Seymenoba

Seymenoba Elektrik Üretimi A.Ş.
Yeni Demiryolu Caddesi No: 62 41135
Kartepe-Kocaeli/TÜRKİYE
Phone: +90 (262) 317 1000
Fax : +90 (262) 317 1099

KIRIKKALE COGENERATION POWER PLANT

SUPPLEMENTARY DOCUMENT FOR INTERNATIONAL ESIA STUDY

dokay
Çevresel Etki Değerlendirme

DOKAY-ÇED Çevre Mühendisliği Ltd. Şti.
Ata Mah. Kabil Cad. No: 140/A Dikmen
06460 Çankaya-ANKARA/TÜRKİYE
Phone: +90 (312) 475 7131
Fax: +90 (312) 475 7130

APRIL 2013

ANKARA

KIRIKKALE COGENERATION POWER PLANT

Project No.: 169.02.02

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April / 2013

REVISION LOG

		Revizyon Numarası Revision Number		
		0	1	2
Tarih Date		11.03.2013	04.04.2013	16.04.2013
Rapor Adı Report Title	Supplementary Document for Kırıkkale Cogeneration Power Plant International ESIA Study			
Hazırlayan Prepared by	Orçun YILDIZCA			
Teknik Kontrol Technical Control	Deniz YURTERİ			
Kalite Kontrol Quality Control	Yeşim AŞTI			
Şirket Müdürü Director	Prof. Dr. Coşkun YURTERİ			

Form No: PJ-001/F02-R04

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ABBREVIATIONS

%	Percentage
°C	Degree Celsius
AES-Entek	AES-Entek Elektrik Üretimi A.Ş.
CEMP	Construction Environmental Management Plan
CPP	Cogeneration Power Plant
DOKAY-ÇED	DOKAY-ÇED Çevre Mühendisliği Ltd. Şti.
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
ESIA	(International) Environmental and Social Impact Assessment
EU	European Union
HSE	Health, Safety, and Environment
HSE CTS	HSE Compliance Tracking System
IFC	International Finance Corporation
kV	Kilovolt
kWh	Kilowatt-hour
m	Meter
m^3	Cubic Meter
MWe	Megawatt electrical
MWt	Megawatt thermal
NTS	Non-technical Summary
OPIC	Overseas Private Investment Corporation
Pcs	Pieces
PR	Performance Requirement
PS	Performance Standard
SEP	Stakeholder Engagement Plan
Seymenoba	Seymenoba Elektrik Üretimi A.Ş

1. INTRODUCTION

Seymenoba Elektrik Üretimi A.Ş., (Seymenoba) a subsidiary of AES-Entek Elektrik Üretimi A.Ş. (AES-Entek) plans to construct a Cogeneration Power Plant (CPP) having an installed capacity of 233.7 MWe nearby the existing Tüpraş Refinery located in Kırıkkale. Project Site is on the southwest of Kırıkkale province and about 10 km distant from the city center of Kırıkkale on Kırıkkale-Kırşehir Road (see Figure 1).

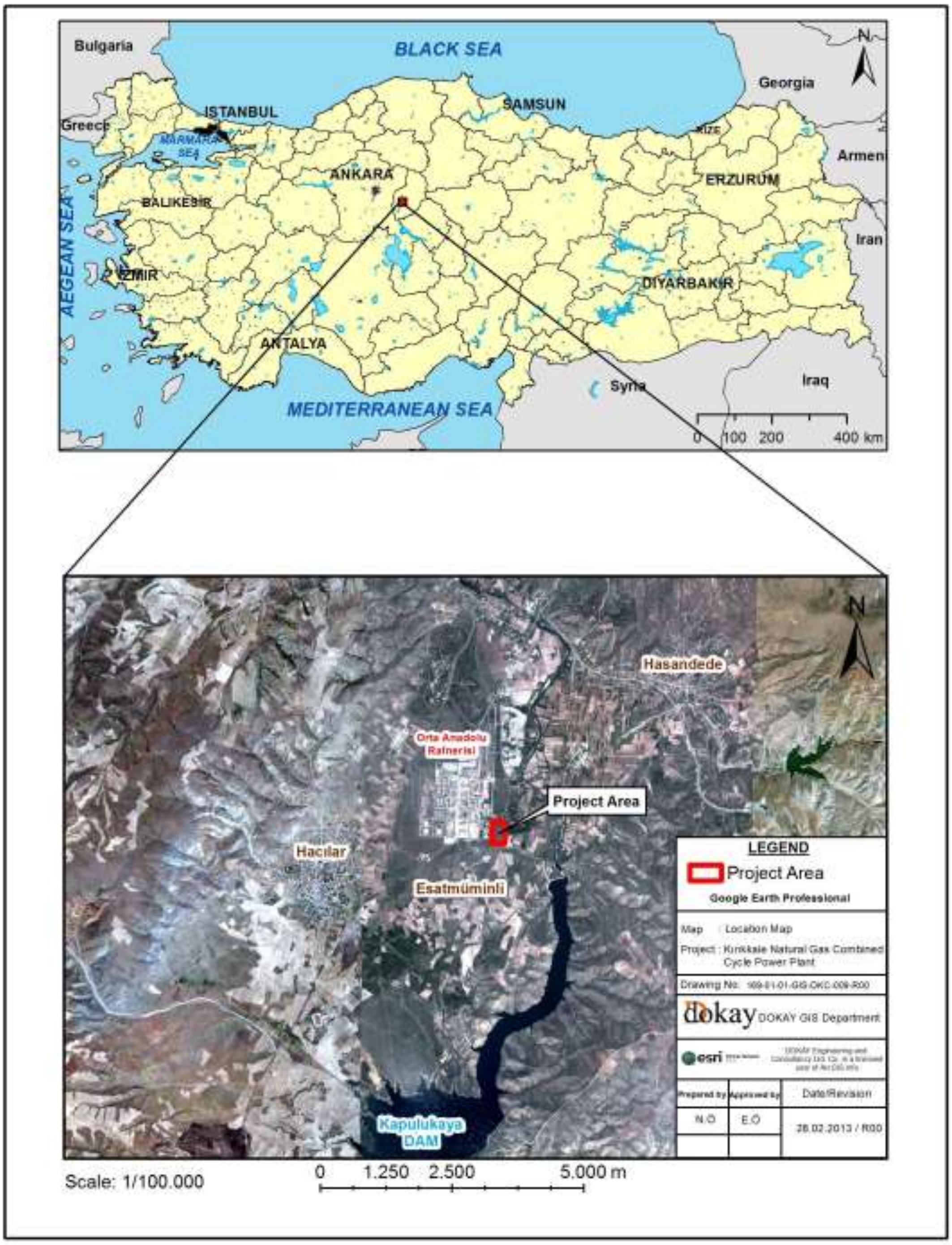

Figure 1. Satellite Image of the Project Area and its Vicinity

The plant will mainly serve to meet steam consumption and electricity demand of the Tüpraş refinery which is 38 MWe. The surplus generation will be supplied to the national mains through 154 kV transmission line.

The Project is included in the scope of the paragraph (a) (the thermal power plants and other incineration systems having a total thermal power of 300 MWt) of the Article 2 of Annex-1 (List of the Projects Subject to Environmental Impact Assessment (EIA)) of the Regulation on Amendment to the EIA Regulation published in the Official Gazette numbered 27980 and dated 30.06.2011.

Kırıkkale Provincial Directorate of Environment and Urbanization has been announced on 28.11.2012 that the Finalized National EIA Report would be disclosed for 10 days.

Seymenoba applied to Energy Market Regulatory Authority (EMRA) on 14.02.2012 to obtain a generation license for the proposed Project.

The European Bank for Reconstruction and Development (EBRD) and Overseas Private Investment Corporation (OPIC) have been approached by AES-Entek to provide financing for the civil engineering works related to the completion of the superstructure, electric transmission lines, gas pipe line, equipment and start-up costs and etc. for the CCP.

The project has been categorized as A category and requires the disclosure of an Environmental and Social Impact Assessment (ESIA).

This document is a supplementary document to the local EIA addressing EBRD, OPIC and Equator Principals requirements for A category Projects. The supplementary ESIA should be great in conjunction with the local EIA, and together forms and ESIA disclosure package in accordance to EBRD and IFC requirements.

2. PROJECT CATEGORIZATION

Under the EBRD Environmental & Social Policy (2008) projects can be categorized as A, B, C or FI based on environmental and social criteria.

As per Appendix-1 of the EBRD Environmental & Social Policy (2008), the proposed Project is categorized as a Category-A project[1] which indicates that the project has the potential to result in significant adverse environmental and social impacts.

As a result of this and in order to meet the requirements of EBRD PR 1, Seymenoba is in the process of producing an ESIA Disclosure Package which will include the following:

- Non-Technical Summary (NTS)
- Stakeholder Engagement Plan (SEP)
- Environmental and Social Management Plan
- Local EIA Report
- Supplementary document addressing any EBRD/IFC requirements that are not covered by National requirements.

[1] *Thermal power stations and other combustion installations with a heat output of 300 MW or more are classified as Category-A projects. Since the proposed Project will have a thermal output of approximately 404 MWt, it is a Category-A Project.*

3. INFORMATION ON THE PROJECT OWNER AND CONTRACTOR

The owner of the Project is Seymenoba, which is a subsidiary of AES-Entek[2]. AES-Entek is a subsidiary of Koç Holding. Koç Group is Turkey's largest group of companies with operations particularly in energy, consumer durables, automotive and finance sectors. Group is the impulsive force of Turkish economy with revenue that constitutes 7% of Turkey's GNP, and an export volume that constitutes 8% of Turkey's total exports. As of 2012, Koç Holding is the only Turkish company in Fortune 500, at 222nd place.

With combined strengths of Koç Group and AES, AES-Entek targets to become one of Turkey's leading private electricity generation companies. To reach such size, AES-Entek closely pursues various investment opportunities including mergers and acquisitions, privatization of generation plants and new plant projects throughout the country.

AES-Entek's shareholder AES is a Fortune 200 international energy company, with diverse electricity generation facilities based on thermal and renewable energy sources as well as electricity distribution assets, and 29.000 employees, providing sustainable energy to 27 countries at favorable prices. AES' revenue in 2010 is 16 Billion dollars, and its total assets are 41 billion dollars.

AES-Entek has appointed Técnicas Reunidas Group as the turnkey EPC Contractor, a Spanish-based general contractor engaged in engineering, design and construction of industrial and power generation plants, particularly in the oil and gas sector.

Since 1960 the Técnicas Reunidas group of companies has designed and built more than 1000 industrial plants worldwide.

Técnicas Reunidas' multinational clients and licensors include the world's leading companies. The projects have been developed in over 50 countries covering the six continents.

The international projection of the Técnicas Reunidas group of companies and the keen specialization in the execution of turnkey projects, have been the bases of Técnicas Reunidas' expansion since the 80's. International projects account for 78% of the company's annual turnover.

[2] *As of December 2010, US-based AES company became a shareholder of Koç Group's electricity production company Entek A.Ş.*

4. PROJECT DESCRIPTION

The installed power of the Project is 233.7 MWe / 404 MWt and it is anticipated to generate a power of 2,030,000,000 kWh per year. The Plant is being established to supply the surplus power to the national grid through 154 kV and to serve the steam and electricity need (maximum 38 MWe) of Tüpraş Refinery. Kırıkkale CPP will consist of two (2) gas turbines, waste heat boilers, one steam turbine and two auxiliary boiler (conventional incineration boiler 95 MWt) blocks. The waste heat boiler will have auxiliary incineration (Post Firing) systems for steam safety of the refinery. There will be four (4) stacks for the Project; two (2) of them belongs to steam boilers and other two (2) will be installed after HRSG units (one for each unit).

At the operation stage, the CPP is anticipated to consume about 300,000,000 m^3 natural gas in average in a year. Natural gas will be supplied from the Kirgaz PRMS station, which is to be constructed about 1200 meters away from the Project Site, or the branch of the station which is located at South border of Tüpraş Refinery.

The cooling type selected for the CPP is wet cooling system and the water to be used for cooling purposes will be supplied from Kapulukaya Dam. Since Tüpraş has financed the construction of Kapulukaya Dam, it is entitled to use 6% of the water. Seymenoba has a protocol with Tüpraş to use this water which has been approved by State Hydraulic Works.

The chlorinated and filtered water will be taken from tanks and treated in the demineralization unit and then be added to the system to compensate the loss the auxiliary steam system and the water-steam cycle.

The proposed CPP will run on natural gas. In the event that any major natural gas interruption or any extraordinary situation occurs at the plant or if it is not possible to supply natural gas, diesel oil will be used in gas turbine for ensuring the electricity and safety of Tüpraş. Nevertheless, in case of any problem, limited amount of steam will be generated by using fuel oil (fuel oil no: 4) in the auxiliary boiler to supply the required steam only for ensuring the safety of the Refinery. Figure 2 shows the working principle of CPPs.

The plant is designed for dual fuel operation with natural gas as the primary fuel, diesel oil being used as the back-up fuel for the GTs and HRSGs, and heavy fuel oil (HFO) being used for the Auxiliary Boilers. It is envisaged that three days storage will be provided for each type of back-up fuel to ensure continuity of steam and electricity supply to the Refinery. Storage tanks will be located on site.

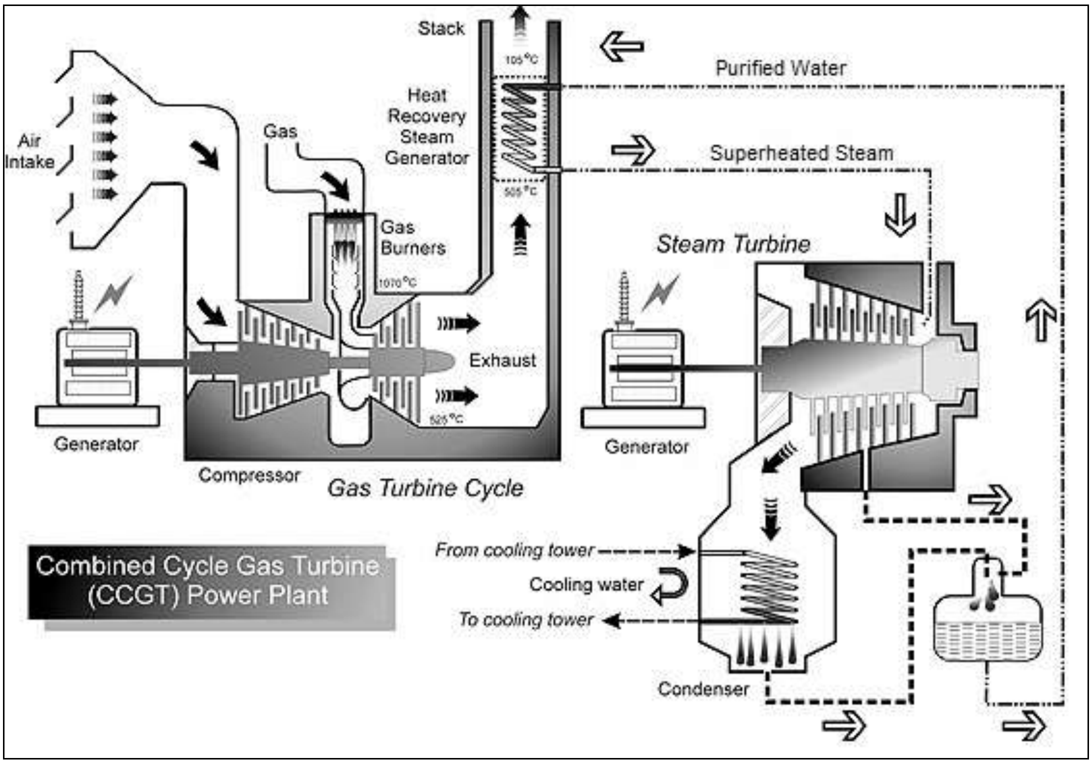

Figure 2. Typical Diagram of a Cogeneration Power Plant

The air taken from the atmosphere is passed through a filter system and enters into the compressor part of the gas turbine, compressed here and then transmitted to the combustion chamber. The fuel sprayed to the combustion chamber mixes with the compressed air and burns.

The high-pressure gas produced by combustion, which is at a temperature above 1000 – 1100 °C, passes through the blades of the turbine and rotates it and thus, electric power is generated by the generator connected to the turbine. The waste gas at the temperature of 500 – 600 °C exiting from the gas turbine is transmitted through an exhaust pipe to the waste heat boiler. The exhaust gas entering into the waste heat boiler cools and then is released to the atmosphere through the boiler flue.

In general, there are three different heat exchanger parts in a HRSG. In Rankine cycle, water first enters into economizer and is heated up to a temperature slightly below the saturation temperature, then is vaporized in the evaporator and this saturated steam is given as superheated steam into the steam turbine after being re-heated in superheater. This is a Rankine cycle for a single-stage pressure group of boiler-steam turbine. However, steam-boiler turbine groups are located in the boiler separately for the three-stage pressure level superheated or non-superheated. Rankine cycle forms different cycles in itself depending upon these stages of pressure. The steam produced in the HRSG and then entered into the steam turbine expands at the stages of turbine. Thus, thermal energy transforms into mechanical energy. With the turbine driven, electric power is generated by the generator connected to the turbine.

The low temperature and pressure steam exiting from the steam turbine reaches to the condenser and is transformed into water by being condensed by cooling system. Then, it is sent, through the condensate pumps, to the feedwater tank for the removal of non-condensed gas content in it. Water is re-sent from the feedwater tank to the waste heat boiler through feedwater pumps. This way, it circulates between the Rankine closed-cycle boiler, steam turbine and condenser. The main technical specifications of Kırıkkale CPP are given in Table 1.

