Istanbul Waste to Energy Environmental and Social Due Diligence Report

The Black Sea Trade and Development Bank, BNP Paribas, Societe Generale, Swiss ECA/ SERV

17 October 2019

ARUP

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Istanbul Metropolitan Municipality Waste to Energy

Environmental and Social Due Diligence Report

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Abbreviations

APCr	Air Pollution Control residues
BAT	Best-Available Technologies
BSTDB	Black Sea Trade and Development Bank
CEMS	Contiuous Emissions Monitoring Systems
CV	Calorific Value
DSI	General Directorate of State Hydraulic Works
E&S	Environmental and Social
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Mitigation Plan
EPC	Engineering, Procurement and Construction
ESAP	Environmental and Social Action Plan
ESDD	Environmental and Social Due Diligence
ESMS	Environmental and Social Management System
EU	European Union
GHG	Greenhouse gases
GIIP	Good International Industrial Practices
HMB	Heat and Mass Balance
HSE	Health, Safety, Environment
HZI	Hitachi Zosen Inova
IED	Industrial Emissions Directive
IFC	International Finance Corporation
IMM	Istanbul Metropolitan Municipality
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Paste Management
ISTAC	Istanbul Environmental Protection, Recycling and Reuse Company
IUCN	International Union for Conservation of Nature
IVM	Integrated Vector Management
KBA	Key Biodiversity Area
MAM	Marmara Araştırma Merkezi
MCR	Maximum Continuous Rating
MoEU	Ministry of Environment and Urbanisation
MSW	Municipal Solid Waste
MTA	General Directorate of Mineral Research and Exploration
OECD	Organisation for Economic Co-operation and Development
OHS	Occupational Health and Safety
OHTL	Overhead Transmission Lines
PM	Particulate Matter
PR	Performance Requirement
PS	Performance Standard
SCR	Selective Catalytic Reduction
SEP	Stakeholder Engagement Plan
SNCR	Selective Non-Catalytic Reduction
TEİAŞ	Turkish Electricity Transmission Corporation
TUIK	Turkish Statistical Institute
UPS	Uninterrupted Power Supply
VOCs	Volatile Organic Compounds
WB	World Bank
WFD	Waste Framework Directive
WtEP	Waste-to-Energy Plant

1 Executive Summary

Arup (the Consultant) has been commissioned by a group of Lenders including The Black Sea Trade and Development Bank, BNP Paribas, Societe Generale, and Swiss ECA and a Swiss Export Risk Insurance company (SERV) to carry out an Environmental and Social Due Diligence study that includes the development of an Environmental and Social Action Plan, a Non-Technical Summary and a Stakeholder Emgagement Plan for a Waste-to-Energy Facility in Istanbul in Eyupsultan District of the Istanbul. The study mainly focuses on the Istanbul Waste-to-Energy Plant (WtEP) itself. Insufficient information on overhead transmission lines (OHTL) was made available to the Consultant; assessment of this associated facility is therefore limited.

The capacity of the WtEP will be 3,000 tonne/day producing up to 90 MWe of electrical energy, with 8,000 hours annual availability. The WtEP will be owned by Istanbul Metropolitan Municipality (IMM).

Hitachi Zosen Inova – Makyol İnşaat Sanayi Turizm ve Ticaret A.Ş. Joint Venture was awarded as the Engineering Procurement and Construction (EPC) company for the Project in 2017. The site handover was completed on 06.11.2017. The construction activities are planned to be completed by the EPC Contractor on 18.09.2020.

The other key stakeholder is the Istanbul Municipality Environmental Protection, Recycling and Reuse Company (ISTAC) which is owned by the IMM. ISTAC will operate the WtEP after first year of operation. Stantec has been appointed as the Owner's Engineer responsible for reviewing the designs and calculations carried out by the EPC Contractor.

The methodology for this study covers three main items, namely: reviewing the baseline, conducting a site visit, and reviewing project documentation. The study was carried out against national legislation and related international standards as well as Lenders'/SERV's environmental and social requirements.

A site visit was conducted on 28-29 May 2019 by the Consultant with experts from environmental, social, waste-to-energy and process engineering, civil, structural, water, electricity and energy disciplines. Key stakeholders were interviewed during the site visit.

The Project Area was allocated to IMM by General Directorate of Forestry for 49 years starting in 1997. No physical and economical resettlement was required or has taken place. Therefore, the ESDD does not consider IFC PS 5.

The Environmental Impact Assessment (local EIA) study of the facility was prepared in July 2012. There are Key Biodiversity Areas 4km to 6 km from the project site. The project is not expected to have an impact on these.

None of the identified or potential flora species in the project site are endemic, rare, or endangered and protected flora species listed on Appendix-1 of the Bern Convention are not present. Similiarly, no endangered animal species (amphibians, reptiles, birds, mammals) are found in the project area.

The EIA study also presents baseline data for noise levels at the nearest sensitive receptors. Although the noise survey and data presented in the EIA studies are considered to be tecnhcally adequate, the data is seven years old and is considerd not to reflect current conditions in the vicinity of the Project Area. It is recommended that a new noise survey is performed to identify baseline noise levels at the nearest receptors.

Air quality sampling and analysis studies were completed for the EIA. However, the Consultant recommends that a new air quality survey is conducted to develop a new baseline and to reflect the impacts of the other recent developments in the area (metro, highways, airport etc.).

In addition to the air quality analysis, an air quality modelling study was carried out in 2015. The stack height had initially been determined as 60m above ground level. However due to the proximity of the new Istanbul Airport, the stack heigh was reduced and modelling studies were completed to assess emissions from a lower stack. The modelling was carried out using AERMOD and PK 3781 software. The minimum stack height was determined to be 23m and a height of 40m was selected. This was later increased to be 3m taller than the building (43m). The Consultant notes that this is considerably lower than would normally be expected for a stack internationally. It is not clear if the studies considered the presence of the WtEP buildings. Building downwash affects plume dispersion and might result in a requirement for a higher stack. The Consultant recommends that the modelling study is re-run taking the WtEP buildings into consideration. The scenarios used during the modelling study should cover start-up, planned, unplanned and emergency disruption/shutdown cases as well as normal operations.

During the construction stage the Consultant recommends that the EPC Contractor fully implements environmental and social management plans and document in accordance with the relevant standards. A grievance mechanism for both the internal and external stakeholders should be implemented. Since there was no soil sampling and analysis done before the excavation works, it is recommended that such studies should be carried out in the excess excavation material dumpsite after stabilization works ends and before plant operation commences.

For both the construction and operation phases, the Consultant recommends that a permits / licences register and a environmental analysis register is prepared by the EPC Contractor and IMM to monitor compliance.

Following the first year of operation, IMM (through ISTAC) will be responsible for the operation of the WtEP. The Consultant recommends actions for IFC PS 1, IFC PS 2, IFC PS 3, IFC PS4, and IFC PS6 in the Environmental and Social Action Plan (ESAP) for both construction and operation phases.

The EPC Contractor has prepared a traffic management plan. Although site circulation and general operational requirements are well defined, this plan does not include any information regarding access roads and construction impacts. This plan should be updated with the transport and logistics requirements, especially for large equipment deliveries. Emergency scenarious should also be considered in the plan.

An additional traffic management plan should be produced by IMM for the operation phase.

Based on the design information received and the requirement for the WtEP to be designed in accordance with the EU Indistrial Emissions Directive, it is considered that the technical controls to be installed will be sufficient to address the environmental requirements of the project. From the information received, the WtEP appears to be designed in a similar manner to what would be expected within the EU.

Istac proposes to transmit the required amount of waste to the Plant from various districts and transfer stations. We understand that there is sufficient amount of waste available for the Plant and Istac is experienced in managing Istanbul Waste.

The actual calorific value (CV) of the waste received will depend on the composition of the incoming waste to the facility. Should the waste CV be higher than 9 MJ/kg or lower than 6 MJ/kg, then there would be a risk that this could not be processed by the WtEP. The most recent waste Calorific Value data provided by Istac is dated back to summer and winter averages of 2017. According to this data the summer and winter CV averages were 7.25 MJ/kg and 6.87 MJ/kg respectively. However, it is not clear how and when the sampling done and there are some districts whose seasonal CV averages are below 6 MJ/kg. No waste composition information provided us so been undertaken, and as such we are unable to comment if the waste CV range is suitable or not. It is recommended that a Project specific study of waste sampling and laboratory analyses should be carried out by the EPC according to international standards such as ASTM. Support of Istac is necessary during the waste sampling process. This study should consider the seasonality variations before the project commissioning to confirm that the operational range is sufficient for the expected waste streams to be processed.

It will need to be ensured that the operational staff receive adequate training and subsequently operate and maintain the WtEP in accordance with good practice as required and intended by the technology supplier in order to maintain the intended operational performance.

The WtEP is located in the 3rd zone earth region according to the Turkish Earthquake Zone Map. The structural and geotechnical designs and calculations carried out by the EPC Contractor have considered this.

Technical information in relation to fire detection and protection within the WtEP has not been provided by the EPC Contractor. It is recommended that this information is requested and reviewed against any requirements that the construction and operational insurers may have and also Good Industry Practice used in comparable facilities in Europe.

Flood Risk studies are ongoing for the WtEP. Recently, EPC has provided initial modelling visuals showing site flood risk is low. However, the Consultant expects to review the full study with calculations behind to have a comment. The stormwater plan includes a stormwater collection system but it should also include information regarding discharge points.

The Overhead Electricity Transmission Line (OHTL) is a very important component of the Project. The connection of the power plant to the grid will be made via 154 kV Taşoluk Transformer Station and 154 kV Habibler Transformer Station. Two separate six kilometres 1272 MCM OHTL will be installed for the connection. Istac envisages that tendering, procurement, construction, commissioning and ministry acceptance of OHTL will take 13 month ending in November 2020. This schedule is tight but can be achievable through good project management and monitoring.

All the electricity from the WtEP will be sent to grid. To benefit from current FiT of 133 USD / MWh for 10 years, the Plant ministry acceptance should be done before the end of 2020. As per the regulation it is possible to apply for ministry acceptance and obtain it with partial capacity comissioned before this date rather than the full capacity.

The main concerns raised during interviews with key stakeholders were the increase in traffic on the roads, potential odour nuisance, and air pollution concerns. There were also enquiries regarding employment opportunities.

Istanbul produces 18,000 tonnes of municipal solid waste daily. One of the earlier examples in Turkey of this scale, this plant will contribute to sustainable management of municipal solid wastes in Istanbul European side with its 3000 tonne incineration capacity. Istanbul Municipality is experienced in managing municipal solid waste through its company Istac. Hitachi Zosen Inova is one of the world’s leading technology providers and its JV partner is very experienced in constructing infrastructure projects in Turkey and many other countries. This project can become an example of good practise for other Turkish Municipalities and regional cities. Our comments, critisms and suggestions in this report should be treated as an contribution to an already prominent project.

2 Introduction

The Black Sea Trade and Development Bank (BSTDB), BNP Paribas, Societe Generale, and Swiss ECA, SERV (the Lenders/SERV) are considering providing finance to Istanbul Metropolitan Municipality (IMM) for the construction of a greenfield solid waste incinerator with energy generation capacity (known as the Project or the Waste to Energy Plant (WtEP)) in Kisirmandira, Eyupsultan District of the Istanbul Province. The capacity of the WtEP will be 3,000 tonne/day producing up to 90 MWe of electrical energy with 8,000 hours annual availability.

The Engineering Procurement and Construction (EPC) contract for the Project was awarded to Hitachi Zosen Inova – Makyol İnşaat Sanayi Turizm ve Ticaret A.Ş. Joint Venture (the EPC Contractor) in 2017.

The Constuction Consultant of the Project is Istanbul Environmental Protection, Recycling and Reuse Company (ISTAC) which is a municipality company. ISTAC will also operate the WtEP (https://www.istac.istanbul/en). Stantec has been acting as Owner' Engineer responsible for reviewing the designs and calculations carried out by the EPC Contractor.

Construction work is ongoing at the site and the current overall progress for the Plant is 45%. The key dates for the Project are as follows:

- Contract Signing with IMM and the EPC Contractor, 11.09.2017,
- Official Site Handover, 06.11.2017,
- End of Construction Phase, 18.09.2020,
- End of Commissioning Test, 18.01.2021,
- End of Reliability Test and Taking into Operation, 20.03.2021,
- End of Operation and Issue of Preliminary (provisional) Acceptance, 20.03.2022,
- End of Guarantee Period, 20.03.2024.

The Lenders/SERV have commissioned Arup Mühendislik ve Müşavirlik Ltd. Şti. ("Arup" or "the Consultant") to carry out Environmental and Social Due Diligence (the ESDD) for the Project. The ESDD study considers national legislation and related international standards as well as Lenders'/SERV's environmental and social requirements.

3 Project Description

3.1 Project Location

The Project is located in Istanbul province, Eyupsultan district, Kisirmandira neighbourhood. The Project area is located 15 km NW of Eyup district center, 7 km NW of Gokturk Neighborhood, 1.3 km S of Ihsaniye Neighborhood and 600 m SW of Isiklar Neighborhood. It is next to an existing compost plant owned by IMM and will be operated by ISTAC.

The geographic location of the Project Area is presented in Figure 1 below.

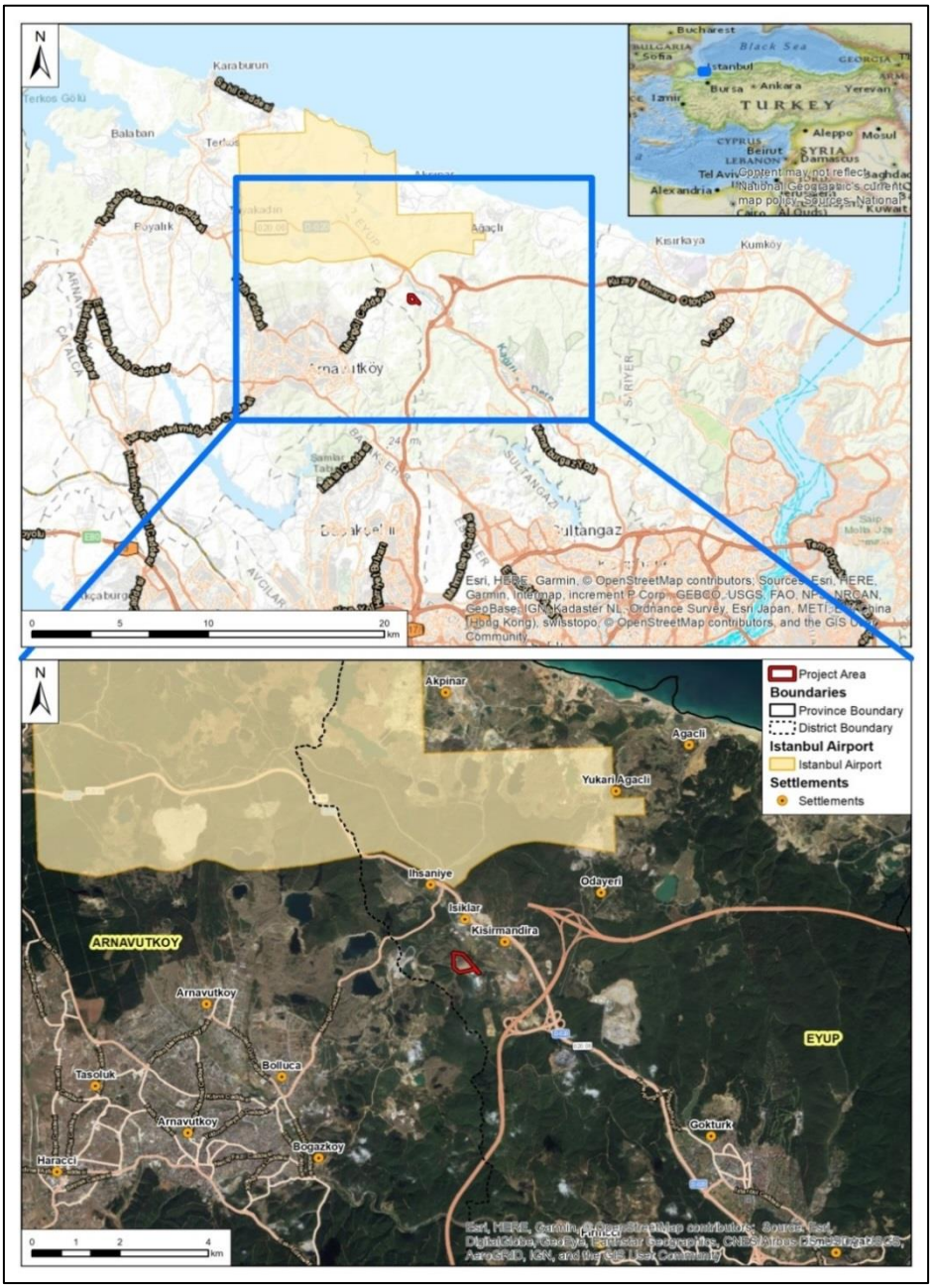

Figure 1: Geographic Location of the Waste to Energy Plant

3.2 Project Design and Technology

The WtEP will generate energy from municipal waste collected in Istanbul through combustion of these wastes. The capacity of the WtEP will be 3000 tonne/day and will produce up to 90 MW of electrical energy. It is planned that the WtEP will work 24 hours daily, and 8,000 hours annually. The remaining 760 hours per year consists of time required for maintenance and planned/unplanned shutdowns

For the purposes of this ESDD, the project boundaries are considered to be as follows:

- Construction of the Project, including site establishment, earthworks, on-site and off-site haul roads and construction of Associated Facilities, as well as construction of the WtEP itself
- Collecting municipal solid waste (MSW) from waste transfer stations in Istanbul and transporting these to the WtEP
- The component operations of the WtEP (waste receiving and storage, combustion and boiler, flue gas treatment, residue handling and energy recovery)
- Transportation of residues to landfill
- Associated Facilities, comprising Overhead Transmission Lines (OHTL).

MSW generated at the district municipalities of the European side of Istanbul will be collected from Halkali, Yenibosna, and Baruthane Transfer Stations, and sent to the WtEP without any pre-treatment. The daily MSW generation of Istanbul is around 18,000 tonne. Currently, most of the generated MSW is sent directly to final disposal facilities (now Seymen Landfill, previously Odayeri Landfill).

The Project will utilize the waste from transfer stations such as Halkali, Yenibosna and Baruthane. According to Istac data, municipality collects waste from different districts of Istanbul such as Arnavutkoy, Sariyer, Kagithane, Besiktas, Beyoglu, Eyup and Sisli by lorries sent to the subject transfer stations.

Table 1: Wastes from Districts and Transfer Stations

AMOUNT of WASTE (tonne)	**TRANSFER STATION**			
DISTRICT NAME	**HALKALI**	**YENİBOSNA**	**BARUTHANE**	**WtE PLANT**
ARNAVUTKÖY	300			300
SARIYER	180		168	348
KAĞITHANE		599		599
BEŞİKTAŞ			456	456
BEYOĞLU			462	462
EYÜP			438	438
ŞİŞLİ			551	551
TOTAL	480	599	2075	3154

As seen above, 3154 tonne/day MSW is available to be sent to the WtEP and it is therefore anticipated that the WtEP will work at full capacity. There will be no municipal solid waste storage at the Project Site.

Municipal solid waste to be delivered to the WtEP will be transported from the abovementioned transfer stations by semitrailers. On daily basis, 352 vehicles are expected to be used in total. These vehicles will use D-010 state road. In addition, 46 trucks will be used for disposal of bottom ash, which will be produced as a result of the incineration process.

The waste will be combusted by grate systems. Combustion technology with grate systems is a common thermal disposal method for domestic waste. In this method, the waste is directly combusted without pre-treatment. Semitrailers bringing municipal solid waste to the WtEP will enter a tipping hall and deposit the waste in a bunker. There will be two cranes for moving waste from the bunker to the feed port. The cranes will also create a continuous mixing process in the storage reservoirs to prevent water from leaching to the bottomand in order to produce a homogeneous waste fuel.

Waste will be transferred from waste bunker to the waste feed hopper for measurement. The hopper will be square in cross-section and designed to prevent blocking. Total waste feed will be 1,000,000 tonnes/year.

The waste will be combusted across three process lines using grate combustion. After the combustion process, gases will be directed to the waste heat boiler to produce steam. Steam at 40 bar pressure and 400°C temperature will be sent to turbine for electricity generation. Air cooled condensers will be used for the cooling of the steam-water mixture that exits the turbines.

All electricity produced at the WtEP will be exported to national electricity grid via 154 kV substations at Tasoluk and Habibler. The route for the OHTL is presented not yet fixed, but a preliminary roite is shown in Figure 2. The process for the OHTL-works was started on 06.05.2019 with an application letter submitted to the Turkish Electricity Transmission Corporation (TEİAŞ). It is anticipated that the design phase will last for 4 months and the construction phase will last for 9 months totalling 13 months. The construction tender will be issued on 15.10.2019.

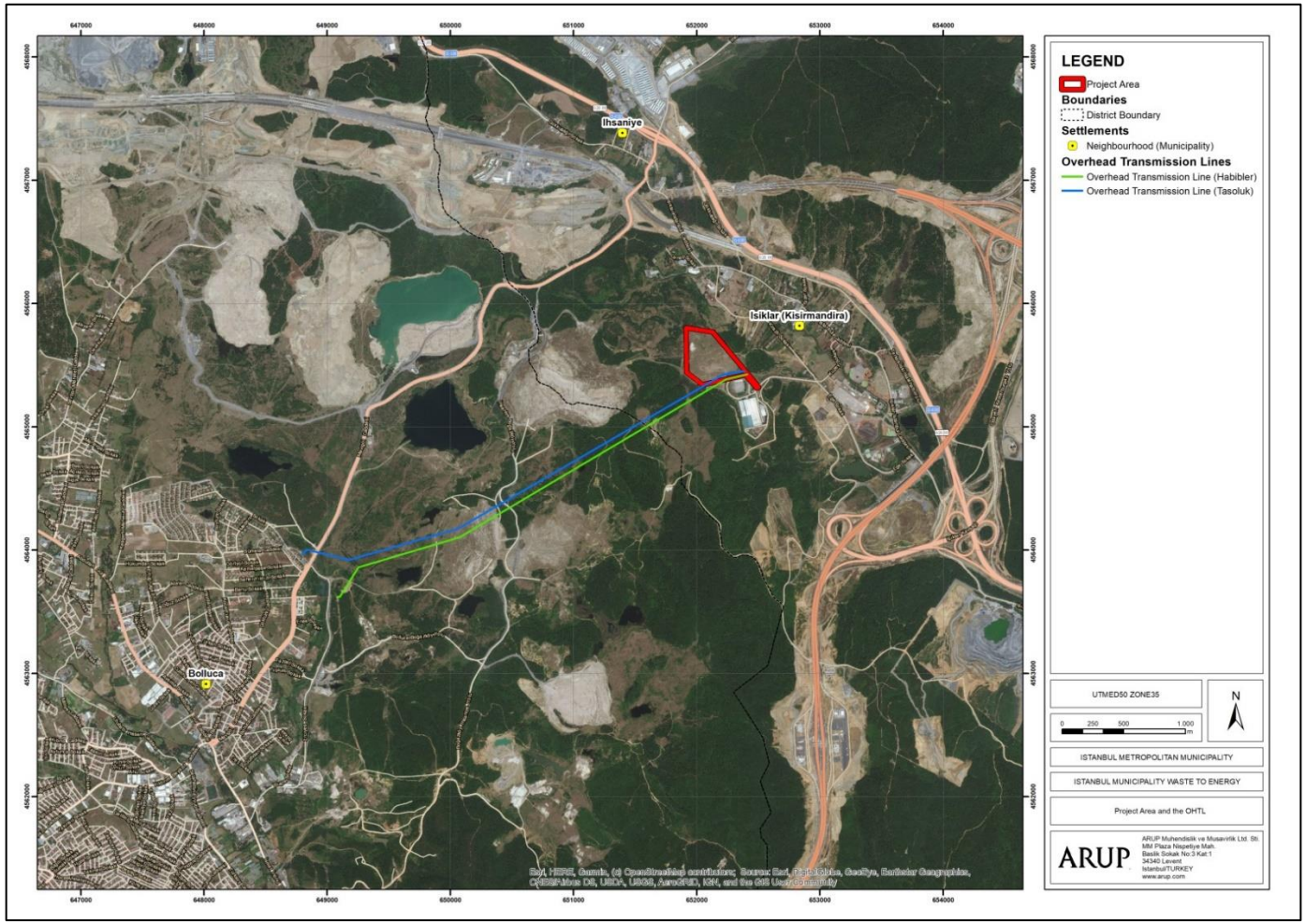

Figure 2 Project Area and the OHTL

A Flue Gas Treatment System will be implemented. Scrubbers will be installed for SO_2 treatment, and for the removal of SO_2 in the flue gas, dry hydrated limestone and carbon will be used. For NO_x removal, a Selective Non-Catalytic Reduction (SNCR) system will be used. There is the potential to convert this to a Selective Catalytic Reduction (SCR) system if required. Bag filters will be used to reduce emission of fly ash. For HCl and HF emissions, acid and alkali scrubbers will be used and Volatile Organic Compounds will be removed from flue gas by activated carbon. Dioxin and furan emissions will be controlled by maintaining the combustion temperature and adding activated carbon in the flue gas treatment system. A Continuous Emission Monitoring system will be installed to monitor all emissions.

Odour generation will only occur in the bunker area where the waste is temporarily stored. This odour will be eliminated by maintaining negative pressure by drawing in air for use as a primary air source for the combustion process. The bunker area will be covered. The layout is presented in Figure 3 below.

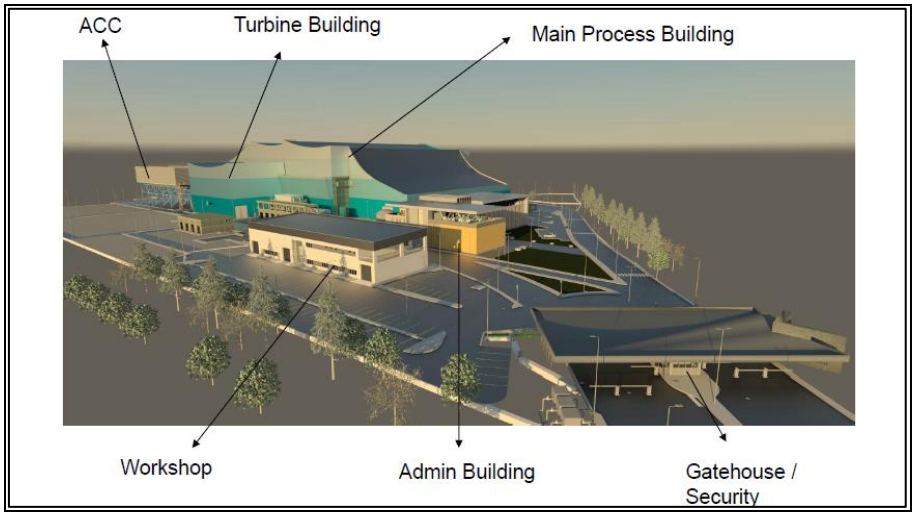

Figure 3: General Layout of the Project

Table 2 below gives general information on the WtEP.

Construction of the WtEP is ongoing and is scheduled to be completed on 18.09.2020.

Table 2: General Information on WtEP

Features	WtE Plant
Power Generation License	License obtained (August 2016)
Project Status	Plant under construction
Location	Eyup Sultan, Istanbul
Total Project Area	14.8 ha
Power Plant Area	8 ha
Installed Capacity	80 MW (initially planned; the license will be amended for Installed Capacity of approximately up to 90 MW energy based on the EIA Report).
Incineration Capacity	1,000,000 tonnes/year
No of Incineration Lines	3
Technology	Grate Combustion System
EIA Status	Environmental Impact Assessment (EIA) Report in place. EIA Positive decision (July 2012)

3.3 Project Alternatives

3.3.1 Project Site Alternatives

The Project Site was allocated to IMM by the General Directorate of Forestry for 49 years.

As stated in the EIA Report, a sewer system which was built for IMM's Compost Plant located adjacent to the Project Site for collecting domestic wastewater was found suitable for the WtEP.

Environmental factors have been taken into consideration while evaluating the alternatives for the Project location, as well as economical and technical issues. The following criteria were considered:

- The site selection should be in accordance with relevant laws and regulations.
- Selection of the project site should be conducted in line with the needs of the Municipality.
- A site belonging to the Municipality should be preferred. If this is not possible, a public or private registered land should be expropriated.
- Operational costs should be taken into consideration by evaluating distance between the final disposal site and the Project site for unutilised waste.
- The WtEP should be easily accessible and be close to main access roads.

- The connection line to be established between the WtEP and the power network should be short in order to minimise loss of energy, construction costs and negative visual impacts.
- Consideration has been given to the fact that the designated area has a sewer system and water supply network.

The site selection model prepared by the Turkish Ministry of Environment and Urbanization (Former Ministry of Environment and Forestry) was used and 11 site alternatives (8 on the European side and 3 on the Asian side of Istanbul) were determined for the Project site. As a result of screening process, three sites (Hasdal, Compost and Odayeri) were shortlisted.

