Contents

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.

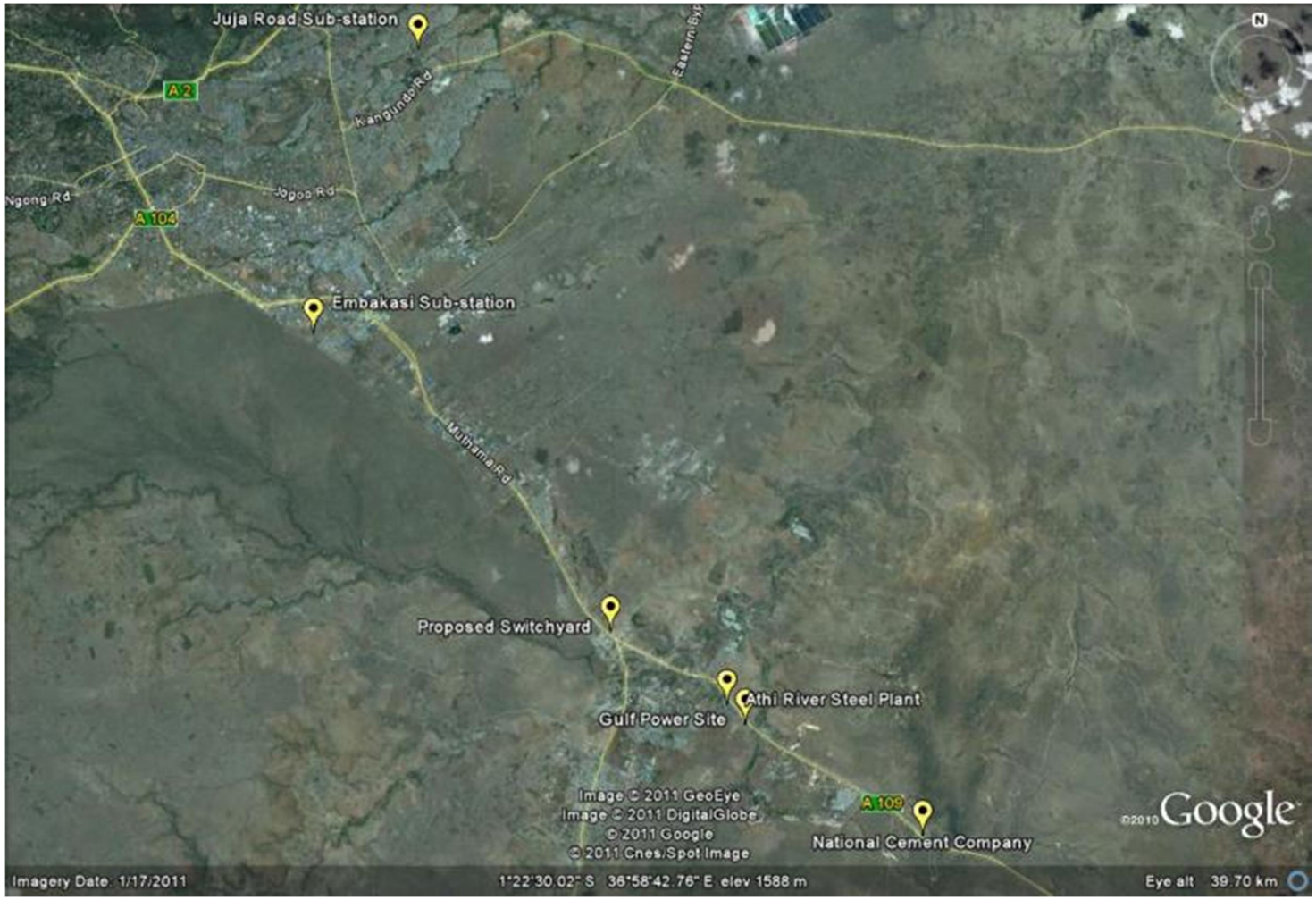
The Gulf Power project is expected to evacuate and supply power to the following locations:

- Embakasi sub-station (300mm^2);
- Juja Road sub-station (300mm^2);
- Athi River Steel Plant Ltd. – ARSP (150mm^2); and
- National Cement Company Ltd. – NCC (150mm^2).

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.

[1]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 300mm^2 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.

