ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY REPORT

FOR

ATHI RIVER 81 MW THERMAL POWER PLANT

Triumph Power Generating Company

November 2011

AUTHENTIFICATION

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ABBREVIATIONS AND ACRONYMS

AIDS	-	Acquired Immune Deficiency Syndrome
ASALs	-	Arid and Semi-arid lands
ASL	-	Above Sea Level
CBOs	-	Community Based Organizations
CEMP	-	Construction Environment Management Plan
DCC	-	Diesel Combined Cycle
DDPs	-	District Development Plans
DEC	-	District Executive Committee
DEMC	-	District Environmental Management Committee
DFIs	-	Donor Financial Institutions
DHP	-	Designated Health Practitioner
DO	-	District Officer
DSDO	-	District Social Development Officer
DWO	-	District Water Officer
EA	-	Environmental Audit
EIA	-	Environmental Impact Assessment
ESIA	-	Environmental and Social Impact Assessment
EAPCC	-	East Africa Portland Cement Company
EHS	-	Environmental Health and Safety
ERC	-	Energy Regulatory Commission
ESMP	-	Environmental and Social Management Plans
EMCA	-	Environmental Management Coordination Act
EMP	-	Environmental Management Plan
EMS	-	Environment Management System
EPFI	-	Equator Principals for Financial Institutions
EPZ	-	Export Processing Zone
FDG	-	Focus Discussion Groups

FPE	-	Free Primary Education
GDP	-	Geo-Data-Base
GoK	-	Government of Kenya
GPS	-	Geographical Positioning System
Ha	-	Hectares
HFO	-	Heavy Fuel Oil
HIV	-	Human Immuno-deficiency Virus
Hr	-	Hour
HSE	-	Health Safety and Environment
ICT	-	Information Communication Technology
IFC	-	International Finance Corporation
IPP	-	Independent Power Producer
KWS	-	Kenya Wildlife Services
Km	-	Kilometres
KPLC	-	Kenya Power and Lighting Company
LCP	-	Local control panel
MAVWASCO	-	Mavoko Water and Sewerage Company
MoH	-	Ministry of Health
MoR	-	Ministry of Energy
MSD	-	Medium Speed Diesel
MW	-	Mega Watts
NEAP	-	National Environment Action Plan
NEMA	-	National Environmental Management Authority
NGOs	-	Non-Governmental Organizations
OSHA	-	Occupational Safety and Health
PCC	-	Public Complaints Committee
PPE	-	Personal Protective Equipments
PRSP	-	Poverty Reduction Strategy Paper
RBCA	-	Risk Based Corrective Action
SCADA	-	Supervisory Control and Data Acquisition
SERC	-	Standards and Enforcement Review Committee

STIs	-	Sexually Transmitted Infections
TOR	-	Terms of Reference
TPH	-	Total Petroleum Hydrocarbons
WHO	-	World Health Organization

EXECUTIVE SUMMARY

Introduction

It was estimated that in 2010 the peak demand of electricity would be 1,010MW of power growing to 1,831MW by 2015 and 13,537MW by the year 2030. On the basis of this reference 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. In response to the increasing power demand in Kenya, the Kenya Power and Lighting Company (KPLC) in 2010 awarded independent power producer, Triumph Power Generating Company, contract for generation of 81 MW of electricity. Accordingly, Triumph Power Generating Company is to construct and operate a Medium Speed Diesel (MSD) 81 MW Thermal power plant in Athi River Township on Export Processing Zone (EPZ) Plot No. 18474/216 (Figure 1.1) which is located behind East African Portland Cement Company (EAPCC). 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 corporations in the energy sector.

Kenya depends heavily on hydro power resources for the generation of electric power in the country. However due to the recent erratic and adverse rainfall patterns experienced in the country, the water levels in the hydro electric power dams have been low resulting in inconsistent electric power generation. In order to supplement the shortfall in supply of electricity, the Government of Kenya has resorted to procurement of emergency electric power primarily from emergency diesel power plants usually at exorbitant costs. Currently, the country has a number of medium speed diesel (MSD) thermal plants 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 the country include geothermal, thermal and molasses. For the long term, significant efforts are being placed on wind power generation.

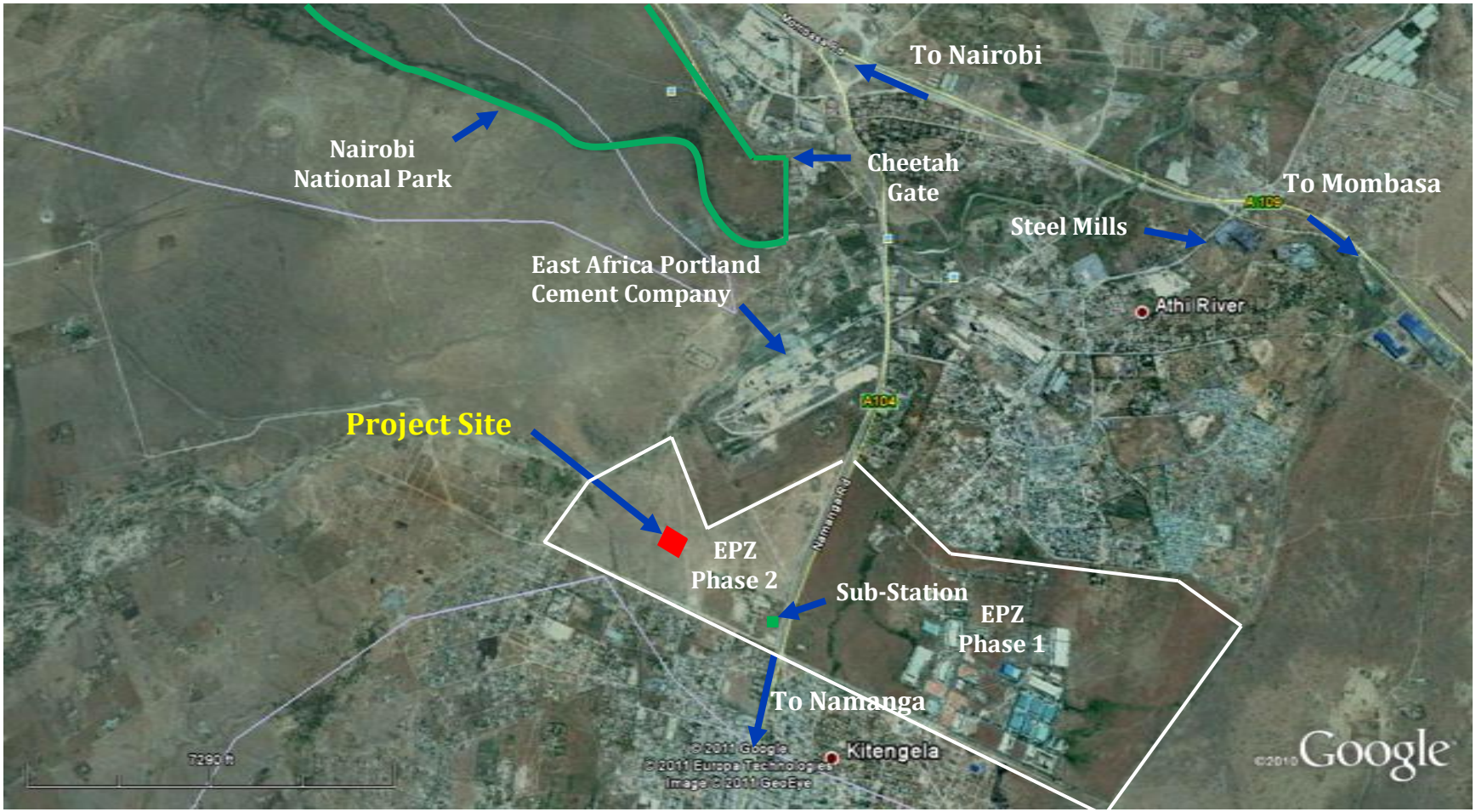

Figure 1.1 Satellite Image showing the location of the proposed Thermal Power Plant at Athi River

Thermal power plants are categorized by the Environmental Management and Coordination Act of 1999 (EMCA) in the Second schedule and, therefore, require a full EIA study. Further, for such project to qualify for donor funding through Donor Financial Institutions (DFIs), it is important that the ESIA study be conducted in line with the International Finance Corporation (IFC) Standards. Consequently, Triumph Power Generating Company contracted Millennium Engineering Services to carry out the ESIA study.

This ESIA Study report presents the ESIA process, findings and Environmental and Social Management Plans ESMP 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).

Study Objectives

The study objectives were to:

1. Conduct an Environmental Impact Assessment to identify both positive and negative impacts of the proposed project and propose most appropriate interventions during construction, operation and decommissioning of the project.
2. Collect baseline socioeconomic data of the project area and potential impact expected from project construction, implementation, operation, and decommissioning.
3. Develop an Environmental Monitoring Program during construction and operation and present plans to minimize, mitigate, or eliminate negative effects and impacts.
4. Describe Environmental Management Plan implementation mechanisms; review the power plant design and its compliance to environmental requirements.
5. Identify and contact stakeholders to seek their views on the proposed project.

Project Description

The project will comprise an MSD power plant situated in the Athi River area of Mavoko in Machakos District. The proposed site for the power plant is at Athi River in Mavoko Municipal Council on 5 ha Export Processing Zone (EPZ) Plot No. 6 located behind East African Portland Cement Company. The site is part of land owned by the EPZ and to the

Triumph. The site borders Kitengela River to the North, East African Portland Cement Company to the east and Kitengela Town residential area to the South. The site is 2 km south of the eastern tip of Nairobi National Park (Figure 1.1). Currently the site consists of eroded grassland (Plate 1).

Plate 1 South View of the Site Showing Eroded Grassland and the Technology Development Centre at the Background.

Technical Specifications

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

- Power house (containing ten 9.0 MW Medium Speed Diesel (MSD) units of the type 18V32/40 manufactured by ZGPT-MAN of China);
- Waste heat recovery system;
- Medium voltage switchgear;
- Step-up transformers 11/66KV;
- High voltage switchgear;
- Transportation and delivery to site;
- Civil and structural works;

- Installation activities;
- Commissioning and start-up; and
- Testing.

The plant will consist of ten 9.0 MW Medium Speed Diesel (MSD) units of the type 18V32/40 manufactured by ZGPT-MAN of China. The 18V32/40 is proven worldwide and considered rugged and extremely reliable in operation. The design and selected equipment with adequate redundancy will provide dependable power with high reliability. The design is utilized in such a way that the units will remain running even after a fault in the integrated network system, and thus can be re-synchronized very quickly.

Two diesel generators each of 1000 kVA capacity have been included for “Black Start” in the event of a total system collapse. A Diesel Combined Cycle (DCC) unit has been included that is capable of supplying a further 4 MW net output from exhaust gases. This will make the plant more fuel efficient and save KPLC and the electricity consumer additional fuel costs. The plant shall be environmentally sensitive and will include a sludge treatment and Incinerator for disposal of liquid and solid wastes. The amount of sludge is estimated at 160 l/hr (or only 3 l/min); therefore, the incineration will have negligible effect on air quality. Nevertheless, the height of the incinerator stack will be set at 2.5 x the height of buildings.

Fuel will be delivered to site by road tankers and pumped into two 10,000 m³ storage tanks with a 30 day fuel reserve. The plant is capable of converting to gas fuel, at a cost, should the need arise. Costs of plant conversions have not been included in the capacity charge.

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 power outrages.

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.

The project life is envisaged in three phases; namely, construction, operation and decommissioning. These phases are described briefly below.

(i) 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 200 to 250 jobs will be created during the construction phase through civil, mechanical and electrical works.

(ii) Operation Phase

There will be minimal water requirements during the operational phase for drinking and sanitation (staff complement of approximately 30). An on-site water tank will hold water for cooling and sufficient for fire-fighting purposes. A stand-alone fire protection system will be provided for the power plant with all 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.

Sewerage 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 banded and provided with a closed system drain where the water will be treated prior to release.

Approximately 30 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.

(iii) 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.

ESIA Process and Timing

The EIA process comprised of two broad phases namely scoping and environmental and social impact assessment. The full ESIA Study was commissioned by Triumph power generating company who were awarded the contract for construction and operation of the proposed power plant. 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 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.

This study was carried out through desk study and field investigations. During the field investigation, reconnaissance survey was conducted to gather information on biophysical and socioeconomic aspects of the area and its environs. In order to address these issues the study team adopted a participatory approach where the communities were consulted in addition to reviews and references to sources of information including legal statutes, design and relevant project documents. Among the key activities undertaken during the assessment were:

1. Interviews and consultations with the immediate neighbours.
2. Physical inspection of the proposed site.

3. Evaluation of the activities around the site and the environmental setting of the wider area, through physical observations, baseline studies and monitoring of soil, air and water.

Notification for the public/stakeholder consultation meetings were done in September and October 2010 respectively. Following notification, Public consultations with the affected and interested neighbours to the thermal power plant were conducted. The approach adopted included administration of questionnaires to individuals and group participation in public meetings.

The Terms of Reference (TOR) for the ESIA

This ESIA was required to carry out the following tasks:

1. Establish the suitability of the site for the set up of a MSD Power Plant in Athi River.
2. A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.
3. A description of the technology, procedures and processes to be used, in the implementation of the project.
4. A description of materials to be used in the construction and implementation of the project, the products, by-products and waste to be generated by the project.
5. A description of the potentially affected environment.
6. Conduct specialized baseline surveys on air, water, soil and noise pollution in the proposed project area.
7. Assessment of ground and surface water sources for the proposed thermal power
8. A description of environmental effects of the project including the social and cultural effects and the anticipated direct, indirect, cumulative, irreversible, short-term and long-term effects.
9. To recommend a specific environmentally sound and affordable wastewater management system.
10. Provide alternative technologies and processes available and reasons for preferring the chosen technology and processes.

11. Analysis of alternatives including project site, design and technologies.
12. Development of an Environmental and Social Management Plan (ESMP) proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.
13. Provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the course of project construction, operation and decommissioning.
14. Propose measures to prevent health hazards and to ensure safety in the working environment for the employees and the neighboring community.

Project Alternatives

The effective national power capacity in Kenya in October 2007 was 1105 MW against a peak demand of 1082 MW. The Kenya Electricity Generating Company Limited (KenGen) is currently able to generate about 85% of the total capacity. Independent power producers (IPPs) contribute the balance of 15%. KenGen is working towards enhancing its capacity through hydro-plants and geothermal sources among other initiatives. However, additional sources will still be required to meet the anticipated growth in demand and provide diversification of technology and fuels especially in the short to medium term. The following alternatives have been considered for the project:

Location Alternatives

The KPLC 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 KPLC sought to acquire land in three separate locations. The KPLC's site selection criteria included the following:

1. A site with minimal environmental impacts.
2. A site from which electric power can easily be evacuated.
3. A site that was available for sale immediately.
4. A site adequate in size to contain the footprint of an 81 MW MSD power plant.

Subsequently, through a number of channels including local authorities, print media, estate agents and the public, the KPLC identified three different locations for the MSD power plants. The sites selected for the three power plants were as described below:

- The proposed site at the Athi River EPZ facility next to East Africa Portland Cement Company.
- A site just before the Stony Athi River.
- A site near Thika town.

Other alternatives

Other alternatives considered as part of the ESIA process included:

1 ***Process/activity/operation alternatives*.** The decision to establish a power plant along the Nairobi – Mombasa highway is influenced by the ease of transmitting power to a proposed industrial/manufacturing consumer in Athi River and the KPLC 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 thermal power plant.

2 ***Demand alternative*s.** 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.

3 ***No 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. Therefore the 'No Action' alternative is not feasible for Kenya.

Key Findings of Specialist Studies

Air and Noise Quality Report

The results obtained from the baseline analysis of the air quality should form a basis of future monitoring after installation/construction of the power plant.

1. Measured air pollutants levels for particulate matter (PM_{10}), and gases (NO_2, CO and SO_2) were all within or below the recommended limits as per WHO and United States EPA.
2. The ambient air around the sampling site is clean and meets the National regulation requirements.

Noise level Simulation

The simulated noise levels meets the World Health standards, that is, not exceeding 70 dB(A), for the surroundings to the facility. However, within the facility the noise levels would occasionally be on the verge of exceeding the limits especially under stable atmospheric conditions at night. This would require mitigation measure by way of insulating the buildings on the leeward (generally westward) side of the facility. The prevailing wind at the site is generally easterly. Any future noise level mitigations measures will consider building located to the west of the facility.

Air Pollution

Supplied data has been reviewed, air pollution levels have been modeled, and the air pollution impacts of the new plant on the surrounding area have been predicted using a computer based 2-D model. It is predicted that, provided the source strength provisions in the project specifications are complied with, air pollution levels will not exceed WHO guidelines at the western site boundary while the eastern site boundary will not be adversely affected by the plant. Air pollution levels are therefore predicted to comply with all applicable legislative requirements.

Air pollutant concentrations should be measured at monitoring sites that are representative of population exposures. Air pollution levels may be higher in the vicinity of specific sources of air pollution from power plants and so protection of populations living in such

situations may require special measures to bring the pollution levels to below the guideline values.

Soil Analysis

Total petroleum hydrocarbons (TPH) were less than 500 mg/kg (µg/g). Therefore, full analysis in terms of assessing BTEXs and PAHs was not required.

Water Quality

Physical and chemical water quality analyses were conducted on a sample from Mbagathi River (in the vicinity of the proposed Athi River Thermal Power Plant) at the University of Nairobi Public Health Engineering Laboratories. Analysis was carried out using standard methods.

Results indicate significant colour, turbidity, conductivity and solids (total and dissolved) which is characteristic of the type of strata and organic matter it traverses. However, the observed hardness is not significance and the water may be classified as moderately soft (50 - 100 $CaCO_3$ mg/l) mainly calcium hardness. The water show very low concentrations of nutrients (phosphate and nitrates) suggesting limited contamination from agricultural sources. Similarly, the water had low concentrations of metals such as copper, manganese, iron and chromium indicating absence of industrial pollution.

Environmental and Socio-Economic Impacts

The positive impacts identified include the following;-

1. Employment opportunities during construction, operation and decommissioning phases.
2. Strengthening and enhancing power supply and reliability in the region.
3. The local economy will benefit from the presence of migrant workers who will seek services and goods that can be availed locally.
4. The power supply will improve the education and health standard since primary, secondary and health facilities will be able to attract and retain qualified personnel. Similarly, students will be able to devote more time to study at night as opposed during the daylight only.

5. Open up the area to internet services where residents will have access to information.
6. A strong power transmission back-bone will enhance development of Information Communication Technology (ICT) facilities in key centres around the proposed thermal power plant.
7. Small scale traders and businesses in centres located around the thermal power plant will flourish from the increased volume of trade due to increased demand of basic commodities and services such as food, construction materials and accommodation during construction stage.

Negative Impacts

The Consultant identified several negative impacts likely to arise during the proposed project's cycle. These included the following:

1. Hazardous wastes arising from various materials used in the construction.
2. Workers accidents during construction
3. Air pollution from the construction machinery.
4. Loss of vegetation cover and habitat.
5. Soil disruption arising from excavation of foundation.
6. Increased cases of sexually transmitted infections (STIs) due to the influx of migrant workers and the resulting changes in sexual behaviours.
7. Pollution of surface water by dumping of construction wastes.
8. Noise and vibration due to movement of vehicles and machinery.
9. Disruption of traffic due to movement of heavy machinery such as excavators.
10. Competition for water resources.

Environment Management Plan

The purpose of the Environment Management Plan (ESMP) 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 ESMP 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 May 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 ESMP is a living document that will be periodically reviewed and updated.

Responsibility for the ESMP will reside in the Health, Safety and Environment (HSE) functional management cluster of the main 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 10 is structured to present the proposed management measures for each potential impact. Programs and plans relevant to the management of potential impacts are also featured. Details relating to these management programs and plans are presented in Chapter 10 in the main ESIA Study report.

Table 10.1 Environmental Management Plan during Construction **(Sheet 1 of 4)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Extraction site impacts to ensure efficient use of raw materials in construction	• Source building materials from local suppliers who use environmentally friendly processes in their operations. • Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered. • Ensure that damage or loss of materials at the construction site is kept minimal through proper storage.	• Project proponent /contractor • Project Engineer/Architect		Periodic and surprise checks	
Loss of vegetation cover	• Ensure proper demarcation and delineation of the project area to be affected by construction works. • Introduction of vegetation (trees, shrubs and grass) on open spaces and around the project site and their maintenance. • Design and implement an appropriate landscaping programme to help in re-vegetation of part of the project area after construction.	• Project proponent /contractor • Project Engineer/Architect		Periodic and surprise checks during construction	
Air pollution by dust and VOCs generated during construction process.	• All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts during construction. • Construction heavy earth moving vehicle drivers will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines. • Careful screening of construction site to contain and arrest construction-related dust. • Exposed stockpiles of e.g. dust and sand, will be enclosed, covered, and watered daily, or treated with non-toxic soil binders. • All workers will be required to wear protective gear • Ensure construction machinery and equipment are well maintained to reduce exhaust gas emission	• Project proponent/contractor • Ministry of Health: provincial public health officer • NEMA inspectors • Ministry of Labour	Periodic Activities	Periodic and surprise checks	100 000 per month over the construction period

Table 10.1 Environmental Management Plan during Construction **(Sheet 2 of 4)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (KShs)
Pollution from Hazardous waste	• Handling of the materials using the material safety data provided by the manufacturers • Appoint a safety officer to ensure that proper disposal guideline are observed • Ensuring that maintenance and/or piece of work carried out on any piece of equipment or construction work is undertaken by qualified personnel • In case of spillage emergency spillage control measures to be instituted • Containerization of any wastes and disposal through a licensed waste handler.	Proponent/contractor Ministry of Health: provincial public health officer NEMA inspectors	Periodic inspection	Periodic and surprise checks	100 000 per month
Noise and vibration by construction activities.	• Use of equipment designed with noise control elements will be adopted where necessary. • Trucks used at construction site shall be routed away from noise sensitive areas where feasible. • Idling time for pick-up trucks and other small equipment will be minimized to limited time. • All workers operating in noisy areas or operating noisy equipment will be provided with earpieces to protect against extreme noise. • Comply with L.N. 25: Noise prevention and control rules, 2005	Project proponent/contractor Divisional Public Health Officer Ministry of Labour Workers NEMA inspectors	Routine Activities	Periodic and surprise checks	40 000 per month over the construction period
Traffic and Transport	• Adequate maintenance to reduce emissions. • Vehicle comply with axle load limits • Take advantage of off-peak hours • Well trained and experienced drivers	Contractor		Periodic and surprise checks	

Table10.1 Environmental Management Plan during Construction **(Sheet 3 of 4)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Adverse effects of lights on animals in the National Park	• Make optimum use of directed lighting in order to minimize adverse effects of lights on the National Park at night.	• Contractor	Periodic inspection	Periodic and surprise checks	Part of initial contract sum
Workers accidents and hazards when handling hazardous wastes.	• Adequate collection and storage of waste will be provided on site, and safe transportation to, and display methods at designated areas. • All receptacles for storing hazardous wastes shall be adequately covered. • All employees will be required to wear protective gear when handling hazardous wastes. • All workers will be adequately insured against unforeseen accidents.	• Project proponent/contractor • Provincial Public Health Officer • Ministry of Labour • Workers • NEMA inspectors	Routine Activities	Periodic and surprise checks	50 000 per month
Generation of solid waste	• Wastes to be collected regularly to control air pollution and vermin/insects etc. • Receptacles will be provided for waste storage prior to collection. • Resource recovery will be encouraged once the project takes off so as to shrink waste stream and recover non-recyclables. • Refuse collection vehicles will be covered to prevent scatter of wastes by wind. • Wastes will be collected by a licensed operator to avoid illegal final dumping at unauthorized sites. • All persons involved in refuse collection shall be in full protective attire.	• Proponent • Hired private contractor • Provincial Public Health Officer • NEMA inspectors	6. Routine 7. Activities	Periodic and surprise checks	10 000 per month

Table 10.1 Environmental Management Plan during Construction **(Sheet 4 of 4)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Workers accidents during construction process.	• All workers will be sensitized before construction begins, on how to control accidents related to construction. • A comprehensive contingency plan will be prepared before construction begins, on accident response. • Accordingly, adherence to safety procedures will be enforced. • All workers to wear protective gear during construction, including helmets. • Construction work will be limited to daytime only	• Project proponent/contractor • Divisional Public Health Officer • Ministry of Labour • Workers • NEMA inspectors	Routine Activities	Periodic checks	40, 000 per month
Inadequate human waste disposal by workers during construction process	• As provided for by the Building Code, a temporary latrine will be provided on site to be used by construction workers	• Project proponent • Contractor • Ministry of Health • Ministry of Labor • NEMA inspectors	Periodic Activities	Periodic checks	50,000 one time
Increase in STI infections	• Sensitization of local communities and staff working on the project on dangers of free lifestyle • HIV/AIDS awareness training for all employees and subcontractors.	• Proponents • Ministry of Health • Contractor	• Voluntary periodic random screening • Secondary data from health institutions	Quarterly	Part of project budget

Table 10.2 Environmental Management Plan during Operation **(Sheet 1 of 2)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Solid waste generation	• Use of an integrated solid waste management system i.e. through several options including of Source reduction Recycling ,Composting and reuse and Incineration • Ensure that wastes generated at the plant are efficiently managed through recycling, reuse and proper disposal procedures. • A private solid waste handler to be contracted to handle solid waste.	• Project proponent /contractor • Project Engineer/Architect	Periodic Activities	Periodic and surprise checks	Part of the operation and maintenance budget
Release of sewage into the environment	• Proponent to construct onsite sewage treatment facility that treats wastewater to meet the set NEMA guidelines.	• Project proponent /contractor • Project Engineer/Architect	Periodic Activities and audits		Facilities to be constructed as part of initial costs and maintained by Proponent.
Air pollution	• Drivers of heavy earth moving vehicles will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines. • All workers on the site will be required to wear protective clothing while on duty. • Suitable wet suppression techniques need to be utilized in all exposed areas • Use of low sulphur fuel to run the engines to be encouraged • The stack chimney of the generators will be constructed to a height of 32 metres and stack emissions regularly monitored using the inbuilt monitoring system. • Set up an air quality monitoring stations at 1.0 and 5 Km west of site to collect SO_2 and NO_x data.	• Project proponent/contractor • Ministry of Health: provincial public health officer • NEMA inspectors • Ministry of Labour	Periodic Activities	Periodic and surprise checks	10 000 per month
Traffic and Transport	• Limit delivery to off-peak hours to reduce disruption of transport links, delays and congestion • Provide warning lights and other signs to reduce risk of accidents along delivery roads and at the site • Keep the earth access load dump to reduce dust • Adequate maintenance of trucks to reduce emissions.	• Contractor • Proponent		Periodic and surprise checks	

Table 10.2 Environmental Management Plan during Operation **(Sheet 2 of 2)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Pollution from Hazardous waste	• Handling of the materials using the material safety data provided by the manufacturers • Appoint a safety officer to ensure that proper disposal guideline are observed • Ensuring that maintenance and/or piece of work carried out on any piece of equipment or construction work is undertaken by qualified personnel • In case of spillage emergency spillage control measures to be instituted • Containerization of any wastes and disposal through a licensed waste handler. • Adhere to L.N. 121: Waste Management Regulations	• proponent/contractor • Ministry of Health: provincial public health officer • NEMA inspectors	Periodic inspection	Periodic and surprise checks	20 000 per month
Workers accidents	• All workers will be sensitized and trained on occupational safety and health issues and on how to control accidents related to construction. • A comprehensive contingency plan will be prepared before begins, on accident response. • Accordingly, adherence to safety procedures will be enforced.	• Project proponent/contractor • Divisional Public Health Officer • Ministry of Labour • Workers • NEMA inspectors	• Routine Activities	Periodic checks and Accident audits	40 000 per quarter
Noise and vibration pollution	• Installation of silencers on the generators • Provision of personal protective equipment for workers in • Do annual noise measurements. • Do employee medical examination • Comply with L.N. 25:Noise prevention and control rules, 2005 and L.N. 61: Noise and vibration pollution regulation, 2009	• Project proponent/contractor • Divisional Public Health Officer • Ministry of Labour • Workers • NEMA inspectors			
Adverse effects of lights on animals in the National Park	• Make optimum use of directed lighting in order to minimize adverse effects of lights on the National Park at night.	• Project proponent	Periodic inspection	Periodic and surprise checks	Part of initial contract sum

Table 10.3 Anticipated Environmental Impacts and Mitigation Measures at Decommissioning of Project (Sheet 1 of 2)

Undesirable Impacts	Mitigation Measures	Responsibility for Mitigation	Estimated Cost (Kshs)
Air pollution during demolition process.	• The demolition exercise will be limited at day time only • All personnel working on the project will be trained prior to commencing the demolition exercise on methods for minimizing negative impacts on air quality. • Construction vehicle drivers will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines. • All active demolition areas will be watered at least twice a day to reduce dust. • All trucks hauling demolition debris/wastes shall be covered. • Careful screening to contain and arrest demolition related dust will be adopted • Exposed demolition debris of e.g. dust and sand, will be enclosed, covered, and watered daily before transported to disposal site. • All workers on the site will be required to wear protectivegear while on duty	• Project proponent • NEMA inspectors • Contractor	**Kshs 800,000**
Noise pollution by disassembly activities	• Portable barriers will be installed to shield compressors • Use of equipment designed with noise control elements will be adopted where necessary. • Trucks used during demolition exercise on site shall be routed away from noise sensitive areas in the neighbourhood, where feasible. • Idling time for pickup trucks and other small equipment will be minimized to limited time. • Use of very noisy equipment will be limited to daytime only. • All workers operating in noisy areas or operating noisy equipment will be provided with earpieces to protect against extreme noise. • The demolition exercise will be limited at day time only	• Project proponent • NEMA inspector • Contractor	**Kshs 600,000**
Traffic and Transport	• Carry out fuel deliveries during the day to avoid noise and disruption of sleep to the residents of the neighbouring Kitengela Township	• Project proponent	

Table 10.3 Anticipated Environmental Impacts and Mitigation Measures at Decommissioning of Project **(Sheet 2 of 2)**

Undesirable Impacts	Mitigation Measures	Responsibility for Mitigation	Estimated Cost (Kshs)
Demolition debris and related wastes	• Private contractor will be engaged to collect demolition debris/wastes • All debris/wastes to be collected regularly to control air pollution and injury etc • A licensed operator to avoid illegal final dumping at unauthorized sites will collect demolition debris. • All persons involved in refuse collection shall be in full protective attire.	• Project proponent • NEMA inspectors • Contractor	**Kshs 4,000,000**
Workers accidents during demolition process.	• All workers will be sensitized before the exercise begins, on how to control accidents related to the demolition exercise • A comprehensive contingency plan will be prepared before demolition begins, on accident response. • Adherence to safety procedures will be enforced at all stages of the exercise • All workers, pursuant to labour laws, shall be accordingly insured against accidents. • All workers will be provided and instructed to wear protective attire during demolition, including helmets. • Demolition work will be limited to daytime only avoid workers accidents due to poor visibility • Provision of mobile clinics	• Project proponent • Provincial Public Health Officer • Ministry of Labour • NEMA inspectors • Contractor	**Kshs 1,000,000**

Conclusion and Recommendations

Following the analysis of the impacts and mitigation measures provided in the EMP and social management plan, the Consultant concludes that the project will not pose any serious adverse and negative environmental impacts.

Accordingly, the Consultant made the following recommendations:-

1. The proponent to implement the mitigation guideline provided in the EMP and social management plan. Specifically, key negative impacts that require careful management during the plant construction and operation phases include;
   i. The risk to public safety and environmental quality (soil, air and water) in case of a spill or large scale incident caused by human error, equipment failure or damage due to third party interference.
   ii. Impacts related to air emissions during the construction and operational phases of the project. An air quality monitoring station should be set up 1.0 and 5 Km west of the project site to continuously monitor ground level concentrations of pollutants like SOx and NO_X.
   iii. 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 exceed recognised Kenya occupational exposure limits or WHO guideline levels.
   iv. Increased risk of disease with influx of workers

2. Monitoring be planned and implemented for auditing and improving on the EMP; conditions to be monitored to include but not limited to those mentioned in 1 above.

3. That National Environmental Management Authority does consider and approve the project and grant the required Environmental Impact Assessment License to the proponent.

CHAPTER 1: INTRODUCTION

1.1 Project Background

In response to increasing power demand in Kenya, the Kenya Power and Lighting Company (KPLC) in 2010 awarded the independent power producer, Triumph Power Generating Company, contract to generate 81 MW of electricity. The contract requires the power producer to install a medium speed diesel (MSD) thermal plant at Athi River, 30 Km south east of Nairobi, on Plot No. 6 within the designated Export Processing Zone (EPZ) area (Figure 1.1). In Kenya, all new projects are required to undertake Environmental Impact Assessment (EIA) study at the planning stage to ensure that all significant environmental impacts are taken into consideration at the implantation stage. Power generation plants are listed in the second schedule of projects that are required to have an EIA by the Environmental Management and Coordination Act (EMCA) of 1999. Consequently, Triumph Power Generating Company contracted Millennium Engineering Services to conduct the Environmental and Social Impact Assessment (ESIA) study of the proposed project. The study was to be carried out within the Legal Framework and Policies in Kenya as stipulate in the EMCA (1999). Furthermore, because of the possibility of international financing for the project, the EIA is required to address the requirements of the International Finance Corporation (IFC) Guidelines on thermal power generating stations.

1.2 Project Description

The proposed thermal power plant will consist of 10 x 9.0 MW medium speed diesel (MSD) units type 18V32/40 manufactured by ZGPT-MAN of China. These units have been proven worldwide and they are considered rugged and reliable in operation. The selected equipment and included redundancy are designed to provide high reliability in power supply. Furthermore, the units are designed to continue running even after a fault in the integrated network system and, therefore, can be re-synchronized quickly.

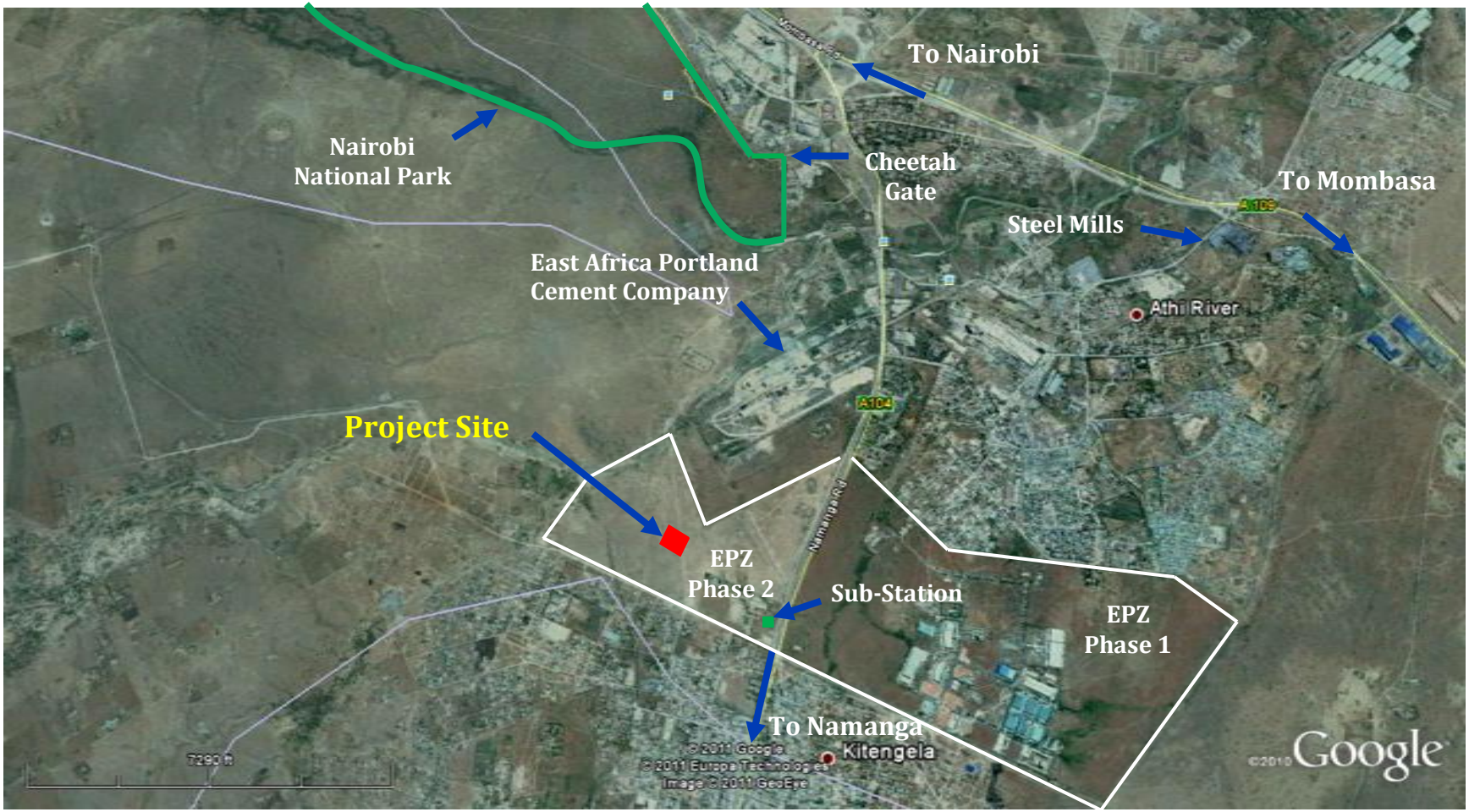

Figure 1.1 Satellite Image showing the location of the proposed Thermal Power Plant at Athi River

Two diesel generators of each 1000 kVA have been included for "Black Start" in the event of a total system collapse. A diesel combined cycle (DCC) unit has been included to extract heat from exhaust gases supply a further 4 MW thus increasing the efficiency of the plant.

Fuel will be delivered to site by road tankers and pumped into 2 x 10,000 m³ storage tanks with a 30 day fuel reserve. The plant is capable of conversion to gas fuel, at a cost, should the need arise. Costs of plant conversions have not been included in the capacity charge.

A KPLC 66 kV Switchyard will be constructed within the Power Plant (Figure 1.2). Power from the MSD Thermal Plant will be feed into the Switchyard through two underground cables. From the switchyard, the power will be connected to KPLC main sub-station next to the Technology Development Centre within the EPZ Area and 800 m from the project site (Figures 1.1 and 1.4 and Plate 1.1). From the sub-station, the power will be transmitted using existing transmission lines.

1.3 Project Justification

Kenya has an installed electrical power generation capacity of 1219 MW comprising: 677 MW hydropower, 127 geothermal, 5.1 MW wind, 383.5 MW thermal, and 30 MW non–firm import from Uganda (Figure 1.3) The national electrification rate averages at 20 %, but 51 % of urban households are connected to the national grid as compared to only 8 % of the rural households. Electricity is mainly used for lighting. Hydro power remains the largest single source. With 56 % of grid connected electricity being generated by hydro power, cuts are common during the dry seasons when the river regimes are at their lowest. In recent times, as the reserve margins have decreased with increased demand and more erratic rains, the seasonal breakdowns have become more frequent. Furthermore, the recipients at the end of the lines often suffer voltage drops that trigger power outages. This has caused the need for standby generators in the country which in 2007 were estimated to have 100 MW capacity.

