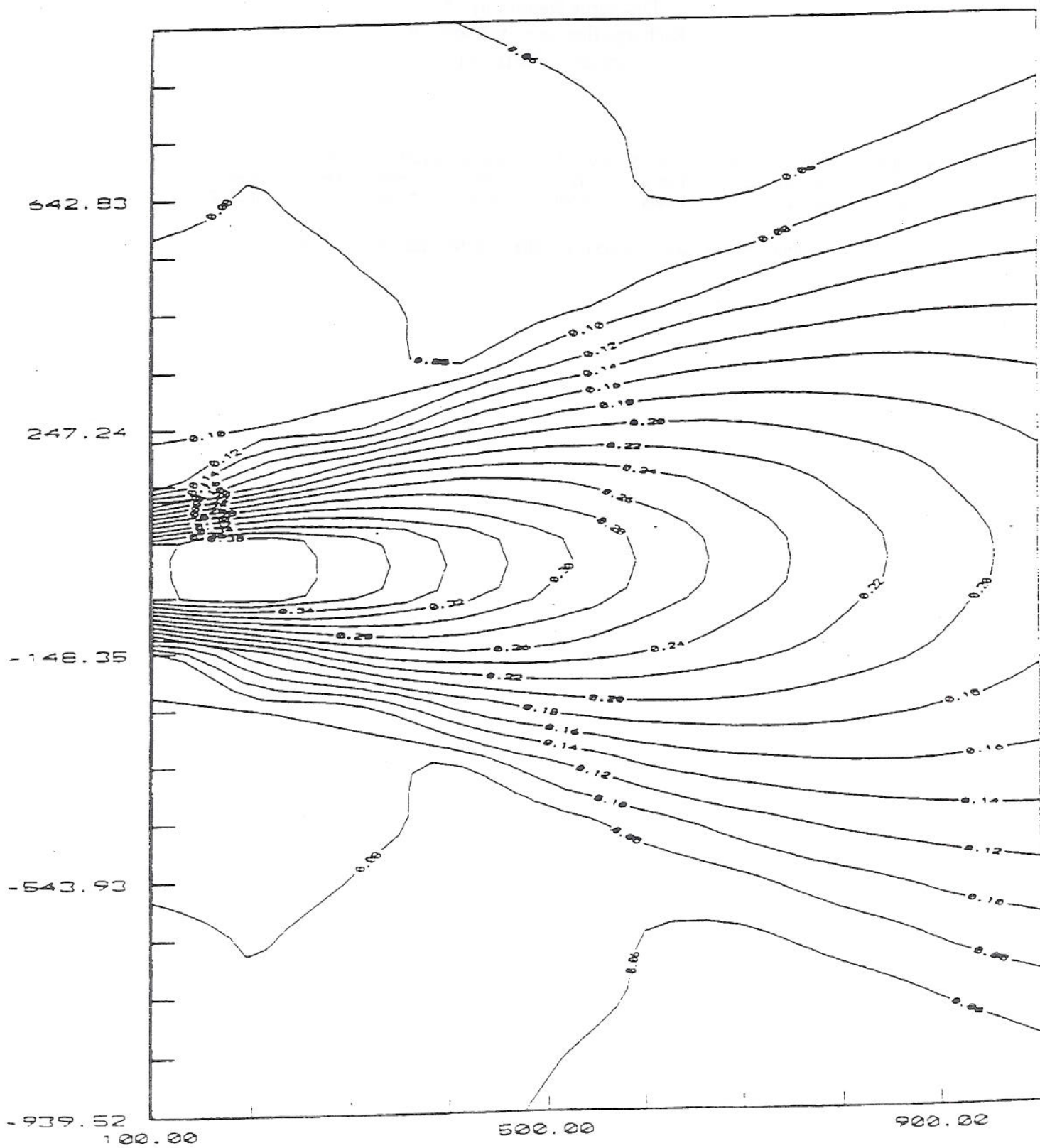


Figure 6
Temperature Difference(ΔT) for the water in the summer

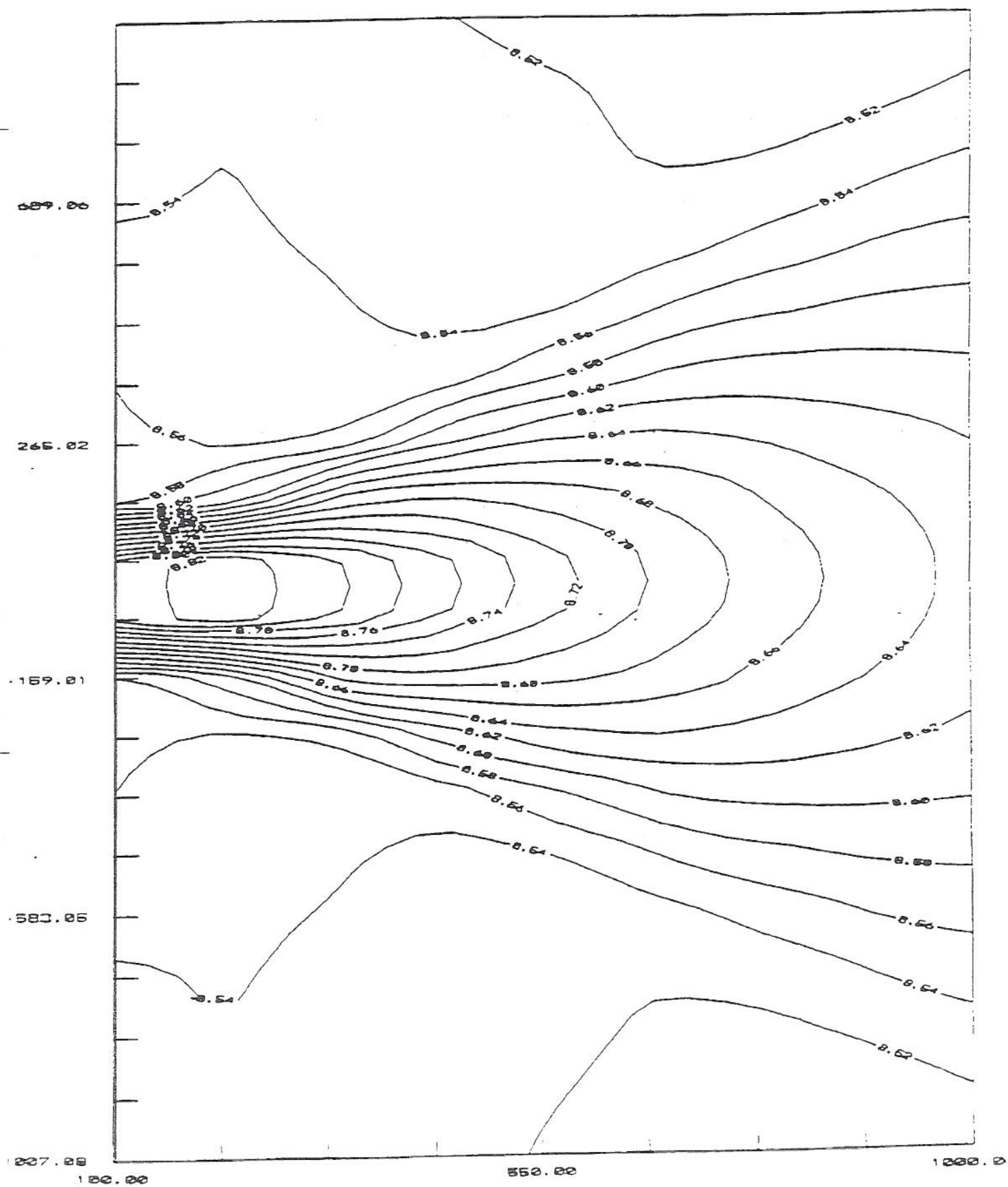


Figure 7
Temperature Difference(ΔT) for the water in the Winter

ANNEX V.4.4.

AIR QUALITY MODEL

AIR QUALITY MODEL

The probable impacts of the exhaust gasses on the environment were tried to be projected thorough a model developed. The plant analyzed is a point source. The present residencies in the region does not alter this status. Gauss Models are the mostly used models for point sources. Therefore, such a model is chosen. This method is also suggested in the Air Quality Control Regulation. Gaussian models are based on normal distribution of pollutants. Source force (amount of pollutants given to the atmosphere per unit of time), wind velocity, atmospheric stability, effective exhaust stack height are used in the model, as well as, special variables of the surrounding environment. In this model the pollution resulting from the source has been analyzed within a grid system. The dimensions of the grid could vary but the average was taken to be 1 km². The movement between the grids can be analyzed. According to the region's meteorology, wind velocity and frequency are among the variables of the model. Therefore, depending on the wind directions, the distributions of the pollutants at ground level can be found. The Gaussian distribution model deals mainly with short term (5 - 10 minutes) average pollutant concentrations. The results have been converted to 24-hour point averages. With the model developed following the details given above, the impacts when natural gas or TÜPRAŞ 400 are used have been analyzed. The source forces used in the model are given in Table V.

Table V. Natural Gas and Fuel Oil Emissions (Single Unit)

Pollutants	Natural Gas kg/h	Fuel Oil (%0.75) kg/h
Nitrogen dioxide	60	188.5
Carbon monoxide	28.7	25.4
Particulate matter	3.5	14.35
Sulphur dioxide	8.8	390

Nitrogen dioxide and sulphur dioxide of the above pollutants were used in the model because of their importance to the environment and for unstable, neutral and stable atmospheric conditions, within a 1 km² grid system, the model gave the ground level concentrations. The results are either below or at level with the limits given in the Air Quality Control Regulations , item 6. (Annex V.)

1. Calculation of Surface Concentration due to Point Sources

Calculation of ground-level concentrations as a result of emissions from the power plant is based on the basic Gaussian plume formulas [1]. According to the basic Gaussian plume formula, the surface concentration of a pollutant emitted from a point source is given as:

$$C = \sqrt{2/\pi} \frac{fQ_p}{\sigma_z r u \frac{2\pi}{16}} \text{Exp} \left[\frac{-H^2}{2\sigma_z^2} \right] \quad (1)$$

where,

Q_p = pollutant emission rate ($\mu\text{g}/\text{sec}$)

C = surface concentration of the pollutant ($\mu\text{g}/\text{m}^3$)

H = effective stack height (m)

r = distance of the receptor point from the source (m)

f = frequency of wind direction towards the sector of interest

u = wind speed (m/sec)

σ_z = vertical dispersion parameter (m)

1.1 The Effective Stack Height

The effective stack height is the sum of the geometric stack height, h , and the plume rise, Δh :

$$H = h + \Delta h \quad (2)$$

Several semi-empirical expressions are given in the literature. In general, these relations include 3 factors which affect the plume rise:

- geometry of the stack,
- meteorological parameters,
- physical and chemical characteristics of the stack gas.

Most of the plume rise formulae include momentum and thermal buoyancy terms. The momentum term contains the vertical momentum due to the exit velocity of the stack gas (V_s), and the thermal buoyancy term represents the rise due to the difference between the stack gas temperature (T_s) and the atmospheric temperature (T_a). The various plume rise formulae available in the literature are summarized below:

Carson - Moses

Carson ve Moses [2] obtained the following equation for Δh as a result of 711 observations using 11 different equations:

$$\Delta h = 0.029 \frac{V_s d}{u} + 2.62 \frac{(Q_h)^{1/2}}{u} \quad (3)$$

Here, Δh , is the vertical distance from the top of the stack to the centerline of the plume, V_s is the exit velocity of the stack gas, d is the diameter of the

stack at the exit point, u is the wind velocity at the stack height, and Q_h , is the heat emission rate (kilojoul/sec) expressed as :

$$Q_h = \dot{m} c_p (T_s - T_a)$$

where ,

$$\dot{m} = \frac{\pi d^2 V_s P}{4 R T_s}$$

is the mass emission rate of the stack gas (kg/san) , c_p is the specific heat of the stack gas at constant pressure, T_s , is the exit temperature of the stack gas and T_a is the atmospheric temperature ($^{\circ}\text{K}$).

Holland

Thomas, Carpenter , and Colbaugh [3] have found that the "Holland" formula given by ,

$$\Delta h = \frac{V_s d}{u} \left[1.5 + 2.68 \times 10^{-3} P d \left(\frac{T_s - T_a}{T_s} \right) \right] \quad (4)$$

agrees well with the observed values.

Briggs

Carpenter et.al.[3] have found the following modified Briggs formula for coal-fired power plants:

$$\Delta h = \frac{114 C (F)^{1/3}}{u} \quad (5)$$

where,

$$F = \frac{g V_s d^2 (T_s - T_a)}{4 T_a}, \text{ m}^4 / \text{sec}^{-3}$$

in which g = gravitational acceleration (9.8 m/sec^2) , $C = 1.58 - 41.4 (\Delta\theta/\Delta z)$ [dimensionless] , $\Delta\theta/\Delta z$ = potential temperature gradient ($^{\circ}\text{K/m}$) .

