



Final Report

Mid Size Sustainable Energy Financing Facility (MidSEFF) Alaşehir Geothermal Electric Power Plant: Non Technical Summary (NTS)

May 2015

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European Bank for Reconstruction and Development

**Alaşehir Geothermal Electric Power Plant:
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The European Bank for Reconstruction and Development (EBRD) launched in January 2011 a financing facility aimed at scaling up Renewable Energy and Energy Efficiency investments in Turkey, to increase the country's energy savings and decrease its carbon emissions. The Turkish Mid Size Sustainable Energy Financing Facility (MidSEFF) launched by the EBRD with support from the European Investment Bank (EIB) and European Commission (source of the Technical Cooperation funds) will provide a total of EUR 975 million in loans through 7 Turkish banks for on-lending to private sector borrowers.

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1. General Plant Description

The Project Alaşehir 2 is located within one of the geothermal concessions of the Company Turkerler Jeotermal Enerji Arama Ve Uretim A.S. The concession covers a total area of 136,5 km², the concession area where Alaşehir I-II Power Plants are located is about 38.4 km². The geothermal concession is near the Sub-District of Piyadeler, District of Alaşehir, and Province of Manisa in Aegean Region of Turkey.



Figure 3-1: Location of the Project Area

The licensed area numbered 227 where Alaşehir I-II Power Plants are located was obtained applying to the Manisa Special Provincial Directorate of Administration.

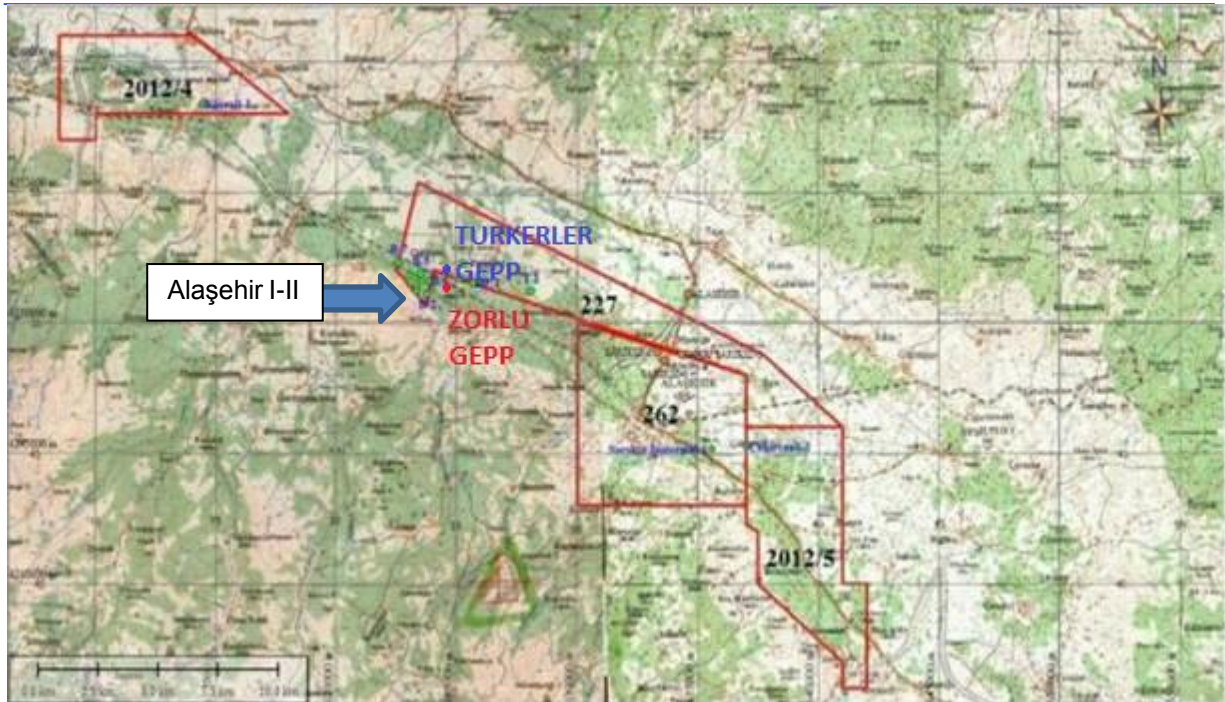


Figure 3-2: Map of the TURKERLER concession with the license areas

The distance of the project area from Manisa city is about 110 km. and the distance from Izmir city is about 135 km.