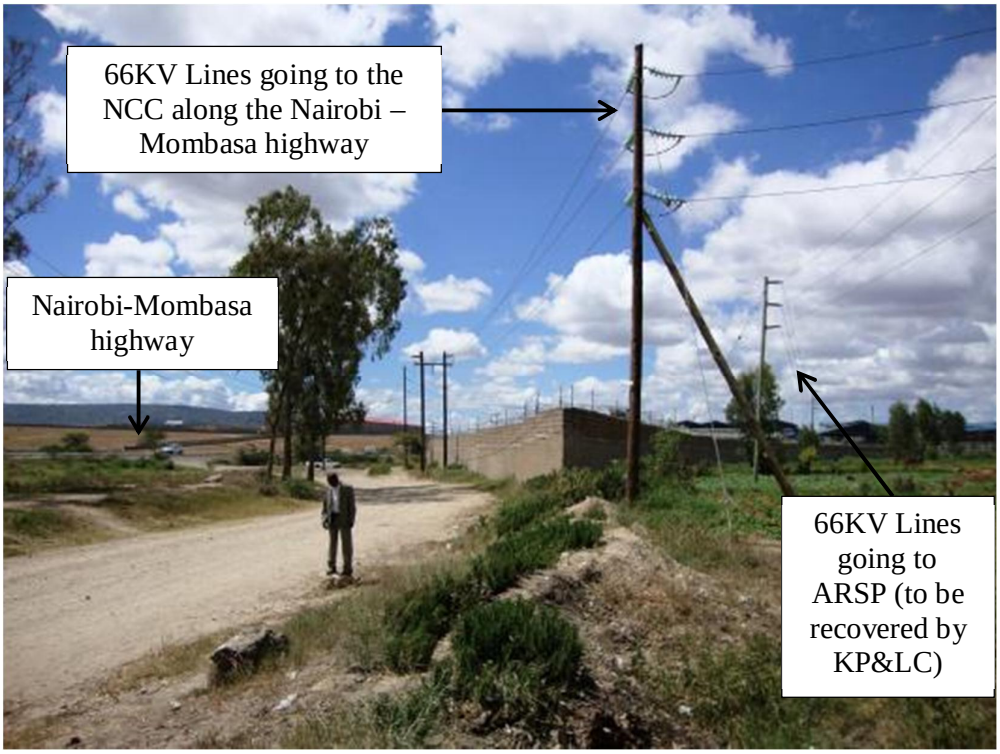
Figure 1-3: Image of the proposed switchyard location opposite Mombasa Cement Company

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 sub-stations 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



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 sub-stations 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 sub-stations 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

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

Figure 1-10: Image of site facing north-west showing the slope direction

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 700km^2 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 µg/m^3.

Site	SO_2	NO_2	Benzene	Toluene	E-benzene	m,p Xylene	o-Xylene
Control	2	7.83	3.54	1.68	<DL	<DL	<DL
Near Athi River	0.65	2.75	2.43	1.53	<DL	<DL	<DL
Near steel plant	5.11	5.11	3.58	3.83	1.16	1.61	1.53
Along Athi River	4.81	4.81	2.54	1.15	<DL	<DL	<DL
Superior Homes	<DL	2.46	1.57	1.25	<DL	<DL	<DL
Maasai manyatta	<DL	3.54	1.24	1.94	<DL	<DL	4.36

<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.

Pollutant	Averaging Period	EC limits ($\mu g/m^3$)	Predicted concentrations ($\mu g/m^3$) and frequencies of exceedences at the sensitive receptors					
			Athi River		Housing estate		Lukenya school	
			ADMS	AERMOD	ADMS	AERMOD	ADMS	AERMOD
SO_x	Highest monthly	350	160	90	300	130	55	**800**
	Hourly FOE	24	-	-	-	-	-	**24**
	Highest daily	125	40	23	27	27	5	60
	Daily FOE	3	-	-	-	-	-	-
NO_2	Highest hourly	200	100	55	175	75	34	**450**
	Hourly FOE	18	-	-	-	-	-	**24**
	Annual average	40	5.5	4	0.5	5	0.3	4
PM_{10}	Highest daily	50	1.7	1	1	1.2	0.2	2.5
	Annual average	40	0.18	0.14	0.02	0.18	0.01	0.13

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 SO_2 and NO_2 hourly limits at Lukenya School with the frequency of exceedence being equal to the limit for SO_2 and slightly over the limit for NO_2. 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

Aspect	Impact	Mitigation Measure	Schedule				Management Plan
			Pre-con	Con	Op	Cl	
Geology and topography	Soil compaction	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.					• Planning and design • Rehabilitation and closure plan
	Soil erosion	To prevent soil erosion all non-built up areas should be landscaped and appropriate soil bind grass planted.					• Planning and design • Rehabilitation and closure plan
Surface water	Impact on flow	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					• Planning and design • Construction management plan • Construction control plan • Rehabilitation and closure plan
	Impact on water quality	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.					• Planning and design • Construction management plan • Construction control plan

Aspect	Impact	Mitigation Measure	Schedule				Management Plan
			Pre-con	Con	Op	Cl	
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					• Conservation of natural habitats program • 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.					• Air quality management program
	Stack emissions	Set up an air quality monitoring station about 10km east of the project site to collect SO_2 and NO_x data. Regularly monitor stack emissions using the inbuilt stack continuous emission monitoring system.					• 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					• Waste management plan