Each of these expressions yield different Δh values. In this work, modified version of the Briggs Δh formula is used which is given in the Air Pollution Control Regulation (4) in the form of:

$$\Delta h = A q^n u^m \quad (6)$$

where,

A, n, m = Coefficients depending on the stability

q = Heat emission rate, $\text{MW} = 1.36 \times 10^{-3} R (T - 283)$

R = Volumetric flow rate of the stack gas at standard conditions (m^3/sec)

T = Stack gas temperature, $^{\circ}\text{K}$

u = Wind speed at the stack height

The coefficient A takes the values 146, 102 and 74.4 for unstable, neutral and stable conditions, respectively. The coefficient n takes the value 0.6 for neutral

and unstable conditions and 0.33 for the stable condition. The coefficient m takes the value -1 for neutral and unstable conditions and -0.33 for the stable condition. The wind speed at the stack height is calculated from a power law relation in the form[4]:

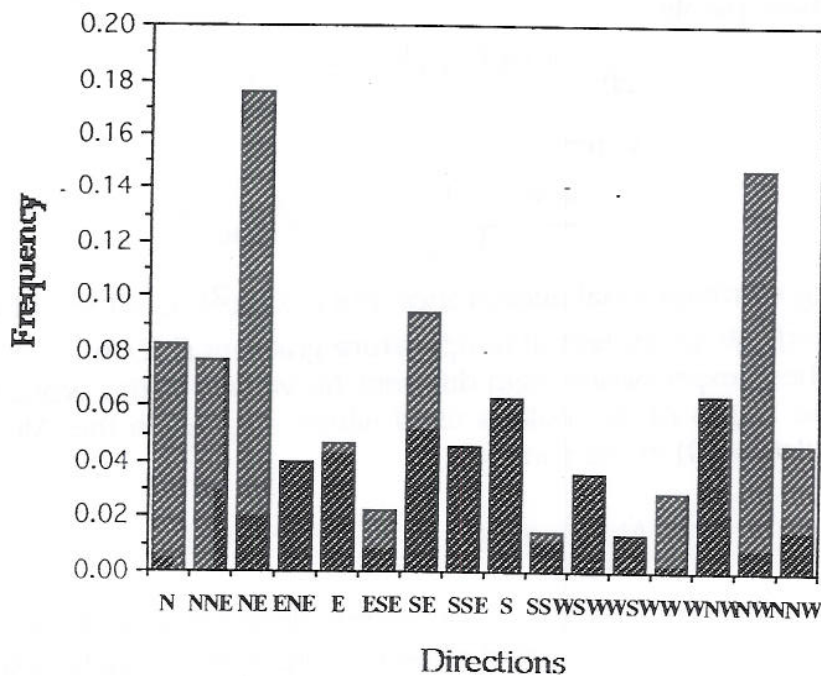
$$u_H = u_r (h/z_o)$$

where, u_r = wind speed at the reference height
 h = stack height
 z_o = reference height

In this work, the reference height is taken as 4m, which is the height at which the ground-level wind speed is measured in the Tekirdağ Meteorological Station.

1.2 Wind Direction Frequency

The wind direction frequency was calculated from the 22 year average data available from the Tekirdağ Meteorological Station. The wind frequencies calculated for 16 wind directions is shown in the Figure below:



As it can be seen, the major wind direction in the region is NE with a frequency of approximately 18 %.

2. Calculation of the Ground-Level Concentration Distribution from the Power Plant.

Equation (1) can be used to estimate the average concentration in the grid square in which the point source is located. The source is assumed to be located in the center of the square, and the average concentration in the circle with radius $\Delta x/2$ is assumed to equal to the average concentration in the square with side Δx [5]. Since there is only one wind direction sector for the source square, the fraction $2\pi/16$ in equation (1) becomes 2π , and the frequency f equals unity. Therefore, for the source square:

$$C_{\text{source}} = \frac{1}{\pi(\Delta x/2)^2} \int_0^{2\pi} d\theta \int_0^{\Delta x/2} \sqrt{\frac{2}{\pi}} \frac{Q_p}{ar^b u 2\pi} \text{Exp}\left[-\frac{H^2}{2a^2 r^{2b}}\right] dr \quad (7)$$

where, Δx = grid distance,
a and b are the coefficients of the vertical dispersion parameter given by the empirical relation[6]:

$$\sigma_z = ax^b \quad (8)$$

where x is the distance in meters. The values of the coefficients a and b depend on the atmospheric stability and are shown in Table 1:

Table1. Values of a and b for various stability classes.

Stability Class	a	b
Unstable	0.40	0.91
Neutral	0.15	0.75
Stable	0.06	0.71

Equation (7) can be numerically integrated by means of a computer program to calculate the concentration, given the input parameters Δx , Q_p , a, b, H and u. The average concentrations in grid squares other than the source grid square are assumed to equal to the concentration in the center of the grid calculated using equation (1). Gifford's reciprocal plume is then used to estimate the total surface concentration in any grid square due to the contributions from the given distribution of point sources by superimposing a 9 by 9 matrix over the the source grid, and multiplying term by term. A Quickbasic program is developed to perform this calculation in a computer (see Appendix A).

This model has been applied and verified for several cases [7,8,9].

REFERENCES

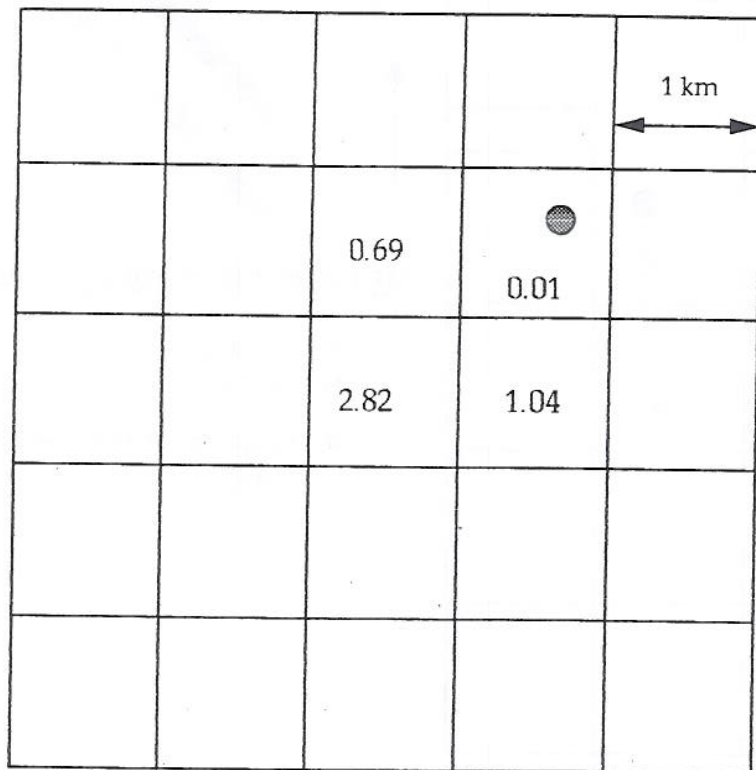
1. Slade, D. (Editor). Meteorology and Atomic Energy, 1968, USAEC, Rept. No. Rept. No. TID-24190.
2. Carson, J.E. ve Moses, H. *J. Air Poll. Cont. Assoc.* **19**, no.11 (1969):862-866.
3. Wark, K. and Warner, C.F. *Air pollution and its control*. Harper & Row, Publishers, 1981.
4. Air Pollution Control Regulation, Official Gazette No.19269, November 2, 1986 pp. 57-59.
5. Hanna, S.R., "Description of ATDL Computer Model for Dispersion from Multiple Sources", in *Industrial Air Pollution Control*, K. Noll(Ed.), p.23-32
6. Smith, M.E.(Editor), *Recommended Guide for the Prediction of the Dispersion of Airborne Effluents*, ASME, (1968).
7. Ertürk, F. "Investigation of Strategies for the Control of Air Pollution in the Golden Horn, Istanbul, Using A Simple Dispersion Model", *Environmental Pollution* (Series B), **11**, p.161-168, (1986).
8. Ertürk, F. "Hydrogen as an Alternative Fuel for the Assessment of Air Pollution Control Strategies in Istanbul by Application of a Mathematical Model", in *Alternative Energy Sources VII*, vol. 4, Bioconversion/ Hydrogen, Editor, Nejat Veziroglu, p.507-518 Hemisphere Publishing Corporation, Washington, D.C., 1987.
9. Vardar, N. "Application of a Mathematical Model for the Assessment of Air Pollution in Bursa", Master Thesis, Yıldız Technical University, 1993.

SCENARIO 1: Single Point Source

Fuel : Natural Gas

Pollutant : NO_x

N

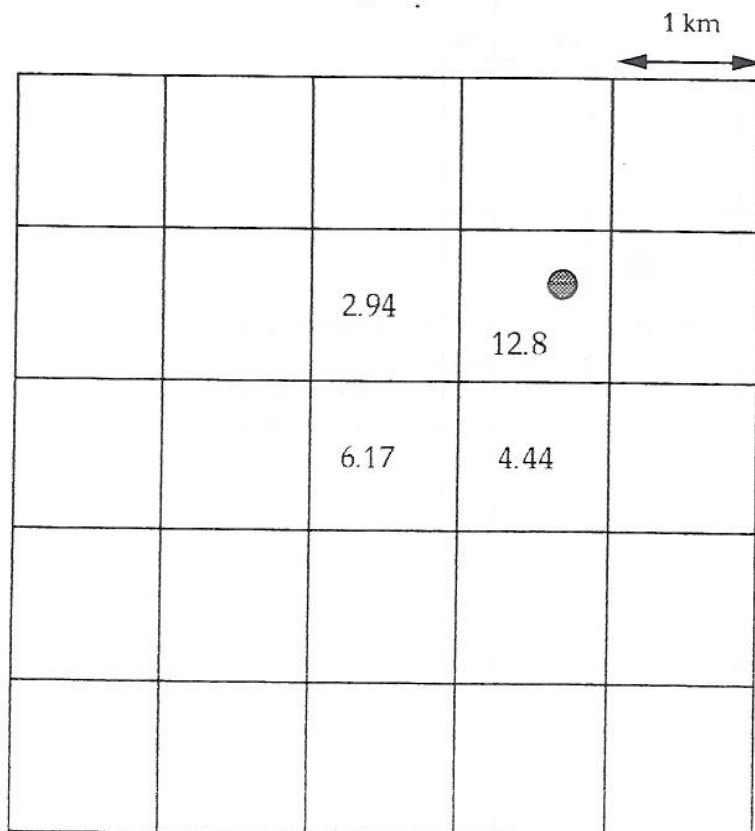


Atmospheric Stability : Unstable

$\Delta h = 314$ m

H = 379 m

● Location of the Power Plant



(Minimum Δh)

$\Delta h = 35$ m

H = 100 m

Figure 1. Ground-level NO_x Concentration Distribution for Unstable Conditions ($\mu\text{g}/\text{m}^3$)

SCENARIO 2: Single Point Source

Fuel : Fuel-oil No2 (0.25 % S)