The sites were assessed and scoring has been applied. As a result of these assessments, advantages and disadvantages of the potential sites were determined and the final site was selected.

Closed and Current Landfills in Istanbul European Side

Previously, the municipal waste generated in the European bank of Istanbul was transferred to the Odayeri Landfill for final disposal. After the completion of Istanbul Grand Airport Project, Odayeri Landfill, which is close to the new airport, has stopped receiving any more waste in order not to attract birds and create safety risks for the airport. Therefore, all the municipal waste is now directed to the new Seymen Landfill located in Silivri District of Istanbul, via Silivri, Halkali, Yenibosna and Baruthane transfer stations. In no action/project alternative, the travelling distances will be greater than the previous case. The locations of former Odayeri Landfill, Seymen Landfill and the Project Area together with the municipal solid waste transfer stations are presented in Figure 4.

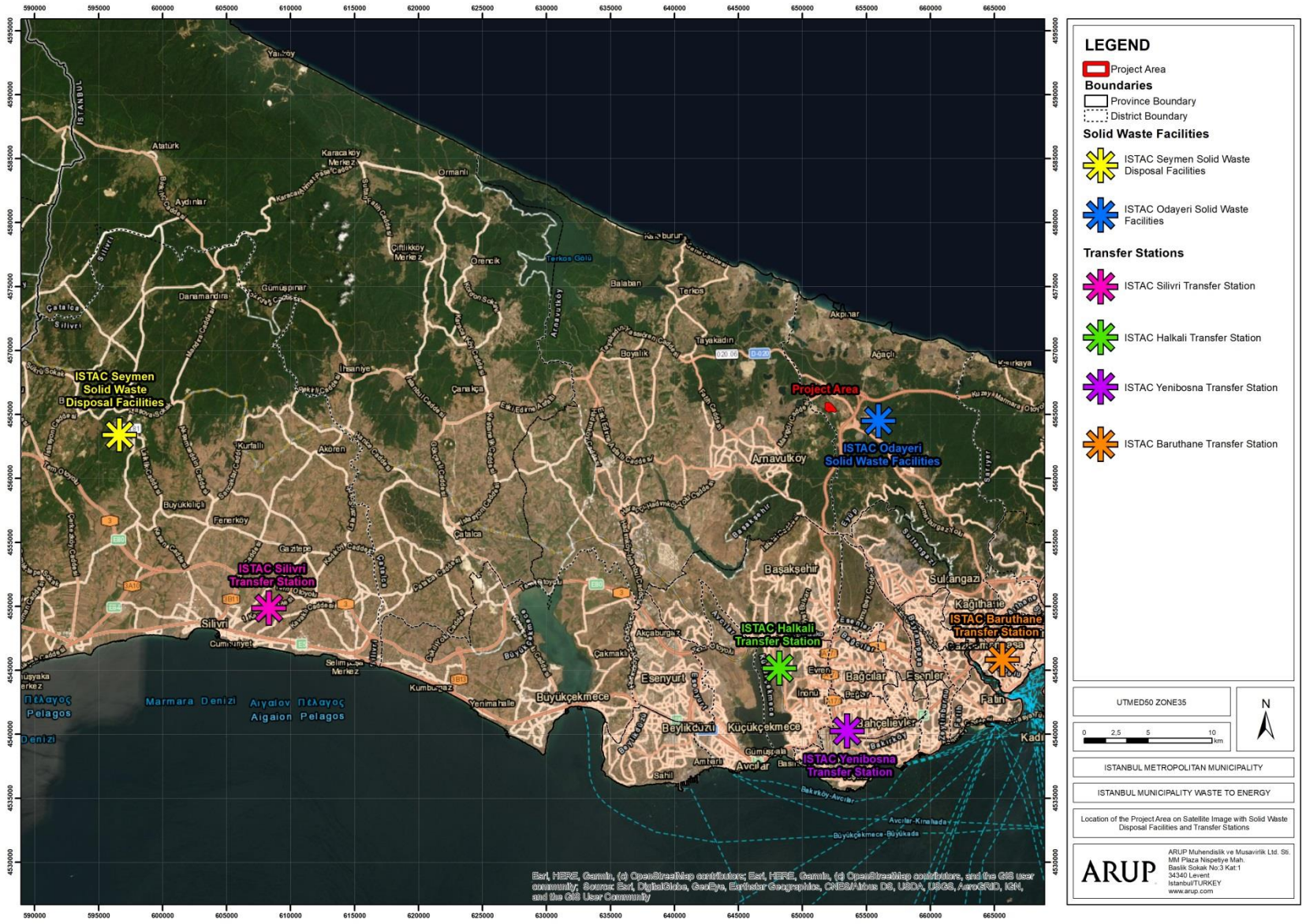

Figure 4: Project Area, Odayeri (former, not in operation) and Seymen Landfills' Locations and Transfer Stations

3.3.2 Technology Alternatives

Incineration is one of a number of thermal waste disposal methods. For the WtEP, Grate Combustion Technology will be used. This has advantages when compared to other technologies such as gasification and pyrolysis:

- No pre-treatment requirement.
- Resistant to variations in waste composition and calorific value.
- Up to 85% thermal efficiency is achievable.
- Minimises problems such as storage gas, leachate and odour.

Comparing to the landfilling of wastes, significant reduction in volume and weight will be achieved by incineration technique.. In addition, while heat from the combustion of wastes can be converted to energy, land requirement for incineration systems are also lower than the landfilling of wastes.

3.4 Land Acquisition Status

The Project Area was allocated to IMM by General Directorate of Forestry for 49 years starting from 1997. Before 1997, the land allocated for the project was state-owned. No resettlement is required and there is no livelihood source on the Project Area. Therefore, the ESDD does not need to consider IFC PS 5.

4 Institutional and Legal Framework

The national E&S legislation and IFC Performance Standards relevant to the Project are described in the following sections. The legal framework forms the basis of the compliance review.

4.1 National Environmental and Social Legislation

National E&S legislation relevant to the Project is summarized in Table 3. The legal framework covers land-use, soil quality, waste, permits, water and wastewater, environmental noise, air quality and health and safety.

Table 3: National E&S Framework Summary

Legislation/Standard Name	Summary of the Related Requirement
Land Use, Soil Quality Control and Management	
Implementation Regulation on Soil Protection and Land Use (Official Gazette dated 09.12.2017; No: 30265)	The Regulation aims to identify soil and land use conditions set forth by the Law on Soil Protection and Land Use (No. 5403); preparation of land use plans, preparation of plans and projects regarding use of agricultural land and soil protection; identification of land that are sensitive in terms of erosion, identification of agricultural land plot size and identification of methods and principles regarding the studies of board of soil protection.
Regulation on the Control of Soil Pollution and Lands Contaminated by Point Sources	The aim of this communique is to regulate fundamentals based on identification of minimum requirements of institutions concerning the clearance work and assessment studies of polluted areas.
Waste Management	
Regulation on the Control of Packaging Wastes (Official Gazette dated 27.12.2017; No: 30283)	The Regulation aims to prevent generation of packaging waste; reduce the amount of packaging waste that will be reused and recycled, prevent direct or indirect disposal of packaging wastes in receiving environments to avoid negative impacts on environment, to identify principles, policies, programs that cover separate collection, transport and separation of such wastes and to identify legal, administrative and technical principles regarding the subject.
Regulation on the Control of Waste Batteries and Accumulators (Official Gazette dated 31.08.2004; No: 25569)	The Regulation aims to identify legal and technical principles for establishment of principles, policies and programs that cover development of a recycling and final disposal system and preparation of related management plans for waste batteries and accumulators.
Regulation on the Control of Waste Oils (Official Gazette dated 30.07.2008; No: 26952)	The Regulation aims to regulate principles and fundamentals regarding; prevention of direct or indirect disposal of waste oils in receiving environments to avoid negative impacts on environment; establishment of technical and administrative standards, regulating principles regarding temporary storage, transport and disposal of such waste; identification of principles and programs for establishment and environmentally appropriate management of temporary storage, treatment and disposal facilities.

Legislation/Standard Name	Summary of the Related Requirement
Regulation on Waste Management (Official Gazette dated 02.04.2015; No: 29314)	The Regulation aims to regulate principles and fundamentals regarding establishment of policies and programs for management of waste in a manner that prevents harm to environment and human health; decreasing natural resource use by means such as decreasing waste generation in source, reuse and recycling; and to ensure appropriate waste management.
Regulation on the Control of Waste Vegetable Oils (Official Gazette dated 06.06.2015; No: 29378)	The Regulation aims to regulate principles and fundamentals regarding establishment of policies and programs for management of waste vegetable from generation to disposal, in a manner that that prevents harm on environment and human health.
Regulation on the Control of End-of-Life Tires (Official Gazette dated 25.11.2006; No: 26357)	The Regulation aims to regulate principles and fundamentals regarding establishment of standards and regulatory measures for prevention of direct or indirect disposal of waste tires in receiving environments to avoid negative impacts on environment; establishment of collection and transport systems for recycling and disposal and preparation of management plans.
Regulation on the Control of Medical Wastes (Official Gazette dated 25.01.2017; No: 29959)	The Regulation aims to identify legal and technical principles for establishment of principles, policies and programs regarding prevention of direct or indirect disposal of medical wastes in receiving environments to avoid negative impacts on environment and human health, separate collection at source, temporary storage, transport and disposal of such waste.
Regulation on the Control of Excavation Soil, Construction and Demolition Wastes (Official Gazette dated 18.03.2004; No: 25406)	The Regulation aims to regulate technical and administrative aspects and identify general principles to be followed regarding reduction of generation at source, collection, temporary storage, transport, recycling, reuse and disposal of such waste in a manner that prevents impacts on environment.
Regulation on the Incineration of Wastes (Official Gazette dated 06.10.2010,No:27721)	The aim of this regulation is to prevent and limit the adverse effects of waste incineration on environment, especially air, soil, groundwater and underground water pollution resulted from emissions and risks on human health with applicable methods.
Environmental Management, Permits and Planning	
Environmental Auditing Regulation (Official Gazette dated 21.11.2008; No: 27061)	The Regulation aims to regulate principles and fundamentals of environmental auditing to be conducted for environmental protection and to identify qualifications and responsibilities of the auditors. Internal monitoring and internal audits are conducted by environmental department or environmental officer. Facilities or activities that do not establish an environmental department or that do not employ an environmental officer procure this service from a firm that is authorized by the Ministry.

Legislation/Standard Name	Summary of the Related Requirement
Environmental Impact Assessment (EIA) Regulation (Official Gazette dated 25.11.2014; No**:** 29186)	Categorization for waste-to-energy projects under Turkish EIA Regulation's Annex-1 and Annex-2 lists is done according to the area or daily plant capacity. Article 11 of Annex-1 indicates that a full EIA process and an EIA Report is required, if "*excluding construction and demolition wastes, waste recycle, combustion (thermal processes such as oxidizing, pyrolysis, gasification, plasma etc.) and final disposal facilities that have areas higher than 10 ha and daily capacity, including the target year, greater than 100 ton/year*". Therefore, an EIA Report was prepared for this Project. The EIA Regulation categorizes overhead transmission lines (OHTL) with 154 kV and more voltage and 15 km or more length under its Annex-1; whereas OHTLs with 154 kV voltage and 5-15 km length are categorized under its Annex-2, meaning that the former (154 kV and more voltage and 15 km or more length) requires an EIA Report and the latter (154 kV and 5-15 km length) requires a Project Information File.
Regulation on Environmental Permit and License (Official Gazette dated 10.09.2014; No: 29115)	The Regulation aims to identify principles and fundamentals to be followed during obtainment process of environmental permits and licenses. This regulation's Annex-1 and Annex-2 categorizes facilities with regard to their environmental impacts. Facilities included in Annex-1 and Annex-2 lists are required to obtain a Temporary Activity Permit. Facilities that obtain this document are required to obtain an environmental permit or environmental license in a year from the issuing date of Temporary Activity Permit.
Regulation for Starting Up and Operating a Workplace (Official Gazette dated 10.08.2005; No: 25902)	The regulation states that a workplace cannot be opened and operated without the appropriate Workplace Opening and Operating License.
Nature Protection	
Regulation on the Protection of Wetlands (Official Gazette dated 04.04.2014; No: 28962)	The Regulation aims to identify principles regarding protection, management and development of wet lands and principles regarding cooperation and coordination of related institutions.
Regulation on Procedures and Principles Concerning the Protection of Game and Wild Animals and their Habitats and Combat with their Pests (Official Gazette dated 24.10.2005; No: 25976)	The Regulation aims to identify principles and fundamentals regarding protection of game and wild animals and their habitats.
Noise Control and Management	
Regulation on the Assessment and Management of Environmental Noise (Official Gazette dated 04.06.2010; No: 27601)	The Regulation aims to provide principles and fundamentals related to measures regarding environmental noise exposure, identification of exposure levels by assessments, preparation of noise maps, acoustic reports, assessment reports and other related documents, informing public on environmental noise and preparation and application of action plans where exposure levels make it necessary.

Legislation/Standard Name	Summary of the Related Requirement
Regulation on Environmental Noise Emission Caused by Equipment Used Outdoors (Official Gazette dated 30.12.2006; No: 26392)	The Regulation aims to provide principles and fundamentals regarding; application standards for noise sourced from equipment used in outdoors, collection of technical documents and information and assessment procedures.
Air Quality Control and Management	
Regulation on the Assessment and Management of Air Quality (Official Gazette dated 06.06.2008; No: 26898)	The Regulation aims to identify air quality goals for prevention of air pollution's impacts on environment and human health, assessment of air quality based on these identified goals and methods, protection of air quality and increasing air quality, collection of sufficient information on air quality and informing public.
Regulation on the Control of the Air Pollution Sourced by the Industry (Official Gazette dated 03.07.2009; No: 27277)	The Regulation aims to identify principles and fundamentals regarding; control of emissions sourced from industry and energy generation facilities and to prevent related impacts.
Regulation on the Control of the Odour Causing Emissions (Official Gazette dated 19.07.2013, No:28712)	The aim of this regulation is to regulate the administrative and technical fundamentals and principles for the control and reduction of odour causing emissions.
Health and Safety	
Regulation on Methods and Fundamentals for Occupational Health and Safety Training for Workers (Official Gazette dated 15.05.2013; No: 28648)	The Regulation aims to identify principles and fundamentals of OHS trainings that will be provided to the workers.
Regulation on Health and Safety Provisions for Use of Work Equipment (Official Gazette dated 25.04.2013; No: 28628)	The Regulation aims to identify; minimum health and safety requirements regarding use of work equipment, employer's responsibilities, control and training requirements.
Regulation on Occupational Health and Safety (Official Gazette dated 09.12.2003; No: 25311)	This regulation provides measures to be implemented for occupational health and safety in workplaces and identifies related principles and fundamentals.
Regulation on Health and Safety Measures to be taken at Works Involving Chemicals (Official Gazette dated 12.08.2013; No**:** 28733)	The Regulation aims to identify principles and fundamentals regarding protection of workers from risks regarding use of chemicals.
Regulation Concerning the Use of Personal Protection Equipment at Workplaces (Official Gazette dated 02.07.2013; No: 28695)	The Regulation aims to identify principles and fundamentals regarding use, specifications and procurement of personal protective equipment, in order to avoid or minimize workplace risks.
Regulation on Health and Safety Signs (Official Gazette dated 11.09.2013; No: 28762)	The Regulation aims to identify the minimum requirements regarding use of health and safety signs that will be used in workplaces.
Regulation on the Transport of Dangerous Goods on Motorways (Official Gazette dated 24.04.2019, No:30754)	The aim of this regulation is to maintain the regular and secure transportation of hazardous materials in public main roads without giving harm to human health, living beings and environment and also to determine the principles and fundamentals related to the responsibilities, liabilities and working conditions of every driver or operator transferring these hazardous materials.

Legislation/Standard Name	Summary of the Related Requirement
Water Quality Control and Management	
Regulation on Septic Tanks Constructed in Districts without Sewerage System (Official Gazette dated 19.03.1971; No: 13783)	This regulation identifies principles and fundamentals for protection of soil, water and food by wastewater stored in septic tanks.
Water Pollution Control Regulation (Official Gazette dated 31.12.2004; No: 25687)	The Regulation aims to lay out legal and technical principles regarding protection and sustainable management of surface and groundwaters, including principles regarding water quality classes, planning principles for protection of water quality, discharge standards for wastewater, principles regarding wastewater treatment and monitoring.
Regulation on the Control of Pollution Caused by Dangerous Substances in and around the Water Bodies (Official Gazette dated 26.11.2005; No: 26005)	This regulation identifies principles and fundamentals regarding determination, prevention and gradual decreasing of water pollution.
Regulation Concerning Protection of Ground Waters Against Pollution and Deterioration (Official Gazette dated 07.04.2012; No: 28257)	The Regulation aims to identify fundamentals regarding protection of current state of unpolluted groundwater sources, prevention of groundwater pollution and measures for remediation of polluted and/or degraded groundwaters.

4.2 International Standards

International standards and international guidelines that provide Good International Industrial Practices (GIIP) have also been used in the scope of this ESDD Report. International finance institutions follow certain policies and procedures that are aimed at assessment and management of environmental and social impacts of the projects they will provide financing for. These environmental and social requirements generally stem from (or are based on) the World Bank's (WB) Safeguard Policies. WB/IFC's Environmental, Health and Safety Guidelines and Performance Standards that are in the scope of IFC's Environmental and Social Sustainability Policy define requirements and standards that are currently most widely used for financing of private sector projects. The following policies, standards and guidelines were used for the purposes of this study:

- WBG policies and Performance Standards on Environmental and Social Sustainability
- WBG General Health and Safety Guidelines (2007)
- WBG Industry Sector EHS Guidelines
- WBG Environmental, Health, and Safety Guidelines for Waste Management Facilities (2007)
- WBG Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution (2007)
- WB Operational Policy 4.01 - Environmental Assessment
- EU Industrial Emissions Directive (IED) 2010/75/EU
- EC Waste Framework Directive 2008/98/EC

- EC Hazardous Waste Directive 94/31/EC

In Table 4 below, IFC PSs and EHS Guidelines are summarized.

Table 4: IFC Performance Standards and WBG EHS Guidelines

IFC PS 1: Assessment and Management of Environmental and Social Risks and Impacts	
Policy	To ensure an effective environmental and social performance, the client will prepare a general policy that includes environmental and social goals and principles. The client will establish an overarching policy defining the environmental and social objectives and principles that guide the project to achieve sound environmental and social performance. The policy provides a framework for the environmental and social assessment and management process, and specifies that the project will comply with the applicable laws and regulations of the jurisdictions in which it is being undertaken, including those laws implementing host country obligations under international law. The policy should be consistent with the principles of the Performance Standards. The policy will indicate who, within the client's organization, will ensure conformance with the policy and be responsible for its execution. The client will communicate the policy to all levels of its organization
Identification of Risks and Impacts	The client will prepare and apply a process for identification of environmental and social risks of the project. Where the project involves specifically identified physical elements, aspects, and facilities that are likely to generate impacts, environmental and social risks and impacts will be identified in the context of the project's area of influence. The type, scale, and location of the project guide the scope and level of effort devoted to the risks and impacts identification process. The scope of the risks and impacts identification process will be consistent with good international industry practice,and will determine the appropriate and relevant methods and assessment tools. When the project involves existing assets, environmental and/or social audits or risk/hazard assessments can be appropriate and sufficient to identify risks and impacts.
Management Programs	Consistent with the client's policy and the objectives and principles described therein, the client will establish management programs that, in sum, will describe mitigation and performance improvement measures and actions that address the identified environmental and social risks and impacts of the project. The management programs will establish environmental and social Action Plans, which will define desired outcomes and actions to address the issues raised in the risks and impacts identification process. The mitigation hierarchy to address identified risks and impacts will favor the avoidance of impacts over minimization, and, where residual impacts remain, compensation/offset, wherever technically and financially feasible. Where the identified risks and impacts cannot be avoided, the client will identify mitigation and performance measures and establish corresponding actions to ensure the project will operate in compliance with applicable laws and regulations, and meet the requirements of Performance Standards 1 through 8.

Organizational Capacity and Competency	The client, in collaboration with appropriate and relevant third parties, will establish, maintain, and strengthen as necessary an organizational structure that defines roles, responsibilities, and authority to implement the ESMS. Specific personnel, including management representative(s), with clear lines of responsibility and authority should be designated. Key environmental and social responsibilities should be well defined and communicated to the relevant personnel and to the rest of the client's organization. Personnel within the client's organization with direct responsibility for the project's environmental and social performance will have the knowledge, skills, and experience necessary to perform their work, including current knowledge of the host country's regulatory requirements and the applicable requirements of Performance Standards 1 through 8. Personnel will also possess the knowledge, skills, and experience to implement the specific measures and actions required under the ESMS and the methods required to perform the actions in a competent and efficient manner
Emergency Preparedness and Response	Where the project involves specifically identified physical elements, aspects and facilities that are likely to generate impacts, the ESMS will establish and maintain an emergency preparedness and response system so that the client, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations associated with the project in a manner appropriate to prevent and mitigate any harm to people and/or the environment. This preparation will include the identification of areas where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communication, including that with potentially Affected Communities and periodic training to ensure effective response. The emergency preparedness and response activities will be periodically reviewed and revised, as necessary, to reflect changing conditions. Where applicable, the client will also assist and collaborate with the potentially Affected Communities and the local government agencies in their preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to ensure effective response. If local government agencies have little or no capacity to respond effectively, the client will play an active role in preparing for and responding to emergencies associated with the project. The client will document its emergency preparedness and response activities, resources, and responsibilities, and will provide appropriate information to potentially Affected Community and relevant government agencies.

Monitoring and Review	The client will establish procedures to monitor and measure the effectiveness of the management program, as well as compliance with any related legal and/or contractual obligations and regulatory requirements. Where the government or other third party has responsibility for managing specific risks and impacts and associated mitigation measures, the client will collaborate in establishing and monitoring such mitigation measures. Where appropriate, clients will consider involving representatives from Affected Communities to participate in monitoring activities. The client's monitoring program should be overseen by the appropriate level in the organization. For projects with significant impacts, the client will retain external experts to verify its monitoring information. The extent of monitoring should be commensurate with the project's environmental and social risks and impacts and with compliance requirements. In addition to recording information to track performance and establishing relevant operational controls, the client should use dynamic mechanisms, such as internal inspections and audits, where relevant, to verify compliance and progress toward the desired outcomes. Monitoring will normally For example, participatory water monitoring. Performance Standard Assessment and Management of Environmental and Social Risks and Impacts January 1, 2012 include recording information to track performance and comparing this against the previously established benchmarks or requirements in the management program. Monitoring should be adjusted according to performance experience and actions requested by relevant regulatory authorities.
Stakeholder Engagement	Stakeholder engagement is an ongoing process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and ongoing reporting to Affected Communities. The nature, frequency, and level of effort of stakeholder engagement may vary considerably and will be commensurate with the project's risks and adverse impacts, and the project's phase of development. Clients should identify the range of stakeholders that may be interested in their actions and consider how external communications might facilitate a dialog with all stakeholders. The client will develop and implement a Stakeholder Engagement Plan that is scaled to the project risks and impacts and development stage, and be tailored to the characteristics and interests of the Affected Communities. Where applicable, the Stakeholder Engagement Plan will include differentiated measures to allow the effective participation of those identified as disadvantaged or vulnerable. In cases where the exact location of the project is not known, but it is reasonably expected to have significant impacts on local communities, the client will prepare a Stakeholder Engagement Framework, as part of its management program, outlining general principles and a strategy to identify Affected Communities and other relevant stakeholders and plan for an engagement process compatible with this Performance Standard that will be implemented once the physical location of the project is known.
Disclosure of Information	Disclosure of relevant project information helps Affected Communities and other stakeholders understand the risks, impacts and opportunities of the project. The client will provide Affected Communities with access to relevant information on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such communities and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.

Consultation	When Affected Communities are subject to identified risks and adverse impacts from a project, the client will undertake a process of consultation in a manner that provides the Affected Communities with opportunities to express their views on project risks, impacts and mitigation measures, and allows the client to consider and respond to them. The extent and degree of engagement required by the consultation process should be commensurate with the project's risks and adverse impacts and with the concerns raised by the Affected Communities. Effective consultation is a two-way process that should: (i) begin early in the process of identification of environmental and social risks and impacts and continue on an ongoing basis as risks and impacts arise; (ii) be based on the prior disclosure and dissemination of relevant, transparent, objective, meaningful and easily accessible information which is in a culturally appropriate local language(s) and format and is understandable to Affected Communities; (iii) focus inclusive engagement on those directly affected as opposed to those not directly affected; (iv) be free of external manipulation, interference, coercion, or intimidation; (v) enable meaningful participation, where applicable; and (vi) be documented.
External Communications	Clients will implement and maintain a procedure for external communications that includes methods to (i) receive and register external communications from the public; (ii) screen and assess the issues raised and determine how to address them; (iii) provide, track, and document responses, if any; and (iv) adjust the management program, as appropriate. In addition, clients are encouraged to make publicly available periodic reports on their environmental and social sustainability.
Grievance Mechanism	Where there are Affected Communities, the client will establish a grievance mechanism to receive and facilitate resolution of Affected Communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project and have Affected Communities as its primary user. It should seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate and readily accessible, and at no cost and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the stakeholder engagement process.
Ongoing Reporting to Affected Communities	The client will provide periodic reports to the Affected Communities that describe progress with implementation of the project Action Plans on issues that involve ongoing risk to or impacts on Affected Communities and on issues that the consultation process or grievance mechanism have identified as a concern to those Communities. If the management program results in material changes in or additions to the mitigation measures or actions described in the Action Plans on issues of concern to the Affected Communities, the updated relevant mitigation measures or actions will be communicated to them. The frequency of these reports will be proportionate to the concerns of Affected Communities but not less than annually.
IFC PS 2: Labour and Working Conditions	

Working Conditions and Management of Worker Relationship	The client will adopt and implement human resources policies and procedures appropriate to its size and workforce. The client will provide workers with documented information that is clear and understandable, regarding their rights under national labor and employment law and any applicable collective agreements, including their rights related to hours of work, wages, overtime, compensation, and benefits upon beginning the working relationship and when any material changes occur. Where the client is a party to a collective bargaining agreement with a workers' organization, such agreement will be respected. Where such agreements do not exist, or do not address working conditions and terms of employment, the client will provide reasonable working conditions and terms of employment. The client will take measures to prevent and address harassment, intimidation, and/or exploitation, especially in regard to women. The principles of non-discrimination apply to migrant workers. The client should ensure that all workers receive notice of dismissal and severance payments mandated by law and collective agreements in a timely manner.
Grievance Mechanism	The client will provide a grievance mechanism for workers (and their organizations, where they exist) to raise workplace concerns. The client will inform the workers of the grievance mechanism at the time of recruitment and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides timely feedback to those concerned, without any retribution. The mechanism should also allow for anonymous complaints to be raised and addressed.
IFC PS 3: Resource Efficiency and Pollution Prevention	
Resource Efficiency (Energy, Water, Raw Materials etc.)	The client will implement technically and financially feasible and cost-effective measures for improving efficiency in its consumption of energy, water, as well as other resources and material inputs, with a focus on areas that are considered core business activities. Such measures will integrate the principles of cleaner production into product design and production processes with the objective of conserving raw materials, energy, and water.
Greenhouse Gases	The client will consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project. These options may include, but are not limited to, alternative project locations, adoption of renewable or low carbon energy sources, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring.
	For projects that are expected to or currently produce more than 25,000 tonnes of CO_2- equivalent annually, the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect emissions associated with the off-site production of energy used by the project.
Water Consumption (and Pollution)	When the project is a potentially significant consumer of water, in addition to applying the resource efficiency requirements of this Performance Standard, the client shall adopt measures that avoid or reduce water usage so that the project's water consumption does not have significant adverse impacts on others

Wastes	Where waste generation cannot be avoided, the client will reduce the generation of waste, and recover and reuse waste in a manner that is safe for human health and the environment. Where waste cannot be recovered or reused, the client will treat, destroy, or dispose of it in an environmentally sound manner that includes the appropriate control of emissions and residues resulting from the handling and processing of the waste material. If the generated waste is considered hazardous, the client will adopt GIIP alternatives for its environmentally sound disposal while adhering to the limitations applicable to its trans-boundary movement.
Hazardous Materials Management	Hazardous materials are sometimes used as raw material or produced as product by the project. The client will avoid or, when avoidance is not possible, minimize and control the release of hazardous materials.
Pesticide Use and Management	The client will, where appropriate, formulate and implement an integrated pest management (IPM) and/or integrated vector management (IVM) approach targeting economically significant pest infestations and disease vectors of public health significance.
IFC PS 4: Community Health, Safety and Security	
Infrastructure and Equipment Design and Safety	The client will design, construct, operate, and decommission the structural elements or components of the project in accordance with GIIP, taking into consideration safety risks to third parties or Affected Communities. When new buildings and structures will be accessed by members of the public, the client will consider incremental risks of the public's potential exposure to operational accidents and/or natural hazards and be consistent with the principles of universal access. Structural elements will be designed and constructed by competent professionals, and certified or approved by competent authorities or professionals.
Hazardous Materials Management and Safety	The client will avoid or minimize the potential for community exposure to hazardous materials and substances that may be released by the project.
Ecosystem Services	The project's direct impacts on priority ecosystem services may result in adverse health and safety risks and impacts to Affected Communities. Where appropriate and feasible, the client will identify those risks and potential impacts on priority ecosystem services that may be exacerbated by climate change. Adverse impacts should be avoided, and if these impacts are unavoidable, the client will implement mitigation measures in the framework identified in the scope of Performance Standards.
Community Exposure to Disease	The client will avoid or minimize the potential for community exposure to water-borne, water-based, water-related, and vector-borne diseases, and communicable diseases that could result from project activities, taking into consideration differentiated exposure to and higher sensitivity of vulnerable groups. Where specific diseases are endemic in communities in the project area of influence, the client is encouraged to explore opportunities during the project life-cycle to improve environmental conditions that could help minimize their incidence. The client will avoid or minimize transmission of communicable diseases that may be associated with the influx of temporary or permanent project labour.

