Environment and Social Impact Assessment Study for the Proposed MSD Power Plant, Athi River, Kenya

Report Prepared for

Gulf Power Ltd.

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Your Health, Safety & Environment Partner
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Where field investigations have been carried out these have been restricted to a level of detail required for achieving the stated objectives of the work.

This work has been undertaken in accordance with the Quality Management System of Nutek Solutions Ltd.
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1. Executive Summary

1.1 Introduction

Gulf Power Ltd. (Proponent) wishes to develop an 80MW medium speed diesel power plant along the Nairobi – Mombasa highway in the Athi River area of Mavoko Municipality. The power plant is part of the Kenya Government’s Least Cost Power Development Plan (LCPDP) which has been developed by the Ministry of Energy in collaboration with energy sector lead agencies and Government parastatals in the energy sector.

The ESIA Study for the project is being coordinated on behalf of the Proponent by Nutek Solutions Ltd. (NEMA registered Firm of Experts). The Firm of Experts has been appointed by the Proponent to complete the ESIA Study in accordance with Legal Notice (L.N.) 101: Environment (Impact Assessment and Audit) Regulations 2003 promulgated under the Environment Management and Coordination Act, 1999. The proposed project will also be required to comply with the Energy Act, 2006 and its subsidiary legislation.

Kenya depends heavily on hydro power resources for the generation of electric power in the country. However due to the recent erratic and adverse climatic patterns experienced in the country, the water levels in the dams have been low resulting in inconsistent electric power generation. This is due to the fact that Kenya has not had a significant amount of rains to keep the dams full for the last two years. In order to supplement the shortfall in demand electricity, the Government of Kenya resorted to procure emergency electric power primarily from Aggreko of the U.K. at exorbitant costs. There are a number of MSD thermal energy power plants in Kenya located in Nairobi, Mombasa and Rabai. These power plants are more economical to run than the emergency diesel power plants. Other sources of electric power in Kenya include geothermal and thermal while there are significant efforts being placed in wind power generation.

The LCPDP postulates three scenarios of electricity demand namely low scenario, reference scenario and high scenario which are based on GDP growth assumptions.

The GDP growth scenario for the low forecast reflects the pessimistic case after considering the performance of the economy in the first quarter of 2009 which was estimated at 3.9%. The main assumption under this scenario is that the domestic economy will grow but at a slower pace than enumerated in the Vision 2030.

The reference scenario assumes a more realistic GDP growth path that is based on the current and probably future economic growth outlook. This scenario assumes that the economic growth will gradually gather momentum but will initially be constrained by the macro-economic disruptions occasioned by the recent internal and external shocks.
The high scenario is based on the economic growth aspirations encapsulated in the vision 2030 of attaining a sustainable economic growth rate of at least 10% per annum from 2013 underpinned on the expectations that the full benefits of the economic restructuring program articulated in the Vision 2030 will be realized. This scenario is the optimistic case.

On the basis of the reference scenario it is estimated that in 2010 the peak demand of electricity will be 1010MW of power growing to 1831MW by 2015 and 13537MW by the year 2030. On the basis of this scenario it is essential for Kenya to grow the power generation pool. Subsequently the proposed power plant aims to increase the amount of electric power available in Kenya for economic development.

This ESIA Study report presents the ESIA process, findings and EMP for the proposed power plant. The National Environment Management Authority (NEMA) is the lead agency in Kenya responsible for authorization of this project in consultation with other relevant lead agencies such as the Energy Regulatory Commission (ERC). The NEMA ESIA Study reference number for this project is NEMA/PR/5/2/6972.

1.2 Project Description

The project will comprise an MSD power plant situated in the Athi River area of Mavoko in Machakos district (see Figure 1-1).
Figure 1-1: Proposed location of power plant
1.2.1 Technical description

The proposed power plant will principally consist of the following project components:

- Power house (containing ten Wärtsilä model 20V32 MSD engines);
- Waste heat recovery system;
- Medium voltage switchgear;
- Step-up transformers 11/66KV;
- High voltage switchgear;
- Transportation and delivery to site;
- Mechanical works;
- Civil and structural works;
- Electrical works;
- Installation activities;
- Commissioning and start-up; and
- Testing.

The power plant will consist of ten Wärtsilä 20V32 turbocharged medium speed diesel (MSD) engines located in a power house. The power plant will consist of a mechanical, electrical and civil/structural specification.

The mechanical specification will consist of the ten generating sets, engine accessories and mechanical auxiliaries. Each of the ten generating sets will be 12.535m long, 3.67m wide and 4.4m high and the weight of the of each generator-engine will be about 130 metric tons. The generating sets will be imported and transported on the Mombasa – Nairobi highway via special flatbed trailers to the power plant site. Special abnormal load transportation arrangements will need to be implemented prior to the generators-engines’ arrival in Kenya. The engines will operate on heavy fuel oil (HFO) the specification of which will be a maximum of 2.0% sulfur content. The engine accessories will include a system for diesel engine diagnostic and predictive maintenance. The mechanical auxiliaries associated with the power plant will include:

- Compressed air system;
- Combustion air system;
- Exhaust gas system;
- Fresh cooling water system;
- Light fuel oil and heavy fuel oil system;
- Steam system/thermal oil system;
- Ventilation system; and
- Waste disposal system.
An electrical system is required to drive various electrical systems that make up the power plant. The electrical system will be capable of exporting net electrical power generated from the power plant, distribute electrical power within the power plant for internal loads and import electrical power during plant outages.

The civil/structural specification will be required to house the various parts of the power. Subsequently the civil/structural specification of the project will include:

- Power house which will include the engine hall, mechanical auxiliaries’ area and loading bay for maintenance and overhauls;
- Electrical building which will include the switch gear room, control room motor control center room, etc.;
- Fuel and lube oil treatment house;
- Aboveground tank farm and tank-truck unloading station; and
- Pump station area and water tank area.

1.2.2 Construction phase

Most raw materials and fittings required for the power plant will be imported although some components may be sourced locally. Heavy duty machinery including cranes, bulldozers, excavators, front-end loaders and electric welding machines will be used during construction. The bulk liquid storage tanks within the tank farm will be tested using x-ray equipment.

Construction activities will generate noise levels to a limit of 85 decibels (dB(A)).

During construction, water will be required for mixing of concrete. This water will be sourced from Mavoko Municipal Council. Hydrostatic testing will be used on the bulk liquid storage tanks and steel pipework. Water used for this purpose will need to be tested and approved in accordance with the NEMA standards before discharge takes place. Storm water will be controlled to minimize the risk of erosion and sedimentation and prevent water contamination. Contaminated storm water will be treated before being released.

It is anticipated that a minimum of 150 to 200 jobs will be created during the construction phase through civil, mechanical, electrical works respectively.

1.2.3 Operational phase

There will be minimal water requirements during the operational phase for drinking and sanitation (staff complement of approximately 28). An on-site water tank will hold water for cooling and sufficient for fire-fighting purposes. A standalone fire protection system will be provided for the power plant with all of the requisite fire-fighting equipment in accordance with relevant local and international codes.

Noise levels will be kept to a minimum by designing the facility to the requirements of Kenyan legislation on noise and ISO 15664:2001. Noise impacts shall not exceed the World Bank guideline levels or result in a maximum increase in background levels of 3 dB(A) at the nearest receptor off-site.
Sewage and waste will be dealt with in accordance with Mavoko Municipal Council by-laws and other relevant Kenyan legislation. The bulk liquid storage tanks will be bunded and provided with a closed system drain where the water will be treated prior to release.

Approximately 28 long-term job opportunities will be generated through the operation of the power plant. Skilled labor will be required in technical fields as well as in power plant operations and management. Local people will be employed wherever possible.

1.2.4 Decommissioning phase

It is envisaged that the power plant will be operational for a minimum of 20 years, and it is likely that this period will be extended. Decommissioning of the facility will be undertaken in accordance with HSE laws and regulations that will be prevalent at the time.

1.3 Associated facilities

The proposed project will evacuate power at 66KV to the national grid and supply two customers directly from the power plant.

Currently the Kenya Power and Lighting Company (KP&LC) feeds power to its consumers in Athi River town and beyond through their Juja Road and Embakasi sub-stations respectively both of which are located in Nairobi.

The Gulf Power project is expected to evacuate and supply power to the following locations:
- Embakasi sub-station (300mm²);
- Juja Road sub-station (300mm²);
- Athi River Steel Plant Ltd. – ARSP (150mm²); and
- National Cement Company Ltd. – NCC (150mm²).

Additionally, a new switchyard is to be constructed for receiving the evacuated power on land owned by KP&LC directly opposite the Mombasa Cement Company.

A location plan indicating the locations of the above facilities is shown in Figure 1-2.
Figure 1-2: Image showing location of transmission facilities from the Gulf Power Plant

1 Image courtesy of Google Earth 2011
1.3.1 Description of associated facilities

The KP&LC will not acquire any new land to install the transmission lines from the Gulf Power project. Instead they will use their existing land and uprate their conductors for evacuating power from the Gulf Power project.

Proposed switchyard

A proposed switchyard is to be constructed by the KP&LC directly opposite the Mombasa Cement Company; the location of the switchyard is shown in Figure 1-2 above; the switchyard will be located on land owned by the KP&LC.

This switchyard which is situated about 5.5km from the Gulf Power project site will receive power from the power plant and transmit it to the Embakasi and Juja sub-stations through two new 300mm² transmission lines.

An image showing the location of the switchyard in relation to the Nairobi – Mombasa highway is given below including the existing 66KV transmission lines feeding the ARSP and the NCC.

Figure 1-3: Image of the proposed switchyard location opposite Mombasa Cement Company

Tee-off point near Athi River Steel Plant

Currently electric power is supplied at 66KV to Athi River Steel Plant (ARSP) and National Cement Company (NCC) from the Embakasi and Juja Road substations respectively. The main 66KV line supplying these two customers is split into two (tee-off point near the ARSP) with one 66KV line going to ARSP from the backside of the steel plant while the other line feeds the NCC and follows the main Nairobi – Mombasa highway.
The existing 66KV transmission lines going to ARSP will be recovered by KP&LC and uprated with a new 300mm$^2$ transmission line emanating from the Gulf Power site and terminating at the proposed switchyard; KP&LC will use their existing infrastructure to mount the new transmission line. An image showing the tee-off point near the ARSP is given below.

**Figure 1-4: Image showing tee-off point near ARSP**

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**Athi River Steel Plant Ltd.**

The Athi River Steel Plant is a large electric power consumer and is situated about 0.8km north-west of the Gulf Power project site. Subsequently a new 150mm$^2$ transmission line will be mounted on concrete poles from the south of the Gulf Power plot along an earmarked road reserve and will terminate to the south of ARSP plot.

Additionally the existing transmission lines from the tee-off point up to the ARSP will be recovered by KP&LC; subsequently a new 300mm$^2$ transmission line emanating from the Gulf Power site to the proposed switchyard will be mounted on the existing KP&LC infrastructure.

Currently the ARSP is supplied power through the Embakasi and Juja Road substations respectively. The images below show the existing transmission lines supplying ARSP.
Figure 1-5: Existing transmission lines to ARSP

Figure 1-6: Image showing termination point of existing transmission line to ARSP
National Cement Company Ltd.

The National Cement Company (NCC) is another large electric power consumer and is currently supplied 66KV power through the Embakasi and Juja Road substations respectively. The NCC is situated about 8km towards the south east of the Gulf Power project site. An image showing the existing power lines going to the NCC is given below.

**Figure 1-7: Image showing existing 66kV line going to National Cement Company**

Existing 66KV line going towards National Cement Company. The Nairobi-Mombasa highway is to the left of the picture

In electrical engineering terms, the KP&LC will “open” the above transmission line at a location fronting the Gulf Power project site and connect a new 150mm$^2$ transmission line from the site to the existing transmission line going to the NCC for evacuating power. Minimal infrastructure changes are expected for this switch in power supply to the NCC.

**300mm$^2$ transmission lines to the proposed switchyard**

Currently KP&LC feeds power to its customers in Athi River town and beyond from its sub-stations located in Nairobi (Juja Road and Embakasi). Once the Gulf Power project is operational, the KP&LC is proposing to evacuate power at 66KV from power plant and feed it into the above two sub-stations via the proposed switchyard using 300mm$^2$ transmission lines.

One 300mm$^2$ transmission line will emanate behind the Gulf Power project site, past the backside of the ARSP and connect to the tee-off point shown in Figure 1-4 above. The existing 150mm$^2$ transmission line between the tee-off point and the proposed switchyard will be recovered and replaced with a new 300mm$^2$ transmission line. At the switchyard, this transmission line will be connected to the existing Embakasi sub-station line.
The second 300mm$^2$ transmission line will emanate from the Gulf Power project site, run along the Nairobi – Mombasa highway to the tee-off point (Figure 1-4) and connect to the new 300mm$^2$ transmission line between the tee-off point and the proposed switchyard. An image showing the existing 66KV transmission line feeding the ARSP and the NCC is given below; this line is to be uprated from 150mm$^2$ to 300mm$^2$.

**Figure 1-8: Image showing existing 66KV line feeding the ARSP and NCC**

### 1.3.2 Environmental assessment of associated facilities

An environment project report for the transmission lines is separately and independently being undertaken by the KP&LC in accordance with the environmental legislation in Kenya. However as part of the Gulf Power project, it is essential to characterize the environmental impacts associated with the transmission lines especially if there will be physical or economic displacement involved.

On the basis of site visits and meetings held with the KP&LC, it has been established that there will be minimal environmental impacts in connection with the associated facilities. KP&LC has minimized the environmental impacts by using their existing infrastructure and wayleaves for evacuating power from the Gulf Power project. Subsequently there will be no adverse physical and economic displacement associated with the evacuation of power from the proposed project.

The KP&LC has a Safety, Health and Environment (SHE) policy and management system which they will use during the construction of the associated facilities.
1.4 EIA process and timing

The EIA process comprised of two broad phases namely scoping and environmental assessment. The KP&LC who have leased the land on which the power plant is to be built and operated undertook an environmental project report (EPR) study. The NEMA did not approve the EPR Study for purposes of issuing an EIA License and subsequently instructed that a full ESIA Study be undertaken. The full ESIA Study was commissioned by Gulf Power Ltd. who was the successful company for the construction and operation of the proposed power plant. Gulf Power Ltd. is the Proponent for this project.

The scoping of potential environmental aspects and impacts included among others things, identification of issues, consultation with and participation of stakeholders (government, traditional authorities, businesses and lead agencies).

The Proponent and the Firm of Experts submitted a proposed terms of reference (TOR) for the full ESIA Study to the NEMA on February 17th, 2010 which included all environmental aspects associated with the proposed; the TOR was approved on February 26th, 2010 and paved way for the detailed environment assessment of the project. The environment assessment phase involved specialist investigations and assessment of the alternatives.

Public participation is integral to the ESIA process and as such directly and indirectly affected stakeholders were afforded a number of opportunities to provide comment. During the public/stakeholder consultation process several stakeholders were invited including the village elders, local communities, provincial administration, local authority administration, etc. The responses of all stakeholders were captured as part of the socio-economic baseline.

Notification for the public/stakeholder consultation meetings were done in February and March 2010 respectively. Following notification, public/stakeholder meetings and comments were solicited as follows:

- Meeting held with the Athi River officer commanding police division (OCPD) on February 22nd, 2010 regarding prevailing security situation in Mavoko area;
- Meeting held with the Athi River Health Centre Clinical Officer on February 22nd, 2010 regarding the facilities available for healthcare in the Mavoko area;
- Meeting held with the Mavoko Municipal Council Physical Planner on February 22nd, 2010 regarding planning permission requirements for the project;
- Meeting held with the Chief of Mavoko on February 23rd, 2010 to solicit guidance on the local administration requirements associated with the project;
- Meeting held with the KP&LC Corporate Safety, Health and Environment Deputy Manager/staff members about the KP&LC’s requirements with respect to the ESIA Study of the project;
- Meeting held with the Athi River District Commissioner on March 3rd, 2010 for solicitation of guidance on local administration aspects associated with the proposed project;
• Meeting held with the Athi River District Officer to organize a public/stakeholder open day meeting;

• Distribution of a background information document (BID) to interested and affected parties. Over 100 BIDs were circulated to the local communities and their leaders;

• Open day public/stakeholder meeting with the local community on March 12th, 2010;

• Meeting held with the KP&LC System Development Manager on March 17th, 2010 to understand the site selection process for the proposed power plant;

• Meeting held on March 24th, 2010 at Superior Homes Greenpark Estate (stakeholder) offices jointly between the IFC and the Firm of experts to solicit their views about the project;

• Meeting held with the Mavoko Municipal Council Deputy Municipal Planner on March 24th, 2010 (IFC officers were present at the meeting);

• Meeting held on March 24th, 2010 between the IFC and village elders at the Athi River Chief’s office.

Anticipated steps for the remainder of the EIA phase are:

• Submission of the final ESIA report and associated EMP to the NEMA, development finance institutions (DFIs) and lead agencies for consideration;

• Approval by NEMA to issue a gazette notices and newspaper adverts for two consecutive weeks to enable the public to review and comment on the ESIA Study for 30 days;

• Determination and issuance of an ESIA license by the NEMA following review of the documentation by lead agencies.

1.5 Consideration of Alternatives

The following alternatives have been considered for the project:

1.5.1 Location alternatives

The KP&LC had initially identified a parcel of land in Athi River near the EPZ for three proposed MSD thermal power plants. However due to the environmental impacts of siting three MSD power plants within the same parcel of land, the KP&LC sought to acquire land in three separate locations. The KP&LC’s site selection criteria included the following:

• A site with minimal environmental impacts;

• A site from which electric power can easily be evacuated;

• A site that was available for sale immediately; and

• A site adequate in size to contain the footprint of an 80MW MSD power plant.
Subsequently through a number of channels including local authorities, print media, estate agents and the public, the KP&LC identified three different locations for the MSD power plants. The three sites selected for the three power plants are as follows:

- The proposed site along the Nairobi – Mombasa highway just before the Stony Athi River;
- A site near the Athi River EPZ facility; and
- A site near Thika town.

1.5.2 Other alternatives

The following alternatives other than location were considered as part of the ESIA process:

- Process/activity/operation alternatives. The decision to establish a power plant along the Nairobi – Mombasa highway is influenced by the ease of evacuating power to a proposed industrial/manufacturing concern in Athi River and the KP&LC Embakasi sub-station. The Nairobi – Mombasa highway location has been selected as it is located in an area where limited industrial activities currently occur. Additionally the location is relatively close to the supply points where power will be evacuated to from the proposed power plant.

- Demand alternatives. Concern about the negative impacts of emergency power plants such as those run by Aggreko is promoting the use of independent power producers. The cost of generating power using MSD engines is relatively more economical than the emergency power generated using diesel fuel.

- No-go option. Not constructing the power plant would mean that benefits, including improved electric power supply and the associated national economic benefits, would not transpire. At the same time, the negative impacts associated with the project would not materialize.

1.6 Key Findings of Specialist Studies

Specialist studies were undertaken on specific aspects of the terrestrial environment with the aim of ascertaining the potential project impacts and making recommendations for measures to avoid and/or mitigate/enhance these effects during the planning and design; preconstruction and construction; operation and closure phases. These recommendations inform the environmental assessment (See EMP in Section 14 of the main report).
1.6.1 Hydrology

The proposed site falls within the upper Athi River catchment basin. The nearest river system is the ephemeral Stony Athi River situated to the east of the power plant site and drains into the main Athi River towards the north. An image of the Stony Athi River is shown in Figure 1-9. The surface soils are generally referred to as vertisols which are black cotton soils that swell during the wet season and contract during the dry season. The site generally slopes towards the Stony Athi River as shown in Figure 1-10.

Figure 1-9: Image of the Stony Athi River with Greenpark Estate in the foreground
Key findings and recommendations include:

- Berms to be constructed downstream of all construction areas to ensure that sediments do not travel downstream during storm events. Any water released from the construction area to the environment will be treated suitably prior to discharge. Stormwater from upstream will be diverted around the construction sites to limit the volumes of water flowing through the site, becoming contaminated and adding to erosion.

- The power plant infrastructure must be constructed and operated to comply with the requisite local and international related codes and standards. Regular testing of facilities should be carried out and records kept.

- For environmentally sound hydrocarbons management within the power plant, the Proponent will implement a leak and failure detection system during the operational phase including bunding of the storage facilities. All dirty areas will be bunded to prevent runoff to the downstream environment. The Proponent will ensure that potentially contaminated wastewater remains on site and is diverted into oil water separators. A water management plan for disposal of contaminated water must be designed and implemented.

- A monitoring program for surface water complying with Kenyan legislation (L.N. 120: Water Quality Regulations, 2006) to be implemented.

- During decommissioning, cleanup of the site should be conducted and the site should be rehabilitated to minimize sediment leaving the site.
1.6.2 Terrestrial ecology

The key findings and/or recommendations of the terrestrial ecology study (dealing with flora and fauna) include:

- The study area falls in the agro-climatic zone V-4 which is described as semi-arid. From a land use perspective, the soils around the project site are generally poor and are characterized by low water content and low natural fertility.
- No red data species were found on the project site, and the site was found to be suitable for the power plant development.

1.6.3 Socio-economic impact assessment

The project lies within Mavoko Municipal Council. The population within the municipality is about 65,000 people and covers an area of about 700km² and the population around the power plant site can be described as sparse. The unemployment rate in the district is generally high and is further exacerbated by the recent global financial crisis which had a significant effect on Kenya’s economy. The key findings and/or recommendations of the social impact assessment include:

- Damage to the Nairobi – Mombasa highway and traffic congestion could result from the power plant construction and operation. This could potentially cause disruption, health and safety impacts, as well as economic impacts. Measures will be required to avoid and/or minimize impacts on roads and disruption of traffic. Road rehabilitation needs to take place during and following construction as applicable.
- Attitude formation against the project could have economic impacts and could impact on social well-being. People’s perception of safety could be affected by the presence of the power plant; thus transparent information should be supplied to the community from the outset of the project.
- There is a potential risk that the construction process could increase HIV/AIDS prevalence in the area. An active HIV/AIDS awareness campaign should be carried out with workers.
- Construction activities could result in significant noise impacts so as to impact on general well-being, health and functioning. Construction activities should be restricted to daytime hours and noise levels should be monitored to comply with relevant Kenyan laws and regulations.
- The safety and security mitigation measures should be strictly followed.
- Local communities should be educated on the safety risks of the power plant. Emergency and prevention plans should involve surrounding communities. Information sharing should be carried out in the form of pamphlets, open days etc. A complaints hotline should be available as part of the grievance procedure.
1.6.4 Environment risk assessment

The key findings and/or recommendations of the environmental risk assessment include:

- The environmental risks for the operational phase are anticipated to be low during the normal operation of the power plant; provided that the design of the facility is carried out in accordance with international standards and codes of practice for MSD engine power plants and include assessment of risk of failure of the infrastructure by project design engineers.

- Infrastructure used for the proposed power plant must be in accordance with international standards and best practice as a minimum, or where Kenyan standards are more stringent, these should be applied. Monitoring of the construction methodologies in accordance with requisite construction specifications and codes must be implemented to ensure that the facility is structurally sound.

- Prior to commencement of operation of the power plant, a health and safety risk assessment should be carried out to comply with the regulatory framework. Evacuation plans must be developed for the surrounding areas. Where the provincial or local administration is providing emergency response, the Proponent must ensure that sufficient infrastructure is in place to manage any eventualities. Where these services are found to be insufficient, the Proponent will fully resource and implement its own emergency management and response plan.

1.6.5 Geology and soils

The volcanic rocks in the area are represented by Upper Athi Series consisting of sediments and Lake Beds, Athi Tuffs and Kapiti phonolite. The thickness of these volcanics varies but generally decreases towards the south and southeast as they reach the limit of the lava flows.

Below the volcanics are the undifferentiated crystalline rocks of the Mozambique Belt that is the Basements System rocks consisting mainly of gneisses and schists. These are shallow seated and have been encountered by several of the numerous Boreholes drilled in the vicinity of the area.

The geological succession underlying the project area consists of the Cenozoic volcanics which, in geo-chronological order, consists of the following formations:

- Upper Athi Series
- Kapiti Phonolites
- Basement System
Findings of the geology and hydrogeology specialist study with respect to the proposed project indicates that the surficial geology provides a good foundation for structures and loads that will be erected on it. A geotechnical investigation was undertaken by the KP&LC during environment project report stage. According to the geotechnical specialist’s report, all excavations should be taken down to the hard rock level where it is estimated that the allowable bearing pressure 300kPa can be used on a pad or strip foundations. Associated settlements of less than 25mm can be expected.

In terms of soils, the project area lies in an area of predominantly dark grey black cotton soil. The thickness of these soils varies and on the project plot it is between 0.6 and 1.2 meters in depth. Below this is an orange-brown lateritic soil. This is a weathering product of the Kapiti Phonolite that underlies it. The geotechnical specialist used a dynamic cone penetrometer (DCP) test method to estimate the soil bearing capacity. On the basis of the site soils having an equivalent California Bearing Ratio (CBR) of 10, it was concluded that an allowable bearing pressure of 100kPa can be used on a pad foundation.

While the soil chemical tests did not indicate the need for protecting buried concrete, it is good practice to use a well compacted concrete with a minimum cement content of 340kg/m$^3$ and a maximum free water:cement ratio of 0.5.

1.6.6 Noise quality

A baseline noise and vibration analysis was carried out in and around the project site. The analysis indicates that the ambient noise quality is generally similar to that found in a rural set-up. The Nairobi – Mombasa highway is adjacent to the project site and presently, vehicles moving over it create noise levels in excess of the permissible limits stipulated in Kenyan legislation.

Nocturnal and diurnal baseline noise contouring was done within and around the site for 16 receptor points to characterize the ambient noise levels. The key findings/recommendations for prevention of noise in excess of stipulated regulations are:

- The contractor shall observe strict hours of operation for the construction of the project. These hours will be 07:30hrs – 18:00hrs during weekdays and 07:30hrs – 14:00hrs during weekends.
- The contractor’s construction plant and equipment will be required to meet the noise characteristics stipulated in L.N. 25: Noise Prevention and Control Rules, 2005 under the OSHA at all times.
- The contractor will ensure that their construction plant and equipment is maintained in a good state of repair during the construction phase and that such plant and equipment does not emit noise in excess of the occupational exposure limit defined in L.N. 25: Noise Prevention and Control Rules, 2005 under the OSHA. If construction plant and equipment does not meet the minimum legal requirements, a hearing conservation program shall be implemented.
• Baseline and periodic audiometric testing of workers exposed to noise levels in excess of 85dB(A) will be undertaken in accordance with L.N. 24: Medical Examinations Rules, 2005 under the OSHA.

• During the operational phase noise will be generated by the ten Wärtsilä engines. These will be located within a power house that will be acoustically designed. According to the manufacturer, noise levels at the fence line will not exceed the guidelines recommended by the World Health Organization (WHO); the community noise levels for commercial facilities as recommended by the WHO are 70 dB(A) at the fence line. The Proponent will ensure compliance with the requirements of Kenyan legislation on noise, specifically L.N. 25: The Factories and Other Places of Work (Noise Prevention and Control) Regulations, 2005 and L.N. 61: Environmental Management and Coordination (Noise and Vibration Pollution Control) Regulations, 2009.

1.6.7 Air quality

The land use around the area of the power plant was observed to be for light inoffensive industrial use and the baseline air quality survey indicates that the ambient air quality is good with respect to the emissions of VOCs, SO\(_x\) and NO\(_x\). The results of the ambient baseline air quality survey conducted in and around the vicinity of the study area are indicated in the table below. All units are in \(\mu g/m^3\).

<table>
<thead>
<tr>
<th>Site</th>
<th>SO(_2)</th>
<th>NO(_2)</th>
<th>Benzene</th>
<th>Toluene</th>
<th>E-benzene</th>
<th>m,p Xylene</th>
<th>o-Xylene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2</td>
<td>7.83</td>
<td>3.54</td>
<td>1.68</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
</tr>
<tr>
<td>Near Athi River</td>
<td>0.65</td>
<td>2.75</td>
<td>2.43</td>
<td>1.53</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
</tr>
<tr>
<td>Near steel plant</td>
<td>5.11</td>
<td>5.11</td>
<td>3.58</td>
<td>3.83</td>
<td>1.16</td>
<td>1.61</td>
<td>1.53</td>
</tr>
<tr>
<td>Along Athi River</td>
<td>4.81</td>
<td>4.81</td>
<td>2.54</td>
<td>1.15</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
</tr>
<tr>
<td>Superior Homes</td>
<td>&lt;DL</td>
<td>2.46</td>
<td>1.57</td>
<td>1.25</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
</tr>
<tr>
<td>Maasai manyatta</td>
<td>&lt;DL</td>
<td>3.54</td>
<td>1.24</td>
<td>1.94</td>
<td>&lt;DL</td>
<td>&lt;DL</td>
<td>4.36</td>
</tr>
</tbody>
</table>

<DL = below detection limits

On the basis of the above results and the fact that the power plant will emit stack emissions, an air dispersion modeling was done in South Africa using the US EPA approved AERMOD model and the European ADMS model. Stack emission design data for the 20V32 generating sets was provided by Wärtsilä Finland.

The two models were run on various parameters including meteorological conditions around the power plant, emission factors gotten from the US EPA and sulfur content in HFO. The results of the air dispersion modeling were compared to the European Community Directive 2008/50/EC on ambient air quality.

The results of the air dispersion modeling using the two methods indicates that ADMS is slightly more conservative than AERMOD in the vicinity of the power plant, while AERMOD is more conservative further away at elevated areas such as the Lukenya Hills. The results of the air dispersion modeling are given in the table below.
### Predicted concentrations (µg/m³) and frequencies of exceedences at the sensitive receptors

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging Period</th>
<th>EC limits (µg/m³)</th>
<th>Predicted concentrations (µg/m³)</th>
<th>Athi River</th>
<th>Housing estate</th>
<th>Lukenya school</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ADMS</td>
<td>AERMOD</td>
<td>ADMS</td>
<td>AERMOD</td>
</tr>
<tr>
<td>SO₂</td>
<td>Highest monthly</td>
<td>350</td>
<td>160</td>
<td>90</td>
<td>300</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>Hourly FOE</td>
<td></td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Highest daily</td>
<td>125</td>
<td>40</td>
<td>23</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Daily FOE</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NO₂</td>
<td>Highest hourly</td>
<td>200</td>
<td>100</td>
<td>55</td>
<td>175</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Hourly FOE</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Annual average</td>
<td></td>
<td>40</td>
<td>5.5</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>Highest daily</td>
<td>50</td>
<td>1.7</td>
<td>1</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Annual average</td>
<td></td>
<td>40</td>
<td>0.18</td>
<td>0.14</td>
<td>0.02</td>
</tr>
</tbody>
</table>

**NOTES:**

FOE: frequency of exceedance of EC limits shown

The key findings/recommendations of the air quality assessment are:

- At the time of the ESIA Study, Kenya had not promulgated the draft air quality regulations;
- During the construction phase, plant and equipment should be serviced in accordance with the original equipment manufacturers (OEM) recommended manuals.
- Dust suppression methods should be deployed during the construction phase at the construction site and access roads.
- At the nearest sensitive receptor of Athi River town and the housing estate immediately after the Stony Athi River, none of the EC limit values are predicted to be exceeded;
- AERMOD predicts exceedences of the SO₂ and NO₂ hourly limits at Lukenya School with the frequency of exceedence being equal to the limit for SO₂ and slightly over the limit for NO₂. The environment mitigation measures are proposed in section 14 of this ESIA Study.
1.6.8 Environment Impact Assessment

A number of potential impacts arising from the proposed development have been assessed by the specialists and the Firm of Experts. The significance of potential impacts identified during the process was assessed by the Firm of Experts according to assessment criteria (severity, spatial scope, duration and frequency of activity and impact). Using an established methodology (See Section 13 of the ESIA Report), impacts were assigned a significance rating on a scale from very low to very high and as positive and/or negative. Each potential impact was rated twice; prior to and after management measures had been implemented. Design and planning considerations informed impact management.

1.6.9 Environment Management Plan

The purpose of the EMP is to ensure that social and environmental impacts, risks and liabilities identified during the ESIA process are effectively managed during the construction, operations and closure of the proposed power plant. The EMP specifies the mitigation and management measures to which the Proponent is committed, and shows how the Project will mobilize organizational capacity and resources to implement these measures. It also shows how management measures aimed at mitigation and enhancement will be scheduled.

Best practice principles require that every reasonable effort be made to reduce and preferably to prevent negative impacts, while enhancing positive benefits, especially within the communities most directly affected by the proposed project. These principles have guided the ESIA process. In many cases, potential negative impacts have been avoided through careful design and location of facilities.

The EMP is a key product of the ESIA process that commenced in March 2010, and is based on information on the management and/or mitigation measures that will be taken into consideration to address impacts in respect of: planning and design; pre-construction and construction activities; operation; and closure, where relevant. It is important to note that the EMP is a living document that will be periodically reviewed and updated.

Responsibility for the EMP will reside in the Health, Safety and Environment (HSE) functional management cluster of the EPC Contractor (during the construction phase) and the Proponent (during the operational phase) but there will be links with other functional clusters in areas such as operation and maintenance services.

Table 1-1 is structured to present the proposed management measures for each potential impact. These impacts are clustered according to aspect (for example surface water, ecology and health and safety). The table presents a schedule for the implementation of management/mitigation activities, subdivided by project phase. Programs and plans relevant to the management of potential impacts are also featured. Details relating to these management programs and plans are presented in Sections 14.4 and 14.5 in the main ESIA Study report.
Table 1-1: Mitigation and Management Plan relating to impacts caused by project activities during all project phases

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact</th>
<th>Mitigation Measure</th>
<th>Schedule</th>
<th>Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pre-con</td>
<td>Planning and design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Con</td>
<td>Rehabilitation and closure plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Op</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cl</td>
<td></td>
</tr>
<tr>
<td>Geology and topography</td>
<td>Soil compaction</td>
<td>In order to prevent irreversible construction compaction effects arising from construction plant and equipment, ensure that to the extent possible, construction is undertaken during dry periods. On completion, all non-built up areas should be landscaped.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil erosion</td>
<td></td>
<td>To prevent soil erosion all non-built up areas should be landscaped and appropriate soil bind grass planted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water</td>
<td>Impact on flow</td>
<td>If possible undertake initial construction activities during the dry season to prevent water/soil run-off especially on side slopes. Water should also be diverted away from the project footprint areas through properly constructed drainage channels</td>
<td></td>
<td>Planning and design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Construction management plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Construction control plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rehabilitation and closure plan</td>
</tr>
<tr>
<td>Impact on water quality</td>
<td></td>
<td>Ensure that spills emanating from construction plant and equipment are cleaned immediately. Any petroleum products stored on site must be stored in bunded areas to prevent contamination of surface water. Contractor to adhere to Construction HSE management plan during the construction phase.</td>
<td></td>
<td>Planning and design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Construction management plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Construction control plan</td>
</tr>
<tr>
<td>Aspect</td>
<td>Impact</td>
<td>Mitigation Measure</td>
<td>Schedule</td>
<td>Management Plan</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>---------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ecology</td>
<td>Impacts on terrestrial ecology</td>
<td>Set up measures to ensure that during preconstruction and construction, impacts on sensitive ecological areas and individual protected biota are minimized and that good management is exercised during operation so as to prevent ecological impacts</td>
<td>Pre-con</td>
<td>• Conservation of natural habitats program&lt;br&gt;• Construction management plan&lt;br&gt;• Construction control plan&lt;br&gt;• Rehabilitation and closure plan</td>
</tr>
<tr>
<td>Air quality</td>
<td>Decreased air quality due to dust and VOC emissions</td>
<td>Develop and implement effective measures for minimization of dust during the preconstruction and construction phase, followed by rehabilitation in a timely manner. Contractor to ensure that construction plant and equipment is in a good state of repair at all times to prevent adverse exhaust air emissions.</td>
<td>Con</td>
<td>• Air quality management program</td>
</tr>
<tr>
<td>Stack emissions</td>
<td></td>
<td>Set up an air quality monitoring station about 10km east of the project site to collect SO₂ and NOₓ data. Regularly monitor stack emissions using the inbuilt stack continuous emission monitoring system.</td>
<td>Op</td>
<td>• Air quality management program</td>
</tr>
<tr>
<td>Waste</td>
<td>Pollution from waste generation</td>
<td>Develop and implement safe procedures for management of non-hazardous and hazardous wastes in accordance with L.N. 121: Waste Management Regulations, 2006. Contractor is responsible for this during the construction</td>
<td>Cl</td>
<td>• Waste management plan</td>
</tr>
<tr>
<td>Aspect</td>
<td>Impact</td>
<td>Mitigation Measure</td>
<td>Schedule</td>
<td>Management Plan</td>
</tr>
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<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>phase and the Proponent during the operational phase of the project.</td>
<td>Pre-con</td>
<td>• Noise managementprogram</td>
</tr>
<tr>
<td>Noise and vibration</td>
<td>Noise during construction</td>
<td>Contractor’s plant and equipment should comply as a minimum with requirements of L.N. 25: Noise Prevention and Control Rules, 2005.</td>
<td>Con</td>
<td>• Noise management program</td>
</tr>
<tr>
<td>Socio-economics</td>
<td>Compatibility with existing and proposed land uses</td>
<td>Proponent should create public awareness about “safe” land uses of any future projects in the vicinity of the proposed project area</td>
<td>Cl</td>
<td>• Community safety plan</td>
</tr>
<tr>
<td></td>
<td>Increased crime and in-migration</td>
<td>Implement measures to manage expectations about job creation during the preconstruction, construction and operational phases. Develop and put into practice strategies to minimize crime, to include effective communication with landowners to inform them about the movement of work teams, and codes of conduct for contractors and employees.</td>
<td></td>
<td>• Land acquisition and compensation plan</td>
</tr>
<tr>
<td></td>
<td>Creation of employment opportunities</td>
<td>Implement where feasible measures to employ local community members during both the preconstruction and construction phase, as well as the operational phase.</td>
<td></td>
<td>• Community safety plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Labor and human resource plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Soil conservation management program</td>
</tr>
<tr>
<td>Aspect</td>
<td>Impact</td>
<td>Mitigation Measure</td>
<td>Schedule</td>
<td>Management Plan</td>
</tr>
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<td>--------</td>
<td>------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td>Increased risk of disease with influx of workers and opportunity seekers</td>
<td>Ensure effective communication with communities to limit expectations of employment creation. Develop and implement a HSE program for employees.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social divisions over limited jobs and perceived preferential access</td>
<td>Develop and implement transparent employment and procurement measures which comply with the regulatory framework and maximize local benefits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accidents as a result of increased traffic</td>
<td>Implement measures to ensure that traffic and road safety hazards are minimized during the preconstruction, construction and operational phases.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic</td>
<td>Damage to roads and other transport infrastructure</td>
<td>Develop and implement measures to prevent damage to regularly used roads to the project site especially the Nairobi – Mombasa highway fronting the project site. Ensure that contractor vehicles comply with axle load limits.</td>
<td></td>
<td>• Community safety plan</td>
</tr>
<tr>
<td></td>
<td>Increased traffic and road safety hazard</td>
<td>Develop and implement a traffic management plan to take advantage of off-peak hours for delivery of construction materials and abnormal loads during the construction phase. Contractor drivers should possess defensive driving skills gotten from a reputable training consultancy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspect</td>
<td>Impact</td>
<td>Mitigation Measure</td>
<td>Schedule</td>
<td>Management Plan</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Health and  | Occupational health and safety      | Develop and implement a contractor safety program which includes the relevant provisions of OSHA, WIBA and their respective subsidiary legislation. Specifically ensure that the construction complies with L.N. 40: Building Operations and Work of Engineering Construction Rules, 1984. |          | • Contractor health and safety program  
• Emergency response plan  
• Social responsibility plan  
• Community safety plan |
1.7 Conclusion

The project which includes the construction and operation of a power plant, is anticipated to bring national economic benefits to Kenya through improved electricity availability. Key negative impacts which will require careful management during the construction and operation of the facility are:

- The risks to public safety and environmental quality (soil, air and water) should there be a large-scale incident caused by human error, equipment failure or damage due to third party interference.
- Impacts on noise quality should the noise levels generated at the fence line exceed those promulgated in Kenya or recommended by the WHO;
- Impacts on air quality arising from stack emissions from the power plant.

It is envisaged that it will be possible to successfully mitigate impacts associated with the development. In particular, the power plant will be designed, constructed and operated according to the latest industry norms and standards. The EMP includes plans to be formulated during the detailed design phase, and has been developed as part of the ESIA to manage potential impacts. Programs and plans developed and implemented through the EMP will be monitored and audited to ensure compliance.