Pollutant : NO_x

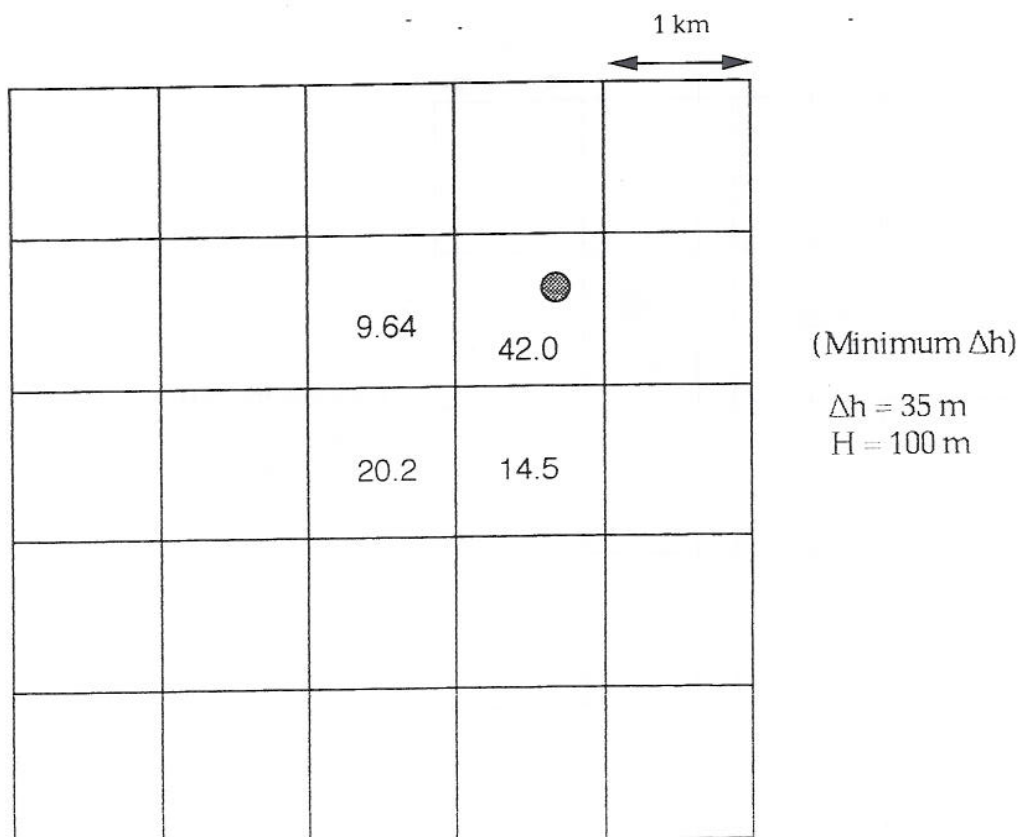
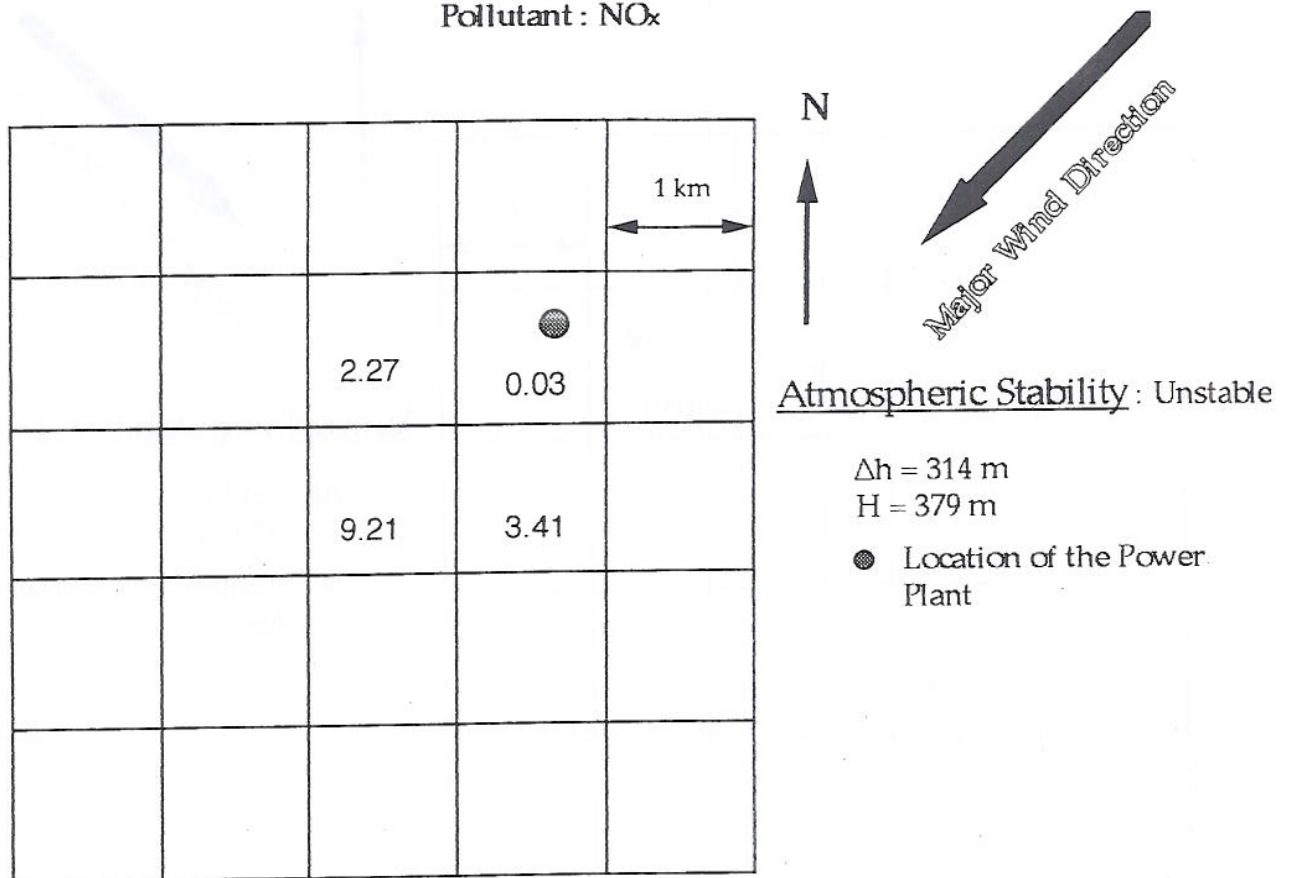


Figure 2. Ground-level SO₂ Concentration Distribution for Unstable Conditions ($\mu\text{g}/\text{m}^3$)

SCENARIO 8: Single Point Source

Fuel : Fuel-oil No.2 (0.7 % S)

Pollutant : SO₂

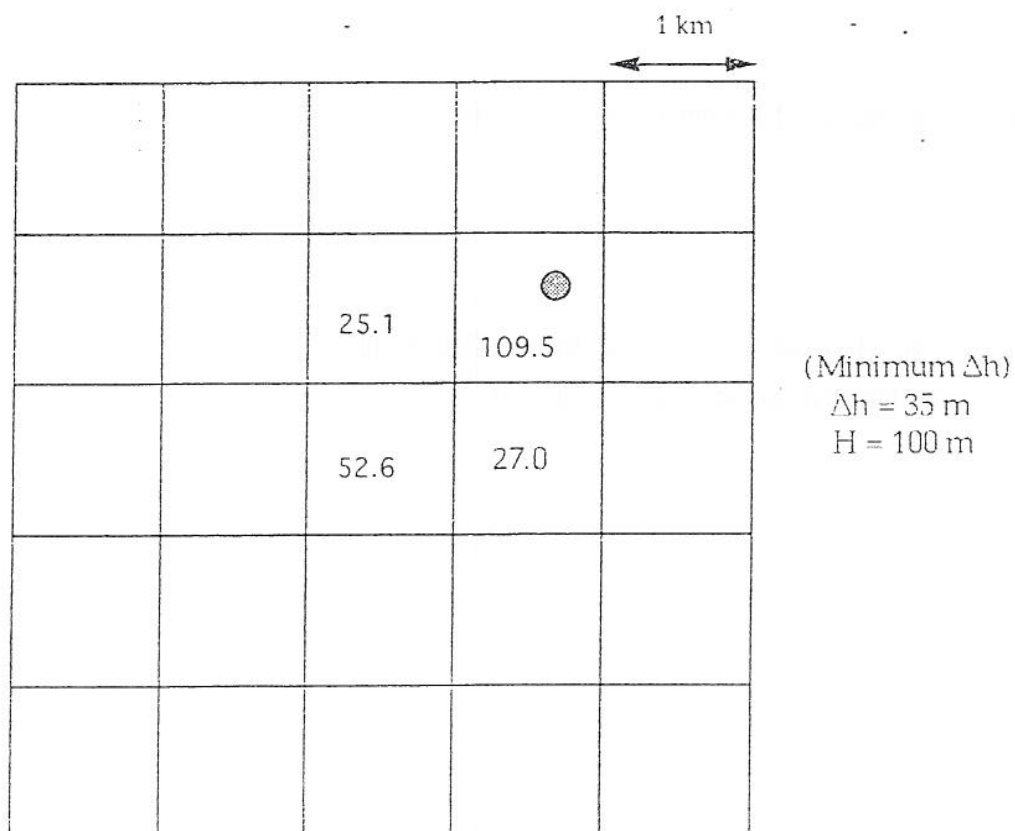
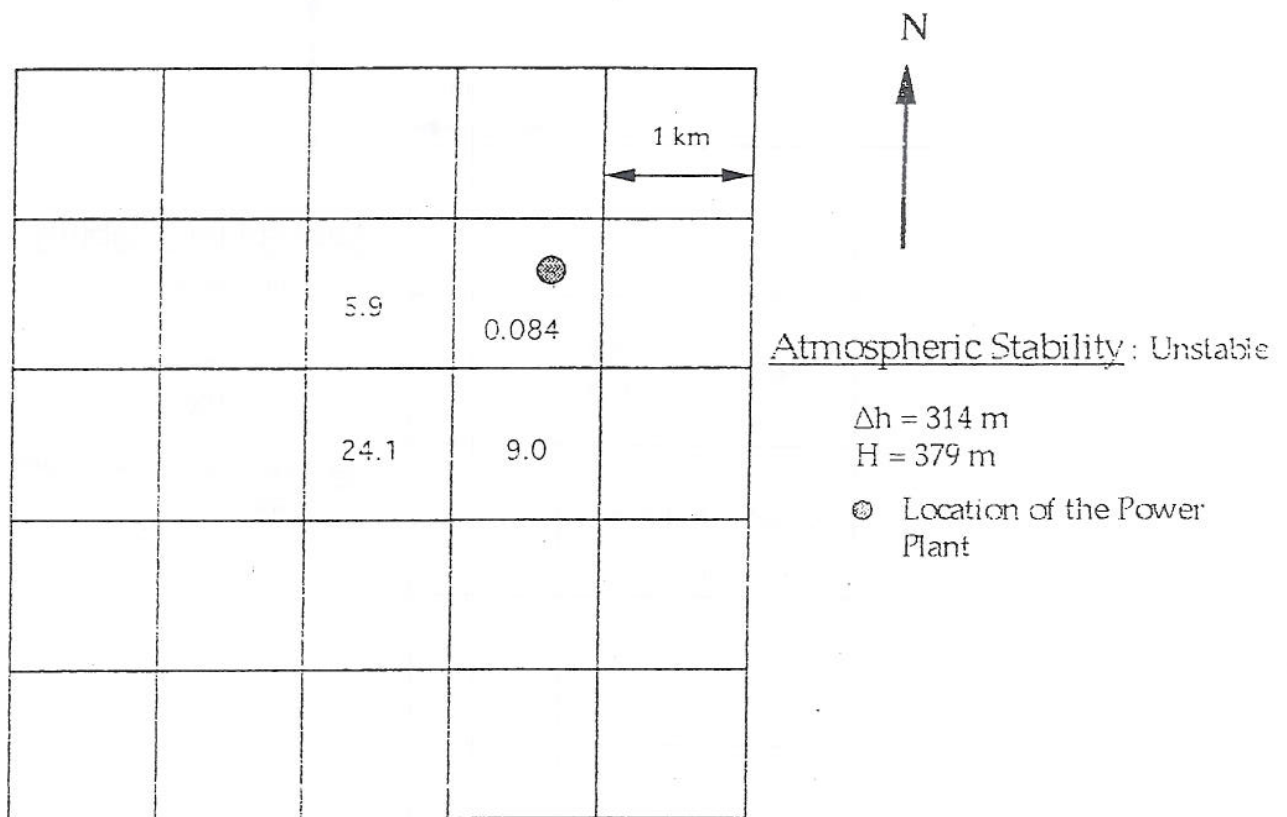
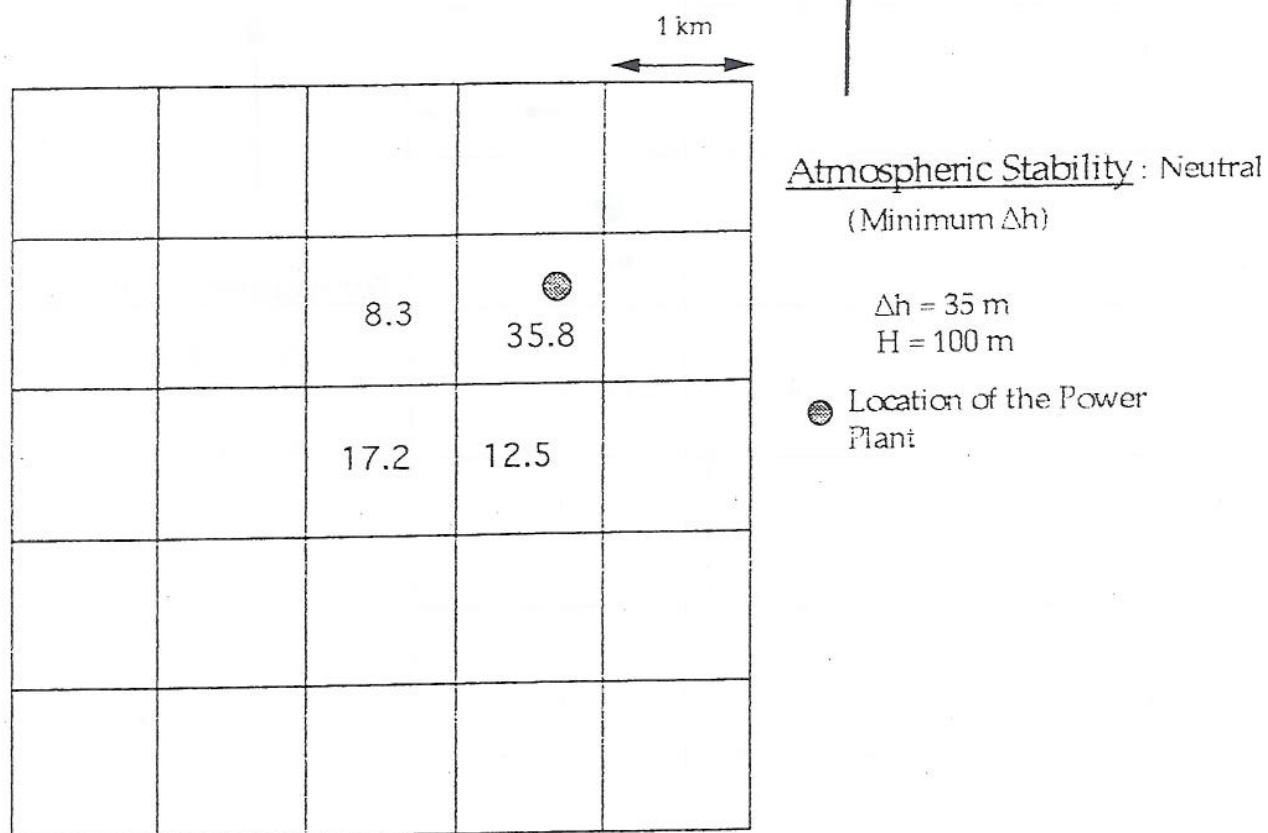


Figure 13. Ground-level SO₂ Concentration Distribution for Unstable Conditions ($\mu\text{g}/\text{m}^3$)

SCENARIO 8: Single Point Source

Fuel : Fuel-oil No2 (0.7 % S)

Pollutant : SO_2



(No detectable concentrations for $H = 232 \text{ m}$)

Figure 14. Ground- level SO_2 Concentration Distribution
for Neutral Conditions ($\mu\text{g}/\text{m}^3$)

ANNEX V.4.5.