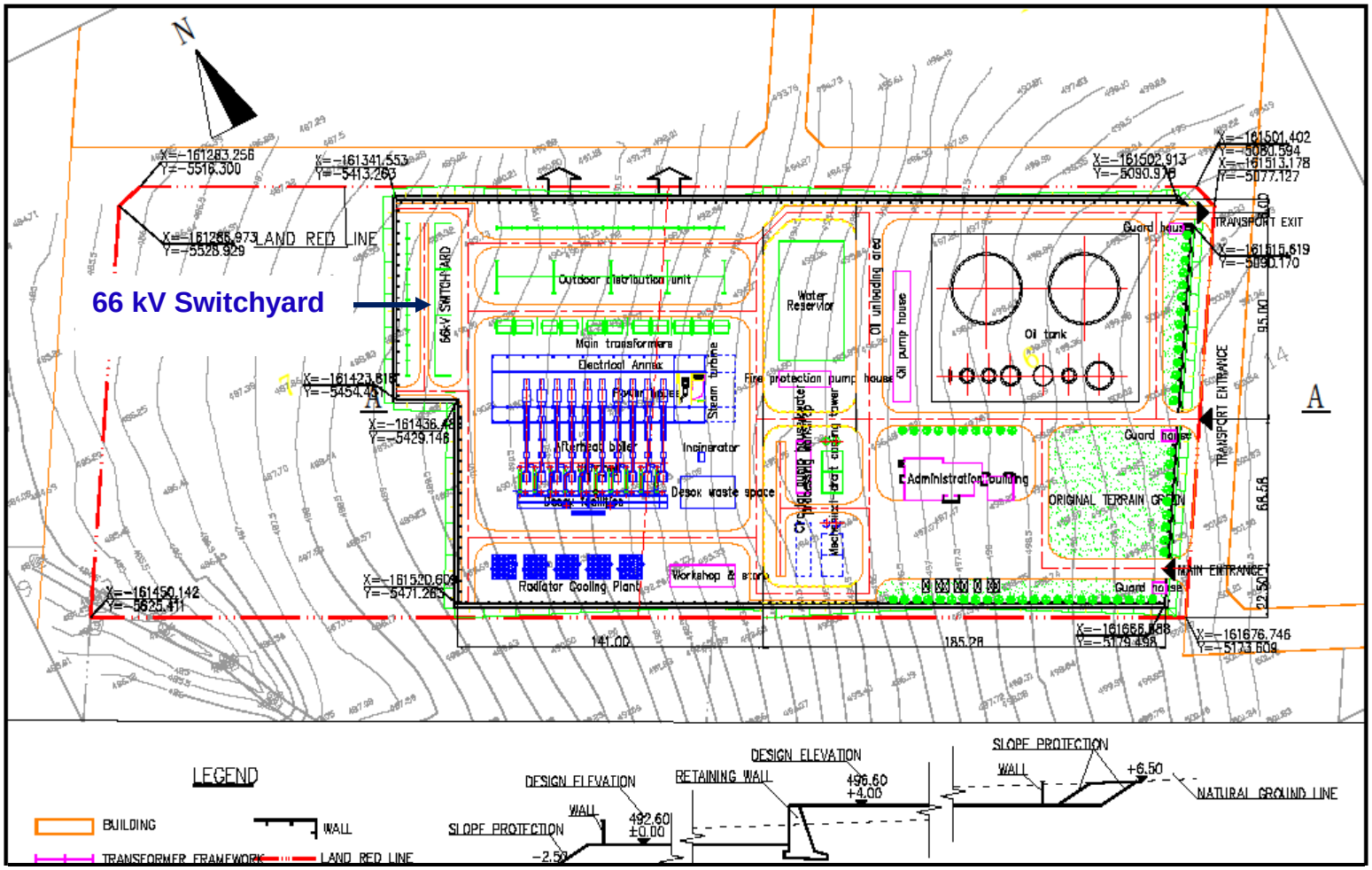

Figure 1.2 General Layout of Proposed Athi River MSD Thermal Plant and the Switchyard

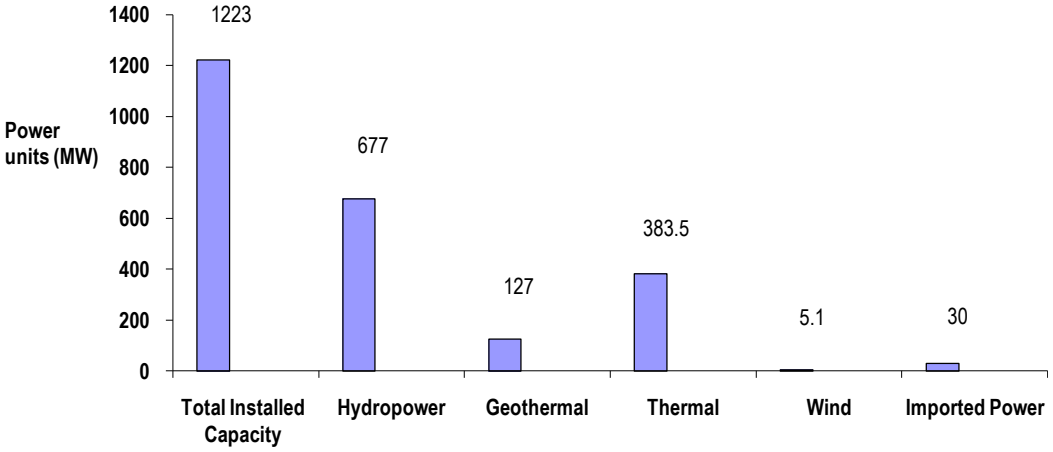

Figure 1.3: Breakdown of Electrical Power Sources in Kenya

The Kenya Electricity Generating Company Limited (KenGen) is responsible for the all public electrical generation facilities. KenGen generates most of its power from hydrodams and to a smaller extent, geothermal sources. Due to inadequate power capacity within the country, a number of Independent Power Producers (IPPs) have been licensed to undertake power generation activities to supplement existing power generation capacity. These include Iberafrica, Westmont Power, Or power 4 and Tsavo Power. The Kenya Power and Lighting Company (KPLC) have the mandate for power distribution in the country. KPLC have contracted Triumph Power Generating Company, an Independent Power Producer to install a MSD thermal plant in Athi River generating 81MW. The Energy Regulating Commission has factored in the project as one of the 'Committed Generation Project' to be commissioned in year 2011. Therefore, this project is incorporated in the national energy framework and enjoys the support of the key players in the industry.

1.4 The ESIA Study Objectives

The ESIA study objectives were aligned to be consistent with the full ESIA study to comply with the NEMA's requirements for ESIA full study terms of reference. The ESIA study objectives included:

1. Conduct an Environmental Impact Assessment to identify both positive and negative impacts of the proposed project and propose most appropriate interventions during construction, operation and decommissioning of the project.
2. Collect baseline socioeconomic data of the project area and potential impact expected from project construction, implementation, operation, and decommissioning.
3. Develop an Environmental Monitoring Program during construction and operation and present plans to minimize, mitigate, or eliminate negative effects and impacts.
4. Describe Environmental Management Plan implementation mechanisms; review the power plant design and its compliance to environmental requirements.
5. Identifying and contacting the stakeholders to seek the views on the proposed project
6. Facilitating public open/public meetings for the stakeholders to air their views
7. Compiling draft and final ESIA reports
8. Compiling the final ESIA report
9. Submission of the final ESIA report to NEMA and follow up to ensure issuance of relevant authorization/permit for the project work to commence

1.5 Overview of the Proposed Site

The proposed site for the power plant is at Athi River in Mavoko Municipal Council on 5 ha (Figure 1.4) Plot No. 6 on L.R. No. 18474/216 located behind East African Portland Cement Company. The site is part of land owned by the Export Processing Zone (EPZ) and leased to Triumph Power Generating Company (See Appendix 2.1). The lease agreement (Appendix 2.1) does not include provision of services by the EPZ.

The proposed site borders Kitengela River to the North, East African Portland Cement Company to the east and Kitengela Town residential area to the South. The site is 2 km south of the eastern tip of Nairobi National Park (Figure 1.1) which is operated by the Kenya Wildlife Services (KWS). Currently the site consists of eroded grassland with isolated acacia shrubs (Plate 1.1). The EPZ area is not fenced off as should be the case. This has enabled pastoralists who graze their animals on any open land as they move from place to place looking for pasture to access the site. The plot will be fenced off and the grazers will move to next available pasture as they normally do. The residents have been informed of the situation (see Appendix 1.3).

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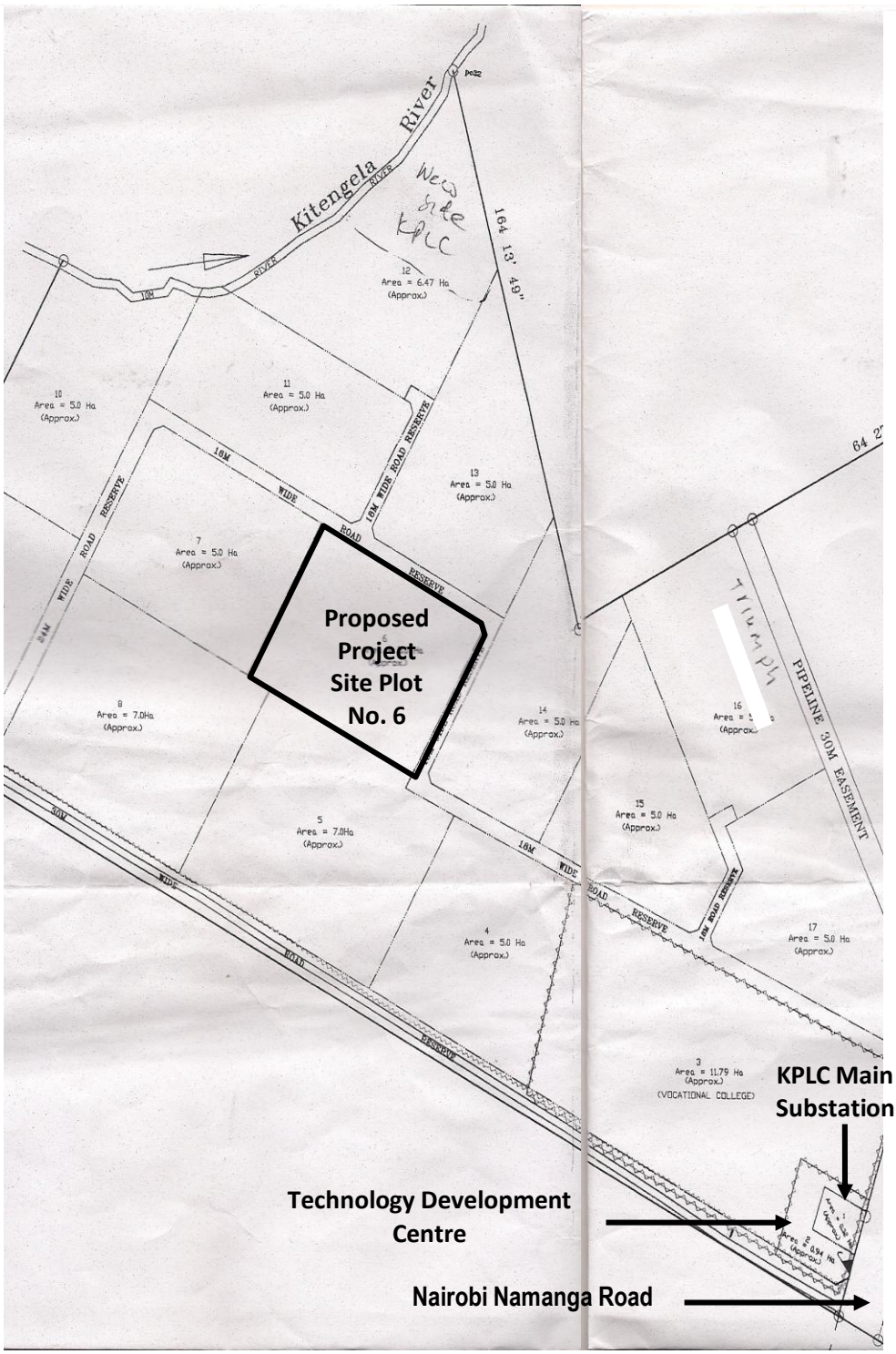


Figure 1.4 Location Plan for the Proposed Thermal Power Plant at Athi River

Plate 1.1 South View of the Site Showing Eroded Grassland and the Technology Development Centre in the Background.

The proposed site is a designated industrial plot within EPZ Phase 2 area west of Namanga road. Unlike Phase 1 Area on the east of Namanga Road which houses several industries mainly apparel firms (Figure 1.1); Phase 2 Area has remained idle since establishment of EPZ in 1990. Therefore, the power plant is not in competition with other industries for the plot. Furthermore, because the plot is currently vacant and is an industrial designated area, implementation of the project will not involve relocation of people

1.6 Scope of the Project

The full project cycle covers construction, operation and decommissioning. The construction activities will involve site preparation (clearance of existing vegetation, preparation of a site office and stores, fencing to avoid intrusion), disposal of excavation and site clearance wastes, landscaping, and earth moving and filling. Other activities will cover procurement of construction materials and delivery to the site, civil, mechanical, electrical, and building works and removal of construction wastes.

Installation works will cover generators, transformers, cabling, fuel storage tanks and piping of fuel lines. Testing of the plant will then be conducted before commission of the plant. All

construction activities including ground preparation, earth moving, materials delivery, building, walling, roofing and the installation of amenities (power, water, communication equipment, etc.), fittings (doors, windows, safety provisions, etc.) will be carried out by competent personnel obtained through respectable contractors/sub-contractors to ensure consistent high standard of finish and providing superb value for money. The MSD power plant will be constructed using common construction materials and construction procedures that are not expected to compromise the safety of the neighboring communities as well as the general environment. The following inputs will be required for construction:

1. Raw construction materials e.g. sand, cement, natural building stone blocks, hardcore, and gravel.
2. Timber (e.g. doors and frames, fixed furniture, etc.).
3. Paints, solvents, white wash, etc.,
4. Generator Sets.
5. A construction labour force (of both skilled and unskilled workers).

1.7 Project Budget

The estimated project cost is approximately project is $123,000,000 (One hundred and twenty-three million US dollars) covering:

1. Equipment procurement, transport and installation.
2. Construction costs including materials and labour.
3. Professional services.

1.8 Structure of the ESIA Report

This ESIA report is presented in 12 Chapters and 8 Appendices. The objective of the ESIA report is to provide a synthesis of the knowledge regarding the proposed project, current environment and socially conditions in the project area, potential impacts associated with the project, mitigation measures an environmental management plan.

Chapter 1 provides the project background, justification and bases for carrying out the ESIA.

Chapter 2 provides details of the methodology in conducting the ESIA study including the public participation process.

Chapter 3 details the Institutional and Legal Framework within which the ESIA is carried out including the requirements of Financial Institutions (EPFI) guidelines.

Chapter 4 provides the environmental and social baseline conditions in the vicinity of the project at the project site.

Chapter 5 analyses the various alternatives for the power plant project so as to determine the most appropriate option.

Chapter 6 describes the Technology, Procedures and Processes

Chapter 7 describes the Construction HSE Management Plan.

Chapter 8 describes the Products, By-Products and Wastes.

Chapter 9 identifies and analyses the potential environmental and social impacts, both positive and negative over the entire life of the project; covering, construction, operation and decommissioning phases.

Chapter 10 details Environmental Management Plan (EMP) for the entire project cycle to include mitigation measures to be taken during and after implementation of the project.

Chapter 11 details mitigation measures and monitoring programmes.

Chapter 12 details Environmental and social action plan.

Chapter 13 presents the conclusions and recommendations of this study.

CHAPTER 2: ESIA METHODOLOGY AND PUBLIC COSULTATION

2.1 ESIA NEMA Process background

To ensure sustainable use of natural resources, the Government of Kenya has developed Environmental and Social Impact Assessment (ESIA) procedures and guidelines for all projects curried out in the country. In 1994, the government developed the National Environment Action Plan (NEAP) to combine economic development with environmental conservation through:

1. Integration of environmental principles into development planning.
2. Promotion of environmental sound usage of renewable and non-renewable resources.
3. Establishment of an institutional framework for the coordination, monitoring and enforcement of environmental legislation as well as providing the manpower to do so.

In 1996, the Physical Planning Act was legislated and aims to provide for the preparation and implementation of physical development plans (Mumma, 1998). The act empowers local authorities to review project applications and to grant permission for developments. A separate act, the Environmental Management and Coordination Act (NEMA), was enacted in 1999 with the aim to identify projects and programmes, plans and policies for which environmental impact assessment, environmental audits or environmental monitoring must be conducted under the Act.

In accordance with the Kenyan EIA process before commencement of an environmental assessment the Terms of Reference (ToR) must be developed in consultation with the relevant authorities in the Scoping Process. At a regional level, a number of committees are in place in each district, with their brief being to guide and coordinate development in the various districts. The District Executive Committee (DEC) which consists of all civil servants, the District Development Committee (DDC) which consists of the DEC together with local leaders and politicians, and the District

Environmental Management Committee (DEMC) which consists of technical officers and local experts.

The ESIA in this project was structured such as to cover the requirements under the EMCA, 1999 as well as the Environmental Impact Assessment and Audit Regulations, 2003 and the IFC requirements. It involved largely an understanding of the project background, the preliminary designs and the implementation plan as well as commissioning.

In addition, baseline information was obtained through physical investigation of the site and the surrounding areas, informal interviews with a random sample of people from the surrounding community, use of public participation forms, site checklist, photography, and discussions with other stakeholders.

The key activities undertaken during the assessment were:

1. Continuous discussions with the stakeholders and accessing other sources of information on the proposed project details, the site planning and implementation plan.
2. Physical inspection of the proposed site, photography, and interviews with people in the immediate neighborhood. A public participation form was used to record their opinion regarding the project.
3. Evaluation of the activities around the site and the environmental setting of the wider area. This was achieved through existing information, literature and physical observations, Review of available documentation, Reporting, review and submissions.

2.2 The ESIA Process

An outline of the basic EIA steps that were followed during this assessment is as follows:

2.2.1 Screening

The environmental and social impacts assessment and prediction is precisely aimed at identification of possible negative and positive impacts including opportunities for enhancement of positive impacts. Screening is the first step in ESIA Study. It enables the project developers to decide early at planning and design stage whether an ESIA

study will be required or not. It involves environmental screening of the project using criteria such as World Bank Guidelines. Through quick initial evaluation considering location, size, scope, importance, sensitivity and expected environmental and social impacts, the project is allotted an environmental category A, B or C. Considering the above criteria, the present project falls under category B for which a limited scale environmental and social impact assessment is required. Conclusively, screening of adverse environmental and social issues is carried out for planning of the environmentally and socio-economically viable mitigation measures and their inclusion in the environmental management plan.

2.2.2 Scoping

If the project screening indicates that an ESA study is required, the next important task is "Scoping". The aim of scoping is to ensure that the ESA study addresses all key environmental and social issues of importance to the decision makers. It involves deliberations of environmental issues with the project stakeholders including project developers, decision makers, the regulatory agency, concerned government and semi-government departments, scientific institutions, local community leaders, local NGOs and other concerned to ensure that all environmental and social issues and concerns are discussed and key environmental and social impacts are identified. The scoping also enables the ESA Study Team to discuss and record views, comments and observations of the project stakeholders regarding negative and positive projects impact and mitigation measures for negative environmental and social impacts.

The scoping process involved discussions with the project proponent as well as data/information gathered from the site investigation and the documentation review, the proposed project was evaluated and rapid assessment of the site and the surrounding area made.

2.3 Establishment of Baseline Conditions

The environmental and social impacts assessment and prediction is based on the pre-existing or baseline conditions. Therefore, a survey of the baseline conditions was carried out covering social economic analysis of the project vicinity and physical inspections and observations.

Environmental sampling and analysis was done on air, water, noise and soil were carried out at the site. The site is located off the busy Nairobi - Mombasa Highway, which is currently being rehabilitated and reconstructed to a dual carriageway. The activities on the Nairobi - Mombasa Highway will impact on the project during constructions and operational phases.

2.4 Environmental and Social Impact Assessment

The scope of the assessment covers preconstruction phase, construction works of the proposed development which include ground preparation, civil works, structural works, Installation of the generators, installation of service lines as well as the utilities required, operational and decommission phases of the thermal power plant. The output of this work is a comprehensive Environmental and Social Impact Assessment Project Report for the purposes of seeking a NEMA license that will approve the project construction and operation. Additionally, the report should satisfy the Financial Institutions (EPFI) guidelines commonly referred to as the Equator Principles.

2.5 IFC Guidelines on ESIA Studies

The IFC's Policy and Performance Standards on Social and Environmental Sustainability include eight performance standards which define the client's roles and responsibilities for managing their projects and the requirements for receiving and retaining IFC support. The eight performance standards are summarized below as:

1. **Social and Environmental Assessment and Management System** - identifying of risks and impacts of proposed projects, it also aims at ensuring that affected communities are appropriately engaged on issues that could potentially affect them.

2. **Management System** - the client should establish management programs to address identified impacts and risks in favour of the avoidance and prevention of impacts over minimization, mitigation, or compensation, wherever technically and financially feasible, otherwise, provide mitigation measures and actions.

3. **Action Plan** - mitigation measures actions plan to reflect and address the outcomes of consultation on social and environmental risks and adverse impacts and the proposed measures and actions to address these.

4. **Organizational Capacity** -The client will establish, maintain, and strengthen as necessary an organizational structure that defines roles, responsibilities, and authority to implement the management program, including the Action Plan.

5. **Training** - The client will train employees and contractors with direct responsibility for activities relevant to the projects social and environmental.

6. **Community Engagement** - When local communities may be affected by risks or adverse impacts from a project, the engagement process will include consultation to build and maintain over time a constructive relationship with these communities, free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information.

7. **Disclosure** - Disclosure of relevant project information helps affected communities understand the risks, impacts and opportunities of the project. Where the client has undertaken a process of Social and Environmental Assessment, the client will publicly disclose the Assessment document.

8. **Consultation** - If affected communities may be subject to risks or adverse impacts from a project, the client will undertake a process of consultation in a manner that provides the affected communities with opportunities to express their views on project risks, impacts, and mitigation measures, and allows the client to consider and respond to them.

2.6 ESIA Study Approach

Based on the detailed review and perusal of the TOR provided by the Client, the Consultant formulated the approach and methodology for achieving the study objectives and fulfilling the TOR as here under:

1. A multidisciplinary integrated approach - All relevant disciplines falling under the project were represented in constitution of the ESIA team.
2. Close consultations with the Client - The proponent was to provide all relevant information regarding the proposed project design.

3. In depth review of background reports.
4. Consultation with the key stakeholders, including opinion leaders, community leaders, and government officials. The specific stake holders were arrived at by conducting an in depth stakeholder analysis.
5. The experience of the project team in implementation of similar projects.
6. Simple, practical and economical measures and options.
7. Collection and usage of primary and secondary data.
8. Baseline studies on soil, water, ambient air and noise studies.

The study was conducted in accordance with the Environmental Assessment and Audit Regulations promulgated in 2003 as set out by the Environmental and Management and Coordination Act (EMCA, 1999). A comprehensive participatory process was adopted to ensure active participation of members of the public to sensitize them on the government proposal and consequently have them air their views on the project. The members of public were also involved since they will be affected by the construction of the project either positively or negatively. All relevant stakeholders were consulted through formal and informal interviews and through discussions.

2.6.1 Sampling and Testing

The Consultant undertook various tests for soil, water, air and noise. Soil samples were obtained from the site and tested contamination by petroleum hydrocarbon at NEMA accredited Jomo Kenyatta University of Agriculture and Technology laboratory while water samples were tested at the Public Health Engineering laboratory, University of Nairobi. Onsite monitoring of baseline gaseous pollutants and noise levels was carried out by the Institute of Nuclear Science of the University of Nairobi. Analysis of the field data was geared to identifying possible health/environment impacts and setting baseline for future audits.

The testing and analysis was based on set Kenya procedures and/or other international standards. The quality assurance (QA) and Quality Control included Trial Blanks (TB) 1 per cooler and Blind Duplicates (BD), 10 % of samples collected per analytical method.

2.6.2 Soil Sample Analysis

An investigation on the contamination status of site soils was undertaken to determine the levels of total petroleum hydrocarbons (TPH), BTEX and PAHs. Soil sample was collected from different trial holes on site using standard soil sampling protocol. To avoid organic material breakdown, soil samples were immediately wrapped in aluminium foils. Groundwater was not encountered within the investigation depth. The analysis carried out on soil provided baseline data in total petroleum hydrocarbons and compared with guideline values (Table 2.1).

Table 2.1 Oil Industry Guidelines for TPH

1. TPH $\leq$ 500 mg/kg, assess on regular basis.
2. TPH between 1000 - 5000 mg/kg, monitoring and remediation of contaminated soil.
3. TPH greater than 5000 mg/kg, require full analysis.

The results at site reveal low concentrations of petroleum hydrocarbons in the soil sampled and full analysis in terms of assessing BTEXs and PAHs is not required. Whereas the released petroleum products do not pose any immediate health risks, the presence of hydrocarbons in the soil need to be monitored. Oil industry guideline for TPH in soil, referred to as ' Risk Based Corrective Action' (RBCA) was adopted to determine the required action to minimise exposure in soil. The soil contamination level is below the oil industry guideline for RBCA. Assessment on regular basis, ongoing monitoring and remediation of contaminated soils should be instituted. Monitoring wells if installed to below UST's bottom level will aid in easy sampling for possible contamination through accumulated ground water. The impact posed by lead levels is mitigated by shift to sale of unleaded petrol.

2.6.3 Air Particulate Matter

A dichotomous PM10 sampler model 241 was used to collect two size fractionated aerosol samples (PM<2.5 and PM2.5<10) during the sampling exercise. The sampler inlet was placed at heights of 2 meters from the ground and the flow rate adjusted to approximately 16.7 L/min. Sampling duration was 8 hours each day. The filter loading

were determined gravimetrically using a 10μg sensitivity Ainsworth (Type 24N) weighing balance in an air-conditioned room at 50% relative humidity and at 20 ^{o}C. The filter load densities were determined from results of volume of air sampled and the weights of the filter loads determined.

2.6.4 Gaseous Pollutants

Measurements of gaseous pollutants; NO_2, CO and SO_2 were obtained by using Nitrogen Dioxide meter data logger model Z-1400XP, Carbon monoxide meter Data logger model Z-500 XP and Sulphur Dioxide meter data logger model Z-1300XP respectively. Gaseous concentrations levels were determined from measurements of data taken at intervals of 10 seconds continuously for 8 hours each day at the sampling site. Some simulations have been performed using source strength of 50 micrograms/m3 of gaseous emissions. The release was assumed to be at 50 m. Supplied data has been reviewed, air pollution levels have been analysed and modeled. The meteorological conditions crucial in air quality management, namely: Wind speed and direction, and atmospheric stability have been analyzed. The air pollution impacts of the new plant on the surrounding area have been predicted using a computer based 2-D model.

The moderately stable to extremely stable conditions, which favor poor air pollution dilution, only occur about 3-5% of the year, during early morning when there is strong temperature inversion. This suggests that the plant should take mitigating measures during early mornings of particularly the cold seasons to minimize adverse effect of the pollution exposure to biological systems within the vicinity of the plant. Analysis of extreme stability for the sake of establishing the worst case scenarios is performed. It is observed that the cold season has the highest frequency of stable conditions.

It is predicted that, provided the source strength provisions in the project specifications are complied with, air pollution levels will not exceed EHS guidelines. Air pollution levels are therefore predicted to comply with all applicable legislative requirements.

Air pollutant concentrations should be measured at monitoring sites that are representative of population exposures.

Air pollution levels may be higher in the vicinity of specific sources of air pollution from power plants and so protection of populations living in such situations may require special measures to bring the pollution levels to below the guideline values.

2.6.5 Noise levels

Noise levels were measured using a digital sound level meter model HP-882A with a measurement range of 30 – 130 decibel and accuracy of ±1.5 dB. Readings were obtained at 8 different points three times every day. The spatial noise distribution meets the Kenyan Regulatory Noise standards within the environs of the facility. However, within the vicinity of the facility the noise levels may occasionally tend to almost exceed the limits especially under stable atmospheric conditions at night. This would require the necessary mitigation measures by way of insulating the buildings on the leeward (generally westward) side of the facility. The prevailing wind at the site is generally easterly. Any future noise level mitigations measures will consider building located to the west of the facility.

2.6.6 Water Quality Analysis

Physical and chemical water quality analyses were conducted on a sample from Mbagathi River in the vicinity of the proposed Athi River Thermal Power Plant, at the University of Nairobi Public Health Engineering Laboratories using standard methods.

Results indicate significant colour, turbidity, conductivity and solids (total and dissolved) which is characteristic of the type of strata and organic matter it traverses. However, the observed hardness is not significance and the water may be classified as moderately soft (50 - 100 as $CaCO_3$ mg/l) mainly calcium hardness. The water show very low concentrations of nutrients (phosphate and nitrates) suggesting limited contamination from agricultural sources. Similarly, the water had low concentrations of metals such as copper, manganese, iron and chromium indicating absence of industrial pollution. These results will form part of the baseline conditions.

2.7 Development of the ESIA Study Report

The compilation of the ESIA report entailed the following:

- Review of the literature on the baseline environment and engineering design basis documents

- Information from the public consultations
- Information from specialist studies on the following:
    - ✓ Noise assessment
    - ✓ Air quality measurements
    - ✓ Traffic impact analysis
    - ✓ Socio-economic impact assessment
    - ✓ Soil and geology description
    - ✓ Surface water analysis
    - ✓ Groundwater assessment
    - ✓ Environment risk assessment
- Compilation of findings to ensure all issues are covered
- Assessment and evaluation of the likely impacts
- Development of environmental mitigation measures for the adverse impacts
- Compilation of full ESIA study report for the project

2.8 Public Participation and Consultation

2.8.1 Introduction

World Bank/ IFC requirements for Public Consultation are being used as the primary point of reference. The requirements with respect to public consultation and disclosure in environmental assessment for projects are set out in Performance Standard 1: Social and Environmental Assessment and Management Systems. Section 19 defines Community Engagement as "ongoing process involving the client's disclosure of information. When local communities may be affected by risks or adverse impacts from a project, the engagement process will include consultation with them. The purpose of community engagement is to build and maintain over time a constructive relationship with these communities. Community engagement will be free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information."

2.8.2 Stakeholders Analysis

The consultant undertook a stakeholder analysis to identify the potentially affected groups by the project. This analysis identified the following groups that were to be consulted during public consultations. They were:

1. East African Portland Cement Company (EAPCC)
2. Technology Development Centre
3. Empakasi Community in Athi River
4. Kasoito village within Athi River
5. Noonkopir Community in Kitengela

In addition a number of lead agencies were identified and consulted in the process; they include:

1. Provincial administration – Chief kitengela
2. District Water officer Athi River District
3. Mavoko Municipal Council
4. Elected representatives(Civic Leaders) of Athi River ward
5. Mavoko Water and Sewerage Company (MAVWASCO)
6. Kenya Wildlife Services (KWS)

During the fieldwork a number of community meetings were conducted within the footprint of the project with households that are likely to be affected by the project and with local administration, community leaders and elders. House – to house interviews/ consultations of were also conducted. List of the meeting attendance and minutes of the same are attached in Appendices 2.1 and 2.2. In addition, sample questionnaires administered to the participants are attached in Appendices 1.5. The Kenya Wildlife Services (KWS) when consulted did not raise any concerns. Plate 2.1 and 2.2 show participants attending public forum organized at Noonkopir and the project site, respectively.

2.8.3 Issues Raised by the Community

The main concerns/recommendations by the participants of public meeting and interviews included the following:

1. Community members were concerned about the existing pollution in the area from existing factories and requested that the best available technology be used in the proposed thermal power plant.
2. Community members were concerned with the increase in the number of respiratory related problems due to air pollution in the area and asked the proponent to put up a dispensary in the area as part of Corporate Social Responsibility.

Plate 2.1 Public Meeting Held at Noonkopir

Plate 2.2 Public Meeting held with Athi River Residents at the Proposed Project Site

3. The community members indicated that the proponent should help in mitigating impact of air pollution and improvement of living environment by establishing tree nurseries in the area and participating in greening of the area lying on the leeward side of the proposed power plant.
4. Proponent should make it a priority to employ casual labour and other qualified personnel from the directly affected community in Athi River and Kitengela. The community proposed to form a committee to facilitate the employment and ensure compliance.
5. Community members should benefit from the business generated by the proposed power plant.
6. Institutions such as the Technology development Centre would like to see some of the trainees participating in capacity building by way of getting opportunities to be attached in the proposed plant when finally constructed.
7. Proponent to install security lights along the existing access road to the site to enhance security in the area.

8. Proponent to construct a footbridge for the community as part of corporate social responsibility across the Kitengela River.
9. The proposed project should not block existing access routes to the neighboring market centers.

2.8.4 Implication of the Public Consultation for Proposed power Plant

The public consultations provided the stakeholders with a forum to be informed of the proposed thermal plant project and to state their views and concerns. The information obtained is incorporated in the Environmental and Social Action Plan (ESAP) of this ESIA. Several themes emerged during the public consultation process and their implications are discussed in following subsections.

2.8.4.1 Air Pollution

There was a general concern on the potential air pollution from the proposed thermal power plant which would be detrimental to the health of the residents. Air pollution from flue gas emissions is a major concern in thermal power plants and it is addressed in detail in this ESIA. The ambient air quality was measured at the project site and will be used as the baseline for future monitoring after construction of the power plant. Air modeling for dispersion of emissions during operation of the plant was carried out based on the expected emissions and climatic data. The modeling indicates area which dispersed concentrations are predicted to be higher than the recommended in the WHO guidelines. These locations will require continuous monitoring.

2.8.4.2 Employment for the Local Residents

The directly affected communities at Athi River and Kitengela expressed strong desire to benefit from employment during the construction of the power plant. They were apprehensive that influential personalities would bring in immigrant workers and deny them jobs. To comply with requirements of the public consultation, the contractor will be required in the contract conditions to engage local residents only, for casual work during the construction. Furthermore, the Contractor will be required to consult with the residents committee for identification of the local residents to be employed.

The implication of recruiting all casual works will be from the vicinity of the project in is that the workers will therefore reside in their homes. Getting casual workers from

outside the Athi River and Kitengela Area will only be carried out following consultations with the local residents. Such workers will be housed in a workers Camp within the 5 ha Project Site.

Similar to the recruitment of casual workers, the contract document will require the contractor to procure all locally available construction materials from the affected community so as to benefit local businesses.

2.8.4.3 Corporate Social Responsibility (CSR) Programmes

The community pointed out several areas where they would like the proponent implements CSR programmes as follows:

(i) Construction of a footbridge for the community as part of corporate social responsibility across the Kitengela River,

(ii) Installation of security lights along the existing access road to the site to enhance security

(iii) Provision of electricity to schools in Athi River North.

(iv) Construction of a dispensary where affected people would be treated

(v) Establishment of a tree nursery to facilitate mitigation of environmental degradation.

CHAPTER 3: ESIA LEGISLATIVE, REGULATORY AND INSTITUTIONAL FRAMEWORK

3.1 Institutional Framework

In Kenya, the Environmental Management and Coordination Act (EMCA) of 1999 is the main legislation that deals with ESIA studies. In retrospect, the EMCA established various administrative bodies to operationalize EMCA. These include among others:
National Environment Council (NEC) – Is the apex body which among other things is charged with the responsibility of developing the national environmental policy in Kenya and setting annual environmental goals and standards.

The National Environment Management Authority (NEMA) – exercises general supervision and coordination over all matters relating to environment in Kenya.

The Public Complaints Committee (PCC) – investigates environmental complaints against any person, submit their findings/recommendations to NEC

The Standards and Enforcement Review Committee (SERC)—advises the NEMA on the criteria an 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. The institutional framework for EMCA is shown in Figure 3.1

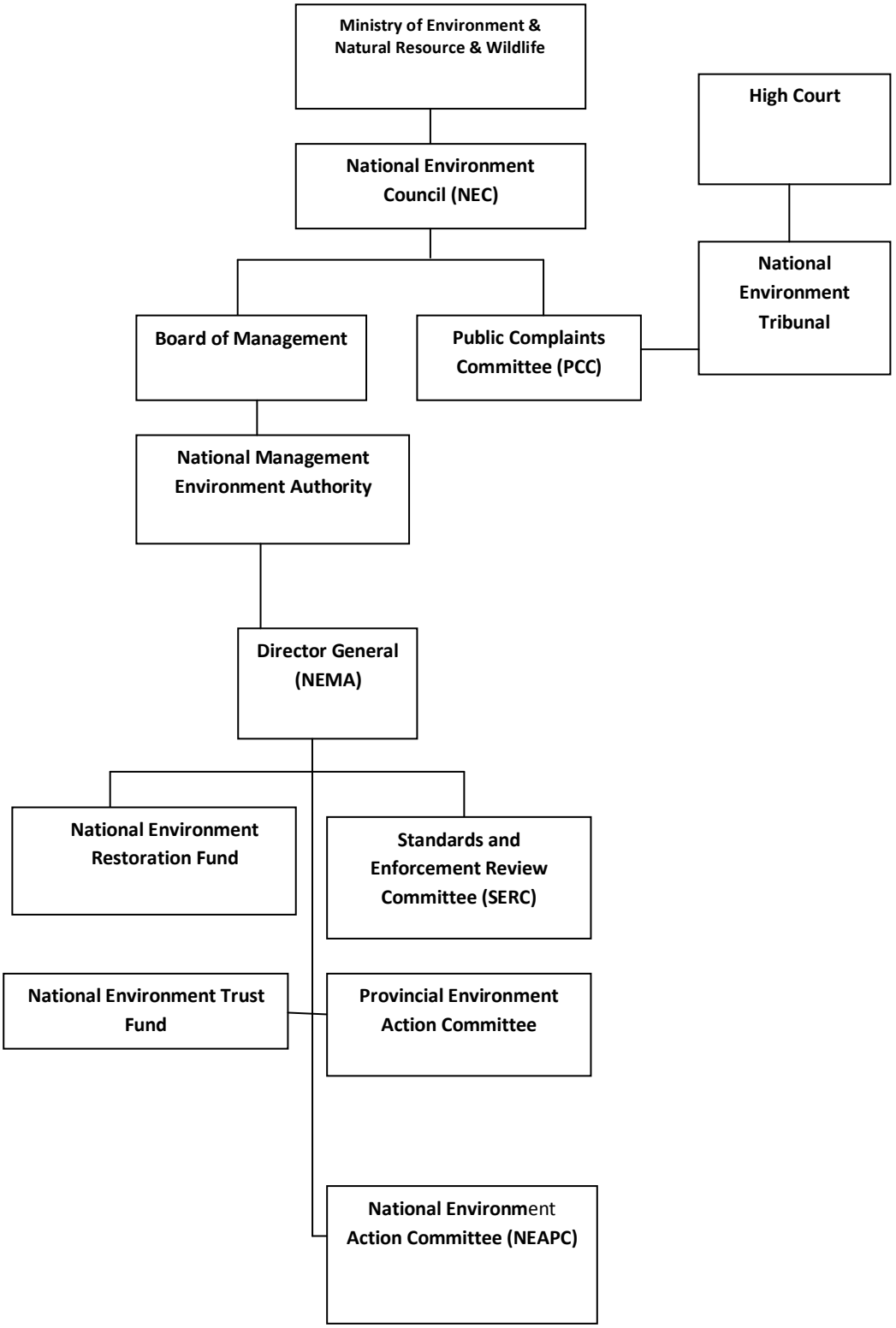


Figure 3.1: Institutional Framework under the EMCA

3.2 Legislative Framework

3.2.1 Environmental Law

The EMCA of 1999, provides for the establishment of an appropriate legal and institutional framework for the management of the environment. The subsidiary legislations under the EMCA are: Legal notice (L.N) 101: Environmental Impact Assessment (EIA)/Environmental Audit (EA) Regulations (2003)

These regulations, promulgated on 13th June 2003, provide the framework for undertaking EIAs 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 NEMA. This ESIA study is undertaken in accordance with the requirements of L.N.101.