The ESIA process is iterative and will accommodate refinement of the power plant site plan and technical design to accommodate safety considerations arising from preliminary hazard analysis. Comments on this ESIA Study will be sought from the public/stakeholders via a 30-day notice to be published in the Kenya Gazette and newspaper of national circulation as required by the NEMA. Comments will further be sought from the lenders of this project. Comments received from this process will be incorporated into the ESIA Study before approval is granted by the NEMA through issuance of an EIA License to the Proponent.
## 1.8 List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>µg/m³</td>
<td>Microgram per cubic meter</td>
</tr>
<tr>
<td>ARSP</td>
<td>Athi River Steel Plant Ltd.</td>
</tr>
<tr>
<td>BAP</td>
<td>Best Available Practice</td>
</tr>
<tr>
<td>BAT</td>
<td>Best Available Technology</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>The variety of life forms, including the plants, animals and micro-organisms, the genes they contain and the ecosystems and ecological processes of which they are a part</td>
</tr>
<tr>
<td>Biomass</td>
<td>The living weight of a plant or animal population, usually expressed on a unit area basis</td>
</tr>
<tr>
<td>BTEX</td>
<td>Compounds of benzene, toluene, ethyl-benzene and xylene</td>
</tr>
<tr>
<td>Community</td>
<td>An assemblage of organisms characterized by a distinctive combination of species occupying a common environment and interacting with one another</td>
</tr>
<tr>
<td>Community structure</td>
<td>All the types of taxa present in a community and their relative abundance</td>
</tr>
<tr>
<td>dB(A)</td>
<td>Decibels on the A-Scale</td>
</tr>
<tr>
<td>DFO</td>
<td>Diesel Fuel Oil</td>
</tr>
<tr>
<td>EA</td>
<td>Environment Audit</td>
</tr>
<tr>
<td>Effluent</td>
<td>A complex waste material (e.g. Liquid industrial discharge or sewage) that may be discharged into the environment.</td>
</tr>
<tr>
<td>EIA/EAs</td>
<td>Environment (Impact Assessment &amp; Audit) Regulations 2003</td>
</tr>
<tr>
<td>EMCA</td>
<td>Environment Management &amp; Coordination Act 1999</td>
</tr>
<tr>
<td>ESD</td>
<td>Emergency Shut Down</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>ESM</td>
<td>Environmentally Sound Management</td>
</tr>
<tr>
<td>Guideline</td>
<td>Trigger values These are the concentrations (or loads) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur. They indicate a risk of impact if exceeded and should 'trigger' some action, either further ecosystem specific investigations or implementation of management/remedial actions</td>
</tr>
<tr>
<td>Ha</td>
<td>Hectare</td>
</tr>
<tr>
<td><strong>Acronym</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Habitat</td>
<td>The place where a population (e.g. Animal, plant, microorganism) lives and its surroundings, both living and nonliving.</td>
</tr>
<tr>
<td>HFO</td>
<td>Heavy fuel oil</td>
</tr>
<tr>
<td>HSE</td>
<td>Health, Safety and Environment</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature and Natural Resources</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>km</td>
<td>Kilometers</td>
</tr>
<tr>
<td>KP&amp;LC</td>
<td>Kenya Power and Lighting Company Ltd.</td>
</tr>
<tr>
<td>m</td>
<td>Meters</td>
</tr>
<tr>
<td>mb</td>
<td>Millibar</td>
</tr>
<tr>
<td>mg/l</td>
<td>Milligrams per liter</td>
</tr>
<tr>
<td>mm</td>
<td>Millimeters</td>
</tr>
<tr>
<td>MT</td>
<td>Metric Tons</td>
</tr>
<tr>
<td>NCC</td>
<td>National Cement Company Ltd.</td>
</tr>
<tr>
<td>NEC</td>
<td>National Environment Council</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Environment Management Authority</td>
</tr>
<tr>
<td>PCC</td>
<td>Public Complaints Committee</td>
</tr>
<tr>
<td>Pollution</td>
<td>The introduction of unwanted components into waters, air or soil, usually as result of human activity; e.g. Hot water in rivers, sewage in the sea, oil on land.</td>
</tr>
<tr>
<td>Population</td>
<td>Population is defined as the total number of individuals of the species or taxon</td>
</tr>
<tr>
<td>ppm</td>
<td>Parts Per Million</td>
</tr>
<tr>
<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
</tr>
<tr>
<td>SEA</td>
<td>Strategic Environmental Assessment</td>
</tr>
<tr>
<td>Sediment</td>
<td>Unconsolidated mineral and organic particulate material that settles to the bottom of aquatic environment.</td>
</tr>
<tr>
<td>SERC</td>
<td>Standards and Enforcement Review Committee</td>
</tr>
<tr>
<td>Species</td>
<td>A group of organisms that resemble each other to a greater degree than members of other groups and that form a reproductively isolated group that will not produce viable offspring if bred with members of another group</td>
</tr>
<tr>
<td>Suspended</td>
<td>Material Total mass of material suspended in a given volume of water, measured in mg/l.</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Suspended matter</td>
<td>Suspended material.</td>
</tr>
<tr>
<td>Suspended sediment</td>
<td>Unconsolidated mineral and organic particulate material that is suspended in a given volume of water, measured in mg/l.</td>
</tr>
<tr>
<td>Taxon (Taxa)</td>
<td>Any group of organisms considered to be sufficiently distinct from other such groups to be treated as a separate unit (e.g. Species, genera, families).</td>
</tr>
<tr>
<td>Toxicity</td>
<td>The inherent potential or capacity of a material to cause adverse effects in a living organism.</td>
</tr>
<tr>
<td>Toxicity test</td>
<td>The means by which the toxicity of a chemical or other test material is determined. A toxicity test is used to measure the degree of response produced by exposure to a specific level of stimulus (or concentration of chemical).</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Measure of the light-scattering properties of a volume of water, usually measured in nephelometric turbidity units.</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile Organic Compounds</td>
</tr>
<tr>
<td>Vulnerable</td>
<td>A taxon is vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.</td>
</tr>
</tbody>
</table>
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Appendix B: Baseline noise level survey report
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Appendix J: EPC Contractor’s Construction HSE Management Plan
Appendix K: IFC Performance Standards
Appendix L: IFC Environment, Health and Safety Guidelines for Thermal Power Plants
Appendix M: WHO Guidelines for air quality and health
Appendix N: Equator Principles
Appendix O: Lease Document for Power Plant
1.10 Acknowledgement

This Environmental and Socio-economic Impact Assessment (ESIA) for the proposed 80MW medium speed diesel engine power plant was carried out by Nutek Solutions Ltd. on behalf of the Gulf Power Ltd.

Nutek Solutions Ltd. acknowledges the collective and individual contributions from a range of companies, academic and scientific experts in the preparation of this ESIA report. Nutek Solutions Ltd. is grateful for the willing assistance of these companies and individuals and their contribution to a rigorous and comprehensive ESIA report.

Nutek Solutions Ltd. acknowledges with thanks the following:

Companies

<table>
<thead>
<tr>
<th>Company</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulf Power Ltd.</td>
<td>Information about the Project</td>
</tr>
<tr>
<td>Wärtsilä Finland Oy</td>
<td>Engineering information about project</td>
</tr>
<tr>
<td>SGS South Africa (Pty) Ltd.</td>
<td>Noise quality baseline assessment</td>
</tr>
<tr>
<td>Airshed Planning Professionals (Pty) Ltd.</td>
<td>Air quality dispersion modeling</td>
</tr>
<tr>
<td>SGS Kenya Ltd.</td>
<td>Baseline ambient air quality data</td>
</tr>
</tbody>
</table>

Academic and scientific experts and their organizations

<table>
<thead>
<tr>
<th>Expert</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Eliud Wamwangi – Reg. Geologist</td>
<td>Geology, hydrogeology and soils specialist study</td>
</tr>
<tr>
<td>Mr. Dickens Odeny – Research Scientist</td>
<td>Ecological Impact Assessment</td>
</tr>
<tr>
<td>Ms. Angela Kabiru – Archeologist</td>
<td>Archeological and Cultural Heritage Impact Assessment</td>
</tr>
<tr>
<td>Mr. Geoffrey Njoroge – Physical Planner</td>
<td>Land use analysis</td>
</tr>
<tr>
<td>Eng. Mordecai Omenda – Roads Engineer</td>
<td>Transport Impact Analysis</td>
</tr>
<tr>
<td>Ms. Priscilla Kinyari – Sociologist</td>
<td>Socio-economic impact assessment</td>
</tr>
</tbody>
</table>
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2. Introduction

2.1 Background

Gulf Power Ltd. wishes to develop an 80MW medium speed diesel (MSD) power plant adjacent to the Nairobi – Mombasa highway in Athi River town in Machakos district. The power plant forms one component of the latest version of the 2010 – 2030 Least Cost Power Development Plan (LCPDP). The land on which the power plant is to be built is owned by the Kenya Power and Lighting Company Ltd. (KP&LC) and will be leased to Gulf Power Ltd. for a period of 20 years. The environmental and social aspects and impacts associated with the proposed power plant are being coordinated by Nutek Solutions Ltd. which is a National Environment Management Authority (NEMA) registered Firm of Experts. Nutek Solutions Ltd. was appointed by Gulf Power Ltd. to complete the Environmental and Social Impact Assessment (ESIA) Study and Environment and Social Impact Management Plan (ESIMP) for the necessary environmental authorizations in terms of the Environment Management and Coordination Act, 1999 (EMCA).

This report describes the ESIA phase for the Gulf Power 80MW MSD power plant and presents the ESIMP. Subsequently a full ESIA Study has been performed for this project in order to provide the necessary inputs for environmental authorization (EIA License). The proposed power plant has been the focus of specialist impact assessment studies undertaken for this report.

The NEMA has been identified as the lead agency for environmental authorization of the project. The NEMA reference number for the project is NEMA/PR/5/2/6972.

2.2 Contact details of the Proponent

Project Proponent: Gulf Power Ltd.
Physical Address: Geminia Insurance Plaza, Geminia Insurance Plaza
Kilimanjaro Avenue – Upper Hill
P.O. Box 61872 – 00200, Nairobi, Kenya
Telephone: (+254) 20 272 5334/5 or 272 9029/30
Fax: (+254) 20 272 5256/9031
Website: www.gulfenergy.co.ke
Contact Person: Mr. Francis Njogu
E-mail: njogu@gulfenergy.co.ke
2.3 Motivation for the project

The Energy Sector policy is defined by the Sessional Paper No. 4 on Energy approved by Parliament in 2004. The objectives of the policy are the enhancement of the legal, regulatory and institutional framework of the sector in order to create both consumer and investor confidence and provision of adequate cost effective supply of energy to meet development needs while protecting the environment. The culmination of Sessional Paper No. 4 resulted in the enactment of the Energy Act, 2006 which is the principal act that is used to regulate the energy sector in Kenya.

In order to provide cost effective energy sources to consumers in Kenya, the Ministry of Energy together with parastatals in the energy sector developed an energy blueprint known as the Least Cost Power Development Plan (LCPDP). Every year, an update of the Least Cost Power Development Plan ("LCPDP") for a twenty year planning is carried out. The last update was completed in March 2008 and covers the period 2009 to 2029. During this period Kenya's maximum demand for interconnected electricity is projected to increase from 1,172 MW to 8183 MW and the corresponding energy demand will rise from 6,928 GWh to 52,623 GWh. To satisfy this increase, generating capacity will have to increase from 1,317 MW to 8,817 MW. This will be achieved through a combination of geothermal, diesel, coal and hydroelectric generating stations and imports from neighboring countries, Ethiopia, Uganda and Tanzania.

Subsequently the proposed 80MW MSD power plant which is included in the LCPDP aims to increase the availability of electricity to Kenya’s national grid. The high level of economic growth predicted in Kenya’s Vision 2030 point towards capacity of the electric power generation system being outstripped by demand if urgent measures are not undertaken to develop cost effective energy generation. Kenya relies heavily on hydroelectric power generation which is dependent on favorable climatic conditions to fill up the dams. The electricity shortages experienced due to adverse climatic conditions recently placed pressure on petroleum supplies due to the addition of emergency power generation using expensive diesel generators.
This had an adverse impact on the overall cost of electricity to consumers resulting in higher uncompetitive prices of goods and services emanating from Kenya for the local and international market.

It is in terms of this background that the proposal to construct an 80MW MSD power plant in Athi River is presented.

2.4 Legislative requirements

A list of legislation that is being considered for this project is shown in section 7 of the ESIA Study. Key legislation applicable to this project is discussed below.

2.4.1 ESIA requirements

The Proponent (Gulf Power Ltd.) has appointed Nutek Solutions Ltd. as the Firm of Experts for the project in terms of the EIA Regulations of 2003. Nutek Solutions Ltd. is producing the ESIA/ESIMP report in accordance with Rule 11 – 23 of the Environment (Impact Assessment and Audit) Regulations 2003.

In January 2010, the KP&LC made an application to undertake an environment project report (EPR) study to NEMA, the lead agency responsible for environmental authorization of this project. The NEMA file reference number for the power plant was given as NEMA/PR/5/2/6972. The Energy Regulatory Commission (ERC) will provide input to the NEMA on the authorization of this project.

2.5 Overview of the study area

The study area falls within the Mavoko Municipal Council in Machakos district which lies within Eastern Province. The proposed project site is about 700m before the Stony Athi River crossing with the main Nairobi – Mombasa highway on the right hand side of the highway.

2.6 Overview of the ESIA process

The ESIA report is being undertaken in two phases:

- Scoping (an environmental project report (EPR) submitted to NEMA by the KP&LC in January 2010); and
- A detailed assessment (the subject of this ESIA report).

The EPR was made available for comment to authorities and other interested and affected parties (IAPs), and the final EPR was submitted to the NEMA for approval. In accordance with Rule 10 of Legal Notice 101: Environmental (Impact Assessment and Audit) Regulations 2003, the NEMA instructed KP&LC to conduct a full ESIA Study which is presented in this report.
Consequently an application for approval was made to the NEMA on February 17th, 2010 for terms of reference to undertake a full ESIA Study. NEMA acknowledged and approved the terms of reference for the full ESIA Study on February 26th, 2010 and formed the basis of environmental investigations and subsequently this report.

This ESIA report will be made available to the authorities and to the public for their comment. Comments received after completion of the public/stakeholder consultation period will be incorporated into the ESIA Study. Once the final ESIA report has been drafted, it will be submitted to the NEMA for their authorization before the development can proceed.

### 2.7 Terms of reference (TOR) for the ESIA Study

The TOR for the full ESIA Study was aligned with those indicated in the Second Schedule of the Environmental (Impact Assessment and Audit) Regulations, 2003. Subsequently the TOR for the full ESIA Study included:

- Conduct an ESIA to comply with the requirements of EMCA and its subsidiary legislation on the proposed 80MW power plant;
- Compile a background information document (BID) on the entire project for the public/stakeholders;
- Undertake public involvement activities for the ESIA phase of the project including interactions with key authorities;
- Arrange and facilitate a public open day/public meeting to provide the stakeholders sufficient opportunity to raise their issues or concerns;
- Compile the draft and final ESIA reports;
- Commission specialist investigations into key issues;
- Compile the final ESIA/ESIMP report.

### 2.8 Purpose of the ESIA phase

The purpose of the ESIA phase is to:

- Provide the rationale for selection of the power plant location.
- Produce the ESIA report based on the proposed power plant location.

### 2.9 Detailed specialist studies

The TOR for the specialist studies is shown in the table below.

<table>
<thead>
<tr>
<th>Specialist study</th>
<th>Summarized specialist investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogeology, geology and soils</td>
<td>• Identify geological formations underlying the site using geological maps.</td>
</tr>
<tr>
<td></td>
<td>• Identify regional groundwater data using hydrogeological maps and other existing data.</td>
</tr>
<tr>
<td></td>
<td>• Identify soil types within the project area.</td>
</tr>
<tr>
<td></td>
<td>• Assess the potential impact of surface and sub-surface soil contamination during the construction and</td>
</tr>
<tr>
<td>Specialist study</td>
<td>Summarized specialist investigation</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td></td>
<td>operational phases of the project.</td>
</tr>
<tr>
<td></td>
<td>• Assess groundwater potential and aquifers, their vulnerability, potential impacts and aquifer protection requirements.</td>
</tr>
<tr>
<td></td>
<td>• Recommend measures to mitigate negative impacts on groundwater resources.</td>
</tr>
<tr>
<td>Ecology</td>
<td>• Describe the structural characteristics of the plant communities.</td>
</tr>
<tr>
<td></td>
<td>• Provide species composition of each distinct vegetation community.</td>
</tr>
<tr>
<td></td>
<td>• Identify Red Data flora and fauna species, and plants of medicinal value.</td>
</tr>
<tr>
<td></td>
<td>• Identify exotic invader species.</td>
</tr>
<tr>
<td></td>
<td>• Identify ecologically sensitive zones.</td>
</tr>
<tr>
<td></td>
<td>• Describe levels of disturbance on the habitats in relation to human impacts on them.</td>
</tr>
<tr>
<td></td>
<td>• Comment on the conservation status and value of the proposed development sites in the context of the area.</td>
</tr>
<tr>
<td></td>
<td>• Identify and assess the impacts of the proposed development and provide management recommendations including future monitoring requirements if required.</td>
</tr>
<tr>
<td></td>
<td>• Where necessary, recommend strategies for the relocation and protection of fauna and flora.</td>
</tr>
<tr>
<td></td>
<td>• Provide recommendations for the rehabilitation of the area following construction, and the implementation of an alien invasive control program.</td>
</tr>
<tr>
<td>Socio-economics</td>
<td>• Compile baseline information on the economic activities in the surrounds of the proposed development.</td>
</tr>
<tr>
<td></td>
<td>• Assess the opportunities and constraints presented by the proposed development for the local community.</td>
</tr>
<tr>
<td></td>
<td>• Identify measures to avoid and minimize negative impacts and enhance benefits of the proposed development.</td>
</tr>
<tr>
<td></td>
<td>• Assess expected future social developments and/or changes in the receiving human environment.</td>
</tr>
<tr>
<td></td>
<td>• Identify and characterize potential social impacts for construction, operation and closure.</td>
</tr>
<tr>
<td></td>
<td>• Identify and assess potential cumulative impacts on the human environment</td>
</tr>
<tr>
<td></td>
<td>• Recommend measures to mitigate negative impacts and enhance positive impacts.</td>
</tr>
<tr>
<td>Specialist study</td>
<td>Summarized specialist investigation</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Archeology and cultural heritage | • Undertake an archeological and cultural heritage assessment within the study area.  
• Develop an understanding of the likely archeological and cultural heritage resources that may be found on the basis of a literature review of historical activities in the area.  
• Detail the likelihood of archeological and cultural heritage resources being present in the area on the basis of the natural setting and suitability for past habitation and/or use.  
• Following a visit to site and discussions with affected communities, identify and map all cultural heritage resources in the area, including graves.  
• Assess the impact of development on such heritage resources.  
• Provide management measures for mitigation of any adverse effects on archeological and cultural resources during and after the completion of the proposed development. |
| Air quality                      | • Undertake baseline ambient air quality sampling and analysis;  
• Using internationally recognized software, carry out air dispersion modeling to predict the ground level concentration of SO\textsubscript{2}, NO\textsubscript{x}, PM\textsubscript{10} and PM\textsubscript{2.5}.  
• Propose mitigation measures where predicted impacts exceed the EC Directive 2008/50/EC on ambient air quality.                                                                                                                                                          |
| Noise quality                    | • Undertake nocturnal and diurnal noise and vibration baseline survey.  
• Construct baseline noise contour maps showing the equivalent sound levels following the noise level survey.  
• Propose noise reduction measures to be in compliance with Kenyan legislation on noise as well as international guidelines.                                                                                                                                               |
| Traffic assessment               | • Undertake a baseline traffic count for the Nairobi – Mombasa highway near the power plant project site.  
• Discuss the pre-construction, construction and operational phase traffic impacts associated with the proposed project.  
• Propose requirements for movement of seven generators-engines from the port of Mombasa to the power plant site.  
• Propose mitigation measures for any adverse traffic impacts that could potentially arise from the pre-construction, construction and operational phases of the proposed project.                                                                                           |
Specialist study | Summarized specialist investigation
---|---
Land use and future planning | - Acquire the latest versions of part development plans, structure plans, land use plans for the Mavoko area and plots surrounding the power plant.
- Discuss the current and future land uses in the Mavoko area.
- Undertake consultation meetings with the planning department of the Mavoko Municipal Council on development permissions process for the power plant
- Propose any mitigation measures on land use and future planning.

2.10 Report structure

This ESIA Study for the proposed 80MW MSD power plant has been laid out as follows:

Section 1: Executive Summary
Section 2: Introduction
Section 3: Methodology for the ESIA Study
Section 4: Project Objectives
Section 5: Project Alternatives
Section 6: Project Description
Section 7: Environmental Legislative and Regulatory Framework
Section 8: Construction HSE Plan
Section 9: Environmental and Socio-economic baseline
Section 10: Technology, Procedures and Processes
Section 11: Construction Processes and Materials
Section 12: Products, By-products and Wastes
Section 13: Environment and Social Impact Assessment
Section 14: Environment and Social Management Plan
Section 15: Incident Prevention and Hazard Communication Plan
Section 16: Health Hazard Prevention and Security
Section 17: Gaps in Knowledge and Uncertainties Encountered
Section 18: Conclusions
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   3.3 Objectives and approach of the EIA Study ......................................................... 3-3
   3.4 Public Participation Process ............................................................................. 3-4
      3.4.1 Public consultation approach and methodology ....................................... 3-4
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   3.5 Power plant location selection process ............................................................. 3-5
      3.5.1 Final site location ..................................................................................... 3-5
   3.6 Development of the ESIA Study Report ........................................................... 3-5
3. Methodology for the ESIA Study

3.1 Description of the ESIA Process

The ESIA process in Kenya is dictated by the requirements of the EMCA and L.N, 101: Environment (Impact Assessment and Audit) Regulations, 2003. The Firm of Experts used the provisions of Part IV of the regulations for undertaking the ESIA Study of the proposed power plant project.

In undertaking the ESIA Study, the following steps were undertaken:

- The landlord of the project site M/s Kenya Power & Lighting Company Ltd. undertook an environmental project report (EPR) study in early January 2010 in order to seek an EIA License from the NEMA. The NEMA issued file reference number NEMA/PR/5/2/6972 for the project. On March 16th, 2010 the NEMA wrote to the landlord asking them to undertake a full ESIA Study of the proposed project by developing a terms of reference for the NEMA’s approval.

- An application requesting for the approval of the terms of reference for the ESIA Study was submitted to the NEMA on February 17th, 2010. The NEMA acknowledged receipt of this application and granted an approval on February 26th, 2010. The NEMA is the lead agency in Kenya responsible for issuing an Environment Impact Assessment license for the project.

- Public/stakeholder consultations were held with the Proponent, provincial administration, residents living near the project site, local authority, etc. The objective of this was to provide an opportunity for the stakeholders to engage fully in the project and to raise issues that needed to be addressed in this ESIA Study. On the basis of this information and professional judgment of the Firm of Experts, various environmental baseline studies were undertaken.

- The development of this report which assessed the likelihood, extent and duration of impacts resulting from the proposed project. An environment management plan (EMP) has been developed for the adverse impacts associated with the project and is incorporated in this ESIA Study. The EMP provides guidelines for avoidance, minimization and mitigation of impacts during the construction, operational and decommissioning phases respectively of the project.

Subsequent to the above, it is envisaged that the following steps will be completed prior to the construction phase of the project:

- This ESIA Study will be submitted to the NEMA for consideration;

- A public review period of 30 days is allowed for stakeholders to comment on the ESIA Study. If there are no comments or comments are not received within 30 days from the date of publishing a gazette notice and newspaper advertisement, the NEMA can determine the ESIA Study and issue an EIA License to the Proponent;

- The Proponent officially appoints Mantrac for the engineering, procurement and construction (EPC) management of the project; and
- The Proponent to seek statutory approvals from other lead agencies whose requirements the Proponent needs to satisfy.

### 3.2 Timing of the EIA Process

The timing of the EIA process has been as follows:
- Project meetings between the Client and the Firm of Experts (October 2009 – to date);
- Desktop review of preliminary design information (February 2010);
- Notification for public participation including preparation of interview questionnaires and responses from the public (March 2010);
- Public open days held with various residents near the project site (March 12th, 2010);
- Administering of Stakeholder Interview Sheets by Sociologist (March 2010);
- Collation of comments from the public/stakeholder consultation meetings and updating of specialist studies (March 2010);
- Undertaking an environment impact assessment based on the findings of the specialist studies (April 2010); and
- Development of an ESIA Study report including an EMP (April – May 2010).

The anticipated timing of the remainder of the EIA phase is as follows:
- Submission of the ESIA Study report to the NEMA (May 2010);
- Permit the Proponent to place NEMA approved advertisements in the Kenya Gazette and a national daily for two consecutive weeks (May – June 2010); and
- ESIA Study approval by the NEMA following review of the EIA documentation by relevant lead agencies (July 2010).

### 3.3 Objectives and approach of the EIA Study

The specific objectives of the ESIA phase for the proposed project have been to:
- Define the proposed 80MW thermal power plant project;
- Complete specialist studies based on the issues raised by the stakeholders and the professional judgment of the Firm of Experts;
- Consider the likelihood, duration and magnitude of impacts identified by the specialists;
- Provide mitigation measures for the adverse environmental impacts and measures to enhance the benefits arising from the project; and
- Prepare an environment management plan for the construction, operation and decommissioning phases respectively of the project.
In undertaking this ESIA Study, the approach adopted has taken cognizance of the following:

- The regulatory requirements and need for authorization from the NEMA prior to commencing the project;
- The involvement of regulatory authorities as follows:
  - Invitations to and meetings with key authorities;
  - Notification of stakeholders during the consultation stage of the project; and
  - Submission of the ESIA Study to the NEMA for consideration.
- The need for a flexible and appropriate public involvement program; and
- The need for an assessment of environmental and social impacts and development of recommendations for management of impacts.

3.4 Public Participation Process

The public/stakeholder consultation process has been an integral part of this ESIA Study. It has been a continuous process involving not only the residents living in the vicinity of the project site but also those arms of Government directly or indirectly affected by the project. The Socio-economic Impact Assessment Report outlines the public participation process, timing, activities and involvement of the public and authorities for the project. A summary of the process is outlined below.

3.4.1 Public consultation approach and methodology

The geographic reach for the process was facilitated by holding a public open day meeting held on March 12th, 2010 at the project site to maximize access to project information and opportunity to comment. Comments from individuals were tallied as separate responses for written and verbal communications.

3.4.2 Public consultation activities

The public consultation activities for this ESIA Study are summarized as follows:

- Several project meetings were held between the Proponent, IFC, Provincial Administration, Mavoko Municipal Council, EPC Contractor and the Firm of Experts;
- A desktop review of available baseline information was done;
- Several one-on-one meetings were convened on various days to elicit information about the project and raise pertinent issues and concerns about the development;
- Further meetings can be arranged if required with relevant lead agencies and local authorities;
On acquiring approval from the NEMA to place advertisements in the Kenya Gazette and a national daily for two consecutive weeks, the ESIA Study will be available for viewing at various locations for public comments for 30 days.

3.5 Power plant location selection process

Site identification and selection for the proposed power plant was based on the following screening process:

- The KP&LC (landlord) advertised in local dailies in 2009 for the outright purchase of land approximately 4 hectares in size. This size of land is adequate for an 80MW thermal power plant;
- Using their internal site selection criteria, the KP&LC selected the proposed site (L.R. 17842/17843) situated between the Athi River Steel Plant and Stony Athi River and equates to approximately 4 hectares.

3.5.1 Final site location

Aspects which still need to be taken into account during final design of the power plant are the following:

- Comments arising from the ESIA Study report;
- Infrastructural requirements;
- Finalization of the land acquisition process (amalgamation of the two plots and acquiring the change of use); and
- Any additional requirements from the lead regulatory agencies.

3.6 Development of the ESIA Study Report

The development of the ESIA Study and EMP has involved the following components:

- Review of literature on the baseline environment and engineering design basis documents;
- Revision of the terms of reference for the specialists supplemented by feedback from the public consultation process;
- Undertaking the specialist studies given below on the basis of public/stakeholder consultation feedback and professional judgment of the Firm of Experts:
  - Noise risk assessment;
  - Air quality risk assessment;
  - Traffic impact assessment
  - Ecological impact assessment;
  - Socio-economic impact assessment;
o Soils and geology;
o Surface water analysis;
o Hydrogeological impact assessment;
o Archeological impact assessment;
o Environmental risk assessment;

- Integration of the findings of the specialists to ensure that all major issues are covered;
- Summary of key findings from the specialist reports;
- Assessment and evaluation of the likely impacts;
- Development of environmental mitigation measures for the adverse impacts identified and an EMP;
- Preparation of a draft EIA Study report for the Proponent’s review;
- Production and submission of a final EIA Study report to the NEMA for consideration; and
- Project meetings between the Proponent, design engineers and the Firm of Experts.
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       4.1.1 Benefits to the local workforce and economy .............................................. 4-2
       4.1.2 Benefits to the country .............................................................................. 4-3
   4.2 Meeting market demand ...................................................................................... 4-4
4. **Project Objectives**

One of the foundations for Kenya’s Vision 2030 is to generate more energy and increase efficiency in energy consumption. The Government of Kenya is committed to continued institutional reforms in the energy sector, including a strong regulatory framework, encouraging private generators of power, and separating generation from distribution.

The Kenyan electricity sector currently has only a 10% reserve balance (difference between peak demand/available capacity), which is largely insufficient given the high dependency on hydrology (57% of production from hydropower, 11% geothermal, 23% thermal, 8% from emergency power), and accordingly suffers risks of load shedding and power shortages.

The Government of Kenya’s long term energy plan (Least Cost Power Development Plan or LCPDP) includes Heavy Fuel Oil (HFO) fired power plants as strategic developments for the sector.

4.1 **Socio-economic objectives and impacts**

A number of socio-economic objectives and impacts will be derived from the power plant. The availability of an additional 80MW of effective electric power in the national grid implies that there will additional power that can be provided for economic growth. The provision of three new additional thermal power plants having an installed capacity of 240MW is identified in the 2009 draft of LCPDP.

Development of the power plant project by the Proponent will benefit various parts of the economy through:

- The front-end engineering and design (FEED) phase, where Kenyan and International expertise will apply the latest design concepts and technologies to design a world class thermal power plant. Ongoing design work is expected to employ highly skilled engineers for the project in Egypt. This technology will hopefully be transferred to Kenyans once completed.

- The construction phase when skilled labor sourced from the local communities and upcountry will work with international experts in the Athi River area to fabricate and install the power house, HFO storage tanks and associated infrastructure;

- The operations phase when the power plant becomes operational and electricity is evacuated to the national grid. All operations of the power plant will be staffed by skilled personnel based predominantly in Athi River. The number of operations personnel is about 28 full-time staff.

4.1.1 **Benefits to the local workforce and economy**

The proposed project is expected to introduce a number of benefits to Kenya in general. The design phase will provide opportunities for skill and knowledge transfer essential to maintaining capability in the power generation industry.
Local construction and service industries will be called upon to support the installation of large capital items, leading to a boost in short term jobs in the construction industries and in industries supplying inputs to construction. Capital goods supplying industries will also experience an increase in demand.

Once the project enters its operations phase, permanent jobs will be created in running the power plant and associated infrastructure facilities.

### 4.1.2 Benefits to the country

The profitable evacuation of electricity from the proposed project will result in significant tax revenues flowing to the Kenya Government throughout the lifetime of the project. The amount of taxation depends on the development concept chosen, the price of tariff the Proponent has negotiated with KP&LC and world oil prices.

The evacuation of electricity from the power plant will add to the Proponent’s revenues directly through charge of a tariff levied on each kilowatt hour of electricity evacuated through it and company tax paid on profits by the Proponent. It will also add indirectly to both the Athi River area and the region by expanding economic activity, employment, income, expenditure and hence the tax base in the country. This in turn will enhance the capacity of the Kenya Government to support desirable social expenditures including infrastructure development.

The taxes paid by the Proponent will enable future governments to reduce taxation on other segments of the Kenyan economy thereby stimulating additional economic activity and job creation. The consumers of the electricity generated by the power plant will pay their own taxes, create additional earnings and employ additional staff.

Social benefits from the construction and operation of the proposed project will also be felt in the Athi River area and the country. These include:

- Improved job prospects in high technology/high skills industry;
- Influx of tertiary educated staff and families;
- Increased national and international recognition of Mavoko as a center for industry;
- Sponsorship by the Proponent who wishes to build a strong and long-term relationship with local communities.

It is in Kenya’s strategic interests for all its neighbors to be prosperous and to have a sound economy capable of meeting the aspirations of its citizens. Development of the proposed power plant project will make a significant contribution to the economy of Kenya, which in turn will reduce the country’s reliance on foreign aid from development partners.
4.2 Meeting market demand

When completed, the proposed power plant project will be able to initially evacuate 80MW of electric power to the national grid. This is a sizeable amount of electric power which could reduce the difference between supply and demand of electricity in the country and maybe more cost effective than the emergency power.
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5. Project Description

The ESIA for which this report has been prepared focuses on the development of an 80MW thermal power plant in the Athi River area in Mavoko municipality. The proposed power plant will run on ten generating sets each having a capacity of 8MW. The fuel type proposed for this power plant is heavy fuel oil having a maximum sulfur content of 2.0%.

The power generated from the thermal power plant will be evacuated via two 66KV sub-stations connected to two step-up transformers.

5.1 Project timing

The following project program is envisaged for the proposed project:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Start Date</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undertaking the ESIA</td>
<td>Commenced February 2010</td>
<td>4 months</td>
</tr>
<tr>
<td>Submission and review of draft ESIA report by Proponent</td>
<td>June 2010</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Submission of final ESIA report to the NEMA</td>
<td>June 2010</td>
<td>-</td>
</tr>
<tr>
<td>NEMA/lead agencies to review ESIA Study</td>
<td>June 2010</td>
<td>30 days</td>
</tr>
<tr>
<td>Approval to advertise in the Kenya Gazette and Newspaper</td>
<td>June 2010</td>
<td>30 days</td>
</tr>
<tr>
<td>NEMA decision</td>
<td>July 2010</td>
<td>45 days after submission</td>
</tr>
<tr>
<td>Planning and design</td>
<td>Underway. To be completed in March 2011</td>
<td></td>
</tr>
<tr>
<td>Raw materials and equipment order</td>
<td>May 2011</td>
<td></td>
</tr>
<tr>
<td>Construction phase</td>
<td>June 2011</td>
<td>Approx. 12 months</td>
</tr>
<tr>
<td>Operational phase</td>
<td>June 2012</td>
<td></td>
</tr>
</tbody>
</table>

Given below is the timeline for the construction and commissioning phase of the project which is approximately 11 months. The project cost is anticipated to be US$ 125 million.
Figure 5-1: Timeline for proposed MSD power plant

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gulf Power 80mw Power Plant</td>
<td>220 days</td>
</tr>
<tr>
<td>2</td>
<td>Down Payment</td>
<td>1 day</td>
</tr>
<tr>
<td>3</td>
<td>Project Engineering Activities</td>
<td>1 mon</td>
</tr>
<tr>
<td>4</td>
<td>Site Handover</td>
<td>0.5 mons</td>
</tr>
<tr>
<td>5</td>
<td>Procurement Activities</td>
<td>40 days</td>
</tr>
<tr>
<td>6</td>
<td>Power Generation Systems</td>
<td>2 mons</td>
</tr>
<tr>
<td>7</td>
<td>Mechanical Systems</td>
<td>2 mons</td>
</tr>
<tr>
<td>8</td>
<td>Electrical Systems</td>
<td>2 mons</td>
</tr>
<tr>
<td>9</td>
<td>Transportation, Customs &amp; Receipt on Site</td>
<td>2 mons</td>
</tr>
<tr>
<td>10</td>
<td>Construction Activities</td>
<td>80 days</td>
</tr>
<tr>
<td>11</td>
<td>Construction Activities</td>
<td>4 mons</td>
</tr>
<tr>
<td>12</td>
<td>Civil Works</td>
<td>4 mons</td>
</tr>
<tr>
<td>13</td>
<td>Installation Activities - Equipment</td>
<td>120 days</td>
</tr>
<tr>
<td>14</td>
<td>Power Generation Systems</td>
<td>6 mons</td>
</tr>
<tr>
<td>15</td>
<td>Mechanical Systems</td>
<td>6 mons</td>
</tr>
<tr>
<td>16</td>
<td>Electrical Systems</td>
<td>6 mons</td>
</tr>
<tr>
<td>17</td>
<td>Mechanical Systems</td>
<td>6 mons</td>
</tr>
<tr>
<td>18</td>
<td>Electrical Systems</td>
<td>6 mons</td>
</tr>
<tr>
<td>19</td>
<td>Instrumentation Works</td>
<td>6 mons</td>
</tr>
<tr>
<td>20</td>
<td>Bulk Storage Tanks</td>
<td>6 mons</td>
</tr>
<tr>
<td>21</td>
<td>Commissioning Activities</td>
<td>20 days</td>
</tr>
<tr>
<td>22</td>
<td>Pre-Commissioning</td>
<td>1 mon</td>
</tr>
<tr>
<td>23</td>
<td>Commissioning &amp; Start-Up</td>
<td>1 mon</td>
</tr>
<tr>
<td>24</td>
<td>Ready for Operation</td>
<td>1 mon</td>
</tr>
</tbody>
</table>
5.2 Technical description

The power plant is designed by Wärtsilä Finland Oy. A preliminary layout plan of the power plant is shown in Figure 5-2 while Figure 5-3 shows a 3D model of a typical MSD power plant. The proposed power plant will principally consist of the following project components:

- Power house (containing ten Wärtsilä MSD engines);
- Waste heat recovery system;
- Medium voltage switchgear;
- Step-up transformers 11/66KV;
- High voltage switchgear;
- Transportation and delivery to site;
- Mechanical and electrical works;
- Civil and structural works;
- Installation activities;
- Commissioning and start-up; and
- Testing.

The proposed project will be designed in accordance with codes of practice and standards developed by the following international bodies:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>DIN</td>
<td>Deutsches Instituit fur Nomung, e.V.</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturer’s Association (USA)</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronic Engineers (USA)</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electric Code</td>
</tr>
<tr>
<td>ISO</td>
<td>International Standards Organization</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electric Code (USA)</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>VDE</td>
<td>Information Technologies (Germany)</td>
</tr>
<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
</tr>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
</tr>
<tr>
<td>AISC</td>
<td>American Institute of Steel Construction</td>
</tr>
<tr>
<td>ICBO</td>
<td>International Conference of Building Officials</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>IAPMO/UPC</td>
<td>International Association of Plumbing and Mechanical Officials, Uniform Plumbing Code</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>API</td>
<td>American Petroleum Institute</td>
</tr>
<tr>
<td>AWS</td>
<td>American Welding Society</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriter’s Laboratories (USA)</td>
</tr>
<tr>
<td>ISA</td>
<td>Instrument Society of America</td>
</tr>
<tr>
<td>SSPC</td>
<td>Steel Structures Painting Council (USA)</td>
</tr>
<tr>
<td>HEI</td>
<td>Heat Exchanger Institute (IEC)</td>
</tr>
<tr>
<td>CIMAC</td>
<td>International Council on Combustion Engines</td>
</tr>
</tbody>
</table>
Figure 5-2: Proposed site layout plan of proposed MSD power plant
Figure 5-3: Typical 3-D model of an MSD power plant
5.2.1 Mechanical Specification

The mechanical specification of the power plant will comprise three primary components namely the Wärtsilä engines, engine accessories and mechanical auxiliaries.

Engine and generator

The proposed power plant will comprise ten generating sets; the specific model of each generator set proposed for the power plant is Wärtsilä model 20V32. This type of engine is a 4-stroke, direct injected, trunk piston turbocharged and intercooled diesel engine. The dimensions of each generating set is approximately 4400mm high x 3670mm wide x 12535mm long; each generating set weighs approximately 130 metric tons. Each generating set will be manufactured as a complete unit overseas and shipped to Mombasa.

The engines will be run on heavy fuel oil (HFO) having a maximum sulfur content of 2.0%. The HFO will probably be imported into Kenya in bulk as the local refinery may be unable to cost effectively produce HFO having a maximum sulfur content of 2.0%.

Waste heat will be generated during the combustion process of the HFO in the MSD engines. This waste heat will be recovered and used for internal processes such as the boiler and other parts of the system that require heating. An image of a typical generator set is indicated in Figure 5-4.

Figure 5-4: Typical image of power house with generator sets installed

Engine accessories

The engine accessories will include a system for diesel engine diagnostic and predictive maintenance. This system is a software based system that continuously monitors various engine parameters during operations.
The engine accessories will also include coupling assemblies for the generator and engine. Additionally it will include spring element mountings for direct elastic mounting of the engine to the foundation block.

5.2.2 Mechanical auxiliaries

The mechanical auxiliaries associated with the power plant will comprise the following elements:

- Compressed air system;
- Combustion air system;
- Exhaust gas system;
- Fresh cooling water system;
- Light fuel oil (LFO) and heavy fuel oil (HFO) system;
- Lube oil system;
- Steam system/thermal oil system;
- Ventilation system; and
- Waste disposal system.

Compressed air system

The compressed air system in the power plant will compress, store and deliver medium pressure (30 Bar) compressed air to start the diesel engines. Through a pressure reducing station, low pressure (8 Bar) air will be delivered for various utility services and instrument requirements. The compressed air system will be designed to provide starting for the engines, control air for the engines and auxiliary systems, and working air for operating cleaning and maintenance tools. There will be two air compressors installed at the power plant for providing compressed air, one driven by electricity and the other by diesel.

Combustion air system

Each of the ten engines will require combustion air for its operation. The combustion air intake system, which is not combined with the powerhouse ventilation system will provide ambient, clean air to the diesel engine for combustion while minimizing inlet air pressure loss to the turbocharger. Subsequently each engine will be provided with its own combustion air system to provide filtered air to the engine for combustion.

Exhaust gas system

An exhaust system for each engine will convey engine exhaust gases through a thermal oil heat recovery unit, then through a silencer, and finally out to atmosphere through a stack. Expansion joints, supports and insulation will be furnished as required. The combustion of HFO in the ten engines will be expelled through an exhaust gas system. A portion of the energy carried by the exhaust gases will be converted to mechanical energy for compressing the charged air which will be generated by the turbo chargers mounted on the MSD engine. Each of the ten MSD engines will have two turbochargers connected to it.
The exhaust gas system will also be fitted with an exhaust gas silencer for each of the ten MSD engines.

**Cooling system**

The power plant will include a fresh cooling water system for cooling the engine cylinder jackets, cylinder heads and turbochargers, as well as to cool the lubricating oil and charge air entering the cylinders after it has been compressed by the turbocharger.

As fuel burns inside the engine, various engine parts become hot. The cooling water system pumps water through the engine to a radiator where the heat is dissipated to the atmosphere. Cooled water from the radiator is then returned to the engine. The radiators are self-contained horizontal units mounted outdoors on structural steel legs. Multiple fans draw cooling air up through the radiators. Aboveground supply and return piping connects the radiators to the engines. An image of a typical radiator setup is shown in Figure 5-5. The cooling water system will further be used to cool the charge air and lube oil used in the engines.

![Figure 5-5: Typical image of radiators](image)

**Bulk liquids storage tank farm**

The power plant will have a bulk liquids storage tank farm for storing fuel oil. The floors and walls of the bulk liquids storage tank farm will be constructed out of reinforced concrete; it will be 100m long x 40m wide x 2.3m high. The volume of the tank farm storage area is designed to retain a minimum of 110% of the volume of the largest storage tank. A typical bulk liquids storage tank farm under construction for an MSD power plant is shown in Figure 5-6.
The tank farm will contain a number of aboveground bulk storage tanks made out of steel for storing various types of petroleum products. These tanks will be designed to the Deutsche Industrie Norm (DIN) “4119-2: Above-ground cylindrical flat-bottom tank structures of metallic materials; Calculation” which is a German standard for above ground storage tanks and API 650. The HFO service tanks (2 x 100m$^3$) will be jacketed as the HFO will be required to be pre-heated prior to it being treated and used in the power plant. The sizes of the various tanks and the products they will store are given below.

**Table 5-1: Capacities of bulk liquid storage tanks**

<table>
<thead>
<tr>
<th>Product</th>
<th>No. of tanks/capacity (m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFO storage tanks</td>
<td>2 x 7,500m$^3$</td>
</tr>
<tr>
<td>HFO service tank</td>
<td>2 x 100m$^3$</td>
</tr>
<tr>
<td>HFO buffer tank</td>
<td>1 x 100m$^3$</td>
</tr>
<tr>
<td>HFO day tank</td>
<td>1 x 300m$^3$</td>
</tr>
<tr>
<td>Light fuel oil (LFO) storage tank</td>
<td>1 x 1000m$^3$</td>
</tr>
<tr>
<td>Lube oil storage tank</td>
<td>1 x 35m$^3$</td>
</tr>
<tr>
<td>Waste oil disposal tank</td>
<td>1 x 20m$^3$</td>
</tr>
<tr>
<td>Lube oil service tank</td>
<td>1 x 7m$^3$</td>
</tr>
<tr>
<td>Sludge tank</td>
<td>1 x 80m$^3$</td>
</tr>
<tr>
<td>Oily water buffer tank</td>
<td>1 x 55m$^3$</td>
</tr>
</tbody>
</table>

An image of a bulk liquids storage tank under construction is shown in Figure 5-7.
HFO fuel system

The HFO system will be designed for storage and treatment of HFO in the power plant. The HFO will be the primary fuel for running the ten engines at the required degree of purity, viscosity and pressure.

A tank truck HFO off-loading station will be constructed at the location shown in Figure 5-2. The tank-truck off-loading station will have the capacity of simultaneously off-loading three HFO laden tanks trucks into the large 7,500m³ storage tanks. The tank truck off-loading station will be made out of reinforced concrete and will have a concrete berm around it to contain any fugitive spills. The drainage system from the bermed area will be connected to a sump and subsequently to an underground drainage pipe system leading to an oil water separator for treatment prior to discharging into the environment. A typical image of an HFO tank-truck off-loading station is shown in Figure 5-8.
Figure 5-8: Image of a typical truck off-loading station

HFO conditioning system

The purpose of the HFO Conditioning System is to deliver clean, heated fuel to the engines at the proper temperature and pressure. The entire HFO conditioning system will be a closed system thereby minimizing fugitive emissions. Conditioning of the HFO will be accomplished through a series of pumps, heaters, separators, day tanks and filters.