Emergency Preparedness and Response	The client will assist and collaborate with the Affected Communities, local government agencies, and other relevant parties, in their preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to respond to such emergency situations. If local government agencies have little or no capacity to respond effectively, the client will play an active role in preparing for and responding to emergencies associated with the project. The client will document its emergency preparedness and response activities, resources, and responsibilities, and will disclose appropriate information to Affected Communities, relevant government agencies, or other relevant parties.
Security Personnel	When the client retains direct or contracted workers to provide security to safeguard its personnel and property, it will assess risks posed by its security arrangements to those within and outside the project site. In making such arrangements, the client will be guided by the principles of proportionality and good international practice in relation to hiring, rules of conduct, training, equipping, and monitoring of such workers, and by applicable law. The client will make reasonable inquiries to ensure that those providing security are not implicated in past abuses; will train them adequately in the use of force (and where applicable, firearms), and appropriate conduct toward workers and Affected Communities; and require them to act within the applicable law. The client will not sanction any use of force except when used for preventive and defensive purposes in proportion to the nature and extent of the threat. The client will provide a grievance mechanism for Affected Communities to express concerns about the security arrangements and acts of security personnel. The client will consider and, where appropriate, investigate all allegations of unlawful or abusive acts of security personnel, take action (or urge appropriate parties to take action) to prevent recurrence, and report unlawful and abusive acts to public authorities.
IFC PS 5: Land Acquisition and Involuntary Resettlement	
Land Acquisition and Involuntary Resettlement	Project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. To help avoid expropriation and eliminate the need to use governmental authority to enforce relocation, clients are encouraged to use negotiated settlements meeting the requirements of this Performance Standard, even if they have the legal means to acquire land without the seller's consent.
IFC PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	
Biodiversity Conservation and Sustainable Management of Living Natural Resources	The aim of this Performance Standard is to protect and conserve biodiversity, to maintain the benefits from ecosystem services and to promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.
IFC PS 7: Indigenous Peoples	
Indigenous Peoples	The aim of this Performance standard is to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.
IFC PS 8: Cultural Heritage	

Protection of Cultural Heritage in Project Design and Execution	In addition to complying with applicable law on the protection of cultural heritage, including national law implementing the host country's obligations under the Convention Concerning the Protection of the World Cultural and Natural Heritage, the client will identify and protect cultural heritage by ensuring that internationally recognized practices for the protection, field-based study, and documentation of cultural heritage are implemented.
Chance Find Procedures	The environmental and social risks and impacts identification process should determine whether the proposed location of a project is in areas where cultural heritage is expected to be found, either during construction or operations. . In such cases, as part of the client's ESMS, the client will develop provisions for managing chance finds1 through a chance find procedure which will be applied in the event that cultural heritage is subsequently discovered. The client will not disturb any chance find further until an assessment by competent professionals is made and actions consistent with the requirements of this Performance Standard are identified.
WBG Environmental, Health, and Safety Guidelines for Waste Management Facilities	
Air Emissions	For air emissions of municipal solid waste incineration facilities, below recommendations are ; Conduct waste segregation and/or pre-sorting to avoid incineration of wastes that contain metals and metalloids, Follow applicable national requirements and internationally recognized standards for incinerator design and operating conditions, Introduce wastes into the incinerator only after the optimum temperature is reached in the final combustion chamber, Minimize the uncontrolled ingress of air into the combustion chamber, Optimize furnace and boiler geometry, combustion air injection, and NO_x control devices using flow modelling, Optimize and control combustion conditions, Implement maintenance and other procedures to minimize planned and unplanned shutdowns, Use primary NO_x control measures and/or selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) systems, depending on the emissions levels required, Use flue gas treatment system for control of acid gases, particulate matter, and other air pollutants, Minimize formation of dioxins and furans by ensuring that particulate control systems do not operate in the 200 to 400°C temperature range.
Ash and Other Residuals	Recommended measures are as follows: Design the furnace to physically retain the waste within combustion chamber, Manage bottom ash separately from fly ash and other flue gas treatment residues to avoid contamination of the bottom ash for its potential recovery, Bottom ash and residuals should be managed based on their classification as hazardous or non-hazardous materials.
Water Effluents	It is recommended to treat the wastewater from flue gas treatment to prevent, minimize, and control water effluents.

4.3 Lenders/SERV Requirements

The Lenders/SERV have added the following requirements for the identification and assessment of the potential E&S risks and impacts associated with the Project and preparation of an ESDD:

- Applicable Turkish local environmental, labor, health and safety, and public information laws and regulations, and the country's commitments under the international law;
- Applicable Lenders/SERV E&S compliance requirements for category A operations, including: IFC PSs, WBG EHS Guidelines, EBRD PRs, OECD Common Approaches etc;
- Applicable EU directives, including but not limited to EIA Directive, Industrial Emissions Directive, and any other sector-specific and cross-cutting directives;
- Applicable international industry-specific best-practices for waste management and waste to energy management.

5 Baseline Conditions

In the scope of this study, baseline conditions regarding physical, biological and socio-economic environment have been assessed. Baseline conditions subject to this study were initially stated in 2012 during the local EIA Stage of the Project. Geological, hydrogeological and hydrological characteristics, seismicity and natural hazard conditions, soil, erosion and land use characteristics, climate, environmental air quality and noise levels, landscape characteristics and protected areas around the Project area have been assessed locally and in the region wise. Surveys and studies conducted within the local EIA have been scrutinized and a summary of updated baseline data is provided the followings sections.

5.1 Physical Environment

5.1.1 Geology

As stated in the EIA, the Project site is mainly made up of Belgrade formation. This formation is covered with heterogeneous type artificial filling on the surface reaching up to a height of 10.20 meters in some places. At the bottom levels of the unit comprised of red, brown, brownish yellow, occasionally white coloured, occasionally cross layered, bad gradated, red clay-silt stuffed, unfixed gravel and coarse gravels, gravels and medium-fine sized sands, there are greenish grey coloured, bentonite clays with occasional low calorie fine lignite strips. According to ground investigation report, it contains silicate wood fragments and with boat-like cross layered.

1/25,000 scale General Geology Map of project site was given in the EIA of the Project.

The geological-geotechnical studies have been conducted related to the Project. In this respect;

According to drills and geophysical studies conducted at the Project Site, the Belgrade formation was discriminated as Tmpb-1 and Tmpb-2 according to the compactness and stiffness of the units. Tmpb-1 unit is composed of greenish gray-brown colored, silty clay unit and contains intense turf and coal levels. On the other hand, Tmpb-2 unit is composed of yellowish-greenish brown colored, graveled sandy clay unit and contain dense carbonate congressions.

The baseline data presented in the EIA Report is found sufficient and no further studies are required.

5.1.2 Natural Hazards and Seismicity

Natural Disasters such as landslide, snow slide rock fall, avalanches do not occur around project area as stated in the EIA Report of the Project.

Furthermore, natural disasters such as collapse, settling, karsting, tsunami, etc. do not occur at the Project site.

Istanbul city center is located on a 1st zone earthquake region. According to the historical records, it is known that there have been many disastrous earthquakes in Istanbul; it does not contain a tectonic fracture that can centrally create an earthquake.

According to the Turkish Earthquake Zones Map, Project area is in 3rd zone earthquake region. Mitigation measures for an earthquake were also indicated in the EIA report.

To sum up, the natural hazards and seismicity evaluation of EIA report were found sufficient and no further studies are anticipated.

Our reviews on how earthquake impacts are considered properly on plant designs are stated in Section 10.2 Geotechnical Review and Section 10.3 Structural Review.

5.1.3 Hydrogeology

During the EIA studies of the Project, investigation drills were conducted to assess the availability of groundwater. The drills showed that the underground water depth ranges between 5.00 and 16.45 m in the Project Site and there is no geothermal source found in the site. The Project Site is not located within the borders of a catchment area of any surface water source which supplies water to Istanbul city.

Hydrogeology studies and findings are found sufficient and further study on hydrogeology is not required.

5.1.4 Water Resources

In the scope of the EIA, the water sources of Istanbul province were listed. There are no surface water bodies in the vicinity of the Project Site. However, water ponds resulting from seasonal precipitation were observed in the Project Site.

In addition, there is not any geothermal source at the Project Site and also no groundwater source was found as a result of the survey drills opened at the site.

The nearest surface water bodies were stated as Göktürk Pond and Alibeyköy Lake, which are 3 km and 7 km away from the Project Site, respectively.

In order to determine the baseline conditions of the project area water samples were taken from the Isiklar neighbourhood which is the nearest sensitive receptor located at an air distance of 600 m southwest of the project area. Quality analysis results from creeks and water ponds close to Işıklar Village were presented in the EIA report. According to the analysis, the surface water source was Class 3 as per Turkish National Water Pollution Control Regulation. The gathered baseline data on water resources are found as sufficient and there is no need for a further study.

Section 10.4 of this study adresses about the stormwater impacts and measures taken aganst and flooding risk considerations.

5.1.5 Land Use, Soil and Landscape

According to the Land-Use Database of the region by Directorate of Rural Services, the Project land allocated to IMM is determined as forest lands, non-calcareous brown forest soil and lands that are not suitable for cultivated agriculture.

The Project Site has been allocated to IMM by General Directorate of Forestry for 49 years. Additional land was requested to be used as dumping area by IMM and the EPC Contractor from General Directorate of Forestry. There is a dump site in the Project Site, which was not elaborated in the EIA report.

As stated in the EIA Report, the Project area is basically represented with excavation materials of heterogeneous character and the project site does not comprise any vegetable soil.

The Project Area had previously been infilled with excavation materials but the EIA Report does not present any information regarding the contamination status of the soil. Therefore, it is recommended that a sampling study for the determination of the contamination status is undertaken following completion of stabilization works in the fill area (see Construction Phase ESAP Item 3.6).

5.1.6 Protected Areas

There are no Key Biodiversity Areas (KBAs) and/or nationally protected areas within the project area or area to be subject to impacts. The closest KBA to the project area is West İstanbul Pastures, which is located 4.1 km to the south of the Project area. The Bosporus KBA is located 4.6 km to the east and Agacli Sand Dunes KBA is located 4.9 km to the north. The closest nationally protected area to the project area is the Göktürk Lake Natural Park, which is 5.9 km away. The map illustrating the protected areas in the vicinity of the project area is shown in Figure 5.

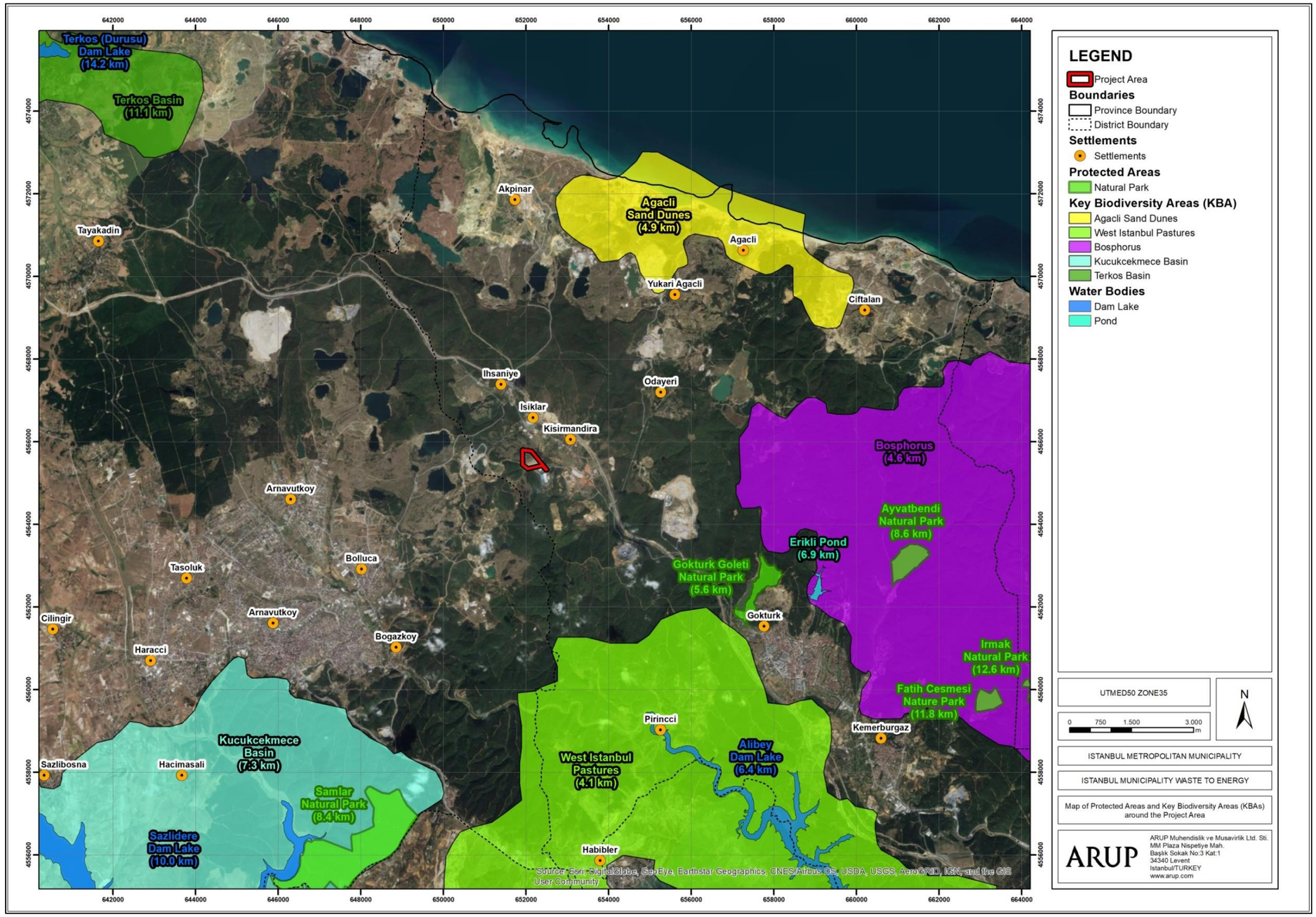

Figure 5: National and International Protected Areas in the Close Vicinity of the Project Area

5.1.7 Meteorology and Climatic Conditions

As stated in the EIA Report of the Project, Eyüpsultan District where the Project Site is located has different climatic features as compared to many residential areas located at the same latitude, both due to its geographical position and physical properties. The district is located at the intersection of the Mediterranean and Black Sea climate types, at a transition area where generally distorted Mediterranean climate and less-influencing Black Sea climate is predominant. Towards the north, the summer rains increase. Getting closer to the Black Sea has a significant role in this climatic feature.

According to the long term meteorological data recorded at Kumköy Meteorological Station the local climatic conditions were identified. Since the EIA report was prepared in 2012, these data are out of date. Major variations in the long-term data are not anticipated and the data presented are found to be sufficient.

5.1.8 Air Quality

In the scope of air quality monitoring studies, Particulate Matter (PM_{10}) sampling was made on November 3-4, 2011 at the sensitive receiving medium of the project site. The particulate matter concentration measured at the nearest residential area (Isiklar Village) to the Project Site was found to be much below the long term limit value stated at Annex-IA of the Air Quality Assessment and Management Regulation (Official Gazette no. 26898 date: 06.06.2008).

Air Quality Modelling Study Report was prepared in June 2015 by 2U1K Engineering and Consultancy Co. Stack gas emissions resulting from the incineration of the municipal waste within the scope of the project were assessed in this report. Stack gas emissions composed of main pollutants, which are sulphur dioxide, nitrogen oxides, carbon monoxide, dust, hydrogen chloride, volatile organic compounds (VOCs) and hydrogen fluoride. Heavy metals, dioxin and furan emissions were also anticipated to be formed in trace amounts as a result of the incineration. The Project is within the scope of Article-14 and Annex-5 of the Regulation on the Incineration of Wastes and Regulation on the Control of the Air Pollution Sourced by the Industry. According to the Air Quality Modelling Study Report, all emissions will be kept below the limit values set by the related regulations with proper mitigation measures. Therefore, the scenarios used during the modelling study are needed to be broaden by covering start-up, planned, unplanned and emergency disrupts/shutdown cases (see ESAP for All Phases Item 3.1).

Measurements were conducted at the project site in order to measure dioxin and furan concentrations between the dates 23-24 January 2012 by TUBITAK Marmara Araştırma Merkezi (MAM). Measurements were conducted at Isiklar Village and Göktürk Neighborhood for 24 hours.

In order to determine air quality in the region, SO_2, NO_2, HCL and HF concentrations were measured by passive sampling method at eight points within the impact area of the project for one month. Besides, PM_{10} concentrations were

measured at one point at Isıklar Village which is the closest settlement to the project area for 24 hours. All results were in compliance with the limit values set by the related regulations.

Greenhouse gas (GHG) emissions were not assessed in the EIA Report. Annual GHG emission contribution is calculated and presented in the further sections of this ESDD Report.

It is recommended that a new air quality monitoring campaign should be conducted to develop a new baseline and to reflect the impacts of the recent developments (subways, highways, airport etc.) occurred in the close vicinity of the Project Area (see ESAP for All Phases Item 3.3).

5.1.9 Noise

In order to determine noise pollution loads, measurement studies were conducted at Işıklar Neighbourhood on September 3-4, 2011 by DOKAY Environmental Laboratory. According to the measurement studies conducted at Işıklar Neighbourhood, measurement results were below the limit values set by the Regulation on Environmental Noise Assessment and Management published by the Official Gazette no. 27601 and dated 04.06.2010. In the scope of the EIA Report, no further assessments are required provided that the measures and commitments stated in the EIA are ensured. For GIIP, communities should be encouraged to state their grievances in case of nuisance from environmental noise. IMM or an appointed environmental consultant should ensure that the grievance mechanism is established and actively working.

To conclude, the noise survey and data presented in the EIA studies are found to be technically adequate. However, the data is seven years old and is considerd not to reflect current conditions in the vicinity of the Project Area. It is recommended that a new noise survey is performed to identify baseline noise levels at the nearest receptors (see ESAP for All Phases Item 3.2). Noise measurements within the Project site are not required since construction works have already commenced.

5.2 Biological Environment

An ecological study was conducted by an expert within the scope of the EIA in order to determine the flora and fauna characteristics of the Project Site. In this study, the properties of the Project Site and its vicinity were examined in terms of flora and fauna.

5.2.1 Terrestrial Flora

Within the project area, floristic species inventories and the habitat structures present were determined following the desk and field studies conducted during the EIA stage of the Project. In this context, 140 plant taxa were identified in the flora list. The semi-natural areas (mixed deciduous forests) around the project area were found under intense anthropogenic pressure due to surrounding settlements and other construction activities.

Among the identified and/or potential flora species that are located in and around the activity area, none are endemic, rare, or endangered and there is no protected flora species listed on Appendix-1 of the Bern Convention present.

According to studies conducted within the project site there are no critical species found in the project area.

5.2.2 Terrestrial Fauna

The terrestrial vertebrate animals (mammals, birds, amphibians and reptiles) within and in the vicinity of the project area have been identified by the desk and field studies conducted for the EIA.

Information on endemism, population densities and trends, and national and international conservation status were checked for those species identified as present or potentially present within the project area.

In the scope of EIA Studies conducted in 2012, IUCN Red List Categories were analysed and it is found that there is not any endangered species (amphibians,reptiles,birds,mammals) found in the project area.

The biological studies to determine baseline conditions in and around the Project Site are found to be sufficient. There is no need for further surveys to be conducted.

5.3 Social Environment

The nearest residential areas to the Project are Isiklar and Ihsaniye Neighbourhoods, which are located 600 m and 1.3 km from the Project Site, respectively.

The Project Area was allocated to IMM by General Directorate of Forestry for 49 years starting from 1997. The land is on state-owned land and there were no economical, agricultural or residential activities on it. The adjacent field has been used by local herdsmen to reach pasturelands. Following commencement of the construction phase of the Project, the EPC Contractor arranged its fencing alignment to provide continued access and safe passage for the herdsmen.

In the EIA report; population data, income of the locals and unemployment rates in the region, social infrastructure services in the region (education, health, cultural services, and transportation), urban and rural land use information were provided.

According to Adress Based Population Registration System (TUIK,2018) data, population of Eyup district is 383,909. The population of Isiklar and Ihsaniye Neighbourhoods are 547 and 189, respectively.

In the scope of EIA conducted in 2012 , it was specified that %34 of population of Eyup district is working in manufacturing sector and %27 in service industry.The district could still be defined as an industrial settlement. It was also specified that the income of locals in Eyup is low.

According to EIA, there are 59 educational institutions in Eyup. In terms of health services, there are 2 hospitals, 10 health centers, 2 maternal and child health and family planning centers, one tuberculosis control dispensary and district polyclinics in Eyup district. It was also stated that health centers are found in %60 of neighborhouds of Eyup.

A Public Participation Meeting was conducted at the meeting hall of the IMM Waste Processing Recycling and Compost Plant on 20.12.2011 in order to obtain public participation to the EIA process, inform the public regarding the activity and receive their opinions and suggestions.

During the site visits performed as part of this ESDD study, meetings were held with the Isiklar and Ihsaniye Neighbourhood muhtars. The points raised by the muhtars are as follows:

- Odour nuisance related with the IMM's Composting Plant was reported.
- The EPC Contractor's representatives provided information about the Project to local residents.
- Both muhtars stated that they seek employment for young people living in the villages, numbers of whom have fallen in the recent years (now 8-10 people).
- The main concerns of the villages relate to other infrastructure projects ongoing in the area, mainly regarding dust generation.
- The muhtars' concerns related to the WtEP Project are:
    - Potential for odour nuisance
    - Concerns about potential harmful emissions to air.
- Heavy goods vehicle access through the villages is restricted following a grievance conveyed to Ministry of Interior by the Işıklar Muhtar.
- Before recent infrastructure projects commenced construction, horticulture and animal husbandry were the main sources of income in the villages.

These issues raised by the muhtars are addressed in the following sections of this report.

To sum up, social aspects of the EIA are found to be insufficient due to the nature of the national EIA regulatory requirements. The ESDD study targets to cover lacking social aspects through assessment of social risks, development of Environmental and Social Action Plan (ESAP) and Stakeholder Engagement Plan (SEP).

6 Methodology

The due diligence assessment consists of desk-top studies, site visit observations and analysis and reporting:

- Desk-top studies comprise review of key documents related with the Project: EIA report and associated baseline data; environmental permits, authorisations and licences from the competent authorities; land lease agreements; layout plans and maps etc.
- Due to the lack of information, the assessment of the OHTLs is limited in this ESDD Report. Medium voltage OHTLs are not subject to the national EIA Regulation and therefore it is anticipated that the risks and impacts would be of a low magnitude.
- A site visit was conducted on 28-29.05.2019 with the participation of team of environmental and social experts from Arup, Lenders' representatives, and representatives of IMM and the EPC Contractor. The objective of the site visit was observation and assessment of environmental and social issues and to verify on the baseline data.
- Analysis of findings from the site visit and the document review has been performed against national legislation and IFC Performance Standards, and the results are presented in the form of matrices. An ESAP is presented in Chapter 7 of this ESDD Report.

The list of documents reviewed includes the following:

- EIA report for WtEP (prepared by DOKAY-CED Environmental Engineering Ltd. May 2012)
- General Project layout
- The proposed technical design and pre-feasibility studies
- Air Quality Modelling Study Report (2U1K.)
- Opinion letters provided by various authorities such as the General Directorate of Mineral Research and Exploration (MTA), Ministry of Environment and Urbanisation (MoEU) and General Directorate of State Hydraulic Works (DSI).

7 Environmental and Social Risk Assessment

7.1 Compliance Review

The environmental compliance for the WtEP has been evaluated within the scope of Annex-1 and Article 12 of the EIA Regulation, which requires the preparation of a full EIA Report. An EIA Report was prepared for WtEP. This was followed by the granting of an "EIA Positive" certificate from the MoEU, No: 2610 dated 4 July 2012. As per the EIA Regulation, the project owner was obliged to start construction activities within 7 years of the approval of the EIA report. Construction was commenced in this period and this no longer represents a risk.

Other environmental requirements for the WtEP include permits, licenses and approvals necessary for pre-construction, construction and operation activities. The Consultant is unable to evaluate the Project-related permits, since scant information has been provided regarding permits, licenses, and approvals. The Consultant has evaluated the following permits, licenses, approvals, and related official letters and no risks have been observed:

- Land allocation letter of General Directorate of Forestry dated 02.06.1997, numbered 1704-792/308
- Approval letter of Istanbul Provincial Directorate of Environment and Urbanization dated 26.12.2011, numbered 116
- Master plan approval letter of IMM Planning Department dated 16.04.2012, numbered 3630
- Water and wastewater connection approval letter of IMM Water and Sewerage Admnisitration dated 05.11.2011, numbered 463051
- Approval letter of General Directorate of Mineral Research and Exploration dated 13.03.2012, numbered 2985
- Spoils disposal site approval letters dated 06.11.2017, 26.03.2018, 27.12.2018, and 31.12.2018, and numbered 54, 100, 105, and 184, respectively
- Pre-license dated 11.07.2019 and numbered ON/8703-1/04276 taken from Energy Market Regulatory Authority
- National grid connection permit dated 08.04.2019 taken from General Directorate of Electricity Transmission Corporation

The Project is categorised in Annex-1 of the Regulation on Environmental Permit and License and therefore,requires environmental permits related to air, noise or wastewater emissions. In the permitting process, the Istanbul Provincial Directorate of Environment and Urbanization will inspect the information and documents that will be provided IMM regarding emissions, discharges, structural safety, fire safety etc.

Working and labour conditions will be inspected by the Ministry of Family, Labor and Social Services and Social Security Institution.

7.2 Environmental and Social Management System Assessment

The Environmental and Social Management System (ESMS) is described as a tool that is used for management of a project's environmental and social risks in accordance with that particular project's nature and scale and as per international environmental and social standards. An ESMS of a project consists of policies, risk and impact assessment, management plans and organizational chart, emergency preparedness and response planning, stakeholder engagement and monitoring components. In this scope, the ESMS was acknowledged as a necessity for the management of each environmental and social aspect of the Project and, therefore, it was considered as a factor in the risk assessment provided below.

Documents available for the assessment of ESMS of IMM, ISTAC and the EPC Contractor in line with national regulations and IFC Performance Standards were examined. Management plans and policies were provided by IMM, ISTAC and the EPC Contractor are as follows:

Table 5: Management plans and policies of IMM, ISTAC and HZI-MAKYOL

IMM	ISTAC	HZI-MAKYOL
• Human Resources Policy • Recruitment Policy • Environmental Magnitude and Impact Assessment Procedure • Risk Assessment Procedure • Emergency Procedure • Instructions on Working with Chemicals • Annual Environmental Performance Monitoring and Measurement Plan • Annual OHS Performance Monitoring and Measurement Plan • Harmonisation Liabilities Procedure • Waste Control Plan • Institutional Zero Waste Management Procedure	• Integrated Management Policy • Energy Management Policy • Laboratory Quality Policy • Waste Management Procedure • Permitting Process Management Procedure • Environmental Nonconformity and Incident Procedure • Environmental Magnitude Identification and Risk Assessment Procedure • Environmental Emergency Procedure • Dangerous Goods Safety Procedure • Emergency Response Procedure • OHS Nonconformity and Incident Procedure • OHS Operation Control Procedure • OHS Risk Identification and Incident Procedure	• Human Resources Policy • Recruitment Policy • Environmental Policy • Health and Safety Policy • Industrial Relations Policy • Quality Policy • Traffic Management Plan • Emergency Preparedness and Response Plan • Emergency Management Plan • Health, Safety, Environment Plan • Environmental Management and Mitigation Plan • Waste Management Plan • Procurement Procedure • Industrial Waste Management Plan • Organization chart

The assessment of the ESMS documentation provided by IMM, ISTAC, and HZI-Makyol showed that environmental and social issues are covered by the various management plans, procedures and instructions. Related mitigation measures are well covered by the documents. Therefore, through proper implementation of these management plans, adverse impacts should be mitigated. However, the implementation of the ESMS by all parties should be strengthened. The recommendations of the Consultant are as follows:

- IMM and ISTAC should develop Project-specific management plans for the operation phase. The plans that needed to be constituted are presented throughout the ESAP for the Operation Stage.
- The EPC Contractor should appoint an Environmental Officer/Engineer to effectively develop and implement the ESMS.
- IMM and ISTAC should update their emergency preparedness and response plans and procedures by considering site-specific issues, the IFC PSs and the guidance provided by the World Bank general and sectoral EHS guidelines.