The planned size of the Alaşehir 2 plant is 23.6 MWe rated load capacity (licence 24 MW) with one alternator driven by two turbines manufactured and installed by ORMAT Inc. The plant technology is a binary organic cycle designed according to the characteristics of the fluid (temperature, steam/water ratio, pressure, gas content, etc). The working fluid is N-pentane.

The electricity generation preliminary licence was initially obtained on 10th July 2014 for a 24 MWe PP size and for a validity period of 30 months.

The plant is expected to start producing energy in July 2016 according to the work schedule.

According to the information given by the Sponsor, it is planned to drill 9 wells in total which will be 3 productions, 1 spare/observation and 5 reinjection wells in detail. During the site visit, it is observed that the 3 production well (BY-6, Ç-1, Ç-2) have already been drilled. BY-7 has been drilled but collapsed and under maintenance now. It will be planned to drill a spare/observation well if BY-7 not to be able to fix. K-1, K-3 and BP-1 have been already drilled for reinjection that they will be 5 reinjection wells in total.

In the same project area, there is Alaşehir 1 GEPP project which is operated by the same Sponsor TÜRKERLER Geo-Thermal Energy Exploration and Generation Joint Stock Co. Alaşehir I GEPP has been already completed and in operation with the 24 MW (4 production 4 reinjection wells) production capacity till 25 September 2014. Its temporary acceptance has been done by EMRA.

The scope of work of the Alaşehir II GEPP Project is the execution of the following programme:

- Drilling of 3 production/1 observation-spare/5 reinjection wells;
- Installation of the fluid collection and disposal system (FCDS);
- Installation of a power plant (ORC technology) with a gross capacity of 24 MWe;
- Construction of a power transmission line (0,1km).
- Auxiliary infrastructures and services (switchyard, access roads, site preparation, water supply, general landscaping works, reinjection and inhibition systems, etc.);
- Advisory services (studies, work direction and supervision, etc.)

Table 1-1: Key project summary data

Project Name	Alaşehir Geothermal Electric Power Plant Project
Project Borrower	<p>Türkerler Jeotermal Enerji Arama ve Üretim A.Ş.</p> <p>The Borrower was established on 16 May 2008 to build and operate electricity production plants in order to produce and sell electricity. The majority shareholder of the Sub-Borrower Company is Türkerler İnşaat Turzım Madencilik Enerji Ticaret ve Sanayi A.Ş.by 51% and the remaining 49% shares belong to Kazım Türker, founder of Türkerler Group.</p> <p>Türkerler has started its geothermal drilling operations in February 2011 near Alaşehir, Manisa. Having four different geothermal exploration licenses in a 140 km² area that within the Eastern part of Gediz graben in the east-west plains of western Anatolia in the inner Aegean region that 250 MW of GEPP projects can be developed</p>
Project Sponsors	The Sponsor Türkerler Group is a family company. Türker Family has started its commercial activities in the fields of textiles and ready-made garment that currently continues of 3 different firms. Selen Giyim which was established in 1989 in Ankara pursues its operations with its production capacity of 15,000 units a month and its manufacturing park consisting of computerized sewing machines. Selen Giyim products are sold in selected stores in 50 provinces of Turkey and in Russia and United Arab Emirates abroad.
EBRD Transaction	The total project cost is USD 96,151,048 including USD 83,485,283 fixed investment cost, USD 7,707,545 VAT, USD 1,522,021 commitment and arrangement fee and USD 610,225 working capital requirement. The debt financing amount of the investment will be USD 80,000,000, of which USD 53.14 million from MidSEFF and the rest from Isbank resources. The debt to equity ratio is calculated as approximately 83:17.
Project Description / Business Purpose:	<p>The location of the proposed geothermal power plant is in the Aegean Region, Manisa Province, Alaşehir district.</p> <p>Alaşehir II GEPP is planned to be almost a twin of Alaşehir I, with the same general design criteria both for the power plant unit and for the other electro- mechanic components, a part from the extraction and the reinjection wells. The plant should start to produce energy in July 2016 according to the work schedule.</p> <p>The planned size of the Alaşehir 2 plant is 23.6 MWe rated load capacity (licence 24 MW) with one alternator driven by two turbines manufactured and installed by ORMAT Inc. The plant technology is a binary organic cycle designed according to the characteristics of the fluid (temperature, steam/water ratio, pressure, gas content, etc). The working fluid is N-pentane.</p> <p>Energy Transmission Line will be 0,1 km and connected to Alaşehir GEPP Transformer Station 154kV via 154 kV Switch which will be located at the Alaşehir GEPP-2 area</p> <p>There are another GEPPs licensed and planned around the project.</p> <ul style="list-style-type: none"> • Alaşehir I GEPP In Operation, 24 MWe Capacity, At the same location • Zorlu GEPP, Under Construction, 45 MW Capacity, 600 m away from the closest well, • Maspo GEPP, Licensed, 35 MW Capacity, 2,5 km away from the western boundary of the project. • Soyak GEPP, Planned, 3 km away from the project boundary of the license. • Sis GEPP, Planned, 10 km away from the project license boundary <p>The GEPP project will contribute to the share of renewable energy in the Turkish market.</p>
Installed Power	24 MWe (licence), 23.6 MWe (actual)
Annual Electricity Production	139,480 MWh/y