The process of conditioning the HFO for use in the engines will include the following steps:

a) HFO will be pumped from the bulk storage tanks to an HFO Separator Module. This module includes a heater (the Separator Heater), pumps and a Fuel Separator. The Fuel Separator is a standard centrifuge that uses centrifugal force and water to wash dirt and contaminants from the fuel.

b) The fuel will flow to a heated Service Tank. This tank will be able to hold enough fuel for 6 hours of plant operation, in case of minor upstream fuel supply interruptions.

c) From the Service Tank, the fuel will flow to an HFO Pre-pressure Module. This module includes an HFO Pre-pressure Pump and an HFO Automatic Filter that back flushes and self-cleans as required.

d) Finally the fuel will flow to an HFO Circulating Module. This module boosts the fuel pressure and precisely heats the fuel to the optimum viscosity for delivery to the engine fuel injection system.

The HFO conditioning system will be housed in a Fuel Treatment building. All tanks in and around the building will be mounted in spill-retention dikes with drains to an oil-water separator.
**Lube oil system**

The purpose of a lube oil system is to deliver clean, cool lubricating oil to the engines at the proper pressure and temperature. Lube oil will be off-loaded into a dedicated bulk lube oil storage tank (35m³ capacity) from tank-trucks. For each of the ten engines, the lube oil system will comprise:

- a main lube oil pump;
- a water cooling module; and
- a lube oil separator;

In addition to these, the lube oil system will have a lube oil maintenance tank and other associated pumps and strainers.

**Steam system/thermal oil system**

The hot exhaust gases generated from the MSD engines will be used to generate steam which in turn will be used to operate boilers. Steam generated from the boilers will be used to heat the HFO tanks, to operate the trace heating system, to pre-heat the HFO and lube oil for separation and to maintain the required injection viscosity.

The thermal oil System will be designed utilizing the exhaust gas heat recovery system for the generation of heated thermal oil for HFO heating applications. Thermal oil will be the heating medium for the fuel pre-heating system. The heating system will also include heat tracing, piping and necessary insulation and controls. The system will be capable of maintaining HFO at proper temperatures over the full range of operating conditions.

**Ventilation system**

The power house will be connected to a ventilation system for provision of air of pure quality in it to cool the alternators. Additionally the ventilation system will endeavor to maintain a convenient operating temperature in the power house. Through a forced ventilation system, the pressure inside the power house will be slightly greater than the ambient to ensure that dust does not enter the building through open doors or other openings. The ventilation system will be equipped with acoustic louvers to maintain a tolerable noise level outside the power house.

**Waste oil collection system**

The power plant will be equipped with a closed waste oil collection system. This will comprise a bulk waste oil storage tank having a capacity of 20m³ located in the main tank farm, a waste oil tank emptying pump, a power house drain pump, two mobile drainage pumps and an oil water separator.
Water systems

The power plant will require an adequate supply of fresh treated water for the following purposes:

- firewater capacity;
- Periodically washing down the equipment and floors; and
- Feed water for the process water treatment system.

Currently the Mavoko Water and Sewage Company is the main supplier of freshwater to the residents of Athi River. Subsequently the Proponent will liaise with this company to connect a water line to the power plant. In the absence of this, the Proponent will sink a borehole within the power plant after acquiring the necessary permit and treat the water prior to its use as outlined above. The proposed project will lay fresh water distribution pipelines underground to buildings and equipment. Hose bibs will be provided at all buildings and near tanks and equipment as required.

Process wastewater systems

Process wastewater may be generated from the following primary areas of the power plant:

- Washing down equipment and floors;
- Tank-truck off-loading station;
- Bulk storage tank farm;
- Regeneration brine from the process water treatment system; and
- Washing down paved vehicle parking areas in the power plant.

All process wastewater will be channeled through a properly designed oil water separator for primary treatment. Prior to being discharged to the environment, the Proponent will ensure that the treated wastewater is in compliance with L.N. 120: Water Quality Regulations, 2006.

Sanitary wastewater system

Sanitary sewage will be collected from sinks, toilets, showers and other sources. In order to discharge this type of waste in an environmentally sound manner, the Proponent could either connect to the Mavoko Water and Sewage Company’s main line sewer or build a conservancy tank.

Fire protection system

The power plant will contain an elaborate fire protection system designed in accordance with relevant international institutions such as the National Fire Protection Association (NFPA) of the USA. The fire protection system will comprise the following components:

- Addressable fire alarm system made up of photoelectric and heat sensors, call points, alarm bells and strobe lights;
- Fire extinguishers including 50kg wheeled dry chemical powder (DCP) type, 12kg portable DCP extinguishers, 6kg carbon dioxide extinguishers and 90liters mobile foam units;
Fire hose cabinets complete with hose reel hydrants (30m long each);
An electrical fire pump approved by Underwriters Laboratories (UL) of the USA, an electric motor and pump controller. The system will also include a jockey pump and all other pump room accessories. The fire protection system will include a dedicated fire water tank having a capacity of 700m³.

5.2.3 Electrical system

Electric power will be required to drive various electrical systems that make up the power plant. Subsequently the electrical specification of the power plant will include the following types of voltage systems:

- Low-voltage 0.4kV system for plant auxiliary loads;
- Medium voltage 11kV system including generator and generator bus;
- High voltage 66kV sub-station;
- Convenience voltage 400/230V distribution system for lighting and convenience outlets; and
- Control voltage 24V DC and 110/125V DC.

The purpose of the electrical system will be to:

- Export net electrical generation from the power plant;
- Distribute electrical power within the power plant for internal loads when the plant is operating; and
- Import electrical power during plant outages.

Low voltage system

The low voltage system will be made up of a switchboard that will be designed to match the required auxiliary power of various electrical consumers of the entire power plant. The AC switchgear operating within and up to 1kV is known as low voltage switchgear. The number of switching operations demanded from low voltage switchgear is expected to be high. The low voltage system will include the following:

- Motor control centers with breakers, motor starters, pushbuttons and indicating lights;
- Power wiring to various internal motors and loads;
- Busbar;
- Switching devices such as ACB, MCCB, MCB;
- CT’s and PT’s;
- Station Service Transformer;
- Measuring instruments and relays;
- Cable termination for incoming and outgoing cables;
- Electrical and mechanical interlocking facility.
Medium voltage system

The medium voltage system is designed to convey power from the engines to the high voltage system for evacuation from the power plant and will be located in an electrical room in the main building. The switchgear will be specific for power plants, industrial and distribution sub-stations; it will be metal clad and designed to operate within the range of 1kV – 36kV. The medium voltage system will be designed to automatically:

- Switch on/off during normal operations; and
- Operate during abnormal operations.

An image of typical low voltage and medium voltage switchgear is shown in Figure 5-9.

Figure 5-9: Image of typical LV switchgear (right) and MV switchgear (left)

High voltage system

The high voltage system will be used to evacuate electricity generated by the power plant to the transmission lines situated outside the battery limits. The proposed location of the power plant sub-station (high voltage system) is indicated in Figure 5-2. The high voltage system will include conversion of 11kV electrical power from the medium voltage system to 66kV for onward transmission. There will be two 11/66kV step up transformers within the sub-station that will be used to step up the voltage from 11kV to 66kV. There will be an outdoor high voltage circuit breaker for installation on the high voltage side of the 11/66kV transformers. Additionally there will be primary and back-up power export metering equipment installed at the high voltage side of the step up transformers.
5.2.4 Civil/structural specification

The power plant is divided into various areas as outlined below.

- Power house which will include the engine hall, mechanical auxiliaries area, and the loading bay area for maintenance and overhauls;
- The electrical building which includes the switchgear room, control room, LV switchgear, the motor control center room, the DC system room, the batteries room, toilets, administration office, canteen and workshop;
- Fuel and lube oil treatment house;
- Tank farm and unloading station;
- Pump station area and water tank area.

Power house

The power house building shall be designed to contain the ten engines and one loading bay area. It will be a pre-engineered building designed and constructed to the local and international building codes. The powerhouse building will be approximately 8.25m high and will be constructed out of a steel structure having mineral wool insulated sandwich panels; the roof of the power house building will be made out of steel sheets.

The power house building shall be insulated for noise abatement to attain the maximum allowable noise levels at the property fence line.

The power house will include the following features:

- Engine hall with 2-ton maintenance crane;
- Open bay for maintenance;
- Reinforced concrete floor, independent of engine-generator foundations;
- Control Room;
- Water closet (in control room);
- Electrical room;
- Equipment annex with raised steel grate floor for equipment access;
- One (1) overhead, electric, coiling door shall be provided in the loading/staging bay;
- Forced ventilation; and
- Lighting and convenience outlets.

Typical images of a power house building under construction and one that is complete are shown in Figures 5-10 and 5-11 respectively.
Figure 5-10: Typical image of power house under construction

Figure 5-11: Image of typical completed power house
Other buildings and civil/structural works

In addition to the power house, there will be a compressor room, fuel treatment house, workshop & warehouse and an administration building within the power plant. These buildings will be made out of masonry stone walls laid on a reinforced concrete floor slab. The height of each of the buildings will be 3 – 4m and the roof will be made out of a reinforced concrete slab. The buildings will contain appropriate doors, windows and staircases.

Other civil/structural works that will take place at the power plant include:

- A site chain link fence 2.5m high all-round the power plant;
- Guard house;
- Radiator foundations;
- Boiler stack foundation;
- Exhaust muffler stack foundation; and
- Landscaping for the fenced area.

5.3 Construction Phase

5.3.1 Construction Process

Materials needed for the construction process include brick, cement, steel, pipelines, sand, gravel and wood. The required supplies will be transported to site by truck. Sand and cement will be sourced from existing local and/or national commercial suppliers.

Necessary equipment includes cranes, bulldozers, excavators, front-end loaders and electric welding machines. The need for blasting will be determined based on final geological investigations. Low-bed trucks will be used for transporting equipment.

Most of the mechanical, electrical and, instrumentation and control infrastructure required for the power plant will be imported. The raw materials to be sourced locally include backfill material, cement, sand, aggregate and masonry stone, which will all be required for the civil/structural specification of the power plant.

Wärtsilä is in the process of appointing their nominated sub-contractors for civil/structural works, mechanical works and electrical works respectively. The PropONENT will make arrangements to provide a laydown which will be used by them and their nominated sub-contractors. There will be 24-hour security at the site throughout the construction phase of the project.

The baseline noise level survey undertaken in February 2010 at the project site and its vicinity exceeds the nationally stipulated permissible noise levels at some receptors. This is a short term impact which is primarily due to the on-going upgrade of the main Nairobi – Mombasa highway to dual carriageway status. The power plant construction plant and equipment will cumulatively add on to the existing noise levels around the project site and its vicinity.
Exact daytime and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work program, work *modus operandi* and type of equipment have not been finalized. However during the construction process, it will be incumbent on Wärtsilä to ensure that they pragmatically implement corrective actions within their span of control to reduce noise levels to ALARP.

5.3.2 Water requirements during construction

During construction, water will be required for mixing of concrete. This water will be sourced from the Mavoko Water and Sewage Company Ltd. Hydrostatic testing will be used on the pipes. Water used for this purpose will need to be tested and approved as per local effluent discharge standards before discharge takes place.

5.3.3 Sewage, waste and storm water runoff

During construction, storm water will be controlled to minimize the risk of erosion and sedimentation and prevent water contamination. Contaminated storm water will be treated before being released.

5.3.4 Site management

Construction will only take place during stipulated hours on weekdays and weekends. During construction there will be 24-hour security onsite and no workers will be allowed to stay overnight at the site.

5.3.5 Staffing requirements

Job opportunities will be generated through the construction of the power plant. Both skilled and unskilled labor will be required in technical fields as well as in the facility operation and management. It is anticipated that about 150 to 190 jobs will be created during the construction phase.

5.4 Operational Phase

5.4.1 Water requirements

During the operational phase, water at the power plant will be required for processes, fire safety, drinking, toilets and showers. The source of water supply is expected to be the Mavoko Water and Sewage Company who currently supplies water to users in the Athi River area. During dry periods, there could be water rationing programs leading to intermittent supply of fresh water to the power plant.
Subsequently the Proponent will consider installation of a borehole at the power plant together with a water treatment system to supplement the inconsistent water supply from the Mavoko Water and Sewage Company.

An on-site water tank will hold water for cooling and fire-fighting purposes. The total firewater demand for the worst case scenario will be calculated by the Proponent’s engineers and Wärtsilä on the basis of a full risk assessment.

5.4.2 Noise

All power plant facilities for this project will be designed to the requirements of ISO 15664: 2001 E titled “Acoustics -- Noise control design procedures for open plant”. All machinery and other noise emitters will comply with exposure limits of the workforce and a weighted basis as per the standard. The following measures will be implemented in order to prevent operational noise from affecting third party receptors.

Rotating machinery

All rotating machinery is purchased against a noise data sheet which will be required to specify a noise level of 85 dB(A) at a distance of 1 m from the machinery (L.N. 25: Noise Prevention and Control Rules, 2005). If this level cannot be met, then the noise level will be mitigated through the installation of a local acoustic enclosure or housing the equipment in a suitable building.

Transport and other equipment

As the project will require the regular use of road transport to deliver HFO to the power plant, measures will be implemented to control traffic movements to regular working (daylight) hours. Where considered necessary, the site will be screened by trees, natural obstructions or artificial constructions with suitable coverings e.g. berms with grass or bush coverings. Remedial measures will include the use of buildings or acoustic enclosures. Where individual items of equipment or operations cannot meet the stringent requirements of the open plant design, the noise shall be mitigated by use of silencers, acoustic enclosures, buildings or screening. The overall noise specification at the facility fence shall not be exceeded under any circumstances.
Personnel Protection

The following noise limits shall apply indoors in order to keep any disturbance of normal working activities within acceptable proportions (See Table 5-2):

Table 5-2: Noise limits in indoor locations

<table>
<thead>
<tr>
<th>Area description</th>
<th>Maximum allowable sound pressure level dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Areas in workshops and machinery buildings where communication is required</td>
<td>70</td>
</tr>
<tr>
<td>• Workshops for light maintenance</td>
<td></td>
</tr>
<tr>
<td>• Workshop offices</td>
<td>60</td>
</tr>
<tr>
<td>• Control rooms, not continuously manned</td>
<td></td>
</tr>
<tr>
<td>• Computer rooms</td>
<td></td>
</tr>
<tr>
<td>• Control rooms, continuously manned Open plan offices</td>
<td>50</td>
</tr>
<tr>
<td>• Changing rooms, wash places and toilets</td>
<td></td>
</tr>
<tr>
<td>• Offices and conference rooms</td>
<td>45</td>
</tr>
</tbody>
</table>

All facilities are to be designed to limit an unprotected operator to a maximum of 85 dB(A) over an 8 hour time weighted average exposure. Where the noise level exceeds this limit, relevant areas must be restricted. The most stringent noise limits shall be determined by the requirements of Kenyan national or local regulations. In the absence of such regulations, the requirements of relevant international standards shall be mandated. The final applicable noise limits shall be stated in the project design.

Noise impacts shall not exceed the World Bank guideline levels presented in Table 5-3, or result in a maximum increase in background levels of 3 dB(A) at the nearest receptor off-site.

Table 5-3: World Bank noise guideline levels

<table>
<thead>
<tr>
<th>Receptor</th>
<th>One Hour Equivalent (dB(A))*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime 07:00 – 22:00</td>
</tr>
<tr>
<td>Residential: Institutional; Educational**</td>
<td>55</td>
</tr>
<tr>
<td>Industrial; Commercial</td>
<td>70</td>
</tr>
</tbody>
</table>

* Guideline values are for noise levels measured outdoors.

** For acceptable indoor noise levels for residential, institutional and educational settings refer to WHO (1999).
5.4.3 Sewage, waste and stormwater runoff

During operation, sewage and waste will be dealt with in accordance with local authority by-laws and relevant environment regulations in Kenya. All areas of the power plant that can potentially generate hazardous waste will be bunded and provided with a closed system drain where the water will be treated via an oil water separator prior to release into the environment.

All hazardous waste generated by the project will be managed in accordance with the requirements of Legal Notice (L.N.) 121: Waste Management Regulations, 2006.

5.4.4 Site management

Due to the high value of the power plant, security measures will be stringent during the operation of the facility. On-site security of the premises will be engaged to maximize safety.

5.4.5 Staffing requirements

Job opportunities will be generated through the operation of the power plant. Both skilled and unskilled labor will be required in technical fields as well as in depot operations and management. There will be fewer jobs in the operational phase than the construction phase, but employment will be long-term. The power plant will be manned by a minimum of 38 people, some of whom will be management and administrative staff. There will also be a dedicated maintenance team for the power plant and other associated infrastructure.

5.5 Decommissioning Phase

It is envisaged that the power plant will be operational for a minimum of 20 years, and it is likely that this period will be extended.

There are currently no specific stipulated requirements for decommissioning under the EMCA for projects. However it would be prudent for the Proponent to set aside funds for the rehabilitation of the power plant and associated infrastructure. The funds if provided will cover:

- The decommissioning and final closure of the operation.
- Post closure management of residual and latent environmental impacts.

The funds should be reviewed annually to ensure that the value of the fund reflects the prevailing inflationary environment, changes to environmental legislation, new technologies for rehabilitation and, if necessary, unforeseen residual impacts. This will ensure that the financial provision remains sufficient to cover costs in the event of the above occurrences at any stage during the life of the project.
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6. **Project Alternatives**

Legal Notice 101: Environment Impact Assessment and Audit Regulations, 2003 states that an outline of the main alternatives studied by the Proponent and an indication of the main reasons for the Proponent’s choice is required in an Environment Impact Assessment. Furthermore where alternatives are available which may still allow the objectives of the project to be met, the existing environment should also be detailed.

Subsequently alternatives for the proposed project have been evaluated from the following perspectives:

- Location alternatives – what is the best site for a proposed development and any infrastructure associated with it?
- Process/activity/operation alternatives – are there other means to achieve the same objective?
- Scheduling alternatives – are there potential time constraints and ongoing activities?
- No-go option – what are the implications of not proceeding with the project?

6.1 **Location alternatives**

The proposed power plant is part of the Ministry of Energy’s Least Cost Power Development Plan (LCPDP) for the period 2010 – 2030. KP&LC has been given the approval to purchase 240MW of electric power from independent power producers (IPPs). The KP&LC tendered out the construction of 3 new medium speed diesel (MSD) power plants in late 2009 each having a capacity of 84MW.

Initially the KP&LC proposed all three power plants at one location within the Athi River EPZ however due to the resulting air emissions, decided to locate the 3 power plants at different geographical locations. Subsequently the KP&LC advertised in the local media for purchase of adequate land to build three new 84MW MSD power plants. From the bids received and using their internal site selection criteria, three sites were identified as follows:

- Athi River EPZ;
- A site near Thika town; and
- The proposed site.

Thereafter KP&LC tendered for the construction and operation of three power plants on a build, own, operate (BOO) basis. Gulf Power Ltd. won the tender to construct the 84MW MSD power plant on the proposed site situated along the Nairobi – Mombasa highway in Mavoko.
6.2 Process/activity/operation alternatives

The decision to establish the proposed power plant in the Mavoko area is influenced by the relative ease of connecting electric power to the national grid. There is a large KP&LC owned electrical sub-station at Embakasi and a potential large consumer of electricity that wants to set up a major industrial activity in Athi River. Athi River town is increasingly becoming a hub of commercial and industrial activity resulting from its close proximity to Nairobi and ease of availability of land for economic development. Locating a power plant in an industrial setting in close proximity to existing sub-stations is essential to the project and the country’s electricity infrastructure in that electricity can be transmitted via the Embakasi sub-station to final consumers.

6.3 Scheduling alternatives

The project schedule for the proposed power plant is being driven by the growth in demand for electricity in Nairobi and its environs. It is also being driven by the unfavorable and unpredictable weather patterns in Kenya which do not allow the hydropower generation consistently. The KP&LC’s objective is to ensure that it continues providing electricity to its existing customers and providing a targeted 200,000 new connections annually. It is therefore imperative that the proposed project be undertaken expeditiously in order for the KP&LC to meet its business and financial objectives.

6.4 Demand alternatives

Global concern about the negative impacts of climate change is promoting improved fuel efficiency. Research into and production of viable alternatives to electric power generation is a growing field and alternatives such as wind, solar and biomass are being increasingly considered. However these alternative sources of power generation are currently unavailable at a scale sufficient to meet demand.

6.5 No-go option

Not constructing the power plant would imply that the benefits including improved electricity availability to KP&LC existing and new customers and associated economic and social benefits would not accrue. Concurrently the adverse impacts associated with the project would not materialize.
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7. Environmental Legislative and Regulatory Framework

7.1 Introduction

Presently environmental legislation in Kenya is provided in over 77 statutes. In order to provide a structured approach to environmental management in Kenya, the EMCA was enacted on January 14th 2000 as a framework law and contains provisions for the ESM of proposed and ongoing Projects respectively in Kenya. With the coming into force of the EMCA, the environmental provisions within the sectoral laws were not superseded; instead the environmental provisions within those laws were reinforced to better manage Kenya’s ailing environment. Under the EMCA a number of institutions were created and the following section provides a brief outline on the institutional framework of the EMCA. Given later in this chapter is a brief outline of some of the main sectoral laws associated with the proposed type of project.

7.2 Institutional framework of the EMCA

In order to operationalize the Act, the EMCA established various administrative structures. These included the NEC, the NEMA, the PCC, the NEMA Board, Provincial and District Environment Committees, the SERC and the National Environment Tribunal amongst others.

The apex body under the Act is the NEC which amongst other things is charged with the responsibility of developing the national environmental policy in Kenya as well as to set annual environmental goals and objectives.

The NEMA is the organ that has been established to exercise general supervision and coordination over all matters relating to the environment in Kenya. Further the NEMA is the Government’s principal instrument in the implementation of all policies relating to the environment.

The PCC was formed to investigate environmental complaints against any person, submit their findings/recommendations to the NEC and to submit periodic reports of its activities to the NEC.

The SERC has been established under the Act to advise the NEMA on the criteria and procedures for the measurement of environmental quality in Kenya. Environmental quality relates to air quality, wastewater quality, waste quality, noise quality, land use quality, etc. Additionally the SERC is required to recommend to the NEMA minimum environmental quality standards for all environmental parameters for which subsidiary legislation is or has been promulgated.

The institutional framework of the EMCA is shown in Figure 7-1 indicating the management structure of various organs under the Act.
7.3 Subsidiary legislation under the EMCA

7.3.1 L.N. 101: EIA/EA Regulations 2003

On June 13th 2003, the Minister for Environment and Mineral Resources promulgated Legal Notice 101: Environment (Impact Assessment and Audit) Regulations, 2003 as provided for under section 147 of the EMCA. These regulations provide the framework for undertaking EIA and EAs in Kenya by NEMA licensed Lead Experts and Firm of Experts. The EIA/EA Regulations also provide information to project proponents on the requirements of either an EIA or EA as required by the EMCA. This ESIA Study has been undertaken in accordance with the requirements of the above legislation.
7.3.2 L.N. 120: Water Quality Regulations, 2006

The above regulation was promulgated on September 4th 2006 and became effective on July 1st 2007. This regulation provides for the sustainable management of water used for various purposes in Kenya. For industries in Kenya, the regulation requires that Proponents apply for an “Effluent Discharge License” annually for discharging process wastewater either into the environment, aquatic environment or public sewers. For discharges into the environment and aquatic environment, the Proponent needs to apply directly to the NEMA. For discharges into public sewers, the Proponent needs to apply for the license to the relevant local authority. The regulation contains discharge limits for various environmental parameters into public sewers and the environment. For the proposed project, Table 7-1 indicates the maximum discharge limits of various environmental quality parameters. Non-compliance with any provision of the regulation carries a penalty of not more than KShs 500,000.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Permissible Limits for Discharge into the Environment</th>
<th>Permissible Limits for Discharge into Public Sewers</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSS</td>
<td>30mg/l</td>
<td>250mg/l</td>
</tr>
<tr>
<td>pH</td>
<td>6.5 – 8.5</td>
<td>6 – 9</td>
</tr>
<tr>
<td>Fecal coliforms</td>
<td>30 counts/100ml</td>
<td>-</td>
</tr>
<tr>
<td>Oil &amp; grease</td>
<td>Nil</td>
<td>10mg/l</td>
</tr>
<tr>
<td>Temperature</td>
<td>Based on ambient ±3°C</td>
<td>20 – 35°C</td>
</tr>
<tr>
<td>Color/dye/pigment</td>
<td>15 Hazen units</td>
<td>&lt;40 Hazen units</td>
</tr>
<tr>
<td>Total phosphorous</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flow</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chromium VI</td>
<td>0.5mg/l</td>
<td>0.05mg/l</td>
</tr>
<tr>
<td>Copper</td>
<td>1.0mg/l</td>
<td>1.0mg/l</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.5mg/l</td>
<td>5mg/l</td>
</tr>
<tr>
<td>Residual chlorine</td>
<td>0.1</td>
<td>-</td>
</tr>
<tr>
<td>Tin</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The proposed project will need to be in compliance with these regulations during the construction and operational phases respectively.
7.3.3 **L.N. 121: Waste Management Regulations, 2006**

The Waste Management Regulations were promulgated on September 4th 2006 and became effective on July 1st 2007. This regulation is comprehensive and covers the management of various kinds of waste in Kenya. For the Proponent it is expected that there will be hazardous and non-hazardous wastes that will be generated periodically during the construction and operational phase of the project respectively. Generally it is a requirement that a waste generator now segregates their waste (hazardous and non-hazardous) by type and then disposes the wastes in an environmentally acceptable manner.

Under the regulation, it is a requirement that waste is transported using a vehicle that has an approved “Waste Transportation License” issued by the NEMA. Wastes generated in Kenya must be disposed off in a licensed disposal facility. Such a facility will require annual environment audits to be undertaken by NEMA registered Lead Experts.

It is a requirement under the regulation for a Proponent to install at their premises anti-pollution equipment for treatment of various types of wastes. The treatment options shall be approved by the NEMA in consultation with the relevant lead agency.

The regulation contains definitions of hazardous wastes in the Fourth Schedule. The regulation requires that prior to generating any hazardous waste, a Proponent shall undertake an EIA Study and seek approval from the NEMA. Labeling of hazardous wastes is now mandatory under the regulation and the specific labeling requirements are provided in Rule 18. The treatment options for hazardous waste disposal provided in Rule 19 include incineration or any other option approved by the NEMA.

Hazardous wastes which may require being exported trans-boundary will require complying with the Basel Convention and Rules 20 – 23 respectively.

The regulation also contains several forms some of which will be applicable to the Proponent for completion prior to discharging their wastes during the construction and operational phases respectively of the project.

7.3.4 **L.N. 61: Noise and Excessive Vibration Control Regulations, 2009**

In May 2009, the Minister for Environment and Mineral Resources promulgated the above regulations for management of noise and excessive vibration. The general prohibition states that no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. The regulations further provide factors that will be considered in determining whether or not noise and vibration is loud, unreasonable, unnecessary or unusual. For fixed installations, excessive vibration under these regulations is defined as any vibration emanating from the source and exceeds 0.5cm/s.
Rules 5 and 6 of the regulations define noise levels for various types of activities that generate noise. The first schedule to the regulations defines permissible noise levels and is reproduced below.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Sound Level Limits (dBA) (Leq, 14h)</th>
<th>Noise Rating Level (NR) (Leq, 14h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Silent Zone</td>
<td>40 35</td>
<td>30 25</td>
</tr>
<tr>
<td>B. Places of Worship</td>
<td>40 35</td>
<td>30 25</td>
</tr>
<tr>
<td>C. Residential:</td>
<td>45 35</td>
<td>35 25</td>
</tr>
<tr>
<td>Indoor</td>
<td>50 35</td>
<td>40 25</td>
</tr>
<tr>
<td>Outdoor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Mixed residential (with some commercial and places of entertainment)</td>
<td>55 35</td>
<td>50 25</td>
</tr>
<tr>
<td>E. Commercial</td>
<td>60 35</td>
<td>55 25</td>
</tr>
</tbody>
</table>

The regulation further stipulates that a noise license will be required during the construction and operational phase of a project if there will be equipment that will produce noise during these two phases.

The EPC contractor shall apply for a noise license from the NEMA during the construction phase of the project. The fourth schedule of the regulations is the application for a noise license while the fifth schedule provides a description of the noise permit that the NEMA will grant the EPC contractor.

7.3.5 Licenses and Permits required under the EMCA

The Minister for Environment has promulgated a number of regulations to further operationalize the EMCA. These include:

- Legal Notice 120: The Environment Management and Coordination (Water Quality) Regulations 2006;
- Legal Notice 121: The Environment Management and Coordination (Waste Management) Regulations 2006; and

The SERC is in the process of drafting new regulations to manage environmental quality in Kenya emanating from diverse industrial activities. These regulations will provide the framework for managing Kenya’s environmental quality in a sustainable manner.
Once the regulations are promulgated Proponents will be required to apply for relevant licenses depending on the types of activities carried out by them. Currently the Ministry of Environment has promulgated Water Quality, Waste Management and Noise and Excessive Vibration regulations respectively. These are discussed above. Some of the licenses required to be maintained annually by Proponents include:

- Effluent Discharge License (for wastewater discharges);
- Waste License (for transport, treatment and disposal of wastes);
- Noise License (for noise and excessive vibrations).

The three promulgated regulations apply to the proposed project; the implication of the three subsidiary pieces of legislation on the proposed project has been discussed above.

### 7.4 The Energy Act, 2006

The Energy Act, 2006 is presently the primary legislation in Kenya that contains provisions for the management of the energy sector. The subsidiary legislation to operationalize the Act is yet to be developed but is expected to stipulate stringent HSE licensing requirements for all types of energy related activities such as the proposed project. A key aspect under this piece of legislation is the requirement for any energy sector project to undergo a full EIA Study such as for the proposed project.

The Act which was promulgated in 2006 with an effective date of July 1st 2007 contains several HSE provisions for the environmentally sound management of the energy sector. These are highlighted below and the Proponent will be required to comply with the provisions highlighted in the Act.

Section 90 of the Act requires a Proponent to seek permission to construct a power plant from the Energy Regulatory Commission (ERC). The application for permission must be accompanied by various documents including an ESIA Study of the project. Once the application and supporting documentation is filed, the ERC will communicate their decision within 45 days of the date of submission of the application.

Section 91 (1) (b) of the Act requires a Proponent to ensure compliance with the requirements of the EMCA.

Section 98 of the Act requires the Proponent to comply with HSE standards set by the ERC.

Section 102 (h) (m) (v) empowers the Minister responsible for Energy to promulgate regulations for the environmentally sound management of energy sector related facilities and infrastructure.
7.5 Occupational Safety and Health Act, 2007 (OSHA)

This Act of Parliament was enacted to provide for the health, safety and welfare of persons employed in workplaces, and for matters incidental thereto and connected therewith.

Part II of the Act provides the General Duties that the Occupier must comply with respect to health and safety in the workplace. Such duties include undertaking S&H risk assessments, S&H audits, notification of accidents, injuries and dangerous occurrences, etc. A number of sections under this part shall be applicable to the proposed project.

Part III of the Act provides the Administrative framework for supervision of the Act.

Part IV deals with the enforcement provisions that the DOHSS has been provided with under the Act. It discusses the instances when Improvement and Prohibition Notices can be issued as well as the powers of OSH officers. This part of the Act will be mandatory for the Occupier to comply with for the proposed project.

Part V of the Act requires all workplaces to be registered with the DOHSS. This part will be applicable for the proposed project as the Occupier will have to apply for registration of their project with the DOHSS on completion of the construction phase and before the operational phase of the project.

Part VI of the Act gives the requirements for occupational health provisions which include cleanliness, ventilation, overcrowding, etc. This part of the Act will apply to the Occupier especially during the operational phase of the project.

Part VII of the Act contains provisions for the safe operation of machinery and includes all prime movers and transmission equipment. Additionally this part includes the safe operation of cranes, chains, ropes, lifting tackles, pressure vessels and their statutory examination by DOHSS Approved Persons. This part of the Act will apply to the Occupier during the operational phase of the project.

Part VIII of the Act contains provisions for general safety of a workplace especially fire safety. This part of the Act will apply to the proposed project during the design, construction and operational phases respectively of the project.

Part IX of the Act deals with Chemical Safety. This will be applicable to the proposed project as it will handle and transport hazardous materials. The Occupier will be required to have MSDS sheets for all chemicals handled in the workplace including labeling all receptacles containing such hazardous materials.

Part X of the Act deals with the General Welfare conditions that must be present during the operational phase of the project. Such conditions include first aid facilities, supply of drinking water, etc.

Part XI of the Act contains Special Provisions on the management of health, safety and welfare. These include work permit systems, PPE requirements and medical surveillance. All sections of this part of the Act will be applicable to the proposed project during the operational phase.

Part XII of the Act deals with Special Applications such as platforms erected over water and workplaces where steam boilers or hoists and lifts are used. This part of the Act may not be applicable to the proposed project.
Part XIII of the Act stipulates the various fines and penalties associated with non-compliance of the Act. It includes those fines and penalties that are not included in other sections of the Act and will be important for the Occupier to read and understand the penalties for non-compliance with S&H provisions.

Part XIV of the Act is the last section of the Act and contains miscellaneous provisions which are not covered elsewhere. Most of the sections under this part of the Act will be apply to the proposed project and it in the interest of the Occupier to read, understand and ensure compliance with it.

Some of the important subsidiary legislation which operationalizes the Act and is applicable to the proposed project is described below.

### 7.6 Subsidiary legislation under OSHA

#### 7.6.1 L.N. 31: The Safety and Health Committee Rules 2004

These rules came into effect on April 28th, 2004 and require that an Occupier formalize a Safety and Health (S&H) Committee if there are a minimum of 20 persons employed in the work place. The size of the S&H Committee depends on the number of workers employed at the place of work.

For the Proponent and Contractor, the Occupational Safety and Health Act and the S&H Committee Rules 2004 are important as they require compliance with the following measures:

- Posting of an Abstract of the Factories and Other Places of Work Act in key sections of each area of the factory or other workplace;
- Provision of first aid boxes in accordance with Legal Notice No. 160 of 1977;
- Ensuring that there are an appropriate number of certified first aiders trained by an approved institutions and that the certification of these first aiders is current;
- Provision of a General Register for recording amongst other things all incidents, accidents and occupational injuries;
- Appointment of a S&H Committee made up of an equal number of members from management and workers based on the total number of employees in the company;
- Training of the S&H Committee in accordance with these rules;
- Appointment of a S&H management representative for the Proponent;

The S&H Committee must meet at least quarterly, take minutes, circulate key action items on bulletin boards and may be required to send a copy of the minutes to the DOHSS provincial office.

Appropriate recordkeeping including maintenance of all current certificates related to inspection of critical equipment such as cranes, air compressors, lifts, pulleys, etc. Such inspections need to be undertaken by a competent person certified by the Director of the DOHSS.
7.6.2 L.N. 24: Medical Examination Rules 2005

These rules provide for Occupiers to mandatorily undertake pre-employment, periodic and termination medical evaluations of workers whose occupations are stipulated in the Second Schedule of the Act and the First Schedule of the Regulation. The workers are to undergo medical evaluations by a registered medical health practitioner duly registered by the DOHSS.

It will be incumbent on the EPC Contractor to ensure that Material Safety Data Sheets (MSDSs) for chemicals used in the construction and operational phase are studied for toxicological and epidemiological information. If any of these products present negative impacts to human health, the workers exposed to the chemicals will be required to undergo medical examinations in accordance with the above Rules.

7.6.3 L.N. 25: Noise Prevention and Control Rules 2005

These rules were promulgated for work related noise exposures on March 10th 2005 and apply to workplaces in Kenya. The regulation is applicable to the project as there will be noise potentially generated by construction equipment that may exceed the permissible noise levels given below. The regulation sets the permissible level for noise in any workplace as follows:

- 90 dB(A) over an 8-hour TWA period over 24-hours; and
- 140 dB(A) peak sound level at any given time.

In addition to the above the regulation sets community noise levels emanating from a workplace as follows:

- 50 dB(A) during the day; and
- 45 dB(A) at night.

If noise levels exceed the above permissible levels, the Occupier is required to develop, rollout and implement a written hearing conservation program which should include the following sections as a minimum:

- Noise Survey;
- Education and training;
- Engineering noise control methods;
- Hearing protection requirements;
- Posting of notices in noisy areas;
- Audiometric testing methods and frequencies for those exposed to high noises; and
- Annual program review.

The Proponent is to ensure that any equipment brought to a site in Kenya for use shall be designed or have built in noise reduction devices that do not exceed 90 dB(A). The Proponent shall request the supplier of the machine or equipment for its noise characteristics.
There is also a requirement for a Proponent to medically examine those employees that may be exposed to continuous noise levels of 85 dB(A) as indicated in Regulation 16. If found unfit, the occupational hearing loss to the worker will be compensated as an occupational disease.

It is expected that during the construction phase of the project, there may be plant and equipment that exceeds the threshold levels of noise stipulated under the Rules. It will therefore be incumbent on the EPC contractor and their sub-contractors to ensure that their equipment is serviced properly and/or use equipment that complies with the threshold noise values given above. Alternatively the EPC contractor will be required to develop, rollout and implement a written hearing conservation program during the construction phase.

### 7.6.4 L.N. 59: Fire Risk Reduction Rules, 2007

These rules were promulgated by the Minister for Labor on April 16th 2007 and apply to all workplaces. The rules apply to the proposed project in several ways as enumerated below.

Regulation 5 requires Proponents to ensure that fire resistant materials are used for construction of new projects. A number of minimum specifications of materials are provided in the regulation.

Regulation 6 requires that all flammable materials to be stored in appropriately designed receptacles.

Regulation 7 requires that all flammable storage tanks or flammable liquid containers be labeled with the words “Highly Flammable” in English or Kiswahili. It is therefore practical for the Proponent to use a system similar to the HMIS system (NFPA 704 standard) of labeling their product tanks. The regulation requires a Proponent to consult the product’s MSDS for appropriate labeling requirements.

Regulation 8(3) requires a Proponent to have a spill prevention, response and countermeasures plan (SPRCC). This is important given the nature of the project and products to be handled by it.

Regulation 16 requires Proponents to ensure that electrical equipment is installed in accordance with the respective hazardous area classification system. It is also a requirement that all electrical equipment is inspected 6-monthly by a competent person and the Proponent is required to keep records of such inspections.

Regulation 17 requires Proponents to clearly delineate fire escape exits. The regulation provides for the minimum standards to be applied in marking out all fire escape exits.

Regulations 20 – 23 require Proponents to have trained firefighting teams within their premises. The above regulations provide for the minimum number of fire team members based on the total number of employees that may be present at any given time within the Proponent’s premises. Each of the fire team members must undergo a training course in fire fighting to be provided by a DOHSS approved institution. The DOHSS may develop a curriculum for this training including the minimum number of contact hours required.
Regulation 22 provides a description of the functions of a fire fighting team. Regulation 23 requires Proponents to mandatorily undertake fire drills at least once a year.

Regulations 24, 26 and 27 refer to the communication system to be employed by Proponents for alerting staff. All premises must have properly marked assembly points and suitable means of alerting workers about a fire. Regulation 27 specifically requires Proponents to display “No Smoking” signs wherever flammable vapors may be present.

Regulation 28 requires Proponents to install fire detection systems in their premises. Such systems must be connected to audible and visual flashing devices and the system must be maintained regularly to ensure its integrity at all times.

Regulations 29 – 31 refer to the installation and maintenance of fire fighting systems in workplaces. Fire extinguishers are to be mounted at least 60cm above ground while a fire hose reel must be located within a radius of 30m. The fire fighting system shall be maintained annually by a competent person and records maintained by the Proponent. Fire extinguishers shall be hydrostatically tested once every 5 years. Any fire extinguisher that does not pass a hydrostatic test or is damaged mechanically shall be put out of service. Regulation 31 provides the types of fire fighting appliances required for different flammable and combustible materials and the minimum distances between firefighting appliances that must be maintained.

Regulation 32 requires Proponents to color code all their pipelines according to the product being conveyed by them. All fire water pipes will be colored in red. Additionally this regulation provides for the color coding to be adopted for fire extinguishers.

Regulation 33 requires Proponents to have adequate fire water storage capacity. As a minimum this regulation requires Proponents to have at least 10m³ of dedicated fire water storage capacity.

Regulation 34 requires Proponents to develop, rollout and implement a comprehensive written Fire Safety Policy. This policy should contain a Fire Safety Policy Statement signed by the CEO, a Fire Safety Policy Manual and a brief summary of the Fire Safety Policy of the company.

Regulation 35 requires a Proponent to notify the nearest OSH area office of a fire within 24 hours of its occurrence and a written report sent to the Director of DOHSS within 7 days.

Regulation 36 requires Proponents to undertake annual fire safety audits by a DOHSS registered fire safety auditor and submit a report to the DOHSS within 14 days. The definition of a fire safety audit includes a fire risk assessment. The cost of undertaking fire safety risk assessments and fire safety audits shall be borne by the Proponent.

7.6.5 L.N. 60: Hazardous Substances Rules, 2007

These rules were promulgated by the Minister of Labor on April 16th 2007 and apply to the Proponent as they are expected to handle chemicals that can potentially expose their employees to hazardous substances.
The Rules state that the Proponent shall ensure that where chemicals come into contact with employees, the exposure limits set out in the First Schedule of the Regulations are not exceeded. Where employees may be exposed to two or more chemicals in the workplace the Proponent shall work out the combined exposure using the narrative given in the Second Schedule of the Regulations. The Minister of Labor is empowered to change the exposure limits given in the First Schedule of the Regulations.

It is the responsibility of the Proponent to ensure that all employees exposed to chemicals in the workplace are protected adequately from exposure to hazardous substances that may be present in them using the hierarchy of hazard control methods. Such methods include elimination of the chemicals, substitution of the chemicals with less hazardous ones, engineering controls, administrative controls, use of PPE and emergency response planning. If engineering controls are applied, the Proponent will undertake the maintenance and testing of the engineering controls once every 24 months by a DOHSS licensed Engineering Controls Examiner who will submit his report to the Director DOHSS within 30 days.

Regulation 11 requires Proponents to ensure that their employees are adequately protected from radioactive substances. For example if radiography is used to check the integrity of pipe welds the Proponent will be required to issue a permit-to-work (PTW) for such work.

Regulation 12 – 15 requires Proponents to have a Hazard Communication program implemented at their workplace. The Proponent is required to maintain an inventory of all MSDSs for the chemicals stored in their workplace. As a minimum the MSDS shall comply with the format indicated in the Third Schedule of the Regulations and will be disclosed fully to the employees handling the chemical by the Proponent. All unused, obsolete or expired chemicals must be disposed off in an environmentally sound manner. All containers containing chemicals must be labeled appropriately as indicated in the MSDS for that chemical. Training of employees on the hazards associated with handling chemicals safely in the workplace will be provided at the Proponent’s cost.

Regulation 16 requires the Proponent to monitor chemical exposure levels in the workplace annually by engaging a DOHSS registered Air Quality Monitor. The cost of the exposure monitoring survey will be borne by the Proponent. The Air Quality Monitor shall submit a report to the DOHSS Director within 30 days.

Regulation 19 requires Proponents that use hazardous chemicals in the workplace to subject those employees exposed to medical examinations in accordance with the requirements of Legal Notice 24: The Factories and Other Places of Work (Medical Examination) Rules 2005.

