SANKO GEOTHERMAL POWER PROJECT

EFFLUENT MANAGEMENT PLAN

Version	Revision	Date	Prepared by	Checked by	Approved by
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SANKO ENERJİ

1. SCOPE AND OBJECTIVE

The Effluent Management Plan (EMP) defines any potential discharge or leakage likely to occur during drilling, construction and operation of Sanko Geothermal Power Plant Project and incorporates appropriate effluent management methods for collection, storage, discharge.

The effluents covered by EMP are generated by the following activities:

- Drilling activities,
- Well testing,
- Both provisional and permanent housing (used during construction),
- Operation activities.

EMP defines the method of management of effluents during drilling, construction and operation of the project including:

- how to minimize potential impacts on human health and environment,
- how to achieve compliance with the Turkish regulations and the environmental targets of Sanko,
- how to maintain this possibilities and means for reducing operating costs and any potential obligations.

This plan also guarantees that the effluents will be managed in a proper manner.

1.1. STRUCTURE OF THE EFFLUENT MANAGEMENT PLAN

EMP covers the following headings in addition to this part, which is of an introductory nature containing the definitions of the terms and a glossary thereof:

- Applicable policies and standards,
- Approved effluent management facilities,
- Geothermal water collection ponds,
- Mud pits,
- Effluent management measures and procedures.

1.2. DEFINITIONS

Effluent Management Facility	Structures built to process effluents or store and reinjection them temporarily or permanently.
Effluent management	Collection, temporary storage, re-injection of effluents produced during drilling, well testing and power plant operation activities.

Effluents	Any hot water produced during well testing and power plant operation activities.
Project	Sanko Geothermal Power Plant Project.
Hazardous wastes	Any substances or objects defined by the Turkish laws (Regulation on the Control of Hazardous Wastes dated March 14, 2005, and Regulation on Waste Management dated 23.03.2017)

2. APPLICABLE POLICIES AND STANDARDS

2.1. ENVIRONMENTAL POLICIES OF SANKO

A number of policies have been identified by Sanko to provide guidance over any operations carried out. The Declaration of Policy provided below covers the policy underlying the environmental operations:

- Sanko Geothermal Power Plant Project is a scheme attaching priority to the preservation of environment.
- Sanko is responsible for elimination or proper minimization of all the potential adverse effects of the project on environment during implementation of good environmental administrative methods.

Accordingly, all the works will be carried out in compliance with applicable environmental laws and regulations as well as with international engineering approaches and standards in general such that environment is preserved and its quality enhanced. In order to attain this goal, Sanko will:

- conduct top management reviews and inspections on an annual basis as a minimum for the purpose of achieving conformity to any established policies, procedures and applicable environmental laws and regulations,
- maintain a commitment to pollution prevention, and shall incorporate such principles in any definitions of project conditions and performance of project operations,
- define, evaluate and manage any environmental risks, exerting its best efforts to determine and review objectives and targets for operation thereof and minimize the risks of occurrence of any adverse environmental effects,
- be committed to building relationships with authorities, the scientific community and the public to promote the development and communication of innovative, cost effective solutions to environmental problems;
- ensure a commitment to the continuous improvement of the Environmental Management System wherever possible and sustainable.

All Project personnel shall be individually and collectively responsible for adherence to, and effective application of the policies and principles contained in this environmental policy statement.

2.2. EFFLUENT MANAGEMENT LEGISLATION

The elements of the Turkish legislation referred to below closely relate to management of effluents which would occur during the project drilling, well testing and operation and this legislation must be complied with strictly.

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Waste Management Regulation	02.04.2015 23.03.2017	29314 30016	• Discharge of effluents generated during drilling and operation of power plant
Water Pollution Control Regulation	31.12.2004 10.01.2016	25687 29589	• Discharge of effluents generated during drilling and operation of power plant
Regulation on the Construction of Septic Tanks at Places Where Sewer Construction is Not Feasible	19.03.1971	13783	• Septic tanks for the collection of domestic wastewater generated at construction and operation stages
Regulation on the Control of Odorous Emissions	19.07.2013	28712	• Odorous emissions generated during the operation stage
Regulation on Soil Pollution Control and Point Source Polluted Areas	08.06.2010 11.07.2013	27605 28704	• Risks of soil contamination at construction and operation stages
Regulation on the Control of Excavation Soil, Construction and Debris Wastes	18.03.2004 26.03.2010	25406 27533	• Transportation and disposal of excavation waste and construction debris at the construction stage
Law on Occupational Health and Safety (6331) (as amended with the Law numbered 7033)	20.06.2012 01.07.2017	28339	• Health and safety measures to be taken during construction and operation stages
Regulation on Monitoring of Surface water and Groundwater	11.02.2014	28910	• Control of effluents
Regulation on Monitoring of Groundwater Against Pollution and Deterioration	07.04.2012	28257	• Control of effluents to protect groundwater

3. EFFLUENT SOURCES AND STREAMS DURING PROJECT ACTIVITIES AND MANAGEMENT OF EFFLUENTS

Geothermal Water After and During the Drilling Operation:

Exploration Wells are conducted in order to prove the commercial viability of potential resources. These Exploration Drillings are the same for both the production wells and reinjection wells. Type of the wells is decided according to the efficiency assessment of the wells based on properties such as temperature, flow rate and pressure. During the drilling operation, liquid drilling mud which is the mixture of different type of chemicals with water will be employed in order to carry rock cuttings to the surface and also lubricate and cool the drill bit. Impacts of drilling mud is provided in the following section.