Table 1. Technical Specifications of Kırıkkale CPP

Parameters	Unit	Value
Plant		
Installed Power	MWe / MWt	233.7 / 404
Installed Power of Gas Turbine	MWe	77.1
Installed Power of Steam Turbine	MWe	79.5
Net Efficiency (minimum)	%	52
Gas Turbine	Pcs	2
Heat Recovery Steam Generator	Pcs	2
Steam Turbine	Pcs	1
Approximate Height of Flue	M	50
Anticipated Electricity Generation Amount	kWh/year	2,030,000,000
Fuel Type	-	Natural Gas
Fuel Requirement	m^3/year	300,000,000

Some of the units planned to be established within the scope of Kırıkkale CPP are listed below:

- Steam Turbine Building
- Main Transformer
- Auxiliary Transformer
- Electrical Building
- Cooling Towers
- Oil / Gas Module
- Closed Cooling Water Pumps and Heat Exchangers
- Inside Parking Lot
- Workshop and Store Building
- Control / Administration Building
- HRSG
- Stack
- Gas Turbine
- Auxiliary Boilers
- Deareator Feedwater Tank
- CEMS
- Demineralized Water Tank
- Heavy Fuel Oil Tank
- Diesel Oil Tank
- Circulating Water Pumps House

5. PROJECT ALTERNATIVES AND CONFIGURATION OPTIONS

5.1 Turkey's Energy Demand and Need for the Project

Fundamental goal of Turkey's energy policy is to decrease the country's external dependence by making efficient, effective, safe and environmentally-conscious use of energy and natural resources, and contributing to prosperity of the country. Within this context, these are the fundamental elements of Turkey's energy policy:

- Decreasing external dependence in energy,
- Providing diversity of source, route and technology,
- Maximum use of renewable energy sources,
- Minimizing the effects on the environment,
- Increasing our country's regional and global activity with regard to energy sector,
- Increasing energy efficiency,
- Making energy accessible by the consumers with regard to cost, time and amount,
- Mobilizing the potentials of public and private sector with competitive market conditions[3].

Turkey is in a struggle to realize its development targets, increase social welfare and bring the sector to a level that it can compete in the international market. This situation brought a rapid increase of energy demand for years. Yearly energy demand has surpassed 109.3 million tons petroleum equivalent (tpe) in 2010. It is expected to reach 170 million tpe in 2015 and 222 million tpe in 2020. Yearly energy demand has surpassed 106.1 million tpe in 2009. It is expected to reach 170 million tpe in 2015 and 222 million tpe in 2020. These values indicate that energy demand will increase by approximately 6%. In 2009, coal had the largest share in energy demand with 31%, natural gas followed it with 30.9%, petroleum with 28.8%, and the remaining 9.3% was provided via renewable sources, with hydraulic and other (wood)[4].

There is a relation between development level and the share of electricity in final energy consumption[5]. In 2010 our electricity consumption has increased by 7.92% compared to the prior year (193.2 billion kWh) and it has reached 208.5 billion kWh, and our electricity production has increased by 7.89% compared to the prior (194.81 billion kWh) year and it has reached 210.18 billion kWh. It is seen that the latest estimated figures for electricity demand issued by the Ministry of Energy and Natural Resources (2010-2019) shows that

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[3] Speech *of Minister of Energy and Natural Resources, Taner YILDIZ, presenting 2011 Budget of the Ministry to TBMM (Grand National Assembly of Turkey) General Assembly.*

[4] *Ministry of Energy and Natural Resources "Blue Book", Ankara 2011.*

[5] *Güray B.Ş., "Supply-Demand Analysis, Expectations and Goals in Energy Sector", 11th International Energy Arena, November 2009.*

based on 2018, it is increased by 1.65% (for the High Demand) and 2.62% (for the Low Demand) compared to the previous study (2019-2018). Revised numbers show that it will reach 389.98 kWh for high demand scenarios, and 367.35 kWh for low demand scenarios by the year 2019[6,7].

With regard to resources, as of 2011 44.7% of total electricity production is done with natural gas, 18% by coal, 22.8% by hydraulic sources, 10% by imported coal, 2.2% by other thermal fuels, 1.35% by wind and 0.47% by geothermal resources and biogas. Compared to 2010, electricity production by wind has increased 62%, production by coal has increased 17% while there is only a slight increase of 4% in natural gas and a 0.55% increase hydraulic. Share of EÜAŞ (Electricity Production Inc.) was 49.2% in 2008; it has decreased to 46.1% in 2009 and 45.4% in 2010. Remaining 54.6% of production is provided by the private sector[8]. Growth numbers in the energy sector, which is among the essential inputs of industry, is very high compared to developed countries. In the last 10 years, Turkey ranks second after China with regard to electricity and natural gas consumption increase ratios.

As a result of the studies, Turkey's potential local energy sources that were determined as of the end of 2011 are shown in Table 2. Only lignite reserves have increased compared to 2010 (from 8.4 billion tons to 11.4 billion tons (approximately 36% increase).

Table 2. Turkey Local Resources Potential as of 2009

Source	Potential
Lignite	11.45 gigaton
Anthracite	1.34 gigaton
Asphaltite	82 gigaton
Crude Oil	6.72 billion barrel
Hydraulic	140,000 kWh/year
Natural Gas	21.86 billion m3
Wind	48,000 MW
Geothermal	31.500 MWt
Biomass	8.6 MTOE
Solar Energy	35 MTOE

Source: Ministry of Energy and Natural Resources, Sinem Çaynak presentation, 2011

If new investments will not be made and the problems of the industry will not be solved in the forthcoming years, electric power deficit will increase incrementally and the deficit will reach up to 144.7 billion kWh in 2016[9]. The recent estimation studies of Turkish Electricity

[6] *TEİAŞ, Turkey Electricity Energy 10-Year Production Capacity Projection (2010-2019), October 2010.*

[7] *TEİAŞ, Turkey Electricity Energy 10-Year Production Capacity Projection (2009-2018), June 2009.*

[8] *TEİAŞ, 2010 Monthly Production Statistics*

[9] *www.euas.gov.tr/_EUAS/Images/Birimler/apk/2009_yillikrapor.pdf*

Transmission Corporation (TEİAŞ) of the Ministry of Energy and Natural Resources (MoENR) suggest the necessity of the new electricity generation plants. Based on the values contained in the Projection Report for Turkish Electricity Energy 10-Year Generation Capacity issued by MoENR and given in Table 3, Turkey's average annual electricity requirement has rapidly increased between 2011 and 2018.

Table 3. Projection for Energy Requirement of Turkey (Base Demand- High Scenario)

Year	Peak Demand (MW)	Increase (%)	Energy Demand (106KWS)	Increase (%)
2011	33,276	6.5	215,907	6.5
2012	35,772	7.5	232,101	7.5
2013	38,455	7.5	249,508	7.5
2014	41,339	7.5	268,221	7.5
2015	44,440	7.5	288,338	7.5
2016	47,728	7.4	309,675	7.4
2017	51,260	7.4	332,591	7.4
2018	55,053	7.4	357,202	7.4

Source: www.teias.gov.tr

Energy investments should be commissioned in timely manner to achieve this projection and ensure the security and sustainability of energy supply. Otherwise, it will be inevitable to face with the energy deficit in the forthcoming years.

5.1.1 No Action (Zero Option)

No action option is essential to understand whether the project is actually needed or not. In addition, it gives the opportunity to compare with the other options. However, non-realization of the Project does not meet the steam and energy requirement of the Tüpraş Refinery and the growing energy demand of Turkey.

The existing Thermal Power Plant (TPP) in Kırıkkale Refinery is constructed in 1986. TPP unit has been equipped with two 12MWe CTR12 type steam turbines and 21 MWe Nuovo Pignone type steam turbine to supply Refinery electric demand. First and second turbine has been built in 1986, third one (21MW) has been built in 2007. There are four 120 t/h boilers in Kırıkkale Refinery burning Refinery Gas and Fuel Oil mixture.

The existing Plant located in Tüpraş refinery has adverse effects from environmental and economic aspects. Energy efficiency of the current plant is lower than the planned CCGT system's efficiency. According to modeling studies, the Project's emissions (NO_x and CO) are extremely lower than the limit values set forth by Turkish regulations. Natural gas is used as the main fuel source which is environmentally friendly as compared with other fuel types. Since the selected system will have back-up fuel; the Project guarantees the continuity of energy supply to the Refinery in any emergency case, which brings an advantage compared with the existing plant. Therefore, no action cannot be considered as a preferable option.

5.1.2 Need for the Project

Fundamental goal of Turkey's energy policy is to decrease the country's external dependence by making efficient, effective, safe and environmentally-conscious use of energy and natural resources, and contributing to prosperity of the country. Within this context, these are the fundamental elements of Turkey's energy policy:

- Decreasing external dependence in energy,
- Providing diversity of source, route and technology,
- Maximum use of renewable energy sources,
- Minimizing the effects on the environment,
- Increasing our country's regional and global activity with regard to energy sector,
- Increasing energy efficiency,
- Making energy accessible by the consumers with regard to cost, time and amount,
- Mobilizing the potentials of public and private sector with competitive market conditions[10].

Tüpraş is the largest and leading industrial organization with its refining capacity of 28.1 million tons/year. Kırıkkale Cogeneration Power Plant having an installed power of 233.7 MWe will both serve to the Tüpraş which has a significant place in the national economy and contribute to the resource diversity in Turkish energy market thus playing an important role in solving the problem of energy deficit and ensuring the security of supply. Accordingly, the Project has a considerable importance for the country.

5.2 Site Alternatives

The Power Plant will be installed adjacent to the Tüpraş Refinery. Seymenoba has identified two possible sites. The first site (ALT-1) of approximately 85000 m^2 at an altitude of 705 m is located adjacent to the South Eastern corner of the Refinery alongside the existing Hacılar substation. The second site (ALT-2) of approximately 114000 m^2 at an altitude of 730 m is located adjacent to the South Western corner of the Refinery and is adjacent to the existing bulk oil storage tanks.

The key features of the two site alternatives are described respectively as follows:

5.2.1 Alternative 1

- The site is adjacent to the existing substation / switchyard allowing existing cable routes to the Refinery to be followed.
- The site is closer to the interconnection points with the Refinery steam headers allowing the pipe runs to be kept as short as possible. This will minimize losses and reduce costs.
- The site is closer to the interconnection points for the electrical supply to the Refinery allowing cable runs to be as short as possible.

[10] Speech *of Minister of Energy and Natural Resources, Taner YILDIZ, presenting 2011 Budget of the Ministry to TBMM (Grand National Assembly of Turkey) General Assembly.*

- The site is close to the source of raw water supply from the nearby Kapulukaya Dam. This is also of benefit for waste water discharge to the river.
- The site altitude is lower than ALT-2 giving a slight increase in efficiency and power output.
- Access to the site is available from the Municipality road.
- There are a number of headroom restrictions along the immediate route to the site. Trunk road overbridge (4m) and overhead lines.
- The topography of the site is quite varied and will require significant earth works to establish the plant grade level.
- An existing natural watercourse traverses the site.
- The existing buried raw water supply pipeline (approximately 800 mm) to the Refinery traverses the South Western corner of the site and buried treated water discharge mains from the Refinery traverse the site in the North West.

5.2.2 Alternative 2

- The site is on the opposite side of the Refinery to the connection point for the electrical power and Refinery steam header interconnection points. This would result in longer cable and pipe routes across the Refinery, increasing losses and costs.
- The site is remote from the Kızılırmak River and Kapulukaya Dam which will be used as a raw water source and waste water discharge route.
- The site altitude is higher than ALT-1 giving a slight reduction in efficiency and power output.
- Access to the site is available from the Municipality road network. The Municipality road is surfaced and narrow. There is no direct surfaced or gravel road access connecting the site to the Municipality road.
- There is a single headroom restriction along the immediate route to the site from overhead lines.
- The topography of the site is gently sloping and is likely to require fewer earthworks than is required for the ALT-1 site.
- There is an earth dam / dyke feature which traverses the site.

5.2.3 Other Site Alternatives

Alternative project areas, different from the ALT-1 and ALT-2, have not been considered, because main function of the Project is to serve Tüpraş Refinery with steam and energy. Other site alternatives shall not be feasible in terms of supplying steam and energy to the Refinery.

5.2.4 Selected Project Area

ALT-1 has been selected regarding conditions described below;

- Wastewater discharge location (Kızılırmak River) is closer as compared with the ALT-2.
- According to "Air Quality Assessment Studies for Alternative Project Sites Report" prepared by DOKAY in May 2012, air quality modeling studies show that NO_x emissions are lower at ALT-1 than the emissions monitored at ALT-2.
- Altitude is lower in ALT-1, providing increment in efficiency and power output.
- ALT-1 is closer to the interconnection points with the Refinery steam headers.

5.3 Cooling Alternatives

In combined cycle power plants, steam turbine exhaust has to be condensed to preserve the needed sub-atmospheric turbine exit pressure and to return the condensate to the HRSG. The main requirement for cooling water is for condensing the steam at turbine exhaust. Condensing (Cooling) alternatives are once-through cooling, wet (cooling tower) cooling, dry cooling, and wet/dry (hybrid) cooling systems. For this specific site two cooling methods has been considered; recirculation using cooling towers or air-cooled condenser (ACC).

5.3.1 Wet Cooling

Wet cooling system consists of cooling tower in which the steam is condensed in water-cooled shell/tube surface condensers. In a cooling tower system, warm water from the condenser is delivered to a cooling tower in which the water is sprayed downwards through nozzles into a flow of air which is forced upwards by a fan or fans. The cooling is achieved by the evaporation which accounts for 65-85% of the total heat rejection.

In order to prevent an over-concentration of dissolved salts in the recirculating water, which could cause scale formation on the condenser tubes, additional water has to be discharged to waste. The water lost by evaporation and the discharge water is replaced by make-up water. The total water loss is likely to be about 4 percent of the amount in circulation.

Cooling towers can be categorized in two ways; natural and mechanical draft towers. A typical natural draft wet cooling tower is presented in Figure 3.

Factors affecting the performance cost of a cooling tower; ambient air wet-bulb temperature, airflow rate, fill type, and water quality.

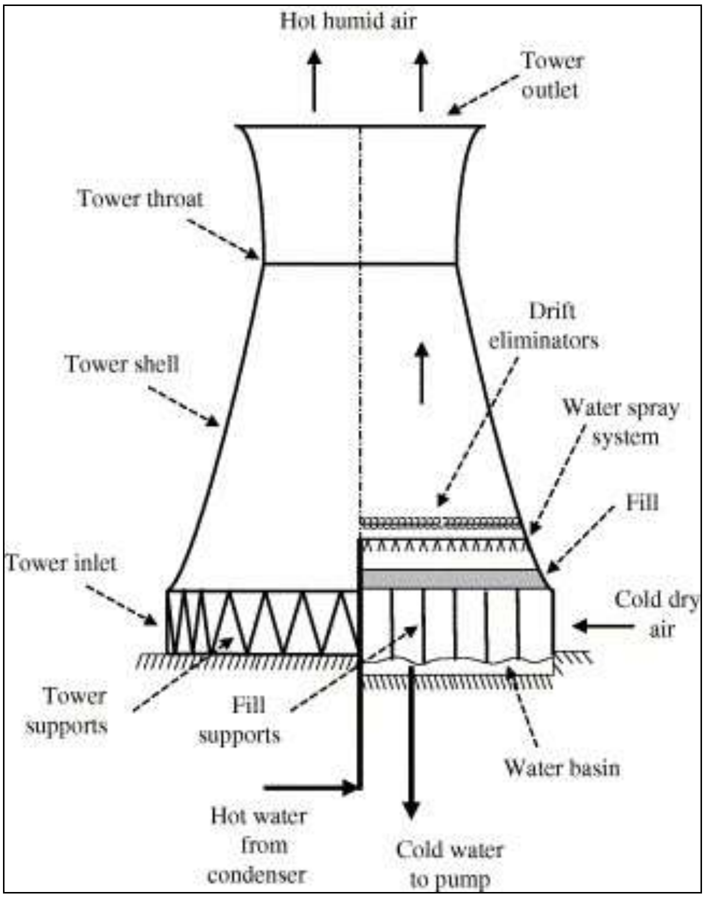


Figure 3. Typical Cooling Tower
Source: *Applied Thermal Enginerering, 2006.*

Advantages:

- High system efficiency,
- High energy output (in terms of MWe), and
- Low capital cost.

Disadvantages:

- Visible plume emissions,
- Chemical dosing, and
- High area requirement.

5.3.2 Dry Cooling

As the dry cooling system, direct cooling, air-cooled condenser (ACC), option has been taken into consideration. In this cooling system, heat rejection to the environment consists of a single step in which condensing of the steam takes place inside finned tubes. Tubes have typically the A-frame configuration. Typical A-frame configuration of ACC system is presented in Figure 4.

The ACC system returns a higher exhaust pressure than the cooling tower option discussed above because the re-cooled water temperature cannot be lower than the dry bulb air temperature.