7.7 Physical Planning Act, Chapter 286

The Physical Planning Act was promulgated for the preparation and implementation of physical development plans and connected purposes. This Act which was promulgated in 1996 requires the Proponent of a Project to submit an ESIA Study to the respective local authority if in the opinion of the local authority the Project is anticipated to have adverse environmental impacts (Section 36 of the Act).
7.8 **IFC Performance Standards**

In addition to meeting the requirements of Kenyan laws and regulations, the proposed project will be required to comply with the requirements of the lenders, specifically the International Finance Corporation (IFC). The IFC has developed eight performance standards (PS) on social and environmental sustainability as follows:

- **Performance Standard 1:** Social and Environmental Assessment and Management System
- **Performance Standard 2:** Labor and Working Conditions
- **Performance Standard 3:** Pollution Prevention and Abatement
- **Performance Standard 4:** Community Health, Safety and Security
- **Performance Standard 5:** Land Acquisition and Involuntary Settlement
- **Performance Standard 6:** Biodiversity Conservation and Sustainable Natural Resource Management
- **Performance Standard 7:** Indigenous Peoples
- **Performance Standard 8:** Cultural Heritage

Performance Standard 1 establishes the importance of:

(i) Integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects;

(ii) Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and

(iii) The client’s management of social and environmental performance throughout the life of the project.

Performance Standards 2 through 8 establish requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment, and to improve conditions where appropriate. While all relevant social and environmental risks and potential impacts should be considered as part of the assessment, Performance Standards 2 through 8 describe potential social and environmental impacts that require particular attention in emerging markets. Where social or environmental impacts are anticipated, the client is required to manage them through its Social and Environmental Management System consistent with Performance Standard 1.

Of the eight IFC performance standards, PS1 – 4 will apply to the proposed project and the EPC Contractor will be required to be in compliance with the latest version of these standards.

In addition the above performance standards, the IFC has developed general and specific HSE guidelines for projects that are financed by them. Subsequently the proposed project will be undertaken in compliance with relevant sections of the following IFC Guidelines:

- General EHS Guidelines;
- EHS Guidelines for Thermal Power Plants; and
- OHS Guidelines.

An annex at the end of this ESIA Study contains the IFC’s EHS Guidelines for Thermal Power Plants as well as the OHS Guidelines which the project will need to be in compliance with throughout its life cycle. The General EHS Guidelines can be downloaded by the Proponent or the EPC contractor from the IFC website www.ifc.org.
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8. Construction HSE Management Plan

8.1 Introduction

Health, safety and environment (HSE) protection is fundamental to the Proponent’s operations and forms an integral part of Gulf Power Ltd.’s HSE Management System. The Proponent is committed to the implementation of the requirements of an HSE system that is consistent with national and international HSE standards for their facilities.

The proposed power plant will be constructed by an engineering, procurement and construction (EPC) management contractor. The EPC contractor is expected to sub-contract the civil, mechanical, electrical, instrumentation and control components to locally based Kenyan contractors. Prior to construction the EPC contractor will develop, roll-out and implement a construction HSE plan which will outline the routine management of HSE aspects associated with the construction phase of the project.

During the operational phase, the Proponent will develop, rollout and implement a formal HSE management system for the operation of the thermal power plant.

This section outlines the framework of a construction HSE management plan that the successful contractor is expected to implement in building the proposed thermal power plant.

8.2 Compliance with HSE legislation

The EPC contractor will need to ensure that their construction HSE management plan complies as a minimum with stipulated laws and regulations in Kenya on HSE. Some of the pertinent laws are referenced below.

- Environment Management and Coordination Act, 1999 and its subsidiary legislation;
- Energy Act, 2006;
- Occupational Safety and Health Act, 2007 and its subsidiary legislation;
- Physical Planning Act, 1996;
- Local Government Act;
- Public Health Act;
- Water Act.
8.3 Compliance with International HSE Framework

As stated in preceding section, the proposed project will be undertaken in accordance with Kenyan legislation on HSE. Additionally it is expected that the EPC contractor and their sub-contractors will comply with the requirements of the IFC on environment, health and safety preservation throughout the construction phase in accordance with relevant IFC guidelines. The EPC contractor will further ensure that the project construction phase complies with the relevant requirements of the Equator Principles as discussed in Section 7 of this ESIA Study.

8.4 Construction HSE management plan

8.4.1 Purpose of a construction HSE plan

A construction HSE plan is management tool used to manage HSE activities associated with the construction of a project. It is a prerequisite for satisfying the Proponent that the successful contractor has implemented a management system for the safe operation of construction related activities in a project.

The construction HSE plan sets out the HSE management system as well as the resources required to implement it. It includes the minimum requirements for compliance with local HSE laws and regulations in order to prevent injuries to workers, damage to property or the environment. In the absence of relevant legislation, the EPC contractor will ensure compliance with international standards, guidelines and best practices in the safe operation of construction activities associated with the project.

8.4.2 Objectives of a construction HSE plan

The principal objectives of a construction HSE plan include:

- Prevention or limitation of injuries to workers, damage of property or the environment through an emergency preparedness and response plan;
- Prevention of recurring accidents or incidents through a program of root cause analysis;
- Ensuring that safe work practices and procedures are issued and understood by all construction workers;
- Verification through planned audits and reviews that procedures and instructions are complied with fully; and
- Counseling construction workers involved in near misses on better safe work practices.
In order to implement the construction HSE plan, the EPC contractor will implement the following strategy:

- The HSE goals/objectives of the project will be verified and commented upon in each HSE meeting;
- A monthly HSE theme relevant to the planned objectives will be issued;
- Monitoring and control of unsafe practices;
- Initiate an unsafe act/condition report system for conveying accountability to affected employees including a disciplinary action system for non-compliance;
- Initiate an HSE recognition and rewards program for good HSE behavior among construction workers;
- Organize HSE competitions to promote interaction of construction workers through direct involvement in routine HSE objectives.

8.4.3 HSE organization and responsibilities

HSE is a management responsibility. Subsequently construction management of the proposed project shall form part of the daily responsibility of each member of the EPC contractor’s management team and the sub-contractors’ they supervise.

The EPC contractor’s organization structure should include several persons who will have routine responsibilities for managing HSE aspects associated with the construction phase of the project. A brief outline of the roles and responsibilities of various actors in HSE management is given below.

The organization chart proposed for the construction of the proposed thermal power plant is indicated below.

<table>
<thead>
<tr>
<th>Position</th>
<th>HSE Roles and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Management Engineer</td>
<td>• Overall EPC contractor representative and retains HSE monitoring role over the project;</td>
</tr>
<tr>
<td></td>
<td>• Has overall responsibility for HSE associated with the project.</td>
</tr>
<tr>
<td>Construction Manager</td>
<td>• Reports to the Project Management Engineer;</td>
</tr>
<tr>
<td></td>
<td>• Promotion of HSE awareness by example (role model behavior);</td>
</tr>
<tr>
<td></td>
<td>• Ensures sub-contractors comply with HSE rules and are trained in HSE;</td>
</tr>
<tr>
<td></td>
<td>• Ensures that the project HSE plan is continuously maintained and updated.</td>
</tr>
<tr>
<td>Plant Engineer</td>
<td>• Reports to the Construction Manager;</td>
</tr>
<tr>
<td></td>
<td>• Promotion of HSE awareness by example (role model behavior);</td>
</tr>
<tr>
<td></td>
<td>• Ensures that all construction plant (cranes, ropes, lifting tackles, etc.) is certified as being safe by a DOHSS approved person;</td>
</tr>
<tr>
<td></td>
<td>• Maintains all HSE records and provides them to</td>
</tr>
</tbody>
</table>
### Position | HSE Roles and Responsibilities
--- | ---
Other managers, supervisors and engineers | - They report to the Construction Manager;  
- Demonstrate their concerns for HSE compliance by good role model behavior;  
- Ensure that subordinates are aware of HSE hazards involved in their respective work tasks through training and work experience;  
- Ensure compliance with HSE legislation including conducting regular HSE inspections at the work site;  
- Ensure that construction plant and equipment is in a good state of repair and made available to the construction workers;  
- Reporting of any unsafe acts or conditions to the Construction Manager’s attention for remedial action;  
- Ensuring that all accidents/incidents are reported immediately and appropriate investigations undertaken;  
- Plan, coordinate and participate in HSE toolbox meetings for construction workers.

Employees | - Carry out their routine construction activities in a healthy, safe and environmentally friendly manner;  
- Use appropriate PPE provided to them by the contractor;  
- Ensure compliance with the contractor’s HSE rules;  
- Be aware of the HSE hazards associated with the construction plant and equipment they will use;  
- Bring to the notice of their immediate management any HSE hazards identified during the construction phase.

HSE manager | - Reports to the Project Management Engineer and is the primary advisor to the EPC contractor on all HSE issues associated with the construction site;  
- Is empowered to halt construction operations if any unsafe acts or conditions are witnessed;  
- Ensures all managers and employees are aware of their HSE responsibilities;  
- Facilitates HSE risk assessments and JSAs;  
- Undertakes regular HSE inspections of the construction site in accordance with the contractor’s HSE policy;  
- Provides HSE training for the EPC contractor’s managers, employees and nominated sub-
<table>
<thead>
<tr>
<th>Position</th>
<th>HSE Roles and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>contractors;</td>
<td>• Undertakes accident/incident investigation in order to establish root causes of accidents/incidents;</td>
</tr>
<tr>
<td></td>
<td>• Ensures statutory HSE audits and inspections are undertaken and reports filed appropriately;</td>
</tr>
<tr>
<td></td>
<td>• Issues a construction HSE project report monthly;</td>
</tr>
<tr>
<td></td>
<td>• Provides HSE documents requested by the Proponent or any HSE related lead agency.</td>
</tr>
<tr>
<td>HSE representatives</td>
<td>• Responsible for ensuring that relevant HSE work instructions are understood and fully implemented by fellow workers;</td>
</tr>
<tr>
<td></td>
<td>• Reporting any accidents/incidents, unsafe acts or conditions to the HSE manager;</td>
</tr>
<tr>
<td></td>
<td>• Reinforcing and encouraging the concept of individual HSE responsibility within their work teams;</td>
</tr>
<tr>
<td></td>
<td>• Attend all HSE meetings and share proceedings with the rest of the work teams.</td>
</tr>
<tr>
<td>Sub-contractors</td>
<td>• Will be subjected to the EPC contractor’s HSE appraisal;</td>
</tr>
<tr>
<td></td>
<td>• Compliance with HSE laws and regulations and EPC contractor’s HSE policies.</td>
</tr>
<tr>
<td>Suppliers</td>
<td>• Comply with the EPC contractor’s HSE policy which will be forwarded to them by the HSE Manager;</td>
</tr>
<tr>
<td></td>
<td>• Provide relevant HSE information to the HSE Manager associated with storage, use and disposal of supplies.</td>
</tr>
</tbody>
</table>

### 8.4.4 HSE performance measurement

The EPC contractor will be required to develop, rollout and implement an HSE performance measurement system. The measurement system will be used to recalibrate the HSE performance of the project during the construction phase to ensure that there are no injuries to people, damage to property or the environment. Some of the performance measurement metrics that should be considered for tracking include the following lagging and leading indicators:

- No. of fatalities;
- Lost time incident rate (LTIR);
- No. of fire incidents;
- No. of environmental incidents;
- Equipment damage/minor injuries;
- No. of health and hygiene reports;
8.4.5 **HSE interface between contractor and proponent**

Throughout the construction phase, there will be an interface between the proponent and the EPC contractor on HSE management. The objectives of this activity are to ensure that:

- The EPC contractor achieves the same or higher HSE standards than those stipulated by the Proponent;
- All HSE related hazards of the construction phase are identified, evaluated and appropriate control measures implemented;
- The EPC contractor understands their obligations with respect to HSE associated with the project;
- HSE performance management arrangements are in place by mutual definition.

The interface on HSE management may be achieved by the proponent and EPC contractor through meetings, reviews and audits during the design and construction phases of the project respectively. Some of the meetings may be defined as follows:

- HSE kick-off meeting;
- Weekly HSE progress meetings;
- Ad-hoc HSE meetings called by either the proponent or the EPC contractor to discuss specific HSE issues; and
- HSE reviews/inspections undertaken by either the proponent or the EPC contractor or both.

### 8.5 Safety action plan

#### 8.5.1 Design phase

This section summarizes the processes that will be used by the EPC contractor during the design phase of the project. The processes include general duties, HSE management during the design phase, design reviews and recording.

**General duties**

It will be the general duty of the EPC contractor’s in-house designers to ensure that the design and construction of the proposed project is achieved without HSE risks as far as is practically possible.
Hazards associated with the construction and commissioning of the proposed project will be identified during the design phase of the project. Where possible the hazard will be removed or avoided however if this is not possible, appropriate control measures will be incorporated in the design phase.

During the design phase, the EPC contractor will develop construction operating procedures to ensure the safety of people, maintain integrity of the proposed project against capital and revenue loss, and ensure against damage to the environment. This will be achieved by employing the following tasks:

- Application of correct design standards, codes of practice, policies, procedures, etc.;
- Critical review of the design and construction activities of the project;
- Formal identification of hazards;
- Qualitative/quantitative analysis; and
- Implementation of actions arising from the above steps.

**HSE management**

HSE management in the design phase will encompass interactions between the following EPC contractor’s specialists:

- HSE Manager;
- Safety and Environmental Engineers; and
- Designers.

Each of the above disciplines will have specific roles to play in ensuring that the proposed project is designed after elimination of all health and safety hazards. Where such hazards cannot be eliminated, a hierarchy of hazard control will be employed to minimize the health and safety hazard exposure to construction workers.

The EPC contractor while conducting the design will ensure that their designers systematically exercise health and safety issues associated with the design of the project. Any risks identified will be eliminated to ensure that there is no risk to worker injury or property damage. The designers will employ a risk assessment approach to the design of the project. Under this approach if the identified risks cannot be eliminated, sufficient information will be included with the design to alert others to the risks which they cannot reasonably be expected to know about.

**Design reviews**

The safety action plan in the design phase will include both internal and external design reviews. Internal design reviews will be initiated by the contractor’s engineering manager and will include verification of all engineering documents before releasing them to the Proponent for external reviews.

The external design review will be undertaken by the Proponent to ensure that the EPC contractor’s project design is adequate and conforms to the terms of the contract health and safety requirements.
Recording process

The EPC contractor will have in place a quality assurance system such as ISO 9001. The EPC contractor’s designers will maintain a record of all design decisions and how health and safety was incorporated into the design.

A health and safety file will be maintained by the EPC contractor containing the risk control measures that need to be implemented during the construction phase of the project.

8.5.2 Construction and fabrication phase

Safety hazards and critical areas

Prior to commencing construction the EPC contractor will identify potential hazards to the safety of personnel associated with construction phase of the project. The list of potential hazards will be updated on-site at regular intervals. For each hazard identified the EPC contractor will ensure that there is a safe work procedure that is developed, rolled-out and implemented for the project.

Safety procedures

As an experienced contractor will be engaged for this project, it is envisaged that they will already have safe work procedures developed for similar types of projects. These procedures will be customized for the proposed project and used throughout the construction phase. Examples of construction activities for which safe work procedures are required include:

- Cranes and lifting equipment operations;
- Electrical work;
- Confined space entry;
- Fire protection and prevention;
- Emergency response;
- Permit-to-work;
- Job safety analysis (JSA);
- Risk analysis;
- Root cause analysis;
- Safety incentive program; and
- Disciplinary system, etc.
Safety training

Health and safety training of workers is required by Kenyan legislation under the Occupational Health and Safety Act, 2007 (OSHA). Additionally the EPC contractor will be required to train their sub-contractors on the safe work procedures some of which are identified above. Health and safety training needs will be identified by the contractor prior to commencement of the construction phase of the project. Health and safety training associated with the project will be extended to all levels of management and workers who may potentially be exposed to health and safety risks during the construction phase of the project. Health and safety training records will be maintained on site by the EPC contractor for review by appropriate lead agencies and the Proponent.

Safety guidelines and rules of operation

The successful contractor will be required to have a formal PPE program that can be implemented for the proposed project. The PPE program will in the main include instructions for:

- Selection of correct type of PPE based on the hazards at the job site;
- Issuance of PPE;
- Correct use of PPE;
- Inspection and maintenance of PPE;
- Replacement of worn out PPE.

In addition to the PPE program, the contractor will evaluate all risks associated with working at heights (1.8m above grade level). For such work, the construction workers will be provided with appropriate safety harnesses or safety nets. All construction vehicles will be fitted with seat belts that operators must wear while working.

The construction site will contain appropriate signs, signals and barricades that are visible to the workers to protect them from potential hazards. Trenches and other excavation will also be provided with appropriate barricades, signs and signals. Where it is necessary to perform work at night, the EPC contractor will ensure that their sub-contractors provide artificial lighting sufficient to permit work to be carried out safely, efficiently and satisfactorily.

All tools and equipment deployed by the EPC contractor and their sub-contractors shall be free from defects, be in good operating condition and maintained in a safe condition. Any equipment that falls under the Examination of Plant Order under the OSHA shall be inspected by a DOHSS approved person and a certificate issued prior to its use at the construction site. Some of the tools, equipment and plant expected to be used for the proposed project include:

- Hand and portable power tools;
- Compressed gas cylinders;
- Scaffolds;
- Cranes and lifting equipment;
In addition to the above, the EPC contractor will develop, rollout and implement the following health and safety rules for the construction site:

- Motor vehicles;
- Ladders.

### 8.6 Occupational health action plan

An occupational health plan is primarily concerned with identification, evaluation and control of environmental health exposure that result from construction processes. The stresses can be physical, chemical, biological and physiological and may cause sickness, impaired health or discomfort to employees.

An occupational health plan therefore addresses the above concerns as they apply to the project and to provide cost effective solutions to assure the health and well-being of project employees.

The successful contractor will engage the services of a medical practitioner(s) based in Athi River or Nairobi with skills and competencies in clinical and occupational medicine, industrial hygiene, toxicology, epidemiology, etc.

### 8.6.1 Medical and health program

The medical and health plan provides the necessary and important parts of a construction project medical and health program. The objectives of this program are to:

- Protect employees against occupational health hazards at the construction worksite;
- Facilitate placement of workers according to their physical, mental and emotional capabilities without endangering their own health and safety or that of others; and
- Ensure adequate medical care and rehabilitation of the occupationally injured or ill person.

The EPC contractor will engage the services of a DOHSS approved Designated Health Practitioner (DHP) for undertaking medical examinations in accordance with the Second Schedule of the OSHA and Legal Notice No. 24: Medical Examination Rules, 2005. For those occupations defined in the Second Schedule of the OSHA, the EPC contractor will avail their employees to a DHP for medical examinations throughout the construction phase of the project during the following occasions:

- Pre-assignment;
- Periodic;
- Post illness or injury; and
- Termination.

An occupational injury or illness will be diagnosed as promptly as practical and treated as appropriate within the capabilities of the workplace medical facility. The EPC contractor’s occupational health program should include treatment of emergency conditions at the work site which may occur during the construction phase of the project.

Construction workers and other employees will be inducted to the potential occupational health hazards that they may encounter in their specific roles. The induction will include methods of recognizing and preventing adverse health and safety effects at the work place.

The occupational health program will also include training of construction workers on the correct use and maintenance of PPE issued to them. The site HSE Manager will periodically inspect and evaluate the workplace for potential adverse occupational health hazards.

Occupational health record keeping will be maintained by the site HSE Manager for all employees that are medically examined. The records will contain sufficient data to reproduce a chronology of an employee’s medical occurrences, illnesses and injuries. All employee medical records will be maintained confidentially.

If the EPC contractor engages catering personnel for their staff, it will be mandatory for each food handler to be immunized every six months as required by the Local Government Act.

### 8.6.2 Record keeping requirements

Medical records will provide data for use in job placement, establishing health standards, health maintenance, treatment and rehabilitation, worker’s compensation cases and assisting project management with program evaluation and management. The record keeping requirements will comply with Kenyan laws and regulations as well as the Proponent’s insurance requirements.
The EPC contractor and their appointed DHP will maintain occupational health records of workers as required by Kenyan legislation (OSHA, WIBA and L.N. 24). The DHP will confidentially maintain health examination records of all employees that visit him/her. Examples of records that need to be maintained include:

- Physical examination reports;
- Clinical reports;
- Chest x-rays,
- Audiograms, etc.

The medical records shall be maintained in locked files and only authorized persons shall have access to them. In certain situations requests for specified medical information may be sought by authorized Government officials. Additionally an employee or his/her designated representative may seek information about themselves or their environmental exposure. These requests shall be turned over to the project managers for handling.

8.6.3 Inspection program

The site HSE Manager will conduct sanitation and health inspections at the job site to ensure compliance with project medical and health rules and regulations. The sanitation inspections will cover the following areas:

- Drinking water;
- Control of vermin and pests;
- Toilet facilities;
- Waste disposal;
- Lunch areas.

Written reports will be issued having target dates for corrective actions to be taken by responsible supervisory personnel.

8.6.4 Training

During the construction phase, the contractor will be required to arrange for training on first aid, health and safety, security and fire safety.

8.6.5 Communications system

The EPC contractor will be required to develop, rollout and implement a rapid communications system to ensure fast and reliable emergency communications between the project site and crews at the scene of an accident.
8.6.6 Procurement and material control

The contractor’s HSE Manager will develop a master listing of all medical and first aid materials, supplies and equipment that will be needed during the construction phase of the project.

8.7 Environment action plan

The purpose of a construction environment management plan (CEMP) is to specify environmentally sound working methods in order to minimize environmental impact of the construction works associated with the proposed project.

The CEMP identifies key environmental aspects and the related impacts which may occur and specifies methods, measures and controls that the EPC contractor will comply with during the construction phase of the project.

8.7.1 Key environmental positions

The beginning of this section identified the key HSE positions that will be used to manage health, safety and environmental aspects during the construction phase of the project. The primary persons from the EPC contractor’s organization responsible for implementing the CEMP include:

- Project Management Engineer;
- Construction Manager;
- Engineering Manager; and
- HSE Manager.

The Project Management Engineer will have overall responsibility for all aspects related to environmental issues and to ensure that the EPC contractor’s environmental policy statement and objectives are complied with.

The Construction Manager will be responsible for developing, rolling out and implementing environmental procedures and work instructions in conjunction with the HSE Manager.

The Engineering Manager will be responsible for reviewing environmental issues during the design phase of the project.

The HSE Manager will be responsible for several environmental functions such as:

- Coordinating environmental inputs to the project and advising the Project Management Engineer and Construction Manager on environmental matters;
- Coordinating the development, rollout and implementation of the EPC contractor’s environment management system (EMS) for the project;
- Routine monitoring of implementation of the EPC contractor’s EMS at the project site;
• Authority to halt any works where actions are found to be in contravention of particular environmental procedures, work instructions or legal requirements;

• Authority to amend work instructions and procedures as required by sound environmental management including amendments to the EMS as identified by audits.

**Environmental training**

The EPC contractor’s management and their sub-contractors will receive environmental induction training prior to commencement of the construction phase of the project. The training will cover the contractor’s EMS and environment work instructions relevant to the construction activities.

### 8.7.2 Environmental objectives

The EPC contractor will develop an environment management system (EMS) in order to comply with basic environmental objectives and targets set for the project. Environmental objectives for the construction phase will be discussed and agreed between the Proponent and the EPC contractor. The EMS will detail the environmental standards for the project and will include a number of environmental work instructions. The EMS will be implemented in conjunction with the EPC contractor’s health, safety and environment action plan. Environmental activities will be audited regularly to ensure continued compliance with predetermined environmental objectives.

Environmental work instructions will be developed to comply with all legislative and regulatory requirements as a minimum. The objective is to endeavor to minimize and prevent where possible adverse environmental impacts. The environment work instructions will apply equally to all the EPC contractor’s workers, sub-contractors, project consultants and suppliers.

The EPC contractor will provide environmental training for their workers in order to minimize the likelihood of environmentally damaging incidents occurring.

### 8.7.3 Environmental procedures

The EPC contractor will develop, rollout and implement environmental procedures for the design and construction phase of the project. The procedures will be organized under two categories namely:

- Management and Organization procedures; and
- Environmental Management Procedures.

The above types of environmental procedures will be developed jointly by the HSE Manager and construction team. Once drafted, the procedures will be discussed with the Project Management Engineer and Construction Manager to ensure operability.
8.7.4 Environmental performance meetings

The EPC contractor will schedule regular meetings to discuss environmental performance of the project during the construction phase. The meetings will be attended by the Project Management Engineer, Construction Manager, HSE Manager and the Proponent. Minutes of the meetings will be circulated to all employees and posted on construction site notice boards.

8.7.5 Environmental reviews

Environmental reviews include both inspections and audits to be conducted by the contractor. Audits will be conducted by the HSE Manager and will include monitoring of construction phase environmental effects against identified performance targets. Findings and recommendations will be shared with the Project Management Engineer, Construction Manager and the Proponent.

Inspections of working areas will be performed periodically using appropriate checklists. Inspections will be undertaken by construction supervisors and findings/ corrective actions discussed in daily construction meetings. A tracking system shall be employed for monitoring status of implementation of corrective actions. Records of inspections will be filed on-site and made available to relevant lead agencies and the Proponent.

8.7.6 Soil conservation and erosion mitigation

The EPC contractor will develop a soil conservation and erosion mitigation plan which will include details on how to perform clearing, grading, excavation, trenching and backfilling work at the project site.

During the construction phase, the EPC contractor will take adequate measures to prevent soil erosion especially during the rainy season. The integrity of soil erosion mitigation shall be sufficient to provide continued protection against erosion until the site soils have stabilized and added protection is no longer necessary.

8.7.7 Site restoration

Prior to handover of the completed footprint to the Proponent, the EPC contractor will undertake a final cleanup of the entire project site including removal of all non-hazardous and hazardous waste or excess materials. Surface restoration and stabilization will be performed in accordance with environmentally sound practices.
8.7.8 **Waste management**

Prior to the construction phase but immediately after award of the contract, the EPC contractor will develop a waste management plan for the project. The waste management plan will be in compliance as a minimum with Legal Notice 121: Waste Management Regulations, 2006 and the Proponent's environmental requirements.

8.7.9 **Spill response**

During the construction phase, the EPC contractor will be required to develop, rollout and implement a spill response procedure for any spills that could potentially result from the EPC contractor’s operations.

8.7.10 **Air quality**

Kenya has developed air quality regulations which are awaiting gazettement. It is envisaged that the EPC contractor’s mechanically driven plant and equipment will emit criteria pollutants to the atmosphere during the construction phase. The EPC contractor will ensure that the plant and equipment they use for the project is in a good state of repair, well maintained, and equipped with suitable mufflers to prevent generation of air pollutants and noise.

8.7.11 **Work site controls**

The EPC contractor through the HSE Manager and HSE representatives will monitor the project construction site daily for environmental non-conformances and submit written HSE reports to the Proponent weekly. Remedial action on environmental non-conformances will be implemented immediately they are observed.

Scheduled environmental inspections will be undertaken by the EPC contractor on a monthly basis and all reports filed on site for inspection by relevant lead agencies or the Proponent.

Construction workers will be provided with environmental induction training as well as on-the-job (OTJ) environmental training by the EPC contractor. On completion of the induction training, each employee will be required to sign a letter stating that non-compliance with the contractor’s environmental policy shall be grounds for immediate dismissal.

8.7.12 **Wastewater management and spill response**

During the construction phase there is a potential for effluent generation and fuel spills from a number of sources. To minimize the likelihood of such adverse environmental impacts the EPC contractor will:

- Bund all on-shore fuel storage areas using impermeable materials;
• Establish an early warning system and identification of contingency plans for spill response;
• Monitor the quality of water used as hydrotest water for the storage tanks and pipelines used for the project before being discharged into the environment.

8.7.13 Noise management procedures

The potential noise generated by construction activities outside normal working hours will be assessed prior to the construction phase of the project and notification sent to the affected persons. Noise sensitive receptors will be identified by the EPC contractor and appropriate noise control measures implemented.

8.7.14 Traffic management procedures

The proposed construction of the project may have an adverse impact on traffic if not properly managed. Such effects include higher noise levels, generation of dust and additional wear and tear to local roads. The EPC contractor will develop, rollout and implement a traffic management plan to include careful planning of routes used by construction vehicles, restrictions on vehicle movements and wetting of road surfaces to reduce dust generation.
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9. Environmental and Socio-economic Baseline

This section provides a brief description of the project environment and is based on a review of the existing information, site visits undertaken by the project team and discussions with the public/stakeholders.

9.1 Geotechnical information

9.1.1 Geology

The lithology of the area comprises several geological sequences. The volcanic rocks in the area are represented by Upper Athi Series consisting of sediments and Lake Beds, Athi Tuffs and Kapiti phonolite. The thickness of these volcanics varies but generally decreases towards the south and southeast as they reach the limit of the lava flows.

Below the volcanics are the undifferentiated crystalline rocks of the Mozambique Belt that is the Basements System rocks consisting mainly of gneisses and schists. These are shallow seated and have been encountered by several of the numerous Boreholes drilled in the vicinity of the area.

The geological succession underlying the project area consists of the Cenozoic volcanics which, in geo-chronological order, consists of the following formations:

- Upper Athi Series
- Kapiti Phonolites
- Basement System

The Upper Athi Series forms part of the extensive Athi tuffs and lake beds. Its occurrence is as a result of consolidation of fragmental volcanic material which was deposited shallowly into water after eruption. Geaverts, 1964, classify the series as all the sediments and tuffs lying between the Nairobi and the Kapiti phonolite. They are taken to include beds of the Kerichwa Valley series where the phonolite and trachytes are absent.

Wherever the contacts of the Kapiti Phonolite are present, the unit underlies associated volcanic rocks and is consequently the oldest lava of the succession. This has been confirmed by numerous borehole sections, which reveal that the sub-volcanic floor over which the Kapiti Phonolite was extruded was irregular and cut in Precambrian rocks. The lava was laid down on an eroded surface covered in places by Tertiary conglomerates and grits (Fairburn, 1963), formed part of the first Miocene flood eruptions. The rock is distinctive in hand specimens by its large white crystals of feldspar and waxy-looking nephelines which are set in a fine grained dark green to black or dark bluish-grey groundmass.

The basement system comprises crystalline rocks of Precambrian age which are exposed in the south west of Kitengela where the volcanic cover has been removed by erosion. They are predominantly biotite gneises, frequently migmatitic and rich in hornblende.
9.1.2 Hydrogeology

The regional hydrogeology indicates that the most significant aquifer system west of the project area is the Upper Athi Series aquifer system. This is the main aquifer for boreholes in Nairobi and Kiambu areas and is composed of tuffs, lakebeds and sediments. Other aquifers in this area are found in the weathered inter-lava layers and in fractured zones. In the eastern part of the project area the volcanic rocks thin out exposing the metamorphic Basement System rocks where aquifers are predominantly found in fractured or deeply weathered zones. The Lukenya Range east and northeast of the project area is basically metamorphic Basement rocks composed mainly of granitic gneiss. The groundwater potential in the Basement System east of the project area is generally lower than that of the volcanic areas to the west.

The hydrogeology of the project area is variable as indicated by the interpreted Vertical Electrical Sounding (VES) data obtained at the site. On the basis of the VES data obtained from the project site, an aquifer could potentially exist between 70m and 100m below grade level. This is expected to be at the contact of the Kapiti Phonolites and the Basement rocks.

On the basis of test yields for boreholes sunk in the vicinity of the project site, it is envisaged that a borehole sunk there would yield between 5 and 15m$^3$ per hour of water. A map showing borehole yields is given in Figure 9-1.

9.1.3 Surface hydrology

The study area falls within the upper Athi River catchment as shown in Figure 9-1; the nearest river system to the project site is the Stony Athi River located about 700m east of the project site. The Stony Athi River flows towards the north and joins the main Athi River. Water quality in the Athi River is impacted by industrial and commercial activities predominantly in Nairobi where a variety of toxic pollutants are discharged.

9.2 Topography

The general terrain of the area is flat to gently undulating and lies at an altitude of 1500m to the east and 1530m towards the west.

9.3 Climate

The power plant site is situated in the upper Athi River catchments; it is dry but adjacent to the seasonal Stony Athi River to the south-east. The average annual rainfall in Machakos district ranges from slightly over 1000 mm in some highlands to slightly below 500 mm in low lying south and south east parts of the district. The rainfall in the area has a bimodal pattern with two rainy seasons occurring from March to May and November to December. A small portion of the district has potential for agriculture.
Athi River town and the greater Mavoko County Council fall under the agro-climatic zone V-4. This zone is characterized as semi-arid with average rainfall amounting to 450 – 900mm annually.

9.4 Vegetation, soils and land uses

9.4.1 Vegetation and soils

The main habitats within the Athi-Kapiti ecosystem are the Grass plain dominated by *Cynodon*, *Themeda*, *Cypress*, and *Digitaria* species; Dry forest, *Olea africana*, *Croton dichogamus*, *Brachylaena hutchinsii*, and *Calodendrum*; Riverine forest/valley forest, *Acacia xanthophloea*, *Euphorbia candelabrum*, *Apodytes dimidiata*, *Canthium schimperiana*, *Elaeodendron buchananii*, *Ficus eriocarpa*, *Aspilia mossambicensis*, *Rhus natalensis*, and *Newtonia* species. A map of the proposed power plant showing randomized species visible as given in Figure 9-2. The vegetation cover over the project area is described a bushland with the potential plant growth being medium to low.

The project area lies in an area of predominantly dark grey black cotton soil. The thickness of these soils varies and on the project plot it is between 0.6m and 1.2m in depth. They are poorly drained, have low infiltration rate and low permeability and are capable of significantly upholding any released contaminants to the groundwater.

Immediately below the vertisols is a orange-brown lateritic soil. This is a weathering product of the Kapiti Phonolite that underlies the vertisols containing rounded grains. A gradual transition from the weathered upper layer of the phonolite formation to a less weathered one occurs. It is noted that the shallow perched aquifer occurs between 0.5m and 1.5m below ground surface. This basically will occur because of the interphase between the clay layer and the phonolitic rock. The other main aquifers are deep and occur from a depth of about 50m onwards.

9.4.2 Land uses

The study area is dominated by industrial and commercial activities. Immediately towards the south of the site is a disused limestone quarry; to the north-west of the site are two steel plants and a new tile and carpet center, and to the east of the site is a residential complex.

Land use within the Municipal Council of Mavoko is divided into nine categories namely residential, commercial, industrial, recreational, educational, public purpose and public utility. The allocation and character of land use in the town is explained below. The land use as per the Athi River Development Plan prepared in 1970 is captured in Figure 9-3.

**Residential**: The Municipality acts as a dormitory town for Nairobi city, other nearby growing centers and also provides housing for the local industrial workers. According to the 1970 land use plan, residential use was divided into three sub-categories namely low, medium and high density and allocated approximately 2722 Ha of land comprising approximately 27% of total land area. There has been
significant development since 1970 that did not entirely conform to the planned land use.

**Industrial:** The area is primarily industrial in character with factories employing three quarters of the town's residents. There are many factories such as Kenya Meat Commission, East Africa Portland Cement, Bamburi Cement, Kapa Oil Refinery, EPZ Authority, Nation Media Group, Mabati Rolling Mills, Devki Steel Works Company, Athi River Steel Plant, Sun-Rose and Primarosa flower companies among others. In total there are over sixty factories. The factories are mainly steel, cement manufacturing, flower farms and textile manufacturers. The Export Processing Zone employs a majority of the women population.

According to the 1970 land use plan Industrial use was allocated approximately 2007 Ha covering 20% of the total land area. The development since 1970 did not conform to the plan.

**Commercial:** The area is characterized by a number of wholesale and retail businesses, small and medium scale enterprises and commercial service providers. According to the 1970 land use plan, commercial use was allocated approximately 102 Ha comprising 1% of the total land area.

**Educational:** The area is served with nursery, primary, secondary and tertiary educational services. There also exists training institutions. According to the 1970 land use plan, educational use was allocated approximately 348 Ha comprising 3% of total land area.

**Recreational:** Recreational land use was allocated approximately 818 Ha according to the 1970 plan, this comprised 8% of total planned area. The recreational activities provided according to this plan were parks, playing fields, public open spaces and a proposed stadium.

**Public purpose:** The 1970 plan provided for public purpose activities such as a social hall, Ministry of Works land, churches, land for administration and a proposed cemetery. The plan allocated approximately 250 Ha comprising 2% of total land area.

**Public utilities:** Public utilities consisting of water, sanitation and waste facilities had an allocation of approximately 76 Ha comprising 1% of total land area according to the 1970 land use plan.

**Transportation:** Approximately 510 Ha of land comprising 5% of total land area was provided for transportation according to the 1970 plan. This included land set aside for roads, railway, petrol services stations, lorry parks and car parks.

**Deferred land:** Deferred land was allocated approximately 3230 Ha comprising approximately 32% of total planned area.

### 9.5 Macro-economic setting

Kenya’s economic blueprint is the Vision 2030 which recognizes the energy sector as one of the enablers of economic, social and political pillars underlying the vision. Sessional paper no. 4 of 2004 on energy also recognizes that affordable, quality and cost effective energy services is an important prerequisite for attainment of accelerated socio-economic growth and development.
The sales growth in electricity demand in Kenya shrank from 8.5% in 2006/7 to 3.5% in 2007/8 to 1.6% in 2008/9 primarily due to the depressed performance of the domestic economy over these periods. Additionally electricity sales in the country were affected by implementation of the load shedding program resulting from poor hydrology in the country’s seven forks cascade which accounts for over 40% of the total installed capacity.

In order to provide cost effective and affordable energy, the Government of Kenya through the Ministry of Energy is committed to the development of a rolling twenty year least cost power development plan (LCPDP). This LCPDP will be updated annually to take into account new information and promising technologies with potential to generate power at competitive costs. In the current LCPDP, there is provision of operationalizing an 80MW medium speed diesel (MSD) power plant in 2010.

With the exception of 2008/2009, Kenya has experienced a significant increase in its economic growth over the past few years which in turn has increased the demand for electricity. Assuming a 5% economic growth rate in 2010, it is envisaged that Kenya should have an installed capacity of 1010MW. The proposed 84MW power plant would greatly contribute in meeting this peak load.

Capacity expansion projects such as the proposed power plant are aimed at reducing the effects of potential shocks to the economy due to load shedding programs. This reduces the risk of major electricity supply interruptions should hydrology around the seven forks cascaded affect the power generation there.

Of the estimated US$125 million project cost, it is predicted that there may be a sizeable local spend which could contribute significantly to the construction sector and engineering services during the construction phase and to the transport industry during the operational phase (resulting from HFO transport from Mombasa to the power plant).

The power plant is predicted to have both positive and adverse economic impacts. Positive impacts include a more stable power supply to the national grid and reduced load shedding. Adverse impacts include air and noise emissions, traffic related accidents and disruption in urbanized areas and road network due to construction activities.

The power plant aims to increase the availability of electricity in Nairobi and its environs. The Gulf Power project is a significant project envisaged in the current LCPDP for the stable supply of electricity.

### 9.6 Social and microeconomic characteristics

This section provides a socio-economic profile of the study area by reviewing demographic trends and economic performance.

#### 9.6.1 Population dynamics

Machakos district has an estimated population of 416,415 and a population density of 139 per/km$^2$. It is predicted that the population density would increase to 147 per/km$^2$ in 2010 and 155 per/km$^2$ in 2012. The population within the
jurisdiction of the Municipal Council of Mavoko is approximately 65,000 according to 2008 estimates. Athi River division has the lowest population density compared to other divisions in Machakos district due to its expansive area. With its close proximity to Nairobi, Athi River town is urbanizing rapidly with the development of several industrial and commercial entities. The population density is therefore expected to rise to 72 per/km$^2$ in 2012.

### 9.6.2 Income distribution and poverty

According to a UN Habitat Report of 2006, people in the lowest income group within Athi River on average earn between KShs 3,000 and KShs 5,000 per month. Two welfare monitoring surveys were undertaken by others in 1994 and 1997 for Machakos district; the results indicated that 68.7% of the population lived below the poverty line in 1994 while 63.3% of the population lived below the poverty line in 1997. A similar exercise undertaken in 2000 indicated that 66.2% of the population lived below the poverty line. It is worth noting that the above welfare surveys were undertaken during periods of either extensive drought or bumper harvests.

Through a household survey in the project area in February 2010, it was established that about 33% of the surveyed households do not have a monthly income while 18% of the population earning less than KShs 10,000 per month. The skills levels vary in Mavoko Municipality and the industries present within Athi River tend to frequently use seasonal labor to control their operating costs.

### 9.6.3 Employment profile

About 8% of the total Kenyan working population of about 21 million resides in Eastern province. While approximately 70% of this population was absorbed by agricultural related activities, the remaining 30% migrate to urban centers such as Athi River town in search for employment. The national labor force absorption capacity (ability of the economy to provide employment) in 2007 was 44%; in Machakos district it was 33% and in Mavoko it was 28%.

From a GDP perspective, Machakos district generates approximately 70% of its income from agriculture and 11% through wage employment; the wage employment income is generated mainly in the urbanized Athi River town. There is an observable trend in increased urban migration to towns such as Athi River in search for wage employment especially during extended drought periods. This is leading to some adverse social problems such as escalation in crime rates and commercial sex activities.

### 9.6.4 Occupational profile

The occupational profile of the study area was obtained through a household survey conducted in February 2010 of about 100 households spread across a radius of 5km from the power plant site.
The survey results indicated that 42% of the sampled population is unemployed, 22% is self-employed, 22% is engaged in seasonal wage employment while 14% are students. The high unemployed percentage of persons will no doubt be looking for job opportunities during the construction and operational phases respectively of the power plant.

9.6.5 Economic performance

Between 2000 and 2007, the Kenyan economy grew steadily and reached a commendable annual growth rate of 7%. However between 2008 and 2009, the economy grew by a paltry 1.7% resulting from the post-election chaos, global financial meltdown, high crude oil prices and extended drought period.

Machakos district exhibited similarities to the growth rates stated above however due to the extensive drought in the district, agriculture was not a dominant source of GDP. Consequently it has been observed that to overcome inconsistent climatic conditions, manufacturing and informal trade is growing in towns such as Athi River where several new industries are mushrooming. It is therefore predicted that sectors such as transport & communications, construction and hotels & restaurants will drive economic performance of Athi River town and by extension Machakos district.

9.6.6 Housing

Housing is a challenge in both rural and urban centers in Kenya. According to the Ministry of Housing, the country currently has a requirement of 200,000 new medium and low cost houses annually. Unfortunately such housing cannot be provided in Nairobi as the land prices are extremely exorbitant with house prices being beyond the reach of many residents. Subsequently metropolitan areas such as Mavoko, Kiambu, Thika, Kitengela, etc. provide an opportunity for housing the hundreds of thousands of people that work in the city. With the dual carriage way between the JKI airport and Machakos currently under construction, Mavoko provides an ideal location for developers to construct affordable housing for people that work in Nairobi. On the ground it is observed that several developers have already constructed housing estates in the Mlolongo area towards Mavoko. About 700m eastwards from the power plant site is middle to high-income development known as Greenpark Estate that is under construction.

As part of the household survey that was carried out in February 2010 for the power plant project, it was established that most of the sampled residents had been living in the area for less than 10 years with the highest influx occurring over the last 3 years (2007 – 2010). Urban poverty is prevalent in Mavoko as a large percentage of its residents live in informal settlements. Subsequently it is not uncommon to see a mix of large informal settlements mixed with planned residential estates in Mavoko.
9.6.7 HIV/AIDS prevalence

While the HIV/AIDS prevalence rate in Eastern province is below the national average, the Mavoko area has a high potential prevalence rate due to its proximity to the Mombasa – Nairobi highway. Sex workers and truck drivers are identified as one of the core group and bridge for the infection to spread to the general population. This implies that the transmission between Nairobi and Mavoko area could easily be linked to the behaviors of workers between the workplace and their dormitories.

9.7 Infrastructure and services

There are huge demands on the Mavoko Municipal Council as indicted in their 2005 – 2010 Strategic Plan. The stakeholders have identified the following key strategic issues affecting the delivery of efficient services to the residents:

- Low satisfaction of community with the council’s services,
- Low accountability of Mavoko Municipal Council to revenue contributors,
- Insufficient personal; and
- Inadequate specialized skills and inadequate revenue collections and allocation procedures.