NOISE PREDICTION CALCULATION

INTRODUCTION

The Power Plant will be based on two Gas Turbine Units type GT 13E2 and one Steam Turbine in Indoor-Configuration (HRSG outdoor).

The acoustical requirements for the power plant is 45 dB(A) at nearest residence (houses under construction - ca 435 m from out line), measured at immission point according ANSI B133.8.

To determine necessary acoustical noise control means to achieve an emission level of 45 dB(A) a Noise Prediction Calculation was used.

This calculation method is to a wide extend based on recently and earlier published methods.

NOISE PREDICTION CALCULATION

The calculation based at the following standards:

- ❖ VDI 2714 Outdoor sound propagation (Schallausbreitung im Freien)
- ❖ VDI 2571 Sound radiation from industrial buildings (Schallabstrahlung von Industriebauten)
- ❖ VDI 3733 Noise at pipes (Geräusche bei Rohrleitungen)

Compared with usually applied methods operating only with A-weighted sound levels, the prediction method from ABB consist of an octave band calculation.

Each individual noise source of the Power Plant will be represented by an equivalent source (either a flat source, line source or monopole) placed in a co-ordinate system.

The sound power level for each (single) component (e.g. compressor intake area) are calculated from basic sound power data (e.g. unattenuated compressor intake noise) and relevant partial additional attenuations (e.g. insertion loss of silencer and filter etc.).

Transmission path attenuation is estimated by means of additiv corrections as spherical divergence, air absorption and if necessary screening.

Ground and meteorological effects and attenuations from vegetation will be considered if possible.

The resulting sound pressure levels at the different receptors assuming moderate downwind or slight temperature inversion, are therefore higher than the long-term equivalent values.

The order of magnitude of expected L_{Aeq} standard deviation is $\pm 1 \dots 2$ dB.

CALCULATION PROCEDURE

To determine the sound emission from the Power Plant 92 different single source were utilised (Fig. 1).

Basic sound data (e.g. determined from existing gas turbines), attenuation values (e.g. insertion loss silencer) used for this calculation are shown in Fig. 2 and Fig 3.

Based on this data the noise impact from each single source at the different receptors will be calculated using the theoretical equations for flat resp. line or monopole sources.

Additional corrections for air absorption and radiation directivity will be taken in consideration.

Adding all single impacts results in the total sound emission level.

With this clearly arranged procedure acoustical optimising of each individual noise source is possible.

RESULTS

The calculation was done for single immission points at first. These points was the existing houses and the houses under construction. After optimising the acoustic of the power plant a grid was calculated (distance between two points 25 m, 1419 immission points). With the values of the sound pressure level at these immission points the sound pressure level isobar curves can be plotted (Fig. 10).

APPENDIX

- | | |
|--------------|--|
| Fig. 1 | Source identification |
| Fig. 2 | Basic sound sources |
| Fig. 3 | Attenuations |
| Fig 4 ... 6 | Geometric data sound sources |
| Fig. 7 ... 9 | Sound sources (with No. of Basic sound sources, attenuation, Diff. correction, Area correction, ...) |
| Fig. 10 | Sound pressure level isobar curves |

Figure 1

MARMARA UNIT / KA 13E2-2

Sound Sources

28.02.94 / ABB Turbo Systems AG
ZXE-11 / Scholz

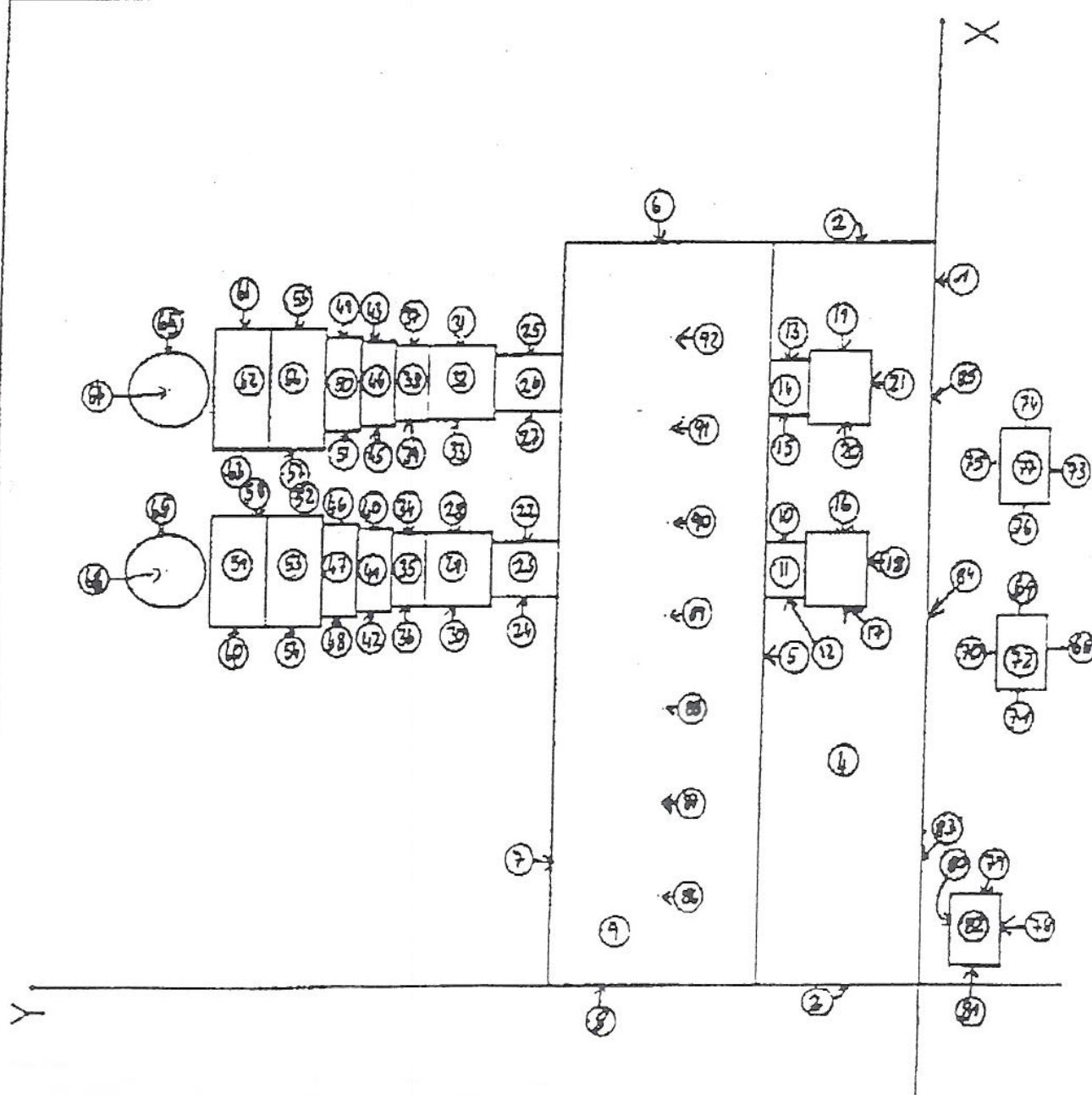


Figure 2

Projezt : Marmara Unit	(28.02.94)
Version : 45d8(A) at Marmara see ANSI 8733.8	

Basic sound sources P1L											
Nr.	Name	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A	11m
		(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dBA)	(dB)
52	GT13E2 EXHAUST	122.0	139.0	139.0	139.0	139.0	140.0	137.0	120.0	145.1	147.4
64	GT+GENO VERSCH	104.0	113.0	93.0	91.0	98.0	97.0	100.0	98.0	105.6	114.1
67	13E2 ANSAUG-→	129.0	131.0	133.0	135.0	147.0	151.0	144.0	138.0	154.1	153.3
153	TRAFU MILLBANK	90.0	105.0	98.0	98.0	91.0	86.0	84.0	78.0	98.5	107.4
301	CACHLÜFTER	88.0	91.0	88.0	87.0	83.0	77.0	72.0	67.0	88.1	95.2

Projekt : Marmara Unit	(28.02.94)
Version : 45dB(A) at Houses acc ANSI 8133.8	

Figure 3

Attenuations									
Nr.	Name	83Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
		(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
7	1MM ST-TRP-BL, 60MM MH	8.0	15.0	18.0	23.0	25.0	30.0	35.0	38.0
52	KESSELDÄMPFUNG	5.0	6.0	7.0	10.0	12.0	15.0	16.0	20.0
53	90° ANSAUG	4.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
54	90° ABGAS	2.0	2.0	2.0	3.0	4.0	4.0	5.0	7.0
50	KANAL 3MM STBL. H. VERSTEI	18.0	22.0	25.0	33.0	34.0	35.0	31.0	35.0
51	KANAL QUAD. 5M, 6MM ST. BL	26.0	28.0	32.0	36.0	39.0	33.0	34.0	42.0
52	KANAL QUAD. 6M, 10MM ST. BL	26.0	32.0	36.0	39.0	33.0	34.0	42.0	46.0
52	KANAL RUND 5M, 6MM	32.0	32.0	30.0	28.0	32.0	34.0	39.0	39.0
104	1MM AL. 200MM MH ELASTISC	2.0	8.0	15.0	20.0	20.0	25.0	25.0	29.0
105	1MM ST 100MM MH INNEN-ISO	2.0	6.0	12.0	18.0	18.0	22.0	22.0	25.0
133	2 STAGE AAF	3.0	2.0	1.0	3.0	5.0	8.0	12.0	19.0
186	350/300/3000, 530 GRD.C	10.0	14.0	21.0	29.0	30.0	29.0	19.0	13.0
256	IN SD 180/160/2000	12.0	17.0	24.0	36.0	37.0	37.0	25.0	17.0
372	KO MASCHINENHAUS AUSGEKL.	-16.0	-13.0	-10.0	-10.0	-9.0	-9.0	-10.0	-10.0
403	DREI BLÖCKE	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8
421	KAMINLÄNGSDÄ. 40 LANG 8 D	0.0	0.0	0.0	0.0	1.0	1.0	2.0	4.0

Projezt : Marmara Unit	(28.02.94)
Version : 45d3(A) at Houses acc ANSI 8733.8	

Figure 4

Geometric data sound sources								
No.	Name	TYP	Coordinates Point 1			Coordinates Point 2		
			X	Y	Z	X	Y	Z
			(m)	(m)	(m)	(m)	(m)	(m)
GEBÄUDE								
GENÖVCORBAU								
SELBST								
1	NORD	FV	0.00	0.00	9.0	80.00	0.00	9.0
2	WEST	FV	80.00	0.00	0.0	80.00	16.00	9.0
3	OST	FV	0.00	16.00	0.0	0.00	0.00	9.0
4	DACH	FH	0.00	0.00	9.0	80.00	0.00	16.0
MASCHINENHAUS								
SELBST								
5	NORD	FV	0.00	16.00	9.0	80.00	16.00	21.5
6	WEST	FV	80.00	16.00	0.0	80.00	37.00	21.5
7	SÜD	FV	80.00	37.00	0.0	0.00	37.00	21.5
8	OST	FV	0.00	37.00	0.0	0.00	16.00	21.5
9	DACH	FH	0.00	16.00	21.5	80.00	16.00	21.0
LÜFTUNG								
LOUVRE								
83	GT 1	FV	3.00	0.00	3.0	9.00	0.00	6.0
84	GT 2	FV	24.00	0.00	3.0	30.00	0.00	6.0
85	OT	FV	70.00	0.00	3.0	77.00	0.00	6.0
DACHLÜFTER								
86	GT 1 A	KU	10.00	26.00	22.0	10.00	26.00	22.0
87	GT 1 B	KU	20.00	26.00	22.0	20.00	26.00	22.0
88	GT 2 A	KU	30.00	26.00	22.0	30.00	26.00	22.0
89	GT 2 B	KU	40.00	26.00	22.0	40.00	26.00	22.0
90	OT A	KU	50.00	26.00	22.0	50.00	26.00	22.0
91	OT B	KU	60.00	26.00	22.0	60.00	26.00	22.0
92	OT C	KU	70.00	26.00	22.0	70.00	26.00	22.0
ANSAUGSYSTEM								
KANALE								
GT1								
10	WEST	FV	48.00	12.00	9.0	48.00	16.00	16.0
11	OBEN	FH	42.00	12.00	16.0	48.00	12.00	4.0
12	OST	FV	42.00	16.00	9.0	42.00	12.00	16.0
GT 2								
13	WEST	FV	67.50	12.00	9.0	67.50	16.00	16.0
14	OBEN	FH	61.50	12.00	16.0	67.50	12.00	4.0
15	OST	FV	61.50	16.00	9.0	61.50	12.00	16.0
FILTER								
GT 1								
16	WEST	FV	49.00	6.00	9.0	49.00	12.00	16.0
17	OST	FV	41.00	12.00	9.0	41.00	6.00	16.0
18	NORD	FV	41.00	6.00	9.0	49.00	6.00	16.0
GT 2								
19	WEST	FV	68.50	6.00	9.0	68.50	12.00	16.0
20	OST	FV	60.50	12.00	9.0	60.50	6.00	16.0
21	NORD	FV	60.50	6.00	9.0	68.50	6.00	16.0
ABGASSYSTEM								
DIFFUSOREN								
GT 1								
22	WEST	FV	48.00	37.00	0.0	48.00	44.00	6.0
23	OBEN	FH	42.00	37.00	6.0	48.00	37.00	7.0
24	SÜD	FV	42.00	44.00	0.0	42.00	37.00	6.0