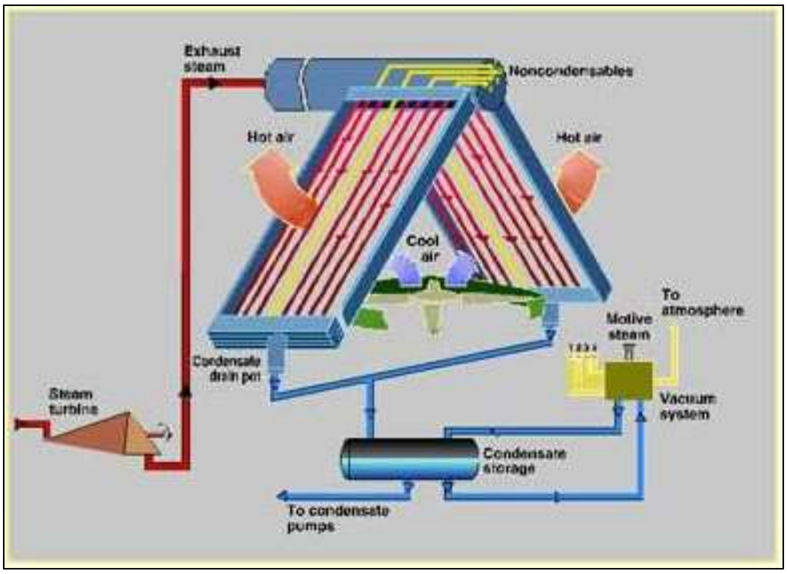


Figure 4. Air-Cooled Condenser Diagram

Advantage:

- Low water consumption.

Disadvantages:

- High O&M costs,
- Low system efficiency,
- Limitations during hot weather conditions,
- High area requirement,
- Low energy output (in terms of MWe), and
- Noise due to fans.

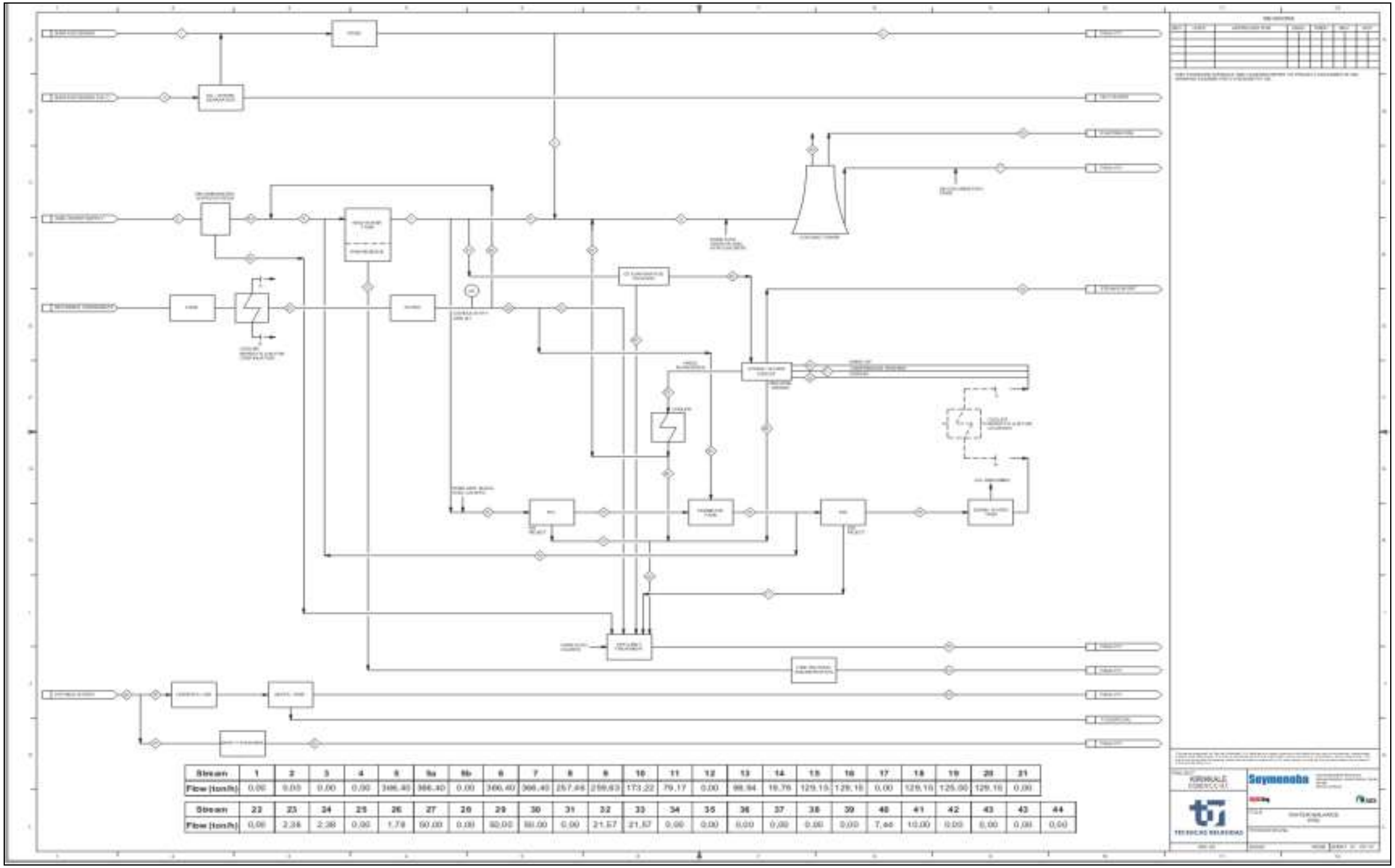
5.3.3 Selected Cooling System

During the cooling system selection, environmental and economic cons/pros have been considered. Cooling tower has been found the most appropriate option for the Project. Factors affecting the system selection are:

- Cooling tower O&M cost is lower than the ACC (dry cooling).
- Efficiency loss is lower in wet cooling system compared with the dry cooling.

- Dry cooling system may have noise impact on near sensitive receptors because of usage of fans.
- Dry cooling is dependent on ambient air conditions (during hot seasons system's efficiency decreases).

Since Tüpraş refinery funded the construction of Kapulukaya Dam, Refinery has the right to use the 6% of the raw water supplied from Kapulukaya Dam. Seymenoba has made a protocol with Tüpraş to use the raw water. Therefore, water supply for the wet cooling system shall not create concern about water supply to the system. Plant's discharge values can be seen in the Project's water balance diagram in Figure 5.



Stream	1	2	3	4	5	5a	5b	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Flow (ton/h)	0.00	0.00	0.00	0.00	366.40	366.40	0.00	366.40	366.40	257.46	259.63	173.22	79.17	0.00	98.94	19.76	129.15	129.16	0.00	129.16	125.00	129.16	0.00

Stream	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	43	44
Flow (ton/h)	0.00	2.38	2.38	0.00	1.78	60.00	0.00	60.00	60.00	0.00	21.57	21.57	0.00	0.00	0.00	0.00	0.00	0.00	7.44	10.00	0.00	0.00	0.00	0.00

Figure 5. Water Balance Diagram of the Project

5.4 Configuration Options

System options have been considered by taking into account some parameters such as ambient conditions, turbine efficiency, cost, power output etc.

For the selected site of ALT-1, altitude of the Project Area was taken as 705 m. Based on the ambient conditions information, following Table 4 has been prepared:

Table 4. Kırıkkale CPP Ambient Conditions

	Winter	Summer	Design	Comments
Ambient Pressure (bar)	0.9315	0.9315	0.9315	*For the altitude of 705 m.*
Ambient Temp. (°C)	1.6	29.7	12.7	*Winter = Dec, Jan, Feb, average temp.* *Summer = June, July, Aug, average temp.* *Design = average of remaining 6 months average temp.*
Ambient RH (%)	80	40	63.46	Assumed by Seymenoba

5.4.1 System Configuration Option Analysis

System shall be configured mainly to meet 38 MWe power requirement of Tüpraş refinery. Options for 2/2/1 and 3/3/1 plant configurations have been considered.

Gas Turbine Options for 2/2/1 Configuration

For the 2/2/1 configuration of plant, three options were considered for gas turbines. Options are described in Table 5.

Table 5. Gas Turbine Options for 2/2/1 Configuration

Gas Turbine	ISO Output on NG	ISO Efficiency on NG	Estimated Unit Cost	Water Consumption at ISO Conditions for NO_x control on oil
Units	MW	%	$ M	t/h
Ansaldo AE64.3A	75	35.9	21.2	18.3
GE 6FA	77.1	35.3	21.8	18.9
Siemens SGT1000F	67.7	35.1	19.8	0

Gas Turbine Options for 3/3/1 Configuration

For the 3/3/1 configuration of plant, six options were considered for gas turbines. Options are described in Table 6.

Table 6. Gas Turbine Options for 3/3/1 Configuration

Gas Turbine	ISO Output on NG	ISO Efficiency on NG	Estimated Unit Cost	Water Consumption at ISO Conditions for NO_x control on oil
Units	MW	%	$ M	t/h
Alstom 8C2	56.3	33.9	17.1	14.2
GE 6B	43	33.1	12.8	11.3
GE 6C	45.4	36.5	14.9	11.0
Siemens SGT800	47	37.5	19.8	0
GE LM6000	42.8	41.4	13.3	7.9
Rolls-Royce RB211 H63	42.5	39.3	N/A	N/A

Design Assumptions

Plant options are determined according to following design assumptions:

- The HRSGs are designed to produce the maximum Refinery steam demand with two steam generators (including auxiliary) out of service;
- Steam turbines are sized for full steam flow of all HRSGs without process extractions and with no supplementary firing in service;
- Condensers and cooling system are designed for the full steam flow of the HRSGs without process extractions and with no supplementary firing in service;
- In order to allow direct comparison, all proposed cycle have been modeled with wet cooling towers as this is the preferred cooling option. A comparison between wet cooling towers and air cooled condensers is made in the following section.
- The supplementary firing temperature is limited to 800 °C.
- Minimum supplementary firing is assumed to be 10% of the design amount or a minimum temperature rise of 20 °C, whichever is the largest. Supplementary firing will be in service at minimum load under normal operating conditions (i.e. it will not be used to increase the power output from the steam turbine).
- Minimum auxiliary boiler load is assumed to be 20% of the design amount (where included). Auxiliary boilers will be in service at minimum load under normal operating conditions (i.e. they will not be used to increase the power output from the steam turbine).

Option 1 - Two (2) GE 6FA GTs in a 2/2/1 Configuration and two (2) Auxiliary Boilers

The plant configuration for this option will be as follows:

- Two GE 6FA gas turbines;
- Two dual pressure HRSGs each rated to produce 50% of the Refinery steam flow. Supplementary firing of the HRSGs is not required in this case;
- One condensing extraction steam turbine rated for a maximum output without steam extraction of 75 MW;
- One condenser, wet cooling towers (with ACC as an option); and
- Two auxiliary boilers each sized for 50% of the Refinery steam load.

Option 2 - Three (3) Siemens ST800 GTs in a 3/3/1 Configuration

For this option, auxiliary boilers are not included. Planned equipment installation is described below:

- Three Siemens SGT800 gas turbines;
- Three dual pressure HRSGs equipped with supplementary firing and forced draft fans. Each HRSG will be capable of supplying 100% of the Refinery steam requirements. NOTE: It is not the intention that HRSGs should be able to operate with their associated GT out of service (i.e. the HRSGs are not auxiliary fired);
- One condensing extraction steam turbine rated for a maximum output without steam extraction of 55 MW; and
- One condenser, wet cooling towers (with ACC as an option).

Option 3 – Three (3) Siemens SGT800 GTS in a 3/3/1 Configuration and two (2) Auxiliary Boilers

The Plant with three (3) units and two (2) auxiliary boilers would have the following equipment installed:

- Three Siemens SGT800 gas turbines;
- Three dual pressure HRSGs equipped with supplementary firing, each rated to produce 33.4% of the Refinery steam demand;
- One condensing extraction steam turbine rated for a maximum output without steam extraction of 62MW;
- One condenser, wet cooling towers (with ACC as an option);
- Two auxiliary boilers each rated to produce 33.4% of the Refinery steam demand.

Summary of Modeling Results for 3 Options

According to modeling study, a summary of results for three options is given in Table 7:

Table 7. Modeling Results of Configuration Options

		Option 1	Option 2	Option 3
Gas Turbine	-	GE 6FA	SGT800	SGT800
Configuration	No. GT/HRSG/ST + Aux.	2/2/1 + 2	3/3/1	3/3/1 + 2
Power Output	MW	193	170	163
Efficiency	%	45.7	44.8	44.5
Capital Cost	US $M	223.077	261.963	217.075
Cost per MW	US $M / MW	1.16	1.54	1.33

5.4.2 Selected Plant Configuration

Result of the modeling study shows that the Option1 has the highest power output and efficiency of the options modeled and the lowest number of gas turbines installed. The HRSGs for the plant do not include supplementary firing and consequently could be considered the simplest cycle design.

The relatively large size of gas turbines that is required and 2/2/1 configuration means that the flexibility of this plant options is limited.

The new and clean power output of the modeled GE 6FA gas turbine is approximately 70 MWe, allowing significant headroom for degradation to meet the maximum Refinery demand of 38 MWe.

Option 1 is the least flexible, but has the highest efficiency and power output with a competitive capital cost, giving the best cost per MW.

Option 2 has good flexibility, but has the highest capital cost and the lowest efficiency with a lower power output than Option 1, giving the highest cost per MW.

Option 3 has good flexibility and the lowest capital cost, but has a lower efficiency and power output than Option 1, with the cost per MW being higher than Option 1.

The Plant configuration selection was carried out considering parameters such as efficiency, capital cost, flexibility, total power output and cost per MW. From the comparison described above, Option 1 (2/2/1 + 2) has been selected for the most feasible configuration of all.

5.4.3 Option 4 (Enhancement of the Selected Configuration)

This option is considered to be changing the number of Steam Boilers from two (2) boilers to one (1) boiler. In the absence of gas turbines, HRSG will run with Fresh Air Firing (FAF). For the selected Option 3, steam supply of HRSG unit (in the absence of gas turbines) is 100 t/h. For this Option 4; since there will be one (1) steam boiler, steam capacity of HRSGs shall be increased from 100 t/h to 181 t/h in the absence of gas turbines. This capacity increase will meet the steam requirement of the Refinery.

This option also involves the option of change Heavy Fuel Oil (HFO) as back-up fuel for Steam Boiler to Diesel Fuel Oil (DFO) in order to reduce the treatment required for Steam Boiler Flue gas. Changing back-up fuel to DFO reduces the Flue Gas treatment with consequent cost and efficiency improvements.

With the usage of DFO as back-up fuel, HFO will not be required in the Kırıkkale CPP so that DFO system capacity will be increased to withstand simultaneous supply to Gas Turbines and Steam Boiler.

Steam Boiler auxiliaries

- Flue Gas Desulphurization System: The DFO composition and particularly the sulphur content don't require installing FGD unit to comply with the SO_x emission limits. Therefore, FGD unit with all its auxiliaries can be removed, and consequently the design, operation and maintenance will be significantly simplified. DFO fuel gas treatment will be reduced to a filtration unit to comply with the particulate matter emission limit.
- DFO System: DFO storage capacity will be increased to contain the volume equivalent to three (3) days of the plant operating in island mode and exporting the maximum power and steam demands to the Refinery. The capacity of the DFO main pumps will be increased to withstand the DFO flow required for Steam Boiler.

Operation Cost Reduction

The FGD process involves variable costs derived basically from the chemical reactants and the hazardous waste treatment. Also, auxiliary energy need for FGD unit is another parameter to decrease the efficiency of the Plant. For the usage of FGD unit, the following additional utilities will be required.

Table 8. Utilities Required in Case of HFO Usage

Utility	Service	Estimated consumption
Sodium bicarbonate	FGD reactive	Flow: 800 Kg/h, fed from a four (4) days capacity Tank.
Solid discharge	FGD waste	Flow: 600 Kg/h to be stored in a four (4) days capacity Tank
Electric power	Compressed air, reactive dosing, IFD increasing, HFO heating system, etc	Approx. 200 kW

Change of FAF Capacity

The new Fresh Air Firing system generation capacity implies the following changes;

- The rated electric power of the new FAF will be more than the double of the original design.
- Dimension of Fresh air suction and discharge duct shall be increased.

- The burner's capacity is increased to approximately double capacity of the original design.
- HRSG Fuel Gas condition system capacity increases for new maximum fuel gas consumption.
- A Flue gas treatment system, Selective Catalytic Reduction (SCR), is included to comply with the NO_x emission limit values. The new SCR system will include the following:
  - Urea Storage;
  - Dissolver Tank;
  - Urea transfer system including pumps, pipes, and auxiliaries;
  - Urea solution Tank;
  - Urea solution transfer system with pumps and auxiliaries;
  - Vaporizer;
  - Blowers;
  - Urea injection skid; and
  - Catalyst reactor

Environmental Aspect

Since the sulphur content of the DFO is less than HFO, FGD unit will no longer be needed which is a plus as compared with the selected configuration. Therefore, daily solid waste (600 kg/h) of the FGD unit will be eliminated.

Use of SCR unit will decrease the NO_x emission of the new configuration. Moreover, use of SCR unit is considered as BAT.

Another advantage of DFO usage in Steam Boiler is the elimination of a storage tank for HFO which requires extra area apart from the DFO storage tank.

6. TECHNICAL SPECIFICATIONS

According to selected plant configuration and cooling system, each component of the Kırıkkale CPP will be described specifically under this section.