L.N 120: Water Quality Regulations, 2006

The regulation was promulgated on September 4th 2006. The regulations provides for the sustainable management of water for various uses in Kenya. For industries, the regulations require the Proponents to apply for an Effluent Discharge License annually for discharging process wastewater either into the environment, aquatic environment or public sewer. For discharges into the environment, the Proponent is required to apply NEMA. For discharge into public sewers , the Proponent needs to apply for the license to the relevant local authority. The regulations contain discharge limits for various environmental parameters into public sewers and environment. Table 3 shows effluent discharge standards for power plants. The non-compliance with the regulations carries a penalty of not more than Ksh 500,000 (1$ = Ksh 80, prevailing exchange rate). The proposed power plant will require adherence to the standards during construction and operational phases. Table 3.1 shows the recommended effluent discharge standards for power plants.

L.N 121: Waste Management Regulations (WMR), 2006

The WMR were promulgated on September 4th 2006 and became operational on July 1, 2007. The regulations cover both hazardous and nonhazardous wastes. For the Proponent, it is expected that there will be hazardous and nonhazardous wastes generated during construction and operational phases of the project.

Table 3-1: Effluent Discharge Standards for Power Plants

Parameter	Permissible limits for Discharge into the Environment	Permissible Limits for Discharge into Public Sewers
TSS	30mg/l	250mg/l
Ph	6.5-8.5	6-9
Feacal coliforms	30 counts/100ml	-
Oil & grease	Nil	10mg/l
Temperature	Based on ambient +3^0 C	20-35^0 C
Color/dye/pigment	15 Hazen units	<40 Hazen units
Total phosphorous	-	-
Flow	-	-
Chromium vi	0.5mg/l	0.05mg/l
Copper	1.0mg/l	1.0mg/l
Zinc	0.5mg/l	5mg/l
Residual chlorine	0.1	-
Tin	-	-

Under the regulation, it is a requirement that waste is transported using a vehicle that has a waste approved 'Waste Transportation License' issued by NEMA. Wastes generated 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.

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

The Minister for Environment and Mineral Resources promulgated in May 2009 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.

The regulation in addition specifies that a noise license will be required during the construction and operational phase of a project if such equipment that will produce noise during these two phases will be used.

There will be need for the contractor to apply for a noise license from the NEMA during the construction phase of the project.

Table 3.2 Permissable Noise Levels

Zone	Sound Level limits(dBA) (leq, 14h)	Noise Rating Level (NR) (leq, 14h)			
		Day	Night	Day	night
A.	Silent Zone	40	35	30	25
B.	Places of Worship	40	35	30	25
C.	Residential: Indoor Outdoor	 45 50	 35 35	 35 40	 25 25
D.	Mixed residential (with some commercial and places of entertainment)	55	35	50	25
E.	Commercial	60	35	55	25

3.2.1.1 Other Legislation under EMCA

The SERC is understood is currently the process of drafting new regulations to manage environmental quality in Kenya emanating from diverse industrial activities. These regulations when promulgated will provide the framework for further managing Kenya's environmental quality and will be adhered to by the Proponents, if the projects fall within their jurisdiction.

3.2.2 The Energy Act, 2006

The Act was promulgated in 2006, with effective date of July 1, 2007. A key aspect under this legislation is the requirement for any energy sector project to undergo full EIA Study . The Triumph Power project falls in this category and thus a Full ESIA study is required.

Section 90 of the Act requires a Proponent to seek permission from Electricity Regulatory Commission (ERC) to construct power plant. The application must be accompanied by among other documents an ESIA study report.

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

Section 98 of the Act requires project's compliance with HSE standards as set by ERC

Section 102 (h) (m) and (v) Empowers Minister for Energy to promulgate regulations for environmentally sound management of energy sector related facilities and infrastructure.

OSHA of 2007 was enacted to cater for the health, safety and welfare of persons employed in workplaces.

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.

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 deals with workplaces. 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.

Part VI of the Act deals with provisions for cleanliness, ventilation, overcrowding, etc.

Part VII of the Act gives provisions for the safe operation of machinery and includes all prime movers and transmission equipment.

Part VIII of the Act deals with general safety of a workplace especially fire safety. This part of the Act will apply to the proposed projectduring the design, construction and operational phases respectively of the project.

Part IX of the Act gives provisions for Chemical Safety. TheOccupier will be required to have MSDS sheets for all chemicals handled in the workplace including labeling receptacles containing such hazardous materials.

Part X of the Act deals with the General Welfare conditions that 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.

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.

Part XIII of the Act stipulates the fines and penalties for non-compliance with S&H provisions.

Part XIV of the Act and contains miscellaneous provisions which are not covered elsewhere.

3.2.3.1 Subsidiary legislation under OSHA

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

The 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:

- Provision of first aid boxes in accordance with Legal Notice No. 160 of 1977;
- Ensuring that there are certified first aiders trained and the certification of these first aiders
- Provision of a General Register for recording ofincidents, accidents and occupational injuries;
- Appointment of a S&H Committee

- Training of the S&H Committee
- Appointment of a S&H management representative for the Proponent;
- The S&H Committee must meet at least quarterly,
- Appropriate recordkeeping including maintenance of all current certificates

L.N. 24: Medical Examination Rules 2005

The regulations provide for Occupiers to mandatorily undertake pre-employment, periodic and termination medical evaluations of workers as specified in the Shedules

The Contractor should ensure that Material Safety Data Sheets (MSDSs) for chemicals used in the construction and operational phase are studied for toxicological and epidemiological information.

The workers exposed to the chemicals will be required to undergo medical examinations in accordance with the above Rules.

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

The regulations are for work related with noise exposures and were promulgated on March 10th2005. 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.
- ✓ Noise levels emanating from a workplace are regulated as follows:
- ✓ 50 dB(A) during the day; and
- ✓ 45 dB(A) at night.

The noise levels exceeding the above permissible levels, the Occupier is required to have in place a 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;
- ✓ Annual program review.

The equipment brought to a site in Kenya for use shall be designed or have built in noise reduction devices that do not exceed 90dB(A). The Proponent shall request the supplier of the machine or equipment forits noise characteristics.

There is in addition a requirement to medically examine those employees that may be exposed to continuous noise levels of 85 dB(A) as indicated in Regulation 16.

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.

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.

Regulation 5 requires 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 refers to flammable materials storage

Regulation 7 refers to storage tanks of flammable materials or flammable liquid containers be labeled with the words “Highly Flammable” in English or Kiswahili.

Regulation 8(3) requires having a spill prevention, response and countermeasures plan.

Regulation 16 relates to electrical equipment. All electrical equipment is required inspected 6-monthly

Regulation 17 refers to fire escape exits. This provides for the minimum standards to be applied in marking out of fire escape exits.

Regulations 20 – 23 provide for the minimum number of fire team members based on the total number of employees.

Regulation 22 deals with the functions of a fire fighting team.

Regulation 23 deals with fire drills which should take place at least once a year.

Regulations 24, 26 and 27 refer to the communication system

Regulation 28 deals with fire detection systems in their premises.

Regulations 29 – 31 deals with the installation and maintenance of fire fighting systems in workplaces.

Regulation 32 deals with the color code all their pipelines according to the product being conveyed.

Regulation 33 deals with fire water storage capacity. To have at least 10cubic meters of fire water storage capacity.

Regulation 34 deals with Fire Safety Policy. The policy should contain a Fire Safety Policy Statement approved by the CEO, Fire Safety Policy Manual and a summary of the Fire Safety Policy of the organization.

Regulation 35 deals with handling occurrence of fire incidences notification of those incidences.

Regulation 36 deals with fire safety audits

L.N. 60: Hazardous Substances Rules, 2007

The regulations were promulgated by the Minister of Labor on April 16th 2007 and apply to chemicals that can potentially expose their employees to hazardous substances. The Rules set the exposure limits set out in the First Schedule of the Regulations.

Regulation 11 deals with protection from radioactive substances.

Regulation 12 – 15 deals with Hazard Communicationprogram to be implemented at workplace. All containers containing chemicals must be labeled appropriately as indicated in the MSDS for that chemical.

Regulation 16 deals with monitoring chemical exposure levels in the Workplace.

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

3.2.4 The Water Act (Act No.8 of 2002)

This is an Act of Parliament to provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services; to repeal the Water Act (Chapter. 372 of the Laws of Kenya) and certain provisions of the Local Government Act; and for related purposes.

In addition to this act and in furtherance of the said related purposes the Minister for Water and Irrigation, through the powers conferred to him by Sections 47(6) and 110(1) of the Water Act, 2002, made THE WATER (WATER SERVICES LEVY) REGULATIONS, 2008. This sought to impose a levy of one per cent (1%) of all sales of water services to consumers by each water service provider operating under the Act.

The Water Act, in general, gives provisions regarding the ownership of water, institutional framework, national water resources, management strategy, and requirement for permits, state schemes and community projects. Part IV of the Act addresses the issues of water supply and sewerage. Section 59 of the Act states that the National Water strategy shall contain details of:-

1. Existing water services.
2. The number and location of persons who are not being provided with basic water supply and basic sewerage.
3. Plans for the extension of water services to underserved areas.
4. The time-frame for the plan; and
5. An investment programme.

3.2.5 Agriculture Act (Chapter 318 of the Laws of Kenya)

This statute seeks to promote and maintain a stable agriculture, to provide for the conservation of the soil and its fertility and to stimulate the development of agricultural

land in accordance with the accepted practices of good land management and good husbandry.

The Minister administering the Act, after concurrence with the Central Agricultural Board and consultation with the District Agricultural Committee, can impose land conservation orders on lands to control cultivation, grazing and clearing. These controls may be necessary to protect the land against soil erosion, to protect fertility, and to maintain catchments. Local authorities are generally empowered to administer these sections of the Act and the District Agricultural Committee is entitled to make regulations relating to these controls.

Agricultural Rules are prescribed under the Act, whereby vegetation clearing in steep slopes areas or adjacent watercourses, without authorization, is controlled.

3.2.6 Wildlife (Conservation & Management) Act Chapter 376 of the Laws of Kenya

This Act of Parliament deals with the consolidation and amendment of the law relating to the protection, conservation and management of wildlife in Kenya; and for purposes connected there with and incidental thereto.

The act provides that where it is desirable that the present powers relating to the management and conservation of wildlife in Kenya should be amalgamated and placed in a consolidated Service of the Government and the prime objective of the Service should be to ensure that wildlife is managed and conserved so as to yield to the Nation in general and to individual areas in particular, optimum returns in terms of cultural, aesthetic and scientific gains as well as such economic gains as are incidental to proper wildlife management and conservation and which may be secured without prejudice to such proper management and conservation.

For the achievement of that objective, that full account should be taken of the varied forms of land use and the inter-relationship between wildlife conservation and management and other forms of land use.

The Act controls activities within the park, which may lead to the disturbance of animals. Unauthorized entry, residence, burning, damage to objects of scientific interest, introduction of plants and animals and damage to structure are prohibited.

3.2.7 Land (Group Representatives) Act (Chapter 287 of the Laws of Kenya)

This is an Act of Parliament to provide for the incorporation of representatives of groups who have been recorded as owners of land under the Land Adjudication Act, and for purposes connected therewith and purposes incidental thereto.

3.2.8 Way leaves Act (Chapter 292 of the Laws of Kenya)

This Act of Parliament provides that any person in the service of the government and any contractor executing any work for the Government, together with his agents and servants, may at any time enter upon any land for the purpose of surveying, setting out and marking the line of any intended sewer, drain or pipeline, or for the purpose of inspecting, repairing, removing, re-laying or cleansing any sewer, drain or pipeline the property of the Government, or for any other purpose under this Act.

3.2.9 Physical Planning Act (No. 6 of 1996)

This Act of Parliament provides for the preparation and implementation of physical development plans and for connected purposes.

Section 36 of this Act provides for Environmental impact assessments and states that:-

If in connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an environmental impact assessment report.

3.2.10 Land Acquisition Act (Chapter 295 of the Laws of Kenya.)

The Land Acquisition Act makes provisions for the compulsory acquisition of land for the public benefit. Under the Act the Commissioner of Lands may in writing authorize any person, together with servants and workmen, to enter upon any land specified in a notice and to survey the land and to do all things which may be reasonably necessary to ascertain whether the land is suitable for the purpose for which it may be required.

Where land is acquired compulsorily under this Act, full compensation shall be paid promptly to all persons interested in the land.

In Kenya there are a large number of enactments all governing land and transactions in land. Thus the substantive land law is to be found in two different statutes while the adjectival land law is to be found in five different statutes not forgetting the customary land law of the various tribes in Kenya.

Systems of Substantive Land Law

There are two systems of substantive land law in Kenya these are:

1. The Indian Transfer of Property Act 1882 as amended by the 1959 Amendment Act. This Act sought to amend the law relating to the transfer of property by act of parties, whereby the transfer of property means an act by which a living person conveys property, in present or in future, to one or more other living persons, or to himself, or to himself and one or more other living persons.

2. The Registered Land Act (Chapter 300 of the Laws of Kenya.) The intention of this Act of Parliament is to make further and better provisions for the registration of title to land, and for the regulation of dealings in land so registered, and for purposes connected therewith.

Conveyance systems

There are three systems of conveyance and these are those applicable to land registered under,

- The Government Lands Act (Chapter 280 of the Laws of Kenya). This Act of Parliament seeks to make further and better provision for regulating the leasing and other disposal of Government lands. The Land Titles Act (Chapter 282 of the Laws of Kenya).This Act of Parliament seeks to make provision for the removal of doubts that have arisen in regard to titles to land and to establish a Land Registration Court.
- Registration of Titles Act (Chapter 281 of the Laws of Kenya): This is an act of parliament to provide for the transfer of land by the registration of titles. Section

32 provides that no instrument, until registered in the manner prescribed in the act shall be effectual to pass any land or any interest therein, or render the land liable as security for the payment of money, but upon the registration of an instrument in the manner prescribed the land specified in the instrument shall pass, or, as the case may be, shall become liable as security in the manner and subject to the agreements, conditions and contingencies set out and specified in the instrument, or declared by this Act.

- Registered Land Act (Chapter 300 of the Laws of Kenya.) This is an Act of Parliament intended to make further and better provision for the registration of title to land, and for the regulation of dealings in land so registered, and for purposes connected therewith.
- Registration Systems
- The five registration systems are those under: -
- The Government Lands Act (G.L.A.)
- The Registration of Titles Act (R.T.A)\
- The Land Titles Act (L.T.A)
- The Registration of Documents Act (Chapter 285 of the Laws of Kenya): This is an Act of Parliament to provide for the registration of documents. It states that: all documents conferring, or purporting to confer, declare, limit or extinguish any right, title or interest, whether vested or contingent to, in or over immovable property (other than such documents as may be of a testamentary nature) and vakallas shall be registered. It should be noted that this Act isn't peculiar to Land Law, as documents completely unrelated to land can be registered under it.
- The Registered Land Act (R.L.A).

Land Ownership

Absolute or complete ownership in land vests in the state. Under the Government Lands Act the Commissioner of Lands, on behalf of the Republic of Kenya grants leases of town plots for any term not exceeding ninety-nine(99) years and of agricultural land for a term not exceeding nine hundred and ninety-nine(999) years.

The grantee (the person receiving the land) becomes the owner and subject to the terms and conditions of the lease he possesses the bundle of the rights of ownership. The 999-year leases can be converted into freehold leases and the 99-year leases into 999-year leases.

On conversion or expiry of the Lease, a new grant may be issued under The R.L.A or the R.T.A. All un-alienated land other than trust land and all reversion of Government leases are vested in the Government, other lands whether held on freehold or leasehold are vested in the grantees as owners having the rights over them.

The power of the State to qualify (extinguish) property rights in the public interest is embodied in Section 75 of the Constitution. The section however makes the exercise of that power subject to due process (this includes the payment of prompt and adequate compensation) Section 117 of the Constitution further provides that an Act of Parliament may empower a county council to set apart trust land for the use and occupation of any person or persons for a purpose which is likely to benefit the residents of that area.

Section 117(4) stipulates that the setting apart of such land is void unless the law under which it is made makes provision for the prompt payment of full compensation. The Trust Land Act, in Sections 7 to 13, makes provisions for the setting apart of land and payment of compensation with regard thereto. All land in urban areas of Kenya and much of the land in rural areas has a registered title. The title to land is either freehold or leasehold. The development and use of freehold title is controlled by land planning regulations which are administered by both the Central Government and the Local Authority in which the Land is situated. (A local Authority is either a County Council or a Municipal Council whose activities are established and controlled by the Local Government Legislation.)

Leasehold land is held on leases from the Central Government or, less frequently, from the Local Authority and such lease will contain provisions governing the development of the land and the use to which the land can be put. The leases frequently contain provisions against any dealing with the land without the consent of the landlord. The

Central Government administers its land through a Department of Lands which is headed by a Commissioner of Lands.

3.2.11 Local Government Act (Chapter 265 of the Laws of Kenya.)

This is an Act of parliament, which provides for the establishment of authorities for local government; to define their functions and to provide for matters connected therewith and incidental thereto. The Act is connected with a wide range of matters that affect the day-to-day activities of individuals and organizations.

Section 163A of this Act gives the local authority the power to grant business permits. It states that a local authority may on receipt of an application under this Act grant a business permit to allow the conduct of a business or trade, including a profession or occupation within its area. Provided that in the case of a business, trade, profession or occupation regulated by the provisions of any other written law, a person shall prior to the submission of an application for a business permit pursuant to this subsection, satisfy all the requirements of that other written law.

Section 163 is another important part of the Act it gives every town council and urban council power, to control or prohibit all businesses, factories and workshops which, by reason of smoke, fumes, chemicals, gases, dust, smell, noise, vibration or other cause, may be or become a source of danger, discomfort or annoyance to the neighborhood, and to prescribe the conditions subject to which such businesses, factories and workshops shall be carried on.

Section 145 of the Act is concerned with the miscellaneous powers of local authorities subsection (w) empowers local authorities to take measures that may be necessary or desirable for the preservation or protection of wildlife, and provide amenities for the observation of wildlife.

Section 146(d) empowers a local authority, with the consent of the Minister to make grants for the establishment and maintenance of game parks and other related facilities.

Section 147(d) controls the cutting of timber and the destruction of trees and shrubs.

Under section 265(1) of the Act, any officer of a local authority duly authorized in writing shall, on producing, if so required, some duly authenticated document showing his authority, have a right to enter any premises at all reasonable hours for the purpose of ascertaining whether there is, or has been, on, or in connection with, the premises, any contravention of this Act or of any by-laws, whether made under this Act or any other written law, being provisions which it is the duty of the local authority to enforce.

3.2.12 Forests Act (Chapter 375 of the Laws of Kenya.)

This is an Act of Parliament intended to provide for the establishment, control and regulation of Central Forests, forests and forest areas in the Nairobi Area and on unalienated Government Land.

Section 6(1) of the Act, the Minister may by notice in the Gazette declare a forest area or a Central Forest or any part thereof to be nature reserve for the purpose of preserving the natural amenities thereof and the flora and fauna therein, and may declare that a nature reserve shall cease to be a nature reserve.

It goes on to provide that in a nature reserve, no cutting, grazing, removal of forest produce or disturbance of the flora shall be allowed except with the permission of the Director of Forestry, and permission shall only be given with the object of conserving the natural flora and amenities of the reserve.

Further, hunting, fishing and the disturbance of the fauna shall be prohibited except in so far as may be permitted by the Director of Forestry in consultation with the Chief Game Warden, and permission shall only be given in cases where the Director of Forestry in consultation with the Chief Game Warden considers it necessary or desirable to take or kill any species.

There is subsidiary legislation in the form of THE FORESTS (CONTROLLED ENTRY) RULES which provide that no person to whom these Rules apply shall enter into or remain in any of the Central Forests specified in the Schedule, save under and in accordance with the terms of a permit in that behalf issued to that person by a forest officer.

These Rules shall not apply to persons using a public line of travel at any hour or to persons traveling on a road constructed by the Forest Department or its licensees

between the hours of 6 a.m. and 7 p.m. unless the road has been closed by a notice or barrier or both.

However, these Rules apply to all persons other than officers of the Government acting in the performance of their duties and employees of the Forestry Department in possession of a valid employment card.

3.2.13 Trust Land Act (Chapter 288)

This is an Act of Parliament which makes provision for Trust land. Section 38(1) of the Act provides that a way leave license may be granted to any person empowering him and his servants and agents to enter upon Trust land vested in the council and to lay pipes, make canals, aqueducts, weirs and dams and execute any other works required for the supply and use of water, to set up electric power or telephone lines, cables or aerial ropeways and erect poles and pylons therefore, and to make such excavations as may be necessary for the carrying out of any such purposes, and to maintain any such works as aforesaid.

Section 8 of the Act provides that where land is set apart, full compensation shall be promptly paid by the Government to any resident of the area of land set apart who:

- Under African customary law for the time being in force and applicable to the land has any right to occupy any part thereof; or
- Is, otherwise than in common with all other residents of the land, in some other way prejudicially affected by the setting apart.

Subsidiary legislation is to be found in the form of THE TRUST LAND (WAY LEAVES FOR ELECTRIC LINES) RULES. In these Rules a way leave license granted under section 38(of the Trust Land Act) for the purpose of erecting or laying an electric line over or under land shall be in the form in the Schedule to these Rules, or as near thereto as possible, regard toeing had to the circumstances and requirements of each case.

Before granting any such wayleave license, the council shall satisfy itself that compensation in respect of disturbance or of any other loss or expenses likely to be caused by the erection or laying of the electric line has been or will be paid to those concerned in like manner and to the same extent as if the land had been set apart under the Act and as if the compensation were being paid under section 8 of the Act.

No such way leave license shall be valid for a longer period than the period of validity of the relevant license issued under the Electric Power Act.

The annual fee to be paid for such a way leave license shall be assessed at 25 cents per annum per pole or pylon, or, where the electric line is laid underground, Sh. 5 per mile.

3.2.14 Public Health Act (Cap. 242)

Environmental degradation may pose a health hazard to the general public. This is among the factors considered by the Public Health Act to constitute "nuisance". For the interpretation of the Act, Section 15 (IX) indicates that any noxious matter or wastewater discharged from any premise, such as a building constitutes nuisance. Any premise not kept in a clean and free from offensive smell such as gases which are injurious to health such as those from commercial establishments shall therefore generate nuisance. The Act therefore stresses that no person shall cause a nuisance to exist on any land or premise occupied by him. Because of the above, the Act acknowledge that it shall be the duty of all local authorities to take all lawful measures for maintaining its district at all times in a clean and sanitary condition for remedy of any nuisance or condition liable to be injurious to health. To safeguard against this, Part X of the Public Health Act states that where in the opinion of the Medical Officer of Health that food stuffs within a warehouse, or a building are insufficiently protected, the owner shall be compelled to observe the require regulations, else he shall be guilty of an offence.

3.2.15 Penal Code (Cap. 63)

The chapter on "Offences against Health and Conveniences" contained in the Penal Code enacted in 1930 strictly prohibits the release of foul air into the environment, which affects the health of other persons. Any person who voluntarily violates the atmosphere at any place, to make it noxious to health of persons in general dwelling or carrying out business in the neighbourhood or passing along public ways is guilty of misdemeanour, i.e. imprisonment not exceeding two years with no option of fine. Under this code, any person who for the purpose of trade or otherwise makes loud noise or offensive awful smell in such places and circumstances as to annoy any considerable

number of persons in the exercise of their rights, commits an offence, and is liable to be punished for a common nuisance, i.e. imprisonment not exceeding one year with no option of fine.

3.3 Environmental Standards

3.3.1 IFC Performance Standards

The World Bank and other international financial institutions require projects to be funded by them directly or indirectly the projects to undergo screening through their approved criteria. These are referred to as The IFC's Policy and Performance Standards on Social and Environmental Sustainability. These are expounded eight Performance Standards which define the clients roles and responsibilities for managing their projects and the requirements for receiving and retaining IFC support.

Social and Environmental Assessment and Management System

This Standard is similar to the NEMA Environment Regulations 2003. In addition to identifying risks and impacts of proposed projects, it also aims at ensuring that affected communities are appropriately engaged on issues that could potentially affect them.

The Standard requires that the area of influence encompasses, as appropriate: (i) the primary project site(s) and related facilities that the client (including its contractors) develops or controls , such as power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and disposal areas, construction camps; (ii) associated facilities that are not funded as part of the project (funding may be provided separately by the client or by third parties including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project; (iii) areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken; and (iv) areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project.

Management System

The standard requires that after EIA, the client should establish management programs that consist of a combination of operational policies, procedures and practices. The measures and actions to address identified impacts and risks will favour the avoidance and prevention of impacts over minimization, mitigation, or compensation, wherever technically and financially feasible. Where risks and impacts cannot be avoided or prevented, mitigation measures and actions will be identified so that the project operates in compliance with applicable laws and regulations, and meets the requirements of the other Performance Standards. The program will define desired outcomes as measurable events to the extent possible, with elements such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods, and with estimates of the resources and responsibilities for implementation. Recognizing the dynamic nature of the project development and implementation process, the program will be responsive to changes in project circumstances, unforeseen events, and the results of monitoring.

Action Plan

Where the client identifies specific mitigation measures and actions necessary for the project to comply with applicable laws and regulations the client will prepare an Action Plan. These measures and actions will reflect the outcomes of consultation on social and environmental risks and adverse impacts and the proposed measures and actions to address these. The Action Plan will: (i) describe the actions necessary to implement the various sets of mitigation measures or corrective actions to be undertaken; (ii) prioritize these actions; (iii) include the time-line for their implementation; (iv) be disclosed to the affected communities (v) describe the schedule and mechanism for external reporting on the client's implementation of the Action Plan.

Organizational Capacity

The client will establish, maintain, and strengthen as necessary an organizational structure that defines roles, responsibilities, and authority to implement the management program, including the Action Plan. Specific personnel, including

management representative(s), with clear lines of responsibility and authority should be designated. Key social and environmental responsibilities should be well defined and communicated to the relevant personnel and to the rest of the organization. Sufficient management sponsorship and human and financial resources will be provided on an ongoing basis to achieve effective and continuous social and environmental performance.

Training

The client will train employees and contractors with direct responsibility for activities relevant to the project's social and environmental performance so that they have the knowledge and skills necessary to perform their work, including current knowledge of the host country's regulatory requirements and the applicable requirements of Performance Standards 1 through 8. Training will also address the specific measures and actions required under the management program, including the Action Plan, and the methods required to perform the action items in a competent and efficient manner.

Community Engagement

Community engagement is an on-going process involving the client's disclosure of information. When local communities may be affected by risks or adverse impacts from a project, the engagement process will include consultation with them. The purpose of community engagement is to build and maintain over time a constructive relationship with these communities. The nature and frequency of community engagement will reflect the project's risks to and adverse impacts on the affected communities. Community engagement will be free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information.

Disclosure

Disclosure of relevant project information helps affected communities understand the risks, impacts and opportunities of the project. Where the client has undertaken a process of Social and Environmental Assessment, the client will publicly disclose the Assessment document. If communities may be affected by risks or adverse impacts

from the project, the client will provide such communities with access to information on the purpose, nature and scale of the project, the duration of proposed project activities, and any risks to and potential impacts on such communities. For projects with adverse social or environmental impacts, disclosure should occur early in the Social and Environmental Assessment process and in any event before the project construction commences, and on an ongoing basis

Consultation

If affected communities may be subject to risks or adverse impacts from a project, the client will undertake a process of consultation in a manner that provides the affected communities with opportunities to express their views on project risks, impacts, and mitigation measures, and allows the client to consider and respond to them. Effective consultation: (i) should be based on the prior disclosure of relevant and adequate information, including draft documents and plans; (ii) should begin early in the Social and Environmental Assessment process; (iii) will focus on the social and environmental risks and adverse impacts, and the proposed measures and actions to address these; and (iv) will be carried out on an ongoing basis as risks and impacts arise. The consultation process will be undertaken in a manner that is inclusive and culturally appropriate. The client will tailor its consultation process to the language preferences of the affected communities, their decision-making process, and the needs of disadvantaged or vulnerable groups.

For projects with significant adverse impacts on affected communities, the consultation process will ensure their free, prior and informed consultation and facilitate their informed participation. Informed participation involves organized and iterative consultation, leading to the client's incorporating into their decision-making process the views of the affected communities on matters that affect them directly, such as proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues. The client will document the process, in particular the measures taken to avoid or minimize risks to and adverse impacts on the affected communities.

Grievance Mechanism

The client will respond to communities' concerns related to the project. If the client anticipates ongoing risks to or adverse impacts on affected communities, the client will establish a grievance mechanism to receive and facilitate resolution of the affected communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address concerns promptly, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the affected communities, and at no cost and without retribution. The mechanism should not impede access to judicial or administrative remedies. The client will inform the affected communities about the mechanism in the course of its community engagement process.

Labour and working conditions

Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers. For any project, the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient to the sustainability of the project. Failure to establish and foster a sound worker management relationship can undermine worker commitment and retention, and can jeopardize a project. Conversely, through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

The requirements set out in this Performance Standard have been in part guided by a number of international conventions negotiated through the International Labour Organization (ILO) and the United Nations (UN).

Children below the age of 18 years will not be employed in any form of work. The client will not employ forced labor, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labor, such as indentured labor, bonded labor or similar labor-contracting arrangements.

Pollution Prevention and Abatement

This performance Standard recognizes that increased industrial activity and urbanization often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level. On the other hand, along with international trade, pollution prevention and control technologies and practices have become more accessible and achievable in virtually all parts of the world. According to this standard, the Client should consider the ambient conditions and apply pollution prevention and control technologies during the design, construction, operation and decommissioning of the project that are best suited to avoid or, where avoidance is not feasible, minimize or reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective

The project-specific pollution prevention and control techniques applied during the project life-cycle will be tailored to the hazards and risks associated with project emissions and consistent with good international industry practice as pollutants in the solid, liquid, or gaseous forms, and is intended to include other forms such as nuisance odours, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light.

Community Health, Safety and Security

The IFC Performance Standard 4 on Community Health, Safety and Security recognizes that projects can increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failures, and releases of hazardous materials. Communities may also be affected by impacts on their natural resources, exposure to diseases, and the use of security personnel.

It is the responsibility of the client in the proposed project to avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances. The client should also ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security.

Land Acquisition and Involuntary Resettlement

Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition. Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition that result in displacement. Unless properly managed, involuntary resettlement may result in long-term hardship and impoverishment for affected persons and communities, as well as environmental damage and social stress in areas to which they have been displaced. For these reasons, involuntary resettlement should be avoided or at least minimized. However, where it is unavoidable, appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented. Experience demonstrates that the direct involvement of the client in resettlement activities can result in cost-effective, efficient, and timely implementation of those activities, as well as innovative approaches to improving the livelihoods of those affected by resettlement. Negotiated settlements help avoid expropriation and eliminate the need to use governmental authority to remove people forcibly. Negotiated settlements can usually be achieved by providing fair and appropriate compensation and other incentives or benefits to affected persons or communities, and by mitigating the risks of asymmetry of information and bargaining power. Clients are encouraged to acquire land rights through negotiated settlements wherever possible, even if they have the legal means to gain access to the land without the seller's consent. The Proponent should aim at improving or at least restoring the livelihoods and standards of living of displaced Persons.

Biodiversity Conservation and Sustainable Natural Resource Management

In order to avoid or minimize adverse impacts to biodiversity in the project's area of influence the client will assess the significance of project impacts on all levels of biodiversity as an integral part of the Social and Environmental Assessment process. The Assessment will take into account the differing values attached to biodiversity by specific stakeholders, as well as identify impacts on ecosystem services. The

Assessment will focus on the major threats to biodiversity, which include habitat destruction and invasive alien species.

The Client should try as much as possible to minimize any conversion or degradation of habitat unless there are no technical or financially feasible alternatives, the overall alternatives outweigh the costs, including those to the environment and biodiversity and any conversion or degradation is appropriately mitigated. The mitigation measures will be designed to achieve no net loss of biodiversity where feasible, and may include a combination of actions, such as;

i. Post-operation restoration of habitats
ii. Offset of losses through the creation of ecologically comparable area(s) that is managed for biodiversity
iii. Compensation to direct users of biodiversity

In areas of critical habitat, which includes areas with high biodiversity value3, including habitat required for the survival of critically endangered or endangered species the client will not implement any project activities unless:

i. There are no measurable adverse impacts on the ability of the critical habitat to support the established population of species.
ii. There is no reduction in the population of any recognized critically endangered or endangered species.
iii. Any lesser impacts are mitigated.

In circumstances where a proposed project is located within a legally protected area, the client will act in a manner consistent with defined protected area management plans, consult protected area sponsors and managers, local communities , and other key stakeholders on the proposed project and implement additional programs, as appropriate, to promote and enhance the conservation aims of the protected area

Intentional or accidental introduction of alien, or non-native, species of flora and fauna into areas where they are not normally found can be a significant threat to biodiversity, since some alien species can become invasive, spreading rapidly and out-competing native species. The client will not intentionally introduce any new alien species (not currently established in the country or region of the project) unless this is carried out in

accordance with the existing regulatory framework for such introduction, if such framework is present, or is subject to a risk assessment (as part of the client's Social and Environmental Assessment) to determine the potential for invasive behavior. The client will not deliberately introduce any alien species with a high risk of invasive behavior or any known invasive species, and will exercise diligence to prevent accidental or unintended introductions.

The client will manage renewable natural resources in a sustainable manner. Where possible, the client will demonstrate the sustainable management of the resources through an appropriate system of independent certification.2.43 IFC Environmental Health Safety (EHS) Guidelines

The IFC has also outlined Environmental, Health and Safety guidelines which contain performance levels and measures that are generally considered to be achievable in new facilities by existing technologies at reasonable costs. The EHS guidelines have broadly been classified into environment, Occupational Health Safety and Community Health Safety.

Environmental guidelines that are applicable to the proposed power generation project are related to:

- Generation of emissions to air at any stage of the project lifecycle such as dust. The guideline provides an approach to the management of significant sources of emissions including specific guidance for assessment and monitoring of impacts related to air pollution.
- Discharge of wastewater from utility operations such as the construction camp to the environment. The project should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment from the discharge such as wastewater management and reuse methods. If septic tanks are used, then they should be properly designed and installed in accordance with local regulations.
- Generation of solid waste. Procedures must be developed that aim at waste minimization through reuse and recycling, transportation and proper disposal of solid waste

- Noise emissions from blasting activities and operation of equipment and machinery that will be under use in the project. Technologies that may be used include installing mufflers on engine exhausts, limiting hours of operation for specific pieces of equipment, relocating noise sources to less sensitive areas

The Occupational Health and Safety guideline provides for implementation of reasonable precautions to protect the health and safety of workers by employers and supervisors. This includes design of structures with all required facilities that will be used during work such the construction camp, communication and training, protection against physical hazards such as rotating and moving equipment, personal protective equipment among others.

The Community Health and Safety provides for protection of people living within the project area. Key areas that are of concern in this project are water quality and quantity protection, traffic safety, disease prevention especially communicable and sexually transmitted among others.

3.3.2 Air Quality

The primary emissions to air from the combustion of fossil fuels or biomass are sulfur dioxide (SO_2), nitrogen oxides (NO_X), particulate matter (PM), carbon monoxide (CO), and greenhouse gases, such as carbon dioxide (CO_2). The amount and nature of air emissions depends on factors such as the fuel (e.g., coal, fuel oil, natural gas, or biomass), the type and design of the combustion unit (e.g., reciprocating engines, combustion turbines, or boilers), operating practices, emission control measures (e.g., primary combustion control, secondary flue gas treatment), and the overall system efficiency.

No air quality limits are available for Kenya. Therefore, the World Bank guidelines shall be applicable in this project. The World Bank Group Environmental, Health, and Safety Guidelines for Thermal Power Plants (World Bank, 2008) provides emission limits for thermal plants at referenced conditions of dry gas excess 30% oxygen, as shown in Table 3.1.

Table 3.1 World Bank Emission Limits for Diesel Driven Thermal Power Plants

Combustion Technology / Fuel	Particulate Matter (PM)	Sulphur Dioxide			Nitrogen Oxides (NOx)		Dry Gas, Excess O2 Content (%)
Reciprocating Engine	NDA	DA	NDA	DA	NDA	DA	
Liquid Fuels (Plant >50 MWth to <300 MWth)	50	30	1,170 or use of 2% or less S fuel	0.5% S	1,460 (Compression Ignition, bore size diameter [mm] < 400) 1,850 (Compression Ignition, bore size diameter [mm] ≥ 400) 2,000 (Dual Fuel)	400	15%

General notes:
- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; S = sulfur content (expressed as a percent by mass); Nm^3 is atone atmospheric pressure, 0 degree Celsius; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack. Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- (a) Compression Ignition (CI) engines may require different emissions values which should be evaluated on a case-by-case basis through the EA process.

Source: Table 6 (A) - Emissions Guidelines (in mg/Nm^3) Environmental, Health, and Safety Guidelines for Thermal Power Plants (World Bank, 2008)

The maximum emissions levels are normally acceptable to the World Bank Group in making decisions regarding the provision of World Bank Group assistance for new fossil fuel fired thermal power plants or units of 50 MW or larger (using conventional fuels). The emissions levels have been set so they can be achieved by adopting a variety of cost-effective options or technologies, including the use of clean fuels or washed coal. For example, dust controls capable of over 99% removal efficiency, such as electrostatic precipitators (ESPs) or bag houses, should always be installed for coal-fired power plants. Similarly, the use of low- NOx burners with other combustion modifications such as low excess air (LEA) firing should be standard practice. The range of options for the control of sulfur oxides is greater because of large differences in the sulfur content of different fuels and in control costs. In general, for low-sulfur (less than1% S), high-calorific-value fuels, specific controls may not be required, while coal

cleaning, when feasible, or sorbent injection (in that order) may be adequate for medium-sulfur fuels (1–3% S). FGD may be considered for high-sulfur fuels (more than 3% S). Fluidized-bed combustion, when technically and economically feasible, has relatively low SOx emissions. The choice of technology depends on a benefit-cost analysis of the environmental performance of different fuels and the cost of controls.
Any deviations from the following emissions levels must be described in the World Bank Group project documentation.

Air Emission

The maximum emissions levels given here can be consistently achieved by well-designed, well-operated, and well-maintained pollution control systems. In contrast, poor operating or maintenance procedures affect actual pollutant removal efficiency and may reduce it to well below the design specification. The maximum emissions levels are expressed as concentrations to facilitate monitoring. Dilution of air emissions to achieve these guidelines is unacceptable. Compliance with ambient air quality guidelines should be assessed on the basis of Good Engineering Practice (GEP) recommendations. The plant should not use stacks heights less than the GEP recommended values unless the air quality impact analysis has been taken into account.

All of the maximum emissions levels should be achieved for at least 95% of the time that the plant or units is operating, to be calculated as a proportion of annual operating hours. The remaining 5% of annual operating hours is assumed to be for start up, shutdown, emergency fuel use and unexpected incidents.

Key Issues concerning the guidelines

The key production and emissions control practices that will lead to compliance with the Word bank guidelines are summarized below taking into account environmental and social factors.

- Choose the cleanest fuel economically available (natural gas is preferable to oil, which is preferable to coal).

- Give preference to high-heat-content, low-ash, low-sulfur coal (or high-heat-content, high- sulfur coal, in that order) and consider beneficiation for high-ash, high-sulfur coal.
- Select the best power generation technology for the fuel chosen to balance the environmental and economic benefits. The choice of technology and pollution control systems will be based on the site-specific environmental assessment.
- Designing stack heights according to Good International Industry Practice (GIIP) to avoid excessive ground level concentrations and minimize impacts, including acid deposition.
- Keep in mind those particulates smaller than 10 microns in size are most important from a health perspective. Acceptable levels of particulate matter removal are achievable at relatively low cost. Consider cost-effective technologies such as pre-ESP sorbent injection, along with coal washing, before in-stack removal of sulfur dioxide. Use low-NOx burners and other combustion modifications to reduce emissions of nitrogen oxides.
- Before adopting expensive control technologies, consider using offsetting reductions in emissions of critical pollutants at other sources within the air shed to achieve acceptable ambient levels.
- Use SOx removal systems that generate less wastewater, if feasible; however, the environmental and cost characteristics of both input sand wastes should be assessed case by case.
- Manage ash disposal and reclamation so as to minimize environmental impacts especially the migration of toxic metals, if present, to nearby surface and groundwater bodies' addition to the transport of suspended solids in surface runoff. Consider reusing ash for building materials.
- Consider recirculation cooling systems where thermal discharge to water bodies may be of concern.
- As stated in the General EHS Guidelines, emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed.