The Mavoko Municipal Council undertook a SWOT analysis for the 6 year plan period. The strengths and opportunities identified after implementation of the strategic plan include good leadership and management, proximity to the Jomo Kenyatta International Airport, its situation at the junction of a regional road network, the industrializing profile, and availability of key natural resources. The weaknesses and threats include low policy development status, inadequate planning and infrastructure, uncontrolled industrial emissions, emergence of slums, the adverse effect of disease especially HIV/AIDS on socio-economic development and overall low capacity.

The inadequate planning and infrastructure includes provision of planned housing units, water supply and sewage services, roads, telecommunications and electricity for the residents.

9.7.1 Roads and rail

The main A109 national highway is aligned in a north-west to south-east direction and is situated immediately to the north of the power plant site. The A109 which is referred to as the Nairobi – Mombasa highway is part of the northern corridor linking the port of Mombasa to Uganda, Sudan and the Great Lakes region. The A109 is currently a single carriage way with one lane in either direction and is presently being upgraded to a dual carriage way with two lanes in each direction. The single carriage way has surfaced shoulders, is generally of good riding quality and was designed to carry heavy loads.

The main Nairobi – Mombasa railway line is situated to the south of the power plant several kilometers away and passes through Athi River town. There are no other railway lines in the vicinity of the power plant.
9.7.2 Electricity

The inherent worth of electricity and its contribution to the development of Kenya cannot be overemphasized. Currently in Kenya the net reserve capacity is extremely low compared to international benchmarks and subsequently alternative measures need to be put in place in order to combat this. The nominal maximum demand from KP&LC’s intake sub-stations such as Embakasi occasionally gets exceeded as the network is continually expanded and interruptions in supply experienced. Concurrently the KP&LC has set itself an ambitious target of connecting about 200,000 new customers annually. In order to meet the growing demand of electricity in the country, the energy generation companies will need to come up with alternative sources of energy.

9.7.3 Water Supply

The Mavoko Water and Sewage Company is responsible for supplying potable water to the residents and businesses in Athi River town and its environs. Currently the town receives water from a variety of sources with the bulk of the water coming from Nairobi through a piped system. The other source of water is the Nol-Turesh water pipeline that emanates from Mt. Kilimanjaro. A third source of water supply is boreholes that the Mavoko Water and Sewage Company contracts out to various service providers. The water from boreholes generally has a high saline content which then requires treatment prior to supply to consumers. The water services company is also exploring ways of rehabilitating a disused dam to generate a considerable amount of water for the growing population in Athi River town and its surroundings.

Despite the above sources, water rationing is carried out by the Mavoko Water and Sewage Company. The Mavoko Water and Sewage Company supplies about 35,000m$^3$ of water per month to 3,000 existing customers. They potentially have 9,000 customers that require water monthly.

9.7.4 Traffic

The proposed power plant is located in Mavoko in Machakos district near the Stony Athi River. The present land use for the study area is not defined by the Ministry of Lands as they have not developed a zoning plan for the area. Subsequently it was observed that there are currently mixed uses of land in the vicinity of the study area. The power plant is situated adjacent to the main Nairobi – Mombasa highway (A109) which carries a significant amount of daily traffic.

The existing A109 fronting the power plant is a single carriageway with one lane in either direction. The A109 is currently being upgraded to a dual carriageway between the Machakos turnoff (C97) and JKI Airport. At present the section of this road (A109) fronting the power plant is under construction. The contractor has excavated several sections of the road and is dumping soil within the power plant site. The existing section of road fronting the power plant is in poor condition and the ambient noise levels are generally high resulting from vehicle movements. Traffic along the A109 is heavy throughout the day and night as it is
the international trunk road linking Mombasa to Nairobi, western Kenya and beyond.

The traffic which the power plant will generate will vary between the construction and operational phases. Damage to the A109 and Namanga Road (A104) is likely to be the highest during pre-construction and construction phases of the project due to the transport of heavy machinery, equipment and components. In addition to this there will be a marginal increase in the in traffic volumes due to the influx of employees traveling to and from the power plant on a daily basis. Other developments within the area for example the new Tile & Carpet Centre, Greenpark estate and Athi River Steel Plant will also contribute significantly to the current traffic load. The heavy traffic generated by the power station during the operational phase will consist of about 10 – 15 HFO tank truck deliveries per day. Consequently during the pre-construction and construction phase, the increase in traffic volumes on the A104 and A109 is likely to contribute to their deterioration as well as impact on the safety of the road users. During the operational phase, the number of HFO tank trucks will have an increased impact on the A109 especially since they will be transporting the HFO from Mombasa to Nairobi.

### 9.7.5 Air quality

Air quality in the Athi River area appears to be inconsistent resulting in a haze over the landscape especially in the morning. The study area is located in the vicinity (about 4km) of Athi River town which is rapidly growing with new industrial and commercial entities. The landscape behind the power plant is degraded following extraction of limestone by a nearby cement manufacturing company.

Air quality has been identified as an issue relating to environmental and health quality in the study area. Key sources of pollution are generated by commercial limestone mining, dust arising from road construction, industry and vehicle emissions.

A baseline ambient air quality survey was undertaken at power plant site for nitrous oxides (NO$_2$) and sulfur oxides (SO$_x$). The survey was undertaken by mounting specific diffusion tubes for SO$_x$ and NO$_2$ at various locations within the power plant and as far as Athi River town as shown in Figure 9-1.

The results of the ambient baseline air quality survey (see table below) indicated minimal to non-detectable ambient concentrations of the criteria pollutants mentioned above.

| Lab Sample ID | Client ID | MDL | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---------------|-----------|-----|------|------|------|------|------|------|------|
| Units         | GL 406    | GL 401| GL 405| GL 402| GL 404| GL 403|
| Sulphur Dioxide| 0.5       | 2.40 | 1.00  | 2.40  | 0    | 0    | 0    | µg   |
| Q$_{298}$     | 119.0      | 119.0| 119.0 | 119.0 | 119.0| 119.0| 119.0| ml.min$^{-1}$|
| Q$_{300}$     | 119.0      | 119.0| 119.0 | 119.0 | 119.0| 119.0| 119.0| ml.min$^{-1}$|
| Exposure period| 10080.0    | 12960.0| 12960.0| 12960.0| 12960.0| 12960.0| 12960.0| minutes|
As the proposed project is an MSD power plant which will use HFO, air dispersion modeling of the stack emissions was undertaken for \( \text{SO}_x \), \( \text{NO}_x \), \( \text{PM}_{10} \) and \( \text{PM}_{2.5} \). The results of the air dispersion model were then compared with the European Community Directive 2008/50/EC on ambient air quality. The two internationally recognized methods namely AERMOD and ADMS4 were used for undertaking the air dispersion modeling. The reason for undertaking the modeling using the two methods was to understand the responses given by the two models.

Emissions rates for \( \text{PM}_{10} \) and \( \text{PM}_{2.5} \) were assumed to be the maximum emissions according to the World Bank I guidelines. Emission rates for \( \text{SO}_x \) and \( \text{NO}_x \) were calculated using the US EPA AP42 emission factors for large stationary diesel engines based on the usage of about 341 metric tons/day of HFO with a calorific value of 42,700 kJ/kg.

The results of the air dispersion modeling indicated the following:

- The ADMS4 prediction is slightly more conservative than AERMOD in the vicinity of the power plant; the AERMOD prediction is more conservative further away at the elevated areas such as Lukenya hills;
- At the nearest sensitive receptor which was Athi River town and a partially developed housing estate near the Stony Athi River, none of the EC limit values were exceeded;
- AERMOD predicted exceedences of \( \text{SO}_2 \) and \( \text{NO}_2 \) hourly limits at Lukenya Hills; the frequency of exceedence for \( \text{SO}_2 \) was 24 times in a year which is given as the allowable limit. For \( \text{NO}_2 \) the frequency of exceedence under the EC directive is 18 times in a year, while the model predicted 24 times in a year.

In the event that a major spill, fire or explosion incident occurs, air quality will be affected by toxic fumes and particulates from smoke. A fire will impact on visibility, impacting traffic safety and aesthetic (visual and odor) impacts. Movement of the plume of smoke could potentially affect a large geographic area dependent on climatic factors and prevailing weather conditions. This can result in risks to people, animals, plants and the general environment.
While the proposed power plant will have a continuous emission monitoring system for monitoring the quality of stack emissions, the Proponent will construct an air quality monitoring station about 10km from the power plant to assess the local impacts on air quality resulting from emissions of the power plant. The monitoring station will be designed to monitor sulfur dioxide, oxides of nitrogen, ozone, fine particulate matter and the relevant meteorological parameters comprising wind speed, wind direction and ambient temperature.

Gas emissions from the nearby Athi River Steel Plant and dust emissions from the construction phase of the power plant as well as emissions from the surrounding mining activities and road construction are likely to enhance the impact on air quality in this area significantly. It will have to be assessed whether or not the cumulative effects on air quality from these activities will fall within guideline limits once the activities are fully operational.

9.7.6 Visual

There is little variation in the landscape with the topography being characterized as rolling and undulating.

The study area is relatively undeveloped and is dominated by interspersed industrial and commercial activities. There are isolated homesteads across the landscape. The Athi River Steel Plant, proposed Tile & Carpet Centre and Greenpark Estate are highly visible developments in the largely open landscape. A disused limestone mining quarry exists immediately to the south of the power plant site and one has to climb the top of the quarry to be able to see Athi River town situated to the west of the project site.

Empirical research has indicated that the visibility of an element in the landscape, and in turn the severity of visual impact, decreases with increased distance between the observer and the element. This is because the further an observer is located from an element in the landscape, the less area it occupies in the observer’s visual field, and the less significant the element becomes in relation to the rest of the viewed landscape. The majority of residents near the power plant are pastoralist Maasai communities are farm residents, who are scattered sparsely across the study area. About 4km west of the study area in Athi River town, a higher density of residents occurs. Due to the low density of people in the study area, there is a low number of affected viewers. However, the topography provides little visual absorption or screening capacity, hence the visibility of the power plant will be high.

9.7.7 Noise

There are various factors that will contribute to ambient noise levels during construction and operation of the power plant. The Equivalent sound level ($L_{eq}$) is used to indicate the average sound level over a period of time and is commonly used in environmental noise studies.
Legal Notice (LN) 25 titled “The Factories and Other Places of Work (Noise Prevention and Control) Regulations, 2005 guide the maximum permissible noise levels that workers can be exposed to. Additionally this regulation provides limits for maximum permissible community noise levels. LN 25 stipulates that an Occupier shall not expose a worker to 90dB(A) over an eight-hour time weighted average period. It further stipulates that noise emanating from a workplace shall not exceed 55dB(A) at the fence line and 45dB(A) at night.

LN 61 titled “Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Regulations, 2009 stipulates the maximum permissible noise levels that can exceeded by any person. The maximum permissible noise levels under the First Schedule of the Regulations are reproduced below.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Sound level limits dB(A)</th>
<th>Noise rating level (NR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L_{eq}$ 14 hours</td>
<td>$L_{eq}$ 14 hours</td>
</tr>
<tr>
<td>A. Silent zone</td>
<td>40</td>
<td>35</td>
</tr>
<tr>
<td>B. Places of worship</td>
<td>40</td>
<td>35</td>
</tr>
<tr>
<td>C. Residential</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>Indoor</td>
<td>50</td>
<td>35</td>
</tr>
<tr>
<td>Outdoor</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>D. Mixed residential (with some commercial and places of entertainment)</td>
<td>55</td>
<td>35</td>
</tr>
<tr>
<td>E. Commercial</td>
<td>60</td>
<td>35</td>
</tr>
</tbody>
</table>

The environmental guidelines of the World Bank and World Health Organization specify 55 dB(A) during the day (06:00 to 22:00) and 45 dB(A) during the night (22:00 to 06:00) for residential purposes.

Due to the relatively flat terrain, there are no natural features that will assist in the attenuation of noise. The current main sources of noise in the vicinity of the power plant site include road traffic and the Athi River Steel Plant.

A baseline noise and vibration survey was undertaken in February 2010 at the power plant site and its environs. The nearest sensitive receptor to the power plant was the Greenpark residential estate located about 700m due east of the power plant site. The findings of the noise survey are summarized as follows:

- The site of the proposed development is located in a predominantly rural environment. The proposed site is however fronted by the A109 highway and is bordered to the north-west by the Athi River Steel Plant Limited.
- The main source of noise in the area is from traffic on the A109, particularly heavy motor vehicles and trailers travelling on uneven road surfaces. The Athi River Steel Plant Limited is the main development in the immediate environment of the proposed development site. Noise emissions from the steel plant appear to be only audible in relatively close proximity to the site.
The closest sensitive receptor is the Green Park Village, a residential complex located approximately 700 m from the proposed site. As the area is largely flat, offering little topographical screening against noise, consideration should be given to natural screening between the proposed site and the residential complex.

The World Bank Guideline of 55dB(A) during the day was exceeded at 5 of the 16 sample points. The highest equivalent noise measurement of 66.7dB(A) was recorded at the approximate entrance to the proposed site. Exceedances at each of these locations were attributed to the proximity to the road and impacts from traffic, particularly heavy motor vehicles on uneven road surfaces.

The World Bank Guideline of 45dB(A) during the night-time was exceeded at 9 of the 16 sample points. The highest equivalent noise measurement of 64.2dB(A) was similarly recorded at the approximate entrance to the proposed site. Relatively higher noise levels were attributed to the proximity of the proposed site to the road and impacts from traffic, particularly heavy motor vehicles on uneven road surfaces.

Construction of the power plant is expected to have an adverse impact on ambient noise. Day-to-day sources of noise will be caused by large-scale equipment and vehicles used for clearing and for construction activities (the typical noise levels of construction equipment at a distance of 15 m, lie in the range of 75 – 100 dB(A)). A one-hour equivalent noise level of between 75-78 dB(A) 50 m away from construction would be typical for the earthmoving phase.

These noises will pose a health risk to construction workers and are likely to present noise disturbance effects on people living in the surrounding rural areas for up to 750 m from the construction (see table below). A night-time source of noise would be from the construction camp.

These noise levels assume that the equipment is maintained in good working order. Conservative attenuation conditions have been applied.

<table>
<thead>
<tr>
<th>Plant/equipment</th>
<th>Typical operational noise level at a given offset, dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5m</td>
</tr>
<tr>
<td>Air compressor</td>
<td>91</td>
</tr>
<tr>
<td>Compactor</td>
<td>92</td>
</tr>
<tr>
<td>Concrete mixer</td>
<td>95</td>
</tr>
<tr>
<td>Concrete vibrator</td>
<td>86</td>
</tr>
<tr>
<td>Crane (mobile)</td>
<td>93</td>
</tr>
<tr>
<td>Dozer</td>
<td>95</td>
</tr>
<tr>
<td>Loader</td>
<td>95</td>
</tr>
<tr>
<td>Mechanical shovel</td>
<td>98</td>
</tr>
<tr>
<td>Pump</td>
<td>86</td>
</tr>
<tr>
<td>Pneumatic breaker</td>
<td>98</td>
</tr>
<tr>
<td>Rock drill</td>
<td>108</td>
</tr>
<tr>
<td>Roller</td>
<td>84</td>
</tr>
</tbody>
</table>
Noise level limits during the operational phase are expected to be high as the power plant is a thermal MSD type. The power house will need to be acoustically designed to limit noise levels generated at the fence line to be in compliance with Kenyan legislation as a minimum.

### 9.7.8 Archeology and cultural heritage

A baseline archeological and cultural heritage impact assessment was conducted in February 2010. The area around Lukenya hill contains some of the most important Later Stone Age archaeological sites found in Kenya. The variety of assemblages identified in the archaeological record show that the area was favored for human habitation, and was continuously inhabited for nearly 100,000 years. Artifacts that have been recovered here include stone artifacts, domestic animal remains, iron smelting sites, ostrich eggshell beads, stone bowls, pollen samples, rock art as well as human remains. Historically, there is however little evidence of habitation and the land has been privately owned since the early 1900s. A survey of the site did reveal a scatter of archaeological debris that is similar to other scatters found on the plains surrounding Lukenya hill. However the artifact density was found to be very low and very thinly spread on the surface to warrant further excavation of the site. The rest of the site was totally devoid of any cultural material, partly due to the fact that part of the land is covered by heaps of soil that have been dumped here from elsewhere. The only other evidence of human occupation here are the remains of a Maasai Manyatta, a temporary settlement which leaves no cultural artifacts. No other activities are presently going on at the site, and the proposed development will not therefore interfere with economic or agricultural activity, neither will it involve the displacement of any group of people.

<table>
<thead>
<tr>
<th>Trucks</th>
<th>-</th>
<th>81</th>
<th>73</th>
<th>67</th>
<th>64</th>
<th>60</th>
<th>57</th>
<th>54</th>
</tr>
</thead>
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Figure 9-2: Image of Catchment area and boreholes in the vicinity of the project site
Figure 9-3: Map of the proposed power plant site with randomized points showing representative species.
Figure 9-4: Map showing land uses in Athi River Town and in the vicinity of the project site
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<td>10.10.2</td>
<td>Flow path</td>
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<td>10.16</td>
<td>Power house ventilation system</td>
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<td>10.17</td>
<td>Water system</td>
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<td>10.17.1</td>
<td>Fresh water system</td>
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10. **Technology, Procedures and Processes**

10.1 **Introduction**

This section presents the technologies, procedures and processes that will be used in the implementation of the project. The power plant is based on ten Wärtsilä model 20V32 reciprocating generating sets with a total capacity of 80MW. Wärtsilä will provide a finished plant designed for safe, reliable, efficient, long-term operation.

The primary fuel for the plant will be heavy fuel oil (HFO), also known as CIMAC E25. Secondary fuel, for maintenance and auxiliary services, will be distillate fuel oil, commonly called diesel (DFO).

Power generated by the plant will be evacuated to the KP&LC.

10.2 **Equipment Scope of Supply**

Wärtsilä will furnish a complete power plant including engineering, procurement, construction, start-up and testing. Once commissioned, the power plant will be operated by Operations and Maintenance Company. The major items which comprise the power plant are listed below.

**Engine-Generator Sets**
- Ten Wärtsilä Model 20V32 turbocharged Diesel engines
- Matching electric generators
- Radiators for engine cooling
- Intake air filters
- Exhaust silencers and stacks
- Control system

**Heavy Fuel Oil (HFO) Handling Systems**
- HFO Truck Unloading Station including pumps and filters
- HFO Bulk Storage Tanks
- HFO heating, purification and delivery system

**Distillate Fuel Oil (DFO) Handling Systems**
- DFO Truck Unloading Station including pumps and filters
- DFO Bulk Storage Tank
- DFO pumping and delivery system

**Thermal Oil System**
- Exhaust heat recovery units for heating thermal oil
- Thermal oil circulating system
Water Systems
- Fresh water tank and pumps
- Process and sanitary wastewater systems

Compressed Air Systems
- Dual air compressors
- Compressed air storage tanks
- Air-start system for engines
- Instrument and service air system

Fire Protection System
- Detection and alarm system
- Extinguishers

Electrical Systems
- Medium voltage generator bus and breakers
- Low voltage system and motor control centers for plant auxiliary loads
- Convenience voltage system for lighting and convenience outlets

Buildings
- Power House including control room
- Maintenance Building
- Fuel Treatment Building
- Admin building
- Guard house

Site Work
- Chain link fence with gates
- Driveways and parking area

Miscellaneous
- Plant startup and commissioning
- Operator training
- Plant testing
- Special tools for engines
10.3 Plant operating philosophy

10.3.1 Normal operations

The plant is designed for continuous operation at constant load, with all engines running at full output, except for maintenance outages. All power, net of internal loads, will be delivered to the end user at high voltage using the plant substation.

Normally the engines will burn heavy fuel oil (HFO) and the plant will be designed to operate continuously on HFO.

10.3.2 Start-up and shut-down

The engines can be started and stopped on HFO. Prior to an extended shutdown however, the engines will be switched over to distillate fuel oil (DFO) until the HFO has been flushed from the system. Upon returning to service, the engines will be started on DFO and switched over to HFO after warm-up.

10.3.3 Part-load operation

The plant can also operate at reduced output by shutting down or throttling one or more engines. In the event of complete loss of load, the plant will be designed to automatically reduce output and continue to supply its own internal power needs without tripping or interruption.

10.4 Plant layout

The plant will occupy a roughly rectangular site, bounded by chain link fence including the buildings and structures described below.

10.4.1 Power House

The largest of the buildings is the Power House, located near the center of the site. This prefabricated metal building houses the engine-generator sets, control room and certain auxiliary equipment. The engine air intake structures are mounted along one wall and the engine exhaust ducts exit through the wall on the same side as the engine intake air.

10.4.2 Maintenance Building

This is a small building located adjacent to the Power House near the main entrance gate. This building houses a maintenance area, parts storage area, offices and a reception area. A parking lot is also provided.
10.4.3 Fuel Treatment Building

This small building houses fuel heating and filtering equipment. It is located near the Power House.

10.4.4 Tank Farm

Located at one edge of the site, the tank farm includes all the major fuel, lubricant and waste oil storage tanks in a single location. All tanks are mounted in spill-containment dikes.

10.4.5 Truck Unloading Station

The Truck Unloading Station includes a driveway that allows trucks to drive in, unload fuel or lubricants, and drive out in a continuous loop. The station also includes hoses with quick-connect fittings, unloading pumps, filters and fuel meters. The driveway and unloading area are located along one edge of the site, and are paved with concrete.

10.4.6 Radiators

Radiators for cooling the engines are mounted near the Power House. The radiators are horizontally mounted on steel legs.

10.5 Design Parameters

10.5.1 General

Site conditions and general design features of the plant are listed in the sections below.

10.5.2 Plant operating range

The plant will be designed for the following ambient conditions.

<table>
<thead>
<tr>
<th>AMBIENT CONDITIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference site ambient temperature</td>
<td>25°C</td>
</tr>
<tr>
<td>Design ambient temperature</td>
<td>32°C</td>
</tr>
<tr>
<td>Minimum ambient temperature</td>
<td>7.5°C</td>
</tr>
<tr>
<td>Wet bulb temperature</td>
<td>27°C</td>
</tr>
<tr>
<td>Charge air cooling water temperature</td>
<td>33°C</td>
</tr>
<tr>
<td>Altitude</td>
<td>1525 masl</td>
</tr>
<tr>
<td>Generator voltage</td>
<td>11000 V</td>
</tr>
<tr>
<td>AMBIENT CONDITIONS</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Frequency</td>
<td>50  Hz</td>
</tr>
<tr>
<td>Power factor (lagging to leading)</td>
<td>0.8 – 0.9</td>
</tr>
<tr>
<td>Service voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Fuel viscosity</td>
<td>380 cst</td>
</tr>
<tr>
<td>Lower heating value liquid fuel</td>
<td>41585 kJ/kg</td>
</tr>
</tbody>
</table>

### 10.5.3 Fuel Quality

Fuel (HFO) must meet one of the following CIMAC (International Council on Combustion Engines) standards:

- A10
- B10
- C10
- D15
- E25
- F25
- G35
- H35
- H45
- H55

Fuel (DFO) must meet one of the following standards: ISO 8217, DIN EN 590, ASTM D396 or ASTM D975.

### 10.5.4 Prohibited Materials

Asbestos, polychlorinated biphenyls (PCBs) and lead-based paint will not be installed anywhere in the plant.

### 10.5.5 Noise

The plant will include a number of noise-abatement features according to the project requirements, such as:

- Engine inlet air silencers;
- Engine exhaust silencers;
- Engines, generators and air compressors enclosed in a sound-attenuated building; and
- Engine hall ventilation silencers.
10.6 Codes and standards

The design and construction of the power plant will be in general accordance with the latest versions of the following codes and standards, as deemed applicable.

- ANSI American National Standards Institute
- DIN Deutsches Institut für Normung, e.V.
- NEMA National Electrical Manufacturer's Association (USA)
- IEEE Institute of Electrical and Electronic Engineers (USA)
- IEC International Electric Code
- ISO International Standards Organization
- NEC National Electric Code (USA)
- ASTM American Society for Testing and Materials
- VDE Information Technologies (Germany)
- ASME American Society of Mechanical Engineers
- ACI American Concrete Institute
- AISC American Institute of Steel Construction
- ICBO International Conference of Building Officials
- AWWA American Water Works Association
- IAPMO/UPC International Association of Plumbing and Mechanical Officials, Uniform Plumbing Code
- API American Petroleum Institute
- AWS American Welding Society
- UL Underwriter’s Laboratories (USA)
- ISA Instrument Society of America
- SSPC Steel Structures Painting Council (USA)
- HEI Heat Exchanger Institute (IEC)
- CIMAC International Council on Combustion Engines

10.7 Engine-generators

10.7.1 Engines

The engines will be Wärtsilä 20V32 diesel units designed especially to burn HFO/DFO. Engines will include the following features.

- Direct fuel injection
- Turbo charging
- Electric turning gear
- Local, free standing monitoring and control panel
- Exhaust valve rotators
- Electronic governor
- Service platforms and ladder
- Special tools

The number of cylinders and operating RPM depend on the engine model and generator frequency are indicated in the table below.

<table>
<thead>
<tr>
<th>Engine Model</th>
<th>Number of Cylinders</th>
<th>Vee or Inline</th>
<th>RPM (50Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20V32</td>
<td>20</td>
<td>Vee</td>
<td>750</td>
</tr>
</tbody>
</table>

### 10.7.2 Generators

The three-phase AC generator shall be designed for the application in base load, peak load and parallel operation. The generator can be used with all types of drive systems such as diesel/HFO engines, gas engines and gas turbines. The generator will be suitable for delivering performance as defined in specifications and data sheets. The generators will be air-cooled units with the following features.

- Class F insulation minimum, limited to an F rise
- Rated for power factor of 0.8
- Vacuum pressure impregnation of stator
- Direct coupling to engine
- Automatic voltage regulator
- Brushless exciter with integral pilot exciter
- Independent two-bearing design
- Two Bearing Resistance Temperature Detectors (RTD's)
- Six RTD’s in stator windings Stator
- Rotor
- Excitation system
- Bearings
- CT’s and PT’s
10.8 Fuel and lubricating unloading systems

10.8.1 Combined HFO, DFO and Lube Oil Delivery Area

Heavy fuel oil, DFO and engine lube oil will be delivered to the plant by truck. Trucks will be owned and operated by others. A truck unloading station will be furnished, consisting of a driveway with the following features:

- The driveway will allow fuel trucks to drive into the site, pull off to the side to wait their turn, unload, and exit the site;
- A rain roof will be provided over the area where the truck cabs will be parked while unloading. The rain roof will also cover the unloading pumps and equipment;
- The system will be sized to keep the plant running at full load (plus a reasonable margin) with truck deliveries limited to normal business hours;
- The width and design turning radius of the driveway will be suitable for tractor-trailer trucks with a single tank trailer;
- The unloading area will be paved with reinforced concrete suitable for heavy trucks, and will include curbs to direct spills and storm water to an oil/water separator; and
- Outdoor lighting will be provided sufficient light for safety after dark.

10.8.2 HFO Unloading and Storage System

The HFO unloading and storage system will pump fuel out of tanker trucks, meter it and pump it into one of two HFO aboveground storage tanks. The unloading pumps and tanks shall be sized according to the fuel consumption requirements of the power plant. The following equipment will be included in the HFO unloading and storage system:

- Flexible unloading hose with quick-connect fittings;
- Two 100% capacity unloading pumps (1 working, 1 standby) with suction strainers;
- Positive displacement fuel meter with totalizing feature;
- Containment dikes around pumps and all HFO handling equipment;
- Two HFO aboveground storage tanks each having a capacity of 5,500m³. These steel tanks will be located in the tank farm which includes spill retention dikes; and
- Heating system for HFO aboveground storage tanks.
10.8.3 **DFO Unloading and Storage System**

The distillate fuel oil (DFO) unloading and storage system will pump fuel out of tanker trucks, meter it and pump it into a DFO above ground storage tank. The unloading pumps and tanks shall be sized according to the requirements of the power plant. The following equipment will be included:

- Flexible unloading hose with quick-connect fittings;
- Two 100% capacity unloading pumps (1 working, 1 standby) with suction strainers;
- Positive displacement fuel meter with totalizing feature;
- Containment dikes around pumps and all DFO handling equipment; and
- One DFO aboveground storage tank having a capacity of 700m$^3$. This steel tank will be located in the tank farm, which includes spill retention dikes.

10.8.4 **Lube Oil Unloading and Storage System**

The lube oil unloading and storage system will pump engine lube oil out of tank trucks and pump it into lube oil aboveground storage tank. The following equipment will be included:

- Flexible unloading hose with quick-connect fittings;
- One unloading pump with suction strainer;
- Containment dikes around the pump and all lube oil handling equipment; and
- One lube oil Bulk Storage Tank. This steel tank will be in the tank farm, which includes concrete spill retention dikes.

10.9 **HFO conditioning system**

10.9.1 **General**

The purpose of the HFO Conditioning System is to deliver clean, heated fuel to the engines at the proper temperature and pressure. This is accomplished by a series of pumps, heaters, separators, day tanks and filters.

10.9.2 **Flow Path**

In simplified terms, the HFO Conditioning System flow path is described below.

a) HFO is pumped from the aboveground storage tank to an HFO separator module. This module includes a heater (the separator heater), pumps and a fuel separator. The fuel separator is a standard centrifuge that uses centrifugal force and water to wash dirt and contaminants from the fuel.
b) The fuel then flows to a heated service tank. This tank holds enough fuel for 6 hours of plant operation, in case of minor upstream fuel supply interruptions.

c) From the service tank, the fuel flows to an HFO pre-pressure module. This module includes an HFO pre-pressure pump and an HFO automatic filter that back flushes and self-cleans as required.

d) Finally the fuel flows to an HFO circulating module. This module boosts the fuel pressure and precisely heats the fuel to the optimum viscosity for delivery to the engine fuel injection system. Major components of the module include:

- Mixing tank which facilitates a stable flow loop to the engine and allows for a smooth transition between HFO to DFO;
- Circulating pump which pumps fuel around the loop;
- Final preheater and viscosity control module which heats the fuel to the ideal temperature and viscosity; and
- A fuel flow meter.

10.9.3 Fuel Treatment Building

The HFO conditioning system will be housed in a fuel treatment building. All tanks in and around the building will be mounted in spill-retention dikes with drains to an oil-water separator. The fuel treatment building will include a monorail chain fall or portable A-frame for removal and handling of centrifuge bowls.

10.9.4 HFO Heating System

Thermal oil will be the heating medium for the above mentioned fuel heaters. The heating system will also include heat tracing, piping and necessary insulation and controls. The system will be capable of maintaining HFO at proper temperatures over the full range of operating conditions.

10.10 Distillate fuel oil system

10.10.1 General

The purpose of the DFO fuel system is to deliver DFO to the engines at the proper temperature and pressure. Because of the superior cleanliness and viscosity characteristics of DFO as compared to HFO, no conditioning is required for DFO.

10.10.2 Flow path

DFO is pumped directly from the aboveground storage tank to the HFO/DFO pre-pressure unit and then to HFO circulation module which functions as previously described in the HFO section above.
10.11 Lube oil system

10.11.1 General

The purpose of the lube oil system is to deliver clean, cool lubricating oil to the engines at the proper pressure and temperature. This is accomplished by a series of pumps, coolers, tanks, and filters.

10.11.2 Flow Path

A lube oil circulating tank serves as a central receiver for lube oil that is circulated to the engine and back in a continuous loop. A lube oil force pump driven by the engine shaft pumps lube oil from the lube oil circulating tank through an automatic filter and through a three-way valve. The three-way valve diverts part of the oil flow through a cooler as necessary to maintain proper temperature. The oil then flows to a duplex filter mounted on the engine and then into the engine itself. Return oil from the engine drains back to the lube oil circulating tank.

A lube oil separator module draws a side stream of lube oil from lube oil circulating tank. This module includes a preheater and a lube oil separator. The lube oil separator is a standard centrifuge that uses centrifugal force and water to wash dirt and contaminants from the oil.

10.12 Combustion air intake and exhaust system

10.12.1 Combustion Air Intake System

The Combustion Air Intake System which is not combined with the powerhouse ventilation system provides ambient clean air to the diesel engine for combustion while minimizing inlet air pressure loss to the turbocharger. Depending on the environmental conditions, the standard system utilizes dry type pocket filter units in rural, baseline temperature environments.

Components of the system include the following:

- Integral droplet separator;
- Filter section: pocket filters;
- Sound attenuator unit with transition piece;
- Transition piece with connection flange(s) (to suit engine specific air inlet connections);
- Fastening and sealing materials; and
- Pocket filter control/differential pressure transmitter.

Features of the system include the following:

- G4 Class filters;
- 12 mbar maximum pressure drop across unit; and
- 40 dB(A) noise reduction through silencer section.

10.12.2 Exhaust System

An exhaust system for each engine will convey engine exhaust gases through a thermal oil heat recovery unit, then through a silencer, and finally out to atmosphere through a stack. Expansion joints, supports and insulation will be furnished as required.

An exhaust system for each engine will convey engine exhaust gases through a silencer, and finally out to atmosphere through a stack. Expansion joints, supports and insulation will be furnished as required.

10.13 Cooling water system

As fuel burns inside the engine, various engine parts become hot. The cooling water system pumps water through the engine to a radiator where the heat is dumped to atmosphere. Cooled water from the radiator is then returned to the engine. The radiators are self-contained horizontal units mounted outdoors on structural steel legs. Multiple fans draw cooling air up through the radiators. Aboveground supply and return piping connects the radiators to the engines.

The power plant Wärtsilä model 20V32 reciprocating generating sets will be configured with two-circuit cooling systems as described below.

10.13.1 Two-Circuit cooling system

This system has two completely independent cooling circuits. A pump is provided in each circuit. Two three-way valves, one in each circuit, maintain the temperature and cooling control in each circuit. The first three-way valve regulates the flow of water from the high temperature loop into the high-temperature section of the radiator. The second three-way valve regulates the low temperature cooling water flow through the first-stage charge air cooler, with full flow into the low temperature section of the radiator. The low and high temperature sections of the radiator are combined into a single unit for each engine. An expansion tank is provided at the high point for each of the two cooling water loops to accommodate water volume changes caused by thermal expansion.
10.14 Heat recovery system

10.14.1 Thermal oil System

The thermal oil system shall be designed, utilizing the exhaust gas heat recovery system for the generation of heated thermal oil for HFO heating applications.

The main components of the exhaust gas heat recovery – thermal oil system include the thermal oil heater unit, exhaust gas bypass system, thermal oil expansion tank, thermal oil drain tank, thermal transfer oil pump, filling and drainage pump, thermal oil circulation pumps for engines and consumers, thermal oil heater control board, and thermal oil auxiliary heater unit.

Several of the main components are engine model specific, including the thermal oil heater unit with bypass damper system. The remaining components are common, sized to serve the entire system; these include the thermal oil circulation pumps, thermal oil expansion tank, thermal oil drain tank and filling & drainage pump, and the thermal oil auxiliary heater unit.

Features of the thermal oil system include the following:

**Thermal Oil Heater Unit**

- Automatic operation according to consumer demand; exhaust gas input adjusted based on thermal oil outlet temperature;
- Heater fitted with exhaust gas bypass damper system for control of exhaust gas input. Bypass dampers are self-regulating type, mechanically linked and automatically controlled.

**Thermal Oil Circulation Pumps**

- Pump capacity is based on parallel use of all exhaust gas boilers at nominal capacity and one oil-fired thermal transfer heater.
- Minimum of two (2) pumps provided for each circulation system, each rated at 100% capacity; one (1) running and one (1) standby.

**Thermal Oil Expansion Tank**

- Expansion tank sizing is according to the thermal oil system configuration matrix.
- Expansion tank is insulated and aluminum clad.

**Thermal Oil Drain Tank**

- Drain tank is sized to accommodate draining of the largest section of the thermal oil system that can be shut-off and isolated.

**Filling and Drainage Pump**

- Electric motor driven screw pump is provided for transfer of thermal oil to and from the drain tank.

**Thermal Oil Heater Control Board**

- One (1) common control system for controlling and operating the exhaust gas heat recovery system for self-demand thermal oil heating.
Thermal Oil Auxiliary Heater Unit

- 500 kW thermal oil auxiliary heater unit rating is identical for all plant configurations.
- All necessary control equipment for automatic operation and system integration to the main heat recovery system are included.
- Burner is a fully automatic pressure atomizing diesel oil (DO) burner.

Thermal Oil Pump/Header Group:

- A thermal oil pump/header group is provided with connections and valves for the following:
  - From thermal oil heater unit.
  - Return to thermal oil heater unit.
  - From thermal oil auxiliary heater unit.
  - Return to thermal oil auxiliary heater unit.
  - To consumers.

10.15 Compressed air system

The compressed air system compresses, stores and delivers medium pressure (30 bar) compressed air to start the diesel engines. Through a pressure reducing station, low pressure (8 Bar) air is delivered for various utility services and instrument requirements. Components of the system include air compressors, air receiver tanks, filters, and a pressure reducing station. The entire system is modularly designed to allow a seamless integration into the plant’s infrastructure.

Features of the system include the following.

- Two separate modules – air compressor and air receiver;
- Two identical air compressors on the air compressor module;
- Two identical air receivers on the air receiver module;
- One set of pre filters to eliminate dust and other particles from entering the intake of the air compressors;
- One set of air filters (for low pressure instrument air only) to aid in removal of any water or oil carry-over;
- One pressure reducing station (consisting of redundant pressure reducing valves) on the air receiver module;
- Each module with a welded steel base sized for transport in a 20 foot ISO container;
- Compressor output through common manifold so only one mechanical connection point;
- One common control panel that handles all control and electrical-power functions of the air compressors located on the air compressor module;
• All electrical wiring will be through rigid conduit to one terminal point in the control panel;
• Air tank output through common manifold with isolation valves;
• Medium pressure air piping constructed of black and oiled carbon steel; and
• Low pressure air piping constructed of non-corrosive material to minimize debris from entering downstream instruments and equipment.

10.16 Power house ventilation system

The powerhouse ventilation system which is not combined with the combustion air intake system, has three (3) basic purposes:

• To provide an environment that permits the machinery and equipment to function properly with dependable service life.
• To provide an environment in which personnel can work comfortably and effectively.
• To provide noise attenuation.

To accomplish this, the powerhouse ventilation system is split into three (3) modules:

• Two (2) ventilation inlet modules – one (1) for the generator side and one (1) for the annex side. Each module includes a filter section, silencer section and fan section, and is directly connected to the powerhouse.
• One (1) ventilation outlet module; sized to naturally exhaust the combined generator and annex side ventilation inlet air volumes.

Features of the system include:

• Two (2) completely separate ventilation inlet modules for each generator set as described above, one (1) for the generator side and one (1) for the annex side.
• Ventilation units are furnished as pre-packaged modules, fully assembled and pre-wired.
• Ventilation air filtration, G4 class.
• Ventilation air silencing, 25 dBA noise reduction.
• Ventilation outlet is natural; no power requirements.
10.17 Water system

10.17.1 Fresh water system

The Proponent’s existing treated water system will provide fresh treated water to the standards required to operate the equipment, through a connection at the power plant battery limits. The connection will include metering, backflow presenters, and isolation valves as required. Fresh water distribution will be by underground piping to buildings and equipment. Hose bibs will be provided at all buildings and near tanks and equipment as required. Fresh water will be used for the following purposes:

- Floor and equipment wash down
- Feed water for the process water treatment system

10.18 Process wastewater system

Wastewater streams that may contain oil will be directed to an oil/water separator. Such streams include floor drains, rainwater from spill containment basins, and sludge from the lube oil, HFO and DFO separators. Clear water discharge from oil/water separators will be discharged to the Proponent’s existing sewer system via a connection at the power plant battery limits. The following wastewater streams will also be discharged to the owner’s existing sewer:

- Regeneration brine from the process water treatment system

10.19 Sanitary wastewater system

Sanitary sewage will be collected from sinks, toilets, showers and other sources. The Proponent has two options for treatment and disposal of sanitary sewage:

- They can build a conservancy tank which will collect sanitary sewage from various parts of the power plant and contract a sewage exhauster company for disposal to the approved Mavoko Water and Sewage Company location; or
- Build a sanitary sewage pipeline to the main Mavoko Water and Sewage Company sewer line.

A cost benefit analysis will be undertaken by the Proponent to decide which option is preferable for managing sanitary sewage from the power plant.
10.20 Fire protection system

The fire detection system will define the power plant’s fire alarm and detection system(s), and electrical fire pump. Components of the system will include pull stations, audible and visual alarms, smoke detection devices, fire protection water storage tank, electric fire pump and portable fire extinguishers.

10.21 Electrical system

10.21.1 General

It is absolutely necessary for the successful operation of the power plant that the entire system be monitored and controlled by a single responsible entity. The intent is to provide that equipment which meets Caterpillar’s requirements to safely monitor, control and operate the essential equipment needed to make the power plant perform to peak efficiency. A complete electrical system will be provided including the major subsystems listed below. The electrical systems will operate at 50 Hz.

- High voltage 66 kV substation;
- Medium-voltage 11 kV system including generator and generator bus;
- Low-voltage 0.4 kV system for plant auxiliary loads;
- Convenience voltage 400/230 V system distribution for lighting and convenience outlets; and
- Control voltage 24 V DC and 110 or 125 V DC.

The primary purpose of the electrical systems will be to:

- Export net electrical generation;
- Distribute station power for internal loads when the plant is operational;
- Import station power during plant outages.

10.21.2 Medium Voltage System

The medium voltage system will comprise an indoor metal clad/metal enclosed AC switch gear with a voltage range of 1 kV to 36 kV used for power plants, industrial and distribution substations etc. This medium voltage switchgear shall be designed to:

- Switch on/off during normal conditions; and
- Automatically operate during abnormal conditions.

A typical metal enclosed switchgear has following components:

- A busbar;
- Switching devices such as VCB, Load break switch;
- CT’s and PT’s;
- Measuring instruments and relays;
- Cable termination for incoming and outgoing cables; and
- Electrical and mechanical interlocking facility.

The switchgear will be located in an electrical room in the main building.

10.21.3 Low Voltage System

The low voltage system is designed to match the required auxiliary power of various electrical consumers of the entire power plant. The AC switchgear operating within and up to 1kV is known as low voltage switchgear. The number of switching operations demanded from low voltage switchgear is very high. Low voltage switchgear is designed for long mechanical and contact life. The low voltage system will include the following:

- Motor control centers with breakers, motor starters, pushbuttons and indicating lights;
- Power wiring to various internal motors and loads;
- Busbar;
- Switching devices such as ACB, MCCB, MCB;
- CT’s and PT’s;
- Station Service Transformer;
- Measuring instruments and relays;
- Cable termination for incoming and outgoing cables; and
- Electrical and mechanical interlocking facility.

10.21.4 Convenience-Voltage System

The convenience voltage system distribution panels and wiring will be provided for lighting and convenience outlets in all power plant buildings. Welding outlets will be provided in the main building and fuel treatment building. Battery-operated emergency lighting and exit signs will be provided.

10.21.5 Control and Protection System

The control and protection systems are designed to provide control, protection and monitoring of the entire power plant. The control systems will be separated into two sections with communication between:

- Power Train Control; and
- Common Plant Control
Power Train Control (one per engine)

The power train control system consists of a freestanding local control panel located next to each engine. The local control panel provides control, monitoring, and protection functions for the engine, engine support modules and the generator. All of the control and monitoring functions are capable of performing locally at the panel using either a panel-door-mounted graphic user interface, or remotely at the plant SCADA system through a high-speed communication link.