6.1 EQUIPMENT TECHNICAL ISSUES

Main equipment that will be described under this section:

- Gas Turbines
- Heat Recovery Steam Generators (HRSGs)
- Bypass Stacks
- Steam Turbines and Auxiliaries
- Steam Boilers and Flue Gas Desulphurization (FGD) System

6.1.1 Gas Turbines

The configuration of the MS 6111 FA (GE 6FA) is a single shaft, bolted rotor with the generator connected to the gas turbine through a speed reduction gear at the compressor or "cold" end. This feature provides for an axial exhaust to optimize the plant arrangement for combined cycle or waste heat recovery applications. Illustrated version of GE 6FA turbine is given in Figure 6.

Figure 6. GE 6FA Gas Turbine

<u>Compressor</u>

The compressor is an 18 stage axial flow design with 1 row of modulating inlet guide vanes and a pressure ratio of 15.8:1 in ISO conditions. Interstage extraction is used for cooling and sealing air (turbine nozzles, wheelspaces) and for compressor surge control during start-up/shutdown. Construction employs 15 full length tie bolts that compress the discs at the bolt circle thereby forming a rigid rotor. The discs are centered by means of rabbets. The compressor blades are attached to the discs with locked-in dovetails. High strength, corrosion resistant GTD450 stainless steel blading material is provided on the first nine stages. The remaining blading, except stage 17 stator and EGV, is of high strength AISI 403+Cb alloy. Stage 17 stator and EGV are cast from high strength 403CB. Because the blading material in the compressor has high corrosion resistance, a coating is not required. The compressor wheel webs are coated with corrosion resistant paint.

Combustion System

A reverse flow, six chamber second generation Dry Low NO_x combustion system is standard with six fuel nozzles per chamber. Two retractable spark plugs and four flame detectors are a standard part of the combustion system. Crossfire tubes connect each combustion chamber to adjacent chambers on both sides. Transition pieces are cooled by air impingement. Thermal barrier coatings are applied to the inner walls of the combustion liners and transition pieces for longer inspection intervals. Each chamber, lines and transition piece can be individually replaced.

Turbine Section

The turbine section has three stages with air-cooling on all three nozzle stages and the first and second bucket stages. The first stage bucket has an advanced cooling system to withstand the higher firing temperature. It utilizes turbulated serpentine passages with cooling air discharging through the tip, leading and trailing edges. The buckets are designed with long shanks to isolate the turbine wheel rim from the hot gas path and integral tip shrouds are incorporated on the second and third stages to eliminate bucket fatigue concerns and to improve heat rate. The first stage has a separate, two piece casing shroud that permits reduced tip clearances.

The rotor is a single shaft, two bearing design with high torque capability incorporating internal air-cooling for the turbine section. Both the compressor and turbine sections are constructed of individually rabbeted discs held with bolts. Each turbine wheel is prestressed with a hot spin process to reduce the operating stresses. The direction of shaft rotation is counter-clockwise when facing the gas turbine output flange (compressor forward shaft flange). The load gear reverses the direction of rotation as it drives the generator rotor. For field changeout, the gas turbine rotor is handled as one piece. The turbine buckets (rotating blades) can be changed in sets or individually without any field balancing of the rotor.

6.1.2 Heat Recovery Steam Generators (HRSGs)

The HRSG units will be double pressure type, comprising economizer, drum, evaporator and superheater sections. The HRSG shall be designed to accept the full gas flow from the GT exhaust and including any additional gas flow arising from the supplementary firing system. The HRSG supporting structure, together with the steelwork for support of the steam drums and access stairways shall be clad by sheeting.

The GTs will be fired primarily on natural gas therefore the HRSG design shall be optimized for gas fired conditions.

The supplementary firing system shall use natural gas as the primary fuel with the ability to fire using diesel oil as a back-up and shall preferably incorporate grid type design technology. The supplementary firing system will be designed for a maximum firing temperature of 800 °C. Figure 7 illustrates a typical HRSG system.

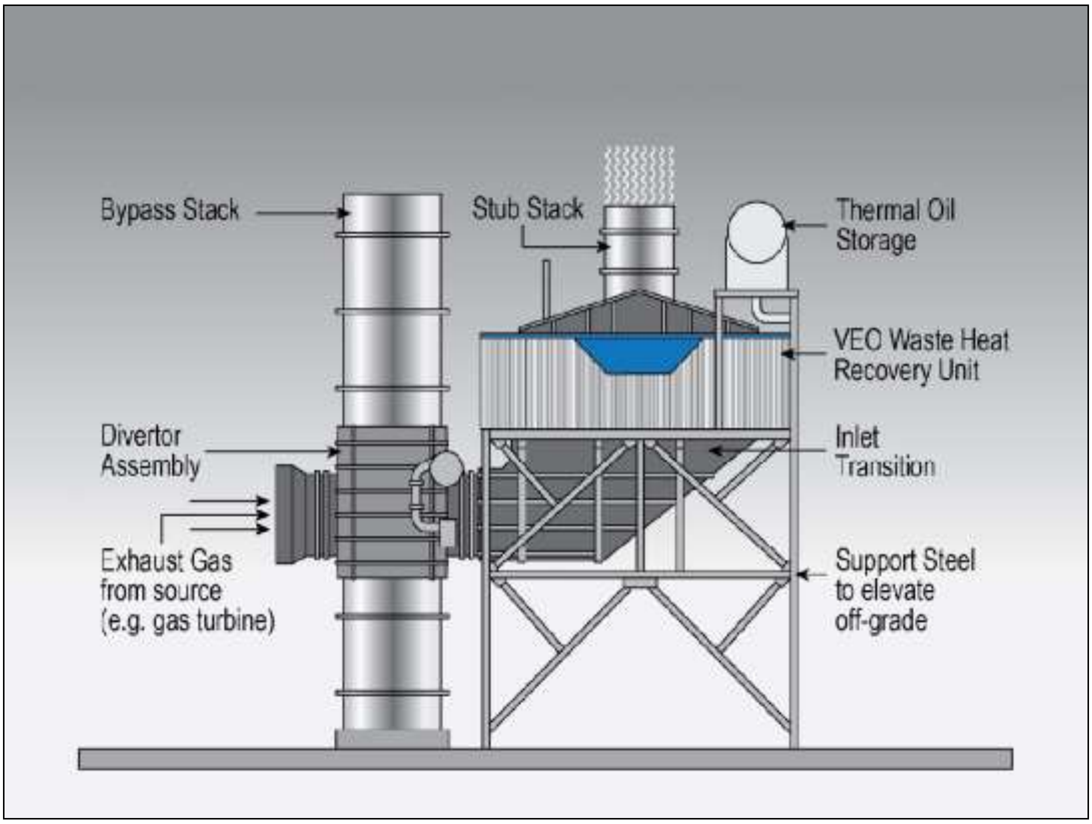


Figure 7. Typical HRSG System

6.1.3 Bypass Stacks

The inclusion of bypass stacks and diverter-dampers for each GT-HRSG unit will allow the GTs to operate in OCGT mode in the event that a HRSG or the ST is not available and will reduce GT start-up time. The damper system can also be designed to be "man safe" to facilitate repairs of the HRSG during OCGT operation. It is recognized that the use of bypass stacks has potential energy loss, increased capital expenditure (CAPEX) and additional maintenance requirements. However, since operational flexibility is of critical importance to this project, the inclusion of bypass stacks and diverter-dampers for each GT-HRSG unit is recommended.

6.1.4 Steam Turbines and Auxiliaries

For the Kırıkkale CPP, the Steam Turbine (ST) output is 79.5 MWe at ISO conditions. The final output will depend on optimizing Power Plant efficiency against steam turbine output.

The ST shall be sized for full condensing mode to maximize power output when the Refinery is shutdown (i.e. it will accept the maximum amount of steam produced by the HRSG when the extractions to the Refinery are closed).

The steam turbine generator and all of its auxiliary and ancillary plant shall be placed in a dedicated ventilated steam turbine building.

6.1.5 Steam Boilers and Flue Gas Desulphurization (FGD) System

6.1.5.1. Steam Boilers

Two (2) Steam Boilers will be installed to supply the maximum steam required for the Refinery, even if no Gas Turbine are running. Boilers allow steam production up to 109 t/h and steam temperature 370 °C. Fuel gas consumption of Boilers is estimated to be 6900 kg/h (at 100% MCR) where HFO consumption shall be 8400 kg/h (at 100% MCR). Possible operation period of Steam Boilers with HFO is estimated to be 5 minutes / month.

The furnaces of boilers shall be of Monowall construction and consist of welded fin-tube panels. Burners are mounted on the furnace front wall covered by refractory. The convection banks of Steam Boilers are made up of bare curved tubes expanded in the upper and lower drums. The expansion is achieved using a pneumatic or electrical expanding machine with torque limit in the drills mechanized on the drums with simple or double grooving depending on the design pressure of the unit. The convection bank tubes are in line. The drums of Steam Boilers are of completely solid welded construction. The drum ends are of semi-elliptical section and supplied with elliptical access of 305 x 406 mm at both ends.

The exhaust system of the Steam Boilers (two (2) boilers each having 95 MWt power) will have two (2) independent stacks (equipped with continuous emission monitoring system for NO_x, dust and SO_x) for the Steam boilers. Therefore exhaust system will consist of two (2) independent FGD in order to comply with emission when operating with Heavy Fuel Oil (HFO).

6.1.5.2. Flue Gas Desulphurization (FGD) System

The FGD system is designed as a dry FGD with sodium bicarbonate injection. The injection of the reagent is realized in the flue gas duct downstream the boiler just before the fabric filters. The dry reactor allows the reagent get into contact with the gas during the necessary treatment time (approximately 2 seconds). The reaction will be finalized in the fabric filers where the solid residue will be accumulated prior to be deposited in waste silo.

With the planned equipment, a desulphurization efficiency of 99% can be achieved. The higher desulphurization efficiency can be achieved by only increasing the reagent feed to the FGD system.

The concentration of dust in the flue gas leaving the FGD absorber is cleaned by the low pressure pulse jet filter to a dust content of below 20 mg/Nm^3, dry (at 6% O_2).

The absorber is arranged downstream of the boiler. The absorber is an empty vertical flue gas duct with venturi shaped nozzles which create the fluidized bed mixture of lime, re-circulated desulphurization products and fly ash.

The absorption product, which mainly consists of calcium sulphite ($CaSO_3$ x ½ H_2O), calcium sulphate ($CaSO_4$ x ½ H_2O), limestone ($CaCO_3$) and fly ash is separated from the clean gas in the downstream low pressure pulse jet filters.

The product is re-circulated back to the absorber via air-slides to prolong the solids retention time of the sorbent. This aims at reducing the Ca/S molar ratio of the process. The Ca/S molar ratio is approximately 1.2-1.8 (or higher, depending on raw as ash content) at the requested data and desulphurization efficiency of approximately 80%.

With the planned equipment, a desulphurization efficiency of 99% can be achieved. The higher desulphurization efficiency can be achieved by only increasing the reagent feed to the FGD system. Guaranteed emission values are given in 9.1.

The concentration of dust in the flue gas leaving the FGD absorber is cleaned by the low pressure pulse jet filter to a dust content of below 20 mg/Nm^3, dry (at 6% O_2).

<u>Technical Features of the FGD System</u>

- Absorber:

Inside the absorber, which is an empty vertical flue gas duct with venture shaped nozzles, a fluidized bed exist of material from ash, absorbent and FGD reaction products. To achieve the optimal reaction temperature, water will be sprayed into the absorber by spill back nozzles.

The absorber is made from normal mild steel without any internal fixed or moving parts. No corrosion protection has to be provided in the absorber. Due to the high reactive solids loading the inner areas of the absorber are continuously cleaned so that corrosive scaling cannot stick on the inner surface.

- Absorbent handling and storage:

FGD process is calculated with feeding of the reagent, which is the basis for desulphurization up to emission limit value. Reagent will be delivered by trucks, and stored in a silo. Through a pneumatic conveying system the reagent is transported to a day silo which is situated close to the CFB absorber.

- Fabric Filter:

A Fabric Filter (or ESP) is used for de-dusting the flue gas downstream the absorber.

- Re-heating system:

The FGD system is typically operating between 75 and 85 °C, which causes a clean gas temperature at stack entrance of approximately 80 to 90 °C. Additional flue gas re-heating is not necessary. The optimum process temperature in the FGD absorber is directly controlled within the CFB FGD system by water injection.

- Ducts and Stack:

The stack does not need some additional protection against i.e. corrosion.

- Water / waste water:

Duct pollutants such as SO_2 and SO_3 will be removed by the following reaction:

$$NaHCO_3 + SO_2 + SO_3 \longrightarrow Na_2SO_3 + Na_2SO_4 + H_2O + CO_2$$

Estimated solid waste amount is 600 kg/h for the maximum steam production.

Description of the Planned FGD System

- The reagent shall be delivered by trucks and stored in a storage silo, sized for 7 days storage time.
- The sorbent shall be of quality suitable for use in the FGD system, with an adequate BET index.
- The fresh sorbent shall be sent directly to the reactor by pneumatic conveying. The reagent storage silo is provided with a flat type fluidized bottom, with fluidization ensured by two (2) 100% dedicated blowers.
- The reagent is transferred by one pneumatic conveying line, sized for the maximum demand of the two units simultaneously operating at MCR, to one daily bin sized for 24 hours operation of two boilers at MCR conditions.
- The fresh lime is fed this bin to the CFB reactor via-air-slides, one (1) 100% duty.
- The flue gas from the CFB reactor goes into the fabric filter for the solids separation.
- Via a main air-slide arranged below the filter hoppers, the solids recovered from the fabric filter are recirculated into the CFB reactor to utilize the non-reacted lime fraction.
- A part of this solid stream will be directed, via a secondary air-slide provided with a flow-regulation valve, into an ash surge bin common to two boiler units, from where the ash will be pneumatically transported to the by-product silo.
- The surge hopper doesn't require long storage capacity: 4 hours operation storage time, for two boilers at 100% MCR can be provided.
- The storage silo will be utilized to store the end products.
- The proposed configuration provides for all necessary redundancies to guarantee the requested steam plant availability.

6.2 Back-up Fuel

Kırıkkale CPP will use natural gas as the primary fuel source. Back-up fuel usage includes Diesel Fuel Oil and Heavy Fuel Oil. Composition of back-up fuel sources is tabulated and explained in Table 9 and Table 10.

Table 9. Expected Diesel Fuel Oil Composition

CHARACTERISTIC	UNIT	VALUE	LIMIT	TEST METHOD
Density (@15 ºC)	kg/m³	820-845		TS1013 EN ISO 3675?TS EN ISO 12185
Polycyclic aromatic hydrocarbons	% weight	11	Max	TS EN 12916
Flash Point	ºC	55	Min	TS 1273 EN 22719
Cold Filter Plugging Point (CFPP)	ºC			TS EN 116
Winter (a)		-15	Max	
Summer (b)		5	Max	
Distillation				TS 1232 EN ISO 3405
Obtained @250ºC	% volume	65	Max	
Obtained @350ºC	% volume	85	Min	
Obtained @360ºC	% volume	95	Min	
Sulphur	mg/kg	10	Max	TS EN ISO 20846?TS EN ISO 20884
Carbon Residue (From 10% distillation residue)	% weight	0,30	Max	TS 6148 EN ISO 10370
Viscosity (@40 ºC)	cst	2.0- 4.5		TS 1451 EN ISO 3104
Copper band corrosion (3 hours@50 ºC)	Degree	No.1	Max	TS 2741 EN ISO 2160
Ash	% weight	0,01	Max	TS 1327 EN ISO 6245
Cetane index	Calculate	46	Min	TS 2883 EN ISO 4264
Cetane number		51	Min	TS 10317 EN ISO 5165
Water	mg/kg	200	Max	TS 6147 EN ISO 12937
Total contamination	mg/kg	24	Max	TS EN 12662
Oxidation stability	g/m³	25	Max	TS EN ISO 12205
Lubrication feature (vsd) Corrected corrosion trace diameter @ 60ºC	µm	460	Max	TS EN ISO 12156-1

(a) October 1 – March 31 (± 15 days)

(b) April 1 – September 30 (± 15 days)

Table 10. Expected Heavy Fuel Oil (HFO) Composition

CHARACTERISTIC	UNIT	VALUE	LIMIT	TEST METHOD
Density (@15 ºC)	kg/L	0.950	Max	TS EN ISO 12185 or TS 1013 EN ISO 3675
Ash	% weight	0,10	Max	TS EN ISO 6245
Flash Point	ºC	56	Min	TS EN ISO 2719
Pour Point	ºC	Summer(1) +10 Winter(2) -1,1	Max	TS 1233 ISO 3016
Water	% volume	0,5	Max	TS 124 EN 1428
Total Residue	% weight	0,15	Max	TS ISO 10307-2
Viscosity (@100 ºC)	cst	10	Max	TS 1451 EN ISO 3104
Sulphur	% weight	1.5	Max	TS EN ISO 8754

(1) Summer: April 1 – September 30 (± 15 days)
(2) Winter: October 1 – March 31 (± 15 days)

6.3 Discharge Water Line

Appropriate disposal routes for the various aqueous discharges from the Plant are not yet to be finalized. It is thought that all types of wastewater (after the appropriate treatment processes) shall be discharged to the Kızılırmak River. There are two options for the discharge line. These are:

- Alt-1: The pipeline parallel to the Refinery's existing discharge line.
- Alt-2: Getting through the parcels straight to the Plant.

Since Alt-2 requires far too much easement right payment to parcel owners, Alt-1 is recommended for the discharge water pipeline route. Moreover, parallel line to the Tüpraş discharge pipeline shall be included to the protocol of Tüpraş for the existing subdivision protocol for the pipeline.