3.3.3 Noise levels

Principal sources of noise in thermal power plants include the turbine generators and auxiliaries; boilers and auxiliaries, such as coal pulverizers; reciprocating engines; fans and ductwork; pumps; compressors; condensers; precipitators, including rappers and plate vibrators; piping and valves; motors; transformers; circuit breakers; and cooling towers. Thermal power plants used for base load operation may operate continually while smaller plants may operate less frequently but still pose a significant source of noise if located in urban areas.

Noise abatement measures should achieve levels shown in Table 3.2 below or a maximum increase in background levels of 3 decibels (measured on the A scale) {dB (A)}.Measurements are taken at noise receptors located outside the project property boundary.

Table 3.2 Allowable Maximum Noise Levels

Receptors	***Maximum allowable log equivalents(hourly measurements), in dB(A)***	
	Day (07:00-22:00)	***Night 22:00-7:00***
Residential Institutional, Educational	*55*	*45*
Industrial Commercial	*70*	*70*

Additional recommended measures to prevent, minimize, and control noise from thermal power plants include:

i. Siting new facilities with consideration of distances from the noise sources to the receptors (e.g., residential receptors, schools, hospitals, religious places) to the extent possible. If the local land use is not controlled through zoning or is not effectively enforced, examine whether residential receptors could come outside the acquired plant boundary. In some cases, it could be more cost

effective to acquire additional land as buffer zone than relying on technical noise control measures, where possible.

ii. Use of noise control techniques such as: using acoustic machine enclosures; selecting structures according to their noise isolation effect to envelop the building; using mufflers or silencers in intake and exhaust channels; using sound absorptive materials in walls and ceilings; using vibration isolators and flexible connections (e.g., helical steel springs and rubber elements); applying a carefully detailed design to prevent possible noise leakage through openings or to minimize pressure variations in piping;

iii. Modification of the plant configuration or use of noise barriers such as berms and vegetation to limit ambient noise at plant property lines, especially where sensitive noise receptors may be present.

Noise propagation models may be effective tools to help evaluate noise management options such as alternative plant locations, general arrangement of the plant and auxiliary equipment, building enclosure design, and, together with the results of a baseline noise assessment, expected compliance with the applicable community noise requirements.

3.3.4 Water Quality

Steam turbines used with boilers and heat recovery steam generators(HRSG) used in combined cycle gas turbine units require a cooling system to condense steam used to generate electricity. Typical cooling systems used in thermal power plants include:

- Once-through cooling system where sufficient cooling water and receiving surface water are available.
- Closed circuit wet cooling system.
- Closed circuit dry cooling system (e.g., air cooled condensers).

Combustion facilities using once-through cooling systems require large quantities of water which are discharged back to receiving surface water with elevated temperature. Water is also required for boiler makeup, auxiliary station equipment, ash handling, and FGD systems. The withdrawal of such large quantities of water has the potential to compete with other important water uses such as agricultural irrigation or drinking water

sources. Withdrawal and discharge with elevated temperature and chemical contaminants such as biocides or other additives, if used, may affect aquatic organisms, including phytoplankton, zooplankton, fish, crustaceans, shellfish, and many other forms of aquatic life. There may be special concerns about the potential impacts of cooling water intake structures located in or near habitat areas that support threatened, endangered, or other protected species or where local fishery is active.

Measures to prevent, minimize, and control environmental impacts associated with water withdrawal should be established based on the results of a project EA, considering the availability and use of water resources locally and the ecological characteristics of the project affected area. Recommended management measures to prevent or control impacts to water resources and aquatic habitats include:

i. Conserving water resources, particularly in areas with limited water resources, by use of a closed-cycle, recirculating cooling water system (e.g., natural or forced draft cooling tower), or closed circuit dry cooling system (e.g., air cooled condensers) if necessary to prevent unacceptable adverse impacts. Cooling ponds or cooling towers are the primary technologies for a reticulating cooling water system.

ii. Reduction of maximum through-screen design intake velocity to 0.5 ft/s to avoid aquatic organisms being trapped.

iii. Reduction of intake flow to the following levels for freshwater rivers or streams to a flow sufficient to maintain resource use (i.e., irrigation and fisheries) as well as biodiversity during annual mean low flow conditions.

iv. If there are threatened, endangered, or other protected species or if there are fisheries within the hydraulic zone of influence of the intake, reduction of impingement and entrainment of fish and shellfish by the installation of technologies such as barrier nets (seasonal or year-round), fish handling and return systems, fine mesh screens, wedge wire screens, and aquatic filter barrier systems.

3.3.5 Waste Management

Solid waste

According to World Bank guidelines, solid wastes including ash and FGD sludge, that do not leach toxic substances or other contaminants of concerns to the environment may be disposed in landfills or other disposal sites provided that they do not impact nearby water bodies, where toxics or other contaminants are expected to leach out, they should be treated by e.g. stabilization before disposal.

In addition, the Environmental Management and Coordination (Waste Management) regulations (2006) of Kenya list the following as the responsibilities of the waste generator:

1. No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle.
2. Any person whose activities generate waste shall collect, segregate and dispose or cause to be disposed off such waste in the manner provided for under these regulations.
3. No person shall engage in any activity likely to generate any hazardous waste without a valid Environmental Impact Assessment license issued by Authority under the provisions of the Act.

Effluents

Effluents from thermal power plants include thermal discharges, wastewater effluents, and sanitary wastewater.

In general, thermal discharge should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water quality temperature standards outside a scientifically established mixing zone. The mixing zone is typically defined as the zone where initial dilution of a discharge takes place within which relevant water quality temperature standards are allowed to exceed and takes into account cumulative impact of seasonal variations, ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations.

The wastewater streams in a thermal power plant include cooling tower blow down; ash handling wastewater; wet FGD system discharges; material storage runoff; metal cleaning wastewater; and low-volume wastewater, such as air heater and precipitator wash water, boiler blow down, boiler chemical cleaning waste, floor and yard drains and sumps, laboratory wastes, and back flush from ion exchange boiler water purification units. The characteristics of the wastewaters generated depend on the ways in which the water has been used. Contamination arises from demineralizers; lubricating and auxiliary fuel oils; trace contaminants in the fuel (introduced through the ash-handling wastewater and wet FGD system discharges); and chlorine, biocides, and other chemicals used to manage the quality of water in cooling systems. Cooling tower blow down tends to be very high in total dissolved solids but is generally classified as non-contact cooling water and, as such, is typically subject to limits for pH, residual chlorine, and toxic chemicals that may be present in cooling tower additives (including corrosion inhibiting chemicals containing chromium and zinc whose use should be eliminated).

The EHS management system requires that for any facilities installed,

- The quality, quantity, frequency and sources of liquid effluents in its installations must be understood. This includes knowledge about the locations, routes and integrity of internal drainage systems and discharge points.
- There should be planning and implementation of the segregation of liquid effluents principally along industrial, utility, sanitary, and stormwater categories, in order to limit the volume of water requiring specialized treatment. Characteristics of individual streams may also be used for source segregation.
- Opportunities to prevent or reduce wastewater pollution through such measures as recycle/reuse within their facility, input substitution, or process modification (e.g. change of technology or operating conditions/modes) must be identified.
- Assess compliance of their wastewater discharges with the applicable: (i) discharge standard (if the wastewater is discharged to a surface water or

sewer), and (ii) water quality standard for a specific reuse (e.g. if the wastewater is reused for irrigation).

Additionally, the generation and discharge of wastewater of any type should be managed through a combination of:

- Water use efficiency to reduce the amount of wastewater generation
- Process modification, including waste minimization, and reducing the use of hazardous materials to reduce the load of pollutants requiring treatment
- If needed, application of wastewater treatment techniques to further reduce the load of contaminants prior to discharge, taking into consideration potential impacts of cross-media transfer of contaminants during treatment (e.g., from water to air or land).

3.4 Environmental Conventions and Treaties

3.4.1 World Commission on Environment and Development

The Commission commonly referred to as "the Brutland Commission" focused on the environmental aspects of development, in particular, the emphasis on sustainable development that produces no lasting damage to biosphere, and to particular ecosystems. In addition, environmental sustainability is the economic and social sustainability. Economic sustainable development is development for which progress towards environmental and social sustainability occurs within available financial resources. While social sustainable development maintains the cohesion of a society and its ability to help its members work together to achieve common goals, while at the same time meeting individual needs for health and well-being, adequate nutrition, and shelter, cultural expression and political involvement.

3.4.2 Convention on Biological Diversity (1992)

This was ratified on 11th September 1994. Agenda 21 – a programme of action for sustainable development worldwide, the Rio Declaration on Environment and Development was adopted by more that 178 governments at the United Nations Conference on Environment and Development, known as the Earth Summit, held in Rio de Janeiro, Brazil from 3rd to 14th June 1992. Principle No. 10 of the declaration

underscore that environmental issues are best handled with participation of all concerned citizens at all the relevant levels. At the national level, each individual shall have appropriate access to information that is concerning environment that is held by public authorities. States shall encourage and facilitate public participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy shall be provided. The foregoing discussion is relevant to the proposed development because EMCA demands that public must be involved before any development project that is likely to have adverse impacts to the environment is initiated by a proponent. The Act has further established Public Complaints Committee (PCC) where the issues raised by the public in regard to any proposed development can be addressed.

3.4.3 Montreal Protocol, 1987

The Montreal Protocol on Substances that deplete the ozone layer (1987) was ratified on November 9, 1988. This treaty was designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion.

3.4.4 United Nations Convention to combat Desertification (1994)

An agreement to combat desertification and mitigate the effects of drought through national action programs that incorporate long term strategies supported by international cooperation and partnership arrangements.

3.4.5 United Nations Framework Convention on Climate Change (1992)

International environmental treaty produced at the United Nations Conference on Envrionment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro in 1992. The treaty is aimed at reduced emissions of greenhouse gas in order to combat global warming.

3.4.6 Bamako Convention (1991)

A treaty of African nations prohibiting the import of any hazardous (including radioactive) waste.

3.4.7 Kyote Protocol (2004)

An amendment to the international treaty on climate change, assigning mandatory emission limitations for the reduction of greenhouse gas emissions to the signatory nations.

3.5 Environmental Policy

3.5.1 Sessional Paper No. 6 of 1999 on Environment and Development

Every person in Kenya is entitled to a clean and healthy environment and has a duty to safeguard and enhance the environment. As envisioned in Sessional Paper No. 6 of 1999 on Environment and Development, Kenya should strive to move along the path of sustainable development to meet the needs of the current generation without compromising the ability of the resource base to meet those of future generations. The overall goal is hence to integrate environmental concerns into the national planning and management processes and provide guidelines for environmentally sustainable development. The policy paper emphasizes that environmental impact assessment must be undertaken by the developer as an integral part of a project preparation. It also proposed for periodic environmental auditing to investigate if developer is fully mitigating the impacts identified in the assessment report.

3.5.2 National Environmental Action Plan (NEAP)

The NEAP for Kenya was prepared in 1994. It was a deliberate policy to integrate environmental considerations in to the country's social and economic development process. The integration was achieved through multi-sectoral approach and a comprehensive framework to ensure that environmental management and conservation of natural resources is an integral part of societal decision-making process.

3.5.3 Poverty Reduction Strategy Paper (PRSP)

The PRSP has the twin objectives of poverty reduction and economic growth. The paper articulates Kenya's commitment and approach to fighting poverty, with the basic rationale that the war against poverty cannot be won without the participation of the poor. The proposed project, during and after implementation, will offer jobs to many Kenyans as a way of contributing to this noble objective of reducing poverty.

CHAPTER 4: ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

4.1 Introduction

Athi River Town is located 30 km South East of Nairobi, Kenya in Machakos District. The town is the main urban centre in Mavoko Municipality and hosts the Mavoko Municipal Council headquarters. Mavoko Municipality covers an area of 693 Km^2 extending from bordering Nairobi City Council to the West and North, Masaku County Council to at the East and Kajiado District to the South. Athi River Town is at the junction of the Nairobi–Mombasa and Nairobi–Namanga Highways. The town also sits at confluence of the Mbagathi and Kitengela Rivers which join to form Athi River, the second largest drainage system in the country and from which it derives its name. Census results show that the Town had a population of 21,789 persons in 1989 and 48,260 in 1999, representing an annual growth rate of 8.43%. The high growth rate was driven by establishment of many industries in the town and its proximity to the capital city, Nairobi where housing is scarce and expensive.

Athi River enjoys good communications being on the main road connecting the major sea port of Mombasa to the capital city of Nairobi and the regions beyond. Other traffic from the Easter Region of Machakos, Makueni, and Kitui also passes through the Town. Furthermore, the town is on the Road to Namanga which connects the country to the neighbouring country of Tanzania. Additionally, the Town is on the Mombasa Nairobi Railway line which has a station within the town. Jomo Kenyatta International Airport (JKIA) on the eastern boundary of Nairobi with Mavoko Municipality is only 15 Km from Athi River.

Athi River has many industries including the four major cement manufactures in Kenya; namely, East African Portland Cement (EAPC), Bamburi Cement, Athi River Mining Company and Mombasa Cement. The town is host to the largest Export Processing Zone (EPZ) in the region which was established in 1995. The EPZ has many industries mostly textile firms exporting clothes to the US under the AGOA trade agreement. The

national headquarters of the Export Processing Zone Authority (EPZA) is located within the EPZ in the Town. Other industries include Devki Steel Works Company and the Kenya Meat Commission (KMC) factory. In the vicinity of the town and within the larger Mavoko Municipality are the Kapa Oil Refinery, Nation Media Printer, Mabati Rolling Mills, and Sun-Rose and Primarosa flower companies among others. In total there are over sixty factories in the vicinity of the Town. These industries are the main employers in the area and attract large numbers of semi-skilled and unskilled workers from around the country.

Apart from the industries, Athi River has several institutions, the most significant being Daystar University, Lukenya Academy, Kitengela Prisons, Labour Training Institute and the Kenya Meat Training Institute. At least three other Universities are planned within 10 km of Athi River Town.

Most of the workers in Athi River are hosted in adjacent municipality's satellite towns of Mlolongo, Athi River and Kyumvi. A large proportion of the work force is hosted at Kitengela Township in Kajido District, which is only 3 km from Athi River Town Centre at the southern boundary. Mavoko Municipal Council is served by eight councillors, of whom six are elected and two nominated.

4.2 District Profile

Machakos District within which Athi River falls borders the Nairobi and Kiambu District to the west, Murang'a and Embu districts to the north, Kitui and Makueni districts to the east and Kajiado District to the south. The District stretches from latitudes 0º 45' south to 1º 31' south and longitudes 36° 45'east to 37° 45' east and covers an area of 6,281.4 km2 most of which is semi-arid. High and medium potential areas where rain fed agriculture is carried out covers only 574 km2 or 26 percent of the total area. Administratively, the district is divided into twelve divisions, sixty-two locations and two hundred and twenty five sub locations as shown in Table 3.1 below

Table 4.1: Population by Administrative Units

DIVISION	AREA (Km^2)	DENSITY
Central	49.5	307
Kalama	330.2	130
Kangundo	178.2	539
Kathiani	205.8	486
Masinga	1,094.0	72
Matungulu	634.3	165
Athi River	957.0	54
Mwala	481.5	195
Ndithini	316.8	107
Yathui	533.0	129
Yatta	491.0	90
Katangi	568.0	164
Total	6,281.4	152

Source: District Survey Office, Machakos, 2001

Kagundo and Kathiani Divisions have the highest population densities in the District because of their relatively high economic potential from fertile soils and moderate rainfall that supports both food and cash crops. Athi River Division which is among the biggest divisions in the District had the lowest density of 51 and 54 persons per km2 (1999 and 2002) although over 50% of the population is concentrated in Athi River Town. The densely populated divisions have a scattered type of settlement with small farms raging from 1 to 10 has while in Athi River Division, the majority of the people are from rural settlements.

4.3 Socio Environmental Status - Demographic and Population Profile

The average population density of the district was 126 and 144 persons per km^2 in 1989 and 1999, respectively representing an increase 14.3 percent or 1.3 percent annually. This increase is attributed to overall population growth rate and migration of people to towns, especially along the major highways.

Divisions with fertile soils and high agricultural potential have higher population densities than the rest of the district. These include the hill masses of Central, Kagundo, Katina and Matungulu Divisions. This population has however put much

pressure o the land and will continue to increase over the years. Marginal divisions have relatively low population densities. Athi River Division has the lowest density of 51 persons per km2. Over 50 percent of this population, however, is concentrated around Athi River Town, where there are opportunities for employment in the industries. The population density is expected to increase up to 59 persons per km^2 in the future.

The Machakos District population stood at 906,644 according to the 1999 Population Census consisting of 442,891 males and 463,753 females representing 48.8% and 51.2% of the population respectively (Table 3.2). At the growth at rate of 1.7%, the population was expected to rise to 1,056,535 in 2008.

The majority of the population of the district is young with 510,507 or 56.3% being below 20 years Table 3.3, below, provides the population projections for 1999 to2010 by age and sex cohorts.

4.4 Population and Development

The Population of Machakos District is estimated to be 954,082 (2002) with a growth rate of 1.7% per annum. By the year 2008 this population is expected to increase to 1,056,535 assuming that the same growth rate persists. Clearly the high population growth rate has serious effect on social and economic development. This is manifested in increased unemployment, high dependency ratio, increased demand for health services, increased demand for agricultural land, more need for fuel and forest products, over-crowding in educational facilities, more demand for better housing, high levels in poverty indices.

If viewed against the limited resources, population growth is a major challenge of the district; poor farming practices coupled with a lack of concern for forest conservation in the district has resulted in soil erosion and environmental degradation which undermines agricultural productivity.

Table 4.2 Demographic and Population Profile of Mavoko Municipality

TPopulation	954,082
hNumber of Males	466,064
eNumber of Females	488,018
lFemale/Male Sex Ratio	100:96
aNumber of Youthful Population (15 – 25) years	223,708
bPrimary school population (6 – 13) years	225,630
oSecondary School Population (14 – 17) years	103,843
uLabour Force (15 – 64) years	489,784
rDependency Ratio	100:94
Population Growth Rate	1.7%
MRural Population at start of Plan Period 2002	421,945
aUrban Population at start of Plan Period 2002	532,137
c	

The labour force in Machakos District is increasing rapidly. According to the 1999 Population and Housing Census, the total population of working age group represented 47.6% (465,432)

4.5 Poverty Analysis

According to the welfare monitoring survey (WMS II) of 1994 and WMS III of 1997, the district had 68.7 percent and 63.3 percent respectively of its population below the poverty level of $1 per day. During the poverty assessment exercise carried out in 2000, the district was estimated to have 66.2 percent of the population as poor.

From these surveys it may not be possible to set out a trend because the surveys were carried out under different circumstances, which may have influenced the results. The 1994 survey was carried out when the district was experiencing very severe drought and as such most of the households could not afford basic essential needs. The1997 survey was carried in March - May, a period when the district had just harvested the

crops and as such most of the households were food secure while the 2000 poverty assessment was carried out against a background of severe drought when most of the households were dependent o relief food. However, from the three results, it can be deduced that over 63 per cent of the people in the district are poor. This compares well with poverty assessment, which put the figure at 63.3 percent. The results also indicate that the district contributed about 4.4 percent to the national poverty. Table 4.4 below presents the social-economic indicators of the district.

Table 4.3 Population Projections by Age Cohort and Sex

	2000		2008		2009		2010	
Age	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
0-4	**69093**	**67230**	**61386**	**59054**	**60114**	**5773**	**58794**	**56366**
5-9	**71164**	**68384**	**72288**	**68896**	**72213**	**6875**	**72112**	**68579**
10-14	**71032**	**67980**	**79729**	**75976**	**80689**	**7684**	**81638**	**77712**
15-19	**59883**	**59778**	**69869**	**69250**	**71039**	**7034**	**72208**	**71445**
20-24	**38924**	**45709**	**46443**	**53023**	**47344**	**5387**	**48247**	**54720**
25-29	**29763**	**36765**	**36029**	**43206**	**36789**	**4396**	**37550**	**44725**
30-34	**24622**	**28488**	**29345**	**34184**	**29911**	**3486**	**30477**	**35553**
35-39	**20212**	**22969**	**24205**	**27646**	**24685**	**2821**	**25166**	**28774**
40-44	**16641**	**18626**	**20434**	**21924**	**20899**	**2231**	**21365**	**22703**
45-49	**13661**	**15222**	**16737**	**17880**	**17113**	**1819**	**17490**	**18506**
50-54	**10880**	**12252**	**13012**	**14838**	**13268**	**1515**	**13524**	**15465**
55-59	**8811**	**9978**	**10164**	**11714**	**10320**	**1191**	**10476**	**12122**
60-64	**6895**	**7841**	**7184**	**7817**	**7201**	**7789**	**7216**	**7758**
65-69	**5688**	**6554**	**5901**	**6614**	**5912**	**6602**	**5921**	**6587**
70-74	**4764**	**5602**	**5239**	**6325**	**5289**	**6406**	**5337**	**6486**
75-79	**4126**	**4986**	**5197**	**6950**	**5330**	**7201**	**5464**	**7454**
80+	**6956**	**7972**	**8969**	**10258**	**9222**	**1054**	**9476**	**10831**
	463115	**486335**	**512131**	**535555**	**517337**	**54071**	**522462**	**545786**

4.6 Schools and Health Facilities

4.6.1 Education

Machakos District has close to 850 primary schools. The primary school enrolment rate is 81% for both boys and girls. School drop-out rate was reported to be 5.5%. The Primary school going population (6-13 years) makes up to 20.3% of district total population and was estimated to be 237,338 in 1999. This age cohort is expected to increase to 276,576 in year 2008. Although the enrolment rate is high (81%), the district will need to invest in the provision of additional educational facilities.

Table 4.4 Socio-Economic Indicators, 2002

Total number of Households	186,297
Average Households size	4.9
Number of female headed households	Not available
Number of disabled groups	Not available
Children needing special protection	15,000
Absolute Poverty (Rural & Urban)	63%
Income from Agriculture	70%
Income from Rural Self employment	10%
Wage employment	11%
Number of unemployed	2%

The district has 154 secondary schools and an enrolment rate of 32% for both boys and girls. The secondary school going age group comprises about 9% of the total population and was estimated to be 98,680 in 1999. It is projected to rise to 114,996 by year 2008.The secondary school drop-out rate was estimated to be 4.7%. Many children drop out of primary and secondary school mainly due to cost of education and the limited number of schools and inability to pay. Others are forced to work to support the livelihood of their families.

4.6.2 Health

In the year 2001, Machakos had over 110 health facilities spread across the district. The population/doctor ratio was 62,325:1 showing an almost non-existent medical coverage. The average distance to a health facility is 5 Km. The most prevalent diseases are malaria and mkin diseases while the childhood diseases include anaemia, marasmus, eye infection, pneumonia, malaria and kwashiorkor.

4.6.3 HIV and Aids

HIV/AIDs in Machakos are a major health problem with the prevalence averaging 15%. About 50% of the hospital beds are occupied by patients with HIV/AIDs related diseases. HIV\AIDS in the district was diagnosed in June 1989 and 4 males and 5 females tested HIV positive. By December of the same year, 42 cases had been reported and since then the numbers have continued to increase. Majority of HIV\AIDS patients are found in Machakos Town and its environs and in all towns along the Nairobi - Mombasa Highway. Cases are being reported in the small up-coming towns in the District like Wamuyu and Matuu. HIV\AIDS incidences along the major highway and upcoming towns are attributed the long distance truck drivers\touts and the commercial sex workers. In Machakos District HIV prevalence is of great concern. In year 2001, HIV prevalence rate was estimated to be 15% in 2001.The impact of the scourge has been felt at all levels of the district's economic and social circles. An increase in the number of HIV/AIDs orphans and street children has been noted.

The biggest challenge facing the district is the increasing cases HIV\AIDS in spite of the awareness level of over 85 per cent. It also faces the challenges of providing medical care for the infected and support for the affected. Currently the district estimates that there are over 15,000 children who are in need of special care (CSP) and this numbers is expected to rise due to the increasing number of HIV\AIDS orphans. Table 4.5 below summarizes the health indicators of the district.

Table 4.5: Health Indicators 1999 *(Source: District Medical Officer of Health (DMOH))*

Crude Birth Rate (CBR)	46/1000
Crude Death Rate (CDR)	9/1000
Infant Mortality Rate (IMR)	53/1000
Under 5 Mortality Rate	78/1000
Total Fertility Rate	3.5
HIV Prevalence Rate	15%
Doctor/POPULATION Ratio	1:62,325

4.7 Natural and Physical Environment

4.7.1 Climate

Machakos District enjoys a peasant climate similar to that of Nairobi although relatively warmer, varying from highland equatorial on the hill summits, to semi- arid on the plains. The topography of the district is varied and rises from 700 m above sea level on the southern part of the district to 1,700 m above sea level in the west. This is however interrupted by an escarpment and a series of hill masses, the highest of which is Kilimambogo (Donyo Sabuk), which rises up to 2,144m above sea level.

The districts have two distinct rainy seasons, the long rains fall between March and May and the short rainy fall between October and December. The annual average rainfall varies from 500 -1300 mm with high altitude areas receiving more rain than low lying areas. The temperatures also vary with altitude, the mean monthly temperature ranges from 12oC in the coldest months (July-to August) to 25°C in the hottest months ((March to October).

Vegetation in the District varies with altitude. The plains, which receive less rainfall, are characterized by open grassland with scattered acacia trees. The high altitude areas that receive high rainfall have dense vegetation and are more suitable for rain fed agriculture.

The district depends upon rivers and streams, dams, borehole, springs and to small extent roof catchments for sources of water. There are three main rivers, Athi, Tana and Thika that traverse the district. The Rivers have water throughout the year but their tributaries dry up during the dry seasons. The forests in the district occupy an area of 2,480.6 hectares. Gazetted forests cover an area of 706.6 ha distributed amongst the Iveti Hills (348.2ha), Uuni Hills (92.7 ha), Kitete Hill (110 ha) Muumandu (139.2 ha) and the forest department compound (16.5 ha). Ungazetted forests are on Kibauni Hill covering an area of 1,619 ha, Mango Hill (45ha) and unsurveyed Kanzalu Hill (110ha).

4.7.2 Geology and Soils

The investigated site lies on pliocene to miocene volcanic material overlying basement system rocks. In the two sections below a discussion on the geology in a regional context is followed by a more detailed assessment of the geology in the investigated area.

The area is located on the eastern side of the Great Rift Valley. Before the formation of the Rift Valley, the whole area was made up of pre-cambrian basement system crystalline rocks of the Mozambique Belt. These very old rocks were laid down, metamorphosed, exposed and eroded and were in pre-tertiary times an 'ancient' land surface.

The formation of the Great Rift was followed by extensive and widespread volcanic activity throughout much of Kenya. In the Nairobi area this activity covered the Old Land Surface, and was characterized by periods of extrusive activity followed by periods of relative calm during which erosion by wind and water occurred. In early Tertiary, during a period of substantially moister climate, numerous river systems deposited erosion debris in extensive lakes, leaving behind the Athi Tuff and Lake Bed deposits which today form an important aquifer known loosely as the Athi Series.

This intermittent volcanic and erosive activity continued throughout the Tertiary Period and into the Pleistocene Epoch of the Quaternary Period, leaving deposits which today are six or seven hundred meters thick in places. In general the sequence is relatively well understood though local detail is sometimes lacking.

In recent times volcanic activity has given way to a prolonged erosive period. This has exposed almost all of the volcanic material at some location, to a lesser or greater extent. To the east of the City the lavas, sediments and pyroclastics are significantly more eroded than they are to the west. There is a well-developed soil cover, and alluvial deposits lie in the valley bottoms of many of the small rivers that traverse the region running roughly west - east.

The project area is characterized by out-cropping Kapiti Phonolites and superficial deposits materials, which are mostly incoherent black soil that developed from weathering and erosion processes of volcanic lavas, pyroclastics and sediments. The volcanic are also exposed in the nearby Mbagathi River. The formations in the area are discussed in details as follows.

Superficial deposits

Superficial deposits of recent age include soils which are the weathering products of the volcanics, alluvial and conglomerates exposed in the principal river courses and in particular the Kitengela River and its tributaries which drain to Athi River. Where the drainage has been impeded, swamps have developed resulting in accumulation of poorly-drained soils of high humus content.

Upper Athi Tuffs and Lake Beds

These form part of the Sattima Series; they are not exposed near the investigated site, although some outcrops appear in the northern part. The tuffs and lakebeds resulted by consolidation of fragmental, volcanic material, which was deposited sub-aerially, into water at distances from the centres of eruption, or washed into a lake. Their presence in the area indicates the former presence of an extensive lake or swampy country into which rivers drained from the shoulders of the Rift Valley.

The Mbagathi Trachytes

This is formation also forms part of the Ngong volcanics. The thickness of the Mbagathi phonolitic trachytes exposed along the Kitengela River suggests that more than one flow is present. The most striking feature of the trachyte is its texture of crowded feldspar laths set in a grey-brown matrix the colour of which is emphasized by rusty brown weathering and alteration products. Athi tuffs and lakebeds with chert band underlie the Mbagathi trachytes.

Kapiti Phonolites

This is the most exposed formation on the project area. The volcanic form the western part of Kapiti plains. To Phonolites disappear under young volcanic rocks and emerges west of Kajiado, extending to the Rift Valley and the Turoka valley.

The Undifferentiated Crystalline Basement System Rocks

The undifferentiated crystalline rocks of the Mozambique belt form the Basement rocks in the investigated area. These are thought to be as a result of intense pressure and thermal activity over a long period of time

4.8 Water sources

The proposed project will require approximately 62.2 m^3/hr of water for cooling purposes. For this reason it is necessary to obtain adequate water from the area. Water in Athi River may be obtained from EPZ through their Nairobi EPZ pipeline, Mavoko Municipal Council (MAVWASCO) from Kilimanjaro Water Pipeline, East African Portland Dam and boreholes or by sinking individual boreholes. Consultations with MAVWASCO established that they would be keen to expanding water customer base by supplying the proposed power plant but that their capacity is limited; however, they had no objection with the Proponent sinking a private borehole (Appendix 2.4). The available options for water supply are described below.

4.8.1 Nairobi-EPZ Water Pipeline

This pipeline runs from in Nairobi to EPZ, Athi River and has a capacity of 5,000 m^3. Currently, the pipeline supplies only 2,000 cubic metres per day because of the slow uptake of the EPZ area. The hydraulic water pressure in this pipeline is 150 bars. This pipeline can only supply up to 1,000 m^3/day (40 m^3/hr) to the Triumph Power plant. The pipeline is approximately 1 km from the proposed site.

4.8.2 Kilimanjaro Water Pipeline

The pipeline is approximately 8 km away from the site and has a capacity is 2,000 m3/day cubic but supplies an average 1,500 m^3/day. The hydraulic pressure in this pipeline is 90 bars. This pipeline can only supply 500 m3/day (40 m^3/hr) to the proposed power plant.

4.8.3 Borehole Sources

The Client has sunk four boreholes at the project site. The drill site and related works did not pose impact on water quality, either surface or groundwater resources. There is no surface water body near the drill site that could be contaminated by waste waters generated during drilling. The entire drilling, borehole construction, pump tests, and

completion works were done under supervision to professional standards. Entry of foreign material was avoided up to completion and only inert materials were used in construction. The boreholes were properly developed to open up the aquifers and clean the borehole water. Monitoring of electrical conductivity during drilling was done to detect and if necessary seal any aquifer with elevated mineralization. The site is not located within a wetland or protected land and, therefore, had no negative impacts on biodiversity.

From records of existing boreholes (Appendix 2.5) there is no borehole which is located within 800 m radius of the project site; hence there is no any foreseen interference with their abstraction trends.

The drilled borehole yields were established by carrying out pumping tests as follows (Appendix 2.6).

Borehole No. 1A - 32 m^3/hr at 170 m depth

Borehole No. 1B - 30 m^3/hr at 175 m depth

Borehole No. 2A - 31 m^3/hr at 124 m depth

Borehole No. 2B - 29 m^3/hr at 175 m depth

The combined boreholes yield is 122 m^3/hr which can meet the proposed plant water requirements of approximately 62.2 m^3/hr and retain approximately 100% stand-by capacity.

Water quality analysis (Appendix 2.5) show that the borehole water is slightly alkaline (pH of 7 – 9) and relatively soft. The quality the water is sufficient for industrial use within the power plant.

4.8.4 East Africa Portland Dam

The dam (Plate 3.3) which is located 1.2 km from proposed site has a total storage of 1,400 m^3 but can be improved to increase the capacity to 3,000 m^3. The dam is named East Africa Portland Cement Company because of its location but it is owned by the Mavoko Municipal Council through MAVWASCO. The dam can supply Triumph with up to 1,500 m^3/day (62.5 m^3/hr) of raw water. This dam has water throughout the year

since it receives water from the perennial (Figure 4.1) Mbagathi River, a tributary of Athi River.

Plate 4.3 EAPC Dam, a Possible Source of Cooling Water

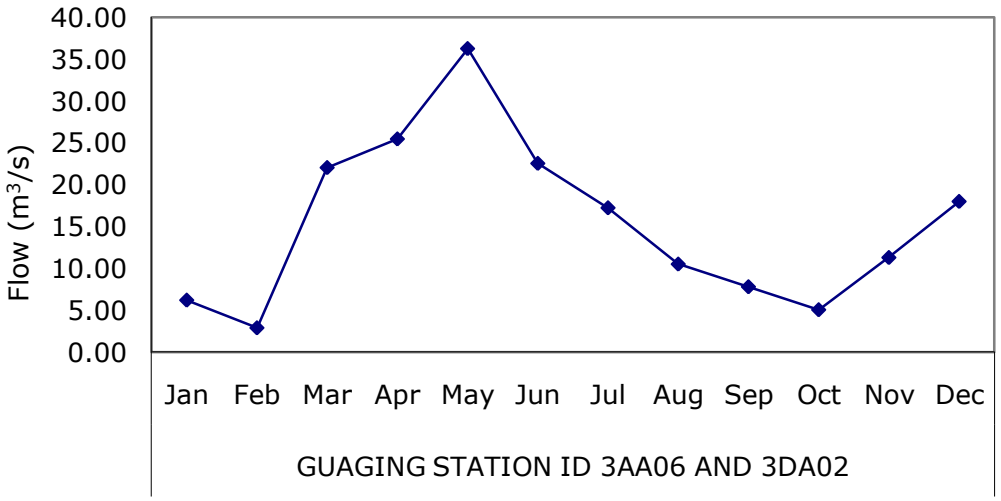


Figure 4.1: Mbagathi River Flows for Year 2009

Following the successful drilling of the boreholes with sufficient yield and stand-by capacity to meet the requirement of the proposed thermal plant, it will not be necessary to abstract water from the East Africa Portland Dam. However, to take advantage of the lower static lift of 35 m as compared to 124 to 175 m for the boreholes, the project will tap floodwater from the Dam in the months of April, May, June, November and December (Figure 4.1). Adverse environmental impact of abstracting floodwater from the Dam will be insignificant.

4.9 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 HIVAIDS 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.

4.9.1 Roads and rail

The main A104 national highway is aligned in a north-East to south-West direction and is situated to the south of the power plant site. The A104 which is referred to as the Nairobi – Namanga Road is part of the Great North Road. 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.

4.9.2 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 KPLC's intake sub-stations such as Embakasi occasionally gets exceeded as the network is continually expanded and interruptions in supply experienced. Concurrently the KPLC 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.

4.9.3 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

35,000 m^3 of water per month to 3,000 existing customers. They potentially have 9,000 customers that require water monthly.

4.9.4 Traffic

The proposed power plant is located in Mavoko in Machakos district near the Kitengela River. The present land use for the study area is zoned for light inoffensive industrial purposes but is surrounded by heavy industrial and commercial entities and limestone mining activities. The power plant is further situated adjacent to the main Nairobi – Mombasa highway (A109) which carries a large amount of daily traffic.

The existing A104 near the power plant is a single carriageway with one lane in either direction while A109 is currently being upgraded to a dual carriage way with two lanes in either direction. 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. The traffic generated by the power station during the operational phase will consist of about 24 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.

4.9.5 Air quality

Air quality in the Athi River area is generally poor and results in unsightly smog over the landscape especially in the morning. The study area is located in the vicinity of the 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 visually identified as an issue relating to environmental and health concerns in the study area. Key sources of pollution are generated by commercial limestone mining, dust arising from road construction, industry and vehicle

emissions. However, the observed dust may not necessarily indicate presence of toxic gases or $PM_{2.5}$ and PM_{10} particulates which have more serious health implications.

A baseline ambient air quality survey was undertaken at power plant site for nitrous oxides (NOx), sulfur oxides (SOx) and particulate matter (PM_{10}). The survey was undertaken by mounting specific diffusion tubes for SOx, NOx and PM_{10} at various locations within the proposed power plant site and as far as Athi River Town. The results of this survey indicated minimal to non-detectable ambient concentrations of the criteria pollutants mentioned above. As the proposed project is an MSD power plant which will use HFO, air dispersion modeling of the stack emissions was undertaken for SOx, NOx, PM_{10} and $PM_{2.5}$. The results of the air dispersion model were then compared with the World Health Organization (WHO) and the IFC's EHS Guidelines for Thermal Power Plants guideline values respectively. The simulated emissions are given in Table 4.6.

Table 4.6 Simulated Emissions

Substance	Emission Concentrations (mg/m^3)
SO_2	1170
NO_2	1850
PM	50
HC	143
CO	432

The moderately stable to extremely stable conditions, which favor poor air pollution dilution, only occur about 3-5% of the year, during early morning when there is strong temperature inversion. This suggests that the plant should take mitigating measures during early mornings of particularly the cold seasons to minimize adverse effect of the pollution exposure to biological systems within the vicinity of the plant. Analysis of extreme stability for the sake of establishing the worst case scenarios is performed. It is observed that the cold season has the highest frequency of stable conditions.

It is predicted that, provided the source strength provisions in the project specifications are complied with, air pollution levels will not exceed EHS guidelines. Air pollution levels are therefore predicted to comply with all applicable legislative requirements.

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 stations 1.0 and 5 Km from the power plant to assess the local impacts on air quality resulting from emissions of the power plant. The monitoring stations 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.

During the construction phase of the power plant, the dust emissions from the as well as emissions from the surrounding mining activities and ongoing road construction are likely to enhance the impact on air quality in this area. 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. Appropriate measures are proposed to mitigate against the dust emissions in the Environmental and social mitigation Plan (ESMP).

4.9.6 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 including the East African Portland Cement Company (EAPCC) factory.

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 residents near the power plant are pastoralist Maasai who move from place to place looking for pasture. However, the EPZ area is meant for industrial development and is owned by EPZ. About 1km east 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.

4.9.7 Noise

There are various factors that will contribute to ambient noise levels during construction and operation of the power plant. The Equivalent sound level (Leq) 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 90 dB(A) over an eight-hour time weighted average period. It further stipulates that noise emanating from a workplace shall not exceed 55 dB(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 be exceeded by any person. The maximum permissible noise levels under the First Schedule of the Regulations are reproduced below.