Common Plant Control System (one per plant)

The common plant control system consists of a freestanding common plant control programmable logic controller (PLC) panel, a plant desktop SCADA (Supervisory Control and Data Acquisition) system, and an engine diagnostic DICARE (a Caterpillar diagnostic and condition monitoring system) system. All components of the common plant control system are located in the power control room. They are interconnected with each other, as well as with the individual power train local control panels, through a high-speed communication network.

10.21.6 Neutral Grounding Resistor

The neutral point of a star connected three phase AC generator is connected to ground through low resistor. Such a resistor is called neutral grounding resistor. The purpose of the neutral grounding resistor is to limit the earth fault current to ground to protect the windings in case of a phase to earth fault. The standard design is one neutral grounding resistor per power plant.

10.21.7 Miscellaneous Electrical

The following miscellaneous electrical items will be provided as part of the electrical system.

- Conduit, wire, cable and trays as required;
- Lightning protection throughout plant;
- Grounding grid;
- Emergency DC power system for critical switchgear and control systems; and
- Outdoor lighting for safety and security.

10.22 Monitoring and control system

10.22.1 General

A complete power plant control system will be provided, consisting of the following major subsystems:

- Engine-Generator local control panels;
- Control and monitoring unit for engine-generators, located in the control room;
- Measurement and protection unit, located in the control room; and
- SCADA system, located in the control room.

Each of these components is discussed below.

**Engine-Generator Local Control Panel**

Each engine will be equipped with a freestanding control panel mounted near the engine. The local control panel (LCP) is an indoor type metal enclosed cubicle with a front accessible door and is free standing on the floor or over a cable trench. The following major components are included in the LCP.

- Programmable Logic Controller (PLC);
- Multifunction Unit (MPU2);
- Automatic Voltage Regulator;
- Electronic Engine Governor System;
- RPM switch for ignition and over speed;
- Control and monitoring unit for genset (CMG2); and
- KFM Temperature Regulator.

The LCP is a solid state fully programmable PLC based unit which serves to control and monitor all the engine functions, protection system for the genset as well as providing the operator interface for starting, stopping, voltage regulation, engine and generator protection, synchronizing and governor control using a front door mounted HMI called CMG2. The LCP is fully capable of providing remote monitoring and control capability as well as data logging.

**Control and Monitoring Unit for Engine-Generators**

The control and monitoring unit is mounted in the control room in a freestanding console. This unit provides remote control of the engine-generators including starting, stopping, changing load, adjusting voltage, adjusting reactive power, controlling the generator breaker and acknowledging faults. Primary components of the system will include:

- Industrial Windows-based computer;
- One human-machine interface (HMI) consisting of graphic color display for each engine;
- Menu-driven display screens including electrical parameters, breaker status, engine P and I Diagram (P&ID) with operating data, data logging, alarm list, etc.;
- Password protection;
- Digital indication of key generator data including voltage, frequency, current, power, reactive power and kWh; and
- Data logging and trending.
Measurement and Protection Unit
The primary purpose of the measurement and protection unit is the control and protection of the medium voltage switchgear. The system mounted in the central control room, is housed in a pre-wired metal cubicle. The following components are included:

- Synchronization equipment;
- PLC;
- Generator protection such as over current, reverse power, over voltage, etc.;
- Mimic diagram of one-line with semaphore indicator for position of circuit breakers;
- Digital indication of key electrical data such as voltage, frequency, current and power factor; and
- Data exchange with individual engine control PLC's.

SCADA System
A complete Supervisory Control and Data Acquisition (SCADA) system will be provided to the power plant. This system located in the control room will include the following features:

- Windows-based computer;
- Display monitor;
- Menu-driven graphic displays;
- Transmission of control commands to the respective systems;
- Password protection;
- Long-term data logging and trending;
- Alarm listing and analysis;
- Monitoring and control of balance of plant systems, including:
  - Fuel oil handling and treatment systems;
  - Lube oil handling and treatment systems; and
  - Compressed air system.
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11. **Construction processes and materials**

This section provides a description of the various construction processes that will be used in constructing the power plant. Descriptions of the facilities that make up the footprint of the power plant are described below.

11.1 **Power House**

The power house building will be a pre-engineered building designed and constructed to the site design requirements. The power house will contain the seven generators-engines that make up the power plant. The building will be made out of tapered columns having a pin base design. The power house building will be insulated for noise abatement to attain the maximum allowable noise levels at the property fence line. The power house will include the following features:

- Engine hall with 2-ton maintenance crane;
- Open bay for maintenance;
- Reinforced concrete floor independent of engine-generator foundations;
- Control room;
- Water closet (in control room);
- Electrical room;
- Equipment annex with raised steel grate floor for equipment access;
- One (1) overhead electric coiling door shall be provided in the loading/staging bay;
- Forced ventilation; and
- Lighting and convenience outlets.

11.2 **Maintenance Building**

The maintenance building will be designed and constructed to the site design requirements. It will house the workshop and associated infrastructure. The building will be made out of tapered columns with a pin base design. The Maintenance Building will be sized for routine maintenance, and will include the following features:

- Ventilation and air conditioning;
- Linoleum floor in office area;
- Workshop area; and
- Spare parts area.
11.3 Fuel Treatment Building

The fuel treatment building shall be a pre-engineered building designed and constructed to the site design requirements. The building will be made out of tapered columns and have a pin base design. The fuel treatment building will include the following features:

- Concrete floor sloped towards the floor drains;
- Ventilation; and
- Lighting and convenience outlets.

11.4 Roads & Paths

The roads within the power plant will be designed and constructed to withstand the expected traffic, frequency and weight of heavy trucks. Materials used for construction of the access roads within the power plant will be concrete or asphalt. Special precaution shall be paid to roads constructed from asphalt in areas where fully loaded trucks turn to prevent undue accelerated degradation of the road.

Secondary roads as defined to carry light truck traffic (fork lift trucks, work trucks, cars and other like vehicles) shall be designed and constructed to withstand the expected traffic frequency and weight. These types of roads shall be made out of compacted gravel with a geo-textile fabric laid beneath the surface. All other parking areas shall be gravel. The roads will be designed to allow proper drainage of storm water and prevent water puddling.

11.5 Fencing

For security purposes, a chain link fence with galvanized mesh and galvanized posts will be installed around the site perimeter. A manually operated vehicular entrance gate will also be provided. The chain link fence will be erected to a height of 2.7m and will contain razor wire fencing at the top.

11.6 Miscellaneous

11.6.1 Piping

Piping for mechanical works will be sized using flow velocity considerations in keeping with good engineering practice. Low point drains and high point vents will be provided. Vents and drains will have valves and caps. Threaded piping connections will not be used for DFO, HFO or lube oil piping. Standard pipe sizes will be used. All pipework will be supported, anchored and guided to prevent undue vibration, deflection or stress on piping or equipment.

Installation and orientation of all gauge glasses, level controllers, thermometers, pressure gauges, etc. on the piping will maximize readability, ease of operation, and ease of maintenance.
Piping systems will be chemically cleaned, blown out, flushed, and/or boiled out as appropriate. Installed piping will be free and clear of all dirt, welding slag, rags and debris.

11.7 Insulation

Insulation will be provided as required on piping, ducts, and equipment to:

- Reduce heat losses;
- Reduce noise; and
- Reduce heat loading of surrounding spaces.

In addition, any accessible hot surface that presents a burn hazard to personnel during normal operations will be insulated. Any hot surfaces within one meter of ladders, platforms, walkways or accessible floor areas will be insulated.

11.8 Paint and Coatings

Vendor-supplied equipment will be finish painted in accordance with vendor standard specifications. Touch-up painting will be completed after installation. All equipment will be painted with the manufacturer’s standard paint.

Piping will be cleaned, primed and finish painted in accordance with good industry practice.

Structural steel will be cleaned, primed and painted in accordance with good industry practice.

Miscellaneous structural steel supports, handrails, ladders, and walkways will be painted or galvanized. The exhaust stacks will be painted with high-temperature paint.

Steel tanks will be cleaned, primed and painted on the outside. Steel water tanks will be coated inside.

Underground carbon steel pipe will be coated and wrapped per good industry practice.

The concrete floor of the Power House and Maintenance Shop will be painted.

11.9 Construction process

Materials needed for the civil and structural works include stone, cement, steel, pipelines, sand, gravel and wood. The required supplies will be transported to site by truck. Sand and cement will be sourced from existing local and/or national commercial suppliers.

Necessary equipment includes cranes, bulldozers, excavators, front-end loaders and electric welding machines. Low-bed trucks will be used for transporting equipment.
Nearly all pipes, pumps and control systems will be imported. The aboveground storage tanks will be made of flat sheets of steel that will be rolled offsite and welded together onsite. Cranes will be used for tank construction, as well as to put the transport gantries in place. Tanks will be tested using x-ray equipment.

Construction activities will generate noise levels to a limit of 85 decibels (dB(A)). Exact daytime and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work program, work modus operandi and type of equipment have not been finalized. Typical noise levels to be generated by the construction plant and equipment are provided in section 9.7.7 of this ESIA Study.

11.10 Water requirements during construction

During construction, water will be required for mixing of concrete and other uses. This water will be sourced from the Mavoko Municipal Council or using contracted water bowsers.

Hydrostatic testing will be used on the pipes. Water used for this purpose will need to be tested and approved as per relevant standards before discharge takes place.

11.11 Sewage, waste and stormwater runoff

During construction, storm water will be controlled to minimize the risk of erosion and sedimentation and prevent water contamination. Contaminated storm water will be treated before being released.

The EPC Contractor will put up site offices which will include ablution facilities. There will be a septic tank that will be constructed to direct the sanitary sewage for collection and disposal by a contracted exhauster company. The sanitary sewage will be discharged at locations approved by the Mavoko Municipal Council.

11.12 Site management

Construction will only take place during daylight hours. During construction there will be 24-hour security onsite and no workers will be allowed to stay overnight at the site.

11.13 Staffing requirements

Job opportunities will be generated through the construction of the power plant. Both skilled and unskilled labor will be required in technical fields as well as in the power plant operation and management. It is anticipated that a minimum of 100 to 150 jobs will be created during the construction phase. The overall organization chart for the power plant project is given in Figure 11-1.
Figure 11-1: Organization chart for the power plant project

Total: 38 employees.

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12. **Products, By-products and Wastes**

This section provides an overview of the products, by-products and wastes to be generated by the power plant. Most of these will be generated during the construction phase of the project while a limited amount will be generated during the operational phase.

12.1 **Construction Phase**

12.1.1 **Products**

The completed footprint will be the primary product of this phase of the project. The footprint will include:

- A power house which houses the ten generating sets;
- An electrical building which will contain the medium voltage switchgear;
- A high voltage (11/66kV) sub-station;
- A treatment house building for treating the HFO, DFO and lube oil;
- A lube oil drums storage shed;
- A bulk fuel storage tank farm for HFO, DFO and lube oil;
- A fire pump station area;
- An administration and maintenance building;
- A vehicle and truck parking area;
- A bulk fuel off-loading area; and
- Other infrastructure including site fencing and gatehouse, foundations for the radiators, boiler stack and exhaust muffler stacks, and, landscaping for the fenced area.

12.1.2 **By-products**

By definition a by-product is a substance, which is incidentally manufactured, processed or otherwise used at the facility at any concentration, and released on site to the environment, released to surface waters or transferred off site for disposal.

During the construction phase of the project it is envisaged that the by-products might include any excess construction materials brought to the project site by the contractor which can be reused later.
12.1.3 Waste

During the construction phase of the proposed project, several waste products are expected to be generated. These shall include:

**Domestic Wastes**
- The construction workers are expected to be supplied with various forms of foodstuffs packed in plastic or other types of containers. These are expected to occur within the site area and in the immediate vicinity. The management of such waste will need to be incorporated by the Contractor in the Construction HSE Management Plan.
- Other forms of waste include sanitary waste and therefore the provision of sanitary facilities will need to be considered both for the site construction workers and the visiting population.
- Kiosks selling various items will also emerge.

**Site Construction Waste**
The project will generate waste from the site construction activities which includes:
- Demolition wastes;
- Excavated soils and vegetation;
- Construction equipment maintenance wastes;
- Dusts and fumes;
- Scrap metals;
- Packaging materials, etc.

**Dust**
The construction activities that will occur particularly during the site excavation process will generate a considerable amount of dust and other particulates that will be released into the atmosphere.

**Smoke Emissions**
The site machinery, equipment and trucks brought in by the Contractor are expected to generate smoke emissions when in operation during the construction activities. The concentration of emissions will depend on the maintenance levels of the equipment, machinery and trucks used by the Contractor.
12.2 Operation Phase

12.2.1 Products

The primary product of the project during the operational phase will be electricity. This is the product that the Proponent will eventually evacuate to the KP&LC from the power plant. An 11/66kV high voltage sub-station within the battery limits will evacuate electricity to transmission lines that the KP&LC is yet to construct.

12.2.2 By-products

During the operational phase of the project there will be minimal amounts of by-products generated.

12.2.3 Waste

Air emissions

One of the significant wastes that will be generated by the project is the air emissions arising from the power plant stack emissions. These emissions will require continuous monitoring at locations where the air dispersion modeling indicates higher guideline values than those recommended in the EC Directive 2008/50/EC on ambient air quality. At the time of this ESIA Study, Kenya did not have air quality regulations for thermal power plants.

Noise emissions

Noise emissions generated by the power plant are considered part of pollution and therefore waste. The design of the power plant incorporates noise levels at the fence line as being those recommended by the WHO.

Effluent Waste

The project is expected to generate potentially contaminated wastewater from fugitive leaks and spills emanating from the operational process areas. This effluent is expected to be channeled through the drainage system into the OWS for primary treatment. Once treated, the effluent is expected to be discharged into the environment. It will be mandatory for the Proponent to comply with the requirements of LN 120: Environmental Management and Coordination (Water Quality) Regulations, 2006 for effluent discharge.

Domestic Waste

The daily operations of the facility buildings in which their will be occupancy will generate wastes such as papers and other sanitary wastes.

Sewage Waste

The employees of the Proponent that will be based within the project area are expected to generate sewage waste which will be channeled through an onsite sewage collection and disposal system.
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13 Environment and Social Impact Assessment (ESIA)

A number of ecological, social and cultural issues associated with the proposed development have been identified by the Firm of Experts and specialists. The impacts identified in Section 13.1 cover all project phases, that is, construction, operations and decommissioning.

Each impact identified is evaluated using a risk ranking criteria before any mitigation measures and after applying appropriate mitigation measures. In instances where impacts were not considered significant by the specialists, an assessment table has not been included.

To facilitate cross referencing, impact identification numbers have been used in the environment impact assessment and the EMP.

13.1 List of potential impacts

- GS: Geology and soils
  - GS1: Extraction of natural resources for construction
  - GS2: Soil erosion
- SW: Surface water
  - SW1: Impact on water quality
- GW: Groundwater
  - GW1: Pollution of groundwater
- S: Soils
  - S1: Contamination of soils
- E: Ecology
  - E1: Impacts on terrestrial ecology
- AQ: Air quality
  - AQ1: Decreased air quality due to dust and VOC emissions
  - AQ2: Decreased air quality due to stack emissions
- W: Waste
  - W1: Pollution from waste generation
- N: Noise and vibration
  - N1: Noise during construction and commissioning
  - N2: Noise during operation
  - N3: Noise during decommissioning
- V: Visual Impacts
  - V1: Impacts on visual landscape
• M: Macroeconomic
  o M1: National economic development
  o M2: Stability of electric power supply
• SE: Socioeconomic
  o SE1: Compatibility with existing and proposed land uses
  o SE2: Increased crime
  o SE3: Creation of employment opportunities
  o SE4: Increased risk of communicable diseases
  o SE5: Social divisions over limited jobs
  o SE6: Accidents as a result of increased traffic
• T: Traffic
  o T1: Damage to roads and other infrastructure
  o T2: Increased traffic and road safety hazard
• HS: Health and safety
  o HS1: Occupational health and safety
• C: Cumulative impacts
  o C1: Economic development
  o C2: Transport

13.2 ESIA assessment methodology

The potential impacts associated with the proposed development have been assessed using the criteria given below.

Figure 13 1: Environmental Risk Assessment Criteria
## Figure 13-1: Criteria for assessing significance of impacts

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>Rating</th>
<th>Frequency of activity</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>1</td>
<td>Annually or less</td>
<td>1</td>
</tr>
<tr>
<td>Minor</td>
<td>2</td>
<td>6 monthly/temporary</td>
<td>2</td>
</tr>
<tr>
<td>Marginal</td>
<td>3</td>
<td>Monthly/infrequent</td>
<td>3</td>
</tr>
<tr>
<td>Significant</td>
<td>4</td>
<td>Weekly/life of the operation</td>
<td>4</td>
</tr>
<tr>
<td>Catastrophic</td>
<td>5</td>
<td>Daily/permanent</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Geographic Extent of impact</th>
<th>Rating</th>
<th>Frequency of impact</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity specific</td>
<td>1</td>
<td>Almost impossible</td>
<td>1</td>
</tr>
<tr>
<td>Project specific</td>
<td>2</td>
<td>Highly unlikely</td>
<td>2</td>
</tr>
<tr>
<td>Local area</td>
<td>3</td>
<td>Unlikely</td>
<td>3</td>
</tr>
<tr>
<td>Regional</td>
<td>4</td>
<td>Possible</td>
<td>4</td>
</tr>
<tr>
<td>National</td>
<td>5</td>
<td>Definite</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Impact duration</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 month</td>
<td>1</td>
</tr>
<tr>
<td>1 - 12 months</td>
<td>2</td>
</tr>
<tr>
<td>13 - 36 months</td>
<td>3</td>
</tr>
<tr>
<td>37 - 72 months</td>
<td>4</td>
</tr>
<tr>
<td>&gt;72 months</td>
<td>5</td>
</tr>
</tbody>
</table>

### Definitions

- **Activity**: Distinct process or task undertaken by an organization for which a responsibility can be assigned.
- **Frequency of activity**: Refers to how often the proposed activity will take place.
- **Frequency of impact**: Refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Magnitude of impact**: Refers to the degree of change to the receptor status in terms of reversibility of the impact.
- **Geographic extent of impact**: Refers to the geographical scale of the impact.
- **Impact duration**: Refers to the length of time over which the stressor will cause a change in the resource or receptor.
13.3 Subjectivity in assigning significance

Despite attempts at providing a completely objective and impartial assessment of the environmental implications of development activities, EIA processes can never escape the subjectivity inherent in attempting to define significance. The determination of the significance of an impact depends on both the context (spatial scale and temporal duration) and intensity of that impact. Since the rationalization of context and intensity will ultimately be prejudiced by the observer, there can be no wholly objective measure by which to judge the components of significance, let alone how they are integrated into a single comparable measure.
This notwithstanding, in order to facilitate informed decision-making, EIAs must endeavor to come to terms with the significance of the potential environmental impacts associated with particular development activities. Recognizing this, the Firm of Experts and specialists have attempted to address potential subjectivity in the current EIA process as follows:

- Being explicit about the difficulty of being completely objective in the determination of significance, as outlined above;
- Developing an explicit methodology for assigning significance to impacts and outlining this methodology in detail in this ESIA Study. Having an explicit methodology not only forces the assessor to come to terms with the various facets contributing towards the determination of significance, thereby avoiding arbitrary assignment, but also provides the reader of the ESIA with a clear summary of how the assessor derived the assigned significance;
- Wherever possible, differentiating between the likely significance of potential environmental impacts as experienced by the various affected parties; and
- Utilizing a team approach and internal review of the assessment to facilitate a more rigorous and defendable system.

Although these measures may not totally eliminate subjectivity, they provide an explicit context within which to review the assessment of impacts.

13.4 Assessment of impacts

The key impacts identified by the Firm of Experts are highlighted in this section, according to the relevant project phases. Design and planning issues have informed the mitigation measures which are presented for the construction, operations and decommissioning phases respectively.

In applying the impact assessment methodology the Firm of Experts used the precautionary principle to establish significance of impacts and their management and mitigation that is, where there is uncertainty or insufficient information, the Firm of Experts erred on the side of caution.

13.4.1 Geology and Soils (GS)

Extraction of natural resources for construction (GS1)

The power plant will require raw materials such as back fill (murram and hardcore), sand and aggregate for construction purposes. Such raw materials will be sourced from local quarries and river beds where they are found. Natural resource depletion may occur if not rationally done through activities such as burrowing and quarrying for construction materials.

Materials sites (quarry and burrow areas) if not reinstated and rehabilitated after natural resource extraction may cause landscape scarring, dangers of overhanging cliffs and falling rocks which creates environmental, health and safety hazards, stagnant water which small children could utilize for swimming purposes.
During the construction phase there is a potential for siltation of the Stony Athi River especially if the site is excavated during the rainy season and proper drainage mechanisms are not implemented.

**Construction phase**

| Unmitigated Impact: Extraction of natural resources for construction |
|------------------|------------------|
| Magnitude of impact | 3                |
| Geographic extent   | 4                |
| Duration of impact  | 2                |
| Frequency of activity | 3               |
| Frequency of impact  | 4                |
| **Result**          | Low-medium (-63) |

**Comment/mitigation**

All burrow pit sites shall be clearly indicated on a plan and approved by the local authority; appropriate authorization to use the proposed burrows pits and quarries will be obtained before commencing activities;

Burrow pits and quarries shall be located more than 100 meters from watercourses in a position that will facilitate the prevention of storm-water runoff from the site from entering the watercourse; Notice will be given 14 days to nearby communities of intention to excavate in the borrow pits or quarries;

Burrow rehabilitation plans, will be prepared prior to use and approved by the local authorities;

Storm-water and groundwater controls shall be implemented to prevent runoff entering streams and the slumping of soil from hillside above;

The use of burrow pits or quarries for material spoil sites must be approved by the local authorities (and/or with the appropriate consent of the “landowner”). Where this occurs, the materials spoiled in the borrow pit shall be profiled to fit into the surrounding landscape and covered with topsoil.

**Mitigated Impact: Extraction of natural resources for construction**

| Magnitude of impact | 2                |
| Geographic extent   | 4                |
| Duration of impact  | 2                |
| Frequency of activity | 2               |
| Frequency of impact  | 2                |
| **Result**          | Low (-32)        |
Soil erosion due to excavation (GS2)

The top soils at the proposed power plant are generally loose clays and held by the natural vegetation. During excavation, top soils will be removed and carted away to approved local authority dump sites.

The excavations and earthworks will lead to the removal of top soil which could end up weakening the soil profile and therefore leading to the soil erosion during construction phase.

Construction phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Soil erosion due to excavation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
</tbody>
</table>

**Result**  
Low (-30)

**Comment/mitigation**

During construction, earthworks should be controlled so that land which is not required for construction is not disturbed. Wherever possible, earthworks should be carried out during the dry season to prevent soil from being washed away by the rain. Excavated materials and excess earth will be kept at appropriate sites approved by the supervising engineer. Wherever possible, the earth dumping sites will be designed in such a manner as to facilitate natural water discharge. Drainage structures should be properly installed.

<table>
<thead>
<tr>
<th>Mitigated Impact: Soil erosion due to excavation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
</tbody>
</table>

**Result**  
Very-low (-16)

13.4.2 Surface Water (SW)

Impact on water quality (SW1)

The proposed site which covers an area of approximately four hectares lies within the upper Athi catchment. The closest river to the site is the Stony Athi River which is about 700m towards the east and south-east of the project location. The Stony Athi River which can become ephemeral during extended drought periods flows northwards into the main Athi River.
It is expected that the entire 4 hectares of land will be developed by the Proponent. The slope of the site is towards the south-east draining into the Stony Athi River and consequently with the completed footprint could potentially exacerbate the run-off response times, erodability and pollutant transport from the site.

During the construction phase, there could be impacts on water quality due to increased erosion, sediment load and sedimentation as a result of a storm event which enters the Stony Athi River. Additionally, the use of construction equipment (excavators, trucks, etc.) poses a risk for leaks of oils and lubricants which could potentially contaminate surface water.

Hydrostatic testing of the heavy fuel oil (HFO) storage tanks and pipelines will be undertaken prior to commissioning the power plant. Depending on the quality of water released by hydrostatic testing, this used water could potentially result in contamination of the Stony Athi River.

During the operational phase, tank trucks loaded with heavy fuel oil (HFO) will be off-loaded into the two large HFO bulk storage tanks. Due to the connection and disconnection operations of the truck hoses it is possible that spillages will occur around the off-loading areas. The spillages will be washed down with water and directed to a primary water treatment system known as an oil water separator (OWS) which will be designed in accordance with international standards. As a minimum, the treated water should meet the discharge standards stipulated in Legal Notice (L.N.) 120: Environment Management and Coordination (Water Quality) Regulations, 2006.

During the construction phase, the EPC contractor and their nominated sub-contractors will develop, rollout and implement wastewater management and control procedures for normal, abnormal and emergency situations. During the operational phase, the Proponent will develop their wastewater management and control procedures for normal, abnormal and emergency situations.

Construction phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Impact on water quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

**Comment/mitigation**

During construction, potentially contaminated run-off should be treated prior to discharging it into the environment. The EPC contractor and their nominated sub-contractors must adhere to the discharge limits stipulated in L.N. 120: Environment Management and Coordination (Water Quality) Regulations 2006.

Mitigated Impact: Impact on water quality

Magnitude of impact | 2  
Geographic extent  | 2  
Duration of impact  | 1  
Frequency of activity  | 2  
Frequency of impact  | 2  
**Result**            | **Very-low (-20)**

**Operational and decommissioning phase**

**Unmitigated Impact: Impact on water quality**

Magnitude of impact | 4  
Geographic extent  | 3  
Duration of impact  | 2  
Frequency of activity  | 2  
Frequency of impact  | 2  
**Result**            | **Low (-36)**

**Comment/mitigation**

The likelihood of leaks and spills during operation can be reduced by the construction of bunded areas around potential operational spill areas. Such areas include the tank farm, truck off-loading bays, pump stations, etc. Consistent monitoring and maintenance of pipes, pump stations and valves during operation will reduce the likelihood of spills.

**Mitigated Impact: Impact on water quality**

Magnitude of impact | 3  
Geographic extent  | 2  
Duration of impact  | 1  
Frequency of activity  | 1  
Frequency of impact  | 2  
**Result**            | **Very-low (-18)**

13.4.3 **Groundwater (GW)**

**Pollution of groundwater (GW1)**

The project area is mainly composed of unconsolidated black cotton soil termed as vertisols, which varies in thickness from 0.5m to 3m. They are poorly drained, have low infiltration rate and low permeability and are capable of significantly upholding any released contaminants to the groundwater.
Immediately below the vertisols, weathered phonolitic brownish deposits with rounded grains are found. A gradual transition from the weathered upper layer of the phonolite formation to a less weathered one occurs.

It is noted that a shallow perched aquifer occurs between 0.5 and 1.5m below ground surface. This basically occurs as the interphase between the clay layer and the phonolitic rock. The other main aquifers are deep and occur from a depth of about 50m onwards. The main aquifer in the area is mostly formed within the old land surfaces and weathered portions between the different volcanic flows; however above it are fresh compact Phonolites highly impermeable that do not allow infiltration of the subsurface contaminants to reach the deeper aquifer.

During the construction phase, fugitive spills from construction plant and equipment related operations could potentially enter the sub-surface through interstitial spaces and or weathered zones within a rock. These types of spills could potentially impact the perched aquifer.

During the operational phase, groundwater contamination is unlikely to occur as most areas of the power plant will be paved with an impermeable surface.

Construction phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Contamination of groundwater</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
<td>2</td>
</tr>
<tr>
<td>Geographic extent</td>
<td>2</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>1</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>4</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td><strong>Low (-40)</strong></td>
</tr>
</tbody>
</table>

**Comment/mitigation**

The EPC contractor and their nominated sub-contractors will ensure that construction plant and equipment is in a good state of repair always and parked/situated in approved locations on site. If any hydrocarbons are stored on-site (drums, tanks, etc.), they will be kept in impermeable bunded areas (drip trays) and always under a canopy cover. Safety and health induction training will be provided to the workers on procedures to be followed in the event of a spillage of hydrocarbon products at the construction site that could adversely impact subsurface soil and/or groundwater quality.

<table>
<thead>
<tr>
<th>Mitigated Impact: Contamination of groundwater</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
<td>1</td>
</tr>
<tr>
<td>Geographic extent</td>
<td>1</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>1</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>2</td>
</tr>
</tbody>
</table>
13.4.4 Soils (S)

Contamination of soils (S1)

The project area is mainly composed of unconsolidated black cotton soil termed as vertisols, which varies in thickness from 0.5m to 3m. Immediately below the soils, weathered phonolitic brownish deposits with rounded grains are found. A gradual transition from the weathered upper layer of the phonolite formation to a less weathered one occurs.

The proposed power plant is to be constructed on a Greenfield site which has had no prior known activity on it. Soil tests were carried out on samples of soil collected from various parts of the site and indicated non-detectable levels of TPH and BTEX. The construction of the power plant will require use of heavy mechanically driven equipment which uses hydrocarbons as a source of energy.

During the construction phase fugitive spills of hydrocarbons can potentially occur resulting from poorly maintained construction plant and equipment, and improper storage, handling, use and disposal of fuels and lubricants.

Most of the areas where fugitive spills can potentially occur during the operational phase will be paved with an impervious material such as reinforced concrete. Fugitive spills which will be washed down by water will be directed to the primary surface water treatment system known as an oil water separator (OWS).

Construction phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Contamination of soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

Comment/mitigation

The EPC contractor and their nominated sub-contractors will ensure that construction plant and equipment is in a good state of repair always and parked/situated in approved locations on site. If any hydrocarbons are stored on-site (drums, tanks, etc.), they will be kept in impermeable bunded areas (drip trays) and always under a canopy cover. Safety and health induction training will be provided to the workers on procedures to be followed in the event of a spillage of hydrocarbon products at the construction site that could adversely impact soil quality.

Mitigated Impact: Contamination of soils
13.4.5 Ecology (E)

Impacts on the biological environment (E1)

The proposed power plant site is located within the upper Athi River catchment area; it is dry but adjacent to the seasonal Stony Athi River towards the east and south-east. The proposed project falls within the agro-climatic zone V-4 which is characterized as semi-arid with average rainfall amounting to 450mm – 900mm annually. The vegetation cover is described as bushland with potential plant growth being medium to low.

The main habitats within the Athi-Kapiti ecosystem are the Grass plain dominated by Cynodon, Themeda, Cypress, and Digitaria species; Dry forest, Olea africana, Croton dichogamus, Brachylaena hutchinsii, and Calodendrum; Riverine forest/valley forest, Acacia xanthophloea, Euphorbia candelabrum, Apodytes dimidiata, Canthium schimperiana, Elaeodendron buchananii, Ficus eriocarpa, Aspilia mossambicensis, Rhus natalensis, and Newtonia species.

The proposed project site is open with short grasses existing with very few trees dispersed at the lower edge of the site. The area is already degraded and there is no sensitive habitat.

The proposed project site is situated in the Athi-Kapiti plain ecosystem and lies about 8.5km to the south-east of the Nairobi National Park. The herbivores (wildebeest and zebra) use Kitengela Conservation Area and migratory corridor to the south of the Park to reach the Athi-Kapiti Plains. The migratory routes for the animals lie in the south of the proposed site.

The main flyways and stop-overs for the migratory birds (Palearctic birds) are within the Rift Valley (Ollorgessailie, Kariandusi, L. Turkana) and Lake Victoria. The proposed project site does not lie close to the bird migratory routes and therefore is not expected to have significant impacts.

Construction and operational phases

Unmitigated Impact: Impact on flora and fauna

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>2</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>2</td>
</tr>
</tbody>
</table>
13.4.6 Air quality (AQ)

Decreased air quality due to dust and VOC emissions (AQ1)

Air quality has been identified as an issue that impacts environmental and health concerns in an area. Currently Kenya is in the process of gazetting new air quality regulations which will be used to manage air pollution from point and mobile sources.

During the construction phase, there are potential air quality impacts resulting from generation of dust and volatile organic compounds (VOCs). These will potentially occur during site clearing activities as construction vehicles move in and out of the site. During the operational phase, there will be minimal dust generation as most areas where vehicles will move will be paved.

The proposed project is a thermal power plant which will use heavy fuel oil (HFO) as the primary energy source to drive the generators. The HFO will be trucked daily from Mombasa to the power plant; it is expected that there may be 10 – 15 tank truck deliveries a day during the operational phase. During this phase, the exhaust emissions from the trucks will potentially have a slight cumulative adverse impact of dust and VOCs into the environment.

Construction and decommissioning phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Decreased air quality due to dust and VOC emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
</tbody>
</table>
Management and mitigation of construction and decommissioning phase impacts will be included in the EMP.

**Mitigated Impact: Decreased air quality due to dust and VOC emissions**

<table>
<thead>
<tr>
<th>Frequency of impact</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Result</strong></td>
<td>Low (-48)</td>
</tr>
</tbody>
</table>

**Comment/mitigation**

Tank trucks should be in a good state of repair at all times. Use of low sulfur and/or ultra-low sulfur diesel in tank trucks is recommended.

**Mitigated Impact: Decreased air quality due to dust and VOC emissions**

<table>
<thead>
<tr>
<th>Frequency of impact</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Result</strong></td>
<td>Very-low (-24)</td>
</tr>
</tbody>
</table>
Decreased air quality due to stack emissions (AQ2)

The power plant is a medium speed diesel type having ten Wärtsilä model 20V32 type engines-generator sets. The engines are designed to run on heavy fuel oil (HFO) having a viscosity between 180cst and 380cst. The HFO consumption of the power plant will be approximately 406MT/day. Air dispersion modeling was undertaken using the US EPA AERMOD and European ADMS4 techniques. The air dispersion model evaluated the predicted ground level concentrations of sulfur dioxide, oxides of nitrogen and particulate matter for HFO containing a sulfur content of 2.0%.

The results of the air dispersion modeling were compared to the EC Directive 2008/50/EC air quality guidelines (AQG). The modeling of the power plant running at full capacity indicates that the power plant will not exceed the particulate matter emissions ($PM_{10}$ and $PM_{2.5}$) AQG.

At the nearest sensitive receptor of Athi River town and the housing estate just past the Stony Athi River, none of the EC limit values are predicted to be exceeded. AERMOD predicts exceedences of $SO_2$ and $NO_2$ hourly limits at Lukenya hills with the frequency of exceedence being equal to the limit for $SO_2$ and slightly over the limit for $NO_2$. It must be pointed out that AERMOD has a range of uncertainty which ranges between -50% and 200%. Subsequently the highest hourly levels of $SO_2$ and $NO_2$ predicted by AERMOD would lie in the above uncertainty range. ADMS4 is slightly more conservative than AERMOD in the vicinity of the power plant with AERMOD being more conservative further away at the elevated areas such as Lukenya Hills.

The impacts of stack emissions will occur during the operational phase of the project.

Operational phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Decreased air quality due to stack emissions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
<td>4</td>
</tr>
<tr>
<td>Geographic extent</td>
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</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>5</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>4</td>
</tr>
<tr>
<td>Result</td>
<td>Medium- high (-81)</td>
</tr>
</tbody>
</table>

Comment/mitigation

Due to the difference in predicted concentrations from the two dispersion models, with the one being more conservative near-field and the other further afield, the Proponent should conduct bi-annual passive air sampling and analysis of ground level concentrations of $SO_2$ and $NO_2$ in the fallout areas on Lukenya Hills to determine actual concentrations of these pollutants.

Secondly the engines should be “emission rated” to ensure that they comply with the latest IFC Guidelines with respect to $NO_2$ emissions (710ppm)
Mitigated Impact: Decreased air quality due to stack emissions

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>3</th>
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<tbody>
<tr>
<td>Geographic extent</td>
<td>3</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>1</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>3</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>3</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td>Low (-42)</td>
</tr>
</tbody>
</table>

13.4.7 Waste management (W)

Pollution from waste management (W1)

Several categories of waste will be generated during the construction and operational phases of the proposed power plant. During construction, waste will be generated from construction activities, domestic waste produced by construction teams, sewage, used oil and lubricants, and wastewater from hydrostatic testing.

A range of wastes will be generated during the operational phase of the project including domestic waste generated by operational and security personnel, used oil, tank sludge and replacement of components of the power plant infrastructure. Hazardous wastes such as contaminated water and soil and redundant electronic equipment and computers, pose significant pollution and health risks.

During decommissioning, waste will be mainly as a result of the dismantling of the depot infrastructure.

Construction and decommissioning phases

Unmitigated Impact: Pollution from waste management

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>2</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>3</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>5</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td>Low-medium (-56)</td>
</tr>
</tbody>
</table>

Comment/mitigation

A waste management plan will be developed and implemented in accordance with L.N. 121: Environment Management and Coordination (Waste Management) Regulations 2006 to cover hazardous and non-hazardous waste. Mitigation and management of waste generation and disposal will be covered in the EMP. The EPC contractor and their nominated sub-contractors will ensure that all waste leaving the site does so in appropriate receptacles and that the waste is disposed off in accordance with the requirements in L.N. 121 and Mavoko Municipal Council.
by-laws on waste management. All waste must be managed according to recognized procedures and no waste disposal facilities are to be managed onsite. All waste should be disposed of in leak-proof containers such that it does not come into contact with and potentially pollute soils, surface water and groundwater.

**Mitigated Impact: Pollution from waste management**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>1</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>3</td>
</tr>
</tbody>
</table>

**Result**  
Very-low (-25)

**Operational phase**

**Unmitigated Impact: Pollution from waste management**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>2</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>5</td>
</tr>
</tbody>
</table>

**Result**  
Low (-49)

**Comment/mitigation**

A waste management plan will be developed and implemented in accordance with L.N. 121: Environment Management and Coordination (Waste Management) Regulations 2006 to cover hazardous and non-hazardous waste. Mitigation and management of waste generation and disposal will be covered in the EMP. The Proponent will ensure that all waste leaving the site does so in appropriate receptacles and that the waste is disposed off in accordance with the requirements in L.N. 121 and Mavoko Municipal Council by-laws on waste management. All waste must be managed according to recognized procedures and no waste disposal facilities are to be managed onsite. All waste should be disposed of in leak-proof containers such that it does not come into contact with and potentially pollute soils, surface water and groundwater.

**Mitigated Impact: Pollution from waste management**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>1</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>1</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>1</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>3</td>
</tr>
</tbody>
</table>
Result | Very-low (-16)

13.4.8 Noise and vibration (N)

噪声和振动（N）

噪声在施工和试运行阶段（N1）

噪声在施工和试运行期间，项目地点位于蒙巴萨-内罗毕主干道沿线上。该主干道的日常交通（其中大量车辆为卡车）对环境噪音水平有显著影响。现有住宅区目前正在该建议项目地点约700米东北方向处建设中。该住宅区的交通噪声在距离其约150米的展示屋内听不到，展示屋位于主干道旁。

施工期间，预计会产生来自施工工人的噪音、大型设备和车辆的使用对清理和开挖、铺设基础、安装储罐、发电厂发动机和相关基础设施的运动噪音。

施工阶段

未缓解影响：施工期间噪音污染

<table>
<thead>
<tr>
<th>参数</th>
<th>值</th>
</tr>
</thead>
<tbody>
<tr>
<td>噪声影响程度</td>
<td>2</td>
</tr>
<tr>
<td>地理分布</td>
<td>2</td>
</tr>
<tr>
<td>影响持续时间</td>
<td>2</td>
</tr>
<tr>
<td>活动频率</td>
<td>2</td>
</tr>
<tr>
<td>影响频率</td>
<td>5</td>
</tr>
<tr>
<td>结果</td>
<td>低 (-42)</td>
</tr>
</tbody>
</table>

评论/缓解

最小限度，EPC承包商及其指定的分包商将确保施工期间使用的设备符合《工厂及其他工作场所（噪声预防和控制）法规，2005年》和《环境管理与协调（噪声和过量振动预防）法规，2009年》的要求。

缓解影响：施工期间噪音污染

<table>
<thead>
<tr>
<th>参数</th>
<th>值</th>
</tr>
</thead>
<tbody>
<tr>
<td>噪声影响程度</td>
<td>2</td>
</tr>
<tr>
<td>地理分布</td>
<td>1</td>
</tr>
<tr>
<td>影响持续时间</td>
<td>2</td>
</tr>
<tr>
<td>活动频率</td>
<td>2</td>
</tr>
<tr>
<td>影响频率</td>
<td>3</td>
</tr>
<tr>
<td>结果</td>
<td>非常低 (-25)</td>
</tr>
</tbody>
</table>
**Noise during operation (N2)**

The proposed power plant is expected to be operational twenty-four hours a day, seven days a week. During operations the principle sources of noise pollution are expected to be generated from the generator sets and trucks entering and leaving the power plant. The proposed power plant is designed to attenuate noise level to 70dB(A) at the fence line. The power plant is expected to comply with the requirements of L.N. 61: Environment Management and Coordination (Noise and Excessive Vibration Control) Regulations, 2009 and L.N. 25: Factories and Other Places of Work (Noise Prevention and Control) Regulations 2005.

**Operational phase**

**Unmitigated Impact: Noise during operation**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>3</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>5</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>3</td>
</tr>
</tbody>
</table>

**Result**

Medium-high (-77)

**Comment/mitigation**

A hearing conservation program will be developed, rolled out and implemented within the power plant in accordance with L.N. 25. Maintenance and service schedules for the equipment should be coordinated to reduce generation of excessive noise and vibration from the power plant. Ambient noise level surveys will be undertaken periodically (annually) to ensure compliance with community noise levels stipulated under Kenyan legislation and shared with the community for educational purposes.

**Mitigated Impact: Noise during operation**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
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<tbody>
<tr>
<td>Geographic extent</td>
<td>3</td>
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<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>2</td>
</tr>
</tbody>
</table>

**Result**

Low (-42)

**Noise generated during decommissioning of the power plant (N3)**

During closure, likely sources of noise pollution will be heavy machinery and equipment for the removal of the generator sets, power house building, heavy fuel oil storage tanks and other associated infrastructure. Abnormal load trucks will need to be utilized for transportation of infrastructure components to an appointed facility where they will be broken down or recycled. During this process, noise
will be generated from the contractors and workers assigned to rehabilitate the land and the equipment used to assist with this activity(ies). Together with these activities, noise will be generated by the rehabilitation team and is more likely to be noticeable at night from the camp due to reduced ambient noise levels.

**Decommissioning phase**

<table>
<thead>
<tr>
<th>Unmitigated Impact: Noise from decommissioning of the power plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

**Comment/mitigation**

Prior to decommissioning, the EPC contractor will undertake a noise level survey to establish the ambient noise levels. During decommissioning the EPC contractor will coordinate activities that produce the most noise levels to take place when the surrounding noise levels are at their peak. The EPC contractor will further improve on the existing management of noise generation from equipment and staff to ensure that they comply with Kenyan legislation at the time of decommissioning.

<table>
<thead>
<tr>
<th>Mitigated Impact: Noise from decommissioning of the power plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

### 13.4.9 Visual Impacts (V)

**Impacts on the visual landscape (V1)**

The study area is dominated by a range of vistas and environments primarily dominated by industrial activities. The project site is fronted by the main Mombasa – Nairobi highway to the north, a disused quarry to the south, a steel manufacturing plant to the north-west and a greenfield site to the east. Dirt roads traverse the landscape which is semi-arid in nature. The study area is currently littered with excavated soils from the excavation of the new Mombasa – Nairobi dual carriageway which is under construction. There are minimal agricultural activities in the study area. The vicinity of the study area is characterized by some limestone quarrying activities as evidenced by open cast limestone mines, stockpiles and limited scarring of the landscape. Due to the largely undeveloped
semi-arid nature of the landscape, the Athi River Steel Plant and the proposed Tile & Carpet Centre projects are clearly visible. The Greenpark residential estate which is located about 700m towards the north-east of the study site is also visible.