6.4 Transmission Lines

The Power Plant is to provide maximum 38 MWe of electrical power directly to the Tüpraş refinery. Any additional power generated by the Power Plant will be exported to the Türkiye Elektrik İletim Anonim Şirketi (TEİAŞ) (Turkish Electricity Transmission Co.) via a new outdoor open terminal 154 kV switchyard included within the site.

Since the TEİAŞ substation (Hacılar Substation) is adjacent to the Power Plant, transmission line to the connection point will not go through any private parcels.

Power supply to the Refinery is via two 154 / 34.5 kV transformers and an intermediate 34.5 kV substation. Interconnectivity between the new Power Plant and the Refinery plant at 34.5 kV demands the correct choice of transformer vector group / voltage phase shift.

Appropriate transmission line route is not yet to be finalized. Two options are considered within this manner:

- Opt-1 is the transmission line going around the Refinery area.
- Opt-2 is the transmission line passing through the security zone of the Refinery.

According to Opt-1, transmission line goes around the Refinery area so that earth works for this option requires large amount of excavation work. It is recommended to choose the Opt-2 for the ease of earth works and economic issues (since Opt-2 requires shorter transmission line).

6.5 Natural Gas Supply Line

The installed power of the project is 233.7 MWe and 300,000,000 m^3 of natural gas has been annually planned to be consumed. There are two options for the supply of natural gas.

- A new BOTAŞ pressure relief and measurement station (PRMS), which is 1200 m far from the Kırıkkale CPP, will be constructed for natural gas which will be used as fuel in the power plant. Natural gas supply from the BOTAŞ PRMS is considered as the Opt-1.
- At the South border of the Tüpraş Refinery, branch of the BOTAŞ PRMS is located. The branch station is located within the borders of the Refinery. Natural gas supply from this station is the Opt-2.

Since Opt-2 is located within the borders of Tüpraş Refinery, there shall not be environmental and socially negative impact of the Opt-2. Therefore, Opt-2 is recommended as the natural gas supply station. Seymenoba shall perform detailed engineering studies to determine the exact route for the chosen option.

7. EXISTING ENVIRONMENTAL CHARACTERISTICS OF THE PROJECT AREA

7.1 Flora and Fauna

The Project site and the impact area are under the continental climatic conditions. Therefore, dominant habitat of vegetation is steppe. During the international evaluations, the categories and criteria set out in the Red List of Threatened Species (IUCN, 2011) issued by International Union for Conservation of Nature, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2004) and Convention on the conservation of European wildlife and natural habitats (BERN, 2002) have been evaluated and the danger categories and protected status identified for each species.

In the examination carried out at national level, the decisions made by the Central Hunting Commission (CHC) are evaluated for all fauna groups identified. Lists of different status are formed based on the CHC decisions made by the commission which convenes each year. Annex lists contained in CHC decisions:

ANNEX I: Wild Animals Protected by the Ministry of Environment and Forestry

ANNEX II: Game Animals Protected by the Central Hunting Commission

ANNEX III: Game Animals the hunting of which is permitted by the Central Hunting Commission for specified periods.

Plant, amphibian, reptile, bird and mammal species encountered and likely to be encountered due to the habitat characteristics at the project site and its area of influence are identified during the National EIA studies, and included to the National EIA Report.

At all stages of the project, protection measures of the BERN convention will be complied with for the fauna species set out in Annex-2 and Annex-3 of BERN Convention and the provisions of the articles 6 and 7 of the same will be applied.

7.2 Geological, Hydrogeological and Hydrological Characteristics

The territories of the province, in general, consist of the medium-height mountains split by stream valleys. The elevation difference between the stream beds and hills is slight. The mountains became round and sometimes pointed hills by being split by the deep valleys on each direction. The southern territories of the province being the coastline of Kizilirmak in the first place are formed by alluvial deposit. Granites are commonly seen in the site extending up to Delice Creek. These granites formed by bulk units of all sizes. The Kizilirmak parts of Karakeçili are covered by hard rocks. In the region, Dizilitaş formation, İncik formation, Bayındır member, Kızılırmak formation takes place.

The geology of the Project Site is formed by the units belong to Kizilirmak Formation. The formation consists of non-bonded slope wash, sandstone, mudstone and lenses having intermediate layers of gypsum in parts. In addition, it contains tuff and limestone layers in some parts.

Kizilirmak Formation is the youngest unit formed under terrestrial conditions. This unit deposited in slopes, streams and lacustrine environments. It includes diverse materials from pebble stone in large amount of mud on the slopes to those which in the size of sand. The formation is generally red in color since the color of the mud is red. The Geological Map of 1/25.000 scale showing the Project Site is presented in Figure 8.

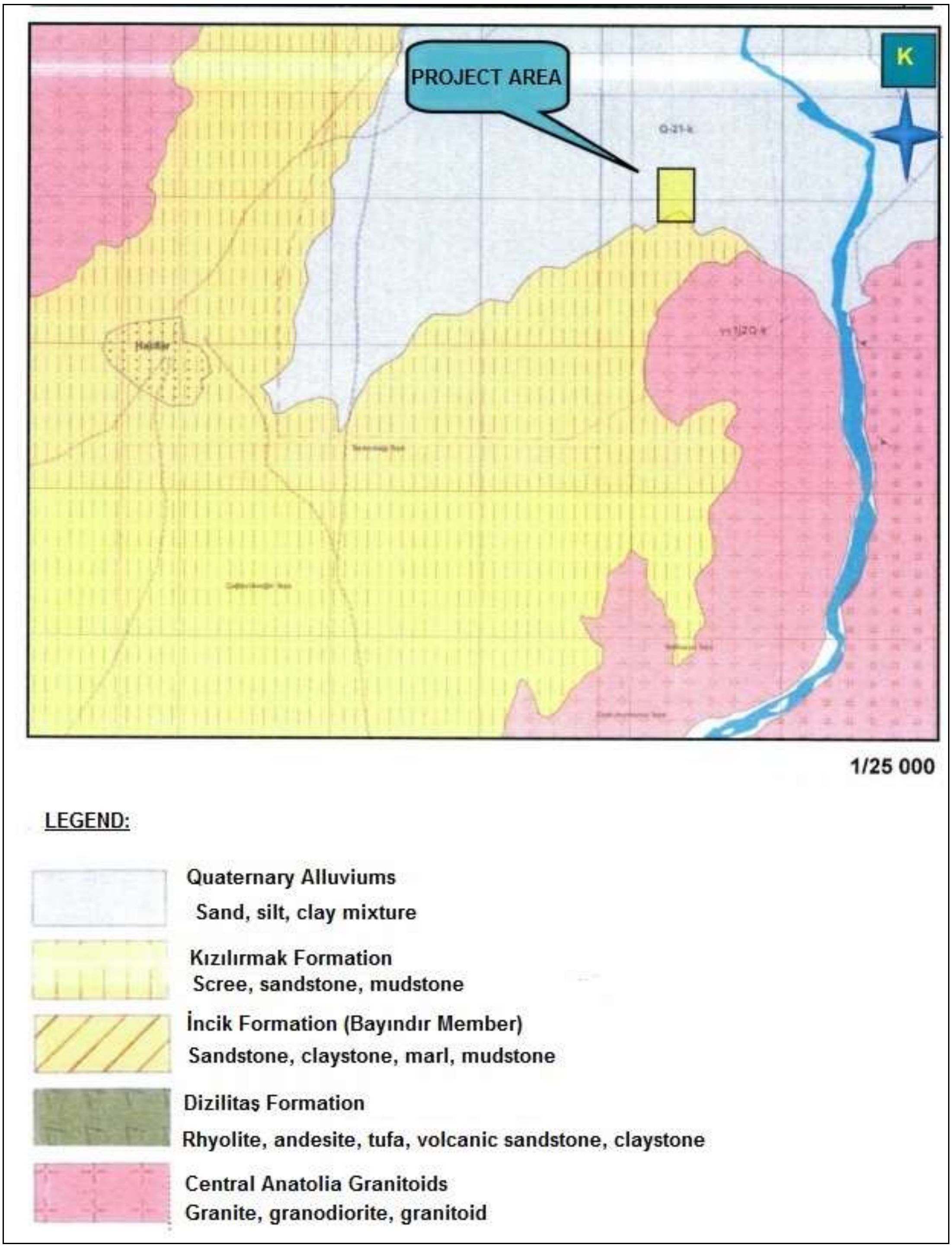


Figure 8. Geological Map Showing the Project Area and its Surrounding

Source: *Kırıkkale-Tüpraş, Natural Gas Cogeneration Power Plant Project Soil Investigation Report, May 2012*

Within the provincial boundaries of Kırıkkale, there are two major water sources, which are Kızılırmak River and Delice River. Kızılırmak Basin contains the entire of Özderesi basin, entire of Çoruhözü basin and a part of Balaban Creek basin. And Delice basin contains the entire of Hitaniöz basin and a part of Kılıçözü basin[11]. The surface water potential of the region is approximately 2500hm^3/year for Kızılırmak River and 750hm^3/year for Delice Creek.

The surface water of Kızılırmak River, which is the surface water source closest to the Project Site, is used limitedly in irrigating farming and power generation. Having been operationalized as a power plant by State Hydraulic Works in 1989, Kapulukaya Dam is used in power generation and also meets the drinking and service water requirement of Kırıkkale Province.

The drinking water of Kırıkkale province, which is entirely included in Kızılırmak Basin, is supplied from Kapulukaya Dam and ground water sources. According to the data from Regional Directorate of State Hydraulic Works, an allocation of water of 142.5hm^3/year is made from the dam to supply drinking and service water to Kırıkkale province and its surrounding settlements. When the ground water potential of the province is considered, the total safe reserve in the province is 10.5hm^3/year and the total ground water potential is 3261 hm^3/year. Table 11 presents the features of Kapulukaya Dam.

Table 11. Features of Kapulukaya Dam

Kapulukaya Dam	
Its Stream	Kızılırmak River
Purpose	Power; supply of drinking , service, domestic and industrial water
Commencement and Completion Dates of Construction	1979-1989
Annual average water	2,700 hm^3
Type	Earth fill
Height (from thalweg)	44m
Height (from Foundation)	61m
Total Dam Volume	1.56 hm^3
Active Volume	136.6 hm^3
Total Lake Volume	282 hm^3
Spillway Project Flow	2960 m^3/s
Annual Drinking Water	142.5 hm^3
Irrigation Area	2086 ha
Water Supply to Ankara (1995)	500 hm^3 between the years 2028 and 2050

Source: Kırıkkale Province Environmental Status Report, 2008

[11] *Kırıkkale Provincial Environmental Report, 2008*

7.3 Meteorological and Climatic Characteristics

Kırıkkale is dominated by Central Anatolian Continental Climate, which is a sub-type of Continental Climate. In the Central Anatolian Region, summers are slightly hot and winters are cold and the severity of the cold increases towards the eastern parts of the Central Anatolian. Natural vegetation is steppes in the lowlands and dry forests on the uplands due to the summer aridness[12].

Kırıkkale Province yearly average relative humidity is 62.5%. Minimum average humidity is seen in August with 3% and maximum average humidity is seen in the months of January and December with 77.6 %.

According to data gathered from Kırıkkale Meteorological Station, maximum temperature is 41.6 °C (July 2000), and the minimum temperature is -22.4 °C (January 1980) recorded between the years 1970 and 2011. Maximum and minimum monthly average temperatures recorded in Kırıkkale Province is given in Table 12.

Table 12. Kırıkkale Meteorological Station Long Years Average Temperature Data

	MONTHS												
Parameter	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**	**Annual**
Minimum Temperature Average (°C)	-3	-1.8	1.4	6.2	10.1	13.8	16.8	16.5	12.2	7.5	2.1	-1.0	-3.0
Monthly Temperature Average (°C)	0.4	2.3	6.9	12.2	16.9	21.2	24.6	24.2	19.6	13.6	6.7	2.2	12.6
Maximum Temperature Average (°C)	4.1	6.9	12.6	18.0	23.0	27.5	30.9	30.8	26.8	20.5	12.3	5.8	30.9

Source: MGM, Kırıkkale Meteorological Station Long Years Meteorological Bulletin (1970-2011).

7.4 Natural and Archaeological Heritage

Natural and archaeological heritages are not available within the Project Area.

7.5 Expropriation & Easement

There is no area to be expropriated within the scope of the Project. The plant will be constructed within the area owned by Tüpraş refinery. Between the CPP and Hacılar substation, expropriation shall not be required for transmission line of 154 kV (CPP and Substation are adjacent) to the Hacılar substation. Transmission line to the Refinery shall get through the area owned by Tüpraş.

The most suitable route for the discharge water (including cooling water) pipeline is the parallel line to the discharge pipeline of Tüpraş refinery. There is a branch station of BOTAŞ PRMS at the South border of Tüpraş refinery which is the favourable the natural

[12] *http://www.mgm.gov.tr/FILES/iklim/turkiye_iklimi.pdf*

gas pipeline route. Since the branch station is located within the Refinery area, natural gas pipeline does not require easement & expropriation.

7.6 Landscaping

After the construction period, landscaping will be carried out around the area with the species suitable for the climate and vegetation of the region in which the power plant will be located.

7.7 Land Use

Based on the field survey carried out at the Project Site and its surroundings, the Project Area is categorized as dry agricultural land.

7.8 Population Characteristics of the Region

According to Turkish Statistical Institute (TÜİK) results of 2012, total population of the province is 274,727 whereas the total population of Turkey is 75,627,384 and population density of the province is 61 and population density of the country is 98. As a result, this number is below the average of Turkey.

According to TÜİK 2011 data, total population of Kırıkkale was 274,992 in 2011, 233,768 of which lived in the city/county centers and 41.224 in towns/villages. In 2011, rural population rate to the general population was 14.99%, while rural population rate to the general population was 85.01%. Rate of population of the province to the general population is above the average in Turkey (76.8%). Distribution of the population by counties is given in Table 13.

Table 13. Distribution of Population in Kırıkkale by Counties

Counties	Province/County Center			Town/Villages			TOTAL		
	TOTAL	Male	Female	TOTAL	Male	Female	TOTAL	Male	Female
Center	193.950	97.411	96.539	8.148	4.224	3.924	202.098	101.635	100.463
Bahşili	5.245	2.628	2.617	1.666	857	809	6.911	3.485	3.426
Balışeyh	2.111	1.059	1.052	4.715	2.427	2.288	6.826	3.486	3.340
Çelebi	782	386	396	1.358	655	703	2.140	1.041	1.099
Delice	2.420	1.304	1.116	7.172	3.467	3.705	9.592	4.771	4.821
Karakeçili	3.115	1.533	1.582	260	124	136	3.375	1.657	1.718
Keskin	10.211	4.975	5.236	9.294	4.766	4.528	19.505	9.741	9.764
Sulakyurt	2.560	1.384	1.176	5.367	2.616	2.751	7.927	4.000	3.927
Yahşihan	13.374	6.202	7.172	3.244	1.648	1.596	16.618	7.850	8.768
TOTAL	233.768	116.882	116.886	41.224	20.784	20.440	274.992	137.666	137.326

Source: TÜİK (Address-based Population Registration System), 2011

7.9 Seismic Activity

Kırıkkale province is located in 1st degree seismic zone. Kırıkkale Province is located in the tectonic region called as Central Anatolian Plain Region. It is under the influence of

Ezine Pazarı Fault Zone and the faults associated with it. 1938 M=6.6 Kırşehir-Keskin Earthquake is the biggest earthquake which affected Kırıkkale in the last century.

At the Project Site, the return period for any two earthquakes having the magnitudes of 5.0 and 6.0 is 7 years and 43 years, respectively. Besides, while the probability of occurrence of an earthquake having the magnitudes of 6. 0 is 20.6%, the probability of occurrence of an earthquake having the magnitudes of 6.0 within a period of 50 years which can be thought as a standard lifecycle has been calculated as 68.5%.

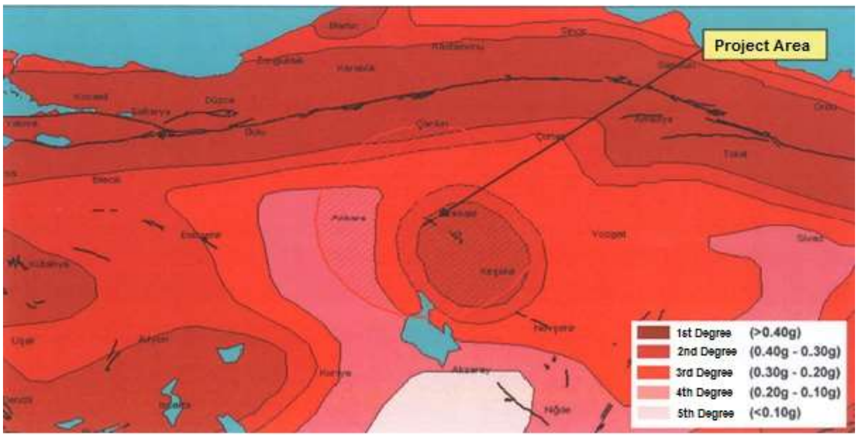


Figure 9. Seismic Map of Kırıkkale

7.10 Soil Characteristics of the Region

The soil in Kırıkkale province generally consists of brown soils. The soil which is brown or grayish on the surface is small-grained and easily dispersible. It has a rich content of lime. Its main rock is of volcanic. These soils are accumulated in the alveolar parts in the highly rugged areas. Exposed volcanic rock surfaces are observed on them. They are fertile since they are rich in minerals. In addition, there are alluvial soils in the riverside on the south. They form thick covers in patches. Their slope is slight. They are suitable for field agriculture and irrigated farming. The fact that the regions dry and receives scare precipitation is an important factor affecting the soil formation[13]. Kırıkkale has an agricultural area of 306,506 ha. 223,040 hectares of which is irrigable. In a 27,907 hectare part of it (9.1%), irrigational agriculture is done.