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 Kitengela Township located about 400 m due west of the power plant site. The findings of the noise survey are summarized as follows:

- The main sources of noise in the area are the East Africa Portland cement factory and traffic on the A104 Nairobi Namanga Road, particularly heavy motor vehicles and trailers.
- The closest sensitive receptor is the Kitengela Town, a residential located approximately 400 m from the proposed site.
- The World Bank Guideline of 55 dB(A) during the day was exceeded at 1 of the 8 sample points. The highest equivalent noise measurement of 73 B(A) was recorded at the approximate centre of the proposed site. The exceedance at this location was attributed to the East Africa Portland cement factory and road traffic.

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 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. 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.

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.

CHAPTER 5: PROJECT ALTERNATIVES

5.1 No Option Alternative

The effective national power capacity in Kenya in October 2007 was 1105 MW against a peak demand of 1082 MW. The Kenya Electricity Generating Company Limited (KenGen) is currently able to generate about 85% of the total capacity. Independent power producers (IPPs) contribute the balance of 15%. KenGen is working towards enhancing its capacity through hydro-plants and geothermal sources among other initiatives. However, additional sources will still be required to meet the anticipated growth in demand and provide diversification of technology and fuels especially in the short to medium term. 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 Therefore the 'No Action' alternative is not feasible for Kenya.

5.2 Options for Power Generation

Generation capacity in Kenya is presently provided by hydropower (62%), conventional thermal power (26%) and geothermal power (12%). At present the total installed capacity in Kenya and interconnected to the transmission and distribution systems amounts to 1098MW (effective 1045MW) with a peak demand of 976 MW. While KenGen is working towards enhancing its capacity through refurbishment of its hydro-plants, extending geothermal sources and completion of an investment program that will intergrate the existing gas turbine (64MW) and diesel plants (72MW) at Kipevu into a combined cycle facility providing an additional 30MW, there is still need for additional generation sources to meet the anticipated demand associated with the prevailing national economic growth in order to provide system stability and maintain reliability requirements. A number of options to address the predicted shortfall in electricity are considered here:

1. Demand management options
2. Fuel diversification options

3. Technology options
4. Location Options
5.

5.3 Demand Management Options

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. In addition to considering new generation capacity, the electricity sector in Kenya has been considering measures that can be taken to manage existing demand and to reduce system losses. Demand management options include:

1. Technical and commercial reduction
2. Time of day pricing

5.3.1 Technical and Commercial Pricing

Kenya losses about 21% of the electricity produced through transmission losses and illegal connections. Losses arise from two main factors. These are;

1. KPLC's transmission system, which because of its age accounts for the largest fraction of the total loss.
2. Theft of power that mainly takes the form of illegal connections to the national grid.

As a result of high losses, the Energy Sector Recovery Project was initiated in 2004. This project has a distribution, reinforcement and upgrade component. Planned technical improvements include re-stringing of conductor lines, installation of capacitors and construction of additional feeders and substations. Commercial improvements include introduction of electronic meters, improvement of meter reading accuracy, fraud control and resolution of billing anomalies. As a result of this project, system losses are expected to be reduced to about 15% by 2008/9. This demand management option can be seen as a medium to long term solution and is not likely to provide an adequate solution to electricity shortages in the short term.

5.3.2 Time of Day Pricing

Consumption patterns in Kenya show that demand for electricity among industrial consumers first peaks to 700 MW in the morning, then drops slightly at midday, reaches 1082MW during prime time and drops back by 700 MW by 10:30 pm. The large variation in load indicates that there is the potential for significant reduction in peak load by instituting lower pricing during the offpeak period. Owning to the very low per capita consumption of electricity at the low voltage level, it is only economical to install time of day pricing on medium and high voltage customers. Medium voltage customers tend to be industrial customers, many of whom have the ability to shift high power demand batch manufacturing processes out of peak demand periods thereby reducing overall power costs to them, as power will be priced lower during off peak periods. KenGen is spearheading the initiative to avert the possibility of taxing customers with a Kshs 1 billion bill from leasing an emergency generator to hedge against dwindling reserve.

The plan to persuade companies to reduce electricity consumption is facing some resistance. Most of the large companies that would be covered by this power-saving initiative say the proposed rebate of Kshs 2 for every unit of electricity consumed against the current power tariff is not enough. The manufacturers claim the rebate would not cover an increase in labour costs of shifting production between 11 pm and 6 am. The level of compensation for manufacturers will be fianlised when it is known how many companies will participate in the programme.

Therefore, the demand management options contribute to a reduction in losses throughout the system. However, they are not sufficient on their own to meet the chronic shortage in electricity supply predicted in the Kenya interconnected system. As a result, KPLC has investigated the installation of new power generation capacity.

5.4 Fuel Type Options

Electricity generation options can be considered by fuel type. This might be nuclear, geothermal, hydro, solar, wind, coal, oil, gas or some combination of the above. The

plant may be leased, rented or purchased and may be located on land or water. The current status of the various fuel type options available in Kenya are outlined below.

5.4.1 Nuclear Power

At present there are nuclear power reactors operating in 30 countries worldwide. These reactors supply about 16% of the world's electricity. Only two nuclear power plants are operational in Africa, both in South Africa. Nuclear power is a sophisticated technology that requires a correspondingly sophisticated infrastructure. This requires careful planning, preparation and investment over a 10 to 15 year period. Presently Kenya does not have the necessary experience, materials, fuels, funding or infrastructure to pursue this option.

5.4.2 Geothermal Power

Kenya is endowed with geothermal resources mainly located in the Rift Valley. Geothermal energy is generated using natural steam tapped from volcanic-active zones. Some 127MW is fed into the national grid from three plants located at Olkaria, this is expected to increase to 576 MW within the next 20 years.

The estimated potential of geothermal energy in Kenya is more than 2000MW when generated using conventional flash-steam condensing turbines. The generation potential may exceed 3000Mw if combined cycle and binary systems were to be used.
The geothermal exploration and developments project are now ongoing. KenGen has conducted surface scientific studies in Suswa, Longonot, Eburru and Menengai. Six exploratory wells were drilled at Eburru. More exploration work is now ongoing in the Lake Baringo area. The various geothermal prospects provide varying benefits and costs but none are achievable within the short to medium term.

5.4.3 Hydropower

Kenya has limited number of rivers which originate from the highland areas and flow into the Indian Ocean, accounting for most of the potential for hydropower. The country has a total estimated potential water-power resource of 1100 MW and the total installed capacity of hydropower in Kenya is 677 MW. Given the severe seasonal water

fluctuations in the River Tana catchment area, the effective potential development on River Tana is around 540 MW, although the estimated potential is 835 MW. Kenya is highly dependent on hydroelectricity which provides about 70% of all electricity output. Five major stations in the Tana River basin supply power to Kenya. These are Kindaruma (44 MW), Gitaru (225 MW), Kamburu (94 MW), Masinga (40 MW) and Kiambere (144 MW). The Turkwel Gorge hydroelectric station in the Turkana district has an installed capacity of 106 MW. The hydro power project of Sondu Miriu (60 MW) has been completed, but has not been commissioned yet due to low water levels while Sangoro Power Plant in the same system is expected to generate 20 MW by November 2011. An additional 30 MW is imported from Owen falls dam in Uganda. Variable hydrology in Kenya means that there is a high risk associated with hydropower production, particularly since most of the power is generated within one catchment.

There are a number of sites suitable for small hydropower projects which are suitable to rural energy demand patterns. The current known potential for mini and micro hydro is estimated to be 300 MW. A number of pilot projects in the area of mini and micro hydropower have been implemented to assess the viability of such systems and create the impetus for accelerated exploitation of the mini/micro hydropower source. KPLC is looking at diversifying the hydropower sector by looking at rivers in Western Kenya which may not be as badly affected by variable hydrology. Further hydropower generation in the short term is not an option.

5.4.4 Wind Power

Wind power generation represent a huge potential for generation of renewable power in Kenya. Already a 5 MW wind farm has been commissioned at the Ngong Hills near Nairobi. According to the Energy Regulatory Commission, two other MW wind farms of 300 MW each by IPPs are planned for Turkana and Marsabit Districts. Wind generation is encumbered by inordinately long roll out periods, large capital outlays and lack of transmission infrastructure to the national grid. Therefore, while wing power presents a huge potential for the medium to long term, it is not available to meet the increasing short term demand.

5.4.5 Solar Power

Solar power is sustainable and available throughout Kenya. The technology is well proven especially for home or single building applications. However, power production is limited to daytime when the sun is shining. Additionally, the electricity production is expensive. Therefore, solar power may only provide a limited short term power solution.

5.4.6 Thermal Power

Thermal generation of power can be through coal, liquid fuels such as diesel and heavy fuel oil or natural gas. In Kenya, coal and natural gas are not available. Liquid fuels on the other hand are imported as crude oil for refinery at the Kenya Petroleum refineries at Mombasa or imported as refined fuel. Thermal power generation has serious disadvantages including the production of CO2, a greenhouse gas, high sulphur levels and greater costs than most other fuels. However, thermal production involves compact and reliable generators that can be installed with a short time frame. Therefore, thermal generation is available to meet short term demand including emergency supplies. Currently, installed thermal power generation includes, Kipevu II, 70 MW; Aggreko, 140 MW; and Rabai, 88.6 MW. Other Energy Regulating Commission committed thermal power plants include, Athi River, Thika and Naivasha MSD; 200 MW and Kipevu III, 120 MW.

5.5 Power Trade/Regional Interconnections (Regional Catchment)

While many power generation projects from different sources are underway, the country can benefit immensely by tapping power from the region. Currently, Ethiopia is installing large power generation capacity through hydro electric power stations. The Southern Africa region also has excess capacity through hydro electric dams in Zambia and Mozambique. On the other hand, the Democratic Republic of Congo has huge potential for power generation in River Zaire. By drawing from this large pool of power the country would benefit from resource complementarities, security of supply and least costs supplies. Currently, the following interconnection projects have been mutted

1. Kenya – Ethiopia interconnection
2. Kenya – Uganda interconnection

3. Kenya –Tanzania interconnection
4. East African Power Pool – EAPP

Regional interconnection may indeed be the long term solution for power supply in the country. However, realising the supply will involve drawn out negotiations, international treaties, and infrastructure development.

5.6 Proposed Athi River Thermal Power Plant

The KPLC 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 locating three MSD power plants within the same parcel of land, the KPLC sought to acquire land in three separate locations. The KPLC's site selection criteria included the following:

1 A site with minimal environmental impacts;
2 A site from which electric power can easily be evacuated;
3 A site that was available for sale immediately; and
4 A site adequate in size to contain the footprint of an 81MW 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:

1. The proposed site near the Athi River EPZ facility next to Portland cement Company
2. A Site just before the Stony Athi River;
3. A site near Thika town.

The proposed thermal power project involves installation of power generation units at Athi River Town. The proposed units are compact and would be delivered by sea to the Port of Mombasa and then by land to Athi River where they will be installed, tested and commissioned. Within the implementation time frame of 18 months, the project will inject 81 MW to the national grid will come in handy in bridging the existing gap between supply and demand. Already, the Energy Regulating Commission has

factored in the project as one of the 'Committed Generation Project' to be commissioned in year 2011. Therefore, the project enjoys the support of the key players in the industry.

Athi River Town is one of the major industrial zones in the country. By locating the project in the vicinity of these industries, the power will be supplied directly to the point of high demand thereby reducing transmission losses.

CHAPTER 6: TECHNOLOGY, PROCEDURES AND PROCESSES

6.1 Introduction

The chapter presents the technologies, procedures and processes that will be applied in the implementation of the project. The thermal power plant consists of 10 – 9.0 MW Medium Speed Diesel (MSD) reciprocating engine-generators sets with a total capacity of 81MW. ZGPT-MAN will provide a finished plant designed for safe, reliable, efficient and 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 termed diesel (DFO). Power generated will be transmitted to KPLC.

6.2 Equipment Scope of Supply

ZGPT-MAN will furnish a complete power plant including engineering, Procurement, construction, start-up and testing. Once commissioned, the power plant will be operated by Triumph Power Generating Company. The major items which comprise the power plant are listed below.

Engine-Generator Sets

- 10 – 9.0 MW MSD Model 18V32/40 turbocharged Diesel engines
- Matching electric generators
- Radiators for engine cooling
- Intake air filters
- Exhaust silencers and 32 m 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
- Thermal oil building
- Administration 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

6.3 Plant operating philosophy

6.3.1 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.

6.3.2 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.

6.3.3 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.

6.4 Plant layout

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

6.4.1 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 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.

6.4.2 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.

6.4.3 Fuel Treatment Building

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

6.4.4 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.

6.4.5 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.

6.4.6 Radiators

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

6.5 Design Parameters

The design parameters are indicated as follows:

6.5.1 Plant operating range

The plant will be designed for the following site conditions. Minimum and maximum ambient temperatures of 4 and 33oC; site elevation (asl) of 1525 m and soil bearing strength of 150 kN/m^2.

6.5.2 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 and H55 under ISO 8217, DIN EN 590, ASTM D396 or ASTM D975. As earlier stated CIMAC-E25 will be the primary fuel for the MSD engines.

6.5.3 Prohibited Materials

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

- Engine hall ventilation silencers.

6.6 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 Instituit fur Nomung, 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

6.7 Engine-generators

6.7.1 Engines

The engines will be 18V32/40 diesel unit designed specifically to burn HFO/DFO fuels. 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

6.7.2 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

6.8 Fuel and lubricating unloading systems

6.8.1 Combined HFO, DFO and Lube Oil Delivery Area

Heavy fuel oil, DFO and engine lube oil will be delivered to the plant by contracted trucks. 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.

6.8.2 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 above ground storage tanks each having a capacity of 5,500 m^3

.

These steel tanks will be located in the tank farm with system for HFO aboveground storage tanks.

6.8.3 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 700 m^3. This steel tank will be located in the tank farm, which includes spill retention dikes.

6.8.4 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. The steel tank will be located in the tank farm, which includes concrete spill retention dikes.

6.9 HFO Conditioning System

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

6.9.1 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.

6.9.2 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.

6.9.3 HFO Heating System

Thermal oil will be the heating medium for the 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.

6.10 Distillate fuel oil system

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.

6.10.1 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.

6.11 Lube oil system

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.

6.11.1 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.

6.12 Combustion air intake and exhaust system

6.12.1 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, 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.

6.12.2 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 the atmosphere through a 32 m stack. Expansion joints, supports and insulation will be furnished as required.

6.13 Cooling water system

As fuel burns inside the engine, temperatures of the engine components get elevated. 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. Above ground supply and return piping connects the radiators to the engines. The power plant engines will be configured with two-circuit cooling systems as follows;

6.13.1 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.

6.14 Heat recovery system

6.14.1 Thermal oil System

The thermal oil system shall be designed to utilize 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 oil heater unit, exhaust gas bypass system, oil expansion tank, oil drain tank, transfer oil pump, filling and drainage pump, oil circulation pumps for engines and consumers, 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.

Features of the thermal oil system include the following:

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.

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.

Oil Expansion Tank

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

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. A single control system for controlling and operating the exhaust gas heat recovery system for self-demand thermal oil heating.

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.

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.

6.15 Compressed air system

The compressed air system compresses, stores and delivers medium pressure (30 bars) compressed air to start the diesel engines. Through a pressure reducing station, low pressure (8 bars) 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 for 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.

6.16 Power house ventilation system

The powerhouse ventilation system which is not combined with the combustion air intake system, has three basic purposes to provide:

- An environment that permits the machinery and equipment to function properly within their service life.
- An environment in which personnel can work comfortably, effectively and efficiently.
- Noise attenuation.

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

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

Features of the system include:

- Two completely separate ventilation inlet modules for each generator set as described above, one for the generator side and another 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.

6.17 Water system

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 through 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

6.18 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 wastewater streams will also be discharged to the owner's existing sewer including the regeneration brine from the process water treatment system

6.19 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 gross margin analysis will be undertaken by the Proponent to decide which option is preferable for managing sanitary sewage from the power plant.

6.20 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.

6.21 Electrical system

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 MSD 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;

- 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.

6.21.1 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.

Typical metal enclosed switchgear has the following components:

- A bus-bar;
- 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.

6.21.2 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;
- Bus-bar;
- 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.

6.21.3 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.

6.21.4 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.

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 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.

6.21.5 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.

6.21.6 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.

6.22 Monitoring and control system

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

- Control and monitoring unit for engine-generators, located in the control room.
- Measurement and protection unit, located in the control room.
- SCADA system, located in the control room.
- Each of these components is discussed here-in.

6.22.1 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.

6.22.2 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 Diagram (PID) 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.

6.22.3 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.

6.22.4 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.

6.23 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.

6.23.1 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 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.

6.23.2 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.

6.23.3 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.

6.23.4 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.

6.23.5 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.

6.23.6 Miscellaneous 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.

6.23.7 Insulation

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

- Reduce heat losses
- Reduce noise
- 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.

6.23.8 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.

6.23.9 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 trucks. Sand and cement will be sourced from existing local 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.

6.23.10 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 browsers. Hydrostatic testing will be carried out on the pipes. Water used for this purpose will need to be tested and approved as per relevant standards before being discharged.

6.23.11 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 Main 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.

6.23.12 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.

6.23.13 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.

It is recommended that the proponent, Triumph Power Generating Company, implements all the suggested programmes in consultation with the community.

6.24 Workers Camps

The workers camps will be constructed on the lower northern part of project site where there will be no construction activities. The construction will be to approved standard and materials and will be provided with basic utilities as described in the following sub-sections.

6.24.1 Health and Hygiene

Workers camp will be provided with portable water supply from Mavoko Water and Sanitation Company (MAVWASCO). The camps will be furnished with communal bathrooms/ flushed lavatories connecting to septic tanks and soak away pits. Waste

sludge in the septic tanks will periodically drawn out using exhausters and disposed off at the Athi River Town sewage treatment works. The camps will be kept clean daily by a cleaning crew.

Sexually Transmitted Diseases (STDs) awareness campaigns will be conducted for those living in the camps.

6.24.2 Catering Facilities

A central canteen for the workforce at the construction camp as will be provided because it would contribute towards the general good health in the camp as kitchen wastes can be disposed of in an organized manner, while hygiene can be monitored.

6.24.3 Garbage Management

The canteen and kitchen will be provided with grease traps. Garbage bins all with cover lids will be provided for both wet and dry garbage at the canteen and kitchen and also in the living quarters. The garbage bins will be provided in sufficient numbers to be emptied daily for garbage disposal with other solid wastes in the plant.

6.24.4 Lighting

The Contractor will provide adequate lighting inside and outside the living areas

CHAPTER 7: CONSTRUCTION HSE MANAGEMENT PLAN

7.1 Introduction

Health, safety and environment (HSE) protection is fundamental to the Proponent's operations and forms an integral part of the Company'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 thermal power plant will be constructed by the main contractor to be appointed by the proponent. The main contractor is expected to sub-contract the civil, mechanical, electrical, instrumentation and control components to locally based Kenyan contractors. Prior to construction, the Main 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.

7.2 Compliance with HSE legislation

The Main contractor will need to ensure that their construction HSE management plan complies with stipulated laws and regulations in Kenya on HSE. Some of the pertinent laws are referenced here-in;

- 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 and
- Water Act.

7.3 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 Main 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 main contractor will further ensure that the project construction phase complies with the relevant requirements of the Equator Principles as discussed in chapter 3 of this ESIA Study.

7.4 Construction HSE management plan

7.4.1 Purpose of a construction HSE plan

A construction HSE plan is a 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 main contractor will ensure compliance with international standards, guidelines and best practices in the safe operation of construction activities associated with the project.

7.4.2 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 main contractor will implement the following strategy:

- The HSE goals/objectives of the project will be verified and commented upon in each HSE meeting and 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.

7.4.3 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 Main contractor's management team and the sub-contractors' they supervise. The Main 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 i.e managers, engineers, supervisors, sub-contractors, suppliers, employees etc. in HSE management should be outlined.

7.4.4 HSE performance measurement

The main 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;
- No. of HSE meetings conducted;
- No. of HSE inspections undertaken;
- No. of emergency drills conducted;
    - No. of HSE training courses conducted.

7.4.5 HSE interface between contractor and proponent

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

- The main 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 main 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 main 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 Main contractor to discuss specific HSE issues; and
- HSE reviews/inspections undertaken by either the proponent or the main contractor or both.

7.5 Safety action plan

7.5.1 Design phase

This section summarizes the processes that will be used by the main 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 main 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 Main 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, cods 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 these steps.

HSE management

HSE management in the design phase will encompass interactions between the following main 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 Main 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 on 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 Main contractor's project design is adequate and conforms to the terms of the contract health and safety requirements.

Recording process

The main contractor will have in place a quality assurance system such as ISO 9001. The main 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 Main contractor containing the risk control measures that need to be implemented during the construction phase of the project.

7.5.2 Construction and fabrication phase

Safety hazards and critical areas

Prior to commencing construction the main 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 Main 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 main 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 main 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 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 Main contractor will ensure that their sub-contractors provide sufficient artificial lighting to permit work to be carried out safely, efficiently and satisfactorily.

All tools and equipment deployed by the Main 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;
- Motor vehicles;
- Ladders.

In addition to the above, the Main contractor will develop, rollout and implement the following health and safety rules for the construction site:

- Job site transportation;
- Daily construction plant inspection;
- Electrical operation;
- Floor, wall openings and stairway;
- Excavation and trenching;
- Steel erection;
- Confined space entry;
- Work near pressurized pipelines;
- Medical services;

- Fire protection and prevention;
- Alcohol and drug abuse.

7.6 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 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.

7.6.1 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 main 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 Main 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 main 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 main 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.

7.6.2 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 main 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.

7.6.3 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.

7.6.4 Training

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

7.6.5 Communications system

The main 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.

7.6.6 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.

7.7 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 Main contractor will comply with during the construction phase of the project.

7.7.1 Key environmental positions

The chapter earlier 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 Main 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 main 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 including:

- 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 main contractor's environment management system (EMS) for the project;
- Routine monitoring of implementation of the main 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.

7.7.2 Environmental training

The main 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.

7.7.3 Environmental objectives

The main 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 Main 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 main 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 main contractor's workers, sub-contractors, project consultants and suppliers. The Main contractor will provide environmental training for their workers in order to minimize the likelihood of environmentally damaging incidents occurring.

7.7.4 Environmental procedures

The Main 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.

7.7.5 Environmental performance meetings

The main 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.

7.7.6 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.

7.7.7 Soil conservation and erosion mitigation

The Main 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 Main contractor will take adequate measures to prevent soil erosion especially during the rainy season and wet the road to reduce soil erosion from dusty surfaces. 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.

7.7.8 Site restoration

Prior to handover of the completed power plant to the Proponent, the Main 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.

7.7.9 Waste management

Prior to the construction phase but immediately after award of the contract, the Main 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.

7.7.10 Spill response

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

7.7.11 Air quality

Kenya has developed air quality regulations that are in the gazetting stage. It is envisaged that the Main contractor's thermal plant and equipment will emit pollutants to the atmosphere during the construction phase. The Main 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 excessive air pollutants and noise.

7.7.12 Work site controls

The main contractor through the HSE Manager and HSE representatives will monitor the project construction site daily for environmental non-conformities and submit written HSE reports to the Proponent weekly. Remedial action on environmental non-conformities will be implemented as soon as possible when observed. Scheduled environmental inspections will be undertaken by the Main

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 main 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 basis for summary dismissal.

7.7.13 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 Main 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.

7.7.14 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 Main Contractor and appropriate noise control measures implemented.

7.7.15 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 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.

CHAPTER 8: PRODUCTS, BY-PRODUCTS AND WASTES

8.1 Introduction

The chapter details the numerous products, by-products and wastes to emanate from the project power plant during the construction and operational phases. The bulk of which, will be generated during the construction phase while a lower amount will be generated during the operational phase.

8.1 Construction Phase

8.1.1 Products

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

- A power house that houses the 10x9.0 MW MSD engines
- An electrical building that 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 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
- Other infrastructure including site fencing and gatehouse, foundations for the radiators, boiler stack and exhaust muffler stacks, and landscaping for the fenced area.

8.1.2 By-products

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

During the project construction phase it is foreseen that the by-products may include any excess construction materials brought to the site by the contractor and can be reused later.

8.1.3 Waste

During the construction phase, numerous waste products are expected to be generated. These 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 including:

- 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 these emissions will depend on their maintenance levels and servicing by the Contractor.

8.2 Operational Phase

8.2.1 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 KPLC from the thermal power plant. An 11/66kV high voltage sub-station within the set limits will evacuate electricity to transmission lines that KPLC will construct.

8.2.2 By-products

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

8.2.3 Waste

Air emissions

One of the significant wastes that will be generated by the project is 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 WHO guidelines.

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 facilities within the power plant will generate wastes such as papers and other sanitary wastes.

Sewage Waste

The employees of the Proponent based within the project area are expected to generate sewage waste which will be channeled through an onsite sewage collection and disposal system.

CHAPTER 9: ENVIRONMENTAL AND SOCIAL IMPACTS OF THE PROJECT

9.1 Introduction

This section identifies and discusses both negative and positive impacts associated with the proposed MSD Power Project, in Mavoko Athi River Township. The impacts are identified according to project phases; namely, construction, operational and decommissioning phases.

The project being a national development agenda in the energy sector has immense benefits that could save the country losses in terms of power rationing due to long drought duration which is affecting the country. However poor planning of the project could also affect the environment that supports millions of Kenyans through the potential hazards that the project could pose to the public like pollution of water and atmospheric resources. The project impacts are classified as positive or adverse. However the study goes further to categorize the impacts in terms of their magnitude, significance, time of occurrence, extent, reversibility and scope of the impacts.

9.2 Positive Impacts during Construction Phase

The construction phase of the proposed MSD Power Project will have several positive impacts on the community, nation and the environment. These positive impacts are discussed below.

9.2.1 Employment Opportunities

During construction of MSD Power Project, employment opportunities will be created especially for casual workers from the local community. Creation of employment opportunities has both economic and social benefit. Economically, existing excess unskilled labour will be used in economic production; socially, the young and energetic but otherwise unemployed people will be engaged in productive employment other than remaining idle. Employees with diverse skills are also expected to work on the site during the construction period. Furthermore, unskilled employees will gain some skills.

9.2.2 Gains in the Local and National Economy

There will be gains in the local and national economy during the construction of the proposed MSD Power Project, through consumption of locally available materials such as timber, sand, and cement. The consumption of these materials in addition to fuel oil and others will attract taxes including value added tax (VAT) and income tax which will be payable to the national government. The cost of the materials will be payable directly to the suppliers.

9.2.3 Provision of Market for Supply of Building Materials

The project will require supply of large quantities of building materials most of which will be sourced locally from the surrounding areas. This provides ready market for building material suppliers such as quarrying companies and hardware stores. The demand for the building materials will in turn spur other economic activities.

9.2.4 Informal Sectors Benefits

During construction phase of MSD power project, the informal sectors are likely to benefit temporarily from the operations. This will involve kiosk operators who will be selling food to the workers on site and will finally promote Jua Kali (informal sector) entrepreneurs in the project area.

9.2.5 Environmental Benefits

MSD power project has a potential for contributing to the good of the environment of the area. The project will supply an additional 81 MW to the National grid which will enable KPLC to connect more consumers leading to a substantial reduction in reliance on other sources of energy e.g. charcoal and firewood that have impacts on the forest cover and greenhouse.

9.3 Negative Impacts during Construction Phase

The following negative impacts are expected to be associated with the construction of the proposed MSD power plant.

9.3.1 Noise pollution

The construction works of the proposed MSD power project is most likely to be a noisy operation due to the moving construction machines and vehicles. Also, the construction workers who will be working in the site will generate some noise as they are

communicating to one another. This will be a potential source of disturbance at the site and surrounding neighbourhood of the proposed MSD power project.

9.3.2 Generation of Exhaust Emissions

Exhaust emissions are likely to be generated by the construction equipment during the construction phase of proposed MSD power project. Motor vehicles that will be used to ferry construction materials would cause air quality impact by emitting pollutants through exhaust emissions. The impacts will not be significant.

9.3.3 Dust Emissions

Particulate matter pollution is likely to occur during the site clearance, excavation and spreading of the topsoil during construction of proposed MSD power project. There is a very small possibility of PM_{10} suspended and settleable particles affecting the site workers and even neighbours' health, it is minimal given the construction method of minimum excavation and nil cart away of soil.

9.3.4 Disposal of Excavated Soil

Though little excavation is likely to take place at the proposed MSD power project site, the excavation works to level the site will result in the generation of small amounts of excavated material. But there will be no cart away of excavated material.

9.3.5 Increased water demand

During the construction phase of the proposed MSD power project, both the construction workers and the construction works will create additional demand for water in addition to the existing demand. Water will be mostly used in the mixing of concrete for civil construction works and for wetting surfaces or cleaning completed structures. It will also be used in the washrooms at the construction site and also during the running period of the project.

9.3.6 Workers accidents and hazards during construction

During construction of the proposed MSD Power Project, it is expected that construction workers especially unskilled temporary employees are likely to have accidental injuries as a result of exposure to workplace hazards. Because of these intensive engineering and construction activities including erection of steel structures, welding, metal grinding and cutting and concrete work among others, construction

workers will be exposed to risks of accidents and injuries. Injuries can result from trips & falls and other physical and mechanical hazards.

9.3.7 Energy Consumption

The proposed MSD Power Project will consume fossil fuels (mainly diesel) to run transport vehicles and construction machinery. Fossil energy is non-renewable and its excessive use may have serious environmental implications on its availability, price and sustainability.

9.3.8 Extraction and Use of Building Materials

Building materials such as hard core, ballast, cement, rough stone and sand required for the construction of the proposed MSD Power Project will be obtained from nearby quarries and hardware stores. Sand harvesters extract sand from rivers and land. Small quantities of these materials will be required for construction of the buildings, the availability and sustainability of such resources at the extraction sites will be negatively affected as they are not renewable in the short term. In addition,the sites from which the materials will be extracted may be significantly affected in several ways including landscape changes, displacement of animals and vegetation, poor visual quality and opening of depressions on the surface leading to human and animal health impacts.

9.3.9 Solid Waste Generation

During construction of the proposed project, solid waste will be generated. These include packaging materials, plastics, scrap metal and timber remains among others. Dumping around the site will interfere with the aesthetic status of the area. This has a direct effect to the surrounding community. Disposal of the same solid wastes off-site could also be a social inconvenience if done in the wrong places. The off-site effects could be aesthetic, pest breeding, pollution of physical environment, invasion of scavengers and informal recycling communities.

9.3.10 Possible Exposure of Workers to Diseases

Workers are likely to be exposed to diseases from building materials during the construction phase of the proposed MSD Power Project. It is therefore recommended that before the construction phase of thermal power Project commences, there is need for the materials to be well inspected according to the occupational health and safety standards and worker encouraged to use personal protective equipments. Employees

who are new to the area may spread or acquire Sexually Transmitted Infections including HIV/AIDS in view of the prevailing prevalence rate in the district.

9.3.11 Increased Storm Water Runoff from New Impervious Areas

Construction of the proposed MSD Power Project buildings and pavements within the proposed project site will lead to additional runoff through creation of impervious areas and compaction of soils. Impervious areas and compacted soils generally have higher runoff coefficients than natural area, and increased flood peaks are a common occurrence in developed areas.

9.3.12 Soil Erosion

There are possibilities of soil erosion occurring during the construction of the proposed MSD Power Project especially during rainy and windy seasons. The impact will however be minimal as there area to be disturbed is small. Roadways and footpaths will be paved with impervious material to minimize soil erosion. Drainages will be constructed to control storm rain water.

9.3.13 Oil Spills

The machines on site may be containing moving parts which will require continuous lubrication to minimize the usual corrosion or wear and tear. This will contaminate the soil. Likewise, moving vehicles on site may require oil change.

9.3.14 Destruction of existing vegetation

The construction process of the proposed MSD Power Project buildings will involve clearing of the existing vegetation cover consisting of mainly shrubs. The developer intends to replace this with trees and grass in the lawns and land boundaries around the project area.

9.3.15 Surface and ground water Hydrology and Water Quality Degradation

Changes in surface hydrology alter the flow of water through the landscape. Construction of impervious surfaces such as parking lots, roads and buildings increase the volume and rate of runoff, resulting in habitat destruction, increased pollutant loads, and flooding. Contaminated soil or ground water in the path of the project could be disturbed by excavation resulting in a potential transfer of the contamination to surface waters. Oil spills during construction could introduce contaminants into subsurface which may end-up into ground water. Development activities such as MSD Power

Project development as well as the spill-over effects of development such as increased demand for water use and increased auto use can impact water quality by contributing sediment, nutrients, and other pollutants to limit water supplies, increasing the temperature of the water, and increasing the rate and volume of runoff.

9.3.16 Fire Outbreaks

Due to various construction activities at the proposed MSD power plant project, fire outbreaks can occur. Handling of inflammable products increases fire risks. .

9.3.17 Traffic Impacts

During construction, movement of trucks carrying heavy construction equipment, excavated materials for disposal, construction materials and heavy plant, will cause several adverse impacts including, road blockage, slow traffic, noise and dust.

9.4 Positive Impacts during Operation Phase

Like construction phase, there are positive impacts associated with the proposed MSD Power Project during operation phase. These positive impacts are discussed below.

9.4.1 Increase in electricity supply

In Kenya the electricity demand by far outstrips the electricity supply. This is because currently the country is experiencing a long drought spell which has lead reduction in water volumes in hydropower generation dams that produce the electricity. The project aims to provide an additional of 81 megawatts to the National grid. With additional electricity in the national grid, more investors are expected to be attracted due to the reliable supply of electrical energy.

9.4.2 Employment Opportunities

Employment opportunities are one of the long-term major positive impacts of the proposed MSD Power Project. This will occur during the operation and maintenance of the MSD Power Project. Other sources of employment will involve direct technical service provision to the MSD Power Project e.g. electrical engineers, mechanical engineers, drivers among others. There could be other indirect sources of employment e.g. businesses associated with the project.

9.4.3 Increase in Revenue

There will be positive gain for the revenue system arising from the sale of the electricity power from the proposed MSD Power Project to Government, the fuel provider, project operator and KPLC which in turn will be supplied to various customers who will be paying taxes to the Government.

9.4.4 Improved Security

With the establishment of the proposed MSD Power Project, the level of security will be improved around the project area. This is as a result of more security lights and security personnel being employed to guard the MSD Power Project. The project site will also be well fenced. Hence if the level of security is increased, the residents will feel more secure than before.

9.5 Negative Impacts during Operation Phase

The following are the negative impacts that are associated with the proposed MSD Power Project during the operation phase.

9.5.1 Waste Generation

The proposed Project is expected to generate some amounts of wastes during its operation phase. The bulk of the solid waste generated during the operation of the project will consist of drums, used oil, paper, plastic, glass, metal, textile and inorganic wastes. Such wastes can be injurious to the environment. Some of these waste materials especially the plastic/polythene are not biodegradable hence may cause long-term injurious effects to the environment.

9.5.2 Fuel Oil Consumption

The proposed MSD Power Project shall consume large amount of diesel in the process of generating electricity. Since fuel oil is produced mainly through non renewable resources, this will have negative impacts on these non renewable resources base and their sustainability.

9.5.3 Increased Population around the project area

With the construction and operation of the proposed Project will lead to the establishment of businesses within the proposed project area and operated by persons who were not previously resident in the area. This will in turn increase the population in the project area.

9.5.4 Water Use

The operation activities during the operation phase of the proposed Project will involve the use of substantial quantities of water initially, but after that recycled water and roof rain water shall be used. 4 no. bore wells shall be dug and a water treatment plant constructed for treatment of all water from various sources. The bore well shall supplement the municipal water this may not increase the strain on water resources in the area.

9.5.5 Increased Pressure on Infrastructure

The proposed Project will have a potential of increasing pressure on existing infrastructure such as roads and water among others. This is because of increased use of water and increased human and vehicle traffic in the project area.

9.5.6 Air Pollution

Operational phase of the proposed project will affect air quality. Particulate emissions represents the main pollutant of concern, with gaseous emissions such as oxide of sulphur (SOx), oxides of nitrogen (NOx) and carbon monoxide (CO) potentially significant due to combustion of the generator fuel. Measurements were made on air samples from the proposed project area and were found to be far much below the limits. Air sampling and tests for pollutants will be done periodically during the operation of the project. The operation of the plant might have some impact on the health of the people working or living in the area.

9.5.7 Increased Storm Water Flow

The building roofs and pavements of the proposed MSD Power Project will lead to increased volume and velocity of storm water or run-off flowing across the area covered by the proposed Project during operation phase. This will lead to increased amounts of storm water in the area and this may lead to soil erosion.

9.5.8 Water Pollution

During the operation phase of the proposed Project, If the sites for dumping solid wastes are not well taken care of, they may cause contamination of ground water sources. There is need therefore for the project proponent to put in place an efficient waste management scheme that will prevent the accumulation of uncontrolled waste,

as well as an efficient collection system and off-site disposal. Oil spills might also lead to contamination of wetlands and ground water sources.

9.5.9 Noise Pollution

Noise pollution from the operation of the generators from the proposed MSD Power Project is inevitable. The only existing sources of noise are the EAPCC and road traffic, especially during the day. However, there are no immediate sensitive receptors of the noise emission as the area is mainly vacant land with very few activities at night. Noise measurements have been made before commencement of the project construction. The noise levels were found to be mostly below the WHO limits. Simulations of engine noise found that the spatial noise distribution meets the Kenyan Regulatory Noise standards within the environs of the facility. However, within the facility vicinity the noise levels may occasionally approach the limits especially under stable atmospheric conditions at night. To mitigate the noise, the generator sets will be housed buildings with solid walls. In addition, noise insulation material will be used in walls and roofs of all buildings with noise sources. Therefore, the noise levels will be limited. However, periodic noise audits will made during the project operation phase.

9.5.10 Vibration

During the operational phase of the proposed Project, the generators will create a low level ground vibration within the surrounding areas. This will be monitored periodically.

9.5.11 Oil Spills Hazards

Potential oil spills and accidents during oil transportation, storage and operations of the generators of the proposed power plant project may occur. In the case of oil spill the relatively lighter, more volatile, mobile, and water soluble compounds in diesel will tend to evaporate fairly quickly into the atmosphere or migrate to groundwater. When exposed to oxygen and sunlight, most of these compounds will tend to break down relatively quickly. Accidental oil spills can occur due to leakage from the storage tanks or site oil pipelines. Poor maintenance of machines can also lead to oil spills. A small amount of used oil may drip from spent oil filters. Test for hydrocarbons were made from soil sampled from the proposed project site. This soil was found to be environmentally clean. Annual tests will be done on soil samples during the project operation.

9.5.12 Visual Impacts

The plant might present unwanted visual impacts, both by its physical presence and profile against the surrounding area, and by visual impacts of the plume (particularly during periods of poor atmospheric dispersion) and secondary formation of aerosols that can reduce visibility on a more regional scale. Large structures such as the 32 m stacks and fuel tanks towers may also adversely impact the visual quality of the area.

9.5.13 Traffic

There will be minimum regular traffic during operation, on average one HFO delivery tank truck per hour. The heavy trucks could however cause noise pollution to neighboring Kitengela residents if delivery is carried out at night. To mitigate against disturbance of the residents at night time the fuel deliveries will be carried out during daylight hours.

9.6 Positive Impacts during Decommissioning Phase

The following positive impacts are associated with the proposed MSD Power Project during the Decommissioning phase:

9.6.1 Site Rehabilitation

Upon decommissioning of the proposed MSD Power Project rehabilitation of the project site should be carried out to restore the site to its original status or to a better state than it was originally. This will include replacement of topsoil and re-vegetation which will lead to restoration of the visual quality of the area.

9.6.2 Employment Opportunities

For demolition to take place properly and in good time, several people will be involved. As a result several employment opportunities will be created for the demolition staff during the demolition phase of the proposed MSD Power Project.

9.7 Negative Impacts during Decommissioning Phase

The following are the negative impacts that are likely to be associated with the proposed MSD Power Project during its decommissioning phase.