Visual impacts are likely to be most severe during the construction phase when the power plant is being constructed. It is not anticipated that there will be severe visual impacts from the power plant during the operational phase as the area is earmarked for industrial purposes by the Mavoko Municipal Council.

The power plant will consist mainly of prominent above ground structures most notably the powerhouse building, stacks and two heavy fuel oil storage tanks. These structures will be visually prominent to passers-by.

**Construction and operational phases**

<table>
<thead>
<tr>
<th><strong>Unmitigated Impact: Impacts on visual landscape</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

**Comment/mitigation**

Trees can be planted along the frontage of the plot to screen the development. The infrastructure should be painted in colors that blend with the local environment. Waste management measures should be in place at all times and the entire site especially the fuel offloading areas must be kept clean.

<table>
<thead>
<tr>
<th><strong>Mitigated Impact: Impacts on visual landscape</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>
13.4.10 Macroeconomic (M)

National economic development

Over recent years, Kenya has experienced significant economic development. The proposed project is part of three new power plants that the KP&LC is financing in order to meet the growing demand for electric power. The proposed power plant will bring significant foreign direct investment into the country thereby boosting the national economy.

The fact that there will be an improved supply of electric power into the national grid implies a number of spin-offs for the country including more available electric power supply for consumers and less black-outs. The industrial and manufacturing sector in Kenya is particularly important since it employs close to 25% of the working population and is a major source of employment opportunities. The electricity generated from the power plant will be evacuated to a proposed industrial concern in Athi River and the KP&LC’s Embakasi substation.

During the operational phase, several positive economic spin-offs are envisaged as well as the creation of a limited number of permanent generally high skilled jobs.

Operational phase

Benefits without construction of power plant: National economic benefits

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>5</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>3</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>4</td>
</tr>
<tr>
<td>Result</td>
<td>Low-medium (+60)</td>
</tr>
</tbody>
</table>

Comment/mitigation

Management of enhancement measures for generation of economic benefits in the Athi River area will be included in a number of programs and plans including a communication and information program, labor and human resources plan and a community liaison development plan.

Benefits with construction of power plant: National economic benefits

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>4</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>5</td>
</tr>
<tr>
<td>Result</td>
<td>Medium-high (+99)</td>
</tr>
</tbody>
</table>
Stability of electric power supply

The above mentioned economic growth in Kenya has resulted in increased demand for electric power supply. Electric power generation currently relies heavily on hydropower and due to unpredictable climatic conditions has had adverse impacts on the economy. The Government has had to contract emergency power generation through Aggreko of the U.K. to supplement hydropower, geothermal and thermal power respectively. The Government through the Ministry of Energy, power generation and transmission companies and key energy lead agencies has developed a least cost power development plan (LCPDP) which is the country’s electric power generation and transmission blueprint. The LCPDP is revised annually on the basis of the demand forecast for electricity and in the current revision of 2009, identified the construction of three 80MW medium speed diesel (MSD) engine power plants. The KP&LC was given the go-ahead to purchase electric power through independent power producers (IPPs).

The construction of the proposed power plant could thus provide additional capacity to feed into the national grid in the short to medium term with benefits of improved availability of electricity to consumers extending for the lifetime of the project envisaged to be twenty years.

Operational phase

<table>
<thead>
<tr>
<th>Benefits without construction of power plant: Stability of electricity supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
<tr>
<td><strong>Comment/mitigation</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits with construction of power plant: Stability of electricity supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>
13.4.11 Socio-economic (SE)

Compatibility with existing and proposed land use (SE1)

The proposed site is currently zoned for “light inoffensive industrial” use. The Mavoko Municipal Council currently does not have a formal master plan of existing and proposed land uses within the local authority’s jurisdiction which begins at the Kapa Oil Refineries along the main Nairobi – Mombasa highway and extends beyond the proposed project site. The Mavoko Municipal Council approves development planning permission for industrial projects fronting the Nairobi – Mombasa highway such as the proposed power plant as long as the project is not out of character with its surroundings. There are already a number of heavy industrial businesses in the vicinity of the power plant such as the Athi River Steel Plant, East African Portland Cement quarry, Tile & Carpet Centre, Devki Steel Mills, etc. There is also a residential estate currently under construction about 700m due north-east of the project site.

During the operational phase, residential development near the power plant should be restricted by the need to comply with noise attenuation levels produced by the power plant at the fence line.

Following decommissioning and closure, the power plant site can be made available for commercial/industrial purposes after appropriate rehabilitation measures are implemented.

Operational phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Compatibility with existing and proposed land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
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<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
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<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

Comment/mitigation

Public awareness should be created about safe land uses in the vicinity of the power plant.

<table>
<thead>
<tr>
<th>Mitigated Impact: Compatibility with existing and proposed land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<td>Duration of impact</td>
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<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
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<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>
Decommissioning phase

Unmitigated Impact: Compatibility with existing and proposed land use

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</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
<td>3</td>
</tr>
<tr>
<td>Geographic extent</td>
<td>3</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>4</td>
</tr>
</tbody>
</table>

**Result** Low (-48)

Comment/mitigation

Rehabilitation of the project site will make it more appealing for commercial/industrial activities to recommence.

Mitigated Impact: Compatibility with existing and proposed land use

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<tbody>
<tr>
<td>Magnitude of impact</td>
<td>2</td>
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<tr>
<td>Geographic extent</td>
<td>3</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>5</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>1</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>2</td>
</tr>
</tbody>
</table>

**Result** Very low (-30)

Increased crime (SE2)

The construction and operation of the power plant could potentially contribute to increased crime levels and in-migration in the study area. Nairobi and by extension Mavoko Municipality in general displays high levels of crime, especially in urban areas. Crime levels are often associated with problems of overcrowding, poor infrastructure, community dislocation, poverty and organized syndicates. Crime is a potential impact during the construction and operational phases as there will be large numbers of contracted workers and service providers. This could give would-be criminals opportunity to commit crime. Attempted theft of electric cables and associated equipment either by individuals or syndicates could be a particular problem, resulting in increased risk to landowners and property.

Construction phase

Unmitigated Impact: Increased crime

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<tbody>
<tr>
<td>Magnitude of impact</td>
<td>4</td>
</tr>
<tr>
<td>Geographic extent</td>
<td>2</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>3</td>
</tr>
</tbody>
</table>
**Comment/mitigation**

The communication and information program must include a strategy to inform communities about job opportunities in order to manage expectations. Construction will generally take place during the day and no workers should be allowed to stay overnight at the site. Security measures need to be put in place during the construction phase to limit theft and malicious damage to the property on the depot. The property should be fenced off and strict security access must be implemented to distinguish between workers and non-workers.

**Mitigated Impact: Increased crime**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
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<tbody>
<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>3</td>
</tr>
</tbody>
</table>

**Result**  
Low (-30)

**Operational phase**

**Unmitigated Impact: Increased crime**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>3</th>
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<tbody>
<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
<td>3</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>4</td>
</tr>
</tbody>
</table>

**Result**  
Low (-49)

**Comment/mitigation**

Management and mitigation measures for crime prevention will be included in the EMP. High-tech security systems will be fully functional during the operational phase and fewer workers will be present on site. Perimeter security lighting will provide luminance which should improve security especially at night.

**Mitigated Impact: Increased crime**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
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<tbody>
<tr>
<td>Geographic extent</td>
<td>2</td>
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<tr>
<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
<td>2</td>
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<tr>
<td>Frequency of impact</td>
<td>3</td>
</tr>
</tbody>
</table>
Creation of employment opportunities (SE3)

Job opportunities will be generated during the construction and operational phase of the power plant. The unemployment rate in Mavoko is generally high and the local communities have expressed their willingness to provide labor and manpower services for the project. The power plant is expected to generate about 100 jobs during the construction phase of the project while another 28 jobs will be created during the operational phase. The construction phase is expected to represent opportunities for local employment and service provision such as the use of local transport, provision of social amenities and sourcing of construction materials locally. There are likely to be spin-offs provided by training of people employed or contracted locally.

Indirect employment opportunities may arise in the operational phase resulting from provision of social services near the power plant site such as kiosks, bars, lodgings, etc. for the tank-truck drivers.

During the operational phase, the increased stability of electric power supply to the grid is likely to enhance the national economy which is likely to result in increased employment opportunities.

**Construction phase**

<table>
<thead>
<tr>
<th>Benefits without the power plant: Creation of employment opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<td>Duration of impact</td>
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<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
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<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

**Comment/mitigation**

The EPC contractor and their nominated sub-contractors should manage labor expectations by providing first preferences for employment to the local communities. The district administration should be consulted when recruiting local workers and service providers.

<table>
<thead>
<tr>
<th>Benefits without the power plant: Creation of employment opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<td>Duration of impact</td>
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<td>Frequency of activity</td>
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<td>Frequency of impact</td>
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<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>
Operational phase

<table>
<thead>
<tr>
<th>Benefits without the power plant: Creation of employment opportunities</th>
</tr>
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<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
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<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
</tr>
</tbody>
</table>

Result | Low (+54)

Comment/mitigation
The Proponent should as far as possible endeavor to provide preference for employment to skilled workers from the local communities.

<table>
<thead>
<tr>
<th>Benefits without the power plant: Creation of employment opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
</tr>
</tbody>
</table>

Result | Medium-high (+80)

Increased risk of disease with influx of workers (SE4)

Kenya experiences a high prevalence rate of HIV/AIDS and other communicable diseases. These types of diseases are exacerbated by the poverty and movement of workers. The high unemployment rate further provides a temptation for people to be drawn into commercial sex.

The construction of the proposed power plant could exacerbate the risk of spread of disease if adequate measures are not taken. Local communities can be exposed to increased risk of communicable diseases such as HIV/AIDS through risky behaviors involving job seekers and people employed on the project. It is anticipated that the risk of communicable diseases will be high during the construction phase as this will be the period when the highest number of people with disposable income will be present. These behaviors could potentially continue during the operation phase albeit at a minimal prevalence rate and are subsequently not assessed.

During the operational phase, the prevalence of HIV/AIDS and other communicable diseases may increase resulting from heavy fuel oil (HFO) tank truck deliveries to the power plant. Tank-truck drivers who are unable to return to Mombasa on the same day of product offloading, may park near the power plant. This behavior will give rise to the mushrooming of commercial sex activities which has been experienced in other parts of Kenya where similar types of petroleum tank-truck activities occur.
Construction phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Increased risk of communicable diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
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<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

Comment/mitigation

Management and mitigation measures for minimizing HIV/AIDS and other communicable diseases will be included in the communication and information program.

Mitigated Impact: Increased risk of communicable diseases

| Magnitude of impact                                       | 2 |
| Geographic extent                                         | 2 |
| Duration of impact                                        | 2 |
| Frequency of activity                                     | 2 |
| Frequency of impact                                       | 3 |
| **Result**                                                | Low (-30) |

Social divisions over limited jobs (SE5)

There is a high unemployment rate throughout the study area; this was evidenced during the public/stakeholder meetings in which the local community was vocal about job creation for their siblings during the construction and operational phases of the project respectively. Subsequently the proposed power plant has already contributed to high expectations of employment creation. Given the high skills generally required for construction and operation of thermal power plants, the number of jobs created at the local community level may be limited. This is likely to lead to discontent in communities if it is perceived that preferential treatment is given to “outsiders” both in terms of procurement and jobs. Corruption and nepotism could exacerbate this impact. This impact is likely to be most significant during the construction phase.

Construction phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Social divisions over limited jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
</tr>
</tbody>
</table>
Frequency of activity | 2  
Frequency of impact | 4  
**Result** | **Low (-48)**

**Comment/mitigation**

The communication and information program should be used to maximize procurement of jobs from the local community as a preference. Employment should be provided to all workers on the basis of merit and experience needed.

**Mitigated Impact: Social divisions over limited jobs**

| Magnitude of impact | 2  
| Geographic extent | 2  
| Duration of impact | 2  
| Frequency of activity | 2  
| Frequency of impact | 3  
**Result** | **Low (-30)**

**Accidents as a result of increased traffic (SE6)**

The influx of construction workers will also entail an increase in traffic on the Nairobi – Mombasa highway. This will be due to an increase in construction vehicles which will be delivering construction material and transporting construction rubble.

During operation there will be a number of fully laden tank-trucks delivering heavy fuel oil (HFO) to the power plant. While the number of tank-trucks that will be used to transport HFO will be determined by the demand for electricity, it is expected that there will be about 10 – 15 HFO tank truck deliveries being done a day. Due to the longer travel distances from Mombasa to Nairobi and given the non-defensive behaviors of some vehicle drivers and pedestrians in the area, there is a potential for increased traffic related accidents in the study area.

**Construction phase**

**Unmitigated Impact: Accidents as a result of traffic**

| Magnitude of impact | 3  
| Geographic extent | 3  
| Duration of impact | 2  
| Frequency of activity | 3  
| Frequency of impact | 4  
**Result** | **Low-medium (-56)**

**Comment/mitigation**

Management and mitigation measures for minimizing damage to transport infrastructure will be included in the EMP. Safety plans for pedestrians and
individuals in road traffic will be included in the EMP.

<table>
<thead>
<tr>
<th>Mitigated Impact: Accidents as a result of traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<td>Duration of impact</td>
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<tr>
<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
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<tr>
<td><strong>Result</strong></td>
</tr>
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</table>

**Operational phase**

<table>
<thead>
<tr>
<th>Unmitigated Impact: Accidents as a result of traffic</th>
</tr>
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<tbody>
<tr>
<td>Magnitude of impact</td>
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<td>Geographic extent</td>
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<td>Duration of impact</td>
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<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
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<tr>
<td><strong>Result</strong></td>
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</tbody>
</table>

**Comment/mitigation**

All road users that are directly involved with the power plant operations will strictly adhere to defensive driving skills. All vehicles entering or leaving the power plant will be maintained in an excellent state of repair.

<table>
<thead>
<tr>
<th>Mitigated Impact: Accidents as a result of traffic</th>
</tr>
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<tbody>
<tr>
<td>Magnitude of impact</td>
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<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
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<td>Frequency of activity</td>
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<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

**13.4.12 Traffic (T)**

**Damage to roads and other transport infrastructure (T1)**

Currently the Athi River – Machakos turn-off section of the Nairobi – Mombasa highway is undergoing construction. The proposed project site has a frontage to this highway and will be used for accessing the project site. Damage to the highway will predominantly occur during the construction phase resulting from
transportation of heavy machinery, equipment and components and construction materials.

Construction phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Damage to roads and other transport infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Geographic extent</td>
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<td>Frequency of impact</td>
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<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

Comment/mitigation

Management and mitigation measures for minimizing damage to transport infrastructure will be included in the EMP.

<table>
<thead>
<tr>
<th>Mitigated Impact: Damage to roads and other transport infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
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<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

**Increased traffic and road safety hazard (T2)**

Kenya generally experiences a high traffic accident rate resulting from poor compliance with road safety rules and un-roadworthy vehicles.

During the construction phase, the proposed project will potentially contribute to increased traffic and safety hazards resulting from transportation of construction equipment, building materials and construction vehicles in the study area. Additionally, there will be a requirement for compliance with abnormal load transportation requirements of the generator sets from Mombasa to the project site; this will potentially cause traffic congestion along the busy Mombasa – Nairobi highway and possibly accidents.

During the operational phase, the risks may reduce resulting from an absence of construction related vehicles in the study area. However, there will be about 10 – 15 fully laden tank-trucks delivering heavy fuel oil a day to the power plant which can potentially lead to increased traffic and road safety hazards.
### Construction phase

**Unmitigated Impact: Increased traffic and road safety hazard**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic extent</td>
<td>4</td>
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<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>3</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>4</td>
</tr>
</tbody>
</table>

**Result**

Low-medium (-70)

**Comment/mitigation**

Minimize the number of construction vehicles on the road in the peak hours. Implement a motor vehicle safety program to ensure that drivers are not fatigued, are “fit-for-duty”, possess the correct type of driving license, have undergone defensive driving training, etc.

**Mitigated Impact: Increased traffic and road safety hazard**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
<th>3</th>
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<tbody>
<tr>
<td>Geographic extent</td>
<td>3</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>3</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>3</td>
</tr>
</tbody>
</table>

**Result**

Low (-48)

### Operational phase

**Unmitigated Impact: Increased traffic and road safety hazard**

<table>
<thead>
<tr>
<th>Magnitude of impact</th>
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<tbody>
<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>4</td>
</tr>
</tbody>
</table>

**Result**

Low-medium (-72)

**Comment/mitigation**

A motor vehicle safety program will be implemented within the company for in-house and contracted transport truck fleet operators. A road transport supplier risk assessment will be undertaken for the successful heavy fuel oil contractor to ensure that they have a safety and health management system implemented.

**Mitigated Impact: Increased traffic and road safety hazard**

| Magnitude of impact | 3 |
13.4.13 Health and Safety (HS)

Occupational health and safety (HS1)

The development of the proposed power plant will involve a range of activities that are potentially unsafe to workers. Examples of such activities include excavation, use of pneumatic drills for cutting through hard rock, working at heights, welding, etc. Such activities require the use and operation of heavy duty equipment, machinery and vehicles.

During the construction phase, the potential occupational safety and health risks could emanate from:

- Injury to workers from the operation of machinery, equipment and construction vehicles;
- Injuries while working at heights;
- Road accidents; and
- Exposures to diseases including malaria, HIV/AIDS and TB.

During the operational phase the potential occupational safety and health risks include: Injuries to workers from routine monitoring and maintenance activities (vehicle accidents, replacement of components/parts, etc.) and emergencies such as equipment malfunction, explosions, fires, etc.

Construction phase

<table>
<thead>
<tr>
<th>Unmitigated Impact: Risks to occupational health and safety of workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
</tr>
<tr>
<td>Geographic extent</td>
</tr>
<tr>
<td>Duration of impact</td>
</tr>
<tr>
<td>Frequency of activity</td>
</tr>
<tr>
<td>Frequency of impact</td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
</tbody>
</table>

Comment/mitigation

The EPC Contractor and their nominated sub-contractors will ensure that they continuously undertake safety and health risk assessments of various potentially harmful activities. Safety and health induction training will be provided to all contractor employees including regular tool-box talks. The EPC contractor will
comply with the Occupational Safety and Health Act, 2007 including all relevant subsidiary legislation under the Act.

### Mitigated Impact: Risks to occupational health and safety of workers

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
<td>2</td>
</tr>
<tr>
<td>Geographic extent</td>
<td>1</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>3</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>3</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td><strong>Low (-30)</strong></td>
</tr>
</tbody>
</table>

### Operational phase

#### Unmitigated Impact: Risks to occupational health and safety of workers

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
<td>4</td>
</tr>
<tr>
<td>Geographic extent</td>
<td>2</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>4</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td><strong>Low-medium (-64)</strong></td>
</tr>
</tbody>
</table>

**Comment/mitigation**

A health, safety and environment (HSE) management system will be developed, rolled out and implemented. This system which will be based on the TQM cycle will be reviewed annually or after a major accident or incident. Periodic H&S inspections and annual statutory audits will be undertaken to verify and validate the competency of the HSE management system with changes being made as necessary.

### Mitigated Impact: Risks to occupational health and safety of workers

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude of impact</td>
<td>2</td>
</tr>
<tr>
<td>Geographic extent</td>
<td>1</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>2</td>
</tr>
<tr>
<td>Frequency of activity</td>
<td>4</td>
</tr>
<tr>
<td>Frequency of impact</td>
<td>2</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td><strong>Low (-30)</strong></td>
</tr>
</tbody>
</table>
13.4.14 Cumulative impacts (C)

A cumulative impact in relation to an activity may be defined as the impact of an activity that in itself may not be significant but may become significant when added to existing and potential impacts emanating from similar or diverse activities or undertakings in the area. This section describes the following cumulative impacts:

**Economic development (C1)**

Currently the demand for electric power in Kenya is greater than what the KP&LC can supply its customers. KP&LC has an ambitious plan of connecting 200,000 new customers annually to the national grid which implies that there will be a greater demand for electricity in the coming years. The construction of the proposed power plant will result in an increased and consistent electric power supply in Nairobi and its environs. This is likely to have positive spin-off effects for economic development in these areas. Subsequently electric power supply will not become a limitation for the national economy. For the study area, consistent supply of electric power is essential for sustaining manufacturing and commercial activities thus contributing to maintaining and increasing employment.

**Transport (C2)**

The development of the proposed power plant during the construction phase of the project is likely to place increasing pressure on the dual carriage way under construction in the study area. This will be alleviated during the operational phase when the volumes of traffic will be reduced due to the absence of construction vehicles and equipment. During the operational phase there will be a minor adverse cumulative impact on the dual carriage way arising from the delivery of heavy fuel oil via tank-trucks to the power plant.

**Visual impacts (C3)**

The construction and operational phases of the power plant are likely to result in slight visual impacts within the local area. The area is zoned for industrial use and is beginning to mushroom with developments such as a ceramic tile and hardware center and two existing steel manufacturing plants. Due to the size of the emission stacks, power house and heavy fuel oil storage tanks, commuters on the Nairobi – Mombasa highway will notice the addition of the power plant to the disturbed landscape. This may have a slight negative impact.

13.5 Summary of impacts

Table 2 summarizes the significance of each identified impact as calculated in Section 13.3.
Table 1: Summary of significance of each identified impact

<table>
<thead>
<tr>
<th>Impact</th>
<th>Code</th>
<th>Significance rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Without mitigation</td>
</tr>
<tr>
<td>Geology and Soils (GS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction of natural resources for construction</td>
<td>Low-medium (-)</td>
<td>Low (-)</td>
</tr>
<tr>
<td>Soil erosion</td>
<td>Low (-)</td>
<td>Very-low (-)</td>
</tr>
<tr>
<td>Surface water (SW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on water quality</td>
<td>Low (-)</td>
<td>Very-low (-)</td>
</tr>
<tr>
<td>Groundwater (GW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution of groundwater</td>
<td>Low (-)</td>
<td>Very-low (-)</td>
</tr>
<tr>
<td>Soils (S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contamination of soils</td>
<td>Low (-)</td>
<td>Very-low (-)</td>
</tr>
<tr>
<td>Ecology (E)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impacts on terrestrial ecology</td>
<td>Low (-)</td>
<td>Very-low (-)</td>
</tr>
<tr>
<td>Air quality (AQ)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased air quality due to dust and VOCs</td>
<td>Low (-)</td>
<td>Very-low (-)</td>
</tr>
</tbody>
</table>
## Impact and Significance Rating

<table>
<thead>
<tr>
<th>Impact</th>
<th>Code</th>
<th>Significance rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Construction</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td></td>
<td>mitigation</td>
<td>mitigation</td>
</tr>
<tr>
<td>Decreased air quality due to stack emissions</td>
<td>Medium-high</td>
<td>Low</td>
</tr>
<tr>
<td>Waste (W)</td>
<td>Low-medium</td>
<td>Very-low</td>
</tr>
<tr>
<td>Pollution from waste generation</td>
<td>(-)</td>
<td>(-)</td>
</tr>
<tr>
<td>Noise and vibration (N)</td>
<td>Low</td>
<td>Very-low</td>
</tr>
<tr>
<td>Noise during construction</td>
<td>Low (-)</td>
<td>Very-low (-)</td>
</tr>
<tr>
<td>Noise during operation</td>
<td>Medium-high</td>
<td>Low</td>
</tr>
<tr>
<td>Noise during decommissioning</td>
<td>Low (-)</td>
<td>Very-low (-)</td>
</tr>
<tr>
<td>Visual impacts (V)</td>
<td>Medium-high</td>
<td>Low</td>
</tr>
<tr>
<td>Impacts on visual landscape</td>
<td>(-)</td>
<td>(-)</td>
</tr>
<tr>
<td>Macroeconomic (M)</td>
<td>Low-medium (+)</td>
<td>Medium-high (+)</td>
</tr>
<tr>
<td>National economic development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stability of electric power supply</td>
<td>Low-medium (+)</td>
<td>High (+)</td>
</tr>
<tr>
<td>Socio-economic (S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact</td>
<td>Code</td>
<td>Significance rating</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-----------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td></td>
<td>mitigation</td>
<td>mitigation</td>
</tr>
<tr>
<td>Compatibility with existing and proposed land use</td>
<td>Low-medium</td>
<td>Low</td>
</tr>
<tr>
<td>Increased crime</td>
<td>Low-medium</td>
<td>Low</td>
</tr>
<tr>
<td>Creation of employment opportunities</td>
<td>Low (+)</td>
<td>Low-medium (+)</td>
</tr>
<tr>
<td>Increased risk of communicable diseases</td>
<td>Low (-)</td>
<td>Low</td>
</tr>
<tr>
<td>Social divisions over limited jobs</td>
<td>Low (-)</td>
<td>Low</td>
</tr>
<tr>
<td>Accidents as a result of increased traffic</td>
<td>Low-medium (-)</td>
<td>Low</td>
</tr>
<tr>
<td>Traffic (T)</td>
<td>Damage to roads and other infrastructure</td>
<td>Low (-)</td>
</tr>
<tr>
<td></td>
<td>Increased traffic and road safety hazards</td>
<td>Low-medium (-)</td>
</tr>
<tr>
<td>Health and safety (HS)</td>
<td>Occupational health and safety</td>
<td>Low-medium (-)</td>
</tr>
</tbody>
</table>
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14.1 Introduction

The purpose of the ESIMP is to ensure that social and environmental impacts, risks and liabilities identified during the ESIA process are effectively managed during the construction, operation and closure of the proposed project. The ESIMP specifies the mitigation and management measures to which the Proponent is committed and shows how the Project will mobilize organizational capacity and resources to implement these measures. The ESIMP also shows how mitigation and management measures will be scheduled.

The key objectives of the ESIMP are to:

- Formalize and disclose the program for environmental and social management; and
- Provide a framework for the implementation of environmental and social management initiatives.

Best practice principles require that every reasonable effort is made to reduce and preferably to prevent negative impacts while enhancing the benefits. These principles have guided the EIA process. In many cases, potential negative impacts have been avoided through careful design and location of facilities.

The ESIA involved concurrent and ongoing data collection and public consultation activities to date.

14.2 Environment and Social Impact Management Plan (ESIMP)

Work underpinning the ESIMP has complied with L.N. 101: EIA/EA Regulations 2003 and IFC Performance Standards and includes the following:

- A public participation process;
- Acquiring the NEMA’s approval on a terms of reference for the ESIA Study based on the issues scoped therein; and
- An ESIA report of the proposed Project, including specialist reports, that aims to:
  - List potential impacts and risks associated with the proposed Project;
  - Identification of mitigation measures relating to the potential negative environmental and social impacts identified during the ESIA process; and
  - Formulation of the ESIMP against the negative impacts.

The ESIMP covers information on the management and/or mitigation measures that will be taken into consideration to address impacts with respect to:

- Planning and design;
• Pre-construction and construction activities;
• Operation; and
• Closure, where relevant.

Given below is a description of the mitigation measures to be applied in the project phases described above.

14.2.1 Planning and design

Planning and design is necessary to ensure that mitigation and impact management can be effectively implemented in the context of relevant HSE policies. Planning involves the following activities:

• Identifying and defining the various environmental aspects and related potential positive and negative impacts that can result from the power plant’s activities;
• Establishing a procedure to identify legal and other requirements to which the organization is subject;
• Identifying and defining appropriate mitigation and management measures, including those reinforcing positive impacts; and
• Establishing and maintaining documented, scheduled environmental objectives and targets at each relevant function and level within the organization.

Environmental aspects and potential impacts will mainly emanate from the following project-related activities:

• Construction of the 84MW thermal power plant which includes:
  o 10 x 20V32 Wärtsilä generating sets;
  o Waste heat Recovery system;
  o Medium Voltage switch Gear;
  o Step up transformers 11/66 KV;
  o High Voltage switch Gear;
  o Transportation and delivery to site of the above components;
  o Civil and structures works;
  o Installation activities;
  o Commissioning and start up; and
  o Testing.
• Construction of an access road from the main Mombasa – Nairobi highway to the project site.
Section 13 described and rated potential environmental impacts in terms of their potential significance. The management measures presented in this ESIMP have been developed in response to these impacts. Performance standards providing a robust measure of the effectiveness of the defined mitigation are defined as part of the project monitoring (See Section 14.7).

There is clear division of responsibility between the design team responsible for the planning of the proposed power plant and the construction team responsible for building it. The most important factors influencing the design of the proposed power plant have been considered over several years by the international community and many countries have local design standards according to which thermal power plants must be built.

The key anticipated environmental impact and/or benefits which could arise with mitigation during preconstruction and construction, operation and closure of the proposed project include the following:

- Impact on flow of surface water;
- Air pollution from the stack emissions;
- Noise and vibration emanating from the gensets;
- Creation of employment opportunities;
- Accidents as a result of increased traffic;
- Compatibility with existing and proposed land uses.

### 14.2.2 Pre-construction and construction

The ESIMP will put in place measures to avoid and mitigate impacts and optimize benefits arising from activities during the preconstruction phase (e.g. establishment of access roads, construction camp and clearing of the construction site) and the construction phase (e.g. installation of gensets, auxiliaries, etc.) of the project. The construction process is detailed in Section 5. The principal focus of project management for pre-construction and construction will include: personnel and contractor management and training; conduct and site management; maintenance of complaints register; emergency preparedness; and management and mitigation of impacts such as noise, dust, safety and pollution. The programs and plans relating to these management measures are presented in Sections 14.4 and 14.5 respectively.

Assignment of responsibility and sub-contractor management by the EPC contractor is especially important during the construction phase, when subcontractors will be building the power plant. Contractors may also be used on an ongoing basis for a range of maintenance and other functions during the operational phase. Contractors will be held to the highest HSE performance requirements to ensure they meet national and international standards.
14.2.3 Operation

The proposed power plant will involve the generation of electric power for evacuation to the national grid by the KP&LC. The heavy fuel oil required to run the gensets will be transshipped from Mombasa by road to the power plant.

The above operational controls require that a responsible party, a budget and an implementation schedule are specified and allocated to further enable and facilitate implementation.

During the operational phase of implementing the ESIMP, specific roles and responsibilities must be assigned. These roles include dedicated HSE management roles and responsibilities of all company personnel.

14.2.4 Checking and corrective action

Checking and if necessary, implementing corrective actions form the fourth component of the ESIMP management cycle. They ensure that:

- The required ESIMP management activities are being implemented; and
- The desired outcomes are being achieved.

As such this component includes four key activities as follows:

- Monitoring selected environmental quality variables as defined in the objectives and targets;
- Ongoing inspections of the operational controls and general state of the operations;
- Internal audits to assess the robustness of the ESIMP or to focus on a particular performance issue; and
- External audits to provide independent verification of the efficacy of the ESIMP.

14.2.5 Construction phase HSE inspections

Section 8 of the ESIA Study discusses the management of HSE during the construction phase of the project. As part of this process, an ongoing and pragmatic HSE inspection program will be implemented to ensure that potential HSE transgressions can be identified proactively and mitigation measures implemented.

14.2.6 Internal and external audits

Where the monitoring data and the inspection reports highlight problems, an internal audit can be used to ascertain the source of the problem and to define action to prevent its recurrence. The three key areas for audit are facilities (are they operating properly?), project procedures (are they properly designed and implemented?) and finally, and perhaps most importantly Contractor’s HSE performance.
International lending institutions and commercial banks may have their own requirements for external, independent monitoring verification, as well as regular audits of the EMP implementation.

14.2.7 Corrective Action

There are several mechanisms for implementing corrective action, both during the construction and operational phases. The main mechanisms to address transgressions include verbal instruction (in the event of minor transgressions from established procedure, usually following a site inspection); written instruction (identifying source/s of problems, usually following an audit) and contract notice (following possible breach of contract).

14.2.8 Reporting

The findings of all of the above will be structured into instructive reporting that provides information to all required parties on HSE performance, together with clearly defined corrective action where this is seen to be required. Both the monitoring and inspections are reported on continuously. Within the reporting structure it is necessary to create a review function that continuously assesses the reporting and prescribes any necessary corrective action. Reporting will include the provision of information on the HSE performance to external stakeholders and surrounding communities.

14.2.9 Management Review

The final component of the EMP management cycle is a formal management review that takes place at defined intervals, both during the construction and operational phases. The purpose of the management review is for senior project management to review the environmental management performance during the preceding period and to propose measures for improving that performance in the spirit of continuous improvement.

14.3 Impact Mitigation and Management

Table 14-1 indicates the EMP for the proposed project. The management/mitigation table is clustered according to aspect (for example water quality). Table 14-1 also presents a schedule for the implementation of management/mitigation activities, sub-divided by project phase.
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact</th>
<th>Mitigation Measure</th>
<th>Schedule</th>
<th>Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology and topography</td>
<td>Soil compaction</td>
<td>In order to prevent irreversible construction compaction effects arising from construction plant and equipment, ensure that to the extent possible, construction is undertaken during dry periods. On completion, all non-built up areas should be landscaped.</td>
<td></td>
<td>• Planning and design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Rehabilitation and closure plan</td>
</tr>
<tr>
<td></td>
<td>Soil erosion</td>
<td>To prevent soil erosion, all non-built up areas should be landscaped and appropriate soil binding grass planted.</td>
<td></td>
<td>• Planning and design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Rehabilitation and closure plan</td>
</tr>
<tr>
<td>Surface water</td>
<td>Impact on flow</td>
<td>If possible undertake initial construction activities during the dry season to prevent water/soil run-off especially on side slopes. Water should also be diverted away from the project footprint areas through properly constructed drainage channels</td>
<td></td>
<td>• Planning and design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Construction management plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Construction control plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Rehabilitation and closure plan</td>
</tr>
<tr>
<td>Impact on water quality</td>
<td></td>
<td>Ensure that spills emanating from construction plant and equipment are cleaned immediately. Any petroleum products stored on site must be stored in bunded areas to prevent contamination of surface water. Contractor to adhere to Construction HSE management plan during the construction phase.</td>
<td></td>
<td>• Planning and design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Construction management plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Construction control plan</td>
</tr>
</tbody>
</table>
**Aspect** | **Impact** | **Mitigation Measure** | **Schedule** | **Management Plan**
--- | --- | --- | --- | ---
Ecology | Impacts on terrestrial ecology | Set up measures to ensure that during preconstruction and construction, impacts on sensitive ecological areas and individual protected biota are minimized and that good management is exercised during operation so as to prevent ecological impacts | Pre-con | Op | Cl | • Construction management plan  
• Construction control plan  
• Rehabilitation and closure plan
Air quality | Decreased air quality due to dust and VOC emissions | Develop and implement effective measures for minimization of dust during the preconstruction and construction phase, followed by rehabilitation in a timely manner. Contractor to ensure that construction plant and equipment is in a good state of repair at all times to prevent adverse exhaust air emissions. | Pre-con | Op | Cl | • Air quality management program
Air quality | Decreased air quality due to stack emissions | Set up an air quality monitoring station about 10km east of the project site to monitor ambient air quality ($SO_x$, $NO_x$, $PM_{10}$, $PM_{2.5}$, etc.). The results of the air quality should be checked against national air quality standards for compliance and in the absence of these, with the WHO air quality guidelines. | Pre-con | Op | Cl | • Air quality management program
Waste | Pollution from waste generation | Develop and implement safe procedures for management of non-hazardous and hazardous wastes in accordance with L.N. 121: Waste Management Regulations, 2006. Contractor is responsible for this during the construction phase and the Proponent during the | Pre-con | Op | Cl | • Waste management plan
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact</th>
<th>Mitigation Measure</th>
<th>Schedule</th>
<th>Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise and vibration</td>
<td>Noise during construction</td>
<td>Contractor’s plant and equipment should comply as a minimum with requirements of L.N. 25: Noise Prevention and Control Rules, 2005.</td>
<td>Pre-con</td>
<td>Noise management program</td>
</tr>
<tr>
<td></td>
<td>Noise during operation</td>
<td>The power plant will be designed to maintain noise levels at 70 dB(A) at the fence line. The Proponent will develop, rollout and implement a written hearing conservation program for those employees that may be exposed to noise environments exceeding 90 dB(A) over an 8-hour time weighted average period or 85 dB(A) continuous noise. This is in accordance with L.N. 25: Noise Prevention and Control Rules 2005.</td>
<td>Con</td>
<td>Noise management program</td>
</tr>
<tr>
<td>Socio-economics</td>
<td>Compatibility with existing and proposed land uses</td>
<td>The Proponent should create public awareness about “safe” land uses of any future projects in the vicinity of the proposed project area</td>
<td>Op</td>
<td>Community safety plan</td>
</tr>
<tr>
<td></td>
<td>Increased crime and in-migration</td>
<td>Implement measures to manage expectations about job creation during the preconstruction, construction and operational phases. Develop and put into practice strategies to minimize crime, to include effective communication with landowners to inform them about the movement of work teams, and codes of conduct for contractors and employees.</td>
<td>Cl</td>
<td>Land acquisition and compensation plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Community safety plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Labor and human resource plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Soil conservation management program</td>
</tr>
</tbody>
</table>

operational phase of the project.
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact</th>
<th>Mitigation Measure</th>
<th>Schedule</th>
<th>Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pre-con</td>
<td>Con</td>
</tr>
<tr>
<td>Creation of employment opportunities</td>
<td>Implement where feasible measures to employ local community members during both the preconstruction and construction phase, as well as the operational phase.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased risk of disease with influx of workers and opportunity seekers</td>
<td>Ensure effective communication with communities to limit expectations of employment creation. Develop and implement a HSE program for employees.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social divisions over limited jobs and perceived preferential access</td>
<td>Develop and implement transparent employment and procurement measures which comply with the regulatory framework and maximize local benefits.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accidents as a result of increased traffic</td>
<td>Implement measures to ensure that traffic and road safety hazards are minimized during the preconstruction, construction and operational phases.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic</td>
<td>Damage to roads and other transport infrastructure</td>
<td>Develop and implement measures to repair regularly used roads to the project site especially the turn-off to the project site from the Nairobi – Mombasa highway. Ensure that contractor vehicles comply with axle load limits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased traffic and road safety hazard</td>
<td>Develop and implement a traffic management plan to take advantage of off-peak hours for delivery of construction materials and abnormal loads during the construction phase.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspect</td>
<td>Impact</td>
<td>Mitigation Measure</td>
<td>Schedule</td>
<td>Management Plan</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
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<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contractor drivers should possess defensive driving skills gotten from a reputable training consultancy.</td>
<td>Con</td>
<td>• Contractor health and safety program</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cl</td>
<td>• Social responsibility plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Community safety plan</td>
</tr>
</tbody>
</table>

Pre-con: Pre-construction phase
Con: Construction phase
Op: Operational phase
Cl: Closure
### 14.4 Estimated cost of mitigation measures and EMP

The following table provides the cost of implementing the mitigation measures and management plan associated with the proposed project. The costs have been estimated on the basis of zero based accounting and may change during the actual pre-construction, construction, operational and closure phases of the project.

**Table 14-2: Estimated cost of mitigation measures and EMP**

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact and mitigation measure</th>
<th>Schedule</th>
<th>Cost estimate (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMP Supervision costs</td>
<td>Costs incurred for supervising the pre-construction, construction (12 months) and operational phases (20 years) respectively</td>
<td></td>
<td>297,000(^1) (Opex)</td>
</tr>
<tr>
<td>Independent environmental monitoring</td>
<td>Monitoring of environmental parameters (air quality-6 monthly, noise quality-annual, effluent quality-quarterly, etc.)</td>
<td></td>
<td>6,000(^2) per annum (Opex)(^3)</td>
</tr>
<tr>
<td>Geology and topography</td>
<td>Soil compaction: all non-built up areas will be landscaped on completion of the construction phase</td>
<td></td>
<td>3,000 (Construction cost)(^4)</td>
</tr>
<tr>
<td></td>
<td>Soil erosion: all non-built up areas will be landscaped on completion of the construction phase</td>
<td></td>
<td>3,000 (Construction cost)</td>
</tr>
</tbody>
</table>

---

\(^1\) Cost includes a full-time HSE Officer based at the site (1 year-construction phase and 20 years-operational phase)

\(^2\) Includes cost of independent sampling and analysis of various environmental parameters

\(^3\) Opex costs are expected to occur over the lifetime of the project which is estimated to be 20 years

\(^4\) Construction costs are one-off costs estimated to occur during the construction phase
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact and mitigation measure</th>
<th>Schedule</th>
<th>Cost estimate (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface water</td>
<td>Impact on flow: drainage channels will be constructed to divert water away from project footprint areas</td>
<td>Con</td>
<td>10,000 (Construction cost)</td>
</tr>
<tr>
<td></td>
<td>Impact on water quality: any petroleum products stored at the project site will be kept in bunded areas</td>
<td>Con</td>
<td>12,000 (Construction cost)</td>
</tr>
<tr>
<td>Ecology</td>
<td>Impacts on terrestrial ecology</td>
<td>Op</td>
<td>10,000 (Opex)</td>
</tr>
<tr>
<td>Air quality</td>
<td>Decreased air quality due to dust and VOC emissions: site watering costs to suppress dust emissions</td>
<td>Con</td>
<td>1,000 (Construction cost)</td>
</tr>
<tr>
<td></td>
<td>Decreased air quality due to stack emissions</td>
<td>Op</td>
<td>Covered under independent environmental monitoring above</td>
</tr>
<tr>
<td>Waste</td>
<td>Pollution from waste generation</td>
<td>Con</td>
<td>4,000 (Construction cost) and 1,500 per month (Opex)</td>
</tr>
<tr>
<td>Noise and vibration</td>
<td>Noise during construction</td>
<td>Con</td>
<td>Covered under independent environmental monitoring above</td>
</tr>
<tr>
<td></td>
<td>Noise during operation</td>
<td>Op</td>
<td>Covered under independent environmental monitoring above</td>
</tr>
<tr>
<td>Aspect</td>
<td>Impact and mitigation measure</td>
<td>Schedule</td>
<td>Cost estimate (US$)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Socio-economic environment</td>
<td>Compatibility with existing and proposed land uses</td>
<td></td>
<td>36,000(^5)</td>
</tr>
<tr>
<td></td>
<td>Proponent’s corporate social responsibility program</td>
<td></td>
<td>200,000</td>
</tr>
<tr>
<td></td>
<td>Increased crime and migration: provision of private security during the pre-construction,</td>
<td></td>
<td>15,000 (Construction cost)</td>
</tr>
<tr>
<td></td>
<td>construction and operational phases of the project respectively</td>
<td></td>
<td>300,000 (Opex)</td>
</tr>
<tr>
<td></td>
<td>Creation of employment opportunities: a Community Liaison Officer to be hired during the</td>
<td></td>
<td>To be determined in accordance with Kenyan labor laws during construction and operational phases of the project</td>
</tr>
<tr>
<td></td>
<td>pre-construction, construction and operational phases of the project</td>
<td></td>
<td>240,000 (Opex)</td>
</tr>
<tr>
<td></td>
<td>Increased risk of disease with influx of workers and opportunity seekers</td>
<td></td>
<td>Costs of community liaison officer covered under creation of employment opportunities</td>
</tr>
</tbody>
</table>

\(^5\) Costs associated with public awareness to be created by the Proponent over the lifetime of the project about adjacent land use.
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact and mitigation measure</th>
<th>Schedule</th>
<th>Cost estimate (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Social divisions over limited jobs and perceived preferential access: Implementation of Proponent’s HR Policy Manual by EPC Contractor</td>
<td></td>
<td>To be determined in accordance with Kenyan labor laws during construction phase of the project</td>
</tr>
<tr>
<td></td>
<td>Accidents as a result of increased traffic</td>
<td></td>
<td>30,000 (Construction cost)</td>
</tr>
<tr>
<td>Traffic</td>
<td>Damage to roads and other transport infrastructure: includes costs of repairing used roads</td>
<td></td>
<td>50,000 (Construction cost)</td>
</tr>
<tr>
<td></td>
<td>Increased traffic and road safety hazards</td>
<td></td>
<td>10,000 (Construction cost)</td>
</tr>
<tr>
<td>Health and safety</td>
<td>Occupational health and safety</td>
<td></td>
<td>100,000 per year (Opex)</td>
</tr>
</tbody>
</table>
14.5 Management programs

14.5.1 Rationale

The majority of mitigation measures outlined in Table 14-1 cannot be implemented as discrete, isolated actions, since there are spatial, temporal and causal interactions amongst impacts. Therefore it is advisable to implement mitigation and management actions via integrated management programs. These programs are outlined below. While generally the programs have been divided into preconstruction and construction, operational and closure phase programs, some of them start during construction and continue into closure, such as soil conservation management, air quality, noise quality and water management.