Geometric data sound sources								
No.	Name	TYP	Coordinates Point 1			Coordinates Point 2		
			X	Y	Z	X	Y	Z
			(m)	(m)	(s)	(m)	(m)	(m)
25	GT 2							
26	WEST	FV	48.00	37.00	0.0	48.00	44.00	6.0
26	OBER	FH	42.00	37.00	6.0	48.00	37.00	7.0
27	SÜD	FV	42.00	44.00	0.0	42.00	37.00	6.0
	SCHALLDÄMPFER							
	GT 1							
28	WEST	FV	49.00	44.00	0.0	49.00	51.00	7.0
29	OBER	FH	41.00	44.00	7.0	49.00	44.00	7.0
30	SÜD	FV	41.00	51.00	0.0	41.00	44.00	7.0
	GT 2							
31	WEST	FV	69.00	44.00	0.0	69.00	51.00	7.0
32	OBER	FH	61.00	44.00	7.0	69.00	44.00	7.0
33	SÜD	FV	61.00	51.00	0.0	61.00	44.00	7.0
	TEIL 1							
	GT 1							
34	WEST	FV	49.00	51.00	0.0	49.00	54.50	10.0
35	OBER	FH	41.00	51.00	10.0	49.00	51.00	3.5
36	SÜD	FV	41.00	54.50	0.0	41.00	51.00	10.0
	GT 2							
37	WEST	FV	69.00	51.00	0.0	69.00	54.50	10.0
38	OBER	FH	61.00	51.00	10.0	69.00	51.00	3.5
39	SÜD	FV	61.00	54.50	0.0	61.00	51.00	10.0
	TEIL 2							
	GT 1							
40	WEST	FV	49.50	54.50	0.0	49.50	58.00	13.0
41	OBER	FH	40.50	54.50	13.0	49.50	54.50	3.5
42	SÜD	FV	40.50	58.00	0.0	40.50	54.50	13.0
	GT 2							
43	WEST	FV	69.50	54.50	0.0	69.50	58.00	13.0
44	OBER	FH	60.50	54.50	13.0	69.50	54.50	3.5
45	SÜD	FV	60.50	58.00	0.0	60.50	54.50	13.0
	TEIL 3							
	GT 1							
46	WEST	FV	50.00	58.00	0.0	50.00	61.50	17.0
47	OBER	FH	40.00	58.00	17.0	50.00	58.00	3.5
48	SÜD	FV	40.00	61.50	0.0	40.00	58.00	17.0
	GT 2							
49	WEST	FV	70.00	58.00	0.0	70.00	61.50	17.0
50	OBER	FH	60.00	58.00	17.0	70.00	58.00	3.5
51	SÜD	FV	60.00	61.50	0.0	60.00	58.00	17.0
	KESSELVORDERTEIL							
	GT 1							
52	WEST	FV	51.00	61.50	0.0	51.00	67.00	20.0
53	OBER	FH	39.00	61.50	20.0	51.00	61.50	5.5
54	SÜD	FV	39.00	67.00	0.0	39.00	61.50	20.0
	GT 2							
55	WEST	FV	71.00	61.50	0.0	71.00	67.00	20.0
56	OBER	FH	58.00	61.50	20.0	71.00	61.50	5.5
57	SÜD	FV	58.00	67.00	0.0	58.00	61.50	20.0
	KESSELHINTERTEIL							
	GT 1							
58	WEST	FV	61.00	67.00	0.0	51.00	72.50	20.0
59	OBER	FH	39.00	67.00	20.0	61.00	67.00	5.5
60	SÜD	FV	39.00	72.50	0.0	39.00	67.00	20.0
	GT 2							
61	WEST	FV	71.00	67.00	0.0	71.00	72.50	20.0
62	OBER	FH	58.00	67.00	20.0	71.00	67.00	5.5
63	SÜD	FV	58.00	72.50	0.0	58.00	67.00	20.0

Geometric data sound sources								
No.	Name	TYP	Coordinates Point 1			Coordinates Point 2		
			X	Y	Z	X	Y	Z
			(m)	(m)	(m)	(m)	(m)	(m)
KAMINE KÖRPER								
64	GT 1	LI	45.00	77.00	4.0	45.00	77.00	65.0
65	GT 2	LI	64.50	77.00	4.0	64.50	77.00	65.0
MÜNDUNGEN								
66	GT 1	KU	45.00	77.00	65.0	45.00	77.00	66.0
67	GT 2	KU	64.50	77.00	65.0	64.50	77.00	66.0
TRAFOS								
GT 1								
SE								
68	NORD	FV	32.00	-12.00	0.0	40.00	-12.00	5.0
69	SÜD	FV	40.00	-12.00	0.0	40.00	-7.00	5.0
70	OST	FV	40.00	-7.00	0.0	32.00	-7.00	5.0
71	WEST	FV	32.00	-7.00	0.0	32.00	-12.00	5.0
72	OBER	FH	32.00	-12.00	5.0	40.00	-12.00	5.0
GT 2								
SE								
73	NORD	FV	52.00	-12.00	0.0	60.00	-12.00	5.0
74	SÜD	FV	60.00	-12.00	0.0	60.00	-7.00	5.0
75	OST	FV	60.00	-7.00	0.0	52.00	-7.00	5.0
76	WEST	FV	52.00	-7.00	0.0	52.00	-12.00	5.0
77	OBER	FH	52.00	-12.00	5.0	60.00	-12.00	5.0
OT								
SE								
78	NORD	FV	2.00	-8.00	0.0	10.00	-8.00	5.0
79	SÜD	FV	10.00	-8.00	0.0	10.00	-3.00	5.0
80	OST	FV	10.00	-3.00	0.0	2.00	-3.00	5.0
81	WEST	FV	2.00	-3.00	0.0	2.00	-8.00	5.0
82	OBER	FH	2.00	-8.00	5.0	10.00	-8.00	5.0

Figure 7

Projekt : Marmara Unit

(28.02.94)

Version : 45dB(A) at Houses
acc ANSI 8133.8

Sound sources																						
No.	Name	Typ	BSrc	Attenuation number										K0	Dirrec	DiffFC	ChanC	AreaC	T	v		
				No.	1.	2.	1.	4.	5.	6.	7.	8.	9.	10.	dB	No.	(dB)	(dB)	(dB)	*K	m/s	
GEBÄUDE																						
GENÖRVORBAU																						
SELBST																						
1	NORO	FV	64	372	7	0	0	0	0	0	0	0	0	403	3	1	-5.0	0.0	-10.2			
2	WEST	FV	64	372	7	0	0	0	0	0	0	0	0	403	3	1	-5.0	0.0	-17.2			
3	OST	FV	64	372	7	0	0	0	0	0	0	0	0	403	3	1	-5.0	0.0	-17.2			
4	DACH	FH	64	372	7	0	0	0	0	0	0	0	0	403	1	1	-5.0	0.0	-7.7			
MASCHINENHAUS																						
SELBST																						
5	NORO	FV	64	372	7	0	0	0	0	0	0	0	0	403	3	1	-5.0	0.0	-8.8			
6	WEST	FV	64	372	7	0	0	0	0	0	0	0	0	403	2	1	-5.0	0.0	-12.2			
7	SÜD	FV	64	372	7	0	0	0	0	0	0	0	0	403	2	1	-5.0	0.0	-6.4			
8	OST	FV	64	372	7	0	0	0	0	0	0	0	0	403	2	1	-5.0	0.0	-12.2			
9	DACH	FH	64	372	7	0	0	0	0	0	0	0	0	403	0	1	-5.0	0.0	-6.5			
LÜFTUNG																						
LOUVRE																						
83	GT 1	FV	64	372	0	0	0	0	0	0	0	0	0	403	1	1	-5.0	0.0	-26.2			
84	GT 2	FV	64	372	0	0	0	0	0	0	0	0	0	403	1	1	-5.0	0.0	-26.2			
85	DT	FV	64	372	0	0	0	0	0	0	0	0	0	403	1	1	-5.0	0.0	-25.6			
DACHLÜFTER																						
86	GT 1 A	KU	301	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0			
87	GT 1 B	KU	301	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0			
88	GT 2 A	KU	301	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0			
89	GT 2 B	KU	301	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0			
90	DT A	KU	301	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0			
91	DT B	KU	301	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0			
92	DT C	KU	301	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0			
ANSAUGSYSTEM																						
KANÄLE																						
GT 1																						
10	WEST	FV	67	53	61	105	0	0	0	0	0	0	0	0	4	1	0.0	-1.8	0.0			
11	OBER	FH	67	53	61	105	0	0	0	0	0	0	0	0	2	1	0.0	-2.4	0.0			
12	OST	FV	67	53	61	105	0	0	0	0	0	0	0	0	4	1	0.0	-1.8	0.0			
GT 2																						
13	WEST	FV	67	53	61	105	0	0	0	0	0	0	0	0	4	1	0.0	-1.8	0.0			
14	OBER	FH	67	53	61	105	0	0	0	0	0	0	0	0	2	1	0.0	-2.4	0.0			
15	OST	FV	67	53	61	105	0	0	0	0	0	0	0	0	4	1	0.0	-1.8	0.0			
FILTER																						
GT 1																						
16	WEST	FV	67	53	0	0	256	133	0	0	0	0	0	0	4	1	0.0	0.0	-5.2			
17	OST	FV	67	53	0	0	256	133	0	0	0	0	0	0	2	1	0.0	0.0	-5.2			
18	NORO	FV	67	53	0	0	256	133	0	0	0	0	0	0	4	1	0.0	0.0	-4.0			
GT 2																						
19	WEST	FV	67	53	0	0	256	133	0	0	0	0	0	0	4	1	0.0	0.0	-5.2			
20	OST	FV	67	53	0	0	256	133	0	0	0	0	0	0	2	1	0.0	0.0	-5.2			
21	NORO	FV	67	53	0	0	256	133	0	0	0	0	0	0	4	1	0.0	0.0	-4.0			
ABGASSYSTEM																						
DIFFUSOREN																						
GT 1																						
22	WEST	FV	62	82	104	0	0	0	0	0	0	0	0	0	2	1	0.0	0.7	0.0			
23	OBER	FH	62	82	104	0	0	0	0	0	0	0	0	0	0	1	0.0	0.7	0.0			
24	SÜD	FV	62	82	104	0	0	0	0	0	0	0	0	0	2	1	0.0	0.7	0.0			
GT 2																						
25	WEST	FV	62	82	104	0	0	0	0	0	0	0	0	0	2	1	0.0	0.7	0.0			

Figure 8

Marmara Unit - 45dB(A) at Houses (28.02.94)