Rotary drilling is used for the wells within the scope of the Project. Casings of three different diameters were employed during drilling of wells which have diameters of 20'', 13 3/8'' and 9 5/8''. At the end 7'' slotted production liners are employed to convey the geothermal fluid to the surface. Cement is applied around the casings and in this way in order to contain the geothermal fluid is contained and uncontrolled generation of geothermal fluid or vapour is prevented. The casings at shallow depth prevent loose near-surface material collapsing into the well and casings with intermediate diameter will support successive wellheads. Casings and concrete wall around casings prevent groundwater and geothermal fluids intervene with each other. No discharge to aquifer will occur due to Project activities.

It is planned to extract 420 tonnes/hour geothermal fluid for 15 MW capacity from wells with a depth of 2500-3000 meter depth. Geothermal fluid extracted from the production wells will be reinjected to the original reservoir through reinjection wells. If the distance to the re-injection wells is provided in the new drilled wells, it is injected to the re-injection well during the test. If the distance of this line is not suitable, new pond is constructed and covered with geo membrane (material is EPDM) near the well site until the test capacity in an appropriate region is reached and the test process is carried out. Then this accumulated water/brine is evaporated.

It is planned to construct an impermeable collection pond to be used in case of any failure during reinjection, operation of the power plant or during maintenance of the wells. The capacity of the collection pond is planned to be 1400 m^3 with the estimation of use of 1400-1500 tonnes/hour geothermal fluid at maximum for a potential capacity increase of the power plant to 50 MW. The capacity of the pond is calculated based on the estimation that the system will stop maximum for 1 hour duration. If the volume of the collection pond is exceeded due to malfunction, extraction of geothermal fluid will be stopped. Geothermal fluid collected in the pond will be reinjected back to the system by reinjection pump. Geothermal fluid discharge to any kind of environment will be prevented during the whole Project lifetime.

Drilling Mud:

Drilling mud will be generated as a result of drillings. Drilling mud will be elevated to the ground collecting solid particles. Drilling mud will be sieved for foreign substances and then passed through solid-liquid separator (decanter). Liquid part is pumped back to the mud tankers to be reused. Solid substances on the other hand, are sent back to waste mud pit. The solid material passing through the decanter has some amount of water content therefore collected as liquid waste in the drilling mud pit. Liquid drilling mud is settled in the pit providing solid substances to deposit.

For the Project 100 lt of drilling mud is expected to be generated for 1 m drilling. Average depth of the drilling wells is estimated to be 2,500 m therefore the amount of drilling mud at each drilling location is calculated as follows:

Amount of drilling mud: 100 lt/m x 2500 m=250,000 lt= 250 m^3

Mud pits with dimensions 60 m x 6.5 m x 3 m with side slope are established for storage of mud at each drilling location. Each pit is covered with impermeable material such as geomembrane and has 1,170 m^3 capacity which is above the calculated value above. Mud collected in the mud pit is settled providing the deposition of solid substances. Waste mud is analyzed for categorization according to the requirements of the Circular on the Disposal of Drilling Mud and Wastes Generated from the Physical Treatment of Chromium Minery (dated 2012/15) and the Regulation on Landfill of Wastes (Official Gazette dated 26.03.2010, no: 27533). If the waste is deemed hazardous waste, it will be disposed according to the requirements of the Circular on the Disposal of Drilling Mud and Wastes Generated from the Physical Treatment of Chromium Minery.

If the waste mud is determined as inert and/or non-hazardous waste then the mud pits will be filled with excavation debris and covered with the vegetative soil which was stripped and stored separately during land preparation.

After the drilling mud is deposited, remaining water on the mud is evaporated or discharged by vacuum truck if drilling mud is determined as non-hazardous or inert. If the mud is classified as hazardous then the water on the mud is collected into IBC tank and disposed according to the requirements the Regulation on Waste Management.

Geothermal Water After Geothermal Power Plant Started-Up :

Spent geothermal fluids generated during operation will be re-injected to the reservoir rock formation, resulting in minor effluent volumes involving reject waters. Potential contaminants in geothermal effluents will vary according to the mineralogy of the host geological formation, temperature of the geothermal water, and site-specific facility processes (IFC EHS Guidelines for Geothermal Power Generation).

Potential for contamination of groundwater will be minimized by installation of leak-proof well casings in the injection wells to a depth to the geological formation hosting the geothermal reservoir.

After the power plant has been started up; in the short term breakdown of the plant, all of the fluid (1500 m^3 pond capacity is enough to carry the available fluid capacity for 3-4 hours) is given to the emergency fluid pond in order to keep the production lines heat. If the trouble longer than capacity, power plant is shut down. After that this pond is injected to re-injection wells.

In the event of emergency discharge of geothermal water to surface waters, geothermal water will be discharged into a retained in a thermal pond, where the temperature of water will drop to allowable limits set by the Water Pollution Control Regulation. The storage pond will be lined and of sufficient size to allow for storage and required cooling to be carried out for the potential duration of the reinjection failure.

The impact of any potential failure of the reinjection system within the Project area can be effectively managed through good design, regular monitoring and development of appropriate emergency responses. Given that a critical failure of the pipeline is extremely unlikely and with a well-prepared management and monitoring plan in place, the residual impacts can be assessed as low.

Groundwater quality monitoring will be conducted at downstream of geothermal fluid storage ponds and reinjection wells quarterly.

Upon DSI approval two locations will be established within the license area and temperature and EC will be monitored in groundwater through installed automated monitoring systems.