- Management of external communications is essential as part of an ESMS. It was observed that there is no External Communications Procedure available for all parties.
- In order to maintain a good relationship with stakeholders, it is essential to keep them informed about responses to their complaints or concerns. Actions taken should be periodically reported to affected stakeholders. It was observed that there is no such reporting process in place. To manage relations with stakeholders, IMM, ISTAC and the EPC Contractor should follow the Stakeholder Engagement Plan developed by the Consultant, which also defines the Grievance Mechanism that should be implemented.
- There is no management plan addressing the management of community health, safety, and security. Therefore; IMM, ISTAC, and the EPC Contractor should prepare and implement a Community Health and Safety Plan which should be in line with the requirements of IFC PS4.
- All management plans should be reviewed by considering the requirements of the IFC PSs and the World Bank EHS guidelines.

7.3 Identification of Environmental and Social Risks of the Project

Project related activities and conditions that may cause potential risks were identified and environmental and social elements that may interact with these activities and conditions were determined. These are presented in Table 6.

Table 6: Project Activities and Potential Impacts*

Impact Source Activity/Condition	Environmental and Social Elements												
	Environmental										Social		
	Land Use Characteristics	Topography - Soil	Subsidence - Seismicity	Biological Environment	Surface Waters	Airand Odour	Background Noise	Traffic	Landscape and Visual Aspects	Protected Areas	Socio-economic Environment	Community Health & Safety	Occupational Health and Safety
Preconstruction and Construction Phase													
Land use													
Construction and cut and fill act.													
Procurement of equipment and materials													
Emissions													
Wastewater (domestic)													
Solid waste													
Employment of the workforce													
Operation Phase													
Procurement and use of other equipment (chemicals etc.)													
Wastewater (domestic)													
Solid waste													
Ash (Bottom, Fly, Boiler)													
Emissions													
Employment of the workforce													
Closure and Post-operation Phase													
Disassembly, demolition etc.													
Water use and procurement													
Solid waste													
Employment of the workforce													

* Potential positive and negative impacts are indicated with green and orange colours, respectively.

Project associated potential impacts for each environmental and social element identified in Table 6 have been assessed based on the probability/consequence assessment criteria given in Table 7 and Table 8 and the matrix presented in Table 9.

The results of this assessment, including the identified positive/negative impacts prior to implementation of mitigation measures are presented in Table 10 and Table 11 for construction and operation phases, respectively.

Table 7: Probability Evaluation Criteria

Probability			**Frequency Description**
1	Improbable/ Very low	May occur exceptionally	Does not occur during construction, may occur 0-1 times during operation
2	Low	May occur rarely	May occur once during construction, may occur a few times during operation
3	Moderate	May occur from time to time	May occur a few times during construction, may occur a few times a year during
4	High	May occur frequently,	May occur a few times a month during

Source: Adapted from Standards Australia / Standards New Zealand, 2005: "Risk Management Guidelines Companion to AS/NZS 4360:2004

Table 8: Criteria for Consequence Evaluation

Consequence/ Severity		Damage/Pollution Impact on Ecosystems[1,2]	Impact on Personnel Health and Safety[1]	Impact on Industrial/Public Facilities[1]		Impacts in the Extent of Legal Framework[2]	Social Impacts/Impacts on Reputation[2]
				Economic Impact	Operational Impact		
D	**No Importance/ Negligible**	Occurrence of local, unimportant and rapidly reversible impacts	Unimportant illnesses Personal, unimportant illness and physical injury that cause no work hours	Material damage below 10.000 ¨TL	Necessity of maintenance and repair that lasts less than 1 day in one or more facilities	Technical inconsistencies that does not result in lawsuits, but gets heightened attention of local authorities	Has no impact on local communities' health and safety Some grievances that do not affect general public/limited to some persons and that do not get attention from local media
C	**Low Importance/ Marginal**	Occurrence of impacts that are temporary, reversible and compensable	Illness and physical injury that results in lost work hours	Material damage above 10.000 ¨TL	Halt of operations for more than a day in one or more facilities	Violation of legal requirements in a way that does not lead to critical results (does not result in lawsuits or important fines) Experiencing difficulties in proceeding with the processes that involve participation of authorities	Occurrence of impacts to local public's health and safety, which can be mitigated by short term and on the spot response Grievances that get the attention of the local public and the local media
B	**Moderate Importance/ Critical**	Loss off important species/areas Large scale destruction of habitats	Loss of life and serious illnesses, injuries that affect more than 1 person	Material damage above 100.000 ¨TL	Halt of operations for a few weeks in one or more facilities	Violation of legal requirements in a way that does lead to critical results (does result in lawsuits or important fines) Experiencing difficulties with authorities that may affect the possibility of acquisition of future permits	Occurrence of important impacts to local public's health and safety, which may require medical intervention Grievances that cause complete reaction from local public and results in attention from regional/national media and NGOs Loss of reputation
A	**High Importance/ Catastrophic**	Occurrence of catastrophic/ destructive and irreversible impacts Immediate and complete loss of ecosystem components	Loss of lives of multiple people, illnesses and injuries that result in multiple loss of lives	Material damage over 1 million TL	General damage in the facility Some facilities becoming completely unusable	Violation of legal requirements that result in class action lawsuits or important fines Cancellation of permits/licenses that are fundamental for operations	Occurrence of severe, irreversible impacts on general public health and safety Reaction and protests from national media and NGOs Serious damage to company reputation and value

Source: [1] Adapted from Canter; 1993: "Pragmatic Suggestions for Incorporating Risk Assessment Principles in EIA Studies"; [2] Adapted from Standards Australia / Standards New Zealand, 2005: "Risk Management Guidelines Companion to AS/NZS 4360:2004

Table 9: Risk Assessment Matrix

		Probability of Occurrence			
Consequence/Severity		High (4)	Moderate (3)	Low (2)	Improbable/ Very low (1)
	High Importance/ Catastrophic (A)	A4 (16)	A3 (12)	A2 (8)	A1 (4)
	Moderate Importance/ Critical (B)	B4 (12)	B3 (9)	B2 (6)	B1 (3)
	Low Importance/ Marginal (C)	C4 (8)	C3 (6)	C2 (4)	C1 (2)
	No Importance/ Negligible (D)	D4 (4)	D3 (3)	D2 (2)	D1 (1)

Risk Level		
	High risk	Risk must imperatively be lowered; activities cannot be continued without lowering the risk
	Moderate Risk	If possible, risk is lowered one level down by related mitigation measures; if not, activities are continued by acknowledging the risk
	Low Risk	Activities can be continued without additional measures, as long as compliance with legal requirements and safety criteria are ensured
	Negligible Risk	Requires no additional measures, as long as implementation of normal operational procedures are applied

Source: Adapted from Canter, 1993: "Pragmatic Suggestions for Incorporating Risk Assessment Principles in EIA Studies"

Table 10: E&S Risk Assessment for Construction Phase

Environmental/Social Element	Potential Negative/Positive Impact (Prior to Implementation of Mitigation Measures)	Risk Assessment		
		Consequence/ Severity	Probability	Risk Level
PS1 – Assessment and Management of Environmental and Social Risks and Impacts				
Environmental and Social Management System	Lack of an Environmental and Social Management System may cause inappropriate/insufficient management of risks. Various negative impacts on various environmental and social receivers may occur if the Environmental and Social Management System is not implemented as planned.	B	3	Moderate (B3)
Cumulative Impacts	There will be some cumulative impacts on Valuable Ecosystem Components such as air quality, land use and soil and settlements. For further information see the Cumulative Impact Assessment Study completed as part of this Assignment.	C	4	Moderate (C4)
Permits, Licenses, Approvals	Limited information was available. Should there be irregularities, there is a risk of regulatory action by the authorities.	A	2	Moderate (A2)
Stakeholder Engagement	In case effective and transparent relations with stakeholders are not established, social impacts may not be managed properly.	C	2	Low (C2)
PS2 – Labor and Working Conditions				
Occupational Health and Safety	Occupational health and safety risks may arise as a result of construction, cut and fill and emergency situations. Health risks may increase due to improper waste management practices.	C	3	Moderate (C3)
Labor Conditions	Lack or insufficiency of human resources policies and procedures, grievance mechanism and subcontractor management may create risks for workforce.	B	2	Moderate (B2)
PS3 – Resource Efficiency and Pollution Prevention				
Background Noise	Increase in background noise will occur during cut and fill works and construction activities. Procurement of equipment and materials and disposal of solid waste by related authorities and firms' disposal trucks will temporarily increase background noise levels due to increased traffic.	C	4	Moderate (C4)
Air	Impacts on air quality may occur during cut and fill works and construction activities due to emissions sourced from heavy machinery. Procurement of equipment and materials will have indirect and temporary impacts on air quality due to increased traffic related emissions.	C	3	Moderate (C3)
Topography and Soil Environment[1,2]	Cut and fill and construction activities will alter topography. Impacts on topsoil will occur during cut and fill works and construction activities. Improper management of waste (wastewater, solid waste) and chemicals may cause soil pollution.	C	3	Moderate (C3)
Surface Water	Improper management of waste (wastewater, solid waste) and chemicals may cause surface water pollution	C	3	Moderate (C3)
Traffic	Procurement of equipment and materials and disposal of solid waste by related authorities and firms' disposal trucks will increase traffic. Besides these, limited number of shuttle vehicles could contribute to traffic.	C	4	Moderate (C4)

Environmental/Social Element	Potential Negative/Positive Impact (Prior to Implementation of Mitigation Measures)	Risk Assessment		
		Consequence/ Severity	Probability	Risk Level
Distribution of Energy	Hazardous materials to be used during the construction of OHTL such as insulating oil/grease, fuel, etc. might create pollution risks.	C	2	Low (C2)
PS4 – Community Health, Safety, and Security				
Land Use Characteristics	Change of land use characteristics will occur in the extent of the Project.	B	3	Moderate (B3)
Community Health and Safety	All activities that require an increase in traffic (construction activities, procurement activities, waste disposal activities) will increase risk of traffic accidents. Improper waste management (wastewater and solid waste) may increase risks regarding community health; Communities may be affected by Project related emergency situations.	B	1	Low (B1)
Infrastructure	Construction activities and material and service procurement activities may cause some damage on local infrastructure.	D	2	Negligible (D2)
Influx of Workers	There will be minor influx of workers to the Project site for construction works. Since the Project area is not rural, the worker-public relations can be managed through implementation of code of conduct and performing related trainings for workers. However, there might be some risks if these are not performed throughly.	C	1	Negligible (C1)
Geotechnical Problems (Subsidence)	Improper groundworks may cause subsidence.	C	1	Negligible (C1)
PS5 – Land Acquisition and Involuntary Resettlement				
Land Acquisition	The Project Area was allocated to IMM by General Directorate of Forestry for 49 years starting from 1997. Therefore, there is no need for land acquisition. The project does not trigger PS5.	No Impact	No Impact	No Risk
PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources				
Biological Environment	Cut and fill and construction activities (dust generation, removal of vegetation etc.) and improper waste management may have direct impacts on biological environment. Other construction activities (increase in traffic and emissions, a potential spillage, improper waste management etc.) may have indirect impacts on biological environment)	C	2	Low (C2)
Landscape and Visual Aspects	Construction activities, cut and fill works alter landscape and have visual impacts. Procurement activities and waste disposal activities will have visual impacts due to increased traffic. Improper waste management may cause visual impacts.	C	2	Low (C2)
Distribution of Energy	Since the unfinalized OHTL route passes through forested areas, the construction might result in alteration and disruption to terrestrial habitat, including impacts to avian species and an increased risk of forest fires.	B	2	Moderate (B2)
PS7 – Indigenous Peoples				
Indigenous Peoples	There are no indigenous peoples in the vicinity of the Project area.	No Impact	No Impact	No Risk
PS8 – Cultural Heritage				
Protected Areas	There are no protected areas in the vicinity of the Project area.	No Impact	No Impact	No Risk

[1]Chemical storage and management issues were evaluated under “Topography and Soil Environment”

[2]Waste management issues are evaluated under “Topography and Soil Environment” and “Surface Water”

Table 11: E&S Risk Assessment for Operation Phase

Environmental/Social Element	Potential Negative/Positive Impact (Prior to Implementation of Mitigation Measures)	Risk Assessment		
		Consequence/ Severity	Probability	Risk Level
PS1 – Assessment and Management of Environmental and Social Risks and Impacts				
Environmental and Social Management System	Lack of an Environmental and Social Management System may cause inappropriate/insufficient management of risks. Various negative impacts on various environmental and social receivers may occur if the Environmental and Social Management System is not implemented as planned.	B	3	Moderate (B3)
Cumulative Impacts	There will be some cumulative impacts on Valuable Ecosystem Components such as air quality, land use and soil and settlements. For further information please see Cumulative Impact Assessment Study.	C	4	Moderate (C4)
Permits, Licenses, Approvals	Limited information was available. Should there be irregularities, there is a risk of regulatory action by the authorities.	A	2	Moderate (A2)
Stakeholder Engagement	In case effective and transparent relations with stakeholders are not established, social impacts may not be managed properly. In case a rapid response mechanism is not applied for grievances, some social risks may arise.	C	2	Low (C2)
PS2 – Labor and Working Conditions				
Occupational Health and Safety	Occupational health and safety risks may arise as a result of operation of plant equipment and emergency situations. Health risks may increase due to improper waste management practices. Occupational exposure to stack gases may occur due to treatment failure.	C	3	Moderate (C3)
Labor Conditions	Lack or insufficiency of human resources policies and procedures, grievance mechanism and subcontractor management may create risks for workforce.	B	2	Moderate (B2)
PS3 – Resource Efficiency and Pollution Prevention				
Background Noise	Some plant components (turbines, coolers, generators etc.) will contribute to background noise levels in the vicinity of the Project area. Procurement of equipment and materials, disposal of solid waste by related authorities and firms' disposal trucks and trucks that bring waste to the WtEP will increase background noise levels due to increased traffic.	C	2	Low (C2)
Air	Latest technology will be used in the WtEP in order to minimize stack gas emissions. Fly ash will be minimized by bag filter; minor amounts of fly ash may be generated. Dioxins and furan formed during the incineration will be kept at minimum level by adjusting the incineration temperature and adding activated carbon process to the stack gas removal system but in case of any failure some dioxin and furan may be released. Improper waste segregation which may result incineration of wastes which contain metals or metalloids (eg. mercury and arsenic). The stack height is found as relatively low compared to other similar plants worldwide and this might create dispersion issues. If re-run of dispersion modeling study results are in compliance with the standards then the risk level can be reduce to low.	B	2	Moderate (B2)

Environmental/Social Element	Potential Negative/Positive Impact (Prior to Implementation of Mitigation Measures)	Risk Assessment		
		Consequence/ Severity	Probability	Risk Level
Topography and Soil Environment	Improper chemical management, improper waste management (wastewater, solid waste) and improper disposal of wastes may cause soil pollution.	C	2	Low (C2)
Surface Water	Improper management of waste (wastewater, solid waste) and chemicals may cause surface water pollution.	D	2	Negligible (D2)
Traffic	Disposal of solid waste by related authorities and firms' disposal trucks and trucks that bring municipal solid waste to the WtEP and trucks that transports the fly and bottom ash of the WtEP to the licensed landfills will increase traffic.	C	4	Moderate (C4)
Fly and Bottom Ash	The fly and bottom ash to be generated during the WtEP activities will be sent to licensed facility for final disposal. However, a facility have not yet been identified and this poses a risk. It is anticipated that a landfill will be identified before the commencement of operation phase.	B	3	Moderate (B3)
PS4 – Community Health, Safety, and Security				
Land Use Characteristics	No impacts are expected on land use characteristics.	No Impact	No Impact	No Risk
Community Health and Safety	All activities that require an increase in traffic (procurement activities, waste disposal activities) will increase risk of traffic accidents, noise, dust emissions. Improper waste management may increase risks regarding community health. Communities may be affected by Project related emergency situations. Improper management of wastes to be incinerated may cause diseases.	C	2	Low (C2)
Infrastructure	Material and service procurement activities may cause some damage on local infrastructure.	D	2	Negligible (D2)
Geotechnical Problems (Subsidence and Micro-seismicity)	Improper foundation or ground construction works may cause subsidence.	D	2	Negligible (D2)
Influx of Workers	No influx of workers are anticipated for the operation phase.	No Impact	No Impact	No Risk
Distribution of Energy	If regular maintenance of vegetation within the right-of-way of the OHTL route will not be performed, this may result in ignition of forest and brush fires. In addition, OHTL might create hazards for public such as electrocution, electromagnetic interference.	B	2	Moderate (B2)
PS5 – Land Acquisition and Involuntary Resettlement				
Land Acquisition and Involuntary Resettlement	There are no land acquisition needs in the operation phase.	No Impact	No Impact	No Risk
PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources				
Biological Environment	Improper waste management may have direct, limited impacts on biological environment.	D	2	Negligible (D2)
Landscape and Visual Aspects	Procurement activities and wastes to be transported by semitrailers ,waste disposal activities will have visual impacts due to increased traffic. Improper waste management may cause visual impacts.	C	3	Moderate (C3)
PS7 – Indigenous Peoples				
Indigenous Peoples	There are no indigenous peoples in the vicinity of the Project area.	No Impact	No Impact	No Risk

Environmental/Social Element	Potential Negative/Positive Impact (Prior to Implementation of Mitigation Measures)	Risk Assessment		
		Consequence/ Severity	Probability	Risk Level
PS8 – Cultural Heritage				
Protected Areas	There are no protected areas in the vicinity of the Project area.	No Impact	No Impact	No Risk

There are no "high risk" impacts for either the construction or operation phases of the Project. For impacts assessed to have "moderate risk", measures must be applied to decrease the related risk levels to either "low risk" or "negligible risk" levels. Application of mitigation measures for impacts with "low" or "negligible" risk levels is not a necessity; however, minimizing or preventing these impacts is more environmentally and socially favourable.

The following sections provide further detail regarding the anticipated impacts.

7.3.1 Impacts on Air Quality

Construction Phase

The major impacts on air quality during the construction phase of the Project will be due to material handling, vehicle movement and emissions from heavy construction machinery (trucks, excavators, etc.). Air pollution will be mainly dust emissions and exhaust emissions. The sensitive receptors that may be exposed to these air emissions would be the local population of Isiklar Neighbourhood.

During construction phase of the project, there will be vehicle movements for the transportation of construction materials to the Project site. Impacts on air quality will be mainly due to dust emissions caused by the vehicle movement on unpaved roads. In addition, exhaust emissions will come from vehicles used in construction activities.

Dust will be generated during the excavation works. However, the receptor sensitivity is assessed as low given the distance between the nearest settlement (Isiklar Neighbourhood) and the construction site, which is 600 m.

When considering the nature of the works and the distance to the nearest settlement, the impacts will not be significant with implementation of mitigation measures and adherence to good construction methods, including:

- Water spraying of unpaved roads during the dry season (June-August)
- Prohibiting burning of any type of waste
- Setting speed limits for all construction machinery and covering dump trucks to prevent fugitive dust emmissions
- Preventing uncontrolled excavation, loading and unloading
- Ensuring use of work-specific PPE.

Operation Phase

In the operation phase of the Project, emissions will mainly come from the WtEP itself. The pollutants potentially emitted are NO_2, HCl, SO_2, HF, and dioxins and furans. Monitoring of these pollutants will be performed by governmental authorities. A Flue Gas Treatment system, described in Chapter 10.1.2, will be in

operation. With this in operation, the impact will be low, long-term, regional and with low significance.

GHG emissions from the Project are assessed in Chapter 7.4.

7.3.2 Impacts on Geology, Soil and Contaminated Land

Construction Phase

During the construction phase of the Project, the impacts on soil will be mainly the loss of a small amount of top soil in the areas where excavation works will be carried out. In addition, soil contamination may occur due to accidental oil spills/leaks. The impacts will not be significant with the implementation of mitigation measures and adherence to good construction methods. The impact is assessed as direct and negative with short term duration, on-site and low significance.

Operation Phase

Operation phase soil impacts might occur due to the improper disposal of any type of waste, especially fly and bottom ash, other types of hazardous wastes, and uncontrolled discharges of wastewater. These issues can be easily managed by the implementation of management plans that would be developed by IMM and/or the Operator. Therefore, the operation phase impacts on soil will be direct, negative with short-term duration, local and low in significance.

7.3.3 Impacts on Water Resources

During the construction phase of the Project, tap water and drinking water will be provided from the adjancent IMM Composting Plant. This facility is already connected to the city network. During the operation phase, the Project will also use this network connection. The wastewater generated during the construction and operation phases of the Project will be discharged to the sewer sytem after treatment. The risk of impacts on water resources from poor management of chemicals and hazardous materials would be eliminated by the development and implementation of necessary management plans by both the IMM and the EPC Contractor. Therefore, the Project will have negligible impacts on water resources.

7.3.4 Impacts on Biodiversity and Ecology

Construction Phase

Construction activities will be carried out in an area that has already lost its natural structure. There is no natural vegetation cover and therefore, no habitat loss will occur.

Indirect impacts from the construction of the Project may include:

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- Disturbance of wildlife and increased numbers of animals killed on roads
- Soil and water pollution affecting habitats and species
- Introduction of invasive species
- Changes in the composition of soil and water quality affecting habitats and species
- Changes in air quality (dust generation, etc.) affecting habitats and species
- Solid and hazardous wastes to be generated due to project activities affecting habitats and species
- Noise pollution that might impact species' behavior.

The following measures should be taken to mitigate these impacts:

- Project construction sites and access roads will be separated from other areas with appropriate signboards, signs and fences.
- Implemeneting measures to control dust and air pollution, as described in Chapter 7.3.1,
- Good management of construction waste,
- Project workers will not be allowed to bring any live animals or plants into the construction site to avoid the risk of pests/invasive species establishing in the Project Area,
- Construction and operation sites will be fenced in order to prevent fauna species' entrance into these areas,
- The OHTL should be installed above existing vegetation to avoid land clearing.

Operation Phase Mitigation Measures

Impacts associated with the operation of the Project may result from improper handling of wastes generated, and air emissions during routine operational activities. There will be mitigation measures in place to ensure that neither human settlements nor the biological environment is affected negatively by these.

During the operation period, bird strikes may ocur due to the stack height. However, this effect can be minimized by ensuring that the stack is visible, noticeable and has warning features, including lighting to alert bird species migrating at night. The installed lighting should include be a flashing strong red warning light.

7.3.5 Noise and Vibration Impacts

Construction Phase

Noise would be potentially generated by vehicles, machinery and outdoor equipment used for preparation of the terrain, trenching, drilling, etc. Construction activities will be carried out in a relatively remote area and it is anticipated that local community will not be affected significantly by increased level of noise.

Noise levels of equipment and machinery will be kept at a minimum with mitigation measures such as use of silencers and regular maintenance.

Vibration that will affect humans or the structures in the vicinity is not expected to occur as there will be no blasting activity within the Project.

The impact is assessed as direct and negative with short term duration, local and low significance.

Operation Phase

The main sources of noise during the operation phase will be turbines, cooling towers and other auxillary facilities. As assessment of this is presented as an annex of the EIA report which concludes that at sensitive receptors, limit values stipulated in the Turkish legislation and those stated in the World Bank EHS Guidelines will be met.

No vibration impact is anticipated for operation phase.

Therefore, under normal operating conditions,the impact is assessed as direct and negative with short term duration, local and low significance.

7.3.6 Waste

Construction Phase

During the construction phase, construction wastes including excavated soil, packaging, wood, medical and domestic waste will be generated. For the collection and disposal of domestic and nonhazardous waste, the EPC Contractor has an agreement with Eyüpsultan Municipality. For the management of medical wastes, IMM has an agreement with ISTAC, which covers all phases of the Project. For other types of wastes, necessary agreements with suitable waste handling organisations should be made. All waste-related impacts of the Project can be easily managed by good practice waste management approaches defined in a Waste Management Plan which would be in line with the IFC PS3 and the World Bank general and sectoral EHS guidelines.

The impact is assessed as direct and negative with short term duration, local and low significance.

Operational Phase

In the operation phase of the Project, wastes such as domestic waste, hazardous waste, medical waste, packaging waste, recyclable waste, fly and bottom ash etc. will be generated. IMM and the Operator will need to prepare and implement a robust Waste Management Plan. With the implementation of this, the waste impacts will be direct, negative, long-term, local and low in significance.

7.3.7 Social Impacts

Local and National Economy

During the construction phase, the local people and the businesses will have a chance of temporary employment. The temporary employment opportunities will be mostly at a local level. A number of positions are likely to be suitable for unskilled and low qualified workforce. Based on the analysis of the data regarding the unemployment rate as well as the data regarding the qualifications of the labour force in the affected settlements, it can be concluded that the local inhabitants will have an opportunity for temporary direct employment at the site. In the operation phase, this opportunity is anticipated to be lower than the construction phase since most of the operational works require a skilled workforce.

In the long term, the Project will also contribute to national economy in many ways such as by reducing Turkey's foreign dependency on energy, which is around 70%. Therefore, the impact is assessed as direct and positive with long-term duration, national and medium significance.

Community Demographics

The construction phase will see an influx of workers, the majority of whom will be males. This will affect the local demographic structure. The workers who migrate to the area willbe accommodated in the Project Area (worker camp). However, the increased populations of resident and non-resident workers may put pressure on social and community services and infrastructure. This will be managed by applying a code of conduct to manage public and worker relations.

In the operation phase of the Project, the number of employees to be recruited will be much lower than in the construction phase and therefore, no impact on community demographics is anticipated for this phase. The impact is assessed as direct and negative with short term duration, local and medium significance.

Infrastructure and Services

Construction activities have the potential to limited access to pastures for local herdsmen. The EPC Contractor has taken this issue to consideration and changed its fencing alignment so as not to block the routes the local herdmen use to access nearby pastures.

Construction activities have increased traffic due to transportation of materials and equipment to the Project site. In the operation phase, the transportation of fly and bottom ash will also result in increased traffic in the region. A Traffic Management Plan was prepared by the EPC Contractor. IMM and the Operator also need to prepare and implement a Traffic Management Plan to manage traffic related impacts both in the operation phase. With these plans in operation, the impact is assessed as direct and negative with short term duration, local and low in significance.

7.3.8 Impacts on Health and Safety

Dring both the construction and operation phases, occupational accidents and risk of injury to workers may occur due to use of machinery and equipment. An additional potential impact is the spread of diseases. These risks will be managed by the mitigation measures developed as part of management plans which will be in line with the IFC PS2 and the World Bank general and sectoral EHS guidelines.

7.3.9 Impacts on Community Health and Safety

Potential health and safety impacts will be associated with community groups living in proximity to the Project-related transportation routes. The movement of trucks and other vehicles and machinery to and from the Project site will pose risk of accidents and injury to the public. Also the presence of large number of workers can give rise to an increased spread of diseases. All this might lead to increased pressure on healthcare infrastructure.

Community Health and Safety Plans should be developed to cover the abovementioned issues and should be in line with IFC PS4 and the World Bank EHS Guidelines.

The impact is assessed as direct and negative with short term duration, local and medium significance.

7.3.10 Impacts on Archeological and Cultural Heritage

There might be the potential for damage to archaeological or cultural heritage elements in the Project area during the construction phase. With a properly managed chance finds procedure this risk can be mitigated.

7.4 Greenhouse Gas Emission Contribution of the Project

7.4.1 Construction Phase

Fuel usage will be most significant activity in terms of climate-relevant emissions. Calculations are made with the data provided by the EPC Contractor. According to the data, total used fuel amount is approximately 3,637,000 liters by June 2019. Total emissions originating from the fuel use is calculated and presented in Table 12. As can be seen from the table, total CO2-e GHGs emission is approximately 9,638 Mg.

Table 12: Construction Phase Combustion Related GHG Emissions

Source	Estimated fuel use (1000L)	*Emission Factor (kg/TJ fuel)			Total Emissions (Mg CO_2-e)
		CO_2	CH_4	N_2O	
Transportation Vehicles	3,637	74,100	3.9	3.9	9,638.05

**IPCC 2006*

7.4.2 Operation Phase

The incineration of municipal waste involves the generation of climate-relevant emissions. These are mainly emissions of CO_2, but also of N_2O, measured as total carbon. CH_4 is not generated in waste incineration during normal operation. It only arises in particular, exceptional, cases and to a small extent (from waste remaining in the waste bunker), so that in quantitative terms CH_4 is not to be regarded as relevant (IPCC, 2000). Also calculations for CO_2 emissions are made according to the case that all of incoming waste is incinerated.