During the preconstruction and construction phase there will be several specific environmental and social impacts which pose various risks. A more detailed construction HSE management program, including contract specifications that apply specifically to construction activities, will be developed during the detailed design phase.

The management programs, principles and key measures which are detailed below, will include:

- Soil conservation management program;
- Water quality management program;
- Air quality management program;
- Conservation of natural habitats program; and
- Noise management program.

The implementation of the EMP is also linked to a series of comprehensive management plans. These are typically substantial initiatives that will be in place for the life of the activity (and in some cases beyond). The management plans are presented in Section 14.5. Management and mitigation measures should adhere to legislative requirements. Where no legal guidance is provided, industry and/or international good practice should be applied as far as is practicable.

14.5.2 Soil conservation management program

This program aims to ensure that soil is conserved for rehabilitation through project construction, operation and closure. The program will include the following requirement:

- The minimum area required for infrastructure construction shall be cleared of vegetation.
- Measures shall be taken to ensure that topsoil and subsoil excavated from the construction site is properly managed. These measures are contained in the construction control plan in Section 14.5.3.
A minimum amount of storm water will be allowed to flow on to the site, and control measures to meet industry norms and standards will be implemented to ensure that storm water damage is avoided and minimized.

Topsoil shall not be disturbed more than is absolutely necessary on the construction site, and where possible should be appropriately stock-piled, such as in the form of a berm to minimize visual impacts. The stockpiled soil can then be reused following closure of the site for rehabilitation purposes.

Denuded areas shall be surfaced as soon as feasible after construction, where clearing or use has been temporarily used for construction.

At closure, the site shall be restored to a suitable land use capability.

14.5.3 Water management program

This program aims to ensure that surface water quality is conserved through preconstruction, construction, operation and closure phases. The surface water management program includes the following:

- Measures shall be instituted to minimize erosion and sediment transport, especially during preconstruction and construction activities. These measures should include: limiting areas cleared of vegetation, the avoidance of clearing during the wet season and the re-vegetation of cleared areas as soon as is feasible. If construction occurs during the wet season, erosion control measures must be used on sloping ground to prevent the development of rills and gullies.

- Remedial measures shall be implemented by the Contractor in the event of erosion resulting in the sedimentation of surrounding areas after due consideration of the costs and benefits of such removal activity.

- Infrastructure shall be designed to ensure that contaminated run-off does not reach watercourses.

- A surface monitoring system, including flows and water quality, shall be established and implemented for the duration of the operation of the power plant. These must comply as a minimum with L.N. 120: Water Quality Regulations, 2006.

**Effluent management**

Provision shall be made for suitable sewage facilities for construction workers and permanent personnel. It is anticipated that an onsite ablation sewerage system will be installed where suitable municipal connections cannot be provided.
14.5.4 Air quality management program

This program aims to ensure that air quality is maintained through preconstruction and construction. The air quality management program includes the following:

**Dust management**

- Areas cleared of vegetation during construction shall be minimized as the primary defense against dust generation. Refer to measures in the construction control plan.
- Dust abatement measures shall be implemented to control dust generated by construction activities. Refer to the construction control plan and construction management plan.
- Cleaning of the construction site and rehabilitation of unsurfaced areas will take place as soon as possible following the installation of infrastructure. Refer to measures in the construction control plan.
- A complaints register and protocol will be drawn up as a means for surrounding landowners, residents and public residents to voice their issues and concerns, particularly those relating to the nuisance effects of dust and noise (See communication and information program). The register will be set up prior to the commencement of construction activities (See communication and information program). These public complaints should be responded to as a matter of urgency and where possible, measures taken to minimize the cause of dust and noise.

**Emissions**

- The Contractor shall ensure the fitment of appropriate components and equipment to prevent fugitive emissions, as per national standards or international practices. The contractor shall ensure the regular maintenance of this equipment.
- A vehicle maintenance plan shall be implemented to prevent excessive emissions. This is pertinent during the construction phase of the project for contractors.

14.5.5 Conservation of natural habitats program

This program aims to ensure that damage of natural habitats is avoided, minimized and mitigated during the construction phase. Wherever possible, the project site shall be designed to minimize impacts on natural habitat, in particular the aquatic/riparian environment. Any regulatory requirements relating to wetland/riparian habitat shall be complied with.

- Measures shall be implemented as part of the construction management plan and construction control plan to avoid and/or minimize the construction footprint for the proposed project/haul roads and access routes, lay-down areas, borrow areas, campsites etc.
• The Contractor shall take measures to rehabilitate the construction site following the completion of proposed project and establishment of associated infrastructure.

14.5.6 Noise management program

This program aims to ensure that noise generated by construction and operation activities is kept to a minimum and adheres to relevant noise standards. The noise management program includes the following:

• The Contractor shall ensure that construction activities are limited to working hours (i.e. between 06:00hrs and 19:00hrs daily) from Monday to Saturday, or as required in terms of legislation and/or negotiated with local landowners. Campsite/s if required will be placed at a distance from neighboring landowners and residents so as to minimize disturbance.

• Noise generating equipment will be designed to control and dampen noise emissions, and will be located at a distance far enough from the nearest noise sensitive development, to ensure that the increase in ambient noise level will comply with ISO standards.

• Landowners, residents and public shall be able to register their complaint / concern about noise through a complaints register set up prior to the commencement of construction activities (See communication and information program). These public complaints should be responded to as a matter of urgency and where possible measures must be taken to minimize the noise.

14.6 Management plans

14.6.1 Overview

The following management plans need to be implemented during construction, operation, decommissioning and closure of the proposed project:

• Construction management plan.
• Construction control plan.
• Labor and human resources plan.
• Workplace health and safety plan.
• Community safety plan.
• Land acquisition and compensation plan.
• Emergency management and response plan.
• Social responsibility plan.
• Rehabilitation and closure management plan.
A number of the issues to be addressed in these plans are regulated in existing laws, regulations and guidelines. In addition, it is recognized that the content of several plans will be generic, in the sense that existing procedures are documented in standard codes of practice, and that adaptations of such generic plans will only be possible as a dynamic process during construction and operation. Plans presented below, therefore, contain specific actions as well as undertakings to prepare additional plans as required prior to the commencement of certain activities during the detailed design phase. The Proponent recognizes the need for ongoing development and revision of all plans to ensure their continued applicability.

14.6.2 Construction management plan

The construction management plan to be implemented by the Contractor shall include the following key measures:

14.6.3 Management of construction campsites

1. The Contractor shall comply with all relevant laws and regulations concerning water provision, sanitation, wastewater discharge and solid waste disposal.

2. The Contractor shall not locate the campsite/s in any area in which vegetation is pristine, nor within 100m of any watercourse, nor in any area that could cause nuisance or safety hazards to surrounding landowners, inhabitants or the general public. The location of a construction campsite requires prior landowner agreement.

3. Prior to the commencement of construction, the Contractor shall also prepare documentation for the construction campsite which will contain, but is not limited to, details of: (a) site layout; (b) topsoil management; (c) sewage treatment; (d) solid waste disposal; (e) erosion control (f) fencing; (g) litter management; (h) provision for vehicle and plant servicing; (i) management of hazardous materials, (j) water supply, (k) management of fire risk (l) rehabilitation; and (m)security. The documentation shall be submitted to the Proponent as a part of the Contractor’s project specific Environmental Plan prior to establishment on site.

4. The Contractor shall keep the construction campsite clean and tidy at all times. The Contractor shall not leave domestic waste uncontained, and temporary storage shall be fenced to keep out people and animals. No permanent domestic waste disposal shall be permitted at the campsite. All domestic refuse is to be removed weekly to an existing licensed domestic landfill.

5. The Contractor shall take specific measures to prevent the spread of fires, caused by activities at the campsite. These measures may include appropriate instruction of employees about fire risks and the construction of firebreaks around the site perimeter.

6. The Contractor shall prevent accelerated erosion from the construction campsite and shall not discharge polluted runoff into drainage lines (See soil conservation and water management programs).
Management of fuels and other hazardous materials

8. The Contractor shall comply with all applicable laws, regulations, permit and approval conditions and requirements relevant to the storage, use, and proper disposal of hazardous materials.

9. The Contractor shall manage all hazardous materials and wastes in a safe and responsible manner, and shall prevent contamination of soils, pollution of water and/or harm to people or animals as a result of the use of these materials.

10. The Contractor shall prepare a hazardous materials and waste management plan for inclusion in the site specific Environmental Plan to be submitted to the Proponent prior to establishment on site. This plan shall include but not be limited to measures to prevent: (a) contamination of soils; (b) pollution of water; (c) safe siting and storage; (d) containment of lubricants and waste oil during maintenance of vehicles; and (e) tampering with tanks.

11. The Contractor shall manage all hazardous materials to be used on site according to L.N. 121: Waste Management Regulations, 2006 under the EMCA and shall ensure that the handling, storage, transport and disposal of these materials meet the requirements of these regulations.

12. The Contractor shall not locate any fixed fuel storage tanks in any location other than at the approved plant yard or campsite. Any fuel storage facilities with a capacity greater than 1000 liters shall be located on flat or gently sloping ground and shall be bermed from the surrounding area to contain at least 110% of the total capacity of the storage containers. The berms and the floor of the bermed area shall be of impermeable material or be lined to ensure that petroleum products cannot escape.

13. The Contractor shall not construct fixed fuel storage, or otherwise service or refuel any vehicle or equipment within 100 m of a watercourse or wetland, within a floodplain, or where there is the potential for spilled fuel to enter a watercourse or groundwater (See water quality management program). Should it not be possible to establish such a facility outside of the 100m zone, the Contractor shall ensure that the necessary precautions are taken to prevent and clean up spillages, including spill kits on the bowsers.

14. The Contractor shall enclose all fixed storage by a security fence with a lockable gate.

15. The Contractor shall place on-site tools and equipment, such as pumps, compressors and generators on bermed impermeable sheeting (e.g. polyethylene or other similar material) to prevent hydraulic fluid or fuel leaks from contaminating soil or groundwater or entering any watercourse or wetland.

16. The Contractor shall take all reasonable precautions to prevent fuel and lubricant spills during the course of construction. To this end, the Contractor shall ensure that: (a) there is no overfilling of diesel bowsers and equipment tanks; (b) regular audits are performed to verify that no leaking or defective equipment is brought onto site; and (c) any oils or lubricants discharged during routine vehicle servicing on site are captured using drip trays, containers or other appropriate containment measures.
17. The Contractor shall ensure that fuelling and repairs are carried out or supervised by personnel familiar with spill containment and cleanup procedures.

18. The Contractor shall ensure that there is sufficient absorbent material available on site to manage accidental spills. The Contractor shall immediately clean up accidental spillages of fuels and oils, or other hazardous substances, and shall report the incident to the Proponent and the measures taken to remediate the spill problem.

Management of the construction site

20. The Contractor shall prevent littering and the random discard of any solid waste on or around the construction site.

21. The Contractor shall manage hazardous waste.

22. The Contractor shall minimize the risk of bush fires.

23. The entire construction site will be hoarded with appropriate fencing.

24. The Contractor shall prevent trespassing on the construction area. Public entry to the area shall be prohibited and signs to this effect shall be erected at points of potential public entry.

25. The Contractor shall ensure that contract employees remain within the construction area and do not trespass on to neighboring land.

26. The Contractor shall determine safe travelling speeds for the construction site and access roads and shall ensure that these restrictions are enforced. This may include, but not be limited to, the monitoring of vehicle speeds and the erection of speed limit signs.

Emergency preparedness

27. The Contractor shall develop an emergency plan that will enable rapid and effective response to all types of environmental emergencies in accordance with recognized national and international standards.

28. The emergency plan shall include the establishment of a network of communication between the Contractor and emergency services including the police, traffic police, local medical and ambulance services, fire departments, etc.

29. The Contractor shall test emergency preparedness with drill operations and shall review drills, conduct mock emergencies and remedy shortcomings to ensure a high level of emergency readiness to deal with environmental and third party incidents.

Fire prevention and management

30. The Contractor shall take all necessary precautions to prevent the ignition of bush fires caused either deliberately or accidentally as a result of the work being performed.

31. The Contractor shall prepare a fire safety policy in accordance with the relevant requirements of L.N. 59: Fire Risk Reduction Rules, 2007.
32. The Contractor shall prepare a fire prevention and fire emergency management plan as a part of the Environmental Plan to be submitted to the Proponent prior to establishment on site. The plan shall include, but not be limited to, the following: (a) sources of fire risk; (b) measures to comply with any requirements of local authority fire departments; (c) measures to meet requirements agreed between the Proponent and the surrounding landowners; (e) measures to minimize the risk of accidental fires caused by any activity related to the work; and (f) measures to control an accidental fire.

33. The Contractor shall provide adequate firefighting equipment at specified localities on the work site to meet any emergency resulting from ignition of a fire. This equipment should as applicable include but not be limited to (a) fire extinguishers; and (b) fire resistant clothing for fire fighters.

34. The Contractor will ensure that hot work is prohibited under specified meteorological conditions with high fire risk and that appropriate and adequate firefighting equipment would be required to be on standby at all times where hot work is being carried out.

35. Wherever practicable, bush shall not be cleared using burning. In instances where this is not possible, controlled burning can only take place upon request of and approval from the surrounding landowner, when there is no wind and appropriate firefighting measures are in place.

Management of dust and noise nuisance

35. The Contractor shall control dust within the construction site and the access road leading to it from the main highway to ensure that no detrimental effects to landowners, occupants or the general public are caused. Control measures to be considered include the use of water bowser to wet down surfaces that have been denuded and which have the potential to generate dust (See air quality program).

36. The Contractor shall comply with the legal requirements for the management of noise impacts as specified in L.N. 25: Noise Prevention and Control Rules, 2005. If instructed to do so by the Proponent, the Contractor shall demonstrate compliance with the noise regulations by means of measurement of residual noise levels at receiver points specified by the Proponent. Measurement shall be in accordance with the requirements of the noise regulations.

Surrounding land owner and occupier relations

38. The Contractor shall respect the property and rights of surrounding landowners and occupiers at all times and shall treat all such persons with deliberate courtesy.

39. Access over land, the integrity of fences, the closure of gates, control of littering, dust control, noise abatement, sedimentation and contamination of ground and surface waters, damage to landscape and vegetation, and all such environmental matters shall be controlled as far as practicable, by the Contractor in the best interests of the land owner or occupier.
Complaints register

41. The Contractor shall establish and maintain a register for periodic review by the Proponent that logs all complaints raised by landowners, occupiers or the general public about construction activities. The register shall be regularly updated and maintain records, including the name of the complainant, his or her domicile and contact details, the nature of the complaint and if any action that was taken to rectify the problem.

Health management

42. The Contractor shall comply with all relevant legislative requirements governing worker health and safety (e.g. OSHA, WIBA, Public Health Act, etc. and their respective subsidiary regulations).

The Contractor shall also prepare and implement a program to minimize the spread of HIV infection as a result of the construction contract. The program shall be prepared with the assistance of a medical doctor with experience of HIV prevention and treatment.

14.6.4 Construction control management plan

The construction control management plan to be implemented by the Contractor shall include the following key measures:

Control of access

1. The Contractor shall strictly control access to the construction site for security and public safety reasons.

Control of topsoil and subsoil

2. The Contractor shall store topsoil (defined as the soil above 150 mm) excavated from the site in a windrow or stockpile which shall be discernibly separate from windrows or stockpiles of any other excavated materials.

3. Topsoil shall not be contaminated with anything that might impair its plant-support capacity (e.g. aggregate, cement, concrete, fuels, litter, oils, domestic and industrial waste).

4. The Contractor shall temporarily stockpile topsoil in a location that will minimize any loss due to erosion or mixing with other material.

5. The Contractor shall ensure that topsoil is stockpiled in a manner and for a period of time that does not result in deterioration in its plant support capacity.

6. Topsoil for the proposed project shall be used to construct a berm to minimize visual impact of the facility. This topsoil shall be stored in such a way that it can eventually be used to appropriately rehabilitate the site following closure of the proposed project, depending on the future land use.
Control of material supply and borrow areas
7. The Contractor shall, as far as possible, source all material needed to
develop the project from existing permitted quarries in the area.
8. The Contractor shall prepare a method statement including plans, detailing
the expected quantity of excavation, temporary and permanent drainage
control, the final contouring of the borrow pit and the proposed method of
rehabilitation and shall submit this to the Proponent for approval prior to
opening the borrow pit.

Control of construction near watercourse crossings
The proposed power plant site is within 700 m of the Stony Athi River and no
drainage lines have been identified on the site. Although direct impacts are not
envisaged on the watercourse during construction, points 9 – 10 below are
included as a precautionary measure:
9. The Contractor is responsible for controlling riparian and stream damage to the
river systems resulting from the construction of the power plant and associated
infrastructure.
10. The Contractor shall comply with any conditions of approval set by the
NEMA or Ministry of Water, over and above the requirements of this EMP.

Rehabilitation
11. The site should be cleared of construction materials. The Contractor should
remove waste materials from the site to appropriate waste disposal sites.
12. The Contractor shall remove all temporary works from the construction site,
restore and re-vegetate the areas along the perimeter of the site.
13. The Contractor shall prevent concentrated run-off along, or next to, the
construction site and shall do so by shaping the land, establishing vegetation
where necessary, and taking other appropriate measures to absorb and disperse
runoff.
14. The Contractor shall establish vegetation cover (using species appropriate to
the local area) in all areas disturbed by the works in the first growing season
after construction, and shall maintain this cover for the duration of the
maintenance period.
15. Re-vegetation shall be done on all borrow areas, temporary access roads, spoil
sites, camp sites and the like.

Hydro-testing
16. The procurement and discharge of water required for hydro-testing shall
comply with the requirements of the Water Act and related regulations. The
standards relating to discharge will depend on the receiving environment into
which the water is discharged, the rate of discharge and the nature of any
additives included in the water.
17. Prior to implementation of the hydro-testing, the Contractor shall prepare a
plan which complies with any requirements set by the NEMA or the Ministry
of Water.
18. The Contractor shall ensure that dust and noise caused by cleaning operations do not cause nuisance to surrounding landowners, occupiers or the general public. The Contractor shall prepare a method statement in this regard which shall include, but not be limited to: the location of cleaning/drying operation sites; the anticipated peak and equivalent equipment noise levels that will result from the operations and the period over which they will occur; the location of surrounding inhabitants; the methods proposed to limit noise levels at the nearest noise receptors to meet the legal requirements of L.N. 25: Noise Prevention and Control Regulations, 2005 under the OSHA.

14.6.5 Labor and human resource plan

The labor and human resources plan to be implemented by the Contractor and the Proponent shall include the following key measures:

1. The Contractor shall establish a labor and human resources plan that addresses the employment of national employees and expatriate employees, which shall be submitted to the Proponent.

2. The plan shall be based on the following principles:
   a) Compliance with national policy and legislation (e.g. Employment Act) and international labor conventions and norms.
   b) Clear and transparent conditions of service, as appropriate.
   c) Open and fair recruitment procedures.
   d) Well-structured, transparent and locally-appropriate remuneration and compensation procedures.
   e) Accessible and appropriate training and development.
   f) Clearly defined and open dispute resolution procedures.

3. Wherever possible, first priority should be given to hiring qualified local people especially from within the project area. It is expected that the great majority of employees in all phases will be Kenyan nationals.

4. The labor and human resources plan shall, as appropriate, be adapted by the Proponent and applied during the operational phase of the project.
14.6.6 Workplace health and safety plan

The workplace health and safety plan to be implemented by the Contractor and the Proponent shall include the following key measures:

1. All relevant national legislation including the OSHA, WIBA and related regulations shall be adhered to in order to provide a safe and healthy environment for all employees, contractors, suppliers and the community during construction and operational phases of the project.

2. The Contractor shall develop a health and safety plan in fulfillment of legal requirements for submission to and approval by the Proponent prior to the start of construction activities.

3. The Proponent shall ensure workplace health and safety during the operational phase of the project. Management should lead by example to ensure that legislative and contractual requirements are met.

4. Health and safety performance will be continuously monitored and procedures reviewed with the aim of eliminating risk as far as reasonably practicable.

14.6.7 Community health and safety plan

The community health and safety plan to be implemented by the Contractor and the Proponent shall include the following key measures:

1. All relevant national legislation including the OSHA, WIBA and related regulations shall be adhered to ensure that the health and safety of proximate communities and the public at large are not threatened during construction and operational phases of the project.

2. During the construction phase, the Contractor shall manage and control construction activities in order to minimize the risks to community health and safety. Special attention shall be paid to threats posed by the movement of construction vehicles, security and access control to the construction site, transport safety management and control of dust, noise and water pollution.

3. The Proponent will undertake a risk assessment of the project prior to its operation. The findings of this assessment will inform the development of an emergency safety plan and be included into the Proponent’s HSE procedures.

14.6.8 Emergency management and response plan

The emergency management and response plan to be implemented by the Proponent shall include the following:

Emergency management planning

1. The Proponent shall develop an emergency management plan to guide the coordination and operational handling of an emergency situation to include:

   (a) Structure and operation of the emergency management team.

   (b) Establishment of an emergency management centre.
(c) Information retained by the emergency management team.
(d) Incidents requiring activation of the plan.
(e) Incident severity classification.
(f) Process to be followed in the event of an emergency.

2. Information pertaining to emergency management shall be reported through the HSE reporting process.

**Emergency response plan**

The community health and safety plan to be implemented by the Contractor and the Proponent shall include the following key measures:

3. The Proponent must compile a comprehensive emergency response plan for the project, in conjunction with the emergency services of the local municipality. As a minimum requirement, the plan must cover the following aspects:
   (a) Kenyan and international safety regulations.
   (b) Scope of the emergency response plan.
   (c) Notification of local authorities.
   (d) Details of the power plant.
   (e) Aim of the emergency response plan.
   (f) Objectives of the emergency response plan.
   (g) Emergency arrangements, procedures and plans.
   (h) Roles and responsibilities in the event of an emergency.
   (i) Information requirements in the event of an emergency.
   (j) Evacuation of people.
   (k) The role of local communities.
   (l) Regular testing of the emergency response plan.
   (m) Planning for the eventuality of failures associated with the project and associated infrastructure.
   (n) Causes of the project failures.
   (o) Probability of project failures.
   (p) Hazards and effects of the project failures, including fire, explosion, toxic effects, blast effects, projectile effects, asphyxiation effects, noise and damage to nearby assets, such as water resources.
   (q) Hazard range and emergency planning distances.
   (r) Anticipation of worst credible incidents.
4. Emergency preparedness will be the responsibility of a manager based at the power plant. The manager will be responsible for implementing a locally relevant emergency response plan, which will include: ongoing staff emergency training; equipment maintenance and inspection; ongoing contact with local emergency staff; emergency fire/contamination drills with and without local emergency services; and communication to local residents.

14.7 Corporate HSE structure

HSE forms part of the core corporate management and administration structure of the Proponent in recognition of its key functions in the company and in order to ensure that environmental and social concerns are integrated throughout company activities and line function divisions.

Key posts in the corporate structure will be established at the onset of project implementation, that is, once the go-ahead is given and detailed design and construction start. At full capacity, the HSE unit will be structured to include a range of posts that will address the various requirements detailed in this EMP. The HSE Manager will be responsible for ensuring that all HSE requirements that have been identified in this ESIA report, as well as others that may become apparent during project implementation, are met effectively.

The HSE Manager will be responsible for all HSE issues that are related in any way to the construction of the project. The Plant Manager will be ultimately accountable for ensuring that all environmental and social management facilities and procedures that will be required during operation of the Project are included in the design, and that operations proceed in compliance with HSE requirements. The Plant Manager will in turn report to the Managing Director.

14.7.1 HSE construction phase roles and responsibilities

The Proponent plans to put in place a specific team to manage the construction phase of the proposed Project. This team will be separate from the operations team, but will coordinate as required to ensure that there are no conflicts between operational and construction requirements. The physical construction will be managed by an EPC Contractor (Mantrac), who in turn will sub-contract specific components to various construction sub-contractors.

The EPC Contractor’s environmental and social staff will be supervised by the Proponent’s HSE organization. The Proponent’s HSE staff may include some or all of the following:

- HSE Manager – to oversee the implementation of all HSE requirements as defined by the Proponent (essentially the requirements stipulated in this EMP, but others may also become apparent and be included during project implementation). He/she should possess the requisite qualification pertaining to HSE and must have necessary experience, five of which a part needs to have been in a senior HSE management position.
• Environment Manager will also oversee environmental matters with his HSE staff (HSE officers). The staff should possess suitable qualifications in a natural science and/or environmental science/management discipline and should have appropriate experience.

• The HSE Officer will be responsible for the implementation of the various environmental management requirements that need to be met by the Managing Contractor as well as the various other contractors that will be operating on the site. This function will include regular inspections, coordination of reporting, and site wide environmental monitoring. The HSE officer should have tertiary qualification in a natural science and/or environmental science/management discipline with suitable and relevant work experience.

• Independent environmental consultant/s – will be commissioned from time-to-time to assist with specific tasks (e.g. review information and provide advice on specialist issues, assist in the preparation of an annual monitoring report and conduct environmental auditing). An independent environmental expert(s), in any field (e.g. wetlands, terrestrial ecology, water management, etc.) may be appointed on request of the Environmental Manager to provide specialist advice.

Contractors will be expected to have their own HSE Managers and their activities will be overseen by the Proponent’s HSE staff. In addition, key line functions will have specific environmental and social management responsibilities included in their job descriptions and performance criteria. Critical among these is the Construction Manager. The Construction Manager will be accountable for environmental and social management during the construction phase. Specific responsibilities will include:

• The effective implementation of the EMP.

• Regular performance reviews.

• Corrective and/or remedial action where this may be required.

An HSE Coordination Committee will be established to review, on an ongoing basis, progress in respect of the implementation of the EMP requirements. This Committee will be made up of representatives of the Proponent and the EPC Contractor. Meetings will be held monthly with the specific objectives of:

• Reviewing implementation progress of the programs and plans described in the EMP against implementation and performance objectives and targets.

• Highlighting areas of concern.

• Identifying any required interventions and prescribing corrective actions and schedule.

• Allocating budget and appointing responsible parties.
14.7.2 Contractor arrangements during the construction phase

The following construction phase contractor arrangements will be made to support HSE and EMP implementation:

- A detailed code of practice for construction teams will be prepared and implemented. This code will guide the management and behavior of construction teams. The code will include items relating to health and safety. The code of practice for construction workers will include provisions for, as minimum, the prevention of HIV/AIDS.

- Information on the implications of construction will be disseminated before construction starts.

- Contracts will be key tools in managing many potential negative impacts, such as transport related incidents. In this context both construction and operational contracts will specify required environmental and social practices.

14.7.3 Training, awareness and capacity building

The presence on site of one experienced HSE Manager with previous exposure to similar projects, will allow on-the-job training on a daily basis. During the execution of the project it will be necessary to develop and implement HSE training and awareness programs. These will range from direct and dedicated training programs for specific HSE functions to broad HSE awareness programs that will need to be rolled out across the entire workforce. The following will be pursued:

- Formal HSE management training.

- HSE awareness training for all levels of workers.

- Supplementary initiatives, including toolbox talks, directives, newsletters, videos and induction programs.

14.8 Monitoring

The programs and plans described above will be subject to monitoring. In general, monitoring will have two key elements: routine monitoring against set standards or performance criteria; and periodic review or evaluation. This will often focus on the effectiveness and impact of the program or plan as a whole. In some cases, independent parties will undertake review and evaluation. The diverse monitoring requirements and responsibilities will be consolidated within the HSE function, and will share human resources, databases and management reporting procedures.

During the construction phase, the Proponent shall be fully entitled to monitor and inspect Contractors’ written records to demonstrate compliance with the ESIMP. This compliance monitoring is intended to verify that the responsible parties are implementing the management measures/procedures/specifications contained in the ESIMP. Compliance will mean that the Contractor is fulfilling his/her contractual obligations.
During the operational phase of the Project, monitoring will be undertaken to ensure compliance with management measures in the ESIMP and operational procedures. Independent auditors will periodically (annually) review the Proponent’s environmental and social performance against established objectives and targets. If the Project is funded by funding institutions, the Proponent will be required to produce an annual monitoring report, which should be independently verified prior to being submitted to the lenders.

14.8.1 Program monitoring

The Proponent shall regularly monitor program implementation. This process will include (as appropriate) the regular monitoring of:

- Erosion of soil resulting in the immediate surroundings of the power plant.
- Air quality and ambient emissions, including dust generated by construction activities (12 months). Air quality will be measured continuously at an air quality monitoring station to be set up about 10km east of the project site.
- Surface water quality and flows and borehole sampling (12 months after construction). This monitoring will be used to establish a water quality baseline against which water quality and flows can be compared.
- Noise (measured in dBA) generated by construction activities (12 months) and arising from the LPG storage facility (after commissioning) using specific measurement parameters, reference times and measurement locations.

14.8.2 Plan monitoring

All of the management plans make provision for monitoring and evaluation. Special attention should be given to the monitoring arrangements related to biophysical impacts, occupational health and safety, and emergency response.

During the construction phase of the Project, the Contractor’s HSE manager must report all environmental impacts (e.g. large scale erosion) as well as accidents and incidents to the Proponent’s representative. These reported impacts and incidents will be captured on a database to ascertain trends and track progress in the implementation of preventative and corrective actions, and benchmarking against other, similar operations.

Depending on the level of severity, accidents and incidents will be investigated by the EPC Contractor’s HSE division, with key input from the line management to ensure accountability. Rewards and recognition could be given to the best performing work team on a monthly basis. The primary objective of these interventions is to recognize the positive behaviors and outcomes of workers with regards to safety.

During operation, the Proponent’s HSE unit will monitor the health and safety of personnel and contractors, in compliance with legislative requirements. Emergency incidents should be reported to the relevant authorities. These reported incidents impacts will be captured on a database to identify weaknesses in the emergency response plan and track progress in the implementation of preventative and corrective actions and benchmarking against other, similar operations.
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15. Incident Prevention and Hazard Communication Plan

This section describes the framework for managing incidents and near misses as well as communication of hazards associated with the proposed project.

It is therefore essential that the project is constructed and operated in a safe and incident free manner in compliance with the Occupational Safety and Health Act, 2007 and its subsidiary legislation particularly Legal Notice No. 40: Building Operations and Works of Engineering Construction Rules, 1984.

This section outlines an incident prevention and hazard communication action plan for the EPC contractor to consider prior to the construction phase of the project.

15.1 Incident Prevention – Construction Phase

Contractor health and safety is an essential component of incident prevention during the construction phase of the project. It is recommended that the EPC contractor’s HSE management system be implemented for the project and containing some of the elements described below.

15.1.1 Responsibilities with regard to safety

The responsibilities with regard to safety must be documented by the EPC contractor for all their sub-contractors to follow while working at the project site. The EPC contractor’s responsibility is to issue procedures, safety rules and safety induction training for all sub-contractors working on site. It is the responsibility of all sub-contractors to strictly adhere to the EPC contractor’s HSE standards and to ensure that every person in the sub-contractor’s employment observes the requirements of the EPC contractor’s regulations.

Each sub-contractor will be required to nominate a contractor supervisor for their specific discipline of the project. This person will be responsible for all HSE compliance requirements of subordinates and will issue instructions regarding HSE which have to be carried out by all contract employees.

The contractor supervisor will be responsible for training all new contractor personnel in HSE as well as the dangers inherent to the area where work is to be performed.

15.1.2 Designation of First Aiders

Each sub-contractor shall ensure that an adequate number of certified first aiders are available at the project site with properly equipped first aid boxes. At least one approved first aider for every 50 employees is recommended.
15.1.3 **Contractor Employee Responsibility with regard to Safety**

Any sub-contractor employee who observes or is involved in an accident will immediately report such incident to the contractor supervisor who will record the details in a General Register as stipulated under the Occupational Safety and Health Act, 2007. The Contractor’s Supervisor on site shall fill out an Accident Report Form known as DOSH 1 which is available for free from the local DOHSS office and submit it to the nearest provincial DOHSS office within 24-hours of the accident.

15.1.4 **Temporary Buildings**

During the construction phase the sub-contractors may erect temporary buildings for use during the construction period. The design of the buildings shall be approved by the EPC contractor before erection of them commences.

15.1.5 **Safety Induction Training**

The EPC contractor will arrange for HSE induction training of their subcontractors prior to the ground breaking at the project site. All new employees shall undergo such training prior to being allowed to work on the project site. The EPC contractor’s nominated sub-contractor(s) shall also provide HSE induction training to all their workers including frequent tool box talks.

15.1.6 **Personal Conduct**

It will be the responsibility of each sub-contractor to ensure that their employees do not engage in any of the following practices during the construction phase of the project:

- Horseplay;
- Personal business; and
- Misconduct.

15.1.7 **Personal Protective Equipment (PPE)**

Each sub-contractor working at the project site shall ensure that all their employees are provided with appropriate and adequate PPE. The sub-contractor will be required to maintain a register indicating the issuance, control and use of PPE which includes the following:

- Safety shoes;
- Safety helmets (hard hats);
- Hand protection (gloves);
- Eye and face protection (safety glasses);
- Hearing protection (ear plugs, ear defenders); and
- Clothing (overalls).
15.1.8 Safety Procedures

The EPC contractor will be required to issue the Proponent with a comprehensive Safety Method Statement for carrying out each phase of the construction works. The EPC contractor will further be required to comply with the safety procedures of the Proponent.

15.1.9 Fire and Emergency Procedures

The EPC contractor, their nominated sub-contractors and all the employees working for them shall be required to be familiar with the Proponent's fire and emergency procedures. The HSE induction training to be provided by the EPC contractor for all their nominated sub-contractors working at the project site will include emergency and evacuation procedures.

15.1.10 Security Procedures

The EPC contractor’s nominated sub-contractors and their employees will be required to familiarize themselves with the EPC contractor’s security procedures and shall ensure that all employees comply with those security procedures.

15.1.11 Working Tools and Equipment

Each nominated sub-contractor will ensure that no unsafe tools are used at the project site. The sub-contractor will further ensure that all scaffolding and ladders, cranes, welding machines, compressors, etc. are in good serviceable condition at all times during the construction phase of the project and have been certified by DOHSS approved persons.

15.2 Incident Prevention – Operational Phase

15.2.1 Proponent’s HSE Management System

Wärtsilä Finland Oy has been selected by the Proponent for the operational phase of the project. Subsequently Wärtsilä will develop, rollout and implement a detailed HSE management system for operating the proposed project incorporating Kenyan HSE laws and regulations and the lenders HSE requirements within the system.

15.2.2 Emergency Response Plan

In the event of an emergency at the project site, the Proponent’s Emergency Response Plan will be activated in accordance with the procedures laid out in it. It will therefore be necessary for the Proponent to develop, rollout and implement their documented emergency response plan prior to the construction phase.
The emergency response plan should as a minimum include the headings given below.
- Introduction;
- Purpose;
- Scope;
- Abbreviations;
- Definitions;
- Emergency response organization;
- Emergency notification system;
- Evacuation procedures;
- Emergency response plan activation;
- Contingency plans;
- Emergency management resources and logistics;
- Crisis control center;
- Deactivation and recovery plan;
- Training;
- Emergency response plan maintenance; and
- Emergency response plan distribution.
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16. **Health Hazard Prevention and Security**

This section describes the types of health hazards that may be present during the construction and operational phases of the project respectively and methods of preventing such hazards.

16.1 **Health Hazards – Construction Phase**

16.1.1 **Sanitary Site Conditions**

The proposed project site is expected to have a sizeable number of employees during the construction phase. The lack of provision of adequate and hygienic ablution facilities will create health hazards for the workers. It will therefore be essential for the EPC contractor and their nominated sub-contractors to ensure that during the construction phase, an adequate number of male and female ablution facilities are provided and that the effluent is managed in an environmentally sound manner. Legal Document 280 under the repealed Factories and Other Places of Work Act required that four (4) water closets be provided for up to 100 male workers and six (6) water closets for up to 100 females.

16.1.2 **Cooking of Meals**

It is common practice on construction sites in Kenya for hawkers to provide cheap meals for construction workers on site. The health hazards associated with provision of meals to workers is that the source of water used for cooking is generally unknown. Secondly the source of ingredients used for preparing meals is unknown. Such practices may give rise to health hazards at the project site and the EPC contractor and their nominated sub-contractors are encouraged to consider providing meals for their employees.

16.2 **Health Hazards – Operational Phase**

16.2.1 **Hazard Communication**

There are various potential health hazards associated with the improper handling of chemicals that can lead to occupational diseases. It is therefore recommended that the EPC contractor develop, rollout and implement a written hazard communication program for the project during the construction phase of the project. a similar hazard communication program should be developed by the Proponent during the operational phase of the project as there will be a number of chemicals stored and used at the proposed project. The hazard communication program will be used to promote employee, contractor and third party awareness of HSE concerns and risks represented by materials and chemicals stored, used and handled at the project site. The hazard communication program should have the following elements:
Chemical Inventory Program;
- MSDS Program;
- Container Labeling; and
- Employee and Contractor Training.

16.2.2 Personal Protective Equipment (PPE)

In order to handle hydrocarbon products and chemicals safely and avoid injuries or health hazards to employees it is necessary for the Proponent to develop, rollout and implement a PPE program for the project during the operational phase. The purpose of this program is to identify the elements necessary for the shielding of employees and contractors from chemical, physical and biological hazards and potential hazards they are likely to encounter in their work environment. As a minimum the PPE program should contain the following elements:

- Written Procedures;
- Engineering and Administrative Work Practice Controls;
- Equipment Selection Criteria;
- PPE Distribution and Storage;
- Routine Maintenance Procedures for PPE;
- Medical Evaluation as required by the OSHA and its subsidiary legislation;
- Employee and Contractor Training; and
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17. **Gaps in Knowledge and Uncertainties Encountered**

17.1 **Assumptions**

The Client has provided the Firm of Experts with limited information regarding the project as it is still in the preliminary design stage. Subsequently the design information is still in the process of evolution and will get refined as it progresses.

The engineering design of the project is being undertaken by Wärtsilä Finland Oy. A geotechnical investigation was undertaken by the KP&LC after they procured the land on which the proposed project is to be constructed. Design features will be implemented to minimize the risks from external factors that could threaten the integrity of the proposed power plant. For example, the design will include measures to minimize the threat of damage to the power plant through accidental and malicious third party activity.

The public consultation process was effective in identifying the critical issues that needed to be addressed through specialist investigations. Specialist input has thus been appropriately scoped to investigate the critical issues.

Due to the interrelated nature of biophysical, social and economic issues, it is assumed that individual specialists collaborated to discuss shared issues and impacts in order to establish complementary ways of avoiding and mitigating adverse environmental impacts.

The Proponent and their selected EPC contractor will implement the measures contained in the EMP. The EMP will be revised as necessary prior to construction and/or operational activities to include written plans, method statements and operational procedures.

A monitoring and evaluation system including auditing will be established and operationalized to track the implementation of the EMP. This will assist in ensuring that management measures are effective to avoid, minimize and mitigate impacts and that corrective action is being taken to address shortcomings and/or non-performances.

17.2 **Limitations**

As is well known, Kenya currently cannot satisfy the demand for electric power to its consumers.

Subsequently the project faces a limitation in the time taken by the lead agencies and the public to review the ESIA Study and provide objective feedback to the Proponent.

While the development is designed to significantly mitigate risk through compliance with the latest thermal power plant industry standards and will include international peer review, the possibility of incidents resulting in fires and explosions cannot be ruled out.
17.3 Uncertainties

Uncertainty arises from a variety of aspects in any development, and for this particular EIA Study has emanated from the following:

- The changes that may occur in baseline conditions, due to external factors over the lifetime of the project;
- Uncertainty related to Proponent’s policy initiatives that might influence the assessment of future baseline and post-development conditions;
- Uncertainty in design information which should be dealt with by the definition of design parameters for the development by the EPC contractor and Proponent; and
- Uncertainty in relation to project planning and implementation as the detailed program and means of construction may be influenced by the choice of subcontractors’ and the detailed design of the development.

In the latter case, proposals for a Construction HSE Management Plan are made to deal with this source of uncertainty and the inherent problems of predicting construction effects. The Proponent has been unable to provide the Firm of Experts with adequate information on the construction phase technologies, procedures and processes; subsequently the Firm of Experts has relied on their past experience of such technologies, procedures and processes of similar types of projects.

The difficulties in compiling the information for this ESIA Study have related principally to the above sources of uncertainty. To obviate these difficulties the Firm of Experts has endeavored to use their past experience wherever possible and consultation with Proponents having similar projects to gauge and recommend appropriate mitigation measures in this ESIA Study.

17.4 Limitations of this Assessment

The key issues pertaining to the project including surface water, hydrogeology, ecology, air quality, noise quality and socio-economics have been assessed and presented in this ESIA Study. ESIA is an iterative process and the Proponent and its consultants will adopt a process of continual improvement in managing and/or mitigating adverse environmental impacts arising from the project. The EMP will be used as a basis of environmental management and will be improved and refined periodically.
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18. Conclusions

This ESIA Study report incorporates the following components:

- A description of the ESIA process;
- An outline of the baseline environment and detailed description of the proposed activity;
- A presentation of the process and findings for the screening of alternatives;
- The key issues and concerns raised by stakeholders during the public open days;
- Findings of the specialist studies undertaken during the ESIA and the Firm of Expert’s assessment of the potential impacts of the preconstruction and construction, operational as well as closure phases of the proposed power plant development.

The project, which includes the construction and operation of a power plant, is anticipated to bring regional and national economic benefit to Kenyans through improved electricity availability. Key negative impacts which will require careful management during the construction and operation of the power plant include:

- Impacts related to air emissions during the construction and especially the operational phase of the project. Passive air quality monitoring will need to be undertaken in the identified fallout areas especially about 10km east of the project site to monitor ground level concentrations of pollutants such as SO$_2$, NO$_2$, etc.;
- Impacts associated with noise and vibration generated by the power plant during operation. This may require a potential buffer zone around the power plant site if the noise levels generated by it at full capacity at the fence line exceed regulated Kenyan occupational exposure limits or WHO guideline values.
- The risks to public safety and environmental quality (soil, air and water) should there be a spill or large-scale incident caused by human error, equipment failure or damage due to third party interference.
- Increased risk of disease with influx of workers.
- Impacts on bulk local infrastructure and services.

It is anticipated that it will be possible to successfully mitigate impacts associated with the development. In particular, the power plant will be designed, constructed and operated according to the latest industry norms and standards. The ESIMP includes plans to be formulated during the detailed design phase, and has been developed as part of the ESIA to manage potential impacts. Programs and plans developed and implemented through the ESIMP will be monitored and audited to ensure compliance.

The iterative EIA process will accommodate the refinement of the project site plan and technical design to accommodate safety considerations arising from health and safety risk assessments. Comments on this ESIA will also be sought from the public/stakeholders and the results thereof incorporated into the ESIA Study.