2. Environmental and Social Baseline

2.1 Environmental description of the project area

The Project Alaşehir 2 is located within one of the geothermal concessions of the Company Turkerler Jeotermal Enerji Arama Ve Uretim A.S. The concession covers a total area of 136,5 km², the concession area where Alaşehir I-II Power Plants are located is about 38.4 km². The concession is located in the Western Anatolia, belonging to the Aegean Region, in Manisa province and in Alasehir District. In its turn, the geothermal concession is part of the wider geothermal area, quite homogeneous from the geological point of view, corresponding to a large part of the Gediz graben. Many of the Turkish geothermal projects at different stages of investigation/evaluation and / or of construction / exploitation are located on this regional tectonic structure.

According to the PIR there is no designated area within the project site, such as natural, protected and sensitive areas. The project area is surrounded by private lands used for agriculture that are encircled vineyard.

The PIR supplied by the Sponsor mentioned about flora and fauna species that are found at the project site. As a result; there are not any species endemic, rare or under protection by national or international agreements. Findings of the faunistic studies conducted for mammals, birds, reptiles and amphibians are summarized in the report. As the result of fauna studies carried out in the study area, all species are listed least concerned (LC) category under IUCN. 13 species were identified in the region under BERN (Annex III) and 32 species under BERN (Annex II).

2.2 Social condition of the project area

The project is located in Aegean Region, Manisa province, Alaşehir district, very close to the Alaşehir town.

The economic activities of Alasehir are linked to the products of the surrounding region. It includes tobacco, raisins and fruits. There is also a mineral spring of heavily carbonated water tapped and sold to neighbour cities. Alasehir is well-connected with other urban centres by rail and road. It lies along the Afyon–Izmir railway. Afyon is 230 km east, Usak 120 km northeast, Denizli 100 km southeast and Izmir 140 km west.

3. Social and Environmental Impact

3.1 Land use

The project site is located on private lands used for agricultural purpose by the owners. Majority of private lands has already been purchased by mutual agreements. To construct the GEPP, expropriation procedures must be done and obtained a decision of public utilities for entire project area. Therefore, the Sponsor has started to proceed with expropriation procedures to get authorization from related authorities and it has been applied for a “Non- Agricultural Utilization Permit” but the permit has not been received yet. For powerhouse location which is 15 hectare, 100% of total area has been purchased by mutual agreements and already applied for a reconstruction permit on December 2014 but the permit has not been received yet. For well locations, 80% of the total area has been purchased. For pipeline area, the sponsor has started purchasing process.

3.2 Water Use Waste Water

Drinking water will be purchased from nearby settlements and delivered to the project site. Based on the assumption that the daily domestic water requirement is 200 litres per person, considering 200 employees during the construction phase and 30 employees during the operation phase, the domestic water requirement are estimated to be 40 m³/day and 6 m³/day, respectively.