9.7.1 Noise and Vibration

The demolition works will lead to significant deterioration of the acoustic environment within the project site and the surrounding areas. This will be as a result of the noise

and vibration that will be experienced as a result of demolishing the proposed MSD Power Project.

9.7.2 Solid Waste Generation

Demolition of the proposed MSD Power Plant and other related infrastructure will result in generation of solid waste. The waste will contain the materials used in construction including concrete, metal, drywall, wood, glass, paints, adhesives, sealants and fasteners. Although demolition waste is generally considered as less harmful to the environment since they are composed of inert materials, there is growing evidence that large quantities of such waste may lead to release of certain hazardous chemicals into the environment.

9.7.3 Dust

Some dust will be generated during demolition works of the proposed MSD Power Plant. This will affect demolition staff as well as the neighbours.

9.7. Traffic Impacts

During decommissioning movement of trucks carrying heavy demolition equipment, demolished materials for disposal, and heavy plant, will cause several adverse impacts including, road blockage, slow traffic, noise and dust.

CHAPTER 10: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

10.1 Significance of an ESMP

Environmental and Social Management Plan (ESMP) for development projects provides a logical framework within which identified negative environmental impacts can be mitigated and monitored. In addition the ESMP assigns responsibilities of actions to various actors and provides a timeframe within which mitigation measures and monitoring can be done. ESMP is a vital output of an Environmental Impact Assessment as it provides a checklist for project monitoring and evaluation. The ESMP covers all aspects of planning, construction, operation and decommissioning of the project, which are relevant to environment. It is essential to implement the ESMP right from the planning stage and then continuing it throughout the construction, operation stage and decommissioning stage. Therefore the main objective of the ESMP is to identify the project specific activities that would have to be considered for investigation of the significant adverse impacts and the mitigation measures required.

10.2 Description of the ESMP Developed for the Athi River Power Plant

The ESMP outlined here (Tables 10.1, 10.2 and 10.3) has addressed the identified potential negative impacts and mitigation measures of the proposed power project during its construction, operational and decommissioning phases, based on the chapters on Environmental Impacts and Mitigation Measures of the expected negative impacts. Rough estimates of the costs of mitigation measures have been proposed.

Technical methods will be used to prevent, control and reduce negative impacts from the power plant project and associated activities in accordance with best available technology and working practices. Efforts will be made to maximize positive benefits and the environmental carrying capacity. Social, economic, cultural and public health approaches will be implemented to minimize negative impacts and enhance positive benefits for the local people in the vicinity of the project area power plant activities.

To insure an integrated internal and external management of identified environmental impacts the project proponent plans to use the following institutional approaches:

- Coordination and cooperation with appropriate governmental, municipal, local communities, and other agencies and firms to insure sound environmental management of project activities.
- Regularly updating information to improve the intention and understanding of regulations and laws at the national and local levels so that project proponent activities conform to existing laws and regulations.
- Regular reporting on environmental performance.

10.3 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 terms of reference for the ESIA Study based on the issues scoped therein.
- An ESIA of the proposed Project, including specialist reports, that aim 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
    - 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 here is a description of the mitigation measures to be applied in the project phases described above.

10.3.1 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 81MW thermal power plant which includes:
        - 10 x 9.0 MW 18V32/40 @ 11 KV
        - Waste heat Recovery system
        - Medium Voltage switch Gear
        - Step up transformers 11/66 KV
        - High Voltage switch Gear
        - Transportation and delivery to site of the above components
        - Civil and structures works
        - Installation activities
        - Commissioning and start up
        - Testing.

    - Construction of an access road from the main Nairobi – Mombasa Highway to the project site.

Chapter 9 described and clarified 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 10.1).

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.

10.3.2 Pre-construction and construction

Requirements for environmental management and mitigation measures will be included in contracts of the construction contractors. However, the oversight and responsibility for implementation during the construction period will remain with the Proponent.

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 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.

Assignment of responsibility and sub-contractor management by the main contractor is especially important during the construction phase, when sub-contractors 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.

10.3.3 Operation

The proposed power plant will involve the generation of electric power for evacuation to the national grid by the KPLC. 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.

10.3.4 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.

10.3.5 Construction phase HSE inspections

Chapter 7 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.

10.3.6 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.

10.3.7 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).

10.3.8 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.

10.3.9 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.

Table 10.1 Environmental Management Plan during Construction **(Sheet 1 of 4)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Extraction site impacts to ensure efficient use of raw materials in construction	• Source building materials from local suppliers who use environmentally friendly processes in their operations. • Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered. • Ensure that damage or loss of materials at the construction site is kept minimal through proper storage.	• Project proponent /contractor • Project Engineer/Architect		Periodic and surprise checks	
Loss of vegetation cover	• Ensure proper demarcation and delineation of the project area to be affected by construction works. • Introduction of vegetation (trees, shrubs and grass) on open spaces and around the project site and their maintenance. • Design and implement an appropriate landscaping programme to help in re-vegetation of part of the project area after construction.	• Project proponent /contractor • Project Engineer/Architect		Periodic and surprise checks during construction	
Air pollution by dust and VOCs generated during construction process.	• All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts during construction. • Construction heavy earth moving vehicle drivers will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines. • Careful screening of construction site to contain and arrest construction-related dust. • Exposed stockpiles of e.g. dust and sand, will be enclosed, covered, and watered daily, or treated with non-toxic soil binders. • All workers will be required to wear protective gear • Ensure construction machinery and equipment are well maintained to reduce exhaust gas emmission	• Project proponent/contractor • Ministry of Health: provincial public health officer • NEMA inspectors • Ministry of Labour	Periodic Activities	Periodic and surprise checks	100 000 per month over the construction period

Table 10.1 Environmental Management Plan during Construction **(Sheet 2 of 4)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (KShs)
Pollution from Hazardous waste	• Handling of the materials using the material safety data provided by the manufacturers • Appoint a safety officer to ensure that proper disposal guideline are observed • Ensuring that maintenance and/or piece of work carried out on any piece of equipment or construction work is undertaken by qualified personnel • In case of spillage emergency spillage control measures to be instituted • Containerization of any wastes and disposal through a licensed waste handler.	Proponent/contractor Ministry of Health: provincial public health officer NEMA inspectors	Periodic inspection	Periodic and surprise checks	100 000 per month
Noise and vibration by construction activities.	• Use of equipment designed with noise control elements will be adopted where necessary. • Trucks used at construction site shall be routed away from noise sensitive areas where feasible. • Idling time for pick-up trucks and other small equipment will be minimized to limited time. • All workers operating in noisy areas or operating noisy equipment will be provided with earpieces to protect against extreme noise. • Comply with L.N. 25: Noise prevention and control rules, 2005	Project proponent/contractor Divisional Public Health Officer Ministry of Labour Workers NEMA inspectors	Routine Activities	Periodic and surprise checks	40 000 per month over the construction period
Traffic and Transport	• Adequate maintenance to reduce emissions. • Vehicle comply with axle load limits • Take advantage of off-peak hours • Well trained and experienced drivers	Contractor		Periodic and surprise checks	

Table10.1 Environmental Management Plan during Construction **(Sheet 3 of 4)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Adverse effects of lights on animals in the National Park	• Make optimum use of directed lighting in order to minimize adverse effects of lights on the National Park at night.	• Contractor	Periodic inspection	Periodic and surprise checks	Part of initial contract sum
Workers accidents and hazards when handling hazardous wastes.	• Adequate collection and storage of waste will be provided on site, and safe transportation to, and display methods at designated areas. • All receptacles for storing hazardous wastes shall be adequately covered. • All employees will be required to wear protective gear when handling hazardous wastes. • All workers will be adequately insured against unforeseen accidents.	• Project proponent/contractor • Provincial Public Health Officer • Ministry of Labour • Workers • NEMA inspectors	Routine Activities	Periodic and surprise checks	50 000 per month
Generation of solid waste	• Wastes to be collected regularly to control air pollution and vermin/insects etc. • Receptacles will be provided for waste storage prior to collection. • Resource recovery will be encouraged once the project takes off so as to shrink waste stream and recover non-recyclables. • Refuse collection vehicles will be covered to prevent scatter of wastes by wind. • Wastes will be collected by a licensed operator to avoid illegal final dumping at unauthorized sites. • All persons involved in refuse collection shall be in full protective attire.	• Proponent • Hired private contractor • Provincial Public Health Officer • NEMA inspectors	Routine Activities	Periodic and surprise checks	10 000 per month

Table 10.1 Environmental Management Plan during Construction **(Sheet 4 of 4)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Workers accidents during construction process.	• All workers will be sensitized before construction begins, on how to control accidents related to construction. • A comprehensive contingency plan will be prepared before construction begins, on accident response. • Accordingly, adherence to safety procedures will be enforced. • All workers to wear protective gear during construction, including helmets. • Construction work will be limited to daytime only	• Project proponent/contractor • Divisional Public Health Officer • Ministry of Labour • Workers • NEMA inspectors	Routine Activities	Periodic checks	40, 000 per month
Inadequate human waste disposal by workers during construction process	• As provided for by the Building Code, a temporary latrine will be provided on site to be used by construction workers	• Project proponent • Contractor • Ministry of Health • Ministry of Labor • NEMA inspectors	Periodic Activities	Periodic checks	50,000 one time
Increase in STI infections	• Sensitization of local communities and staff working on the project on dangers of free lifestyle • HIV/AIDS awareness training for all employees and subcontractors.	• Proponents • Ministry of Health • Contractor	• Voluntary periodic random screening • Secondary data from health institutions	Quarterly	Part of project budget

Table 10.2 Environmental Management Plan during Operation **(Sheet 1 of 2)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Solid waste generation	• Use of an integrated solid waste management system i.e. through several options including of Source reduction Recycling ,Composting and reuse and Incineration • Ensure that wastes generated at the plant are efficiently managed through recycling, reuse and proper disposal procedures. • A private solid waste handler to be contracted to handle solid waste.	• Project proponent /contractor • Project Engineer/Architect	Periodic Activities	Periodic and surprise checks	Part of the operation and maintenance budget
Release of sewage into the environment	• Proponent to construct onsite sewage treatment facility that treats wastewater to meet the set NEMA guidelines.	• Project proponent /contractor • Project Engineer/Architect	Periodic Activities and audits		Facilities to be constructed as part of initial costs and maintained by Proponent.
Air pollution	• Drivers of heavy earth moving vehicles will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines. • All workers on the site will be required to wear protective clothing while on duty. • Suitable wet suppression techniques need to be utilized in all exposed areas • Use of low sulphur fuel to run the engines to be encouraged • The stack chimney of the generators will be constructed to a height of 32 metres and stack emissions regularly monitored using the inbuilt monitoring system. • Set up an air quality monitoring stations at 1.0 and 5 Km west of site to collect SO_2 and NO_x data.	• Project proponent/contractor • Ministry of Health: provincial public health officer • NEMA inspectors • Ministry of Labour	Periodic Activities	Periodic and surprise checks	10 000 per month
Traffic and Transport	• Limit delivery to off-peak hours to reduce disruption of transport links, delays and congestion • Provide warning lights and other signs to reduce risk of accidents along delivery roads and at the site • Keep the earth access load dump to reduce dust • Adequate maintenance of trucks to reduce emissions.	• Contractor • Proponent		Periodic and surprise checks	

Table 10.2 Environmental Management Plan during Operation **(Sheet 2 of 2)**

Possible Impacts	Proposed Mitigation Measures	Responsibility for Mitigation	Means for Monitoring	Frequency for Monitoring	Estimated Cost (Kshs)
Pollution from Hazardous waste	• Handling of the materials using the material safety data provided by the manufacturers • Appoint a safety officer to ensure that proper disposal guideline are observed • Ensuring that maintenance and/or piece of work carried out on any piece of equipment or construction work is undertaken by qualified personnel • In case of spillage emergency spillage control measures to be instituted • Containerization of any wastes and disposal through a licensed waste handler. • Adhere to L.N. 121: Waste Management Regulations	• proponent/contractor • Ministry of Health: provincial public health officer • NEMA inspectors	Periodic inspection	Periodic and surprise checks	20 000 per month
Workers accidents	• All workers will be sensitized and trained on occupational safety and health issues and on how to control accidents related to construction. • A comprehensive contingency plan will be prepared before begins, on accident response. • Accordingly, adherence to safety procedures will be enforced.	• Project proponent/contractor • Divisional Public Health Officer • Ministry of Labour • Workers • NEMA inspectors	• Routine Activities	Periodic checks and Accident audits	40 000 per quarter
Noise and vibration pollution	• Installation of silencers on the generators • Provision of personal protective equipment for workers in • Do annual noise measurements. • Do employee medical examination • Comply with L.N. 25:Noise prevention and control rules, 2005 and L.N. 61: Noise and vibration pollution regulation, 2009	• Project proponent/contractor • Divisional Public Health Officer • Ministry of Labour • Workers • NEMA inspectors			
Adverse effects of lights on animals in the National Park	• Make optimum use of directed lighting in order to minimize adverse effects of lights on the National Park at night.	• Project proponent	Periodic inspection	Periodic and surprise checks	Part of initial contract sum

Table 10.3 Anticipated Environmental Impacts and Mitigation Measures at Decommissioning of Project (Sheet 1 of 2)

Undesirable Impacts	Mitigation Measures	Responsibility for Mitigation	Estimated Cost (Kshs)
Air pollution during demolition process.	• The demolition exercise will be limited at day time only • All personnel working on the project will be trained prior to commencing the demolition exercise on methods for minimizing negative impacts on air quality. • Construction vehicle drivers will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines. • All active demolition areas will be watered at least twice a day to reduce dust. • All trucks hauling demolition debris/wastes shall be covered. • Careful screening to contain and arrest demolition related dust will be adopted • Exposed demolition debris of e.g. dust and sand, will be enclosed, covered, and watered daily before transported to disposal site. • All workers on the site will be required to wear protectivegear while on duty	• Project proponent • NEMA inspectors • Contractor	**Kshs 800,000**
Noise pollution by disassembly activities	• Portable barriers will be installed to shield compressors • Use of equipment designed with noise control elements will be adopted where necessary. • Trucks used during demolition exercise on site shall be routed away from noise sensitive areas in the neighbourhood, where feasible. • Idling time for pickup trucks and other small equipment will be minimized to limited time. • Use of very noisy equipment will be limited to daytime only. • All workers operating in noisy areas or operating noisy equipment will be provided with earpieces to protect against extreme noise. • The demolition exercise will be limited at day time only	• Project proponent • NEMA inspector • Contractor	**Kshs 600,000**
Traffic and Transport	• Carry out fuel deliveries during the day to avoid noise and disruption of sleep to the residents of the neighbouring Kitengela Township	• Project proponent	

Table 10.3 Anticipated Environmental Impacts and Mitigation Measures at Decommissioning of Project **(Sheet 2 of 2)**

Undesirable Impacts	Mitigation Measures	Responsibility for Mitigation	Estimated Cost (Kshs)
Demolition debris and related wastes	• Private contractor will be engaged to collect demolition debris/wastes • All debris/wastes to be collected regularly to control air pollution and injury etc • A licensed operator to avoid illegal final dumping at unauthorized sites will collect demolition debris. • All persons involved in refuse collection shall be in full protective attire.	• Project proponent • NEMA inspectors • Contractor	**Kshs 4,000,000**
Workers accidents during demolition process.	• All workers will be sensitized before the exercise begins, on how to control accidents related to the demolition exercise • A comprehensive contingency plan will be prepared before demolition begins, on accident response. • Adherence to safety procedures will be enforced at all stages of the exercise • All workers, pursuant to labour laws, shall be accordingly insured against accidents. • All workers will be provided and instructed to wear protective attire during demolition, including helmets. • Demolition work will be limited to daytime only avoid workers accidents due to poor visibility • Provision of mobile clinics	• Project proponent • Provincial Public Health Officer • Ministry of Labour • NEMA inspectors • Contractor	**Kshs 1,000,000**

CHAPTER 11: MITIGATION MEASURES AND MONITORING PROGRAMMES

11.1 Mitigation of Negative Impacts during Construction

The following measures can be considered as mitigation measures of the negative impacts associated with the proposed MSD Power Plant during construction phase.

11.1.1 Minimization of Noise and Vibration

The project proponent shall put in place several measures that will mitigate noise pollution arising during the construction phase. The following noise-suppression techniques will be employed to minimize the impact of temporary construction noise at the project site.

- Install portable barriers to shield compressors and other small stationary equipment where necessary.
- Install sound barriers for pile driving activity.
- Use quiet equipment (i.e. equipment designed with noise control elements).
- Co-ordinate with relevant agencies regarding all construction.
- Limit vehicles to a minimum idling time and observe a common-sense approach to vehicle use, and encourage drivers to switch off vehicle engines whenever possible.
- Compliance with the recently issued Noise and Vibration Regulations of 2009 is expected at all the phases of the project.

11.1.2 Generation of Exhaust Emissions

In order to control exhaust emissions that are likely to occur during the construction of the proposed MSD Power Plant, the following measures shall be implemented during construction.

- Vehicle idling time shall be minimized
- Alternatively fuelled construction equipment shall be used where feasible
- Equipment shall be properly tuned and maintained
- This will also be achieved through proper planning of transportation of materials to be used during construction of the project to ensure that vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road.

11.1.3 Dust Emissions and Air quality

Controlling dust emissions that is likely to take place during construction phase of the proposed MSD Power Plant is useful in minimizing nuisance conditions. It is recommended that a standard set of feasible dust control measures be implemented for all construction activities. Emissions of other contaminants (NO_x, CO_2, SO_x, and diesel related PM_{10}) that would occur in the exhaust from heavy equipment are also included. The project proponent is committed to implementing measures that shall reduce air quality impacts associated with construction. During construction, any stockpiles of earth should be enclosed / covered / watered during dry or windy conditions to reduce dust emissions

During construction, sprinkle the construction area with water to keep dust levels down. Construction trucks removing soil from the site, delivering sand and cement to the site should be covered to prevent material dust into the surrounding areas:

- All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts during construction. This means that construction workers will be trained regarding the minimization of emissions during construction and they limit their speeds so that dust levels remain low.
- Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines.
- Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.
- Maintain all machinery and equipment in good working order to ensure minimum emissions including carbon monoxide, NO_X, SO_X and suspended particulate matter.

11.1.4 Excavated Soil during Construction

The Excavated soil during the construction of the proposed MSD Power Plant will not be disposed. It's recommended that part of the topsoil excavated from the proposed construction site be re-spreading areas to be landscaped.

11.1.5 Minimization of increased Water Demand

The proponent of the proposed MSD Power Plant shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water use. A bore-hole shall be dug so as not to strain the existing water sources i.e. municipal water, which is sometimes unreliable.

11.1.6 Minimization of Worker Accidents and Hazards during Construction Phase

To reduce the workers accidents and hazards during the construction phase of the proposed MSD Power Plant, the contractor and proponent are expected to adhere to the provisions of the Occupational Safety and Health Act, 2007 and its subsidiary legislation. It is the responsibility of the project proponent and contractor to provide a safe and healthy environment for construction workers as outlined in the EMP. An MSD Response and Evacuation Plan must be in place in addition to safety education and training shall be provided to the employees.

11.1.7 Reduction of Energy Consumption

The project proponent and contractor shall ensure responsible electricity use at the construction site through sensitization of staff to conserve electricity by switching off electrical equipment or appliances when they are not being used. In addition, proper planning of transportation of materials will ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts. Complementary to these measures, the proponent shall monitor energy use during construction and set targets for reduction of energy use.

11.1.8 Reduction of Impacts at Extraction Sites and Efficient Use of Raw Materials

The proponent of the proposed MSD Power Plant will source building materials such as sand, ballast and hard core from registered quarry and sand mining firms whose projects have undergone satisfactory environmental impact assessment/audit and received NEMA approval. Since such firms are expected to apply acceptable environmental performance standards, the negative impacts of their activities at the extraction sites are considerably well mitigated. To reduce the negative impacts on availability and sustainability of the materials, the proponent will only order for what will be required through accurate budgeting and estimation of actual construction requirements. This will ensure that materials are not extracted or purchased in excessive quantities. Moreover, the proponent will ensure that wastage, damage or loss (through runoff, wind,

etc) of materials at the construction site is kept minimal, as these would lead to additional demand for and extraction or purchase materials.

In addition to the above measures, the proponent shall consider reuse of building materials and use of recycled building materials. This will lead to reduction in the amount of raw materials extracted from natural resources as well as reducing impacts at the extraction sites.

11.1.9 Solid Waste during Construction Phase

It is recommended that demolition and construction waste be recycled or reused to ensure that materials that would otherwise be disposed off as waste are converted for productive uses. The proponent is committed to ensuring that construction materials left over at the end of construction will be used in other projects rather than being disposed off. In addition, damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects. Such measures will involve the sale or donation of such recyclable/reusable materials to construction companies, local community groups, institutions and individual residents or home owners.

The proponent shall put in place measures to ensure that construction materials requirements are carefully budgeted for and to ensure that the amount of construction materials left on site after construction is kept minimal. It is further recommended that the proponent should consider the use of recycled or refurbished construction materials. Purchasing and using once-used or recovered construction materials will lead to financial savings and reduction of the amount of construction debris disposed of as waste.

Additional recommendations for minimization of solid waste during construction of the proposed thermal power plant include:-

- Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time
- Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements
- Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials

- Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste
- Use of construction materials containing recycled content when possible and in accordance with accepted standards.
- Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided.

11.1.10 Possible exposure of workers to diseases

Possible exposure of workers to diseases from building materials at construction site shall be mitigated by compliance with occupational health and safety standards.

11.1.11 Minimization of Storm Water Run-off and Soil Erosion

The proponent of MSD Power Plant will put in place some measures aimed at minimizing soil erosion and associated sediment release from the project site during construction. These measures will include terracing and leveling the project site to reduce run-off velocity and increase infiltration of rain water into the soil. In addition, construction vehicles will be restricted to designated areas to avoid soil compaction within the project site, while any compacted areas will be ripped to reduce run-off. Increased runoff from paved grounds and expansive roofs causing extreme flooding and overflows of drainage systems shall be mitigated. Surface runoff and roof water shall be harvested and stored in underground reservoir for reuse. A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structures will be designed.

- Excavations at the site will be restricted to the sections where the plant will be. Excavated earth will be held away from trenches and on locations of the site not susceptible to surface runoff of storm water. The earth removed for external disposal will require to be deposited on sites without the risk of being washed down during rains and where it will not compromise other land use activities in those areas. Caution will be required during construction at times of heavy rains.
- Re-vegetate exposed areas around the site so as to mitigate erosion of soil by storm water runoff.

- The final site grade should facilitate drainage and avoid flooding and pooling. A site drainage plan should be developed to protect against erosion.
- Installation of drainage trenches, construction of runoff and retention ponds is necessary.
- Minimization of disturbances and scarification of the surface should be observed to reduce erosion impacts.
- All slopes and working surfaces should be returned to a stable condition and topsoil on the final site would be graded and planted as appropriate.

11.1.12 Controlling Oil Spills during Construction Phase

The proponent of the proposed MSD Power Plant will control the dangers of oil spills during construction by maintaining the machinery in specific areas designed for this purpose hence might not be a serious impact as a result of the construction of MSD Power Plant.

11.1.13 Minimization of Vegetation Disturbance

Clearance of part of the vegetation (mainly grass and shrubs) at the Proposed MSD Power Plant site to pave way for construction will be inevitable. However, the project proponent will ensure proper demarcation of the project area to be affected by the construction works. This will be aimed at ensuring that any disturbance to flora is restricted to the actual project area and avoid spill-over effects to the neighbouring areas. In the same vein, there will be strict control of construction vehicles to ensure that they operate only within the area to be disturbed by access routes and other works. Another important measure aimed at reducing disturbance of vegetation in the proposed project area will be preservation of individual trees within the site. In addition, the proponent will be involved in re-vegetation of some of the disturbed areas through implementation of a well designed landscaping programme.

11.1.14 Hydrology and Water Quality Degradation

Several measures shall be put in place to mitigate the impacts that are likely to lead to Hydrology and water quality degradation at the proposed MSD Power Plant. The project proponent will prepare a hazardous substance control and MSD response plan that will include preparations for quick and safe clean up of accidental spills. It will prescribe hazardous-materials handling procedures to reduce the potential for a spill during construction, and will include an MSD response programme to ensure quick and safe cleanup of accidental spills. The plan will identify areas where

refueling and vehicle maintenance activities and storage of hazardous materials, if any, will be permitted. Trial holes digging will be conducted before construction begins and soil information will be provided to construction crews to inform them about soil conditions and potential hazards. Oil absorbent material, tarps and storage drums will be used to contain and control any minor releases of engine and other equipment oil.

11.1.15 Traffic Impacts

Movement of heavy plant will be limited to off-peak hours between 10:00 am and 4:00 pm. Night delivery will not be allowed to prevent noise pollution to the residents of the neighboring Kitengela Township. Dust will be controlled by watering the earth access load to bind the dust particles.

11.2 Mitigation of Negative Impacts during the Operation Phase

Impacts anticipated during the construction phase can be mitigated as discussed in the sections below

11.2.1 Ensuring Efficient Solid Waste Management

The project proponent of the proposed Power Plant will be responsible for efficient management of solid waste generated by the project during its operation. In this regard, the proponent will provide waste handling facilities such as labeled waste bins and skips for temporarily holding solid waste generated at the site. In addition, the project proponent will ensure that such are disposed off regularly and appropriately. It is recommended that the proponent puts in place measures to ensure that the MSD Power Plant operating personnel manage the waste efficiently through segregation, recycling, reuse and proper disposal procedures. The proponent will put in place an integrated solid waste management system and give priority to reduction at source of the materials. This option will demand a solid waste management awareness programme in the management and the operator employees. Solid wastes shall be disposed off in a manner that is acceptable to NEMA and Environmental Regulations.

11.2.2 Ensure Efficient Energy Consumption

To ensure efficient energy consumption during the operation phase of the proposed plant, the proponent plans to install an energy-efficient lighting system at the site. This will contribute

immensely to energy saving during the operational phase of the project. In addition, the plant operators be sensitized to ensure energy efficiency in their domestic operations. To complement these measures, it will be important to monitor energy use during the operation of the proposed MSD Power Plant and set targets for efficient energy use.

11.2.3 Ensure Efficient Water Use

The proponent of the proposed power plant will install water-conserving automatic taps and toilets. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by qualified staff. In addition, the plant operators of the proposed MSD Power Plant will be sensitized to use water efficiently. The project will adopt the policy of water reuse especially for cooling purposes of the plant.

11.2.4 Air Pollution

The proponent of the proposed power plant will ensure minimal CO_x and SO_x emissions through timely and frequent service and maintenance of the generators. This will improve combustion of fuel which will make the generators more efficient and reduce emissions. The proponent will ensure that the fuel oil used in the generators shall have a low sulphur content of not more than 1.9%. One way of NO_x reduction is injecting water directly into the combustion chamber, humidifying the charge air, or mixing the water with diesel fuel.

- No burning of any waste materials whatsoever should be permitted within the site both during construction and operation;
- Use of low sulphur fuel will help in minimizing SOx emissions.
- Nitrogen oxide emission should be controlled through burner management and water injection to the combustion turbines. Smoke treatment (denitrification); choice of combustion technology; Burners/low-NOx combustion chambers; water or steam injection.
- Particulate emissions should be reduced through good combustion control to minimize the products of incomplete combustion. Reduction of ash content in fuels: choice of combustion technology, electrostatic precipitators, bag filters, CO control of combustion conditions operating measures (including stack cleaning).
- The MSD Plant operator will be required to install and operate dedicated stack gas samplers or analyzers, and report both summary data and violations of standards or limits.

- Annual source testing will also be routinely required to confirm continued compliance with emission limits.

11.2.5 Oil Spills

To prevent oil spills and environmental contamination, the power plant and pipelines should be designed with spill prevention and detection systems to protect the environment. With spill prevention and protection measures there should be no adverse effects to the ground and surface water and soil. Appropriate protection devices against accidental discharge of toxic substances (bases/airtight tanks for machines, reservoirs etc.) should be provided.

Storage and liquid impoundment areas for fuels, raw and in-process material solvents, wastes and finished products should be designed with secondary containment (e.g. dikes/berms) to prevent spills and the contamination of soil, ground and surface water.

All the fuel above ground storage tanks should have secondary containment with sufficient volume to contain a spill from the largest tank in the containment structure. The containment area should have a means of removing accumulated water. A retention area should be designed that surrounds the fuel storage tanks.

The plant operator should provide containers for the storage of chemical and lubricating products. Drains should be routed through a site/water separator. A spill and MSD response plan would be developed and put in place prior to commencement of construction.

A written MSD response plan should be prepared and retained on the site and the workers should be trained to follow specific procedures in the event of a spill. The project proponent will orientate the workers on site on their specific EHS policies to prevent incidents and accidents of oil spill.

Frequent inspection and maintenance of facility can minimize spilling from the transfer pipeline.

The proponent will collect the waste oil or used oil and lubricants from maintenance of operational equipment for proper disposal. In the Environmental Management Plan (EMP), disposal of used oil will be the responsibility of the project operator. The proponent will identify a reputable company to handle disposal of oil and oil filters.

Fuel supplier proposes to enclose fuel tanks in an earth bund wall and the floor lined with plastic sheets to prevent accidental contamination of soils and groundwater. At the off loading area, they propose to mitigate leakage by constructing a sump for temporal containment when fuel is off loaded. It is proposed that the operator uses rail transport for fuel in order to minimize chances of oil spillage on the roads.

11.2.6 Visual Impacts

The visual negative impacts can be mitigated through landscaping the area with trees to screen the project stacks and fuel tanks by the project plant proponent of the proposed power plant.

11.2.7 Minimization of Sewage Release

The project proponent of the proposed will ensure that there are adequate means for handling the sewage generated at the proposed MSD Power Plant. It will also be important to ensure that toilets are kept clean and properly maintained. Onsite wastewater treatment plant to be installed to treat domestic wastewater generated from the facilities. The wastewater discharged to conform to discharge guidelines set out the Environmental Management and Coordination Act (EMCA) (Table 11.1). The point of discharge will be downstream of the EAPC Dam.

Table 11.1 Standards for Discharge into Natural Water Courses

Parameter	Maximum allowable (Limit)
pH	6.5-8.5
BOD (5days at 20^0c) not to exceed	30mg/l
COD not to exceed	50mg/l
Temperature not to exceed ^{0}c	±3 of ambient temperature of the water body
Total Coliform Count /100ml	1000
E.coli (Counts/100ml)	Nil
Colour	15 Hazen units (H.U.)
Total dissolved solids	1200mg/l
Total suspended solids	30mg/l
Oil and Grease (mg/l)-if conventional treatment is used	Nil
Ammonia , ammonium compounds, NO_3, compounds and NO_2 compound (Sum total of ammonia –N times 4 plus –N- and Nitrite-N)	100mg/l
Arsenic	0.02mg/l

Arsenic and its compounds	0.1mg/l
Benzene	0.1mg/l
Boron	1.0mg/l
Boron and its compound-non marine	30mg/l
Mercury (mg/l)	0.05
Cadmium not to exceed	0.01 mg/l
Cadmium and its compound	0. 02 mg/l
Carbon tetrachloride	0. 1 mg/l
Lead	0.01mg/l
Lead and its compound	0.1mg/l
Chromium VI	0.05 mg/l
Cis-1,2-dichloro ethylene	0.4 mg/l
Copper	1.0 mg/l
Zinc	0.5 mg/l
Dichloromethene	0.2 mg/l
Dissolved iron	10 mg/l
Dissolved manganese	10 mg/l
Fluoride	1.5mg/l
Fluoride & its compound (Marine and non marine)	8mg/l
Selenium	0.01 mg/l
Selenium and its compound	0. 1 mg/l
n-Hexane extracts (animal and vegetable fats)	30 mg/l
n-Hexane extracts (mineral oil)	5 mg/l
Nickel	3.0 mg/l
Oil and Grease	5 mg/l
Nitrate	20 mg/l
Phosphates	30 mg/l
Cyanide	2 mg/l
Sulphide	0.1mg/l
Hexavalent chromium VI compounds	0.5mg/l
Phenols	0.001mg/l
Simazine	0.03mg/l
Detergents	nil
Tetrachloroethylene	0.1mg/l
Thiobencarb	0.1mg/l
Thiram	0.06mg/l
Total Cyanogen	Nd
Mercury	0.005
Trichloroethylene	0.3mg/l
Whole effluent toxicity	Nil
Total Phosphorous	2mg/l
Total Nitrogen	2mg/l

11.2.8 Fire Suppression

The proposed power plant must have fire fighting equipments of high standards and in key strategic points all over the project site. Fire pumps, hydrants, sprinkler/water spray systems, hose houses, dry chemical systems, carbon dioxide systems, detection/alarm systems, portable fire extinguishers among others shall be installed at the site. A fire evacuation plan must be posted in various points of the construction site including procedures to take when a fire is reported. All workers must be trained on fire management and fire drills undertaken regularly.

11.2.9 Flue Gas

To mitigate the effects of flue gas affecting the micro-climate of the area, the stack chimney of the generators will be 32 (thirty two) metres. This will enable plume dispersal high preventing smoke and heat from affecting the surrounding area.

11.2.10 Workers Health and Safety

All workers entering the MSD power plant site must be equipped with appropriate and adequate PPE including ear muffs, safety footwear, overalls, gloves, dust masks, among others. The PPE should be those meeting the international standards of PPE. Personal protection gear must be provided and its use made compulsory to all. The entire workforce of the plant should be trained in the use of protective gear, handling of chemical products and acid storage cells, electric safety equipment, procedures for entering enclosed areas, fire protection and prevention, disaster response and evacuation procedures. Employees shall undergo periodic health and safety training. Safety signs shall be posted where necessary. Machines and Equipments must be operated only by qualified staff and a site supervisor should be on site at all times to ensure adherence. The project operator must develop a Workplace Health and Safety Policy Manual for which all the workers should be conversant and comply with. The project operator should appoint a responsible person from the management team to be in charge of workplace Safety, Health and Environmental issues. The operator should develop a Disaster Response Plan for handling any emergencies arising thereof during the project implementation phase.

11.2.11 Hazardous waste

The amount of hazardous waste created will be very low and possibly originate from maintenance sources. The waste would consist primarily of spent lubricants and their containers, spent oil filters, used rags and spent clean-up solvents. The used oil filters should be segregated and stored in a place with a drip collection mechanism before they are collected by the disposal agent for proper disposal.

- The proponent should ensure that the filters are properly disposed and should apply the principle of cradle to grave.
- The mitigation measure is to provide training to site operation staff and to properly handle and dispose hazardous wastes using acceptable methods. Hazardous wastes on the site shall be clearly marked out and the entire workforce trained to recognize the danger signs and familiarize themselves with procedures to be followed before entering hazardous areas.

11.2.12 Noise and Vibration

Noise and vibration are expected during the operation phase of the project. Noise will be mitigated through installation of generator engines in suitable structures with inbuilt sound and vibration absorption mechanisms.

11.2.13 Traffic Impacts

Delivery of fuel by heavy trucks will be limited to day time hours to prevent noise pollution and nuisance to the neighboring residencies.

11.3 Mitigation of impacts during the decommissioning Phase

The negative impacts of the decommissioning phase of the proposed power plant can be mitigated as follows:

11.3.1 Minimization of Noise and Vibration

Significant impacts on the acoustic environment will be mitigated by the project proponent of the proposed power plant shall put in place several measures that will mitigate noise pollution arising during the decommissioning phase. The following noise-suppression techniques will be employed

to minimise the impact of temporary destruction noise at the project site. Install portable barriers to shield compressors and other small stationary equipment where necessary.

- Limit vehicles and other small equipment with engines to a minimum idling time and observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.
- Demolish mainly during the day, a time with minimal noise disturbance.

11.3.2 Efficient Solid Waste Management

Solid waste resulting from demolition or dismantling works associated with the proposed MSD Power Plant during decommissioning phase will be managed as follows:

- Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of demolition waste generated during decommissioning phase
- Provision of facilities for proper handling and storage of demolition materials to reduce the amount of waste caused by damage or exposure to the elements
- Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided.

11.3.3 Reduction of Dust Concentration

High levels of dust concentration resulting from demolition or dismantling works will be minimized as follows:

- Watering all active demolition areas as and when necessary to lay dust.
- Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard.

CHAPTER 12: ENVIRONMENTAL AND SOCIAL ACTION PLAN (ESAP)

12.1 Introduction

As part of corporate commitment to managing project in a responsible, safe and sustainable manner such that protection of the environment and safety of people take priority, Triumph Power Generating Company has prepared an Environmental and Social Action Plan (ESAP) that describes the environmental and social management measures that will guide the project implementation (Table 12). The ESAP has been prepared in accordance with the environmental and social review procedure set out in the International Finance Corporation (IFC) principles and standards and specifically principle 4 on action plan and management system. The ESAP incorporates all mitigation measures required to ensure that all environmental regulations are met. It also incorporates mitigation measures that have been agreed following extensive consultations with a wide range of interested parties. It includes the specific mitigation measures identified in the ESIA and details the organization/body responsible for the action, the period for which the action should be taken, and the need for short, medium or long term monitoring.

The following principles were adopted in preparation of the ESAP:

(i) Compliance with relevant legislation, standards, codes, and practices in the application of safe technologies.
(ii) Minimization of impacts on the environment and human beings.
(iii) Performance of all activities in a safe and effective manner.
(iv) Maintenance of all equipment in good operating condition for the protection of the health and safety of all persons
(v) Conserve the environment and property.

Ultimately, this Environmental and Social Action Plan (ESAP) has been developed to address key problem areas identified for the Athi River Thermal Power Plant to substantially decrease environmental pollution and to improve quality output, cost and energy efficiency of the Power Plant.