In waste incineration plants, CO_2 constitutes the chief climate-relevant emission and is considerably higher, by not less than 10^2, than the other climate-relevant emissions (IPCC, 2000).

In Germany, the incineration of 1 Mg (tonne) of municipal waste in MSW incinerators is associated with the production/release of about 0.7 to 1.2 Mg of carbon dioxide (CO_2 output). (IPCC, 2000).

7.4.2.1 GHG Emissions of Incineration Activity

Carbon Dioxide, CO_2

The incineration of 1 Mg of municipal waste in MSW incinerators is associated with the production/release of about 0.7 to 1.2 Mg of carbon dioxide CO_2. Although this carbon dioxide is directly released into the atmosphere and thus makes a real contribution to the greenhouse effect, only the climate-relevant CO_2 emissions from fossil sources are considered for the purposes of a global analysis. Since the municipal waste incinerated is a heterogeneous mixture of wastes, in terms of sources of CO_2 a distinction is drawn between carbon of biogenic and carbon of fossil origin. In the literature, the proportion of CO_2 assumed to be of

fossil origin (e.g. plastics) and consequently to be considered as climate-relevant, is given as 33 to 50 percent (IPCC, 2000).

Assuming that carbon dioxide emissions from MSW incineration average 1 Mg per Mg of waste, then of these CO_2 emissions 0.33 (0.50) Mg are of fossil and 0.67 (0.50) Mg are of biogenic origin. In subsequent calculations, the proportion of climate-relevant CO_2 is figured out as an average value of 0.415 Mg of CO_2 per Mg of waste. The measured CO_2 output content of the exhaust gas (dry) in MSW incineration plants is round about 10 Vol. Percent multiply with 5,500 m^3 exhaust gas volume (dry) per Mg waste multiply with 1.9768 kg/ m^3 density of CO_2 result in 1087 kg CO_2 per Mg waste. The content of C in CO_2 is round about 27.3 percent resulting in 297 kg C per Mg waste (IPCC, 2000).

Another way to develop the estimate of climate-relevant CO_2 emission from the input, was to estimate the amount of non-biogenic carbon in the waste. Usually, three waste categories contain non-biogenic carbon: plastics, textiles, and a combined category for rubber and leather (U.S. EPA 1997).But it is a problem to determine the real content of carbon in the heterogeneous MSW, because it is variable from day to day. The waste's carbon content of German MSW is generally in the range of 28 - 40 wt .percent (averages, related to dry matter) or 280 - 400 kg C per Mg waste (IPCC, 2000).

Since plant will use 10^6 Mg MSW per year, calculations are made for this amount of MSW. Calculations for CO_2 emission are presented below.

Total Emission CO_2 = 0.415 Mg CO_2 /Mg waste • 10^6 Mg waste/ year

Total Emission CO_2 = 415,000 Mg/ year

Nitrous Oxide, N_2O

As well as the above nitrogen oxide compounds NO and NO_2, nitrous oxide N_2O is of relevance from a climate perspective. Emission levels of 1 to 12 mg/m^3 have been determined in individual measurements at MSW incineration plants, with an average of 1 - 2 mg/m^3. Calculations for N_2O emission are presented below.

Total Emission N_2O = 2 mg/m^3 ● 5,500 Nm^3 /Mg waste ● 10^6 Mg waste/year

Total Emission N_2O = 11 Mg/year

Total emission CO_2-equivalent = 11 Mg N_2O/y ● 310 Mg CO_2 /Mg N_2O

Total emission CO_2-equivalent N_2O = 0.00341 ● 10^6 Mg CO_2 /year = 3,410 Mg CO_2/year

7.4.2.2 GHG Emissions of Fuel Usage

Secondary CO_2 emission source will be fuel usage of transportation vehicles. Transportation will be needed for bringing the MSW to the facility. Also, bottom ash that generated from incineration will be transported in the operation phase. Numbers of transportation vehicles that will be used for these activities are provided in table below.

Table 13: Number of Transportation Vehicles

Type of Truck used for delivery of MSW	**Number of Trucks Assumed**
16 m. Trailer Truck	4 pcs/hr
Old Type Trailer Truck	1 pcs/hr
District Municipality Vehicle	6 pcs/hr
Medical Waste Truck (Standard Size)	1 pcs/hr
Medical Waste Truck (Big Size/White Colored)	1 pcs/hr
Dumptruck	3 pcs/hr
Total/hr	16 pcs/hour
Total for delivery of MSW/day	**352 pcs/day**
Ash Removal/Transportation	**46 trucks/day**
Total	**398 pcs/day**

As it can be seen from the table above, 398 times transportation is needed on daily basis to operate the WtEP. Average route distance is anticipated as 30 km. Therefore, total distance of daily transportation will be 11,940 km. Average fuel consumption of transportation vehicles is assumed 30 liters for 100 kilometers. Thus, approximately 108,000 liters of diesel fuel will be used monthly and operation phase combustion related GHG emissions are calculated based on this amount. Calculated total emissions are provided in Table 14 below. As it can be seen from the table, approximately 286 Mg CO_2 equivalent GHG emissions will be released monthly by fuel use.

Table 14: Operation Phase Combustion Related GHG Emissions

Source	**Estimated fuel use (1000L/month)**	***Emission Factor (kg/TJ fuel)**			**Total Emissions (Mg CO_2-e/month)**
		CO_2	**CH_4**	**N_2O**	
Transportation Vehicles	108	74,100	3.9	3.9	286,2

**IPCC 2006*

The calculations described above are summarized in Table 15 below. As can be seen from the table, total CO_2-e GHG emission of the Project will be 421,844.4 Mg/year in the operation phase.

Table 15: Summary Table of Calculated GHG Emissions of the Project (Operation Phase)

Activity	**GHG**	**Calculated Amount (CO_2-e Mg/year)**
Incineration of MSW	CO_2	415,000
Incineration of MSW	N_2O	3,410
Incineration of MSW	CH_4	0
Fuel Usage	CO_2, N_2O, CH_4	3,434.4
Total	421,844.4	

8 Environmental and Social Action Plan (ESAP)

The ESAP identifies the actions required, the timing of the action, the basis of the requirement and the criteria for determining whether the purpose of the action has been successfully achieved. This ESAP may be updated from time to time during the Project based on reviews of performance against actions identified.

The ESAP is presented in three parts, Table 16 for aspects cutting across all phases, Table 17 for items specifically related to the construction phase and Table 18 for items specifically related to the operation phase. Note that requirements applying to HZI-Makyol listed under the construction phase will need to apply to the commissioning phase and first year of operation, for which they are responsible.

For ease of understanding priorities, Table 19 presents a ‘red flag table’ with ESAP items listed according to urgency. The ESAP items with the most urgent deadlines are indicated as ‘red category’, those with less urgency as ‘orange category’, and those with least urgency as ‘yellow category’. Some ESAP items do not have a deadline and must be implemented over a time period (e.g. construction phase, operation phase, etc.); those items are indicated as ‘blue category’

Table 16: Environmental and Social Action Plan for all phases

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
1	Assessment and Management of Environmental and Social Risks and Impacts							
1.1	Develop a Permit/License Register and process for ensuring this is updated The register should include what permits/licenses are required by Turkish legislation, what has been obtained so far and what remains to be obtained, renewal dates, when and who is responsible for that.	Reduction the risk of penalties, fines, and other enforecement action.	IFC PS1 Turkish Legislation	Company resources	2019 Q4	-Permit/Licence Register	IMM	
3	Resource Efficiency and Pollution Prevention							
3.1	Perform new air quality monitoring survey at the nearest receptors	The baseline air quality data presented in EIA are very old considering the recent developments in the region; new data is required to reflect the current situation at the receptors.	-IFC PS3 -World Bank EHS Guidelines	Company resources	Q1 2020	- Air quality monitoring results	IMM	
3.2	Re-run the dispersion modeling study by covering scenarios such as start-up, planned, unplanned and emergency disruption/shutdown cases.	Prevention of air pollution risks	-IFC PS3 -World Bank EHS Guidelines -GIIP	Company resources	By the end of Q1 2020	- Dispersion modeling results	IMM	
3.3	Perform new noise monitoring survey at the nearest receptors	The baseline noise levels presented in EIA are very old considering the recent developments in the region; new data is required to reflect the current situation at the receptors.	-IFC PS3 -World Bank EHS Guidelines	Company resources	Q2 2020	- Noise monitoring results	IMM	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
3.4	Provide a Project Spesific waste sampling, composition test results and analysis of waste streams for further evaluation by Lenders/SERV according to international standards and by considering seasonality	To ensure that the waste CV and composition is technically appropriate for the design of the WtEP	-IFC PS3 -GIIP	Company resources	Starting shorlty and completing before the commissioning of first line	- Sampling, Analysis and testing results	To be carried out by HZI-Makyol and IMM together	

Table 17: Environmental and Social Action Plan for Construction Phase[1]

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
1	Assessment and Management of Environmental and Social Risks and Impacts							
1.1	Implement project -specific Environmental and Social Management System (ESMS). Develop project-specific Environmental and Social Policy Develop an Environmental and Social Management Plan	All environmental and social issues and impacts are appropriately addressed; Optimisation of environmental management through a formalised system	IFC PS1 Turkish EIA Regulation	Company resources	By the end of January 2020	-Written project specific Environmental and Social Policy -Written Project specific Environmental and Social Management Plan (including sub plans/procedures) -Environmental monitoring measurements and analysis results register	HZI-Makyol	
1.2	Constitute and implement Project-specific Emergency Preparedness and Response Plan	Reduction of risks to people and the environment arising from emergency situations	IFC PS1	Company resources	End of 2019 Q4	-Written Project-specific Emergency Preparedness and Response Plan for Construction Phase - Emergency personnel assignments done - Training given for EPRP	HZI-Makyol	
1.3	Constitute and implement Environmental and Social Monitoring Plan	Monitoring compliance to minimise risk and maximise benefits	IFC PS1	Company resources	By the end of January 2020	-Written Environmental and Social Monitoring Plan -Training Plan for implementation of the ESMP revised for WtEP	HZI-Makyol	
1.4	Implement Stakeholder Engagement Plan (SEP)	Appropriate stakeholder engagement and information disclosure	IFC PS1 IFC PS 5	Company resources	By the end of January 2020	-Adopt SEP prepared by the Consultant	HZI-Makyol	

[1] Requirements applying to HZI-Makyol listed under the construction phase apply to the commissioning phase and first year of operation, for which they are responsible

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
						-Disclosed project-related environmental and social documents -Stakeholder engagement database established -Records on the stakeholder engagement activities/events conducted -Presence/functionality of Project website/hotline -No unresolved complaints about insufficient information disclosure for stakeholders		
1.5	Establish and implement Grievance Mechanism in line with the SEP Develop and implement Grievance Procedure	Constructive relationships with all stakeholders.	IFC PS 1	Company resources	By the end of January 2020	-Comment forms available to the public at relevant locations and on company website in line with the SEP -Grievance logs -Assignment of personnel(s) for the management of grievances -Separate mechanism established for workers' grievances	HZI-Makyol	
1.6	Develop and implement a Contractor Management Plan.	Ensuring that all contractors and subcontractors working on the site are following	IFC PS1. PS2	Company resources	By the end of January 2020	-Contractor Management Plan - Training records	HZI-Makyol	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
		the relevant E&S procedures.				-Contracts to include environmental, health, safety and social requirements		
2	Labour and Working Conditions							
2.1	Develop and implement Human Resource Management Procedure under Project's Labor and Employment Policy for construction phase	Ensuring that the highest international standards and national law are followed and applied to all own and external workers.	IFC PS2	Company resources	2019 Q4	-Written Labor and Employment Policy (under Environmental and Social Policy) and Human Resource Management Procedure -Employment data for the Project -Records on stakeholder engagement activities related to the recruitment process and employment opportunities	HZI-Makyol	
2.2	Implement measures to ensure adequate working conditions during construction phase	Protect worker's health, wellbeing and work-life balance.	-IFC PS 2 -World Bank EHS Guidelines	Company resources	2019 Q4	-Adequate working conditions provided to Project personnel including contracted workers -No unresolved grievances from Project personnel related with accommodation conditions	HZI-Makyol	
2.3	Prepare and implement Occupational Health and Safety Management Plan	Improved health and safety performance	-Legislative -IFC PS 2 -World Bank EHS Guidelines	Company resources	Before commissioning	-Project-specific Occupational Health and Safety Management Plan -Written HSE Training Program covering occupation health and safety aspects	HZI-Makyol	
2.4	Develop and implement HSE Training Plan	Formalises system for developing and ensuring	IFC PS2	Company resources	2020 Q1	- Written HSE Training Plan	HZI Makyol	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
		adequate EHS competence				-Training records		
2.5	Implement maintenance and operational checks of fire safety equipment/ systems annually	Fire risk is managed	-IFC PS 2 -World Bank EHS Guidelines	Company resources	2020 Q1	-Records of regular maintenance and checks -Fire drill reports	HZI Makyol	
3	Resource Efficiency and Pollution Prevention							
3.1	Prepare and implement Soil Management Plan and Erosion Control Procedure	Prevent dust emissions Reduce imported and exported material volumes Control erosion risks	-IFC PS3	Company resources	2020 Q2	-Soil Management Plan and Erosion Control Procedure -Spoil storage area management and storage measures undertaken	HZI Makyol	
3.2	Rehabilitate construction sites, slopes, dumpsite and worker accommodtion site when the construction activities are completed	Site is returned to a good environmental condition and wastes are removed and dealt with appropriately	-Legislative -IFC PS3 -Project-level needs -World Bank EHSGuidelines	Company resources	Construction Stage	-Written Rehabilitation Plan for construction sites, slopes, dumpsite and worker accommodtion site -Records of amount of top soil volumes reinstated and maps showing reinstation locations	HZI-Makyol	HZI-Makyol should have a document that presents the strategy for the rehabilitation, especially for the dumpsite, although the General Directorate of Forestry is responsible for the rehabilitation of it.
3.3	Update and implement Waste Management Plan and under this plan develop the following: -Procedure for Management of Hazardous Waste and Storage Sites -Procedure for Management of Contaminated Soil -Procedure for Management of Waste Vegetable Oils -Procedure for Management of Recyclable Wastes and Storage Sites	Appropriate management of wastes, reducing risks to the environment	-Legislative -PS3 -World Bank EHS Guidelines	Company resources	Construction and Operation Stage	-Updated Waste Management Plan containing all required procedures -Waste management/disposal agreements completed with licensed service providers -Inventory of hazardous materials purchased/used/disposed of	HZI-Makyol	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
	-Procedure for Separate Collection and Disposal of Municipal Wastes -Procedure for Management of Medical Wastes -Procedure for Management of Waste Tyres -Procedure for Management of Waste Batteries and Accumulators -Procedure for Management of Excavation, Construction and Demolition Wastes					-Inspection records - Records on the amounts of reused/recycled/disposed wastes		
3.4	Prepare and implement Air Quality and Emissions Management Plan and measures to reduce and control air emissions	Emissions to air are managed appropriately	-Legislative -PS 3 -World Bank EHS Guidelines	Company resources	2019 Q4	-Air Quality and Emissions Management Plan -No unresolved grievances received on the subject of air quality -Monitoring records as appropriate	HZI-Makyol	
3.5	Prepare and implement Noise Control and Management Plan and measures to reduce and control noise generation	Noise and vibration risks are managed appropriately	-IFC PS 1, PS 3 -World Bank EHS Guidelines -Legislative	Company resources	2019 Q4	- Noise Control and Management Plan -No unresolved grievances on the subject of noise or vibration -Monitoring records as appropriate	HZI-Makyol	
3.6	Perform soil sampling campaign to determine soil contamination	Prevention of OHS and community health and safety risks	-IFC PS3 -World Bank EHS Guidelines	Company resources	After completion of earthworks	- Soil sampling analysis results	HZI-Makyol	
4	Community Health, Safety, and Security							
4.1	Prepare and implement a Community Health and Safety Management Plan.	Prevention of impacts on community health, safety and security.	-Legislative -World Bank EHS Guidelines -PS4	Company resources	2020 Q1	-Community Health and Safety Management Plan	HZI-Makyol	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
						-No unresolved grievances related to community health and safety		
4.2	Prepare and implement a Chemicals and Hazardous Materials Management Plan. This should be linked with the Community Health and Safety and OHS Plans.	Prevention of community exposure to hazardous materials used for the Project.	IFC PS 4	Company resources	2020 Q1	-Chemicals and Hazardous Materials Management Plan	HZI-Makyol	
4.3	Implement measures against airborne/communicable diseases	Prevention of community exposure to diseases that can be caused by project personnel.	-Legislative -World Bank EHS Guidelines -IFC PS 4	Company resources	Construction Stage and Operation Stage	-Include measures in Community Health and Safety Management Plan -Health Records of Provincial/District Directorate of Health - Written HSE Training Program covering general hygiene rules to be followed by personnel	HZI-Makyol	
4.4	Prepare and implement Security Plan including measures for security personnel arrangements during the construction phase	Reduced risk to the communities from improper behaviour by security personnel	- IFC PS 4 -Legislative	Company resources	Q1 2020	-Security Plan to be prepared -Required permits to be obtained from authorities -Contractual agreements with relevant contracting companies -Employment data on security personnel -No unresolved grievances regarding the acts of security personnel	HZI-Makyol	
4.5	Update of Traffic Management Plan	Reduced risk to the communities from traffic	- IFC PS 4 -Legislative	Company resources	Q1 2020	-This plan should be updated with the transport	HZI-Makyol	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
						and logistics requirements during the construction stage. Also, emergency scenarios should be considered in the plan.		
4.6	Prepare a Flood Risk Analysis Study	Reduced risk to for the Plantside and community	- IFC PS 4 -Legislative	Company resources	End of Q4 2019	-This study should consider the stormwater basin where the Plant locates and discharge points	HZI-Makyol	In preparation
4.7	Fire Risk Assessment and Protection Design	Reduced risk to for the Plantside and community	IFC PS 4 -Legislative	Company resources	End of Q1 2020	-Potential fire zones and resources should be determined and fire protection / fighting systems should be installed to the plant	HZI-Makyol	
5	Land Acquisition and Involuntary Resettlement							
5.1	N/A							
6	Biodiversity Conservation and Sustainable Management of Living Natural Resources							
6.1	N/A							
7	Indigenous Peoples							
7.1	N/A							
8	Cultural Heritage							
8.1	N/A							

Table 18: Environmental and Social Action Plan for the Operation Stage

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
1	Assessment and Management of Environmental and Social Risks and Impacts							
1.1	Develop and implement ESMS including plans and procedures as follows: - Abnormal Operation Management Plan - Air Quality and Emissions Management Plan - Chemicals and Hazardous Materials Management Plan - Community Health and Safety Management Plan - Contractor Management Plan - Emergency Preparedness and Response Plan - Employees' Grievance Mechanism - Environmental and Social Management System - Framework - External Grievance Mechanism - Human Resources Management Plan - Labor Management Plan - Noise and Vibration Management Plan - Occupational Health and Safety Management Plan - Security Management Plan - Supply Chain Management Plan - Traffic Management Plan	All environmental and social issues and impacts are appropriately addressed; Optimisation of environmental management through a formalised system	-IFC PS1 -Turkish EIA Regulation	Company resources	2020 Q1	-Develop and implement an ESMS to be certified to ISO 14001 and ISO 45001 -Written project-specific Environmental and Social Policy -Written Project specific Environmental and Social Management Plan (including sub-plans and procedures)	IMM	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
	- Updated Stakeholder Engagement Plan - Waste Management Plan - Wastewater Management Plan							
1.2	Develop and Implement Project-specific Emergency Preparedness and Response Plan (EPRP)	Reduction of risks to people and the environment arising from emergency situations	IFC-PS1	Company resources	2020 Q1	-Written Project-specific EPRP for Operation Phase - Emergency personnel assignments done - Trainings given on EPRP	IMM	
1.3	Develop and Implement Environmental and Social Monitoring Plan	Monitoring compliance to minimise risk and maximise benefits	IFC PS1	Company resources	2020 Q1	-Training Plan for implementation of the ESMP revised for WtE Plant -Contractor Management Plan -ESMP included in contractors' contract agreements.	IMM	
1.4	Adopt Stakeholder Engagement Plan (SEP) prepared by the Consultant	Appropriate stakeholder engagement and information disclosure	IFC PS1 IFC PS 5	Company resources	2020 Q1	-SEP adopted -Disclosed project-related environmental and social documents -Stakeholder engagement database established -Records on the stakeholder engagement activities/events conducted -Presence/functionality of Project web-site/hotline	IMM	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
						-No unresolved complaints about insufficient information disclosure for stakeholders		
1.5	Develop and implement External Grievance Mechanism in line with the SEP Implement Grievance Procedure	Constructive relationships with all stakeholders.	IFC PS 1	Company resources	2020 Q1	-Comment forms available to the public at relevant locations and on company website in line with the SEP -Grievance logs -Assignment of personnel(s) for the management of grievances -Separate mechanism established for workers' grievances	IMM	
1.6	Develop a set of Key Performance Indicators for easy monitoring of Environmental and Social performance of the facility. The KPIs shall be related to the facility's productivity and shall cover as a minimum: -emissions of controlled air pollutants -GHG contribution of the WtEP -energy efficiency -water consumption -fuel consumption -auxillary materials consumption - waste generated -breakdowns (number, duration, reason)	Structured approach to environmental and social issues	-Good Practice -IFC PSs	Company resources	Development of set of KPIs prior to the signing Monitoring of KPIs starting from the commencement of operation phase	- KPIs - Annual Environmental and Social Performance Reports to the Lenders/SERV	IMM	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
	-internal and external grievances (number, reason, status) -accidents at work -other than normal operations -near misses							
2	Labour and Working Conditions							
2.1	Develop and implement Human Resources Management Plan under Project's Labor and Employment Policy for operational phase	Ensuring that the highest international standards and national law are followed and applied to all own and external workers.	IFC PS2	Company resources	2020 Q1	-Labor and Employment Policy (under Environmental and Social Policy) and Human Resource Management Plan -Employment data for the Project -Records on stakeholder engagement activities related to the recruitment process and employment opportunities	IMM	
2.2	Develop and implement measures to ensure adequate working conditions during operation phase	Protect worker's health, wellbeing and work-life balance.	-IFC PS 2 -World Bank EHS Guidelines	Company resources	2020 Q1	Adequate working conditions provided to Project personnel including contracted workers -No unresolved grievances from Project personnel related with accommodation conditions	IMM	
2.3	Develop and implement Occupational Health and Safety Management Plan	Improved health and safety performance	-Legislative -IFC PS 2 -World Bank EHS Guidelines	Company resources	Prior to the commencement of testing / commissioning phase	-Written Project-specific OHS Management Plan -Written HSE Training Program covering occupation health and safety aspects	IMM	OHS Management Plan that covers both construction and operation phases of the Project, contractor responsibilities, and monitoring requirements should be prepared.

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
2.4	Develop and implement HSE Training Plan	Formalises system for developing and ensuring adequate EHS competence	IFC PS2	Company resources	2020 Q2	- Written HSE Training Program -Training records	IMM	
2.5	Develop and implement Contractor Management Plan	Ensuring that all contractors and subcontractors working on the site are following the relevant E&S procedures.	IFC PS2	Company resources	Prior to the commencement of testing / commissioning phase	-Contractor Management Plan -Training records -Contracts to include environmental, health, safety and social requirements	IMM	No Contractor Management Plan in place
2.6	Conduct maintenance and operational checks of fire safety equipment/systems annually	Fire risk is managed	-IFC PS 2 -World Bank EHS Guidelines	Company resources	Prior to the commencement of testing / commissioning phase	-Records of regular maintenance and checks -Fire drill reports	IMM	
3	Resource Efficiency and Pollution Prevention							
3.1	Prepare and implement Waste Management Plan and under this plan implement the following: -Procedure for Management of Hazardous Waste and Storage Sites -Procedure for Management of Contaminated Soil -Procedure for Management of Fly, Bottom and Boiler Ash -Procedure for Management of Waste Vegetable Oils -Procedure for Management of Recyclable Wastes and Storage Sites -Procedure for Separate Collection and Disposal of Municipal Wastes	Appropriate management of wastes, reducing risks to the environment	-Legislative -PS3 -World Bank EHS Guidelines	Company resources	Construction and Operation Stage	-Waste Management Plan containing all required procedures -Waste management/disposal agreements completed with licensed service providers -Inventory of hazardous materials purchased/used/disposed of -Inspection records -Records of the amounts and types of reused / recycled / disposed wastes,	IMM	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
	-Procedure for Management of Medical Wastes -Procedure for Management of Waste Tyres -Procedure for Management of Waste Batteries and Accumulators -Procedure for Management of Excavation, Construction and Demolition Wastes					including fly and bottom ash		
3.2	Develop and implement Air Quality and Emissions Management Plan including measures that cover planned/unplanned shutdown and emergency situtations Conduct quarterly Air Quality monitoring regarding the emission gases throughout the operational lifetime of the WtEP at the nearest sensitive receptors in addition to the continuous monitoring at the WtEP.	Emissions to air are managed appropriately	-Legislative -PS 3 -World Bank EHS Guidelines	Company resources	2020 Q1	-Air Quality and Emissions Management Plan -No unresolved grievances received on the subject of air quality -Air quality monitoring results	IMM	
3.3	Develop and implement Noise and Vibration Management Plan and measures to reduce and control noise generation	Noise risks are managed appropriately	-IFC PS 1, PS 3 -World Bank EHS Guidelines -Legislative	Company resources	2020 Q1	-Noise and Vibration Management Plan -No unresolved grievances on the subject of noise disturbance -Monitoring records as appropriate	IMM	
3.4	Calculate energy efficiency of the WtEP under EU Waste Framework Directive and report to Lenders/SERV	Ensuring that the facility meets the requirements of the Waste Framework Directive	-IFC PS3 -EU Waste Framework Directive	Company resources	Annual	-Include in Annual Environmental and Social Performance Reports to the Lenders/SERV	IMM	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
3.5	Ensure waste segregation and/or pre-sorting to avoid incineration of wastes that contain metals and metalloids	To avoid pollution to air with these substances	-IFC PS3 -World Bank EHS Guidelines for Waste Management Facilities	Company resources	During operation phase	- Records of the amount of segregated metals and metaloids segregated	IMM	
4	Community Health, Safety, and Security							
4.1	Develop and Implement a Community Health and Safety Management Plan.	Prevention of impacts on community health, safety and security.	-Legislative -World Bank EHS Guidelines -PS4	Company resources	2020 Q2	-Written Community Health and Safety Management Plan -No unresolved grievances related to community health and safety	IMM	No Community Health and Safety Management Plan available.
4.2	Implement measures to ensure structural safety, traffic safety and pedestrian safety during operation (See Section 10.5)	Prevention of community exposure to hazards from the Project.	IFC PS 4	Company resources	2020 Q1	-Written Operation and Maintenance Procedures covering health and safety aspects for community -Accident statistics during operation -No unresolved grievances related to traffic	IMM	-
4.3	Implement measures against airborne/communicable diseases	Prevention of community exposure to diseases that can be caused by project personnel.	-Legislative -World Bank EHS Guidelines -IFC PS 4	Company resources	Operation stage	-Include measures in Community Health and Safety Management Plan -Health Records of Provincial/District Directorate of Health -Written HSE Training Program covering general hygiene rules to be followed by personnel	IMM	No program available for prevention or minimization of communicable diseases.
4.4	Prepare and implement Traffic Management Plan	Reduced risk to the communities from traffic	-IFC PS 4	Company resources	Operation stage	-Traffic Management Plan	IMM	

Ref	Action Required	Environmental and Social Risks (Liability/Benefits)	Requirement (Legislative / IFC PS / Best Practice)	Resources, Investment Needs/ Responsibility	Timetable	Target and Evaluation Criteria for Successful Implementation	Related Company	Status/ Comments
4.5	Monitor regular vegetation clearance and maintenance requirements of OHTL route and communicate with related authority	Reduced forest fire risks	IFC PS4 IFC PS5 World Bank EHS Guidelines for Electric Power Transmission and Distribution	Company resources	Operation stage	-Related correspondance	IMM	
5	Land Acquisition and Involuntary Resettlement							
5.1	N/A	-	I/A	I/A	I/A	I/A	-	
6	Biodiversity Conservation and Sustainable Management of Living Natural Resources							
6.1	N/A	-	I/A	I/A	I/A	I/A	-	
7	Indigenous Peoples							
7.1	N/A	-	I/A	I/A	I/A	I/A	-	
8	Cultural Heritage							
8.1	N/A	-	I/A	I/A	I/A	I/A	-	

Table 19 Red Flag Table

ESAP Item	Timetable	Related Party
ESAP for All Phases		
Red Category		
1.1	2019 Q4	IMM
3.1	Q1 2020	IMM
3.2	By the end of Q1 2020	IMM
3.4	Starting shortly and completing before the commissioning of first line	HZI-Makyol and IMM together
Orange Category		
3.3	Before the commencement of operation phase	IMM
ESAP for Construction Phase		
Red Category		
1.1	By the end of January 2020	HZI-Makyol
1.2	End of 2019 Q4	HZI-Makyol
1.3	By the end of January 2020	HZI-Makyol
1.4	By the end of January 2020	HZI-Makyol
1.5	By the end of January 2020	HZI-Makyol
1.6	By the end of January 2020	HZI-Makyol
2.1	2019 Q4	HZI-Makyol
2.2	2019 Q4	HZI-Makyol
3.4	2019 Q4	HZI-Makyol
3.5	2019 Q4	HZI-Makyol
3.6	After completion of earthworks	HZI-Makyol
4.5	Q1 2020	HZI-Makyol
4.6	End of Q4 2019	HZI-Makyol
4.7	End of Q1 2020	HZI-Makyol
Orange Category		
2.4	2020 Q1	HZI-Makyol
2.5	2020 Q1	HZI-Makyol
3.1	2020 Q2	HZI-Makyol
4.1	2020 Q1	HZI-Makyol
4.2	2020 Q1	HZI-Makyol
4.4	2020 Q1	HZI-Makyol
Yellow Category		
2.3	Before commissioning	HZI-Makyol
Blue Category		

ESAP Item	Timetable	Related Party
3.2	Construction stage	HZI-Makyol
3.3	Construction and operation stages	HZI-Makyol
4.3	Construction and operation stages	HZI-Makyol
ESAP for Operation Stage		
Red Category		
-	-	-
Orange Category		
1.1	2020 Q1	IMM
1.2	2020 Q1	IMM
1.3	2020 Q1	IMM
1.4	2020 Q1	IMM
1.5	2020 Q1	IMM
2.1	2020 Q1	IMM
2.2	2020 Q1	IMM
3.2	2020 Q1	IMM
3.3	2020 Q1	IMM
4.2	2020 Q1	IMM
Yellow Category		
1.6	Prior to signing	IMM
2.3	Prior to the commencement of testing / commissioning phase	IMM
2.4	2020 Q2	IMM
2.5	Prior to the commencement of testing / commissioning phase	IMM
2.6	Prior to the commencement of testing / commissioning phase	IMM
4.1	2020 Q2	IMM
Blue Category		
3.1	Construction and operation stage	IMM
3.4	Annual	IMM
3.5	During operation phase	IMM
4.3	Operation stage	IMM
4.4	Operation stage	IMM
4.5	Operation stage	IMM

9 Stakeholder Engagement

As part of the ESDD exercise, the external stakeholders who may have an interest in the Project are identified and the current proposals for consultation with these people and organisations during the course of the ESDD studies are outlined. The Stakeholder Engagement Plan will be kept under review and updated as the studies proceed.