Domestic waste water generated by project workers will be collected in impermeable septic tanks constructed in line with Turkish regulation.

Geothermal hot water occurs during drilling operations. Mud-pits are designed by leak-proof material and placed in all well area as the 2400 m³ volume. Drilling liquids are allowed to cool to 35 °C then kept waiting on mud-pits for the purpose of evaporation. After that it is discharged by vacuum truck if necessary. There is another storage pool (catch-pit) with 5000 m³ volumes in BY-4 area. It is used for cooling and subsidence of geothermal liquids taken out of the wells during the testing process. Since the geothermal liquid includes heavy metals and the temperature of it is higher than discharge limits to receiving environment (river, stream etc.), uncontrolled discharge should be definitively avoided.

During the operation, binary system design of the Alaşehir-II GEPP will not result in any liquid emission as this system allows the geothermal fluid to circulate in a closed loop except fault conditions. For fault conditions, there is a storage tank planned with 1000 m³ volume to store liquid for an hour. If the problem duration exceeds 1 hour, production will be stopped and not allowed to discharge the geothermal liquids.

According to the above information the GEPP project will not affect the water component.

3.3 Waste Production and Management

As a result of construction activities there will be domestic waste, construction waste, excavated materials and demolition waste, hazardous waste and special waste. These will be managed according to related Turkish regulations.

Domestic solid waste will be produced by construction workers on-site. Daily domestic solid waste production is assumed as 1.15 kg per person, considering 200 employees during the construction phase and 30 employees during the operation phase, the domestic waste produced will be 242 kg/day and 36 kg/day, respectively. The recyclable waste will be displaced in separate waste containers.

Potentially hazardous waste will be segregated from non-hazardous construction site waste and domestic waste. This will be accomplished by training of the project personnel on the types of waste.

Drilling mud accumulated in the mud-pits are placed in every well area and designed by leak-proof membrane as the 2400m³ volumes. Drilling mud is allowed to cool to 35 °C and kept waiting on

mud-pits for the purpose of evaporation. After evaporation ends, it is disposed where it is located in the well area. According to the test result, the waste characteristics are evaluated by The Regulations Relating to the Storage of Waste Regularly. It is defined as non-hazardous waste and can be disposed in allowed area in accordance with the related regulation.

Excavated material will be used for landscaping and remaining amount will be stored off site. Separate temporary storage areas, having impermeable bases, will be designated for the storage of waste oils, fuels, hazardous substances, etc.

3.4 Top Soil and Soil Removal

The construction works will include site clearing/levelling, slope stabilization works, construction of project units including powerhouse, electric power transmission lines and wells.

The total amount of topsoil to be stripped is estimated to be around 5,700 ton from the well and powerhouse area. To minimize the impacts on the topsoil, the stripped material will be carefully removed and stored in a manner to avoid deterioration due to the weather conditions. During the topsoil stripping, the impurities will be removed from the soil. In order to preserve soil fertility, the piles will be slightly compacted and covered with organic material or green seeding with pioneer plant species. The stripped topsoil will be used in the future landscaping works.

3.5 Emissions to Air

Potential impacts of the Alaşehir GEPP on air quality would occur basically during the construction phase of the project.

Dust formation from earthmoving activities and other exhaust gas emissions from construction machinery will be the main sources of impacts on air quality during the construction phase of the project.

Impacts on the air quality, mainly due to dust emissions occurred by excavation works, will be temporary being during the construction phase but the calculated value is under the legal limit value of 1 kg/hour and a modelling study is not necessary.

The air emissions that will occur from the use of the vehicles are below the legal limit values and for this reason a modelling study is not necessary.

Trace amount of gas, mainly in form of H₂S, could occur during drilling operations. However, as such releases would be minor in volume and would occur in short period, the impact will be limited to the working area. Since there is agricultural area around the project area, it should be avoided any damages on harvest and necessary precautions should be taken into consideration. Drillings crews will be provided with safety devices and trained for emergency cases.