Table 12: Environmental and Social Action Plan (ESAP)

Item No.	Description of Environmental / Social Action	Environmental and Social Risks/Benefits	Reference Standards (i.e. legislative, best practice)	Investment Needs / Resources	Targeted Completion Date / Time Frame	Indicators / Status	Comments
12.2 Environmental Management							
1	Promote and enhance integrated quality, environmental, health and safety management system	Integrated control over quality, environmental and health and safety issues; continuous improvement	IFC standards and exhibit III; ISO 9001, ISO 14001 and OHSAS 14001 standards National regulation: LN: 101	Internal resources	2011 Following Plant Commission (FPC)	ISO 9001, ISO 14001, OHSAS 18001 compliance and certification	-
2	Definition of new environmental aspects/impacts to be monitored during construction	Effective monitoring of potential environmental aspects associated to the construction	ISO 14001; National regulation: LN: 101	Internal resources	2011 (FPC)	Updated environmental aspects identification	-

Item No.	Description of Environmental / Social Action	Environmental and Social Risks/Benefits	Reference Standards (i.e. legislative, best practice)	Investment Needs / Resources	Targeted Completion Date / Time Frame	Indicators / Status	Item No.
12.3 Environment							
1	Enforce noise mitigation measures (noise mufflers, protective housing for generators, installation of equipment inside closed structures, sound insulation)	Reduction of noise impacts on the surrounding properties, to comply with regulations and minimize the risk of claims from neighbours	World Bank guidelines and Standard 3 ISO 19011 National Regulations: LN 25; LN 61	The investment need is already included in the Investment Programme	2011 (FPC); Maintain throughout the project cycle	Noise levels below regulatory limits and permissible levels	Noise mitigation measures already defined in the ESIA study
2	Ongoing monitoring of the content of solid particles in the atmosphere, VOCs and meteorological conditions of the subsidence construction area	Monitoring to exercise control and prevent impact on the environment	WHO air quality guidelines; National Regulations: LN 24; LN 60; Best practices	The investment need is already included in the Investment Programme	2011 (FPC); Maintain	Register with updated data about solid particles in the atmosphere, radioactivity and meteorological conditions regarding subsidence construction area	Provide update in each annual report to Bank

Item No.	Description of Environmental / Social Action	Environmental and Social Risks/Benefits	Reference Standards (i.e. legislative, best practice)	Investment Needs / Resources	Targeted Completion Date / Time Frame	Indicators / Status	Comments
3	Geodetic survey including; excavated grounds, vegetation disturbance and oil spills of the subsidence construction area	Monitoring to exercise control and prevent impact on the environment	IFC standards; National Regulation: LN 121 Best practices	The investment need is already included in the Investment Programme	2011 (FPC); Maintain	Geodetic data, soil and vegetative parameters regarding subsidence construction area	Provide update in each annual report to Bank
4	Monitoring of water quality in the subsidence construction area	Monitoring of water quality to exercise control and prevent impact on the environment	National Regulations: LN 120 Best practices	The investment need is already included in the Investment Programme	2011 (FPC); Maintain	Water quality data regarding subsidence construction area	Provide update in each annual report to Bank
5	Separate system for leachate collection and for the drainage of water accumulating on the surface in the subsidence construction area	Protection of surface water and groundwater	National Regulations: LN 120; LN 121 Best practices	The investment need is already included in the Investment Programme	2011 (FPC); Maintain	Separate collection of leachate and superficial water in the subsidence construction area	-

Item No.	Description of Environmental / Social Action	Environmental and Social Risks/Benefits	Reference Standards (i.e. legislative, best practice)	Investment Needs / Resources	Targeted Completion Date / Time Frame	Indicators / Status	Comments
12.4 Health and Safety							
1	Monitoring of subcontractors' compliance with health & safety requirements	Periodic surveys to verify subcontractors' compliance with H&S policy/procedures and contract requirement	OSHE 1800;1 WHO air quality guideline; IFC standards 3 and 4: National Regulations: LN 24; LN 3; LN 56 and LN 60 Best practices	Internal resources	2011 (FPC); Maintain throughout the project cycle	Number of inspections performed. Number of non compliances detected (e.g. subcontractors not wearing required PPEs or not using required protective equipment	Provide update in each annual report to Bank
2	Qualified subcontractors – insert in the register of qualified subcontractors a penalizing system for those found not to be compliant with H&S requirements	Control and improvement of H&S operations executed in the Plant	ISO 10012; Best practices	Internal resources	2011 (FPC); Maintain	Updated register of qualified subcontractors	-

Item No.	Description of Environmental / Social Action	Environmental and Social Risks/Benefits	Reference Standards (i.e. legislative, best practice)	Investment Needs / Resources	Targeted Completion Date / Time Frame	Indicators / Status	Comments
3	Health & Safety monitoring - creation of a register including also near-misses events, STIs and subcontractors' accidents from equipment, machinery and vehicles/trucks.	Monitoring of happened accidents and of critical situations/events that could lead to accidents.	National Regulations: LN 31; Public health Act (chap 242); Best practices	Internal resources	2011 (FPC); Maintain throughout the project cycle	Number of accidents and STIs cases per typology of gravity and place of occurrence (both for power plant employees and subcontractors) Number of near-misses events per typology of gravity and place of occurrence (both for power plant employees and subcontractors)	Provide H&S statistics in each annual report to Bank
12.5 Social							
1	Definition of a formal procurement policy	Even if anti-bribery recommendations are present in contracts, definition of a clear and shared procurement company policy	ISO 10014; Best practices	Internal resources (HR department)	2011 (FPC); Update continuously	Procurement policy accessible to employees, clients and contractors	-

Item No.	Description of Environmental / Social Action	Environmental and Social Risks/Benefits	Reference Standards (i.e. legislative, best practice)	Investment Needs / Resources	Targeted Completion Date / Time Frame	Indicators / Status	Comments
2	Development of a Stakeholder Engagement Plan	Definition of a clear framework for stakeholder engagement and consultation	IFC Principle 5	Internal resources/ external consultants	2011 (FPC)	Stakeholder Engagement Plan agreed with the Bank	-
3	Creation of a Stakeholder register	Systematic identification of all stakeholders involved, to be used for defining communication strategies	IFC Principle 6; ISO 10013 Best practices	Internal resources (PR department	2011 (FPC); Maintain	Updated stakeholders register available (including stakeholders involved in the Unit 6 project	-
4	Creation of a register of external communications, including the minutes of the meetings held with the public	Systematic collection and analysis of communications with external stakeholders, in order to provide more effective response to all enquiries	IFC Principle 5 Best practices	Internal resources	2011 (FPC); Maintain	Updated external communication register available	-

Item No.	Description of Environmental / Social Action	Environmental and Social Risks/Benefits	Reference Standards (i.e. legislative, best practice)	Investment Needs / Resources	Targeted Completion Date / Time Frame	Indicators / Status	Comments
5	Creation of grievance management system	Grievance system accessible and monitored, in order to prevent possible problems with internal and external stakeholders	IFC Principle 6	Internal resources (allocate HR and PR staff to grievance management)	2011 (FPC); Maintain throughout the project cycle	Grievance system regarding both community and workers Total number of community grievances, and number of unresolved grievances Total number of labour grievances, and number of unresolved grievances	Provide update in each annual report to Bank

Key:

PR: Public Relation
HR: Human Resource
ISO 9001: Quality Management Systems
ISO 14001: Environmental Management System
OHSAS 18001: Occupational Health and Safety Management System
ISO 19011: Quality and Environmental Management Systems Auditing
ISO 10013: Quality Management System Documentation
ISO 10014: Financial and Economic Benefits

CHAPTER 13: CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusions

Kenya is currently experiencing electrical power shortage due to various factors including climatic conditions, inadequate investment in the power sector and rapid economic growth that is expected to reach 10% by 2012. The Athi River 81 MW MSD Power project is one of the committed power generation projects that are expected to meet Kenya's short to medium term power needs.

The proposed location of the power plant is an industrial designated zone owned by the Export Promotion Zone Authority (EPZA), a statutory body. This and several other plots have remained idle with no takers since 1990 when the EPZ was established. Therefore, the power plant is not in competition with other industries for the plot. Furthermore, the location of the plant in an industrial area minimizes potential environmental impacts. Notably, the implementation of the project will not involve relocation of people.

This ESIA has analyzed potential environmental and social impacts of implementing the power plant during construction and operational phase based on both the requirement of the EMCA (1999) and those of the IFC's Policy and Performance Standards on Social and Environmental Sustainability. The study has demonstrated that with relatively easy and cost effective mitigation measures, the environmental and social impacts can be kept at acceptable levels. Therefore, it is concluded that with implementation of the mitigation measures developed in the ESMP, the project development will not pose any serious adverse and negative environmental impacts. Ultimately, it will be possible to successfully mitigate the impacts related to the development since the power plant will be designed, constructed and operated according to the latest international recognized standards.

The positive impacts are significant mainly at the national and also at the host community level. At the national, level, the added power supply will reduce load shedding and spur economic benefits and growth through improved electricity reliability. At the community level, short term jobs will be created during construction which will spur a host of other activities including enhancing small scale business. Furthermore, a market for construction materials will be created. The community will also benefit from the proponent's corporate social responsibility projects.

13.2 Recommendations

Following the ESIA study, the following recommendations were made;

1. The proponent to implement the mitigation guideline provided in the EMP and social management plan. Specifically, key negative impacts that require careful management during the plant construction and operation phases include:
    (i) The risk to public safety and environmental quality (soil, air and water) in case of a spill or large scale incident caused by human error, equipment failure or damage due to third party interference.
    (ii) Impacts related to air emissions during the construction and operational phases of the project. An air quality monitoring station should be set up about 10 km west of the project site to continuously monitor ground level concentrations of pollutants like SO_2 and NO_X.
    (iii) 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 exceed recognised Kenya occupational exposure limits or WHO guideline levels.
    (iv) Increased risk of disease with influx of workers

2. Monitoring be planned and implemented for auditing and improving on the EMP; conditions to be monitored to include but not limited to those mentioned in 1 above.

3. That National Environmental Management Authority do consider and approve the project and grant the required Environmental Impact Assessment License to the proponent.

LIST OF REFERENCES

1 2002-2008 District Development plan for Machakos District

2 Agriculture Act (Chapter 318 of the Laws of Kenya)

3 Energy for development. The potential role of renewable energy in meeting the Millennium Development Goals. Christopher Flavin and Molly Hull Aeck, World Watch Institute

4 Electric Power Act (Act No. 11 of 1997)

5 Emissions Guidelines (in mg/Nm^3) Environmental, Health, and Safety Guidelines for Thermal Power Plants (World Bank, 2008)

6 Environmental Management and Coordination Act No. 8 of 1999.

7 Kenya Vision 2030. A Globally Competitive and Prosperous Kenya. 2007

8 Legal Notice No. 101: The Environmental (Impact Assessment and Audit) Regulations, 2003.)

9 Occupational Health and Safety Act

10 Physical Planning Act (Cap. 286)

11 The Energy Act, 2006

12 The Forests Act (Chapter 375 of the Laws of Kenya.)

13 Land (Group Representatives) Act (Chapter 287 of the Laws of Kenya)

14 The Public Health Act (Cap. 242)

15 The Local Government Act (Cap. 265)

16 The National Environmental Action Plan (NEAP)

17 The National Shelter Strategy to the Year 2000

18 The National Poverty Eradication Plan (NPEP)

19 The Poverty Reduction Strategy Paper (PRSP)

20 The Rio Declaration on Environment and Development

21 The World Commission on Environment and Development

22 Sessional Paper No. 6 of 1999 on Environment and Development

23 Wildlife (Conservation and Management) Act Chapter 376 of the Laws of Kenya

24 Way leaves Act (Chapter 292 of the Laws of Kenya)

APPENDIX: 1 PUBLIC CONSULTATION

Appendix: 1.1 Lists of Community Members Attending Public Meeting at Noonkopir

Appendix: 1.2 Minutes of Public Meeting Held at Noonkopir on 26/05/2010

Appendix: 1.3 Minutes of Meeting with Residents of Athi River held on November 3 2010 at the Proposed Project Site

Appendix: 1.4 Lists of Participants of Public Held in Athi River on 3rd November 2010

Appendix: 1.5 Sample Questionnaires to the Lead Agencies

Appendix: 1.6 Sample Questionnaires Administered to Lead Agencies

APPENDIX: 2 LETTERS OF AUTHORITY AND AGREEMENTS

Appendix: 2.1 Lease Agreement

Appendix: 2.2 Approval for extraction of water from the EAPCC dam

Appendix: 2.3 Borehole Drilling Letter

Appendix: 2.4 No Objection Borehole drilling Letter from MAVWASCO

Appendix: 2.5 Boreholes in the Vicinity of the Project Site

Appendix: 2.6 Boreholes Tests and Water Quality Analysis

APPENDIX: 3 SPECIALISTS STUDY REPORTS

Appendix: 3.1 Air and Noise Quality Report

Appendix: 3.2 Noise Level Simulations

Appendix: 3.3 Gaseous Emission Simulations

Appendix: 3.4 Soil Analysis and Results

Appendix: 3.5 Water Quality Report

APPENDIX: 4 Equator Principles

APPENDIX: 5 IFC Performance Standards

APPENDIX: 6 WHO Air Qualities and Health

APPENDIX: 7 EHS for Thermal Power Plant

APPENDIX: 8 ESIA Terms of Reference (TOR)

APPENDIX 1 PUBLIC CONSULTATION

Appendix 1.1 Minutes of Public Meeting Held at Noonkopir on 26/05/2010

The meeting began at 3.25 pm with prayer by Pastor David Meuba. The Area Assistant chief James Kahiga welcomed all members for the meeting and he invited one of the E.I.A representatives to explain to the locals present the reasons for inviting them to the meeting and to introduce themselves to the locals present.

1. The consultant informed the locals the reason for inviting them to the meeting which was mainly the proposed construction of 81MW thermal power project at Athi River by Triumph Power Generating Company. The Consultant explained the general layout of proposed project, the anticipated positive and negative impacts and the measures the proponent is instituting to abate the negative impacts.
2. One of the local people present welcomed the E.I.A team and said they were happy about the project because it will help them get casual jobs during construction and he requested the company to consider constructing a big street light to help fight insecurity in the area.
3. Another member present said that the power project will increase the pollution in Kitengela and he said that the locals were involved in public consultations previously before East Africa Portland Cement Company was constructed and were informed that it will not pollute the environment but it pollutes the area heavily, he suggested that the proposed thermal power project be relocated in another area because air pollution has made their children and them become very sick often from the dust emitted by the cement company. He insisted that no more pollution should be introduced in the area no matter the benefits that may accrue from the proposed thermal power plant.
4. Another local member said that the area is already polluted by the cement companies. Members present however suggested that if the thermal power plant will not increase the levels of pollutions already being experienced in the area, the proponent should go ahead and invest on the proposed Thermal power plant.
5. Another local member said because the proposed power plant will use a lot of diesel and therefore emit a lot of smoke in the area he should be informed how the emissions would be controlled so as not to affect their health.

6. Another local member was concerned that thermal electricity is expensive for them and the country and wondered why other sources of energy should not be considered. He also wanted to know what other benefits would accrue to the locals if the proposed thermal power plant is put in their area, apart from employment opportunity. Given possible health effects, he did not consider the possible employment benefits worthwhile.
7. Another member suggested that because thermal power pollutes the environment, Triumph Power Generating Company should construct a dispensary in the proposed power plant site well equipped and managed by them so that the locals can be treated in case they are affected by pollution from the power plant.
8. Another member wanted the consultant to tell them how the pollution would be controlled and how the local people would benefit from the power project and also to guarantee that the local people will be given first priority for employment opportunity that will arise during constructions and when the power plant is generating power.
9. Another member suggested that because the Triumph Power Generating Company is constructing the thermal plant to make profit, he requested as a way to compensate locals he the company should constructing schools and hospital for the benefit of the local people.
10. Locals suggested that because the proposed power plant will lead to pollution, the proponent should consider putting up a tree nursery so that locals can get tree seedlings they plant them so that they can try to purify the polluted air in their area.
11. One of the local wanted assurances that their views will be incorporated in the report and also that all what they have suggested is acted upon. Other members suggested that a committee be formed to follow up all issues on their behalf and act as a link between the proponent and the local communities.
12. The area Assistant Chief requested that Triumph Power Generating Company help the local people fully and that the local people be allowed to access the premises to look for casual jobs, and that the local women to be allowed to sell food to those doing construction work. The Chief also requested as a corporate social responsibility (CSR), Triumph Power Generating Company erect street lighting to help fight high insecurity in that area.

The meeting ended at 5.00 pm with prayer by Zipporah Mtakai who also thanked all the local people present for the meeting and the E.I.A team for informing them about the proposed power plant.

Appendix 12 List of Community Members Attending Public Meeting at Noonkopir

PUBLIC CONSULTATION MEETING HELD AT NOONKOPIR (KITENGELA) FOR THE PROPOSSED SAMWATH RIVER 81MW THERMAL POWER PROJECT

Triumph Power Generating Company is an Independent Power Producer (IPP) proposing to construct an 81MW thermal power plant in Athi river town. As one of the potentially affected stakeholders, it is a requirement Environmental Management Coordination Act 1999, Environmental Impact Assessment and Environmental Audit Regulation 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, operation and decommissioning.

LIST OF MEMBERS PRESENT

SNo.	Name	ID/No.	Signature	Address
1	Agnes Muoni			—
2	~~Mteri~~ Veronica Mteri	—		—
3	Janet Mideva			
4	Mary Muinaki	21206283		
5	Florence Adesso			
6	ALFRED MWAI	12926127		—
7	JOHNSON MAKORI	20067610		
8	BENSON LIMA	11814852		0725452622
9	Rose Nyamburra			0727479222
10	JAMES KAMAU ASSISTANT	10848219		0713487264
11				
12				
13				
14				
15				
16				
17				
18				
19				

District: KAJIADO NORTH Division: ISINYA Location: KITENGELA
Sub location: KITENGELA Village: NOONKOPIR
The meeting ended 5.00 Pm
Secretary Thomas Kamau. N
Community Representative MR. NJOROGE ELDER LEADER
Environmental Consultant Representative James. W
Date 26/05/2010.

Appendix 1.3 Minutes of Meeting with Athi River Residents on November 3 2010

Present

Chief, Athi River North Location

Elders and Community Leaders

Community Policy Group

CDF Secretary

Nominated Councillor

Residents of Athi River (133 No. see attached Attendance lists)

Consultant's Representatives

The meeting was called to order at 12.00 p.m. The chief introduced the participants as above and invited the Consultants to explain the purpose of the meeting.

Minute 1/3/11/2010 Consultant's presentation

The Consultant's Representative informed the participants the requirement for disclose and consultation with stakeholders about the proposed project. He explained that the meeting was being held at the site so that the residents could understand and appreciate the project. He said that the project was a medium speed diesel thermal power production plant and that it was important because it would produce power needed for development of industries in line with Vision 2030. The project had been initiated by the Kenya Power Lighting Company (KPLC) by licensing Triumph Power generating Company and would take one year to complete. The project would produce 81MW thermal power, and was expected to bring the following benefits:

- Improvement of national economy
- Creation of employment for both skilled and unskilled workers
- Generation of short – term businesses such as retail business and food kiosks etc
- Improvement of housing business
- Opening up the area through new infrastructure such as access roads and lighting
- Improvement of security through opening up of the area and additional lighting

The consultant informed the meeting that the planners had anticipated several problems emanating from the project and had already put in place plans to mitigate them. These are as follows:

- Emissions from stacks
- Noise – Reduced to permissible levels by use of sound barriers
- Air quality – would be monitored
- Solid waste and wastewater
- Visual intrusion
- Water - Use of boreholes to supplement what is available from the Mavoko Municipal Water Supply, cooling and recirculation.
- Social issues from influx of workers – to be mitigated through community awareness and training

Minute 2/3/11/2010 Concerns of the Community

The participants from the community raised the following concerns:

1. Who would ensure the employment of locals in the project given that the contractor had not attended the meeting? They were informed that those concerns would be incorporated in the NEMA report, and that they would be included in the NEMA advertisement and the conditions of contract would required the contractor o adhere to it.
2. Community participants complained that in the past, many companies had approached them politely but once they established themselves, they became hostile to the community. They insisted that the residents be given 80% of work opportunities, preliminary work, external and groundwork in particular.
3. There were complaints that casual labourers were sometimes paid peanuts and had poor working conditions and inappropriate clothing. The practise should be avoided in the current project.
4. Village elders involved in identification of possible employees to pre-empt influence wielders bringing in outsiders.
5. Would the project require them to stop grazing their sheep at the site? They were informed that the site was designated as industrial plot and the grazing was only temporally.
6. That all people (gender, age) be employed in the project

7. That the proponent carry out corporate social responsibility (CSR) projects including the following; provide water to neighbouring community, extend tarmac road beyond the site, build a bridge for crossing Kitengela River during rain seasons, construct a dispensary for neighbours, provide street lighting to boost security, support schools, provide electricity to churches and schools, etc.
8. They expressed concern that environmental policies had not been implemented effectively making the community bear the consequences.
9. Smell: Community participants requested that the project ensures that there is no smell noting that awful smell emanated from existing industries. They added that the project should be sensitive to the health of residents.
10. Whether there would be waste disposal to the river: They were informed that project included a water treatment facility. Also, that waste engine oil would be incinerated.
11. Wondered where they would take their complaints in case of poor environmental practices; they noted that existing industries have had disposed waste in residential areas including Kitengela. The participants were assured that avenues such as Public Complaints Committee existed to address any grievances.
12. To mitigate emissions, the residents suggested that trees are planted along the boundary. They requested for free seedlings
13. Access from Athi River North and particularly from the Kasoito area through the site should not to be blocked.
14. How what had been said would be followed-up. It was suggested that a committee to include the Councillor be formed to coordinate the follow-up.

Minute 3/3/11/2010 Acceptance of Project

The Chief asked the participants if they would accept the project. They accepted the project unanimously.

There being no further business, the meeting ended at about 1:30 pm.

Appendix 1.4 List of Participants at Athi River Public Meeting on November 3 2010

PUBLIC CONSULATION MEETING ATTENDANCE LIST FOR THE PROPOSED 81 MW ATHI THERMAL POWER PLANT

Triumph Power Generating Company is an independent power producer (IPP) proposing to construct an 81 MW thermal power plant in Athi River Town. As one of the one of the potentially affected stakeholder, it is a requirement by Environment Management Coordination Act 1999, Environmental Impact Assessment (EIA) and Environmental Audit Regulations 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, and operation and decommissioning.

List of Members Present

SNo.	Name	ID/No.	Signature	Address / Cell phone
1	Veronica Muranza	20708720		0713 683014
2	Rose nduku	22954802		0724734799
3	ELIZABETH NTHENYA	28749103		0711208201
4	Rose Mutindi	22756831		0711764908
5	faith Karutha	22827731		0728424278
6	ELIZABETH MWIKALI MUIA	23168147		0724083426
7	MONICA KAUATA KATUKU	27336198		0713589221
8	DAMARIS MUIVKALI	24284384		0725823159
9	FLORENCE MUSYOKA	22066121		0724085067
10	Samuel Mosyoka	28116299		0712721884
11	OLIVER MUSYIMI MAINGI	7710673		0715473662 ~~0715~~
12	MUSYOKA KIKUVI	14469882		0717081508
13	BENSON NGUTO	28434265		0725109835
14	Faith Wavinya	26382864		0723566639
15	Florence Muhindi	28917160 ~~27007613~~		0700776913
16	Alice Ndunge	26340703		0714153525
17	Yvonne Muthoki Muiekai	26747631		
18	Teresia Mbinya	27917160		

District: ATHI RIVER Division: MAVOKO Location: ATHI RIVER
Sub location: ATHI RIVER NORTH Village: Kasoito
The meeting ended: 1-30 P.m
Secretary.....
Community Representative.....
Consultant Representative.....
Date: 3/11/10

PUBLIC CONSULATION MEETING ATTENDANCE LIST FOR THE PROPOSED 81 MW ATHI THERMAL POWER PLANT

Triumph Power Generating Company is an independent power producer (IPP) proposing to construct an 81 MW thermal power plant in Athi River Town. As one of the one of the potentially affected stakeholder, it is a requirement by Environment Management Coordination Act 1999, Environmental Impact Assessment (EIA) and Environmental Audit Regulations 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, and operation and decommissioning.

List of Members Present

SNo.	Name	ID/No.	Signature	Address / Cell phone
1	ELIZABETH SAMUEL	21164626		96
2	JOSEPH KILONZO	21795530		1018
3	MAURICE KIMEU	11602591		660 A/RIVER
4	KIMOLO KINGUYU			16 A/River
5	WAYUA D. OSEA	4937358		0727025822
6	ABDIAS KOMUGA	18783341		
7	ZIPPORAH NDINDA	9561761		
8	MARGARET WAMBUI	26370449		
9	Josephine Muka	2591716		0718703258
10	Mukonyo Dison	2627377	Mukonyo	
11	KOKI KIMUYU KALELI	3056399	KOKI	
12	WINFRED MUKULU MUASYA	24122076		
13	Josephine Musembi	10578417		0729513963
14	MUTHINA M. KITANYA	6130889	muthina	0720741946
15	Angela Ngina	27163565		0721686606
16	MICKA MBINYA			
17	Charles M. Mtchira	0416809		0725445876
18	Alice Waya			

District: ATHI-RIVER Division: MAVOKO Location: ATHI-RIVER
Sub location: KIM TIVER NORTH Village: Kasoito
The meeting ended: 1.30 P.M
Secretary
Community Representative
Consultant Representative
Date: 3/11/10

PUBLIC CONSULATION MEETING ATTENDANCE LIST FOR THE PROPOSED 81 MW ATHI THERMAL POWER PLANT

Triumph Power Generating Company is an independent power producer (IPP) proposing to construct an 81 MW thermal power plant in Athi River Town. As one of the one of the potentially affected stakeholder, it is a requirement by Environment Management Coordination Act 1999, Environmental Impact Assessment (EIA) and Environmental Audit Regulations 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, and operation and decommissioning.

List of Members Present

SNo.	Name	ID/No.	Signature	Address / Cell phone
1	Peris M. Ngige	12534050		76 Kitengela
2	Serah ndegge			660 Athi
3	Esther Kimani			120 Athi
4	WINFREAD MUTIVA	24381283		76 Kitengela
5	ELIBETH MUTIVA			76 Kitengela
6	MARGRET ACHING	26865577	MARGRET	76 Kitengela
7	CATHERINE WAMBUI			76 Kitengela
8	SAMUEL MBUTU	25552470		
9	ASSOCINES MUANGE	25986110		65 ATHI-RIVER.
10	SAMMY - M PETER	24174935		185 Athi-River
11	HARUN Mutia	11269102		185 Athi River
12	MARIA A MUMAVI			76 KITENGELA
13	SATAN KAYAYA	21706123		38 Athi River
14	MUSOKA MTONGO			0727 130 157
15	PETER KICO	11080279		0721-284338
16	Thomas Wambua	27941229		
17				
18				

District: ATHI RIVER Division: MAVOKO Location: ATHI RIVER
Sub location: ATHI RIVER NORTH Village: IASOLIN
The meeting ended: 1.30 P.M
Secretary.....
Community Representative.....
Consultant Representative.....
Date: 3/11/10

PUBLIC CONSULATION MEETING ATTENDANCE LIST FOR THE PROPOSED 81 MW ATHI THERMAL POWER PLANT

Triumph Power Generating Company is an independent power producer (IPP) proposing to construct an 81 MW thermal power plant in Athi River Town. As one of the one of the potentially affected stakeholder, it is a requirement by Environment Management Coordination Act 1999, Environmental Impact Assessment (EIA) and Environmental Audit Regulations 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, and operation and decommissioning.

List of Members Present

SNo.	Name	ID/No.	Signature	Address / cell phone
1	JEREMIAH MALULA	9316398		0728054920 BOX 3 ATHI RIVER
2	Simon SEMEI	6115849		BOX 46 ATHI RIVER
3	RICHARD AHlenlee	2976868		0733847867 BOX 165 ATHI RIVER
4	Stephen Riro	14622140		BOX 65 Athi
5	Kamini Mwenzia	09065324		Box 65 A/R
6	Jeremiah ole Matuna	13447787		Box 183 Kasindo
7	John. K. Kakure	0742117		Po. Box 614
8	Rose Mutumi			
9	JOSPHT. M. MULWA	11203006		POBOX 52
10	MUSA. KIMULI	10977913		BOX 272
11	JOSEPH. O. OTIENDE	0793096		Box 65 St. Jude
12	PATRICK NGEI MATEI	4417662		205
13	NICODEMUS N. MATUVA	10174791		304
14	REV ELIJAH Mutie	14562633		452 A/River
15	BENARD KOOL	0791909		0721923615
16	JOHN PISOI	6086487		0715000055
17	BACKSON PARMSA	0091315		0724749582
18	Wilson Kirayian	11587448		0723-376480

District: ATHI-RIVER Division: MAVOKO Location: ATHI-RIVER
Sub location: ATHI-RIVER NORTH Village: Kaloto
The meeting ended: 1.30 P.m.
Secretary
Community Representative
Consultant Representative
Date: 31/1/10

PUBLIC CONSULATION MEETING ATTENDANCE LIST FOR THE PROPOSED 81 MW ATHI THERMAL POWER PLANT

Triumph Power Generating Company is an independent power producer (IPP) proposing to construct an 81 MW thermal power plant in Athi River Town. As one of the one of the potentially affected stakeholder, it is a requirement by Environment Management Coordination Act 1999, Environmental Impact Assessment (EIA) and Environmental Audit Regulations 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, and operation and decommissioning.

List of Members Present

SNo.	Name	ID/No.	Signature	Address / cell phone
1	STEPHEN MATHEKA	20315191		252 Athi River
2	AGNES KALU	21564011		0735 727 938
3	DAMARIS MUVELO	12534780		0728859274
4	JOHN THOMAS MUTUA	20652479		0714705773
5	ANDREW MUSEE	12533789		0714565900
6	Florence Ndoku	7945017		0724106241
7	JAFFERSON JUMA	10514208		0724562268
8	Joseph KINGOLA	22647785		
9	JOYCE S KITHIGA	5045399		0729157651
10	GEORGY NZYOKA	2978515		0725026380
11	ANTONY MUSYOKA BISHOP	23947814		0701 254 765
12	David N. MICHAEL	22889621		0718157457
13	Wambu Michael	22655247		0718972962
14	FRANCIS MATHEKA	10275314		0720-687536
15	DAMARIS KALUNDE	9411768		0716 280630
16	DOLLEEN MUTHONI	13354162		0727347812
17	KIRISH MARTINE	11680997		0722-806963
18	WILSON MSEMEI	11680817		0722750476

District: ATHI-RIVER Division: MAVOKO Location: ATHI-RIVER
Sub location: ATHI-RIVER NORTH Village: KASOLO
The meeting ended: 1:30 pm.
Secretary.....
Community Representative.....
Consultant Representative.....
Date: 3/11/10

PUBLIC CONSULATION MEETING ATTENDANCE LIST FOR THE PROPOSED 81 MW ATHI THERMAL POWER PLANT

Triumph Power Generating Company is an independent power producer (IPP) proposing to construct an 81 MW thermal power plant in Athi River Town. As one of the one of the potentially affected stakeholder, it is a requirement by Environment Management Coordination Act 1999, Environmental Impact Assessment (EIA) and Environmental Audit Regulations 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, and operation and decommissioning.

List of Members Present

SNo.	Name	ID/No.	Signature	Address / Cell phone
1	JOYCE KIMAVI	22163133		BOX 27
2	KIOKO MUTISYA WISI	9550758		0723820978
3	MAGKESEMULO KAMMETE	5727762		0720621807
4	PENNINAH PETER	9558781		0724246278
5	Msay Musaro	12585296		0750418715
6	Dorothy Chebet	25755920		0711315043
7	Christine Munyiva	22279573		0714970324
8	Elizabeth M. Bostre	10469012		0728276056
9	SARABINA KEMUNTO	28108851		0729257948
10	JULIET NTHENTA	22449405		0715355467
11	Auleria Muthei	23632979		0725566831
12	MARK MUTHOKA	7405626		0715363317
13	JOSEPHINE MUKULU	13421829		
14	Winfred Mueni Munyasya	03215089		0724850710
15	Muthoni Kaundu	24987411		
16	Rubert Songoro			0729251946
17	Samson M. Bostre			0729581440
18	Jane Muongeri	07252994		0713939929

District: ATHI – RIVER Division: MAKUKA Location: ATHI – RIVER
Sub location: ATHI-RIVER NORTH Village: KASOITO
The meeting ended: 1:30 P.M.
Secretary
Community Representative
Consultant Representative
Date: 3/11/10

PUBLIC CONSULATION MEETING ATTENDANCE LIST FOR THE PROPOSED 81 MW ATHI THERMAL POWER PLANT

Triumph Power Generating Company is an independent power producer (IPP) proposing to construct an 81 MW thermal power plant in Athi River Town. As one of the one of the potentially affected stakeholder, it is a requirement by Environment Management Coordination Act 1999, Environmental Impact Assessment (EIA) and Environmental Audit Regulations 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, and operation and decommissioning.

List of Members Present

SNo.	Name	ID/No.	Signature	Address | Cell phone
1	ONESMUS M. MUNYAO	2976469		0727757552
2	ELIZABETH MUTUA	13266045		
3	MARIA KAMENE	12533895		
4	MUKONYO MUTHUKUI			
5	SYOKAU LULU	2978822		
6	RAEL MUNINI			
7	ALICE MBINYA	2977802		
8	PHILES MWIKALI			0727144459
9	EMMAH WANZA	2977757		
10	ELIZABETH KIMANI	29861021		0729861021
11	Beatrace KATUMBI			
12	Charles Kajeli	24304434		0716 631 659
13	ANTHONY KYAKO	46168400		0728217301
14	FAITH WAYUA			0727130248
15	CAROLINE MUNKALI	28001250		0716 103 899
16	ANN KAVINDU			
17	CATHERINE NZULA	25002869		0713 364 111
18	DAVID MUTUME	1167432		0710 145 318

District: ATHI-RIVER Division: MAVOKO Location: ATHI-RIVER
Sub location: ATHI-RIVER NORTH Village: Kasoito
The meeting ended: 1-30 P.M
Secretary
Community Representative
Consultant Representative
Date: 3/11/10

PUBLIC CONSULATION MEETING ATTENDANCE LIST FOR THE PROPOSED 81 MW ATHI THERMAL POWER PLANT

Triumph Power Generating Company is an independent power producer (IPP) proposing to construct an 81 MW thermal power plant in Athi River Town. As one of the one of the potentially affected stakeholder, it is a requirement by Environment Management Coordination Act 1999, Environmental Impact Assessment (EIA) and Environmental Audit Regulations 2003 and the Equator Principles that your views and concerns be incorporated in the project planning, implementation, and operation and decommissioning.

List of Members Present

SNo.	Name	ID/No.	Signature	Address / Cell phone
1	SAMMY MUANGE	496347		0701205503
2	HARRON MALU	8762568		0712224670
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				

District: ATHI-RIVER Division: MAVOKO Location: ATHI-RIVER
Sub location: ATHI-RIVER NORTH Village: Kasoi N.
The meeting ended: 1:30 P.M.
Secretary.....
Community Representative.....
Consultant Representative.....
Date: 3/11/16

Appendix 1.5 Sample Questionnaires to the Lead Agencies

Public Consultation Athi River Thermal power ESIA

ATHI RIVER THERMAL POWER ESIA PUBLIC CONSULTATION-LEAD AGENCIES

Triumph Power Generating Company is an Independent Power Producer (IPP) proposing to construct an 81MW thermal power plant in Athi River town on Plot No. 18474/216 located behind EAPCC. As one of the key lead agencies, it is a requirement Environmental Management Coordination Act 1999, Environmental Impact Assessment and Environmental Audit Regulation 2003 and the Equator Principles that your views and concerns be incorporated in the project planning implementation operation and decommissioning. This questionnaire is therefore administered to collect these views and concerns to form part of Environmental and Social Impact Assessment (ESIA). Kindly answer the questions below as correctly as possible. Thanking you for our cooperation.

General Information

1. Lead Agency: MAVOKO MUNICIPAL COUNCIL
2. Respondent's name: C. M. WARUTERE
3. Respondent's Address: 11 - 00204 ATHI RIVER
4. Respondent's telephone number : 0721 319698
5. Respondent's Email Address: waruterec010@yahoo.com
6. Date of interview: 11-8-2010
7. Respondent's Signature:

Comments and Concerns:

How do you think the proposed project will affect the operations of your organization?

1. None
2.
3.
4.
5.

What are your main concerns regarding the proposed thermal power project?

1. Disposal of construction waste
2. Disposal of oil fuel wastes
3. Removal of trees & vegetation
4. Disruption of top soil in new site.

How do you suggest that these concerns be addressed?

1. Provide for disposal of construction waste
2. " " " " of oil fuel waste.
3. Compensate trees cut from site by planting more
4. by contributing to Council's tree planting program.

Public Consultation Athi River Thermal power ESIA

What are the positive impacts do you anticipate from the proposed thermal power project?

1. Fewer power blackouts.
2. Increased employment opportunities
3. Increased power in national grid.
4. Reduction of power rationing
5.
6.
7.
8.

What negative impacts do you anticipate from the proposed thermal power project?

1. Destruction of vegetation
2. Pollution of environment by discharge
3. Emission pollution from running machineries
4. Increased risk of accidents of electrical shocks
5.
6.
7.

Suggest ways through which the positive impacts can be enhanced

1. Employ local labour in construction phase.
2.
3.
4.
5.

Suggest ways through which the negative impacts can avoided, reduced or mitigated enhanced

1. Create green areas on the site.
2. Enhance tree planting in Compound (site)
3. Use of PPE's on site.
4.
5.

I Approve/~~Disapprove~~ the proposed thermal power project Approve

Signature ..... Date 11/8/2010

ATHI RIVER THERMAL POWER ESIA PUBLIC CONSULTATION-LEAD AGENCIES

Triumph Power Generating Company is an Independent Power Producer (IPP) proposing to construct an 81MW thermal power plant in Athi River town on Plot No. 18474/216 located behind EAPCC. As one of the key lead agencies, it is a requirement Environmental Management Coordination Act 1999, Environmental Impact Assessment and Environmental Audit Regulation 2003 and the Equator Principles that your views and concerns be incorporated in the project planning implementation operation and decommissioning. This questionnaire is therefore administered to collect these views and concerns to form part of Environmental and Social Impact Assessment (ESIA). Kindly answer the questions below as correctly as possible. Thanking you for our cooperation.

RECEIVED 02 JUL 2010 MAVWASCO LTD.

General Information

1. Lead Agency:.....
2. Respondent's name: MAVOKO WATER & SEWERAGE
3. Respondent's Address: 582-00204 ATHI RIVER
4. Respondent's telephone number : 045-6622768/9
5. Respondent's Email Address: jambundo@mav-water.org
6. Date of interview: 02nd August 2010
7. Respondent's Signature: .....

Comments and Concerns:

How do you think the proposed project will affect the operations of your organization?

1. Increase our supply base / demand both industrial & domestic
2. Increase Sewerage quantity. both industrial / domestic
3. Industrial effluent discharges especially emergency situations.
4. .....
5. .....

What are your main concerns regarding the proposed thermal power project?

1. Provision of adequate supply of water for industrial / domesti
2. Extension of sewerage services
3. .....
4. .....

How do you suggest that these concerns be addressed?

1. Increase water procurement structures - dams / boreholes
2. Extend sewerage services - lay sewer mains
3. Industrial waste management plan.
4. .....

1

What are the positive impacts do you anticipate from the proposed thermal power project?

1. Increased supply of water - domestic & industrial
2. Increased revenue
3.
4.
5.
6.
7.
8.

What negative impacts do you anticipate from the proposed thermal power project?

1. Industrial effluent discharges
2. Pollution of water bodies through dust, oils spillages
3.
4.
5.
6.
7.

Suggest ways through which the positive impacts can be enhanced

1. Obtain sources to abstract water
2. ~~Ex~~
3.
4.
5.

Suggest ways through which the negative impacts can avoided, reduced or mitigated enhanced

1. Through environment discharge management plan
2. Hydroseeding, oil/grease traps
3.
4.
5.

I Approve/Disapprove the proposed thermal power project I approve

Signature ..... Date 02/08/2010

MAVOKO WATER
AND SEWERAGE CO. LTD.
P. O. Box 582 - 00204
ATHI RIVER

2

APPENDIX 2. LETTERS OF AUTHORITY AND AGREEMENTS

Appendix 2.1 Land Lease Agreement - EPZ & Triumph Power Generating Company

Export Processing Zones Authority

Administration Building
Viwanda Road,
Off Nairobi - Namanga Highway
Athi River, Kenya.
E-mail: info@epzakenya.com
Website: www.epzakenya.com

P.O. Box 50563 - 00200
Nairobi, Kenya.
Tel: +254-45-6626421/6
Wireless: +254-20-2511969
ISDN line: +254-45-6621000
Fax: +254-45-6626427

CONF/EPZ/1192/VOL.I(31)

24th November 2010

The Chairman
Triumph Power Generating Co. Ltd
P. O. Box 11640 – 00400
NAIROBI

LEASE OF PART OF PLOT LR 18474/216 PORTION NO 6

I refer to your letter dated 3rd November 2010 regarding the lease of a portion of plot LR 18474/216.

The Authority has no objection to your request to have portion No. 6 instead of 13. Meanwhile, we advise that you undertake exhaustive site investigation in order to avoid further requests on changes.

The correct land number will be indicated in the lease once survey is complete. The terms and conditions of your tenancy remain the same. We shall forward an offer for the additional 5 Ha you have requested for.

J. N. Kosure
Ag. CHIEF EXECUTIVE

JM/aw

...Promoting, facilitating & creating enabling environment for investments...