Stakeholder engagement is an integral and ongoing activity within the preparation of the ESDD for the Project.

A review has been undertaken to identify organisations and groups who may be expected to have an interest in the Project. An indicative list of stakeholder groups in presented below:

- Communities (local people living in Isiklar and Gokturk Neighbourhoods, relatively close locations to the Site, and access roads of the Project)
- Local Governmental Organizations (e.g. IMM, Eyupsultan Municipality, District Governorship of Eyupsultan, Governorship of İstanbul, İstanbul Provincial Directorate of Environment and Urbanization);
- National Governmental Organizations (e.g. Ministry of Agriculture and Forestry, Ministry of Energy and Natural Resources, Ministry of Environment and Urbanization);
- Local communities in the Project area (villagers, muhtars, District Municipality
- Associations
- NGOs
- Media
- EPC Contractor and their employees
- Businesses (e.g. local businesses around the Project Area)
- Plant employees
- Contractors and their employees
- Lenders/SERV

During the site visit, the project site and its surroundings was visited and information was gathered from the representatives of the EPC Contractor/Contractors, employees and consultations were with project personnel employed at the project site. In addition to the Project personnel, Isiklar, which is the closest settlement to the Project site was visited. within the scope of the ESDD Study. Potential stakeholders were identified according to the information obtained. Potential stakeholders were contacted by social experts of Arup and brief discussions were held with the muhtars of Isiklar and Ihsaniye villages during the site visit. Discussions were focused on presenting the Project and

understanding the socio-economic background and the people's initial environmental and social suggestions or concerns.

The above mentioned engagement face-to-face meetings were held in Turkish language and were aimed at presenting the intention to develop the Project, describing its key components,and encouraging community to use IMM's grievance hotline Alo 153 Beyaz Masa.

The stakeholders' main concerns raised during the interviews were:

- Increase in the traffic on the roads,
- Odour nuisance,
- Air pollution concerns,
- Job opportunities.

A Stakeholder Engagement Plan (SEP) has been prepared and presented in Appendix 5.

10 Technical Evaluation

This section includes the Consultant reviews on Construction Progress and Key Dates, process, structural, geothechncial transport and flooding / drainage studies.

10.1 Construction Progress and Key Dates

By the end of September 2019, plant construction progress is 45%. Construction work is ongoing at the site. The key dates for the Project are as follows:

- Contract Signing with IMM and the EPC Contractor, 11.09.2017,
- Official Site Handover, 06.11.2017,
- End of Construction Phase, 18.09.2020,
- End of Commissioning Test, 18.01.2021,
- End of Reliability Test and Taking into Operation, 20.03.2021,
- End of Operation and Issue of Preliminary (provisional) Acceptance, 20.03.2022,
- End of Guarantee Period, 20.03.2024.

10.1.1 Overhead Electricity Tranmission Lines (OHTL)

According to the documents provided, the connection of the power plant to the grid will be via 154 kV Taşoluk Transformation Station and 154 kV Habibler Transformation Station. Two separate six kilometres 1272 MCM OHTL will be installed for the connection. Tender will be carried out on 30 September 2019.

Istac has shared a work programme including the tasks with the proposed deadlines.

Table 20: OHTL Work Programme

	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	June 20	July 20	Aug 20	Sep 20	Oct 20	Nov 20
Transformer Center and ETL Approvals													
Transformer Center Approvals													
ETL Approvals													
Electrical Works													
Preparation of Primer and Seconder Electrical Works and Approvals													

	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	June 20	July 20	Aug 20	Sep 20	Oct 20	Nov 20
Procurement and Installation of the Components													
Primer and Seconder Plant Tests													
Energising and Commissioning													
Temporary Ministry Acceptance													
Preparation of As-built projects													
Construction Works													
Preparation of Construction Projects and Approvals													
Excavation and Filling Works													
Fencing													
Construction Works (foundations, walls, cable routes etc.)													
Drainage Works													
Switchyard Steel Construction Procurement and Installing													
Inventory Stock Procurement													

Key highlights:

- The total duration of the project is 13 months.
- Transformer center and OHTL approvals will start in November 2019 and will be completed in 5 months.
- During this stage, preparation and approval of electrical works and procurement of the components will start.

- Construction projects and excavation and filling works will also start at the same time.
- Construction works will start in December 2019 and will continue 11 months.
- Procurement and construction of the electrical components will start in January 2019 and will be completed in eight months.
- Temporary ministry acceptance will be carried out in October 2019.

The duration of the work programme is tight but achievable with good project management. Procurement periods for all components should be followed carefully. A delay in manufacturing can also affect the all programme. Testing period which is two months in total for primer and seconder plants, is acceptable.

10.1.2 Links with Feed-in Tariffs (FiT)

All the electricity from the WtEP will be sent to grid. To benefit from current FiT of 133 USD / MWh for 10 years, the Plant ministry acceptance should be done before the end of 2020. As per the regulation it is possible to apply for ministry acceptance and obtain it with partial capacity comissioned before this date rather than full capacity.

10.2 Process Design

The agreed scope to be addressed in the technical review is stated as, "*Review the Project's design, equipment, waste processing technology chosen, power generation, efficiency of treatment installations for emissions, effluents, residual and hazardous wastes streams, etc., against the Best-Available Technologies (BAT) applicable for similar projects. The Consultant will assess whether the controls to be employed to safely manage the E&S issues are appropriate, and/or what additional measures may be necessary in this respect*."

The documents provided and reviewed for the below observations, recommendations and conclusions include the following:

- Purchaser/Owner issued Technical Specification for Procurement:
  - 'IMM EfW Specs-Corrections_04.05.2018.docx';
- Contractor Issued Technical Design Documents:
  - 'DAA-HZI-40073941_5.0_Drawing Boiler.pdf';
  - 'DAA-HZI-40075037_3.0_Drawing Refractory Lining and Cladding.pdf';
  - 'EAA-HZI-50067814_3.0_Single Line Diagram.pdf';
  - 'EFW-PRT-M-PWL-UZA-0004-Rev_0.2_Water balance Plant.pdf';
  - 'Istanbul_WSC HMB_Rev5.0 - SKODA_CtrlExtr_120mbar_18DG_ ACC.pdf';
  - 'PDE-HZI-50067156_1.0_Combustion Diagram-signed.pdf';
  - 'PDE-HZI-50067167_0.0_HMB-CB-signed.pdf';
  - 'PDE-HZI-50067517_0.0_Water Balance Process_Signed.pdf';
  - 'PFD-HZI-50067475_0.0_Bloc Flow Diagram_Signed.pdf';

- 'S4_Technical Guarantees_Contract (signed E-Version).pdf'; and
- 'PDE-HZI-50067164_0.0_Boiler Corrosion Diagram.pdf'.

We have not received the Contractor's final technical proposal. As such, some of the comments below may have been superseded or there may be items we have been unable to identify as technical issues or concerns due to the lack of a final confirmed version.

Our technical review is limited to the content of the documents as listed above.

10.2.1 Technical Specification

The General Description and Scope of Work for the facility as stated in the tendered Technical Specification is that the, "Istanbul Büyüksehir Belediyesi (IBB, Istanbul Metropolitan Municipality) will build a Waste Incineration and Energy Generation Plant for Municipal Waste at Istanbul / Turkey. The new plant will be designed with a total capacity of 1.000.000 tonnes/year with 3 incineration lines.". The company employed as Contractor for the technical process plant is Hitachi Zosen Inova (HZI) of Switzerland.

Technical Scope

Whilst we have not undertaken a detailed review of the technical scope covered by the tender specification, we have undertaken a high-level review in-line with the agreed scope of our review. The technical scope covered appears to be commensurate of a project of this type with regards to the waste processing, heat recovery, power generation and flue gas treatment requirements for energy from waste projects. We have not seen the full detail of the technical design proposed by HZI but key elements such as boiler arrangement, power generation and electrical equipment have been reviewed and are covered in sections below.

There is a general requirement stated in the tender specification that the, "*Technical Specification includes the design, supply, manufacture, production testing, certification, shipment, erection/ assembly, painting, operator training, commissioning, testing on completion of the works and 1-year operation. This scope also covers all main and auxiliary equipment and systems, piping and connections, cabling, instrumentation of all items, supplies and services required to provide a complete working plant meeting the Specifications and provision of all of the warranties and guarantees necessary for operation and maintenance.*". This is similar to other general overriding requirements included in energy from waste specification with the requirement, "*to provide a complete working plant*". We consider that this is a useful inclusion in the tender specification to require the Contractor to provide all essential equipment required to allow the WtEP to operated. We would recommend that the final version of the specification is reviewed to confirm that this provision has been retained.

We understand that an Owner's Engineer has been engaged to undertake design review activities throughout the design and construction of the project. We would recommend that the Owner's Engineer is engaged to seek opinion as to the status of the design being provided by the Contractor with regards to compliance with

the tender specification and completeness of the design against good industry practice for energy from waste.

Waste

Within the tender specification, a fuel specification is provided for which the WtEP is to be designed to. The parameters listed in this specification are detailed in Table 21 below.

Table 21: Waste Composition

Element	Units	Waste Range	
Sulphur	kg/kg	0.001	0.005
Chlorine	kg/kg	0.005	0.01
Mercury	mg/kg		0.5
Water	%	40	55
Inert	%	5	10
Density	kg/m^3		400
CV	MJ/kg	6.00	9.00

We have not seen any details of waste composition testing and analysis of the waste streams which will be delivered to the WtEP. We would recommend that any existing compositional analysis is requested for review and comparison to the design parameters set within the tender specification. A key parameter for energy from waste design is chlorine content of the waste. As per the above, the range to be assumed for design is 0.5% to 1% content. A chlorine content of 1% in the incoming waste stream is in line with the general assumptions used in municipal waste plants elsewhere within Europe.

It should be noted that the incoming waste may include a degree of hospital waste. As per Schedule 11 of the tender specification, this is limited to a maximum of 100 tonnes per day. This equates to 1.39 tonnes per hour per line if processed as a homogeneous mix. This processing rate is also displayed on the HZI Firing Diagram as illustrated in Figure 6 in our review of the Contractor's Technical Proposal.

It is not clear what type of waste streams the hospital waste will contain. Typically, there are several types of hospital waste which can range from soiled paper to syringes (plastic/metal),organic wastes and other more hazardous materials. We would recommend that the nature of the expected hospital waste streams is reviewed to determine if there are any materials which may be more onerous to handle and treat. In addition, used gas cylinders can often end up within hospital waste streams. From our experience of energy from waste projects, gas cylinders are usually a prohibited waste for technology providers as the explosions on the grate can interrupt the waste combustion leading to boiler trips and emission breaches. In extreme circumstances, damage can be caused to the furnace walls from impacts of airborne materials.

Waste Analyses and Calorific Value (CV)

Most recent waste analyses were done in winter and summer seasons of 2017. Exact dates are not clear, and the only parameter provided so far are CV (Calorific Value) without composition. There are some minor inconsistencies in the waste amount data given by the Istac.

Tables below highlight the summer and winter data for the CV Values regarding the Districts where the required waste amount for the Project will be collected.

Table 22: Summer 2017 CV Values

District Name	Daily Waste Generated (tone)	Humidity (%)	Dry (kcal/kg)	As Received (kcal/kg)	As Received (joule/kg)	Ash (%)
BESIKTAS	456	47.4	3429.5	1522.2	6368.9	26.9
BEYOGLU	462	45	3781.2	1815.6	7596.5	16.6
EYUP	438	53.5	4010	1551.4	6491.1	13.8
FATIH	520	45.5	4068.3	1943.9	8133.3	10.2
KAGITHANE	599	51.8	4410	1672.6	6998.2	11.1
SARIYER	348	43	4059.6	2063.8	8634.9	17.4
SİSLİ	551	49.8	3806.9	1648.3	6896.5	22.9
ARNAVUTKOY	0	55.2	3750.2	1356.5	5675.6	26.2
TOTAL	3,374					
AVERAGE		48.3	3952.2	1734.3	7256.4	16.8

Table 23: Winter 2017 CV Values

Municipality	Daily Waste Generated (tone)	Humidity (%)	Dry (kcal/kg)	As Received (kcal/kg)	As Received (joule/kg)	Ash (%)
BESIKTAS	456	69.5	5367.7	1240.7	5191.1	12.9
BEYOGLU	462	66.7	5372.8	1390.9	5819.6	14.5
EYUP	438	52.2	4484.8	1834.5	7675.5	16.4
FATIH	520	61.0	5444.0	1778.5	7441.1	14.1
KAGITHANE	599	56.5	4857.2	1778.9	7443.1	18.8
SARIYER	348	61.2	5166.2	1648.3	6896.5	12.3
SİSLİ	551	54.7	4578.0	1753.1	7335.0	18.2
ARNAVUTKOY	0	66.6	4979.7	1235.0	5167.1	18.2
TOTAL	**3,374**					
AVERAGE		60.0	5025.2	1642.5	6872.3	15.6

We notice that the average CV values are within the design ranges, however, it is not clarified which standards were applied during sampling and analyses. Furthermore, there are some districts that are lower CV value than the threshold limits in winter such as Besiktas, Beyoglu and Arnavutkoy.

We suggest that a Project specific study of waste sampling and laboratory analyses should be carried out by the EPC considering international standards such as ASTM and considering the seasonality variations before the project commissioning. These studies should be supported by Istac / Municipality.

Emissions

The tender specification contains several clear references to the requirements to comply with emission limits and legislation. Examples of these requirements include:

- Operating conditions in the furnace to comply with Article 6 of the EU Industrial Emissions Directive (IED) 2010/75/EU under all circumstances when waste is being combusted;
- Combustion condition guarantees are absolute and must be met completely as a condition of plant acceptance;
- The WtEP should be built according Best Available Technologies and must fulfil Turkish and European Regulations;
- Maximum emissions to atmosphere shall not exceed those given in EU IED 2010/75/EU or equivalent local regulation;
- The whole of the works shall be designed in accordance with good engineering practice. All plant, equipment and systems, their components and auxiliaries provided for the works shall be of proven design and supplied by reputable manufacturers, reflecting stat-of-the-art and Best Available Technique;
- Residues from flue gas treatment process must be dry and should meet landfill sites criteria;
- The design of the drainage system shall not give rise to any uncontrolled or unauthorized aqueous emissions from the site during construction or operations;
- A list of 33 separate Turkish environmental regulations;
- The EC Waste Framework Directive 2008/98/EC; and
- The EC Hazardous Waste Directive 94/31/EC (note now enforced via the above 2008/98/EC).

The references throughout the tender specification with regards to emission compliance to EU standards and the use of Best Available Techniques are considered suitable for a project of this type.

Turkey ,in its accession process, have been harmonizing its environmental regulations with EU. For this purpose, the regulatory limits have been dropped

gradually. Additionally there will be a main environmental permit needs to be received after operation covering main elements such as air, soil, water quality. The operator will need to have continuous stack monitoring and stay within both local and EU limits as per local rules and commitments in the tender.

Noise

Within the tender specification a requirement for noise emissions is stated as, "*the noise contribution from any of the receptors of the plant nominated in the permission should not result in an overall noise level increase greater than 80 dB(A). The existing background noise level should be assumed to be 52.3 dB(A)*." We would recommend that the drafting of this clause and the requirements within the WtEP permission are reviewed to confirm the noise limits for the WtEP during operations. We would expect that a noise level increase of 80 dB(A) above current background levels to be a significant increase and typically we would expect noise levels to be defined at the boundary of the site or at a local receptor. In each case, noise levels at a distance from the WtEP should be expected to be much lower than 80 dB(A) as an absolute value whereas the drafting allows for an 80 dB(A) increase above current levels.

10.2.2 Contractor's Technical Proposal

Hitachi Zosen Inova (HZI) is the Contractor supplying the mechanical and electrical equipment for the WtEP. The WtEP will comprise of three independent combustion lines producing superheated steam to drive a single, common, steam turbine.

Firing Diagram

The capacity of each combustion line is illustrated by a Firing Diagram. The Firing Diagram provided by HZI is illustrated in Figure 6 below.

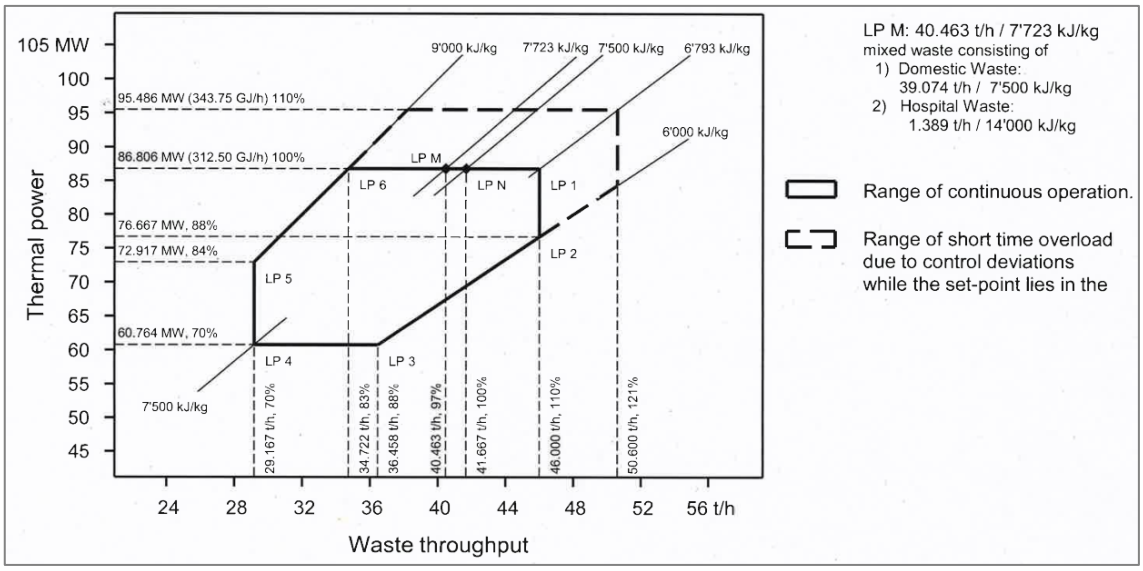

Figure 6: HZI Firing Diagram

The Firing Diagram defines the range of operation and capacity for each combustion line (combustion grate and boiler) in terms of:

- Mechanical Throughput (tonnes of waste per hour);
- Waste Calorific Value (CV) (energy content of the waste); and
- Thermal Input (MW / GJ/h, energy input to the boiler resulting from the combustion of waste).

The continuous operating envelope of each of the boilers is defined by the solid black line in Figure 6 with a temporary operating envelope to allow for short term fluctuations defined by the broken black lines.

The maximum and minimum continuous operational envelope for each line is:

- Mechanical Throughput – 29.17 t/h to 46 t/h;
- Waste CV – 9.00 MJ/kg to 6.79 MJ/kg (6.00 MJ/kg for reduced thermal input); and
- Thermal Input – 60.76 MW to 86.81 MW.

Thermal input can generally be equated to steam flow production from the boiler and thus electricity generation from a steam turbine-generator. The 100% thermal input line is referred to as the 100% Maximum Continuous Rating (MCR). For 100% MCR, which can be achieved for waste CV between 6.78 MJ/kg and 9.00 MJ/kg, 100% electricity generation should be achievable. Should waste CV fall below 6.78 MJ/kg, thermal input, and thus electricity generation, would need to reduce to stay within the continuous operating envelope of the Firing Diagram. Between 6.00 MJ/kg and 6.79 MJ/kg, waste throughput would be maintained at its maximum (46.00 t/h) but thermal load and electricity production would be reduced.

There is an operational design point on the Firing Diagram defined as LP M (Load Point M) which is 40.46 t/h of waste at a CV of 7.72 MJ/kg. This operational point is based upon mixed waste with a consisting of 39.07 t/h of domestic waste at CV of 7.50 MJ/kg and 1.39 t/h of hospital waste at CV of 14.00 MJ/kg. Additionally, there is a design point defined as LP N which is 41.67 t/h of waste at a CV of 7.50 MJ/kg which we would assume to be 100% domestic waste. Both LP N and LP M result in a thermal input of 86.81 MW.

The actual waste CV received will depend on the composition of the incoming waste to the facility. We have not undertaken any analysis of waste composition and as such we are unable to comment if the waste CV range is suitable or not. Should waste CV be higher than 9.00 MJ/kg or lower than 6.00 MJ/kg, then there would be a risk that this could not be processed by the WtEP.

In order to maintain full electrical generation, waste CV would need to be between 6.79 MJ/kg and 9.00 MJ/kg. We would recommend that waste analysis data is requested and reviewed to confirm if the operational range is sufficient for the expected waste streams to be processed.

Temporary thermal overload can be accommodated up to 110% MCR and temporary mechanical overload can be accommodated up to 50.60 t/h, 10.60 t/h above the continuous maximum of 46.00 t/h.

HZI References

HZI has extensive experience in the design and delivery of energy from waste facilities. We have direct experience of a number of these plants and are aware of its reference plants. As such, we have selected a number of operational references which we consider most closely reflect the design capacity of the Istanbul WtE plant. This information is based upon publicly available data. The corresponding parameters for Istanbul are identified in bold text within the table.

Note that the selected facilities are operated on higher waste CV for full thermal load than the Istanbul WtE plant with most European facilities designed to a minimum CV of 8.50/9.00 MJ/kg for full thermal load which coincides with the maximum waste CV anticipated for Istanbul.

Table 24: Selected HZI References

Plant Name	Location	Completed	Thermal Input (MW)	Steam Conditions	Waste Throughput (t/h)
Riverside RRF	London, UK	2011	3 x 79.50 (238.50)	427°C / 72 bar	3 x 31.8 (95.4)
Dublin WtE	Ireland	2017	2 x 102.50 (205.00)	443°C / 62 bar	2 x 32.0 (64.0)
Greatmoor	Buckinghamshire, UK	2015	1 x 101.80 (101.80)	402°C / 52 bar	1 x 39.4 (39.4)

Plant Name	Location	Completed	Thermal Input (MW)	Steam Conditions	Waste Throughput (t/h)
Ferrybridge	Yorkshire, UK	2015	2 x 117.38 (234.76)	430°C / 70 bar	2 x 42.2 (84.4)
Roosendaal	Netherlands	2011	2 x 62.00 (124.00)	422°C / 61.5 bar	2 x 19.0 (38.0)
Issy-les-Moulineaux	Paris, France	2007	2 x 85.20 (170.40)	400°C / 50 bar	2 x 30.5 (61.0)
Istanbul	**Turkey**	**In Construction**	**3 x 86.81 (260.43)**	**426°C / 72 bar**	**3 x 46.0 (138.0)**

The Istanbul facility is closely aligned to the Riverside facility in London in terms of number of combustion lines, thermal input per line and steam conditions. The Greatmoor plant presents the closest reference in terms of combustion line processing capacity which at 39.4 t/h is lower than the maximum capacity for Istanbul which is 46.0 t/h. However, Greatmoor does align with the nominal waste throughput design of Istanbul which is 40.0 t/h. The references above are for plants which will generally have higher waste CV such that the thermal input per tonne of waste is higher than the design of Istanbul. As such, there are no direct references for the combination of waste throughput and thermal input. However, we consider that collectively, the above references indicate that HZI has sufficient experience in designing and delivering a facility of the capacity proposed for Istanbul in terms of the three key parameters of waste throughput, thermal input and steam conditions. Further review and discussion on technical aspects of the HZI design are provided in other sections.

Electricity Generation

Within the Contractor technical documentation provided for our review, there is a set of five Heat and Mass Balances (HMBs). These HMBs define the following operational modes for the WtEP:

- Three combustion lines at nominal load;
- Two combustion lines in operation;
- One combustion line in operation;
- Turbine island operation; and
- Turbine bypass operation.

For each of the HMBs, the waste CV is set to 7.50 MJ/kg. Based on our review of the Firing Diagram, this is assumed to be 100% domestic waste. All HMBs assume an ambient air temperature of 18°C which is the ambient air temperature design point related to performance guarantees. The HMBs illustrate the main energy flows through the Our review of the above HMBs is summarised below. We have added the corresponding gross electrical generation guarantee where applicable for the below HMBs based upon the technical guarantees for the project. The internal (parasitic) electrical consumption is also added. This is

provided as a guarantee for one year. We have therefore back calculated based on 8,000 hours operation, the annual availability guarantee, to assess the internal load to estimate net electrical efficiency for each HMB.

It should be noted that gross and net electrical efficiency will vary with ambient air temperature as this affects the performance of the air-cooled condenser and turbine. Generally, with increasing ambient temperature, gross and net efficiency will reduce but increase as the ambient temperature falls. As such, provided that the average annual temperature is used as the basis for the design and guarantee point. We have not undertaken any assessment to confirm if 18°C is suitable as the design point for the location of the WtEP. We would recommend that this is reviewed.

Similarly, HZI does not appear to have provided HMBs or guarantees above or below this ambient temperature. We would recommend that alternative HMBs are requested from HZI with indicative gross generation in order to assess performance at alternative ambient temperatures, for example +/- 10°C from the design of 18°C.

Three Combustion Lines

For three combustion lines in operation, the following key parameters have been observed in the HMBs and performance guarantees.

Table 25: Three Combustion Lines

Parameter	Unit	Value
Number of Combustion Lines	No.	3
Thermal Input Per Line	MW	86.7
Total Thermal Input	MW	260.2
Waste Throughput Per Line	t/h	41.6
Total Waste Throughput	t/h	124.9
Ambient Air Temperature	°C	18.0
Gross Electrical Output (Guarantee)	MW	77.2
Implied Gross Efficiency (Calculated)	%	29.7
Electrical Parasitic Load	MW	7.8
Implied Net Electrical Output (Calculated)	MW	69.4
Implied Net Efficiency (Calculated)	%	26.7

Three combustion lines in operation represents the normal operating mode for the WtEP and the most efficient in terms of energy generation. The calculated net electrical efficiency of 26.7% is considered good for a modern large-scale energy from waste plant. It should be noted that this should only be considered an indication of the expected instantaneous net electrical efficiency as this is based upon a combination of design parameters and guarantees. The parasitic load

required to run the internal consumers of the WtEP equates to 10.1% of gross generation. This aligns with our expectations for a plant of this type where parasitic load can typically range between 8% and 12%.

Two Combustion Lines

For two combustion lines in operation, the following key parameters have been observed in the HMBs and performance guarantees.