[13] *http://www.kirikkale.gov.tr/index.asp?islem=cografya*

8. ENVIRONMENTAL IMPACTS OF THE PROJECT AND MITIGATION MEASURES

8.1 Use of Natural Resources

In this section, usage of natural resources such as water (for cooling and construction/operation activities), fuel, and land within the Project will be discussed.

8.1.1 Land Use

The Project Site of approximately 85000 m^2, at an altitude of 705 m, is located adjacent to the South Eastern corner of the Refinery alongside the existing Hacılar substation. There is no forest land and Protected Area within the Project Site.

The Project Site is within the Tüpraş Refinery boundary, therefore there is no agricultural activity within the Project Site.

8.1.2 Fuel Use

The main fuel for the operation of the Project is natural gas. Estimated consumption of the natural gas is 300,000,000 m^3/year.

When natural gas is cut-off or an extraordinary occurrence breaks out and natural gas is not supplied, diesel oil will be used to meet the requirements in the gas turbine with the aim of providing electric and steam safety of Tupras. In spite of these measures; if any problem occurs, heavy fuel oil will be utilized in the auxiliary boiler and the limited amount of steam will be produced for the procurement of steam required for the safety of Refinery.

Diesel fuel will be used as fuel for the construction equipment and machinery.

8.1.3 Water Use

It has been foreseen that approximately 550 personnel will work in the construction stage of the project. Based on the assumption in which per capita water consumption will be 185[14] L/day-per capita, water need of the personnel will be 101,75 m[15] /day-per capita. The need of drinking water will be met by bottles.

it is assumed that approximately 35 personnel will be employed for the operation stage and per capita water consumption is 185 L/day, the amount of domestic water which is required within the scope of the project will be approximately 6,475 m^3/day including hand washing, showers, emergency response cleaning showers, toilets, kitchen and general cleaning works. The drinking water requirement will be met by the bottles, as in the construction stage. The reserve water which will be utilized in the cooling system will be provided from Kapulukaya Dam. Pure (demineralised) water to be stored in the pure water

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[14] http://tuikapp.tuik.gov.tr/Bolgesel/tabloOlustur.do

[15] http://tuikapp.tuik.gov.tr/Bolgesel/tabloOlustur.do

tank will be primarily used for boiler feed water, chemical solution preparation and chemical washing.

8.2 Impacts and Mitigation Measures

In this section, the impacts of the project on physical and biologic environment are defined and legal, administrative and technical measures which will be taken to improve, minimize and prevent these impacts are separately and elaborately explained.

8.2.1 Wastewater

During the construction, the wastewater will be collected within wastewater tank via suitable waster system and treated by package treatment system in accordance with the Water Pollution Control Regulation. The wastewater will be used to prevent the dust which may occur during the construction activities. The expected amount of wastewater during the construction stage has been estimated to be 101.75 m^3/day. Since the treated water is used for dust control during construction activities, there will be no discharge of wastewater during the construction period.

Wastewater management during the operation period will be the industrial wastewater treatment plant for the wastewater produced from;

- Process Water: HRSG blow down water, HRSG drainage water, chemical drainage water and other operational wastewater.
- The blow down water of the cooling tower for the free chlorine control.
- Wastewater including oil which is filtered from oil separator.
- Wastewater generated from reverse osmosis system to be used in the cooling water process.

Wastewater used for the cooling system will be discharged to Kızılırmak River. Seymenoba commits that the effluent from the neutralization treatment plant together with cooling tower blow-down will comply with the following national limits:

Table 14. Wastewater Discharge Limit Values for the Project

Parameter	Unit	Composite Sampling 24-hours
COD	mg/L	30
TSS	mg/L	100
Oil and Grease	mg/L	10
Total Phosphorus	mg/L	-
Total Cyanide	mg/L	0.5
Temperature	°C	35
pH	-	6-9

Discharge of the cooling water may affect the aquatic ecosystem. Warm water increases the temperature of the receiving body. This situation causes O_2 depletion, therefore change in the ecological status of the water.

The following waste water streams will be treated on-site before being mixed and discharged to the river:

- Process water effluents including HRSG blowdown, HRSG drain water, chemical drains and other process waste water will be treated in a neutralization pit;
- Cooling tower blowdown shall be treated to control the free chlorine content;
- Sewage (domestic/human waste) will be collected in a septic tank and the liquid effluent mixed with domestic waste water; and
- Surface water contaminated with oil that has been passed through an oil / water separator.

The following waste water streams will be recycled if it is practical to do so:

- Surface water shall be collected and transferred to the cooling tower basin.
- Condensate return from refinery in a small holding tank prior to testing. If the quality is acceptable it will be transferred into the steam / water cycle after polishing, otherwise it will be transferred to the raw water tank or disposed of.

If the above options are not practical, the wastewater streams will be mixed with the other wastewater streams and discharged to the Kızılırmak River.

During the operation stage of the Project, estimated amount of wastewater will be 2400 m^3/day (0.0278 m^3/s). According to Kızılırmak monitoring station report of State Hydraulic Works, annual average flow rate of Kızılırmak River is 74.99 m^3/s. On the other hand, as mentioned above, wastewater discharge to the river is 0.0278 m^3/s. According to IFC's Guideline on Environmental Wastewater and Ambient Water Quality, discharged cooling water shall not result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place. Water balance calculations show that flow rate of the discharge water is insignificant as compared with the flow rate of the river. Therefore, temperature of the discharge water will not affect the actual temperature of the Kızılırmak River due to well mixing and dispersion of the discharged water.

8.2.2 Flora/Fauna

During the operation period of the Project, anthropogenic factors have been expected to have impact on fauna and flora, therefore on the biological diversity. For this reason; people who are temporarily or permanently stay within the Project Area will be ensured to keep the negative impacts on the flora and fauna at the minimum level. The gathering plant species, the damage on wild animal species, hunting or killing those animals will be definitely prevented.

The wastewater will be handled and treated in a suitable way according to discharge limit values described above.

Moreover; Bern agreement protection measures in regard to the fauna species listed in Bern Agreement Annex-2 and Annex-3 as well as 6^{th} and 7^{th} articles of the agreement will be followed in the operation stage of the project.

8.2.3 Noise

The noise to be generated during the operation stage will be resulted from the gas turbines, steam turbines and air-cooled condensers. The amount of noise reaching to the nearest receptors will be minimized by the selection of suitable equipment, noise absorbers and isolation.

8.2.4 Solid Waste

The construction waste will be composed of plates, metal parts, packages and boxes, iron, steel, cement packages, wood residual and scrap metals. The storage areas which are assigned for collecting construction waste within short-term will be present in the field. The construction waste which is recyclable will be recycled and non-recyclable construction waste will be disposed in accordance with the related regulation.

Recyclable solid waste (glass, paper, plastic, etc.) which will be generated by the personnel during the construction activities will be collected within separate containers and given to the licensed recycling companies in accordance with the provisions of “Regulation on Control of Package Waste”. On the other hand, non-recyclable waste will be collected within separate containers and disposed in accordance with the provisions of “Regulation on Control of Solid Waste”.

The amount of excavation soil which will be obtained as a result of excavation to be performed in the construction stage within the scope of the project has been expected to be approximately 35,000 m^3. The excavation material will be primarily used as filling material for the plants to be built as well as rehabilitation of the current roads and environmental planning. Unused part of the excavation waste will be disposed in the excavation storage area determined by the related municipality in accordance with the provisions of “Regulation on Control of Excavation Soil, Construction and Debris Waste”.

As the construction activities progress, it has been expected that waste which may be specified as hazardous waste such as painting boxes, diluting containers, etc. will be generated. These wastes will be temporarily stored in the waterproof concrete area separate from other wastes and sent to the plant with waste disposal license for the final disposal. During the storage and transportation stages; these materials will be disposed in accordance with the provisions of “Regulation on Control of Hazardous Waste”.

Packaging waste will be generated by the personnel working during the site preparation, construction, and operation stages of the Project. Recyclable solid waste such as package material and similar waste which will be generated from the construction works will be recycled; having signed the protocol with Hacılar Municipality; non-recyclable waste given to the solid waste collection system will be disposed. Packaging waste such as paper, cardboards, etc. which may be recycled will be collected in the containers whose tops are covered within the construction site separate from the domestic solid waste and then sent to the licensed recycling companies.

If tyres of vehicles and construction vehicles are required to be changes in the Project Site, the tyres changes will be delivered to the licensed carriers in accordance with the provisions of “Regulation on Control of Tyres Which Have Completed Their Life-Cycles”.

Solid waste being generated by FGD unit will be deposited in waste silo temporarily then, will be sent for the final disposal by a licensed firm. Wasted material will be handled with the provisions of “Regulation on Control of Hazardous Waste”.

8.2.5 Emission

The manner in which the pollutants which will be released to the atmosphere from the flue of the proposed plant will spread within the specified construction area (17.5 km in north-south direction, 17.5 km in east – west direction) under the current meteorological conditions and the possible level ground concentration (YSK) values generated by the pollutants in question have been examined with the Air Quality Modelling Study conducted in September 2012. The modelling study has been conducted including existing thermal power plant operation and planned CCGT’s normal operational phase and the back-up phase.

Generally, the source of SO_2 emissions in the gas flue is the oxidation of the sulphur within the fuel. The emission control is performed by either decreasing the sulphur content of the fuel or increasing SO_2 gas. Since natural gas including the sulphur in the negligible level will be used as main fuel in Kırıkkale Cogeneration Power Plant, SO_2 emissions generated from the plant will be in the negligible level. Since diesel fuel will be used as reserved fuel, it has been expected that SO_2 will be generated under the working conditions in which diesel fuel is used.

There are two factors causing NO_x emissions which will be generated as a result of combustion process to be performed in the plant. The first one is nitrogen content of the fuel used for the combustion process. However; more importantly, NO_X emission is generated from the high-temperature oxidation of the nitrogen free in the air. The generation of NO_X is easier when the combustion temperature increases. The boiler combustion, combustion temperature, pressure etc. are the factors determining the emissions in question within the plant to be built. The low-NO_X burner will be used to control NO_X emissions generated from the planned power plant. NO_X will be increased by decreasing the air rate within specific areas as possible as and fixing the deficient fire.

CO emissions are generated as a result of inefficient combustion. The suitable persistency period and high-temperature should be ensured to complete the controlled combustion. The limit value of CO emission is % 15 O_2 and 100 mg/Nm^3 in the volume. CO emission to be generated from the flue of the plant will be maximum 100 mg/Nm^3.

Estimated mass flow rates of pollutants running on natural gas and diesel oil are tabulated below:

Table 15. Mass Flow Rates and Concentrations of Pollutants for Natural Gas Conditions

Parameter	Values
NO_x	33 mg/Nm³ (dry, %15 O_2) 18.12 kg/h (as NO_2)
CO	62 mg/Nm³ (dry, %15 O_2) 34,04 kg/h

Table 16. Mass Flow Rates and Concentrations of Pollutants for Diesel Oil Conditions

Parameter	Value[1]	
	Gas Turbine	Auxiliary Boiler
NO_x	33 mg/Nm³ (dry, %15 O_2) 18.12 kg/h (as NO_2)	150 mg/Nm³ (dry, %15 O_2) 30 kg/h (as NO_2)
CO	62 mg/Nm³ (dry, %15 O_2) 34,4 kg/h	80 mg/Nm³ (dry, %15 O_2) 16 kg/h
SO_2	100 mg/Nm³ (dry, %15 O_2) 54,91 kg/h	200 mg/Nm³ (dry, %15 O_2) 40 kg/h

** The values are design values of the Project*

Guaranteed emission values are given in Section 9.1.

8.2.6 Transmission line and Pipelines

Wastewater discharge pipeline

Appropriate disposal routes for the various aqueous discharges from the Plant are not yet to be finalized. It is thought that all types of wastewater (after the appropriate treatment processes) shall be discharged to the Kızılırmak River. Possible impact of the wastewater discharge to the Kızılırmak River is the thermal pollution. As described in Section 8.2.1, the flow rate of the wastewater is much lower than the flow rate of the river. Therefore, cooling water discharge shall not cause thermal pollution in the river hence; aquatic ecosystem will not be affected.

Transmission line

Since the TEİAŞ substation (Hacılar Substation) is adjacent to the Power Plant, transmission line to the connection point will not go through any private parcels. Hence, there won't be negative impact on the environment. Minimum working distance of 1.11 meters will be applied as per IFC's Electric Power Transmission and Distribution Guideline.

Natural gas supply line

Natural gas will be supplied from the BOTAŞ PRMS station, which is to be constructed about 1200 meters away from the Project Site, or the branch of the station which is located at South border of Tüpraş Refinery. Since the branch of the PRMS is within the borders of the Refinery, this option shall not cause environmental and social negative impact.

9. COMPLIANCE WITH BEST AVAILABLE TECHNIQUES (BAT) AND INDUSTRIAL EMISSIONS DIRECTIVE

The European Council Directive on Industrial Emissions (Integrated Pollution Prevention and Control) (Directive 2010/75/EU of November 24, 2010) aims at an integrated approach of pollution prevention and control arising from industrial activities listed in its Annex I. The Directive requires that "The Commission shall organize an exchange of information between Member States and the industries on best available techniques, associated monitoring, and developments in them". The results of exchange of information have been published by the Commission as Best Available Techniques reference documents (BREFs) on each industrial activity listed in Annex I.

To organize the exchange of information the Commission has set up the so called Sevilla process in order to produce BREFs in all for 33 industrial activities. One of the BREFs is the BREF on Large Combustion Plants (LCP), which deals with "Combustion installations with a rated thermal input exceeding 50 MW" according to the IPPC Directive's Annex I.

This chapter has been developed to determine the Project's compliance with BAT and Industrial Emissions Directive. According to IED Article 30 (3), Part 2 of Annex V shall be applicable for the emissions limit values. IFC EHS Guidelines for Thermal Power Plants states the emission limit values in its tables 6 (B) and 6 (C). Tables 6,7,8,9 of BREF on LCPs' will also be followed. In the following section, comparison of limit values will be provided. Those limit values will be the guaranteed emission values for the Project.

9.1 Emissions

Emissions to air are one of the most significant risks to the environment presented by the energy sector and a broad range of substances with the potential to harm the environment are emitted as a result of combustion activities.

The energy sector is one of the largest contributors to greenhouse gas emissions through CO_2 and to a lesser extent N_2O emissions which pose a significant threat to the global environment.

Emissions to air from combustion installations also have the potential to cause significant impacts on local air quality. There are a range of emissions and emission sources ranging from dust from solid fuel and ash storage and handling to NO_x, SO_x, CO, hydrocarbons, particulates and heavy metals from combustion plant. All these emissions have the potential to adversely affect the air quality.

SO_2 Emission

Use of FGD System reduces the sulphur oxides which is included in the Project. Following tables represent the comparison of limit values for different standards.

Steam Boilers consist of independent stacks and each boiler has a thermal input of 95 MWt. Therefore, capacity criteria of 50-100 MWt range has been used for the determination of limit values. According to

Generally, natural gas is considered to be free from sulphur. Therefore, SO_2 limit values do not create concern while running on natural gas as a fuel.

NO_x Emission

Use of dry low NO_x combustion system is seen as the BAT for the NO_x reduction. Since the Project uses NO_x combustion system, the Project complies with the BREF.

CO Emission

Since BAT for the minimization of CO emissions is complete combustion, the Project meets the BAT standard for the CO reduction. As it is stated in the Section 7.5.4 of BREF on LCP, “a well optimized system to reduce emissions of NO_x will also keep the CO levels below 100 mg/Nm^3.” Seymenoba commits to keep CO level below the 100 mg/Nm^3 for 15% of O_2.

Heavy Metals

75-90 % reduction of heavy metals can be achieved by the use of fabric filters. Use of sodium bicarbonate as the reagent in dry FGD follows this guidance to minimize heavy metals content.

Emission Guarantees

According to GT and HRSG emission guarantees of the Project;

- NO_x exhaust gas emissions will not exceed the following concentrations during stead-state operation from base load down to 70% load over the ambient temperature range from -22.4°C to 41.6°C.
- CO exhaust gas emissions will not exceed the following concentrations during steady-state operation at base load down to 70% load over the ambient temperature range from -22.4°C to 41.6°C.

Table 17. GT and HRSG Emission Guarantees*

Pollutant	Natural Gas			Liquid Fuel		
	IFC	Annex V of IED	BREF on LCPs	IFC	Annex V of IED	BREF on LCPs
NO_x (mg/Nm^3)	51	50	50-100	152	50	150-300
SO_x (mg/Nm^3)	N/A	35	N/A	Use of 1% or less S fuel	350	350**
CO (mg/Nm^3)	N/A	100	30-100	N/A	100	30-100

** Guaranteed values are for 15% O_2, 0°C, 101.325 kPa dry flue gases*
***For the absence of GTs*

According to Steam Boiler emission guarantees of the Project;

Each steam boiler will not exceed the following concentrations during steady-state operation from base load down to 50% load over the ambient temperature range from -22.4°C to 41.6°C.