Sound sources																				
No.	Name	Type	BSrc	Attenuation number										K0	Dires	DiffC	CharC	AreaC	T	v
				No.	1.	2.	3.	4.	5.	6.	7.	8.	9.							
26	OBEN	FH	62	82	104	0	0	0	0	0	0	0	0	0	1	0.0	0.7	0.0		
27	SÜD	FV	62	82	104	0	0	0	0	0	0	0	0	2	1	0.0	0.1	0.0		
	SCHALLDÄMPFER																			
	GT 1	FV	62	62	104	0	0	0	0	0	0	0	0	2	1	0.0	-0.6	0.0		
28	WEST	FH	62	62	104	0	0	0	0	0	0	0	0	0	1	0.0	0.0	0.0		
29	OBEN	FV	62	62	104	0	0	0	0	0	0	0	0	2	1	0.0	-0.6	0.0		
30	SÜD																			
	GT 2	FV	62	62	104	0	0	0	0	0	0	0	0	2	1	0.0	-0.6	0.0		
31	WEST	FH	62	62	104	0	0	0	0	0	0	0	0	0	1	0.0	0.0	0.0		
32	OBEN	FV	62	62	104	0	0	0	0	0	0	0	0	2	1	0.0	-0.6	0.0		
33	SÜD																			
	TEIL 1																			
	GT 1	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-3.6	0.0		
34	WEST	FH	62	60	0	186	0	0	0	0	0	0	0	0	1	0.0	-4.6	0.0		
35	OBEN	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-3.6	0.0		
36	SÜD																			
	GT 2	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-3.6	0.0		
37	WEST	FH	62	60	0	186	0	0	0	0	0	0	0	0	1	0.0	-4.6	0.0		
38	OBEN	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-3.6	0.0		
39	SÜD																			
	TEIL 2																			
	GT 1	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-4.1	0.0		
40	WEST	FH	62	60	0	186	0	0	0	0	0	0	0	0	1	0.0	-5.7	0.0		
41	OBEN	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-4.1	0.0		
42	SÜD																			
	GT 2	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-4.1	0.0		
43	WEST	FH	62	60	0	186	0	0	0	0	0	0	0	0	1	0.0	-5.7	0.0		
44	OBEN	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-4.1	0.0		
45	SÜD																			
	TEIL 3																			
	GT 1	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-4.6	0.0		
46	WEST	FH	62	60	0	186	0	0	0	0	0	0	0	0	1	0.0	-6.9	0.0		
47	OBEN	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-4.6	0.0		
48	SÜD																			
	GT 2	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-4.6	0.0		
49	WEST	FH	62	60	0	186	0	0	0	0	0	0	0	0	1	0.0	-6.9	0.0		
50	OBEN	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-4.6	0.0		
51	SÜD																			
	KESSELVORDERTeil																			
	GT 1	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-3.4	0.0		
52	WEST	FH	62	60	0	186	0	0	0	0	0	0	0	0	1	0.0	-5.6	0.0		
53	OBEN	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-3.4	0.0		
54	SÜD																			
	GT 2	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-3.4	0.0		
55	WEST	FH	62	60	0	186	0	0	0	0	0	0	0	0	1	0.0	-5.3	0.0		
56	OBEN	FV	62	60	0	186	0	0	0	0	0	0	0	2	1	0.0	-3.4	0.0		
57	SÜD																			
	KESSELHINTERTEIL																			
	GT 1	FV	62	60	0	186	52	0	0	0	0	0	0	2	1	0.0	-3.4	0.0		
58	WEST	FH	62	60	0	186	52	0	0	0	0	0	0	0	1	0.0	-5.6	0.0		
59	OBEN	FV	62	60	0	186	52	0	0	0	0	0	0	2	1	0.0	-3.4	0.0		
60	SÜD																			
	GT 2	FV	62	60	0	186	52	0	0	0	0	0	0	2	1	0.0	-3.4	0.0		
61	WEST	FH	62	60	0	186	52	0	0	0	0	0	0	0	1	0.0	-5.3	0.0		
62	OBEN	FV	62	60	0	186	52	0	0	0	0	0	0	2	1	0.0	-3.4	0.0		
63	SÜD																			
	KAMINE																			
	KÖRPER																			
64	GT 1	LI	62	82	54	186	52	0	0	0	0	0	0	0	1	0.0	15.4	0.0		
65	GT 2	LI	62	82	54	186	52	0	0	0	0	0	0	0	1	0.0	15.4	0.0		

Figure 9

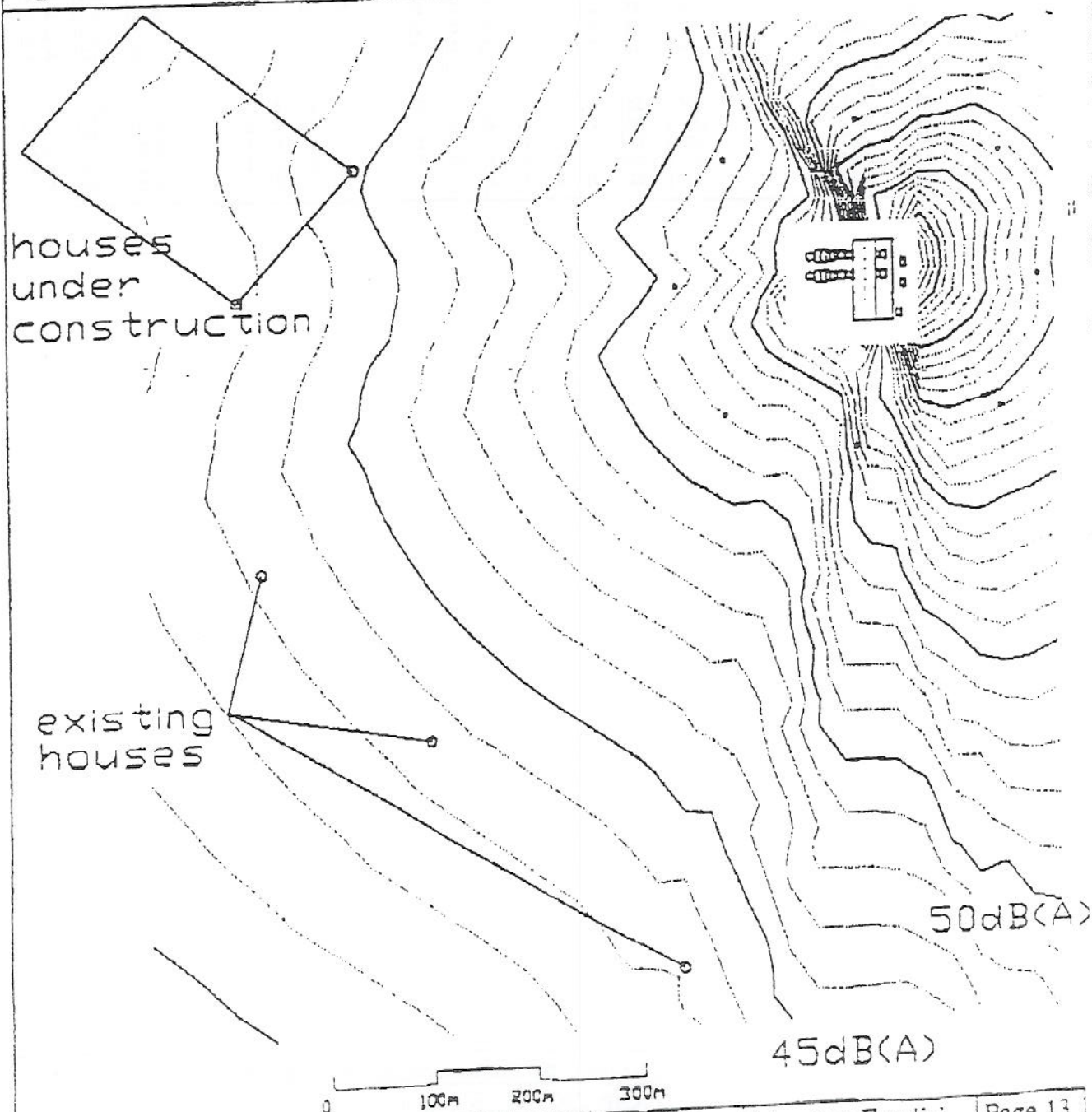
Marmara Unit - 45dB(A) at Houses (28.02.94)

Sound sources																			
No.	Name	Type	ESrc	Attenuation number										K0	Dirac	DiffC	ChanC	AreaC	T
			No.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	dB	No.	(dB)	(dB)	(dB)	*K/m/s
56	MÜNDÜNGEN																		
66	GT 1	KU	62	0	54	186	52	42	1	0	0	0	0	0	-1	0.0	0.0	0.0	393
67	GT 2	KU	62	0	54	186	52	42	1	0	0	0	0	0	-1	0.0	0.0	0.0	393
68	TRAFOS																		
68	GT 1																		
68	SE																		
68	NORD	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-6.3	
69	SÜD	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-8.3	
70	OST	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-6.3	
71	WEST	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-8.3	
72	OBERN	FH	155	0	0	0	0	0	0	0	0	0	0	0	1	0.0	0.0	-6.3	
73	GT 2																		
73	SE																		
73	NORD	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-6.3	
74	SÜD	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-8.3	
75	OST	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-6.3	
76	WEST	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-8.3	
77	OBERN	FH	155	0	0	0	0	0	0	0	0	0	0	0	1	0.0	0.0	-6.3	
78	GT																		
78	SE																		
78	NORD	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-6.3	
79	SÜD	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-8.3	
80	OST	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-6.3	
81	WEST	FV	155	0	0	0	0	0	0	0	0	0	0	3	1	0.0	0.0	-8.3	
82	OBERN	FH	155	0	0	0	0	0	0	0	0	0	0	0	1	0.0	0.0	-6.3	

Figure 10

MARMARA UNIT / KA 13E2-2

Sound pressure level isobare curves
1.5 m above ground
28.02.94 / ABB Turbo Systems AG
ZXE-11 / Scholz
calculation without influence of
ground elevation



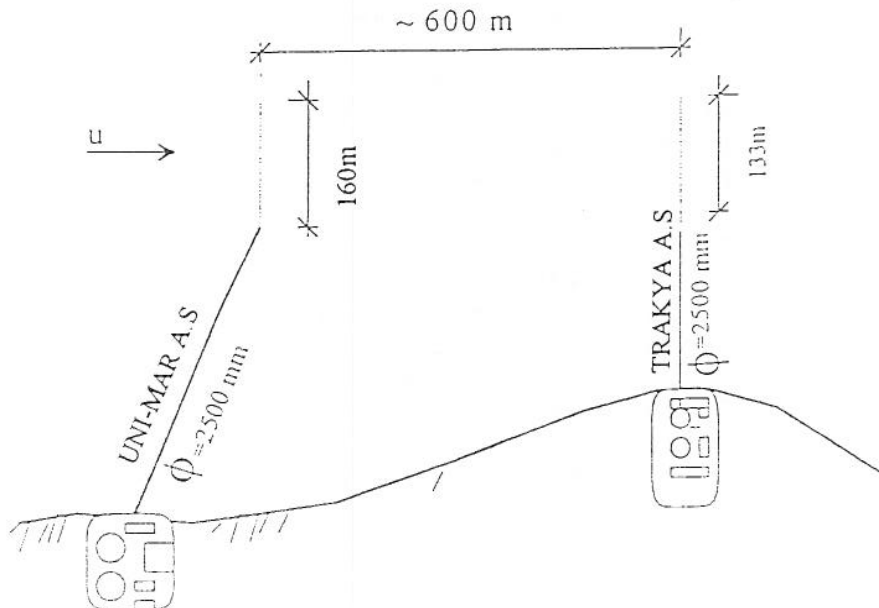
**THERMAL DISCHARGE
CUMULATIVE EFFECTS
of
UNI-MAR ENERİ YATIRIMLARI A.Ş.
and
TRAKYA ÜRETİM ve TİCARET A.Ş.
COMBINED CYCLE POWER PLANTS
at
MARMARA EREĞLİSİ**

**İTÜ FACULTY of CIVIL ENGINEERING
Department of
ENVIRONMENTAL ENGINEERING
JUNE, 1994**

MARMARA EREGLISI TWO NATURAL GAS POWER PLANTS THERMAL DISCHARGE CUMULATIVE EFFECTS

Data related to thermal sea discharges of the two Combined Cycle Power Plants being planned in Marmara Ereğlisi, by UNI-MAR Enerji Yatırımları A.Ş. (UNI-MAR) and TRAKYA Elektrik Üretim ve Ticaret A.Ş. (TRAKYA) companies were utilized in the THERMOD model developed by the Environmental Engineering Department of ITU and the cumulative effect of both discharges were studied. Based on this data and taking into consideration the prevailing flows, wind and other oceanographic data calculations were made. The model showed that thermal discharge cloud from the UNI-MAR Natural Gas Power Plant may overlap the thermal discharge outlet point of the other Power Plant. Thus, the additional effect of the UNI-MAR Plant discharge on the TRAKYA Plant discharge was examined.

The two discharge lines are situated 600m apart from each other. The temperature of the UNI-MAR thermal discharge cloud at the sea the surface after secondary dilution and 600m away from UNI-MAR discharge was calculated using THERMOD computer model, and the results were used in calculating TRAKYA discharge surface temperature. The model was also used to calculate the TRAKYA discharge surface temperature alone, without the interference of the UNI-MAR Plant and the difference between the two results was calculated. According to this result, UNI-MAR thermal discharge increases the temperature of the TRAKYA discharge primary dilution by 0.02°C . According to the Water Pollution Control Regulation, the allowable temperature difference between existing sea surface temperature and the temperature at the sea surface after primary dilution is $<2^{\circ}\text{C}$. For TRAKYA discharge, jet temperature at the surface after primary dilution is 9.06°C and sea surface temperature prior to discharge at this point is 8.47°C . Accordingly, temperature difference due to discharge is $9.06-8.47=0.59^{\circ}\text{C}$. Therefore, the cumulative effect of the two discharges are considered within the Regulation limits. In Summer, a submerged field is formed from the UNI-MAR discharge and the temperature of the thermal cloud decreases down to the temperature of the medium, at 600m. As a result, in summer, UNI-MAR thermal discharge does not have an additional (negative) effect on the TRAKYA thermal discharge. On the other hand, TRAKYA discharge would not effect the UNI-MAR discharge whereas the prevailing flow is from Istanbul to Çanakkale direction.