In Alaşehir field, the amount of NCG gases in the fluid is about 2.06%. Considering the technology of the project, during operation, the main issue is the possible release to the atmosphere of NCGs contained in the steam. The non-condensable gases (NCG) that are produced together with steam from the geothermal well are vented to the atmosphere. The brine measurement shows that the NCG consist of almost pure CO₂ (99.9%). CO₂ is a greenhouse gas, but it is a non-toxic gas. Based on the information sponsor provided, the last production test seems to indicate a slight progressive decline in NCG content during the time. NCG percentage of the geothermal liquid was 2.2% by weight at first analyses for Alaşehir I Production wells. Then recently analyses are shown that the percentage of NCG is around 1.2-1.5%. It indicates %32-45 decline.

The sponsor informed that they are seeking for the alternatives to eliminate of NCGs. The sponsor has been working on using Carbon dioxide in frozen food industry.

3.6 Noise

Noise emissions will be generated during construction due to earthmoving works, construction of power plant and fluid collection and reinjection system (FCRS) and drilling and completion of production and reinjection wells and operation of construction machinery and equipment.

A study within the PIR, assess the overall impact of noise level during construction phase with respect to distances. For the study, the worst case scenario, in which all equipment are assumed to be used with their maximum sound power levels at the same time at the same location, has been used to calculate the noise levels. Within a distance of 150 m, the resulting cumulative noise level for construction phase is found to be below the noise limit values defined by the Regulation on Assessment and Management of Noise. There is a house in the Piyadeler Village which is located 250 meter away from the nearest well. Noise level is found 64.24 dBA which is below the noise limit values (70dBA) defined by the Regulation.

No noise assessment has been performed to evaluate the noise emissions during drilling phase. The MidSEFF Team suggests the assessment of noise emissions during this phase of the project in consideration of the nearest settlement areas in the vicinity.

During the operation phase, the sources of noise will be the machinery and equipment (gas turbine, pumps etc) in the plant. Because of their low noise level the impact can be reasonably considered not a critical aspect. In the PIR, the operation phase noise levels are also found negligible due to sound absorption by the walls of plant building. The MidSEFF Team suggests the assessment of noise emissions during operation phase of the project in consideration of the nearest settlement areas in the vicinity and the existence of the Alaşehir I GEPP. Besides this, noise measurement which will be controlled during the final acceptance by MENR (Ministry Of Energy And Natural Resources) should be checked by the MidSEFF Team.

3.7 Subsidence

Subsidence occurs as a result of internal loading and/or extraction or alteration of material below the surface, the reinjection could represent a solution to avoid the subsidence but on the other hand this action can increase the fluid pressure and induce micro-seismic activities. The pressure increase, however, is not expected to be significant since geothermal fluids will be withdrawn simultaneously from nearly the same horizon.

In the PIR, the monitoring of the subsidence of the area and of the seismic events is not foreseen. The MidSEFF Team considers this a gap to be filled and suggests adding a monitoring activity of subsidence and of the seismic activity during the operation phase.

3.8 Landscape

The plant will include the horizontal structure (pipeline) and some vertical structures, such as cooling tower or other facilities in the project area. Although, there is no national regulatory requirement, the MidSEFF Team suggests an assessment of visual impact with a photomontage.

Since there will be tree cutting in vineyard and earth moving during the construction of plant and well location, landscape reinstatement plan is suggested.

Table 3-1: Impact Quantification

COMPONENT	IMPACT	QUANTIFICATION
Land use	<u>Different use of the land</u>	38.4 km ² (total concession area of Alaşehir I-II)
Water	<u>Utilization and Discharge</u>	40 m ³ /day during construction for 200 employees 6 m ³ /day m ³ during operation for 30 employees, 10

		m ³ for dust suppression.
Waste	<u>Production of solid waste</u>	242 kg/day during the construction for 200 employees phase and 40.25 kg/day during the operation for 30 employees
	<u>Excavation waste</u>	5700 ton topsoil 7500 ton total excavation waste
Subsidence	<u>Change of the ground level</u>	To be monitor
Landscape	<u>Visual impact</u>	Photomontage simulation is suggested
Emissions	<u>Noise</u>	Construction phase: 64.24 dBA < 70dBA (law limit) Operational phase: no disturbance for the nearest receptors No noise assessment has been performed to evaluate the noise emissions during drilling phase. It is suggested.
	<u>Dust emission</u>	0,066 kg/hour < 1 kg/h (law limit)

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