Aspect	Impact	Mitigation Measure	Schedule				Management Plan
			Pre-con	Con	Op	Cl	
		phase and the Proponent during the operational phase of the project.					
Noise and vibration	Noise during construction	Contractor's plant and equipment should comply as a minimum with requirements of L.N. 25: Noise Prevention and Control Rules, 2005.					• Noise management program
	Noise during operations	The Proponent should comply with the requirements of L.N. 25: Noise Prevention and Control Rules, 2005 and L.N. 61: Noise and Vibration Pollution Regulations, 2009.					• Noise management program
Socio-economics	Compatibility with existing and proposed land uses	Proponent should create public awareness about "safe" land uses of any future projects in the vicinity of the proposed project area					• Community safety plan • Land acquisition and compensation plan • Community safety plan • Labor and human resource plan • Soil conservation management program
	Increased crime and in-migration	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.					
	Creation of employment opportunities	Implement where feasible measures to employ local community members during both the preconstruction and construction phase, as well as the operational phase.					

Aspect	Impact	Mitigation Measure	Schedule				Management Plan
			Pre-con	Con	Op	Cl	
	Increased risk of disease with influx of workers and opportunity seekers	Ensure effective communication with communities to limit expectations of employment creation. Develop and implement a HSE program for employees.					
	Social divisions over limited jobs and perceived preferential access	Develop and implement transparent employment and procurement measures which comply with the regulatory framework and maximize local benefits.					
	Accidents as a result of increased traffic	Implement measures to ensure that traffic and road safety hazards are minimized during the preconstruction, construction and operational phases.					
Traffic	Damage to roads and other transport infrastructure	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.					• Community safety plan
	Increased traffic and road safety hazard	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.					

Aspect	Impact	Mitigation Measure	Schedule				Management Plan
			Pre-con	Con	Op	Cl	
Health and safety	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

Acronym	Definition
µg/m^3	Microgram per cubic meter
ARSP	Athi River Steel Plant Ltd.
BAP	Best Available Practice
BAT	Best Available Technology
Biodiversity	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
Biomass	The living weight of a plant or animal population, usually expressed on a unit area basis
BTEX	Compounds of benzene, toluene, ethyl-benzene and xylene
Community	An assemblage of organisms characterized by a distinctive combination of species occupying a common environment and interacting with one another
Community structure	All the types of taxa present in a community and their relative abundance
dB(A)	Decibels on the A-Scale
DFO	Diesel Fuel Oil
EA	Environment Audit
Effluent	A complex waste material (e.g. Liquid industrial discharge or sewage) that may be discharged into the environment.
EIA/EA Regulations	Environment (Impact Assessment & Audit) Regulations 2003
EMCA	Environment Management & Coordination Act 1999
ESD	Emergency Shut Down
ESIA	Environmental and Social Impact Assessment
ESM	Environmentally Sound Management
Guideline	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
Ha	Hectare

Acronym	Definition
Habitat	The place where a population (e.g. Animal, plant, microorganism) lives and its surroundings, both living and nonliving.
HFO	Heavy fuel oil
HSE	Health, Safety and Environment
IUCN	International Union for Conservation of Nature and Natural Resources
kg	Kilogram
km	Kilometers
KP&LC	Kenya Power and Lighting Company Ltd.
m	Meters
mb	Millibar
mg/l	Milligrams per liter
mm	Millimeters
MT	Metric Tons
NCC	National Cement Company Ltd.
NEC	National Environment Council
NEMA	National Environment Management Authority
PCC	Public Complaints Committee
Pollution	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.
Population	Population is defined as the total number of individuals of the species or taxon
ppm	Parts Per Million
SCADA	Supervisory Control and Data Acquisition
SEA	Strategic Environmental Assessment
Sediment	Unconsolidated mineral and organic particulate material that settles to the bottom of aquatic environment.
SERC	Standards and Enforcement Review Committee
Species	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
Suspended	Material Total mass of material suspended in a given volume of water, measured in mg/l.

Acronym	Definition
Suspended matter	Suspended material.
Suspended sediment	Unconsolidated mineral and organic particulate material that is suspended in a given volume of water, measured in mg/l.
Taxon (Taxa)	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).
Toxicity	The inherent potential or capacity of a material to cause adverse effects in a living organism.
Toxicity test	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).
Turbidity	Measure of the light-scattering properties of a volume of water, usually measured in nephelometric turbidity units.
VOC	Volatile Organic Compounds
Vulnerable	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.

1.9 List of Appendices

Appendix A: Air dispersion modeling report
Appendix B: Baseline noise level survey report
Appendix C: Geology and Hydrogeology Report
Appendix D: Soils Report
Appendix E: Ecological Assessment Report
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Appendix J: EPC Contractor's Construction HSE Management Plan
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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

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Ms. Angela Kabiru – Archeologist	Archeological and Cultural Heritage Impact Assessment
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Eng. Mordecai Omenda – Roads Engineer	Transport Impact Analysis
Ms. Priscilla Kinyari – Sociologist	Socio-economic impact assessment