Table 18. Steam Boilers Emissions Guarantees*

Pollutant	Natural Gas			Liquid Fuel		
	IFC	Annex V of IED	BREF on LCPs	IFC	Annex V of IED	BREF on LCPs
NO_x (mg/Nm^3)	240	100	50-100	400	300	N/A
SO_x (mg/Nm^3)	N/A	35	N/A	900-1500	350	100-350
CO (mg/Nm^3)	N/A	100	30-100	N/A	80	N/A

** Guaranteed values are for 3% O_2, 0°C, 101.325 kPa dry flue gases*

9.2 Water Contamination

There are a number of aqueous effluent sources from power generation plant. One of the most significant effluents is discharge of cooling water, either from once-through cooling or from cooling tower blowdown. Other effluents include boiler blowdown, effluent from reverse osmosis plant, waste water from desulphurization plant etc.

According to BREF on LCP, prevention of oil contamination by oil separation wells is a BAT. Installation of a wastewater treatment plant to remove heavy metal content and to decrease the amount of solid matter from the water is another BAT.

According to BREF on Industrial Cooling System (ICS), BAT consists of several approaches such as reduction of water requirements, emissions to water, energy consumption etc. for the industrial cooling systems.

- The Project complies with some of BAT approaches for the reduction of water requirement such as:
  - Optimization of heat reuse; and
  - Recirculating systems (cycle amount is 3.28).
- For the reduction of entrainment, the Project applies the following BAT approaches:
  - Optimization of water velocity with raw water tank to limit sedimentation.
- For the reduction of emissions to water, the Project applies a wet cooling tower against the effect of reduced environmental impact of reduced heat discharge. Aim is to reduce Delta-T in the Kızılırmak River for each operational season (summer and winter conditions). The following BAT approaches are also considered for the Project:
  - Operating the system for the pH between 7 and 9;
  - Closing blowdown temporarily after dosage;
  - Monitoring and control of cooling water chemistry;
  - Selecting the right material to prevent corrosion;

- Avoiding stagnant zones in the system;
- Automated cleaning systems; and
- Keeping the water velocity above 0.8 m/s.

After the determination of the water discharge pipeline route, a study on thermal modeling is recommended.

The liquid effluent from the neutralization treatment plant together with cooling tower blowdown will be discharged to the River, to follow the recommended pipeline route and will comply with the following discharge limits:

Table 19. Guaranteed Wastewater Discharge Values

Parameter	Unit	Composite Sampling 24-hours
COD	mg/L	30
TSS	mg/L	100
Oil and Grease	mg/L	10
Total Phosphorus	mg/L	-
Total Cyanide	mg/L	0.5
Temperature	°C	35
pH	-	6-9

10. ADVANTAGES ON THE CURRENT POWER PLANT OF TÜPRAŞ REFINERY

The existing Thermal Power Plant (TPP) in Kırıkkale Refinery is constructed in 1986. TPP unit has been equipped with two 12 MWe CTR12 type steam turbines and 21 MWe Nuovo Pignone type steam turbine to meet the Refinery's electric demand. First and second turbine has been built in 1986; third one (21MW) has been built in 2007. There are four 120 t/h boilers in Kırıkkale Refinery burning Refinery Gas and Fuel Oil mixture.

According to Tüpraş Refinery emissions monitoring study, following Table 20 and Table 21 are prepared.

Table 20. Features of Power Plant Unit Common Flue

Source	**F-2201A**		**F-2201B**		**F-2201C**		**F-2201D**	
Total Thermal Power MW	211.6							
Thermal Power MW	50.45		52.29		54.43		54.43	
Thermal Power MW	5.62	44.83	4.95	47.34	5.88	48.55	5.88	48.55
Fuel Type	Gas	Fuel-Oil	Gas	Fuel-Oil	Gas	Fuel-Oil	Gas	Fuel-Oil
Fuel Amount	657.3 Nm^3/h	4,100 kg/h	579 Nm^3/h	4,330 kg/h	686.6 Nm^3/h	4,440 kg/h	686.6 Nm^3/h	4,440 kg/h
Efficiency	89.3%							
Flue Cross Section	Ø = 2.4 m							
Flue Height	120 m							

Table 21. Monitoring Results of Power Plant Unit Common Flue from current operations at the Refinery

Parameters		1st Measurement	2nd Measurement	3rd Measurement	Average
Flue Diameter (m)		2.40			
Flue Height		120			
Gas Temperature (^{O}C)		131	131	131	131
O_2%		13.15	13.13	13.13	13.14
Pressure (atm)					0.933
Humidity (%)					12.9
Flue Gas Velocity (m/s)					16.3
Flue Gas Flow (m^3/hour)					265.327
Flue Gas Flow (Under Normal Conditions) (Nm^3/hour)					167.280
Flue Gas Flow – Dry Base (Under Normal Conditions) (Nm^3/hour)					145.701
Efficiency (%)		89.3	89.3	89.3	89.3
Concentrations (mg/Nm^3)					
Dust	mg/m^3	28.6	30.3	37.4	32.1
	mg/Nm^3	39.5	41.8	51.6	44.3
	3%O_2	90.5	95.7	118.1	101.4
Carbon monoxide (CO)	ppm	1	4	1	2
	mg/m^3	1	3	1	2
	mg/Nm^3	1	5	1	3
	3%O_2	3	11	3	6
Sulfur dioxide (SO_2)	ppm	216	218	217	217
	mg/m^3	389	393	391	391
	mg/Nm^3	617	623	620	620
	3%O_2	1415	1425	1418	1419
Nitric oxide (NO)	ppm	97	101	97	98
	mg/m^3	88	91	88	89
	mg/Nm^3	130	135	130	132
	3%O_2	298	309	297	301
Nitrogen dioxide (NO_2)	ppm	102	106	102	103
	mg/m^3	142	147	142	143
	mg/Nm^3	210	218	209	212
	3%O_2	481	498	479	486
Total Organic Compound	mg/Nm^3	0.856	0.915	0.832	0.868
Mass Flow (kg/hour)					
Total Organic Compounds					0.1264
Dust					6.4576
Carbon monoxide					0.3643
Sulfur dioxide (SO_2)					90.3348
Nitrogen oxides	NO				19.1883
	NO_2				30.9385

The existing Plant located in Tüpraş refinery has adverse effects from environmental and economic aspects. Energy efficiency of the current plant is lower than the planned CCGT system's efficiency. According to modeling studies, the Project's emissions (NOx and CO) are extremely lower than the limit values set forth by Turkish regulations. Natural gas is used as the main fuel source which is environmentally friendly as compared with other fuel types. Since the selected system will have back-up fuel; the Project guarantees the continuity of energy supply to the Refinery in any emergency case, which brings an advantage compared with the existing plant.

11. OVERVIEW OF ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM

The ESIA was undertaken between April and November 2012 and conducted by DOKAY on behalf of AES-Entek. As required in EBRD PR1, the ESIA provides an overview of the environmental and social baseline at the site, the identification of works that may affect the baseline and an assessment of the direct and indirect effects of the project. Where impacts are identified the ESIA has identified mitigation measures that to diminish the impact of the project on sensitive receptors and resources. The ESIA is considered to be sufficient for the proposed works and given that construction works at the site are well advanced it is considered appropriate that any environmental and social gap are addressed within the ESAP.

The initial compassing stage of the ESIA identified that the following environmental and social aspects could be out of the scope assessment which include:

- Indigenous people;
- Land acquisition, involuntary resettlement and economic displacement; and
- Cultural heritage

11.1 Occupational Health, Safety, and Environmental Policies of the Project Owner and the Contractor

Seymenoba Elektrik Uretim A.S and Técnicas Reunidas appointed by AES-Entek as the turnkey EPC Contractor, apply the procedures established in their HSE Management Systems in all projects, certified according to:

- OHSAS 18001, Occupational Health and Safety Management Systems; and
- ISO 14001, Environmental Management Systems.

<u>HSE Policies</u>

Seymenoba commits that everyone, including employees, contractors, visitors and members of local communities are the first consideration. Seymenoba believes that all occupational accidents are preventable, and each individual is responsible for their own safety as well as the safety of their colleagues and other persons affected by their work activities. Seymenoba is committed to implement its HSE Policy in terms of the following concerns:

- Seymenoba will ensure that adequate resources are allocated and appropriate responsibilities are identified to meet the requirements of its HSE Policy.
- Seymenoba will establish and implement programs, and best practices for conducting safe, healthful, and environmentally sound operations.
- The Project will fully comply with all related Turkish HSE laws and regulations, EBRD PRs, IFC PS's, and applicable EU Directives.
- What about CEMS and EHS management systems? ISO certification?

- Seymenoba will spend all necessary efforts for the prevention of environmental pollution, and will seek ways to manage natural resources.
- Seymenoba will improve its health, safety, and environmental performance continuously by setting and reviewing objectives and targets with the required performance measurements and assessments.

The major element of the HSE Management of the Project is the tracking of all significant HSE Management actions required to control the Project HSE hazards/risks. Legal compliance is required to ensure all management actions meet with certain standards. Construction Permit, Environmental Permit and Independent Control requirements are the main elements of legal compliance. For the tracking of each action, HSE Compliance Tracking System (HSE CTS) will be used. This is a database of information on each action item, which is updated at regular intervals (nominally monthly).

The compliance structure of the Seymenoba HSE Policy with shareholders' policies, National and International Requirements during the construction of the Kırıkkale CPP is shown in Figure 10.

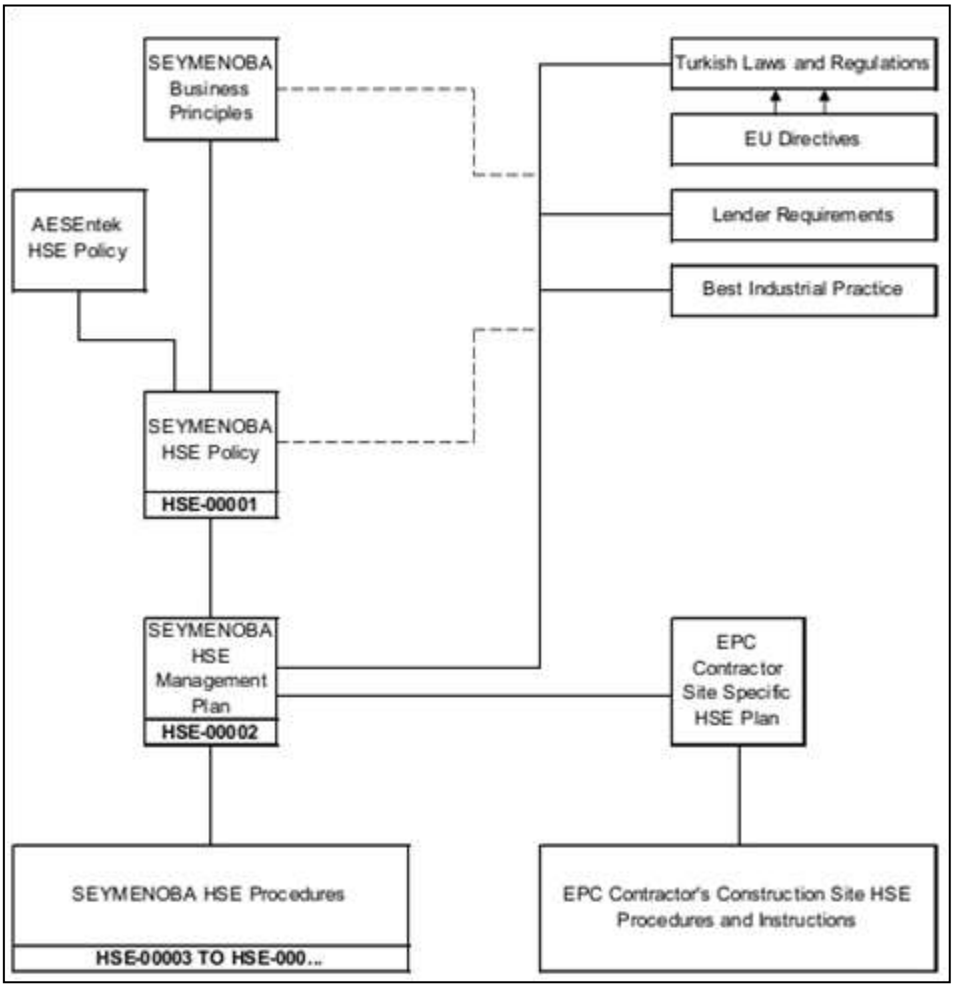

Figure 10. Kırıkkale CPP Construction Stage Health, Safety, and Environmental Management System Document Structure

Source: *Kırıkkale CPP Project HSE Management Plan*

The HSE structure and responsibilities are defined in Kırıkkale CPP Project HSE Management Plan as follows:

- Construction Director – overall responsibility for HSE performance
- Site Manager – overall responsibility for HSE performance
- HSE Manager – coordination and leadership of HSE management

AES-Entek's HSE Management applies a procedure for controlling contractors. This procedure is called "Contractor Selection and Management". The procedure sets down the way in which contractors are selected due to HSE qualifications, the HSE management plans, programs, procedures and resources which must be provided to support the contracted work, and the methods which are used to control contractors working within the Project.

Seymenoba commits in the National EIA that waste control/disposal will be conducted according to National and International requirements. Recyclable materials will be transported by licensed vehicles to licensed recycling facilities.

Hazardous wastes will be disposed in compliance with related regulations.

A study about area of influence of transmission lines was not conducted during the National EIA as it will be concern of a separate EIA study. However, as per EBRD and IFC requirements; influence area and impacts of transmission lines will be covered during the ESIA studies.

Corporate HSE Policy of Técnicas Reunidas is based on two main principles:

- The level of safety and the standards of health and ergonomics can be controlled and achieved.
- The adverse environmental impacts of the projects are minimized.

Técnicas Reunidas believes that achievement of such principles will be ensured with a continuous monitoring of the design along the whole project. HSE issues and actions will be properly identified and documented.

Técnicas Reunidas ensures that its Quality, Health, Safety, and Environmental Policy is understood, implemented, continuously updated and communicated at every level of the Organization. The company commits to:

- Foster a continuous improvement in the work methods and procedures, promoting a philosophy of prevention before remedy, "do it right the first time".
- Establish objectives in Quality and HSE and review them periodically.
- Satisfy all requirements established by Seymenoba, current legislation and applicable codes, as well as any further requirements that Seymenoba may choose to endorse.

- Promote the Quality and HSE knowledge of its staff, partners, and other collaborators as well as encourage their awareness.
- Provide staff, partners, and other collaborators with adequate and continuous training.
- Take into account the efficient use of energy, protection of the environment and prevention of pollution in its all activities.
- Foster a philosophy of accident prevention in order to provide all staff a safe and healthy work environment.

Project and Site HSE organization charts of Técnicas Reunidas are presented in Figure 11 and Figure 12 respectively.

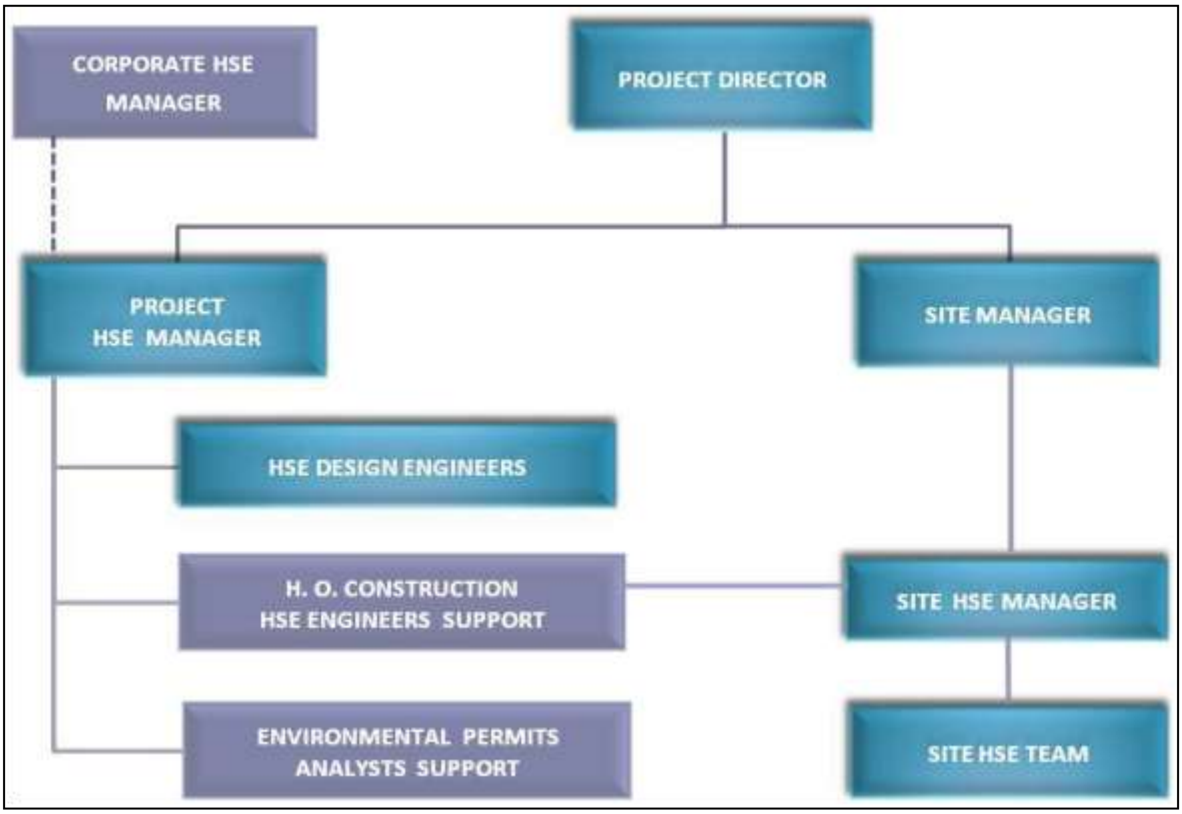

Figure 11. Técnicas Reunidas Project HSE Organization Chart

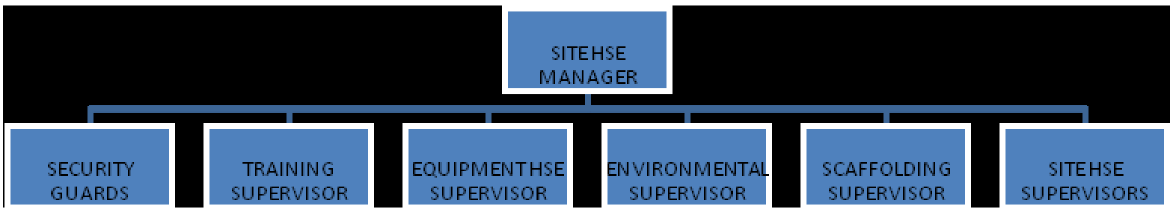

Figure 12. Técnicas Reunidas Site HSE Organization Chart

For the construction period of the Project, a Construction Environmental Management Plan (CEMP) will be prepared to meet national and international standards. The CEMP will cover such topics as applicable legislation and project standards, environmental policy and organization, permit issues, induction and trainings, inspections and reporting as well as environmental monitoring mechanisms.