Table 26: Two Combustion Lines

Parameter	Unit	Value
Number of Combustion Lines	No.	2
Thermal Input Per Line	MW	86.7
Total Thermal Input	MW	173.4
Waste Throughput Per Line	t/h	41.6
Total Waste Throughput	t/h	83.2
Ambient Air Temperature	°C	18.0
Gross Electrical Output (Guarantee)	MW	49.5
Implied Gross Efficiency (Calculated)	%	28.5
Electrical Parasitic Load	MW	5.3
Implied Net Electrical Output (Calculated)	MW	44.2
Implied Net Efficiency (Calculated)	%	25.4

The main differences between three line and two line operation is the overall efficiency of the WtEP. As the steam turbine will be most efficient at its normal operation load, when steam flow is reduced the gross efficiency is lower. Similarly, the parasitic load as a percentage of gross generation can be expected to increase as there will be some common consumers which will operated for both two line and three line operation. The anticipated values for gross and net electricity generation are considered reasonable. As with three lines, it should be noted that this should only be considered an indication of the expected efficiencies.

One Combustion Line

For one combustion lines in operation, the following key parameters have been observed in the HMBs and performance guarantees.

Table 27: One Combustion Line

Parameter	Unit	Value
Number of Combustion Lines	No.	1

Parameter	Unit	Value
Thermal Input Per Line	MW	86.7
Total Thermal Input	MW	86.7
Waste Throughput Per Line	t/h	41.6
Total Waste Throughput	t/h	41.6
Ambient Air Temperature	°C	18.0
Gross Electrical Output (Guarantee)	MW	21.4
Implied Gross Efficiency (Calculated)	%	24.7
Electrical Parasitic Load	MW	3.1
Implied Net Electrical Output (Calculated)	MW	18.3
Implied Net Efficiency (Calculated)	%	21.1

The comments made above for two line operation regarding changes in efficiency as one line is removed can also be made for the one line operational mode. The anticipated values for gross and net electricity generation for one line operation are considered reasonable. As with three and two lines, it should be noted that this should only be considered an indication of the expected efficiencies.

Turbine Island Mode

A HMB has been provided for island mode operation. Island mode operation is when the WtEP is operational but not connected to the external electrical network. Island mode operation is considered essential for energy from waste plants as it allows the combustion lines to operate and the WtEP to generate its own electricity during times when the grid connection is not available. This may occur due to failure of export equipment (such as transformer) at the WtEP or issues with the external network. The HMB provided indicates that it should be possible to continue to process the full design waste throughput across all three combustion lines even when the grid is not available. It should be noted that whilst waste can continue to be received and combusted, there will be no electrical revenue when operating in island mode.

Turbine Bypass Mode

In a similar situation to island mode, an essential requirement of energy from waste plants is the ability to operate in turbine bypass mode. Should the turbine be unavailable due to a failure or scheduled maintenance then all three combustion lines can continue to process waste with all steam sent directly to the air-cooled condenser for cooling. In this mode, the WtEP will not be capable of exporting any electricity and would have to import electricity from the external network to operate the WtEP. Whilst this will result in a cost for electricity, waste can continue to be received and combusted.

Generation Efficiency

The above data indicates that in normal operational mode with all three combustion lines operating at 100% MCR, the WtEP should achieve a gross electrical efficiency of 29-30% and net electrical efficiency of 26-27%. This is expected to be the values which could be measured during test conditions and at the ambient air reference temperature of 18°C. Due to load fluctuations, part load operations when one, or more, combustion lines are offline for maintenance and variations in ambient temperature, the annual average gross and net efficiency are typically lower than the value which can be achieved under test conditions.

Under the current revised draft waste incineration BREF, expected to be formally published by the end of 2019, the requirements for gross electrical efficiency for energy from waste plants are defined. The requirements are expected to be that 'New' plant will be required to achieve a gross electrical efficiency of 25-35%. For 'Existing' plant, a gross electrical efficiency of 20-35% is expected. We would expect that the definition of 'New' and 'Existing' will be linked to the time at which an environmental or operational permit was issued for an energy from waste plant.

However, based upon the design data received from HZI, we would expect that the facility should be capable of achieving the lower limit for both 'New' and 'Existing' plant and as such, in line with Best Available Techniques for energy efficiency. However, this would need to be tested and demonstrated.

Another criteria for energy efficiency is the 'R1 Energy Efficiency Formula' outlined within the EU Waste Framework Directive (WFD) (Directive 2008/98/EC). The WFD is listed as applicable legislation within Schedule 12 of the draft technical specification we have received. Under the WFD, energy efficiency of the entire plant would be calculated over the course of one complete year and to determine if the plant is a Recovery operation rather than Disposal operation. In order to be classified as Recovery, an R1 value of 0.65 and above is required. From our experience of energy from waste plants of comparable design such as thermal capacity, steam conditions and gross/net efficiency, we would expect that an R1 value greater than 0.65 should be achievable. For comparison, we are aware from publicly available data that the HZI designed Riverside RRF (see Table 2) has achieved annual R1 values of 0.77-0.81.

Following our request, HZI has provided an R1 calculation based upon design data which indicates that an R1 value of 0.75 should be achieved based upon an annual availability of 8,000 hours operating at full load. We have reviewed the inputs and assumptions to the calculation and consider that these are reasonable. It should be noted that the actual value for R1 will need to be based upon the annual values of energy input, usage and output once the facility is operational if R1 is to be determined officially. Due to potential fluctuations in operational load and efficiency when one or more boilers may be offline for outages, the actual value achieved may differ from the predicated 0.75. However, provided that the design data presented by HZI is achieved and the plant is operated in a similar manner to comparable plants, we consider that there should be sufficient margin above the threshold of 0.65 such that the plant could be expected to be classified as a Recovery operation.

Boiler Design

Drawings have been provided which illustrate the general arrangement design and corrosion protection measures for the boilers for the WtEP.

Boiler General Arrangement

The general arrangement design is illustrated in Figure 7 below.

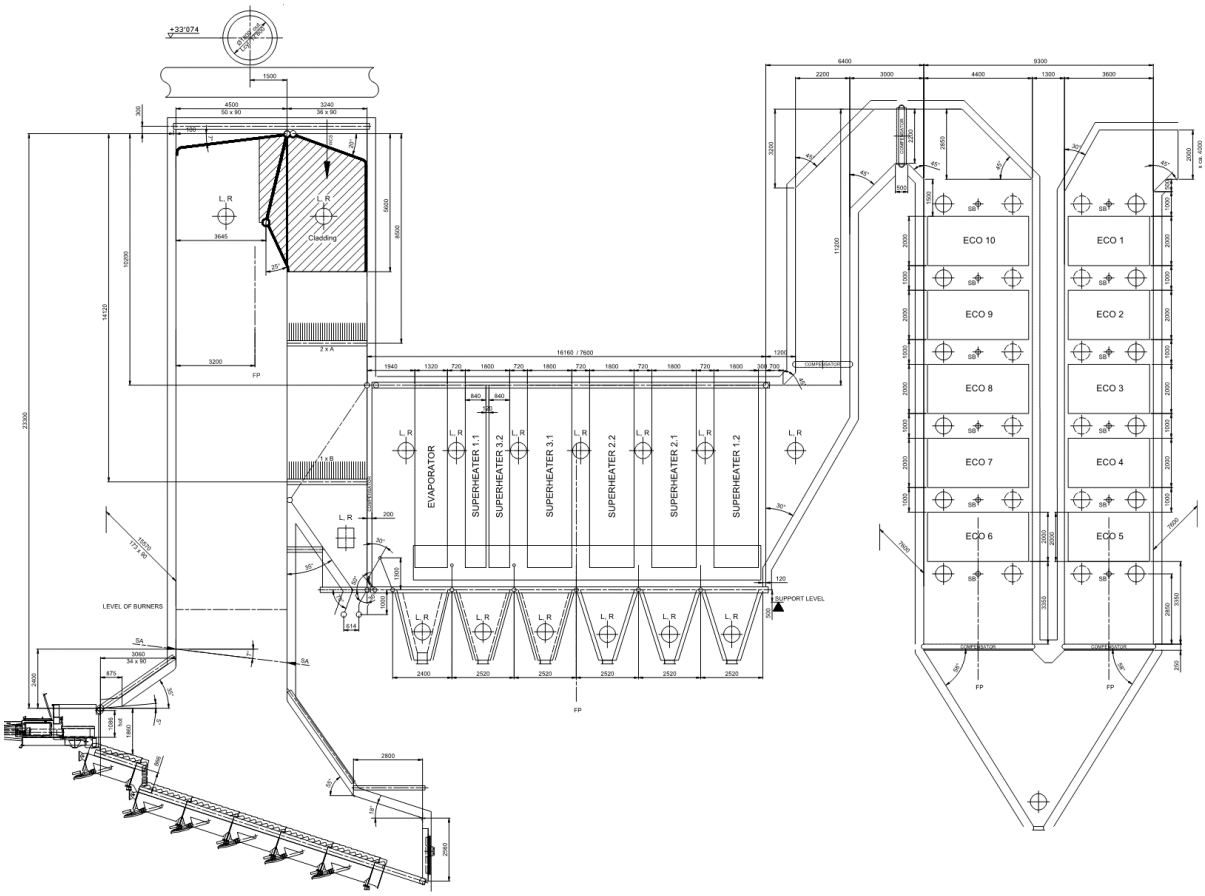

Figure 7: Boiler General Arrangement

The boiler design proposed by HZI comprises of the following key elements:

- Two vertical passes;
- Horizontal third pass with evaporator and superheaters; and
- Two vertical passes with five economisers in each.

Based upon our experience of HZI boiler designs used for other projects, the overall arrangement is considered comparable to other projects we have been involved with. Typically, energy from waste technology providers will base a design on its preferred arrangement philosophy and amend the sizes and dimensions depending on the project.

Based upon the arrangement and numbering of the superheater elements, it would appear that HZI has located its coldest steam temperature element (SH 1.1) in the location of highest flue gas temperature, this is after an evaporator element. As

flue gas temperature decreases, superheater elements which will have increasing steam temperatures are positioned (SH 3.2, SH 3.1, SH 2.2, SH 2.1 and SH 1.2). This arrangement is expected to be used in order to control the tube metal temperature by balancing steam temperature with flue gas temperature. As metal temperature increases, the risks of corrosion can also be expected to increase with flue gas from waste combustion. Locating SH 1.1 upstream of SH 3.2 will act as a form of protection to SH 3.2. Similarly, locating an evaporator element (lower water/steam temperature) upstream of SH 1.1 will also be used to cool flue gases and provide protection to the superheaters.

HZI has included for a total of ten economiser elements. Economisers are used to heat the boiler feed water and increase the overall heat recovery of the boiler. Based upon the design of the flue gas treatment system, we anticipate that ten economisers are used in order to reduce the flue gas temperature to a sufficient level for the flue gas treatment process rather than use water injection to cool the gases. The temperature of the flue gas at the inlet to the flue gas treatment plant is indicated as 135°C on the HZI mass flow diagram which is considered to be in line with other flue gas treatment plants which do not have water spray cooling.

Each of the economiser elements is provided with a sootblower at the leading and trailing edges for cleaning and removing ash from the tube surfaces. In addition, two doors are provided either side of each sootblower in order to undertake inspection and maintenance during outages.

Boiler Corrosion Protection

The general arrangement design for corrosion protection in the boiler is illustrated in Figure 8 below.

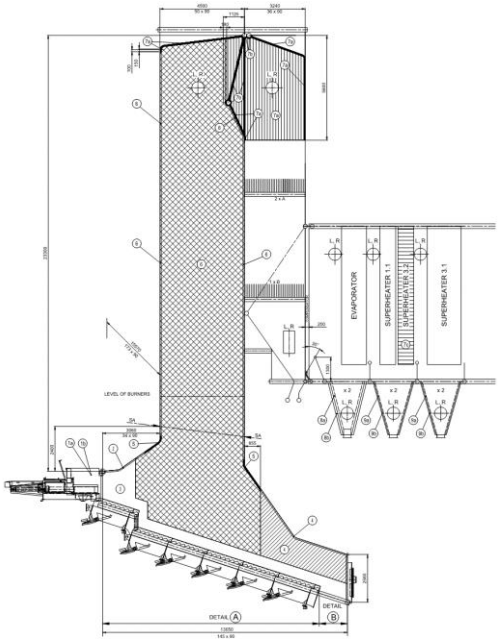

Figure 8: Boiler Corrosion Protection

The boiler protection included by HZI is a combination of refractory and Inconel overlay.

Refractory is a concrete like, heat resistant material. It will be mainly installed within the first pass of the boiler and in the areas close to the combustion grate. Refractory is used to provide corrosion protection to the tubes by providing a barrier from the corrosive flue gas and to maintain the temperature of flue gas within the furnace in order to achieve the temperature residence time (two seconds above 850°C) as required by the European Union (EU) Industrial Emissions Directive (IED).

Achieving the two second residency time is a requirement of the technical specification and based upon HZI's experience we would expect that its design would achieve this. However, we would recommend that a calculation of residence time is requested for both nominal operating mode and the most onerous operating condition which is typically low thermal load with minimum waste CV. Under all operating conditions, the flue gas temperature must be maintained above 850°C for two seconds.

Inconel is a metal which is applied as a welded overlay to a base metal tube. Inconel primarily provides corrosion protection in locations of high metal temperature and also provides a degree of erosion protection from high particle laden flue gas.

HZI propose to provide Inconel to the roof of the first and second boiler passes and on the vertical walls at the top of the second pass. Inconel is installed in the roof areas of energy from waste boilers due to high temperature flue gas and increased risks of erosion resulting from the change of direction of flue gas flow. Typically, we would expect to see Inconel also applied to the vertical walls at the top of the first pass of the boiler in a similar manner as proposed for the second pass. We have often seen issues with refractory damage and failure as a result of expansion and contraction during operation and maintenance in locations with changes of direction or joints. With refractory installed up to the roof of the first pass we would recommend that HZI is requested to demonstrate that this has been considered in the design to mitigate the risk of damage to refractory so that boiler tubes are not exposed to flue gases in this location.

From our experience of operational plants, we have seen examples where the transition from Inconel to bare tube in the second pass has been extended downwards to provide increased protection in this area. This has generally been undertaken as a lifecycle improvement activity to prevent premature failures in this area. During operations, we would recommend that the operator is requested to take regular tube thicknesses measurements to assess the corrosion/erosion rate to evaluate the cost-benefit of increasing corrosion protection in this area.

Inconel protection is also provided to all tubes within superheater element SH 3.2. This is a typical design requirement in the energy from waste industry and we consider that this represents good practice to install Inconel on the hottest steam temperature superheater.

In all cases where Inconel is used, it is proposed to be a thickness of 2 mm. We would consider this to be typical of many energy from waste boiler designs in operation.

HZI has provided a corrosion diagram for review. This diagram indicates the anticipated corrosion risks for various elements and location in the boiler based upon flue gas temperature and water/steam temperature. The diagram is based upon operation in a 'clean' condition (c. 800 hours after manual clean) and a 'fouled' condition (c. 8,000 hours after manual clean). These are the standard periods used by designers and can be assumed to represent the two extreme operating conditions for energy from waste boilers. Fouling increases the temperature of flue gas entering the higher corrosion risk superheater section and as such the 8,000 hour operating case should represent the worst case during an annual operating campaign. The diagram for this case is shown in Figure 9 below.

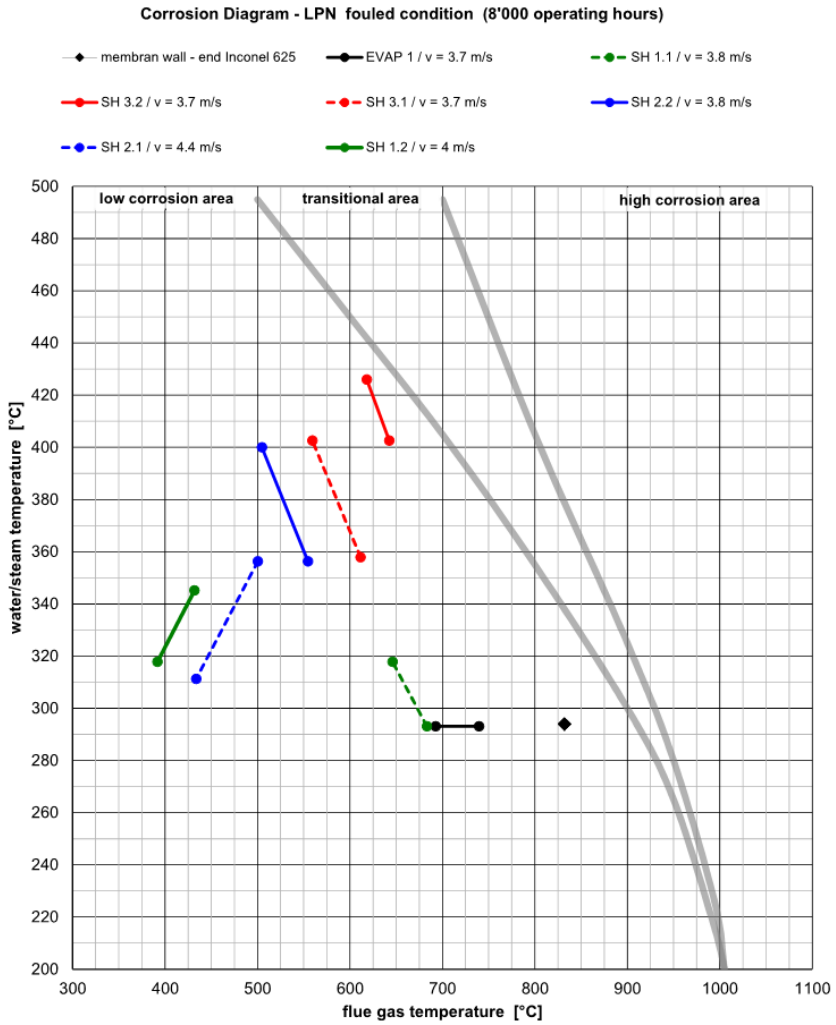

Figure 9: Boiler Corrosion Diagram 8,000 hours

The dots joined by lines in the above indicate individual boiler elements with the corresponding flue gas temperature at the inlet and outlet of the element along with the water/steam temperature at the inlet and outlet. The grey curved lines are based upon empirical data gathered from operational experience of energy from waste and are an indication of when higher corrosion risks, linked to metal temperature, can be expected to be experienced. The curves are commonly based upon the bare tube base metal without protection.

As can be seen, superheater SH 3.2 (hottest steam superheater) presents the highest corrosion risk but remains within the 'low corrosion zone'. In addition, this is the superheater which is protected with Inconel overlay which increases the corrosion resistance of the tube metal to reduce the wear rate. The black diamond represents the position in the second vertical pass where the Inconel protection ends, and bare tubes begin. As stated above, we have seen examples where Inconel protection has been extended in this area such that this diamond would move to the left (lower flue gas temperature). As above, our recommendation would be that the corrosion/wear of the bare tubes at this transition are monitored by the operator during operations in order to determine if additional protection is required here.

Flue Gas Treatment

Flue Gas Treatment Systems

Based upon a process flow bloc diagram from HZI, the methods of flue gas treatment to be utilised at the WtEP will include:

- Selective Non-Catalytic Reduction (SNCR);
- HZI Xerosorb flue gas scrubbing; and
- Fabric bag filter.

SNCR is used to control emissions of nitrogen oxide (NOx) and involved the injection of ammonia solution in the first pass furnace of the boiler. SNCR technology is widely used throughout the energy from waste industry and can be considered a Best Available Technique for control of NOx emissions.

Within the HZI Xerosorb system, dry hydrated lime and activated carbon are injected into a reaction duct upstream of the bag filter to control emissions of acid gasses such as hydrogen chloride (HCl) and Sulphur Dioxide (SO_2) and heavy metals, dioxins and furans. The use of hydrated lime and carbon for abatement of emissions is used widely within the energy from waste industry and can be considered a Best Available Technique. The system designed by HZI is a fully dry system which reduces the consumption of water and increases the energy recover of the boiler through additional cooling of flue gas by use of economisers for feed water heating rather than water spray injection to cool gases.

A fabric bag filter will be located after the injection of consumables to filter out the spent consumable and any remaining boiler fly ash as Air Pollution Control residues (APCr). The cleaned flue gases are then sent to a flue gas stack to atmosphere. Bag filters are used widely within the energy from waste industry and can be considered a Best Available Technique for removal of particles from flue gas.

Flue Gas Treatment Emissions

Within Schedule 12 of the draft technical specification we have received, compliance with the EU Industrial Emissions Directive (IED) (2010/75/EU) is stated as a requirement. The guaranteed emission limits stated in the

documentation received are aligned with the IED limits and are listed in Table 28 below. In addition, the expected emissions calculated by HZI and displayed on its process flow bloc diagram and the current draft BREF emission limits for 'New' and 'Existing' plant are also listed for comparison.

Table 28: Flue Gas Emission Limits

Emission	Units	IED / Guarantee (Daily Average)	HZI Expected Emission	Draft BREF (New/Existing Plant)
Total Dust	mg/m^3	10	< 2	2 – 5
Total Organic Carbon	mg/m^3	10	2	3 – 10
Hydrogen Chloride	mg/m^3	10	9	2 – 6 / 2 – 8
Hydrogen Fluoride	mg/m^3	1	0.1	1
Sulphur Dioxide	mg/m^3	50	48	5 – 30 / 5 – 40
Nitrogen Oxide	mg/m^3	200	195	50 – 120 / 50 – 150 (180 SNCR)
Carbon Monoxide	mg/m^3	50	10	10 – 50
Ammonia	mg/m^3	10	1.7	2 – 10 (15 SNCR)

Based upon the information presented, and our experience of operational energy from waste plants, we consider that the current IED emission limits as guaranteed by HZI should be achievable by the technology selected. We would expect these to be tested and measured during an acceptance period for the WtEP so that compliance with the IED requirements are demonstrated by HZI. Should the current draft BREF emission limits be adopted in the future, the main changes to emission limits which may impact on the WtEP are expected to be dust, hydrogen chloride, sulphur dioxide and nitrogen oxide.

With the current installed technology, we would expect that reduced dust emissions would be achievable without any changes to the installation based upon our experience of the performance of bag filters in operational energy from waste plants.

Emissions of hydrogen chloride and sulphur dioxide are both controlled by the injection of hydrated lime. Should the emissions from the WtEP need to be reduced, this would typically be achieved by increased injection of hydrated lime to a level sufficient to meet the required limit. It should be noted that this would have an impact on the operational cost of the WtEP via increased hydrated lime consumption and increased APCr production and disposal. We would recommend that HZI is requested to provide confirmation that the current installation is

sufficient to meet the draft BREF limits for hydrogen chloride and sulphur dioxide and an indication of any increased usage requirements for hydrated lime.

Nitrogen oxide is controlled by dosing of ammonia within the furnace of the boiler. There are a number of potential reductions to emissions of nitrogen oxide proposed by the current draft BREF which could be imposed by the environmental regulator for the WtEP. Whilst we cannot advise as to which revised limits, if any, will be imposed we can comment on the expected capabilities of SNCR systems in general. We have seen examples of SNCR systems achieving nitrogen oxide limits down to around 150 mg/Nm^3 via increased dosing of ammonia but should lower limits be imposed, there could be a requirement to install a Selective Catalytic Reduction (SCR) system which would require installation of additional equipment. However, we are aware that HZI can supply an SNCR system named DyNOR which is claimed to achieve nitrogen oxide limits down to 120 mg/Nm^3. We would recommend that HZI is requested to confirm the design of the SNCR system and what the lowest nitrogen oxide emission which can be achieved via the installed system and if any future modifications can be made if required.

We note that within the tender specification it is stated that space within the building should be reserved for an SCR system in the future is required to meet emission limits. From the drawings we have reviewed there does not appear to be any space reserved. We would recommend if this is a requirement of the contractor or what the intentions are regarding future SCR. It is sensible to reserve a space for such a system but the implications and requirements would need to be fully understood as the space requirements (SCR unit including ductwork) is not insignificant. As state above, SNCR systems can be designed to achieve relatively low nitrogen oxide emissions and the balance between an optimised SNCR system versus SCR system would need to be reviewed.

Within the information provided by HZI, Continuous Emissions Monitoring Systems (CEMS) will be installed to monitor the emissions from all three combustion lines. This is also stated within the tender specification that the monitoring requirements of the IED are to be complied with. We would expect to see one duty unit per combustion line and a common spare unit which would automatically switch to monitor a failed unit if required. We would recommend that this is checked to confirm the redundancy which will be installed within the WtEP.

Stack Height

Based upon the drawings issued to us, the height of the flue stack above ground level appears to be c.43 m and the height above the highest point of the building appears to be c.2m.. For a facility of this size, the stack height is lower than we would expect to see for energy from waste facilities built under the EU IED and to environmental impact assessment criteria. Based on high level reviews we would expect to see a higher stack height to ensure adequate dispersion of emissions.

Air quality sampling and analysis studies done during the local EIA stage. In addition, an air quality modelling study was carried out by 2U1K Engineering in 2015. The stach height had initially been determined as 60m from the ground

level. However by the affect of new Istanbul Airport, the stack heigh was reduced to 43 m and modelling studies was done by this height.

Modelling was carried out using the AERMOD software by 2U1K which is an internationally accepted model. The minimum stack height calculated by the PK 3781 software is reported to be 23m and the stack height was selected as 40m after. The stack is now 3m taller than the building (43m). This figure is below our expectations. Building downwash affects plume dispersion and might result in higher stack heights being required. It is not clear if the studies includes considers the WtEP buildings or not. The Consultant recommends that the modelling study should be re-run by taking the buildings in the layout into consideration. The scenarios used during the modelling study should be covering start-up, planned, unplanned and emergency disrupts/shutdown cases as well.

Flue Gas Treatment Residues

The solid residues which will be removed from the WtEP will be removed from three separate locations which are:

- Bottom ash (wet) from the end of the combustion grate;
- Boiler ash (dry) from the second pass of the boiler, superheaters and economisers; and
- Air pollution control residue (APCr) from the fabric bag filter.

According to the process flow diagram it appears that bottom ash will be collected from all three combustion lines and stored before removal from site. Boiler ash and APCr appear to be removed, conveyed and combined and stored in silos before removal for disposal. Typically, plants in the United Kingdom and the Netherlands are permitted to combine fly ash with bottom ash for treatment and disposal. However, in most of continental Europe boiler ash is removed and treated with the APCr material due to higher level of contaminants. As such, combining boiler ash with APCr is not unusual but it will increase the quantity of APCr type material requiring disposal which can often incur a higher cost than bottom ash which generally has less contamination requiring treatment.

The arrangements for final disposal of bottom ash and boiler ash/APCr will need to be reviewed to confirm that these are adequate from an environmental perspective and that the costs for safe disposal are modelled correctly. For a plant of this size, the quantity of residues will be significant and will require a secured disposal route. Generally we would anticipate that 18-25% of waste tonnage will exit as bottom ash and 2-4% of waste tonnage will exit as boiler ash/APCr. For an annual waste tonnage of 1,000,000 tonne, we would estimate that this could result in approximately 200,000 to 290,000 tonnes of residue per year requiring disposal. The assumptions around residue quantities and disposal should be reviewed and confirmed.

Effluent

Based upon process flow diagrams provided, we understand that the process plant has been designed to result in zero discharge of waste water. This can be achieved

by routing all process waste water for use as quench water to cool the bottom ash as it leaves the combustion grate. We are aware of operational plants where this approach is used and consider that this should be achievable.

The process flow diagram also indicates that there will be a connection to the city sewage system for disposal of domestic waste water produced in the administration areas (showers, toilets, kitchens etc.) and that this connection will also be used for disposal of dirty rain water and excess clean rain water which cannot be used to displace potable towns water in the process plant.

The effluent disposal arrangements are considered typical of energy from waste facilities we have experience of. We have not reviewed the connection agreement with the city for disposal of domestic waste water and clean/dirty rain water and recommend that this is reviewed with regards to acceptable composition and flow rates.

Tipping Hall and Bunker Odour and Pest Control

We have not seen any specific details relating to the odour control and pest control measures intended for the tipping hall and waste bunker. However, we have received a general arrangement elevation drawing which illustrates these two parts of the building. This is illustrated in Figure 10 below.