THERMAL DISCHARGE CUMULATIVE EFFECTS of UNI-MAR A.S. and
TRAKYA A.S. POWER PLANTS
MODEL INPUT and OUTPUT for WINTER SEASON

Effluent Temperature (°C): 20
Effluent Salinity (‰): 28.422
Diameter of Discharge Line Pipe (m): 3
Port Diameter (m) .45
Tickles of Mixing Layer (m): 1
Discharge Depth (m) 6
Discharge Flowrate 9.5
Number of Ports 30

No	DEPTH	TEMPE	SALN	AV.DEN	AX.DIL	AX.DENS	AV.DIL	AV.DEN	AV.TEM
1	6	8.305	28.636	22.2305	4.0363	21.6262	8.0726	21.9284	9.7870
2	5	8.381	28.535	22.1407	5.5042	21.7634	11.0084	21.9850	9.4222
3	4	8.457	28.433	22.0970	6.6022	21.8189	13.2043	22.0036	9.2620
4	3	8.461	28.437	22.0995	7.5057	21.8527	15.0113	22.0152	9.1658
5	2	8.465	28.441	22.0971	8.2889	21.8758	16.5777	22.0229	9.0997
6	1	8.468	28.432	22.0892	8.9890	21.8924	17.9781	22.0281	9.0507

Length of Difuzer Pipe (m): 133
Angle between the Current and the Diffuser(°): 90
Current Velocity(m/sec): .1
Distance of Temperature Curves from the Diffuser (m): 1000

T(100 0)= 9.043551
T(100 81)= 9.037618
T(100 163)= 9.020185
T(100 245)= 8.992313
T(100 326)= 8.955654
T(100 408)= 8.912282
T(100 490)= 8.864508
T(100 571)= 8.814671
T(100 653)= 8.764957
T(100 735)= 8.717251
T(100 817)= 8.673034
T(100 898)= 8.633339
T(100 980)= 8.598753

T(200 0)= 8.994523
T(200 81)= 8.989099
T(200 163)= 8.973158
T(200 245)= 8.947674
T(200 326)= 8.914153
T(200 408)= 8.874496
T(200 490)= 8.830812
T(200 571)= 8.785242
T(200 653)= 8.739786
T(200 735)= 8.696164
T(200 817)= 8.655733
T(200 898)= 8.619437
T(200 980)= 8.587813

T(300 0)= 8.933305
 T(300 81)= 8.928514
 T(300 163)= 8.914438
 T(300 245)= 8.891933
 T(300 326)= 8.862332
 T(300 408)= 8.827312
 T(300 490)= 8.788737
 T(300 571)= 8.748496
 T(300 653)= 8.708355
 T(300 735)= 8.669835
 T(300 817)= 8.634131
 T(300 898)= 8.602079
 T(300 980)= 8.574154

T(400 0)= 8.877925
 T(400 81)= 8.873709
 T(400 163)= 8.861319
 T(400 245)= 8.84151
 T(400 326)= 8.815454
 T(400 408)= 8.78463
 T(400 490)= 8.750675
 T(400 571)= 8.715255
 T(400 653)= 8.679922
 T(400 735)= 8.646016
 T(400 817)= 8.61459
 T(400 898)= 8.586378
 T(400 980)= 8.561797

T(500 0)= 8.831065
 T(500 81)= 8.827334
 T(500 163)= 8.816371
 T(500 245)= 8.798843
 T(500 326)= 8.775788
 T(500 408)= 8.748513
 T(500 490)= 8.718469
 T(500 571)= 8.687127
 T(500 653)= 8.655864
 T(500 735)= 8.625862
 T(500 817)= 8.598055
 T(500 898)= 8.573092
 T(500 980)= 8.551341

T(600 0)= 8.791903
 T(600 81)= 8.788577
 T(600 163)= 8.778806
 T(600 245)= 8.763185
 T(600 326)= 8.742638
 T(600 408)= 8.718329
 T(600 490)= 8.691552
 T(600 571)= 8.66362
 T(600 653)= 8.635756
 T(600 735)= 8.609018
 T(600 817)= 8.584235
 T(600 898)= 8.561987
 T(600 980)= 8.542603

T(700 0)= 8.759079
T(700 81)= 8.756094
T(700 163)= 8.747322
T(700 245)= 8.733299
T(700 326)= 8.714853
T(700 408)= 8.693031
T(700 490)= 8.668994
T(700 571)= 8.643918
T(700 653)= 8.618904
T(700 735)= 8.594901
T(700 817)= 8.572653
T(700 898)= 8.552681
T(700 980)= 8.535279

T(800 0)= 8.731365
T(800 81)= 8.728666
T(800 163)= 8.720739
T(800 245)= 8.708065
T(800 326)= 8.691394
T(800 408)= 8.671671
T(800 490)= 8.649946
T(800 571)= 8.627283
T(800 653)= 8.604675
T(800 735)= 8.582981
T(800 817)= 8.562874
T(800 898)= 8.544823
T(800 980)= 8.529095

T(900 0)= 8.707763
T(900 81)= 8.705309
T(900 163)= 8.6981
T(900 245)= 8.686575
T(900 326)= 8.671415
T(900 408)= 8.65348
T(900 490)= 8.633724
T(900 571)= 8.613115
T(900 653)= 8.592558
T(900 735)= 8.57283
T(900 817)= 8.554545
T(900 898)= 8.538131
T(900 980)= 8.523829

T(1000 0)= 8.68749
T(1000 81)= 8.685246
T(1000 163)= 8.678655
T(1000 245)= 8.668116
T(1000 326)= 8.654254
T(1000 408)= 8.637855
T(1000 490)= 8.619791
T(1000 571)= 8.600946
T(1000 653)= 8.58215
T(1000 735)= 8.564111
T(1000 817)= 8.547392
T(1000 898)= 8.532382
T(1000 980)= 8.519305

**AIR POLLUTION
CUMULATIVE EFFECTS
of
UNI-MAR ENERİ YATIRIMLARI A.Ş.
and
TRAKYA ÜRETİM ve TİCARET A.Ş.
COMBINED CYCLE POWER PLANTS
at
MARMARA EREĞLİSİ**

**İTÜ FACULTY of CIVIL ENGINEERING
Department of
ENVIRONMENTAL ENGINEERING
JUNE, 1994**

AIR POLLUTION CUMULATIVE EFFECTS of TWO NATURAL GAS POWER PLANTS at MARMARA EREGLISI

The effects in the case of a second Combined Cycle Natural Gas Power Plant (480 MW) is built close to the UNI-MAR Plant were studied utilizing Gauss Dispersion Model, which was used before to determine the effects of the UNI-MAR Plant on the ambient air quality. The model is able to estimate effects from more than one point source. The two Power Plants were placed on the 1 km² grid system with their coordinates. The characteristics of both Plants (exhaust stack temperature, stack plan, pollutant emissions) and the meteorological variables were used as input data.

The source characteristics of the second Plant are unknown. Therefore the capacity and pollution characteristics of the second Power Plant assumed to be equivalent to UNI-MAR Plant and taking the same fuel specifications for both Plants, calculations were made by the model for the following scenarios.

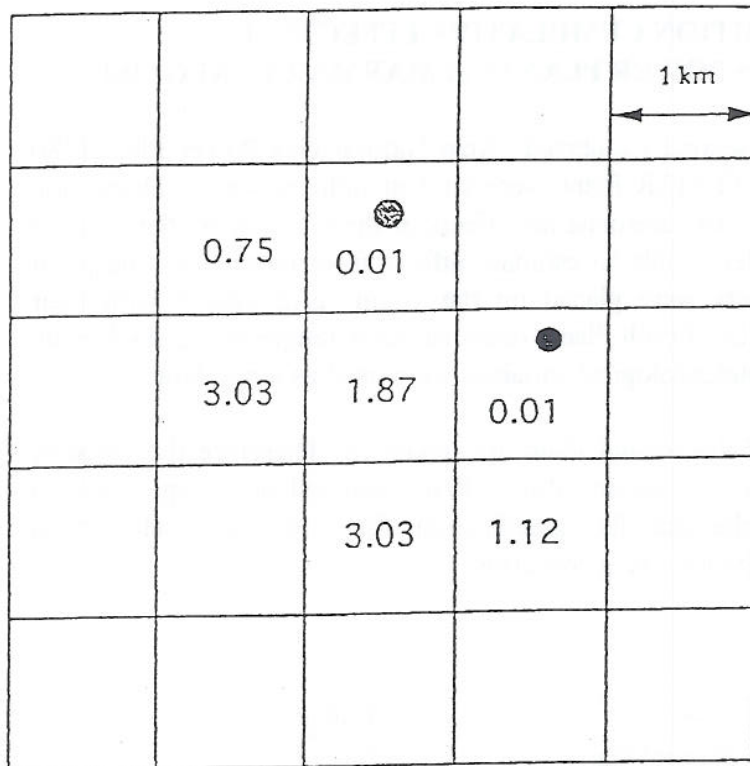
	Fuel	Pollutant
Scenario 4	Natural Gas	No _x
Scenario 9	Fuel oil (%0.75) (Tüpras 400)	SO ₂

The scenarios are studied under unstable and neutral atmospheric stability categories and for two different plume heights (314m and 35m). Calculated dispersions are given in Figure 1, Figure 2 and Figure 3.

The model results show that, NO_x and SO₂ concentrations are below the air quality standards given in the Air Quality Control Regulation.

SCENARIO 4: Two Point Sources

Fuel : Natural Gas
Pollutant : NO_x



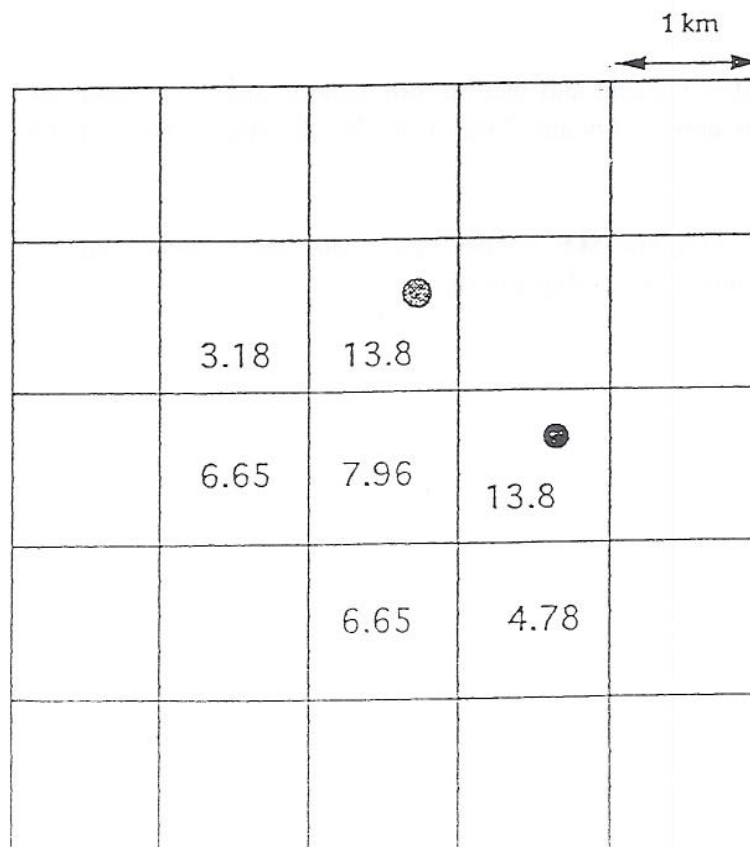
Atmospheric Stability : Unstable

$\Delta h = 314$ m

$H = 379$ m

⊗ Location of the 1st Power Plant

● Location of the 2nd Power Plant



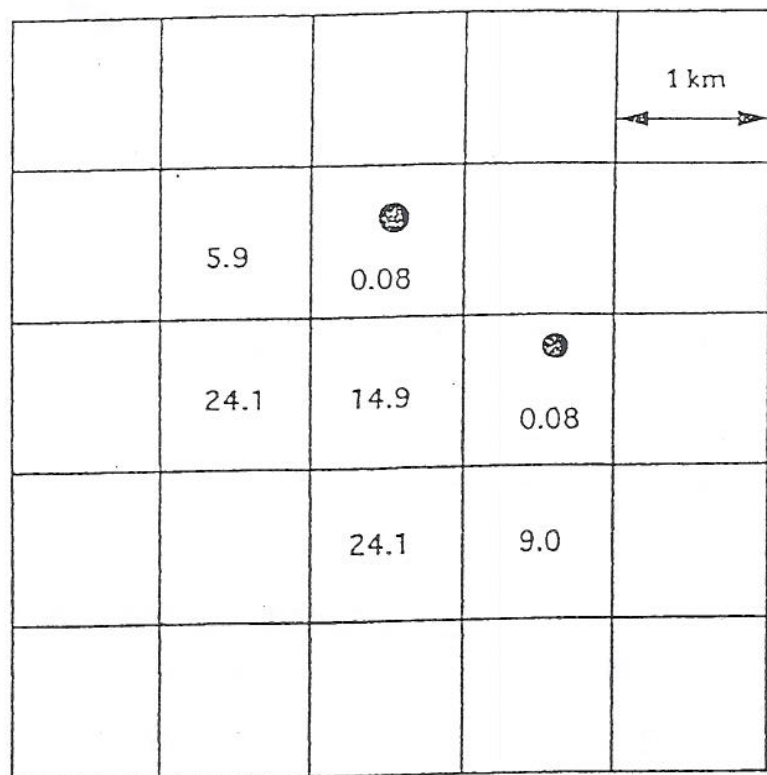
(Minimum Δh)