11.2 Social Policies of the Project Owner and the Contractor

11.2.1 Grievance Mechanism for Workers

AES-Entek has a “Helpline” for its staff to raise workplace concerns. The details of this mechanism are presented in Figure 13.

THE HELPLINE

The Helpline is available

- 24 hours a day
- 7 days a week
- In Turkish

What is it?

AES Entek strives to create a work environment where AES Entek people feel free to raise questions or concerns directly to AES Entek leaders. However, in some cases AES Entek people may not feel comfortable doing this. The Helpline offers another option for AES Entek people to request advice or report wrongdoing.

All efforts are made to preserve the confidentiality of the Helpline report.

AES Entek will not tolerate retaliation against any AES Entek person for raising questions or making a good faith report of improper behavior.

Caller may remain anonymous.

How does it work?

- Caller makes a report via the Internet or telephone
- Caller receives a report identification number and is assigned a date to check back on the status of the report
- All reports are tracked in a confidential database
- At the conclusion of the investigation, a final response is delivered to the caller and logged in the database

How to contact the Helpline?

YARDIM HATTI

Yardım Hattı'na

- 7 gün
- 24 saat
- Türkçe ulaşılabilir.

Yardım Hattı Nedir?

AES Entek, çalışanlarına sorularını ve kaygılarını amirlerine rahatça paylaşabilecekleri bir çalışma ortamı yaratmak için çaba gösterir. Bazı durumlarda, AES Entek çalışanları kendilerini bu durumda rahat hissedemeyebilir. Yardım Hattı, AES Entek çalışanlarının tavsiye alabilecekleri ve görevi suistimali bildirebilecekleri başka bir seçenektir.

Yardım Hattı'na iletilen raporların gizliliğinin korunması için her türlü önlem alınmıştır.

Bir ihlali, şüpheli bir davranışı ya da gerçeğe dayalı bir endişeyi raporlayan bir çalışana karşı misilleme yapana tölerans gösterilmeyecektir.

Arayan kişi adını gizleyebilir.

Nasıl çalışır?

- Arayan kişi Internet ya da telefon hattından ulaşabilir
- Arayan kişiye bir kimlik numarası verilir ve raporun durumunu kontrol etmesi için bir tarih verilir
- Bütün raporlar gizli bir veritabında takip edilir
- Soruşturmanın sonunda, arayana nihai karar bildirilir ve sisteme kaydedilir.

Yardım Hattı'na nasıl ulaşılır?

Telefon / Phone +1 704 544 31 43 **www.aeshelpline.com**

Figure 13. AES-Entek Helpline

11.2.2 Community Relations and Grievance Mechanism for the Project

The grievance mechanism will be maintained during the project life and also available for the project labor, including non-employees engaged though sub-contractors.

The objective of a grievance procedure is to ensure that all comments and complaints from any project stakeholder, including local/regional authorities, residents of nearby residential areas, Seymenoba employees, Seymenoba contractors' staff and other interested parties, are considered and addressed in an appropriate and timely manner. All grievances will be acknowledged and responded to within a reasonable timeframe.

Seymenoba Elektrik will accept all comments and complaints associated with the project. A Complaints Form is given in Figure 7. The comments and complaints will be summarized and listed in a Complaints/Comments Log Book, containing the name/group of commenter/complainant, date the comment was received, brief description of issues, information on proposed corrective actions to be implemented (if appropriate) and the date of response sent to the commenter /complainant. Any person or organization may send comments and/or complaints in person or via post, email, or telephone using the contact information.

Records of the community relations program and complaints received by the companies shall be kept.

These records shall include the following information:

- Minutes of Community Liaison Meetings
- Minutes of HSE Committee Meetings
- Minutes of Plant Management HSE Performance Review Meetings
- Complaints Forms for complaints made in person, by telephone or in writing
- Master copies of any other communications in whatsoever form related to the community relations program

The records of the community relations program shall be kept for the operational lifetime of the company.

Records of the community relations program shall be kept in a manner which allows easy access and review.

Seymenoba

SEYMENOBA ENERJİ ÜRETİMİ VE TİCARET A.Ş. KIRIKKALE COGENERATION PLANT CONSTRUCTION PROJECT	Page/Sayfa: ... / ...
COMPLAINT FORM / ŞİKAYET FORMU	

Complaint Received by / Şikayeti Alan: **Date / Tarih :**

Position / Pozisyon : **Time / Saat :**

COMPLAINT

Name of Complainant / Şikayetçinin Adı : ______________________

Contact Details / Kontak Detayları : **Address :** ______________________

____

____

Telephone No: ______________________

Type of Complaint / Şikayetin Tipi :

☐ Personal Visit / Ziyaret ☐ Telephone Call / Telefon ☐ Written Inquiry / Yazılı

Description of Complaint / Şikayetin Tarifi :

____

____

____

RESPONSE / YANIT

Urgency / Aciliyet:

☐ Normal Response (within 5 days) / Normal (5 gün içinde)

☐ Urgent Response (one day or less) / Acil (bir gün veya daha az)

Solution / Çözüm:

☐ Change to plant engineering & design / Tasarım değişikliği

☐ Change to operating systems/programs/procedures / Sistem değişikliği

☐ Change to personnel behaviour / Kişisel davranış değişikliği

☐ Correction of misconception of complainant/Yanlış anlaşılma düzeltilmesi

☐ Provision of information to complainant / Şijkayetçiye bilgi temini

Complaint Form

Seymenoba

SEYMENOBA ENERJİ ÜRETİMİ VE TİCARET A.Ş. KIRIKKALE COGENERATION PLANT CONSTRUCTION PROJECT	Page/Sayfa: ... / ...
	COMPLAINT FORM / ŞİKAYET FORMU

Complaint Received by / Şikayeti Alan: **Date / Tarih :**

Position / Pozisyon : **Time / Saat :**

COMPLAINT

Name of Complainant / Şikayetçinin Adı : ____________________

Contact Details / Kontak Detayları : **Address :** ____________________

Telephone No: ____________________

Type of Complaint / Şikayetin Tipi :

☐ Personal Visit / Ziyaret ☐ Telephone Call / Telefon ☐ Written Inquiry / Yazılı

Description of Complaint / Şikayetin Tarifi :

____

RESPONSE / YANIT

Urgency / Aciliyet:
☐ Normal Response (within 5 days) / Normal (5 gün içinde)
☐ Urgent Response (one day or less) / Acil (bir gün veya daha az)

Solution / Çözüm:
☐ Change to plant engineering & design / Tasarım değişikliği
☐ Change to operating systems/programs/procedures / Sistem değişikliği
☐ Change to personnel behaviour / Kişisel davranış değişikliği
☐ Correction of misconception of complainant/Yanlış anlaşılma düzeltilmesi
☐ Provision of information to complainant / Şijkayetçiye bilgi temini

Complaint Form

Figure 14. Seymenoba Complaint Form

11.2.3 Health, Safety, and Environment (HSE) Management Plan

This part addresses the overall management plan and system which will used to control health, safety and environmental (HSE) management and specially applies for the construction, installation, start-up and commissioning activities of Kırıkkale 233.7 MWe Natural Gas Fired Cogeneration Plant Construction Project owned by Seymenoba Elektrik Üretim ve Ticaret A.S.

The purpose of this part is to set down the guiding principles, management structure, organization and outline of the specific programs which implement Health, Safety and Environmental (HSE) management within the construction, start up and commissioning activities at the project.

Construction Director is responsible for ensuring the overall implementation of the HSE Management Plan and related plans and programs in construction project. Site Manager is responsible for ensuring the overall implementation of the HSE Management Plan and related plans and programs on site. HSE Manager is responsible for the design, organization, management and ensuring the overall implementation of the HSE Management System and related plans and programs on site. Personnel are responsible for implementing the HSE Management System, plans, programs and all its individual components, as part of their general duties and in relation to all work activities which they carry out.

Seymenoba Elektrik is committed to a high standard of health, safety and environmental (HSE) management, and throughout the project's construction and operational process. This commitment is central to the Company objective of implementing best industry practices and being a welcome, responsible and long-term member of the local community. The HSE management system has been developed to provide a framework by which the Company can effectively manage the HSE issues related to construction, start up and commissioning activities. The philosophy is that HSE considerations should be integrated into the day-to-day work activities of the Company, so that good HSE management becomes a normal, accepted part of work, and is not considered an additional burden or separate effort divorced from construction. The HSE management system has been designed in accordance with state-of-the-art, international principles and practices for the HSE management of power plant constructions, including best industry practices and the requirements specified for an HSE management system under ISO 14001:2004 – Environmental Management System and OHSAS 18001:1999 - Occupational Health and Safety Management System promoting continuous improvement in HSE performance. However the ISO 14001 and OHSAS 18001 Certifications are not mandatory but a matter of project management's decision. The HSE management system follows the "continual improvement" model of PLAN-DO-CHECK-ACT, as shown in Figure 15 below:

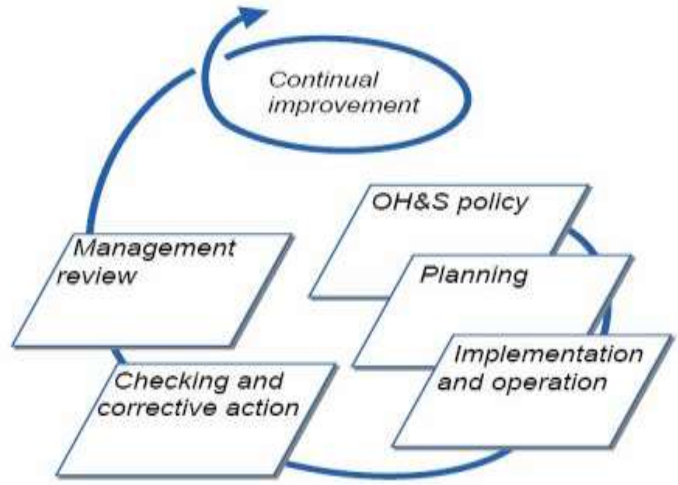

Figure 15. Seymenoba "Continual Improvement" Model of PLAN-DO-CHECK-ACT

The policy stage involves the management commitment to managing health and safety, environmental issues.

The planning (PLAN) stage involves the hazard identification and risk assessment of the project and its associated work activities, and the designing of appropriate management programs by which to control these hazards/risks. The implementation and operation (DO) stage covers the implementation of controls over construction, start up and commissioning activities (via written procedures, information/instruction/training to personnel and record-keeping) to ensure that the hazards/risks are properly managed. The checking and corrective action (CHECK) stage contains confirmation that control measures are implemented, via field inspections, walk-downs, reviews, audits, etc. to ensure that what has been prescribed is actually being executed in the field. Finally, the management review (ACT) stage includes reviewing the performance of the Company in relation to the whole HSE management system, and the HSE management system itself as a working tool, and making any necessary changes to ensure that it continues to be effective and promotes continuous improvement in performance.

The HSE management system considers all aspects of HSE management, including organization and roles & responsibilities, communication, physical control of work activities, work procedures, response to accidents and emergencies, and welfare facilities for personnel. Part of the HSE management system covers both internal and external communications, including community relations. Therefore, when implemented fully, the HSE management system is a comprehensive, complete way of operating safely and protecting the environment, which is integrated with construction, start up and commissioning activities, and makes a significant contribution to the business success of the Seymenoba Elektrik.

Risk Analysis and Emergency Response Plans including fire, accidents and spills will be prepared for the construction phase of the project. However, general mitigation measures regarding occupational health and safety are:

- Employees will be trained for the health and safety requirements;
- All the precautions related with working at heights will be taken throughout the construction and operational phases of the proposed project in accordance with the EBRD Guidelines and the local regulations;
- Material Safety Data Sheets for all chemicals used at the plant will be available at site and in easy reach to concerned employees;
- Proper and approved Personal Protective Equipment (PPE) will be provided to all employees handling chemicals and will be trained on their use and maintenance;
- Key personnel will be trained in first aid and have a valid training certificate;
- Employees will be trained on the use of firefighting systems and equipment.

11.2.4 Workers Accommodation and Transportation

During the construction phase, workers will live in a hostel provided by Project Contractor in city of Kırıkkale or Hacilar District. They will travel to work on a bus-in/bus-out (BIBO) basis which will be provided by Project Contractor. Workers who are locally resident in central of Kırıkkale will be transported to the construction site on a daily basis where they work on a rotational shift basis in common with all other workers. At present, this journey takes around 30 minutes but might be significantly reduced if bypass route is designated.

The Project Construction Area is managed in accordance with applicable Turkish standards and the guidance contained in the EBRD Guidance Note "*Workers Accommodation Processes and Standards*". The key elements of the standards are as follows:

- Climatic aspects: given the extreme weather conditions that may occur at site, accommodation is provided with heating in winter and ventilation or air conditioning in summer so that the inside temperature is constantly kept around 200C;
- Drinking water: is provided in sufficient quantities at all times, either from regular taps if drinking water quality can be ensured or in bottles;
- The following standards apply for accommodation and sanitary facilities:
    - 100 liters of water per worker per day are available in average for personal hygiene purposes. This water is drinking water quality unless explicitly marked otherwise;
    - One hand wash sink per ten persons;

- One toilet per ten persons;
- One urinal per fifteen persons.

The construction area is designed to accommodate up to 585 workers, supervisory and management staff. Construction area is equipped with mess halls, recreational facilities and medical facilities. The remote construction camps accommodate up to 585 workers and are sustained by supplies from Hacilar District central onsite facilities. Extinguishers are provided and fire emergency procedures are in place, with trained fire wardens in the construction area. All the necessary safety measures will be taken by the Constractor including emergency exist door, fire alarm system, etc.

11.2.5 Human Resources Policies

AES-Entek has an “Ethical Rules of Conduct and Implementation Principles” document. The document includes principles and responsibilities of AES-Entek in internal and external relations as well as ethical rules of conduct to be complied with by employees. The employees are aware of the document and they are expected to behave accordingly.

In this document, AES-Entek lists its basic principles relating to employee relations as follows:

- In recruitment and employment, to seek for certain objective job-related qualifications as the key and single criterion, and to provide and offer equal opportunities;
- Employment decisions will not be made on the basis of personal characteristics, such as gender, race nationality, ethnic origin, religion or belief, disability, age or sexual orientation, unrelated to inherent job requirements;
- Human resources policies will be maintained appropriate to the workforce;
- All workers will receive documentation on their working conditions and terms of employment including their entitlement to wages, hours of work, overtime arrangements and overtime compensation, and any benefits;
- To attract to the Company the most qualified and talented young and the most experienced professionals who may take and carry the Company forward;
- To make the most of the skills, strengths and creativity of its employees;
- To offer equal opportunities for training, guidance and development of its employees in order to let each and every employee to strive for excellence;
- To reward the success and achievement through fair and competitive wage policies and effective and objective performance assessment and appraisal systems and practices;
- To improve and encourage loyalty of employees to the Company by offering equal opportunities in promotion and rewarding policies;
- To preserve and maintain labor peace at all times and try to show each and every employee that the Company could be an ideal place to work;

- To provide the employees with clean, healthy, hygienic and safe working conditions;
- To create and maintain a transparent work environment encouraging mutual respect, where the most important components are cooperation solidarity and acting with integrity;
- To show not a bit of tolerance to harassment at work;
- To welcome, evaluate and respond to comments and suggestions of employees and take motivation increasing actions; and
- Not to share with third parties any proprietary information of employees without knowledge of and prior consent of the relevant employee, except for legal obligations.

In its Recruitment Policy, Técnicas Reunidas commits the following:

- Técnicas Reunidas carries out their recruitment processes respecting equal opportunities and non-discrimination.
- The recruitment processes at Técnicas Reunidas is guided by respect for people, the transparency of information, honesty and professionalism at work.
- Técnicas Reunidas guarantees confidentiality of candidates participating in recruitment processes.

12. REFERENCES

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