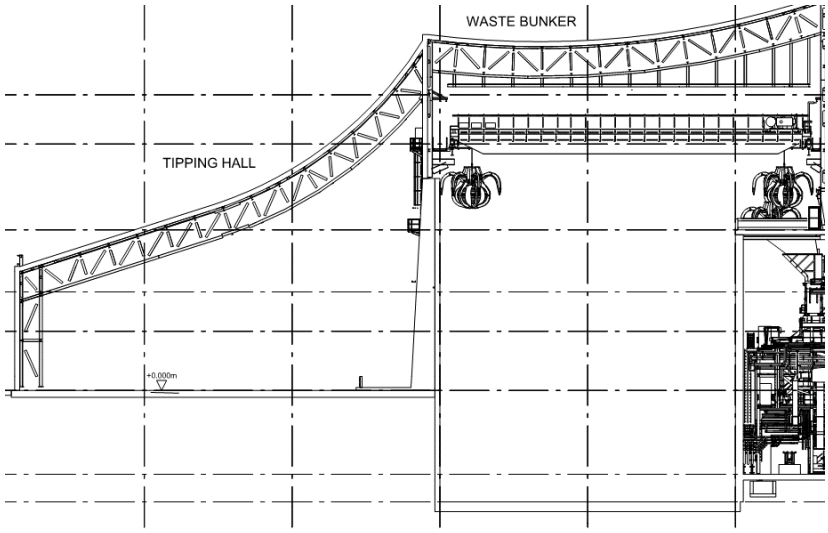

Figure 10: Tipping Hall and Waste Bunker

Based on the drawing above, it appears that the entire tipping hall and waste bunker will be enclosed within the permanent superstructure of the building. On similar drawings we have seen roller shutter doors indicated at the vehicle entrance and exits (either end) of the tipping hall. These are standards design elements for energy from waste end ensure that the waste receiving and storage area are contained to minimise odour release and access for pests.

Energy from waste plants are designed so that the combustion air for each boiler will be extracted from the waste bunker volume. This constant air flow will result in a slightly negative pressure within the bunker and tipping hall and draw clean air into the space via louvres in the tipping hall building envelope and the roller

shutter doors when open. We have not seen details to confirm this philosophy and would recommend that HZI and/or the Owners Engineer is engaged to review the current design proposals with regards to odour control to confirm that this philosophy is being followed.

The WtEP is arranged with three combustion lines. As such, maintenance outages will be scheduled throughout the year in a staggered manner so that the time period when two or three lines are out of service, and airflow not being drawn through the bunker, is reduced to a minimum. On comparable three line plants we are aware of, the time when all three lines are out of service can be around five days every two years in line with statutory insurance inspections of common pressure part systems. Should odour become an issue within the waste bunker, deodoriser sprays can be installed and used to suppress any offensive odours during operations or outages. If this is not currently within the scope of the project, we would recommend that once operations commence odour is monitored and a deodorising system installed should issues be experienced.

Electrical Design

A single line diagram illustrating HZI electrical system design for the WtEP has been provided. This indicates the high-level arrangement of the grid connection and internal power distribution arrangements. Key observations regarding the design include:

- Import/export grid connection at 154 kV with main 154/10 kV transformer;
- Import grid connection at 34.5 kV with 34.5/10 kV import transformer;
- Redundant 10/0.4 kV transformers and feeds provided to each combustion line boiler and flue gas treatment plant;
- Redundant 10/0.7 kV transformers and feeds provided to the induced draft fans (all three on common busbar);
- Redundant 10/0.7 kV transformers and feeds provided to the air-cooled condenser;
- Redundant 10/0.7 kV transformers and feeds provided to the feed water pumps (five pumps);
- Redundant 10/0.4 kV transformers and feeds provided to the common system low voltage busbars;
- Three 10 kV emergency diesel generators each with capacity 2.25 MVA connected to the process plant;
- One 0.4 kV emergency diesel generator with capacity 2.5 MVA connected to the building services; and
- Redundant uninterrupted power supplies (UPS) feeding emergency process consumers with one hour capacity.

Based on the notes on the single line diagram, the Purchaser is responsible for the scope of supply (design and construction) of the 154/10 kV and 34.5/10 kV

transformers and grid connections with HZI responsible for all internal equipment with its termination point at the grid side of the generator circuit breaker.

In addition, the three diesel generators connected to the process plant appear to be designed for safe shutdown of the entire plant with n-1 redundancy such that only two of the three generators are required to shut the WtEP down safely. The generators also appear to be provided to start-up one combustion line in the absence of the grid connection; this is commonly described as 'black start'.

The 34.5 kV import connection is provided as a back-up power supply should the main connection be unavailable or there be an equipment failure with the 154 kV import/export connection. This is expected to be included due to potential reliability concerns with the 154 kV connection. Whilst this should provide redundancy in the power supply from the external grid, there may be a number of operations which rely on the 34.5 kV system as a back-up to the 154 kV grid. As such, we would recommend that the grid capacity of this this connection is reviewed to confirm its suitability and reliability.

In general, the overall design of the electrical system appears to include a high degree of redundancy both for internal distribution of power to consumers and in supply of power which can be achieved by either the steam turbine-generator, 154 kV grid connection, 34.5 kV connection or diesel generators. It should be noted that the WtEP is also designed to operate in island mode with all combustion lines operating and the steam-turbine generator providing internal power in the absence of any grid connection.

Fire Risk

We have not seen any technical information from the EPC Contractor in relation to fire detection and protection within the energy from waste plant. We would recommend that the designs are requested and reviewed against any requirements that the construction and operational insurers may have and also Good Industry Practice used in comparable energy from waste facilities in Europe.

10.2.3 Conclusion

Our main observation regarding environmental and social impact is regarding the stack height which is lower than we would expect to see for an energy from waste plant of this capacity. We would recommend that this is reviewed in conjunction with air quality assessments and dispersion modelling and the environmental thresholds for pollution to land and water.

Other than stack height, based upon the design information received and the requirement for the WtEP to be designed in accordance with the current IED, we consider that the technical controls to be installed in the project will be sufficient to address the environmental and social requirements of the project. From the information we have received, the WtEP appears to be designed in a similar manner to what we would expect within the EU.

It will need to be ensured that the operational staff are trained accordingly and subsequently operate and maintain the WtEP in accordance with good practice as

required and intended by the technology supplier to maintain the intended operational performance.

Summary of our key findings related to the process are provided in the table below together with our recommendations. The key points are included in end ESAP table as well.

Table 29: Summary of Process Related Key Findigs and Recommendations

Topic	Report Reference	Issue	Recommendation
Owner's Engineer	10.2.1 Technical Specification (Technical Scope)	We have not seen the full detail of the technical design proposed by HZI and have limited our review to key process elements such as boiler arrangement, power generation and electrical equipment. However, we understand that an Owner's Engineer has been engaged to undertake design review activities throughout the design and construction of the project.	We would recommend that the Owner's Engineer is engaged to seek opinion as to the status of the design being provided by the Contractor with regards to compliance with the tender specification and completeness of the design against good industry practice for energy from waste.
Waste Composition	10.2.1 Technical Specification (Waste)	Whilst a fuel specification is provided in the tender specification for which the WtEP is to be designed to, we have not seen any details of waste composition testing and analysis of the actual waste streams which will be delivered to the WtEP. The only analysis provided has been calorific value analysis undertaken in Summer and Winter 2017.	We would recommend that a project specific study of waste sampling and laboratory analysis should be carried out to assess the composition and calorific value of various waste streams and any seasonality variations.
Waste Composition	10.2.1 Technical Specification (Waste)	The incoming waste may include a degree of hospital waste which is limited to a maximum of 100 tonnes per day (1.39 tonnes per hour if homogeneous mix) in the tender specification. It is not clear what type of waste streams the hospital waste will contain. Typically, there are several types of hospital waste which can range from soiled paper to syringes (plastic / metal),organic wastes and other more hazardous materials.	We would recommend that the nature of the expected hospital waste streams is reviewed to determine if there are any materials which may be more onerous to handle and treat. In addition, used gas cylinders can often end up within hospital waste streams. From our experience of energy from waste projects, gas cylinders are usually a prohibited waste for technology providers.

Topic	Report Reference	Issue	Recommendation
Noise	10.2.1 Technical Specification (Noise)	Within the tender specification a requirement for noise emissions is stated as, "*the noise contribution from any of the receptors of the plant nominated in the permission should not result in an overall noise level increase greater than 80 dB(A). The existing background noise level should be assumed to be 52.3 dB(A).*" We would expect that a noise level increase of 80 dB(A) above current background levels to be a significant increase and typically we would expect noise levels to be defined at the boundary of the site or at a local receptor. In each case, noise levels at a distance from the WtEP should be expected to be much lower than 80 dB(A) as an absolute value whereas the drafting allows for an 80 dB(A) increase above current levels.	We would recommend that the drafting of this clause and the requirements within the WtEP permission are reviewed to confirm the noise limits for the WtEP during operations.
Electricity Generation Design Point	10.2.2 Contractor's Technical Proposal (Electricity Generation)	Gross and net electrical generation and efficiency will vary with ambient air temperature. An ambient air temperature of 18°C has been set as the design point related to performance guarantees and used in the heat and mass balances submitted for review.	We would recommend that historical weather data is reviewed to confirm that 18°C is a suitable average annual temperature. In addition, we would recommend that additional heat and mass balances are requested from HZI with indicative gross generation in order to assess performance at alternative ambient temperatures, for example +/- 10°C from the design of 18°C.
Furnace Two Second Residency Time	10.2.2 Contractor's Technical Proposal (Boiler Design)	Achieving the two second, 850°C, residency time is a requirement of the technical specification and based upon HZI's experience we would expect that its design would achieve this. However, we have not seen any design	A calculation of residence time (computational fluid dynamics) should be requested for both nominal operating mode and the most onerous operating condition which is typically low thermal load with minimum waste CV. Under all operating conditions, the

Topic	Report Reference	Issue	Recommendation
		calculations to confirm this.	flue gas temperature must be maintained above 850°C for two seconds. During commissioning, this should then be verified through manual measurement of temperatures and calculation.
Refractory / Inconel Protection (Boiler Furnace)	10.2.2 Contractor's Technical Proposal (Boiler Design)	HZI propose to install refractory (concrete-like material) up to the roof of the boiler first pass to a transition to Inconel (metal overlay) to protect boiler tubes. We have often seen issues with refractory damage and failure as a result of expansion and contraction during operation and maintenance in locations with changes of direction or joints.	With refractory installed up to the roof of the first pass we would recommend that HZI is requested to demonstrate that this has been considered in the design to mitigate the risk of damage to refractory so that boiler tubes are not exposed to flue gases in this location.
Inconel Protection (Boiler Second Pass)	10.2.2 Contractor's Technical Proposal (Boiler Design)	From our experience of operational plants, we have seen examples where the transition from Inconel to bare tube in the second pass of the boiler has been extended downwards beyond the current location proposed by HZI to provide increased protection in this area. This has generally been undertaken as a lifecycle improvement activity to prevent premature failures in this area.	During operations, we would recommend that the operator is requested to take regular tube thicknesses measurements to assess the corrosion/erosion rate to evaluate the cost-benefit of increasing corrosion protection in this area.
Flue Gas Treatment and BREF Compliance	10.2.2 Contractor's Technical Proposal (Flue Gas Treatment)	Within the EU, changes to the BREF emission limits will be taking place over the next few years with the main changes likely to be NO_x, HCl and SO_2. If Turkey adopts these limits in the future, additional dosing of consumables is expected in order to comply with any reduced limits.	We would recommend that HZI is requested to provide confirmation that the design of the current installation is sufficient to meet the revised BREF limits for NO_x, HCl and SO_2 by increasing dosing of consumables and the estimated dosing rates required to meet the revised limits.
Flue Gas Treatment Emissions Monitoring	10.2.2 Contractor's Technical Proposal (Flue Gas Treatment)	Within the information provided by HZI, Continuous Emissions Monitoring Systems (CEMS) will be installed to monitor the emissions from all three combustion	We would expect to see one duty unit per combustion line and a common spare unit which would automatically switch to monitor a failed unit if required. We would

Topic	Report Reference	Issue	Recommendation
		lines. This is also stated within the tender specification that the monitoring requirements of the IED are to be complied with.	recommend that this is checked to confirm the redundancy which will be installed within the WtEP.
Stack Height	10.2.2 Contractor's Technical Proposal (Flue Gas Treatment)	The stack height is understood to be 43 m and 2 m above the highest point of the building. This is lower than we would expect to see for energy from waste facilities built under the EU IED and to environmental impact assessment criteria. It is not clear if the air quality study considers the WtEP buildings or not.	We would recommend that the modelling study should be re-run by taking the buildings in the layout into consideration. The scenarios used during the modelling study should be covering start-up, planned, unplanned and emergency disrupts/shutdown cases as well.
Process Residue Disposal	10.2.2 Contractor's Technical Proposal (Flue Gas Treatment)	For a plant of this size, the quantity of residues will be significant and will require a secured disposal route. Generally we would anticipate that 18-25% of waste tonnage will exit as bottom ash and 2-4% of waste tonnage will exit as boiler ash/APCr. For an annual waste tonnage of 1,000,000 tonne, we would estimate that this could result in approximately 200,000 to 290,000 tonnes of residue per year requiring disposal.	The arrangements for final disposal of bottom ash and boiler ash/APCr will need to be reviewed to confirm that these are adequate from an environmental perspective and that the costs for safe disposal are modelled correctly. The assumptions around residue quantities and disposal should be reviewed and confirmed.
Effluent Disposal	10.2.2 Contractor's Technical Proposal (Effluent)	The effluent disposal arrangements are considered typical of energy from waste facilities we have experience of. However, we have not reviewed the connection agreement with the city for disposal of domestic waste water and clean/dirty rain water.	We recommend that the connection agreement is reviewed with regards to acceptable composition and flow rates.
Waste Bunker Odour Control	10.2.2 Contractor's Technical Proposal (Bunker Odour Control)	Energy from waste plants are designed so that the combustion air for each boiler will be extracted from the waste bunker volume. This reduces the risk of odour release from the building. The WtEP is arranged with three combustion lines. As such,	Should odour become an issue within the waste bunker, deodoriser sprays can be installed and used to suppress any offensive odours during operations or outages. If this is not currently within the scope of the project, we would recommend that once

Topic	Report Reference	Issue	Recommendation
		maintenance outages will be scheduled throughout the year in a staggered manner so that the time period when two or three lines are out of service, and airflow not being drawn through the bunker, is reduced to a minimum.	operations commence odour is monitored and a deodorising system installed should issues be experienced.
Electrical System	10.2.2 Contractor's Technical Proposal (34.5 kV Import Connection)	The 34.5 kV import connection is provided as a back-up power supply should the main connection be unavailable or there be an equipment failure with the 154 kV import/export connection. Whilst this should provide redundancy in the power supply from the external grid, there may be a number of operations which rely on the 34.5 kV system as a back-up to the 154 kV grid.	We would recommend that the grid capacity of this this connection is reviewed to confirm its suitability and reliability.
Fire Detection and Protection	10.2.2 Contractor's Technical Proposal (Fire Risk)	We have not seen any technical information from the EPC Contractor in relation to fire detection and protection within the energy from waste plant.	We would recommend that the designs are requested and reviewed against any requirements that the construction and operational insurers may have and also Good Industry Practice used in comparable energy from waste facilities in Europe. We would expect the Owner's Engineer to have reviewed this, its comments should be requested.

10.3 Geotechnical Review

The Geotechnical review is based on the following documents:

- Geotechnical Interpretation Report and Pile Load Tests' Evaluation Reports provided by MAKYOL.
- '2017-11-19- Ek Sondaj Noktaları.dwg'
- 'EA-IBB ATIK YAKMA-GEO-RP-EK-20180201.pdf'
- 'RAPOR+EKLER.pdf '
- IBB_Yakma Tesisi Loglar
- Pile Loading Test Documents including various results

- 'İSTAÇ MAKSİMUM.pdf'
- 'Rapor(1).pdf'
- 'TEST 2450 KN.pdf'
- 'MANOMETRE VE KOMPARATÖRLER.pdf'
- 'PİSTON KALİBRASYON.pdf'
- 'Rapor.pdf'
- 'TEST FÖYÜ MAX. YÜK.pdf'
- 'TEST FÖYÜ yeni.pdf'
- 'İBB katı atık makyol yükleme deneyi.pdf'
- 'KOMPARATÖR-2018.pdf'

10.3.1 Topoghraphy and the Geology of the Site

The topography of the site is inclined towards SouthWest-NorthEast direction with elevations varying from a maximum elevation of +121.00 down to +86.00, which is the lowest elevation. The slopes are varying from 0% to 40%. The geological formation is mainly Ağaçlı branch of Danişmen formation, Tda.

10.3.2 Soil Investigations and Idealized Soil Profile

Soil investigations held on the site are given in Figure 11. The site investigation programme is adequate to cover the area to create necessary soil profiles for a proper foundation design. In total, 33 boreholes with varying depths of 20.0m to 52.5m are executed on site with a total depth of 1297m. Laboratory and site tests were performed to define the physical and mechanical properties of the soil and rock layers encountered.

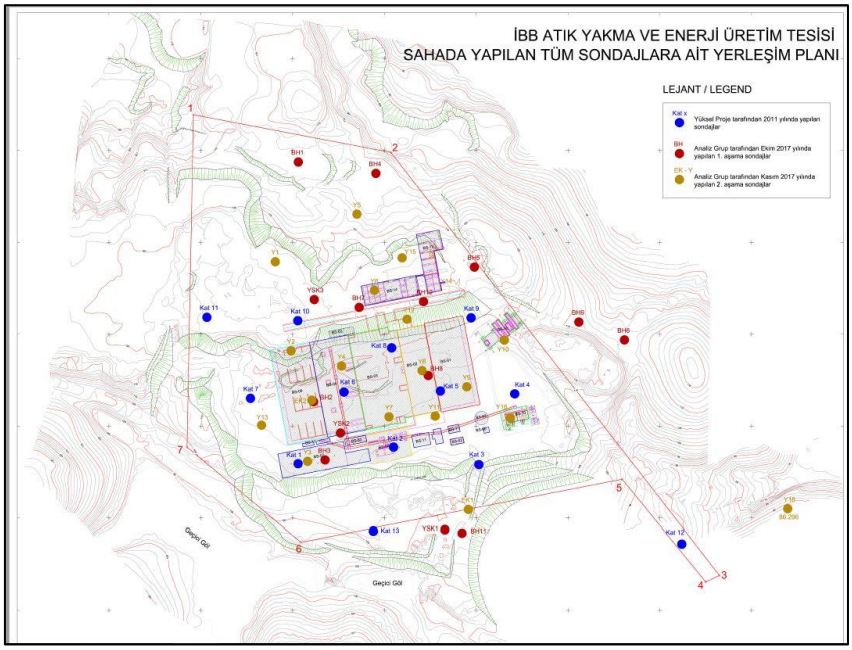

Figure 11 Site Investigation Programme held on site (Ref: Geotechnical Report provided)

The soil profile is summarized as below:

- The top 15-40m is composed of uncontrolled fill material.

- Below the uncontrolled fill lies a hard clay layer which is formed from the weathering of the Danişmen formation material. There are some coal layers in between those hard clay layers, which are 1-3m layers.
- Below Danişmen formation hard clays lies sandstone-shale mixtures and limestone-shale of the Trakya formation.

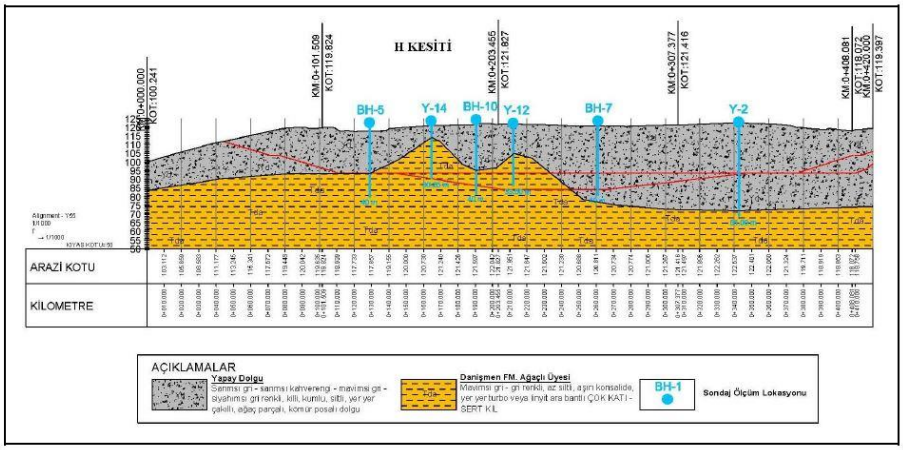

Figure 12 A typical geological section from the Geotechnical Report

10.3.3 Excavation and Slope Stability

The foundation excavation had been done by a shoring system and completed. Therefore; in that sense; there is not any risk level involved with the excavation. The cut slopes were relatively shallow (4H:1V); however, as the characteristics of the soil is prone to sliding, the ditches shall be constructed immediately, after the completion of the cuts. The slope shall also be covered by vegetation to mitigate the risk of surficial flows. The slope stability risk is assessed to be low around the facilities.

If there will be steep slopes for the access roads, necessary slope stability analyses should be performed to ensure that the long term stability of the slopes are guaranteed.

10.3.4 Evaluation of the Foundation System

Uncontrolled fill layer is definitely not suitable to serve as a founding layer.

The foundation system is selected as piled foundations as the structures could not rest on shallow foundations where there are such deep layers of uncontrolled fill. As the material is heterogenous, it is not that easy to improve the soil and to validate the outcome by controlling the quality of the work. Therefore; piled foundations are the most reliable foundation system for this site. Pile load tests were executed on site. We had been provided three of them.

According to the technical specification, the proof test for each of pile shall be executed. There are piles having diameters of D=80cm, D=100cm and D=120cm and there were two pile load tests executed on D=80cm and D=100cm diameter

piles, and those piles are loaded to failure. However; there had not been any test executed on D=120cm diameter piles.

Regarding the pile load tests on working piles, not any number is indicated in the technical specification. The general practice is to have a pile load test on every 100-200 piles. The number of pile load tests on working piles could have been more to cover the area better. The foundation construction is already completed and as the test results are consistent from the available tests and the capacity obtained from each test is quite higher than the theoretically calculated values given in the structural reports, there is not any risk foreseen.

In the technical specification, pile integrity tests on each pile is also defined to be executed during construction. We have received 1433 results for foundation piles of 7 different structures, and there have not any problems reported regarding the integrity of the piles constructed. The results could be evaluated as satisfactory to assure the quality of the piling works. In conclusion; the risk is assessed to be low for the pile design and construction.

10.3.5 Seismicity and the Risks involved at Site:

The area is located in Earthquake zone 3 according to the Turkish Earthquake code. The earthquake acceleration value is 0.20 for the area which was taken ito account in the calculations based on our high-level reviews.

10.4 Structural Review

Structural reinforced concrete and steel design calculation reports send by MAKYOL were reviewed.

The documents provided by the EPC Contractor are as follows:

- ‘STEEL STRUCTURE CALCULATION REPORT.pdf’
- ‘Ana Proses Binası Statik Raporu.pdf’
- ‘Turbin Binası Statik Raporu.pdf’

10.4.1 Structural Analysis

Reinforced concrete and structural steel parts of project were designed per TS 500: Design and Construction of Reinforced Concrete Buildings and New Turkish Steel Design Code-2016, respectively. Snow and wind loads were considered in accordance with TS EN-1991-1-1-3 and TS EN-1991-1-1-4, respectively.

TSC-2007 was used in seismic design since the design completed before 1st January 2019. Seismic design parameters considered in the project are given below in brief;

Table 30: Seismic Design Parameters

Seismic Zone	3
Effective Ground Acceleration (A0)	0.2g

Local Site Class	Z2
Building Importance Factor (I)	1.5
Structural Response Factor (R)	4

Design codes considered in design and material qualities are convenient. No major error detected in the review.

10.5 Hydrological, Drainage and Wastewater Reviews

This section covers hydrological (flood risk), drainage and wastewater reviews and based on technical Spesifications, drawings, calculation reports for site-wide stormwater plus wastewater.

The stormwater system was prepared as two separate system to transfer the stormwater coming from the larger basin to the WtEP and to collect and convey the precipitation inside the Project site.

10.5.1 Flood Risk Study

As per the EPC Contractor representatives, the Flood Risk Assessement Study is ongoing.

Flood Risk studies are ongoing for the WtEP. Recently, EPC has provided initial modelling visuals showing site flood risk is low. However, the Consultant expects to review the full study with calculations behind to have a comment.

10.5.2 Stormwater Drainage System

Our comments about site-wide stormwater drainage system are as follows:

- The report should provide information about the principles of stormwater system,
- Stormwater plan includes only stormwater collection system, but also it should include the system as fully integrated with the outside canals to for the discharges,
- Legends should be added to the projects,
- The reasons to use concrete pipe should be explained clearly in the report,
- Drain channels should be added to the ramps,
- Drain channels are recommended for the building entrances,
- Coarse part and iron storage area’s drainage plan should be prepared,
- In case of overlapping of planned sewer pipes and stormwater pipes, the minimum distance should be 30cm. But, there is 5 cm distance between the sewer pipe and stormwater pipe at the point which pipe MH21-22 crosses,
- The hydraulic calculation for the open roofs should be made according to roof channel calculation specified in the BS or similar standards addressed in the

Spesification. Roof discharge pipe connections should be coordinated with stormwater lines,

- Two separate stormwater collection systems are planned as roof stormwater and ground storm water collecting system. The water collected from the roof is discharged to OF-3 point in the project area and ground drainage is discharged to OF-2 point. If the purpose of designing the stormwater system as 2 separate lines is to be considered as the recycling water of the system coming from the roof, a note should be written on the plan and information should be given in the report. If the OF-2 is an existing line, it should be showed and marked on the plan. There isn't enough information about OF-2 and OF-3 points,
- Reports and drawings must comply with the relevant specifications. For example, manhole covers are specified in the specification as Ductile font covers and their frames will be made in accordance with DIN 4271 or BS 497. This standard should be written in the report and
- There are only sewer and stormwater projects in the project area. The other infrastructure lines such as water supply line, fire network, electricity lines etc. are not provided to the should be considered together on a single plan (superposed) to ensure that the distances between them are available during maintenance practises.

10.5.3 Sewer System Plan

In sewer system design (EFW_PRT_I_SNT_GNL_1001_Rev0.3) the listed points need further explanation and clarifications.

In this context;

- The report shouldprovide information about the principles and sewage system,
- House connection pipe of Ø150mm PVC should be mentioned in the drawings to ensure te coordination during construction,
- There is a gap between calculation report and design standards set. Sewer collectors fullness ratio should be max 50%. But It is up to 70% in calculations,
- Legends should be added to the projects,
- The reasons to use concrete pipe should be explained clearly in the report,
- The planned sewer water line was discharged to the point indicated by O-1. The existing sewer line at point O-1 should be displayed on the relevant drawing,
- Although the slopes value is 1/500 in the report, there are different figures in the drawings. Report content and drawings should be consistent and
- Reports and drawings must comply with the relevant specifications. For example, manhole covers are specified in the specification as Ductile font covers and their frames will be made in accordance with DIN 4271 or BS 497. This standard should be written in the report.

10.6 Transport and Accessibility Review

The documents provided by the EPC Contractor and subject to our review are as follows

- 'EFW-PRT-T-RPT-GNL-1000-Rev_0.4.pdf',
- 'EFW-PRT-T-RPV-GNL-0001-Rev_0.4.dwg',
- 'EFW-PRT-T-RPV-GNL-0001-Rev_0.4.pdf'and
- 'SPA_Switchyard.dwg'

10.6.1 Traffic Impact, Location and Access

Traffic Management Plan Report does not include any information regarding access roads to site. It is not clear which major and/or minor roads would be used to access site regarding logistics.

Thus, it is not clear if there would be any need to build/upgrade/improve any of access roads whether it is capacity, geometric or pavement constrained.

It is understood that various traffic demands regarding operational requirements have been assessed within Traffic Management Plan report. While this calculation is based on an existing facility in order to propose a foundation, results are not presented with consideration of roads in the vicinity.

It is also presented in report that a vehicle simulation has been undertaken. Report states that "partly vehicle queue in front of the entering section of the WtEP". However, details are not provided.

It is understood that the EPC Contractor's scope is limited to the Project site, however the EPC Contractor should clarify how to manage the transportation of large equipment to the site. Also the Municipality should prepare a traffic impact plan considering the number of daily vehicles, routes, roads and existing conditions.

10.6.2 In-site Roadways and Circulation

Site circulation and general operational requirements are well defined within Traffic Management Plan report.

Swept path analyses are undertaken based on operations. It is seen from report figures that geometric design checks for circulation of proposed vehicles are done.

10.6.3 Traffic Lights

It is clear that traffic circulation will be controlled through traffic lights. No information is provided about traffic lights control or any related staff.

10.6.4 Emergencies, Disruptions to Operation and Response Plan

Fire truck circulation has been stated to be suitable within the report. Traffic Management Plan report does not present any information related to disruptions to operation in related to transportation.

A response plan is not available to operational failures such as mechanical failures of vehicles – especially at critical sections such as west part of south road, tipping hall entry and exit points. The existing traffic management plan should be updated with emergency response scenarious and transportation of large equipment. (Please see ESAP for Construction Stage Item 4.5).

APPENDIX

Appendix 1: Summary of Key Findings

Appendix 2: Site Visit Notes

Appendix 3: Gap Analysis

Appendix 4: Non Technical Summary (NTS)

Appendix 5: Stakeholder Engagement Plan (SEP)

Appendix 6: Cumulative Impact Assessment