$\Delta h = 35$ m

$H = 100$ m

Figure 1. Ground-level NO_x Concentration Distribution for Unstable Conditions ($\mu\text{g}/\text{m}^3$)

SCENARIO 9: Two Point Sources
 Fuel: Fuel-oil No.2 (0.7 %S)
 Pollutant: SO_2



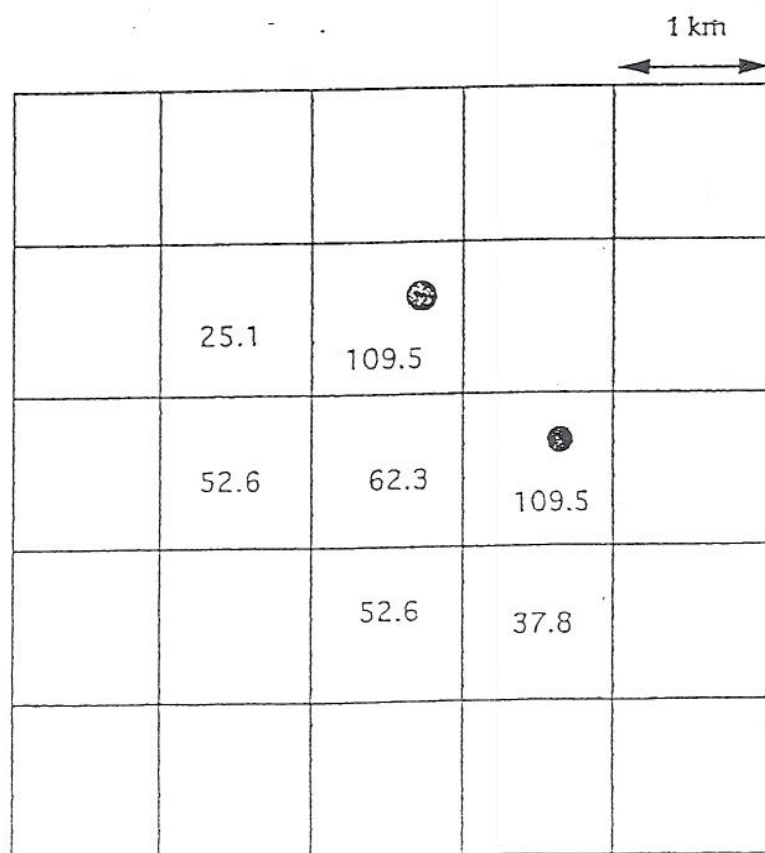
Atmospheric Stability: Unstable

$\Delta h = 314 \text{ m}$

$H = 379 \text{ m}$

⊗ Location of the 1st Power Plant

⊙ Location of the 2nd Power Plant



(Minimum Δh)

$\Delta h = 35 \text{ m}$

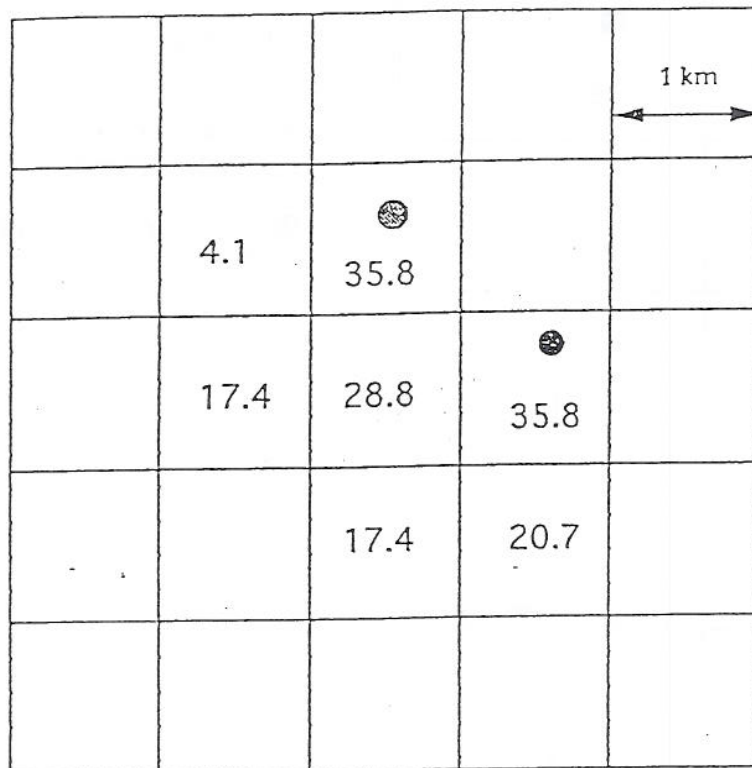
$H = 100 \text{ m}$

Figure 2. Ground-level SO_2 Concentration Distribution for Unstable Conditions ($\mu\text{g}/\text{m}^3$)

SCENARIO 9: Two Point Sources

Fuel : Fuel-oil No.2 (0.7 %S)

Pollutant : SO₂



Atmospheric Stability : Neutral

(Minimum Δh)

$\Delta h = 35$ m

H = 100 m

- Location of the 1st Power Plant
- Location of the 2nd Power Plant

(No detectable concentrations for H = 232 m)

Figure 3. Ground- level SO₂ Concentration Distribution for Neutral Conditions ($\mu\text{g}/\text{m}^3$)

ANNEX VIII.5.1

PROTOCOL

The following agreement has been reached between UNI-MAR A.S. and the Municipality of Marmara Ereğlisi concerning construction and erection of the 500MW B.O.T. Power Plant which will be realized in Marmara Ereğlisi-Sultankoy

The following agreement has been reached between UNI-MAR Enerji Yatirimlari A.S. and/or its Contractor and/or Subcontractors and the Municipality of Marmara Ereglisi for cooperation and assistance in the frame of related Laws and Regulations, during construction and operation of 500 MW Combined Cycle Power Plant which will be constructed and operated by UNI-MAR Enerji Yatirimlari A.S. on Built-Operate-Transfer basis in Marmara Ereglisi, Sultankoy location.

Marmara Ereglisi Municipality will;

- allocate disposal area for excess excavation material, solid waste, domestic solid waste, and all waste material such as: mud, metal, debris, garbage, chemical waste (like paint, battery i.e.),
- discharge septic tank which will be used at the Site during construction,
- give opinion and recommendation for the accommodation of the Power Plant into the environment,
- cooperate for local urban plan, modification of existing urban plan(s), expropriation, land value evaluation works and determination of the health protection zone.

UNI-MAR A.S. will;

- finalize all technical work for the local urban plan and plan modification for the Power Plant Site,
- complete all studies and take necessary measures in order to get permits, consent and other services that will be given by the Municipality,
- inform the public through the Municipality before use of explosives or any other activity that may cause sudden noise impact during construction.
- take necessary measures to prevent environmental discomfort, particularly dust emissions during construction.
- carry out technical, administrative and financial responsibilities that envisaged by the Laws, Regulations and Tariffs and required for environmental works and the Municipal services

UNI-MAR A.S.
Alaaddin Kayihan

Marmara Ereglisi Municipality
Mayor
Enis SULUN

PREPARERS

LIST OF PREPARERS

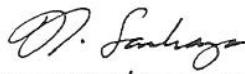
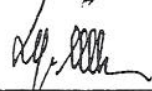
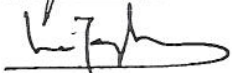
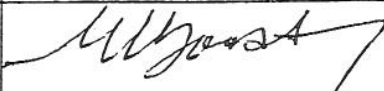
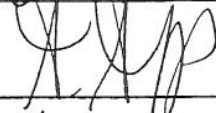
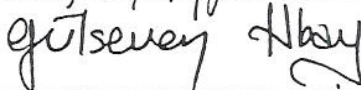
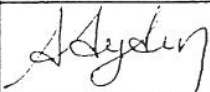
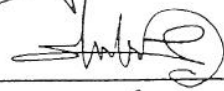
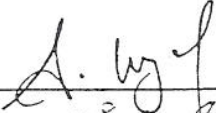
I.PREPARERS FROM THE ENVIRONMENTAL ENGINEERING DEPARTMENT OF ITU

Preparer	Experience and Expertise
Prof.Dr. Veysel Eroğlu Project Manager (Except last month)	Civil and environmental engineering, 20 years of teaching, research and design experience. Specialized in the fields of optimization, water and wastewater treatment technologies.
Assoc.Prof.Dr. İzzet ÖztürkProject Manager (During the last month)	Civil and environmental engineering. 17 years of experience Specialized in marine pollution control, sea outfalls, biotechnology, and treatment technologies.
Dr. İbrahim Demir Assistant Project Manager	Civil and environmental engineering, 10 years of experience. Specialized in anaerobic treatment.
Prof.Dr. Hasan Z.Sarıkaya	Civil and environmental engineering. 25 years of experience. Chairman of the Department for the last 3 years. Specialized in water pollution control, sea discharges, water quality modelling, environmental economics and treatment technologies
Prof.Dr. Remzi Ülker	Civil and geotechnical engineering 35 years of experience. Specialized in soil mechanics and foundation engineering.
Prof.Dr. Nadir Yayla	Civil and transportation engineering.30 years of experience. Dean of the Faculty of Civil Engineering. Specialized in highway design and transportation engineering.
Assoc. Prof. Dr. Mehmet Borat	Civil and environmental engineering. 30 years of experience. Specialized in solid wastes, hazardous wastes, EIA, planning of environmental
Assis. Prof. Dr. Atilla Altay	Civil and environmental engineering. 15 years of experience. Specialized in noise pollution control.
Dr. Kadir Alp	Chemical engineering. 10 years of experience. Specialized in air pollution control and analytical technique.
Dr. Gülseven Ubay	Environmental engineering, 7 years of experience. Specialized in anaerobic wastewater treatment and modelling.
Hürrem Bayhan	Biolog 15 years of experience. Specialized in hydrobiology, microbiology and marine biology.
Ali Fuat Aydın	Environmental engineer, 4 years of experience. Water quality modelling, computer programming, modelling of the thermal discharges.

II. PREPARES FROM OTHER INSTITUTIONS

Preparer	Experience and Expertise
Prof.Dr. Ferruh Ertürk	Chemical and environmental, engineering. Head of Environmental Engineering Department of Yıldız Technical University. 20 years of experience. Specialized in air pollution control and air pollution modelling.
Assoc.Prof. Dr. Erdoğan Okkuş	Marine biologist. Marine Sciences Institute of Istanbul University.
Dr. Ayhan Uysal	Marine biologist. Istanbul University, Institute of Marine Sciences and Management 20 years of experience. Specialized in stock assesment, macrobenthos and marine biology.
İpek Erzi	Environmental Engineer.

This environmental impact assessment report was prepared by the experts whose signatures appeared below.

Preparer	Signature
Prof.Dr. Veysel Eroğlu Project Manager (Except last month)	
Assoc.Prof.Dr. İzzet Öztürk Project Manager (During the last month)	
Dr. İbrahim Demir Assistant Project Manager	
Prof.Dr. Hasan Z.Sarıkaya	
Prof.Dr. Remzi Ülker	
Prof.Dr. Nadir Yayla	
Assoc.Prof. Dr. Mehmet Borat	
Assoc. Prof. Dr. Atilla Altay	
Dr. Kadir Alp	
Dr. Gülseven Ubay	
Hürrem Bayhan	
Ali Fuat Aydın	
Prof.Dr. Ferruh Ertürk	
Assoc.Prof. Dr. Erdoğan Okkuş	
Dr. Ayhan Uysal	
İpek Erzi	

ACKNOWLEDGMENTS

We would like to extend out thanks to

Prof.Dr.Olcay Tünay, Cengiz Baske, Chemical Engineer,MS. Nursen Eldem, Research Assistant Rüya Taşlı and Technician Hakan Kalender for their contributions to laboratory analyses,

Assistant Prof.Dr. Yunus Kalkan and Research Assistant Reha Alkan for their help in for topographic studies,

Dr. Ayşe Gül Baysal Tanık and Research Assistant Emine Ubay for their assistance in the organization and translation of this report,

Finally, Department Secretaries Aynur Bilen and Ayşe Bayraktutan for their contribution in typing of this report.