ISO : 14001 : 2004

ISO : 9001 : 2008

Export Processing Zones Authority

Administration Building
Viwanda Road,
Off Nairobi - Namanga Highway
Athi River, Kenya.
E-mail: info@epzakenya.com
Website: www.epzakenya.com

P.O. Box 50563 - 00200
Nairobi, Kenya.
Tel: +254-45-6626421/6
Wireless: +254-20-2511969
ISDN line: +254-45-6621000
Fax: +254-45-6626427

CONF/EPZ/1192/VOL I (29)

22nd October, 2010

Triumph Power Generating Co. Ltd
P. O. Box 11640 – 00400
NAIROBI

LEASE OF PART OF LR. 18474/216 PORTION NO. 13

I refer to your letter dated 4th October, 2010.

I am pleased to advise that we have considered your proposal to inter-change your allocated plot number 16 with plot number 13 and find it acceptable, especially for zoning purposes. Your letter of offer dated 5th March, 2009 refers to a portion of Land ref: 18474/216 and this is correct for portion number 13.

I note further that your rent is paid up to March 2011. Your next rent will be due in April 2011. You may access the plot number 13 and proceed with construction.

The correct land number will be indicated in the lease once survey is completed. The terms and conditions of your tenancy remain the same.

J. N. Kosure
Ag. CHIEF EXECUTIVE
JM/aw

...Promoting, facilitating & creating enabling environment for investments...

ISO : 14001 : 2004

ISO : 9001 : 2008

Export Processing Zones Authority
Administration Building
Viwanda Road,
Off Nairobi-Namanga Highway
Athi River, Kenya
Website: www.epzakenya.com
Email info@epzakenya.com

P.O. Box 50563 00200
Nairobi, Kenya
Tel: 254-045-26421-6
Fax: 254-045-26427

EPZA /CONF / 1192 (18)

March 5, 2009

The Managing Director,
Triumph Power Generating Company Ltd,
P. O. Box 90787– 80100,
MOMBASA.

Attn: Mr. Ahmed Rufa Abass

RE: LEASE OF PART OF LAND REF/NO. 18474/216 MEASURING APPROXIMATELY 5 HECTARES – ATHI RIVER EPZ

Following confirmation of your interest to lease a portion of the above parcel of land, we set out below the terms and conditions upon which the Authority will grant you a lease.

DEMISE	:	Part of Land known as Land Reference No. 18474/216 measuring approximately 5 hectares or thereabouts.
LEASE	:	The term of lease will be fifty (50) years commencing 1st April, 2009.
USE	:	The premises will be used for Construction of a Power Generating Plant.
SURVEY AND SUB-DIVISION	:	Survey on the parcel of land is currently ongoing, and the formal lease shall be entered into only upon completion of the survey.
RENT	:	The rent payable shall be United States Dollars Four Thousand only (US$4,000) per hectare per annum exclusive of service charge. The total amount payable for the Five (5) hectares shall be United States Dollars Twenty Thousand (US$20,000) per annum exclusive of Service Charge.

Letter of Offer to: TRIUMPH POWER GENERATING CO. LTD Page 1 of 3

INITIAL ONE TERM PAYMENT : That you shall make a one term payment to the Authority of United States Dollars Eight Thousand (US$8,000) per hectare giving a total of United States Dollars Forty Thousand (US$ 40,000) on acceptance of the offer. This amount is non refundable.

SERVICE CHARGE : In addition to the rent which will be payable yearly in advance, a service charge will be levied to cover all Landlords outgoings, operations and overheads.

The Service Charge will be based on the assessment of Fifteen per cent (15%) of the amount of rent payable i.e. United States Dollars Three Thousand only. (US$ 3,000). You will be levied yearly in advance upon the usual and same days as the rent.

DEPOSIT : Upon acceptance of this offer, you shall be required to pay a deposit of United States Dollars Fifteen Thousand Only (US$15,000) which deposit shall be refundable at the end of the lease term.

RENT PAYMENT: The first annual rent and service charge is payable in advance beginning the 1st day of April, 2009 and every 1st day of the term hereby created.

STANDARD LEASE : The standard lease will include all the terms referred to in this letter in addition to the standard clauses set out therein.

EXECUTION OF LEASE/BREACH OF THE COVENANTS : Until such time as the standard form of lease hereafter referred to has been executed and registered, all the covenants and conditions and the rent agreed shall be deemed to be incorporated in this letter.

If the rent agreed or any part thereof shall at any time remain unpaid for seven (7) days after becoming payable (whether demanded or not), or if at any time hereafter you are in breach of any covenants or conditions referred to in the standard lease, it shall be lawful for the landlord to re-enter the premises or any

part thereof and thereupon this Agreement of Lease shall be terminated absolutely.

GUARANTEE: The guarantors to the Lease shall be the directors of **TRIUMPH POWER GENERATING COMPANY LTD.** They (the guarantors) shall be required to join in the Lease to guarantee payments and fulfilment of your obligations as stipulated therein.

VALIDITY OF OFFER: This offer is valid until **30th April, 2009** after which the same will lapse and the land will be available for rent to other tenants.

If the above terms and conditions are acceptable to you, kindly sign and return to us the attached copy of this letter.

J. N. Kosure
Ag. CHIEF EXECUTIVE

We confirm that the above terms and conditions are acceptable to us.

TRIUMPH POWER GENERATING
COMPANY LIMITED

..... 9/3/2009

MR.AHMED RUFA ABASS **DATE**
DIRECTOR
TRIUMPH POWER GENERATING CO. LTD.

Appendix 2.2 Approval for Extraction of Water from the EAPCC Dam

BLUE TRIANGLE Cement

THE EAST AFRICAN PORTLAND CEMENT COMPANY

Holding Life Together

Athi River Off Namanga Road
P O Box 20-00204 Athi River
Tel: (254) 045 – 6620627, 6622777
Fax:(254) 045 – 6620406, 6622378
E-mail: info@eapcc.co.ke
Website: www.eastafricanportland.com

Ref: EAPCC/MD/023/VOL.II (64)

14 September 2010

The Chairman
Triumph Power Generating Co. Ltd
P.O. Bo 11640 - 00400
NAIROBI

Dear Sir

RE: REQUEST TO TAP WATER FROM PORTLAND DAM – ATHI RIVER

Please refer to your letter dated 27th August, 2010 on the above matter.

This is to inform you that the Board approved your request subject to you entering a Memorandum of Understanding (MOU) with East African Portland Cement Co. Ltd.

The precise terms of the MOU will include but not limited to the matters raised in our letter to you of 1st September 2010.

Please contact the undersigned in order to fix a meeting for further discussions.

Yours faithfully
For: East African Portland Cement Co. Ltd

Kephar L. Tande
Ag. MANAGING DIRECTOR

Appendix 2.3 Water Resources Management Authority Borehole Drilling Letter

WATER RESOURCES MANAGEMENT AUTHORITY

Athi River Water Catchment Region
Nairobi Sub Region
P O Box 18150 - 00500
NAIROBI

Tel: 020 – 556319 Wireless 020-3585133
Fax: 020-556319
Email: wrmanairobisubregion@yahoo.com

Ref: WRMA/30/NRB/3AC/10214/G
Date: 13th October, 2010

Triumph Power Generation Company Limited
P.O. Box 11640-00400
Nairobi

RE: ACKNOWLEDGEMENT OF RECEIPT OF GROUNDWATER PERMIT APPLICATION

This is to acknowledge receipt of your groundwater permit application dated 13th October 2010.

After perusal of the application documents, we have noted that all the documents/requirements are in order.

Please note that as per section 29(8) of the Water Act 2002, section 26(2) of the Water Resources Management Rules 2007 and Water Resources Management Charter, your application will be determined within a maximum period of 6(six) months from the date of receipt of the application.

G.K WACHIRA
SUB REGIONAL MANAGER

Cc

The Regional Manager
Athi Water catchment Region
P.O. Box 1159-90100
Machakos

Appendix 2.4 No Objection to Borehole Drilling Letter from MAVWASCO

MAVWASCO
Mavoko Water & Sewerage Company

Adjacent to Athi River Post O
Mavoko Road, Athi River
Off-Nairobi-Namanga Highw
P.O. Box 582 - 00204 AthiR
Tel: 045-6622768/9,
Fax: 045-6622771
Wireless: 0202- 106291
Email: info@mav-water.org

Our Ref: **MAV/PBH/VOL.1/ 132** Date: 21st September 2010

TRIUMPH POWER GENERATING COMPANY LTD
P.O BOX 11640 - 00400
NAIROBI

Dear Sir/Madam,

RE: NO OBJECTION TO DRILLING A BOREHOLE ON PARCEL PLOT NO.12 ATHIRIVER EPZ AREA MACHAKOS.
The above subject refers.

We hereby give a no objection to your request to drill a borehole vide your letter dated 21st September 2010.

We require that you duly inform us in writing immediately after sinking the borehole. In your response, enclose the pump test results (indicating borehole yield) and a copy of water quality analysis report from an accredited laboratory preferably the Government's Central Laboratory.

This letter does not authorize you to supply/sell water from the proposed borehole to the general populace for any drinking purposes or alter the use thereof other than that for which your license will permit.

Please note that our no objection letter, does not preclude our earlier discussions on alternative water tapping for the conventional water supply. Kindly, be informed and act accordingly.

MICHAEL Y. MANGE'LI
MANAGING DIRECTOR

Cc
The Sub-Regional Manager,
Water Resources Management Authority,
Athi Water Catchment Region
P. O. Box 18150-00500
NAIROBI

Appendix 2.5 Boreholes in the Vicinity of the Project Site

TRIUMPH POWER GENERATING CO. LTD

KITENGELA POWER STATION

1.1 Existing boreholes

A number of boreholes have been drilled in the project area. Available records were studied for 12 boreholes within a radius of about 2.7km from the present site. Results of the data inventory are presented in Table 4.1 while the approximate location of the boreholes has been indicated in Figure 4.1.

Table 4.1 - Boreholes in the Vicinity of the Site

A	B	C	D	E	F	G	H
Owner	Borehole No. 'C'	Distance/ Direction (km)	Total Depth (m)	Water Struck Levels (m)	Water Rest Level (m)		Tested Yield (m^3/hour)
	2301	1.8/SSW	127	33, 125	24		11.55
	2303	2.0/SSW	140	61, 76, 131	19		9.09
BAT	4001	1.3/NW	200	109, 132	33.7		103.2
KMC	4053	2.7/NW	143.3	5.2, 54.9	24.7		10.9
Athi Leather Works	4734	2.3/NW	110	8, 94	4.5		30
Bawazir Tanneries	10533	3.2/NW	152	4-6, 92	68		12
	10724	3.0/NW	106	10, 89	58		12.8
Youth for Christ	11719	2.8/ENE	101	26,32,38-50	20		1.6
Devki Steel	12473	2.5/NW	100.6	24.4-36.6, 47-79	55.1		7.2
Athi River Steel	13717	1.1/NW	175	138, 170	46.3		2.16
Superior Homes	New BH	1.1/E	110	-	26.4		24
BH opp. AR Steel	New BH	1.0/NNW	160	70, 130, 150	63.2		11

Appendix 2.6 Boreholes Tests and Water Quality Analysis

Biselex
KENYA LIMITED
Water Pumps Specialists:-Booster Pumps, Submersible Pumps, Industrial Pumps, Generating Sets

Avon Centre, Enterprise Road,
P.O Box 18711-00500, Nairobi, Kenya.
Tel:(254)020 - 559845, 556260
Fax:(254)020-536471,
Email:biselex@africaonline.co.ke,
Web:www.biselex.com

DAILY WORK SHEET | JOB NO: 1015

CLIENT: Triumph power Generating Co. Ltd B/H 2B | DATE: 18/09/2011

TECHNICIANS: Ashok Peter Mawa, Sammy, Jack, mwalo | S/NO:

REPORT | Time Arrival at Site | Time Departure From Site | TOTAL HRS

DETAILS:

→ Carried out this step down test & immediately 24 hrs continuous test pumping
→ Monitored the drawdown & discharge
→ Collected water sample for chemical analysis
→ Recovery test for 4 hrs
Total depth 200 mts
Types of pump used - BP 30-21
Static water level - 40.85 mts
Pumping water level - 174.95 mts
Yield 29 m³/hr
Pump set - 182 mts

TECHNICIANS WORK REQUIRED

ITEMS USED

TECHNICIAN | SUPERVISOR | CLIENT:

TRANSPORT | Vehicle: KeK 640 A | Other Sites Visited:
Mileage at W/Shop on previous Site | Mileage at Site: | Total KMS:

COSTING	Hrs @		SUMMARY	CODE	AMOUNT
	Hrs @		TOTAL LABOR		
	Hrs @		TRANSPORT KMS @		

KENYA LIMITED
Water Pumps Specialists:-Booster Pumps,
Submersible Pumps, Industrial Pumps, Generating Sets

Tel:(254)020 - 609846, 606060
Fax:(254)020-536471,
Email:biselex@africaonline.co.ke,
Web:www.biselex.com

DAILY WORK SHEET | JOB NO:

CLIENT: Triumph Power Generating Co. Ltd B/H No [redacted] | DATE: 11/09/011

TECHNICIANS: SOLOMON, NZAU, JOSEPH & ANTHONY | S/NO: 809

REPORT | Time Arrival at Site | Time Departure From Site | TOTAL HRS

DETAILS: BOREHOLE 1A

We carried out a 4 Hrs Step down test and monitoring after carried out a 24 Hrs Continous test pumping monitoring both the drawdown (m) and discharge (m³/hr) against time (min) thereafter we took a recovery test for 2 hrs.

We also took water samples for chemical analysis.

Borehole details as tested :- Type of pump used – Sp 40/26
B/H total depth – 200m
Depth of pump intake – 176.m
S.W.L – 20.83 m
D.W.L – 170.94 m
Yeild – 32m³/hr

TECHNICIANS WORK REQUIRED: Report after analysis.

ITEMS USED:

TECHNICIAN: SOLOMON | SUPERVISOR: | CLIENT:

TRANSPORT: Vehicle: KBR 683 N | Other Sites Visited:
Mileage at W/Shop on previous Site | Mileage at Site: | Total KMS:

COSTING			SUMMARY	CODE	AMOUNT
	Hrs @				
	Hrs @		TOTAL LABOR		
	Hrs @		TRANSPORT KMS @		
	SUNDRY				

Biselex
KENYA LIMITED
Water Pumps Specialists:-Booster Pumps, Submersible Pumps, Industrial Pumps, Generating Sets

Avon Centre, Enterprise Roa
P.O Box 18711-00500, Nairobi, Keny
Tel:(254)020 - 558845, 55826
Fax:(254)020-53647
Email:biselex@africaonline.co.k
Web:www.biselex.co

DAILY WORK SHEET

JOB NO: 1014

CLIENT: Triumph power Generating Co. Ltd B/H 1B

DATE: 11/04/2011

TECHNICIANS: Ashok Creul Cmaura, Samson, Jack, Mwaura

S/NO:

REPORT

Time Arrival at Site | Time Departure From Site | TOTAL HRS

DETAILS:

- Carried out 4 hrs step down test & immediately 24 hrs Continuous test pumping
- Monitored both drawdown & discharge
- Took Water Sample for Chemical analysis
- Recovery test for 2 hrs
  - Type of pump used - SP 30-26
  - Tested depth - 200 mts
  - Static Water level -
  - Pumping Water level - 174.5 mts
  - Yield - 30 m³/hr
  - pump set - 176 mts

TECHNICIANS WORK REQUIRED

ITEMS USED

TECHNICIAN | SUPERVISOR | CLIENT:

TRANSPORT

Vehicle: KmK 616 A | Other Sites Visited:

Mileage at W/Shop on previous Site | Mileage at Site: | Total KMS:

COSTING

		SUMMARY	CODE	AMOUNT
Hrs @				
Hrs @		TOTAL LABOR		
Hrs @				
SUNDRY		TRANSPORT KMS @		

Biselex
KENYA LIMITED
Water Pumps Specialists:-Booster Pumps, Submersible Pumps, Industrial Pumps, Generating Sets

Avon Centre, Enterprise Road,
P.O Box 18711-00500, Nairobi, Kenya.
Tel:(254)020 - 559845, 556260
Fax:(254)020-536471,
Email:biselex@africaonline.co.ke,
Web:www.biselex.com

DAILY WORK SHEET | JOB NO: 1016

CLIENT: Tsavo Power Generating Co. LTD BH 2A | DATE: 16th Sep 2011

TECHNICIANS: Mawa, Sammy, Jack & Muiarki | S/NO:

REPORT | Time Arrival at Site | Time Departure From Site | TOTAL HRS

DETAILS:

- Carried out 4 hrs step down test & immediately 24 hrs test pumping. Monitoring the drawdown & Recharge
- Took water sample for Chemical analysis
- Recovery test for 4 hrs
  - Total depth 200 mts
  - Static water level 54.53 mts
  - pumping water level 123.90 mts
  - Yield 21 m³/hrs
  - Pump used = SP 30-21
  - Pump Set = 182 mts

TECHNICIANS WORK REQUIRED

ITEMS USED

TECHNICIAN | SUPERVISOR | CLIENT:

TRANSPORT | Vehicle: Kat 6400 | Other Sites Visited:
Mileage at W/Shop on previous Site | Mileage at Site: | Total KMS:

COSTING

		SUMMARY	CODE	AMOUNT
Hrs @				
Hrs @		TOTAL LABOR		
Hrs @				
SUNDRY		TRANSPORT KMS @		

Borehole Water Quality Analyses

MINISTRY OF ROADS

Telegraphic Address: "MINWORKS", Nairobi
Telephone: Nairobi 554950/3/4 Fax: 554877
E-mail: chief.engineer@materials.go.ke
If calling or telephoning ask for
When replying please quote
Ref. No. **M.1780/35/R/4/107**
And date

CHIEF ENGINEER (MATERIALS)
MACHAKOS ROAD
INDUSTRIAL AREA
P. O. Box 11873
NAIROBI

18 October, 2011

M/s Triumph Power Generating Co.
KITENGELA.

Dear Sirs,

RE : ANALYSIS OF WATER.
JOB CARD NO. 00509/CH/11

The samples you submitted on 20/9/2011 gave the results shown below:-

Our Ref. Your Ref.	646/Ch/11 Borehole1A	647/Ch/11 Borehole1B	648/Ch/11 Borehole 2A	649/Ch/11 Borehole2B
pH	8.36	8.10	8.23	8.18
Free carbon Dioxide, mg/l	7.99	25.97	11.49	13.99
Alkalinity as ,m mol/l	0.96	0.94	0.86	0.87
Total Hardness as $CaCO_3$, m mol/l	1.46	0.66	0.57	0.81
Calcium Hardness as $CaCO_3$, m mol/l	0.84	0.40	0.40	0.44
Magnesium Hardness, m mol/l	0.62	0.26	0.17	0.37
Dissolved solids, mg/l	119	122	58	63
Suspended Solids, mg/l	2114.6	1398.2	1317	1365.5
Carbonate Hardness as $CaCO_3$, m mol/l	0.96	0.66	0.57	0.81
Non carbonate Hardness as $CaCO_3$, m mol/l	0.5	Nil	Nil	Nil
Dissolved Oxygen, m mol/l	7.85	5.35	5.75	5.60

Your account of Kshs. 20,000/= has been settled vide receipt No.MR.7942816 dated 18/10/2011 of Ksh. 18,000 and receipt No.MR.7939293 of Ksh. 2,000 dated 20/9/11.

Yours faithfully,

CHIEF ENGINEER MATERIALS
MINISTRY OF ROADS
P.O. Box 11873,
NAIROBI

Eng.S.K.Kogi
ENGINEER (MATERIALS)

MINISTRY OF ROADS

Telegraphic Address: "MINWORKS", Nairobi
Telephone: Nairobi 554950/3/4 Fax: 554877
E-mail: chief.engineer@materials.go.ke
If calling or telephoning ask for
When replying please quote

CHIEF ENGINEER (MATERIALS)
MACHAKOS ROAD
INDUSTRIAL AREA
P. O. Box 11873
NAIROBI

Ref.No. **M.1390/35/R4/100**

And date 27 July, 2011

M/s Triumph Power Generating Co. Ltd
KITENGELA

Dear Sirs,

RE: ANALYSIS OF WATER
JOB CARD NO. 0099/CH/11

The Water samples you submitted on 19/7/2011 gave the results shown below:-

Our Ref Your Ref	337/Ch/11 Borehole water	338/Ch/11 Dam Water
pH	9.21	7.72
Free Carbon Dioxide, mg/l	Nil	10.99
Alkalinity as $CaCO_3$, m mol/l	0.51	0.31
Total Hardness as $CaCO_3$, m mol/l	0.55	0.93
Calcium Hardness as $CaCO_3$, m mol/l	0.04	0.66
Magnesium Hardness as $CaCO_3$, m mol/l	0.12	0.27
Dissolved Solids, mg/l	391.5	120.0
Suspended Solids, mg/l	365.25	220.5
Oil Content, mg/l	Nil	Nil
Carbonate Hardness as $CaCO_3$, m mol/l	0.51	30.5
Non-Carbonate Hardness as $CaCO_3$, m mol/l	Nil	0.62
Dissolved Oxygen, mg/l	8.75	7.95

Your account of Kshs. 10,000/= has been settled vide receipt No.MR.130220 dated 19/07/2011.

Yours faithfully,

CHIEF ENGINEER MATERIALS
MINISTRY OF ROADS
P.O. Box 11873,
NAIROBI.

Eng.S.K.Kogi
CHIEF ENGINEER (MATERIALS)

APPENDIX 3 SPECIALIST STUDY REPORTS

Appendix 3.1 Air and Noise Quality Report

Report on the Assessment of Air Pollution and Noise Monitoring at the Proposed Site for MSD Thermal Power Plant in Athi River Town, Mavoko Municipal Council

INSTITUTE OF NUCLEAR SCIENCE & TECHNOLOGY

UNIVERSITY OF NAIROBI

May, 2010

Contents

1. INTRODUCTION

In this report we present results for the spot check assessment of air pollution at proposed thermal power plant site in Mavoko Municipal Council which was done on 26th & 27th May 2010.

The site located near Kitengela town, approximately 30 km south of Nairobi city. The anticipated power plant is expected to generate 81MW of electricity.

a. Problem statement

In order to comply with construction/building regulations by NEMA on Environmental Impact Assessment (EIA), Trimph Power Generating Company Ltd consulted the Institute of Nuclear Science and Technology to carryout assessment of air pollutants; Gases (NO2, SO2, CO), Particulate matter (PM10) and Noise levels at the proposed site. The data collected will serve as baseline data before the commencement of the construction work.

b. Objectives

The objectives of the exercise were to measure;

i. Concentration of particulate (PM_{10})
ii. Levels of pollutant gases namely; CO_2, SO_2 and NO_2
iii. Ambient noise levels

2. METHODOLOGY

Sampling was done for two consecutive days at one point which was identified as the centre of the proposed construction site as shown in Figure 1 below.

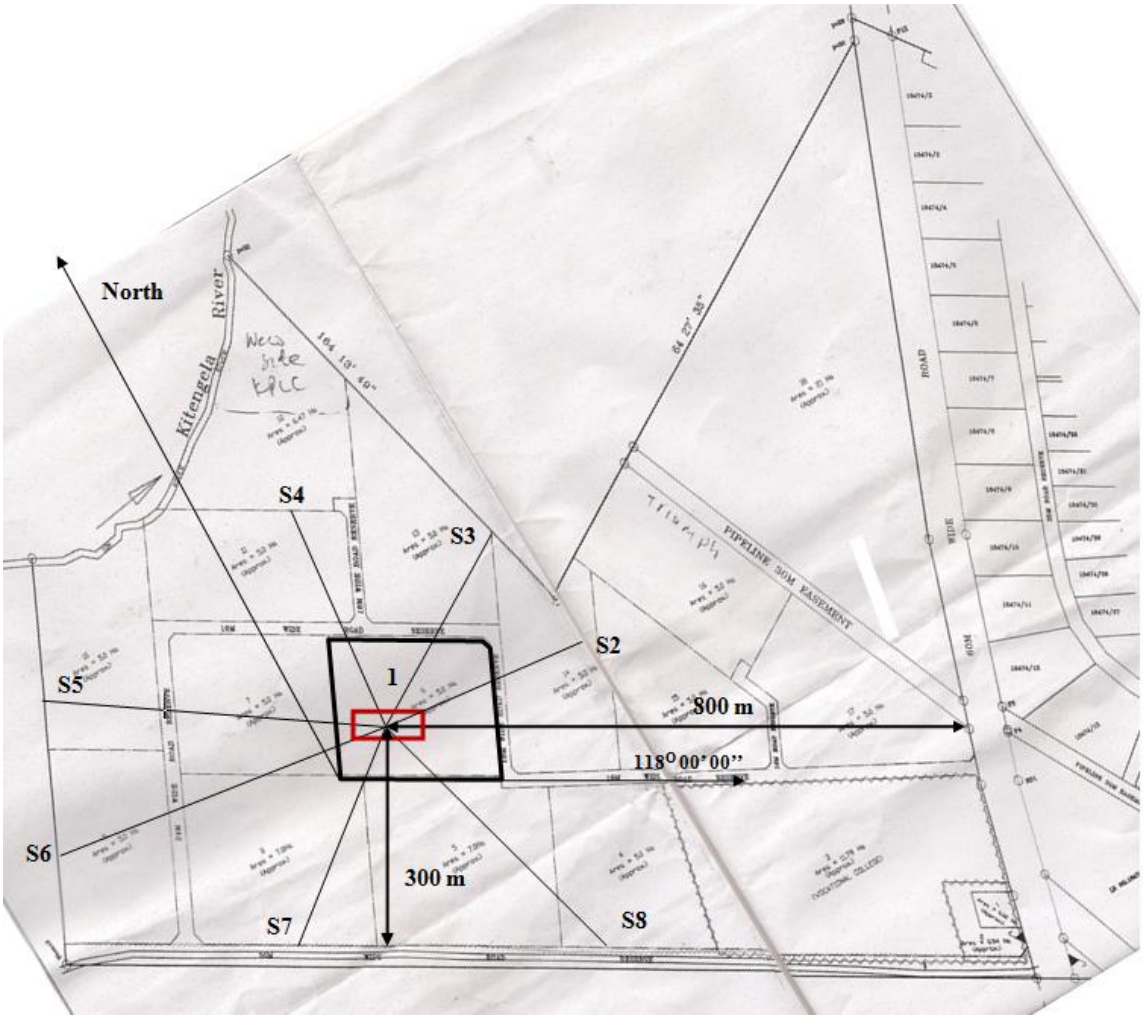
Air Particulate Matter

A Dichotomous PM_{10} sampler model 241 was used to collect two size fractionated aerosol samples ($PM_{<2.5}$ & $PM_{2.5<10}$) during the sampling exercise. The sampler inlet was placed at heights of 2 meters from the ground and the flow rate adjusted to approximately 16.7 L/min. Sampling duration was 8 hours each day.The filter loading were determined gravimetrically using a 10μg sensitivity Ainsworth (Type 24N) weighing balance in an air-conditioned room at 50% relative humidity and at 20°C. The filter load densities were

determined from results of volume of air sampled and the weights of the filter loads determined.

2.2 Gaseous Pollutants

Measurements of gaseous pollutants; NO_2, CO and SO_2 were obtained by using Nitrogen Dioxide meter data logger model Z-1400XP, Carbon monoxide meter Data logger model Z-500 XP and Sulphur Dioxide meter data logger model Z-1300XP respectively. Gaseous concentrations levels were determined from measurements of data taken at intervals of 10 seconds continuously for 8 hours each day at the sampling site.



Key: S1-8 Indicate Noise Level Measurement Points

Figure 1 Sketch of the Sampling Site

The filter load densities were determined from results of volume of air sampled and the weights of the filter loads determined.

2.3 Noise levels

Noise levels were measured using a digital sound level meter model HP-882A with a measurement range of 30 – 130 decibel and accuracy of ±1.5 dB. Readings were obtained at 8 different points three times every day (Figure 1).

Table A.2.1.1 Distances to Noise Monitoring Points

Sampling Point	Δx (m)	Δy (m)	Distance from S1 (m)
S1	0	0	0
S2	254	106	275
S3	144	263	300
S4	-158	295	335
S5	-471	58	475
S6	-452	-189	490
S7	-117	292	315
S8	310	-298	430

3. RESULTS

Tables 1, 2 & 3 show the summary of average results for Particulates, Gases and Noise levels measured during the sampling period.

3.1 Total Particulate

The total particulate matter (PM_{10}) concentration was less than maximum limit of 150 μg/m^3 set by WHO (1987) and EPA (1999).

Table A.2.1.1: Average Results of Particulate Measurements (ngm^{-3})

Fraction	PM ($\mu g/m^3$)
Fine ($PM_{2.5}$)	435
Coarse ($PM_{2.5<10}$)	994
Total (PM_{10})	1429

3.2 Gaseous Pollutants

Gases' average concentrations were generally low compared to the recommended levels by WHO and EPA.

a. NO_2 maximum measured value was 300 ppb and the maximum 8 hour average was 128 ppb. The average result is within the one-hour maximum exposure of between 100 – 1170 ppb as cautioned WHO (1999).
b. CO maximum measured concentration was 1100 ppb and an 8 hour average maximum of 32 ppb. Maximum allowable concentrations as set by United States EPA are 35 ppm for 1 hour and 9 ppm for 8 hours.
c. Highest SO_2 measured concentration was 100 ppb and the 8 hour calculated average was 1.8 ppb. These values are far less than the safe level set by United States EPA (1999) of 140 ppb (averaged over 24 hours).

The ambient air around the sampling site is clean and meets the National regulation requirements.

Table A.2.1.2: Average Concentration Levels for Gaseous Air Pollutants; NO_2, SO_2 and CO (ppb)

Gas	Concentration (ppb)	Maximum
CO	24.4	1100
NO_2	97.4	300
SO_2	0.9	100

3.3 Noise levels

Noise levels measured in the 8 sites ranged between 42 - 72 dB and an 8 hour average of 47.2 dB (Table A.2.1.3). This average value is however less than the 24 hour exposure level of 70 dB as recommended by US EPA.

Table A.2.1.3 Athi River Site Noise Levels (dB)

Noise Level (dB)			**Average**			**Minimum**	**Maximum**
Date	**26/5/2010**		**27/5/2010**				
Time	**11:00 - 11:44 hrs**	**15:25 - 16:02 hrs**	**9:00 - 10:02 hrs**	**12:30 - 13:30 hrs**	**15:55 - 16:00 hrs**		
Location							
N1	56	73	45	51	44		
	46	70	43	47	45		
	45	72	47	48	47	**43**	73
N2	45	48	44	45	46		
	52	44	43	43	52		
	47	50	47	44	48	**43**	52
N3	44	45	46	44	48		
	46	50	48	46	51		
	48	47	51	47	49	**44**	51
N4	45	46	45	44	47		
	47	44	43	44	50		
	47	45	46	46	48	**43**	50
N5	51	50	42	45	50		
	46	48	45	43	45		
	47	54	43	44	47	**42**	54
N6	48	49	43	42	42		
	45	47	41	43	43		
	50	51	44	42	41	**41**	51
N7	49	44	42	43	43		
	46	43	41	41	44		
	51	45	44	44	45	**41**	51
N8	46	49	44	42	46		
	48	46	42	44	50		
	52	53	46	46	48	**42**	53

5. RECOMMENDATIONS

The results obtained from the baseline analysis of the air shed quality should form a basis of future monitoring after installation/construction of the power plant.

LIST OF REFERENCES

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2. Environmental Survey at Westlands Roundabout on 22 June 2005. A JICA-NCC project.
3. Digital sound meter operation manual MODE:882A.
4. Environmental Survey For A Road Construction Project in Kileleshwa, Lavington, Riverside Drive and Yaya Centre – Sub Urbans in Nairobi Between 7th – 17th February, 2006 – A JICA-NCC Project.
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6. KARUE J. M., A.M. KINYUA and A. H. S. EL-BUSAIDY (1992). Measured Components in Total Suspended Particulate Matter in A Kenyan Urban Area. Atmospheric Environment Vo. 26 No.4, pp. 505-511.
7. KINYUA A.M., MANGALA, M.J., GATEBE, C.K., KAMAU, G.N. KWACH R., MUGERA W.G., KORIR I AND MUKOLWE E.A (1998). Suspended Particulate Matter in Nairobi and the Impact on Health. Proceedings of the Kenya Meteorological Society (KMS) Workshop, Nairobi pp. 416-420.
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9. UNEP (1996). Air Quality Management and Assessment capabilities in 20 major cities. WHO/EOS 95.7 UNEP, Nairobi, pp245.
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11. UNEP/WHO (1992). Urban Air Pollution in Megacities of the World, Blackwell Publishers, UK, pp 230.

Appendix 3.2 Noise Level Simulations

NOISE LEVEL SIMULATIONS

1. SCOPE OF STUDY

The site will be required to comply with noise level limits, which are discussed below.

This assessment aims to:

(i) Model existing noise levels after the proposed installation of a power plant Athi River.

(ii) Verify compliance with the limits, and

(iii) Provide the operator with sound level simulation maps of the site and adjoining area within a radius of about 5 km for mitigation purposes. This will help quantify the requisite mitigation measure.

2. ASSESSMENT CRITERIA

2.1 National Noise Standards

The Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations, 2009 sets out maximum permissible noise levels in the First schedule of the Regulation for various zones (Table 1).

Table 1 : Maximum permissible noise levels

Zone		Sound Level Limits dB(A) (L_{eq}, 14h)		Noise Rating Level (NR) (L_{eq}, 14h)	
		Day	Night	Day	Night
A.	Silent zone	40	35	30	25
B.	Places of worship	40	35	30	25
C.	Residential: indoor Outdoor	45 50	35 35	35 40	25 25
D.	Mixed residential(with some commercial and places of entertainment)	55	35	50	25
E.	Commercial	60	35	55	25
	Time frame				
	Day:	6.01 a.m. – 8.00 p.m. (L_{eq}, 14h)			
	Night:	8.01 p.m. – 6.00 a.m. (L_{eq}, 10h)			

3. METHODOLOGY

3.1 Supplied Data

The Figure 1 below has been supplied by manufacturer of the plant. The projected noise levels have a maximum level depicted by the blue colour, reaching about 85 dB.

3.2. Background Noise Climate

The cumulative noise levels after installation of the plant is summed with the background noise levels before the installation. This is done as follows:

For the addition of the two sound pressure levels, the total sound pressure level (L_{pt}) is given by:

$$L_{pt} = 10\log_{10}\left[\sum_{i=1}^{n}\log^{-1}(L_{pi}/10)\right] \quad \text{……..(1)}$$

Reference is made to the measured background noise levels, within and around the site in 2011. The highest levels at the site at around noon may be taken as 73 dB. In the afternoon, however, the worst case level may be taken as 43dB.

3.3 Noise Pollution Modeling

The noise sources from the proposed plant may be considered as emanating from a set of line sources or point sources, for each of which the inverse square law applies. In this case, the worst case noise pollution scenario is obtained by assuming a line source rather than a point source. Specifically, the following assumptions are made for modeling purpose:

(i) Four line sources are considered for sound propagation modeling, namely: each side of the rectangle in figure 1b constitutes a line source. The source strength for each line is estimated using equation 1 below to obtain

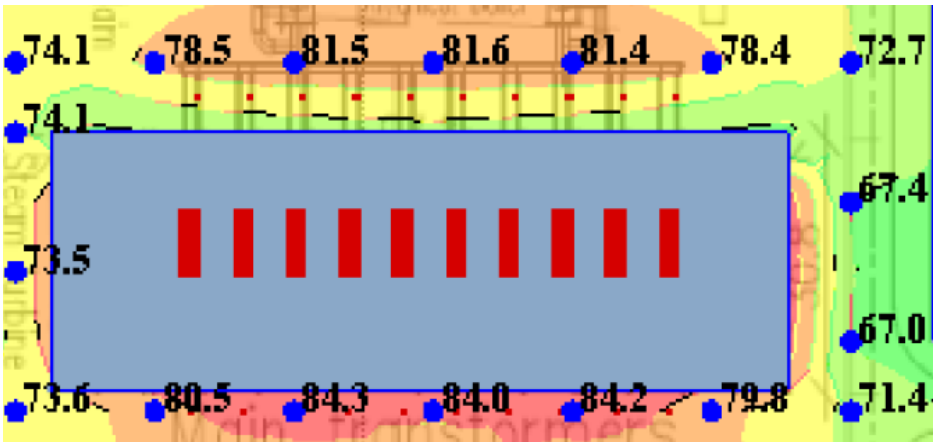

Figure 1b: The Four Line Source Adopted for Modeling

Sound propagation is the computed from the rectangle outwards using equation 2. Thus the model input data is given by figure 2 below.

(ii) Assuming that the line is radiating in cylindrical form, the surface area of the cylinder is proportional to its radius. Sound intensity will therefore decrease directly with distance from a line source.

Since the surface area of a cylinder of radius r and length *l* is $2\pi rl$, it can be proved that the ratio of sound intensity level for two perpendicular distances R & r from the line is given by :

$$L_r - L_R = 10\log_{10}(R/r)$$

If R = 2r, then

$$L_r - L_{2r} = 10\log_{10}(2)$$
$$= 3dB \qquad \text{.....(2)}$$

Therefore, only 3 dB reduction of sound intensity is attained for a doubling of the distance from the line source. The noise levels are modeled by putting in cognizance the supplied information that is devoid of background noise.

Therefore, the supplied noise level data at each grid point within the central part of the plant (Figure 1b) is used to calculate the input data for simulating the noise levels around the plant. The maximum noise level along each line is adopted as the value for the given line source as follows:

Table 2a: Dimensions of the Line Sources

Side of rectangle	Sound level (dB)
*R.H.S – Width	72.7
*L.H.S- width	74.1
Top – length	81.6
Bottom – length	84.3

*Right\Left Hand Side

The estimated background noise levels at each grid point within the central part of the plant, from the measured levels are tabulated in Tables 2b and 2c below.

Table 2b: Measured Background Noise Levels (Noon Time)

Side of rectangle	Sound level (dB)
*R.H.S – Width	54
*L.H.S- width	73
Top – length	52
Bottom – length	51

*Right\Left Hand Side

Table 2c: Measured Background Noise Levels (Afternoon)

Side of rectangle	Sound level (dB)
*R.H.S – Width	42
*L.H.S- width	43
Top – length	41
Bottom – length	44

*Right\Left Hand Side

Consequently, the following four scenarios are simulated assuming sound propagation from the four line sources under the stated conditions:

(a) Using only supplied noise level data and assuming zero background noise (Scenario 1)

(b) Using supplied noise level data and assuming noon time background noise of 73 dB (Scenario 2)

(c) Using supplied noise level data and assuming afternoon background noise of 43 dB (Scenario 3)

Using Equation 1 above, the cumulative source strengths of the three scenario as tabulated in Tables 2a, 2b and 2b produce noise levels in Table 3 below.

Table 3: Source Strengths for the Three Scenarios

Side of Rectangle	Sound level (dB)		
	Scenario 1	**Scenario 2**	**Scenario 3**
*R.H.S – Width	72.7	72.8	72.7
*L.H.S- width	74.1	76.6	74.1
Top – length	81.6	81.6	81.6
Bottom – length	84.3	84.3	84.3

It may be noted that scenarios 1 and 3 yield the same results.

4. SIMULATED NOISE LEVELS

4.1 Wind patterns

The prevailing wind speed influences the spatial distribution of noise from any source. The frequency distribution of wind speed and direction is analyzed using Frequency Wind Rose. The wind Roses for the period January 2010 to December 2010 illustrate the frequency of the prevailing wind speed and direction during each of the four seasons.

Figure 1 to Figure 12 show the Frequency Wind Roses computed using hourly gridded model data for the location of the plant within the meteorological model domain. Wind roses typically show the frequency of wind direction at a single location on a 16-point compass over an extended period of time. In addition, rings are plotted that represent the wind speed frequency for seven wind speed classes identified by color. The wind rose can be helpful in projecting the spread of noise from the line source.

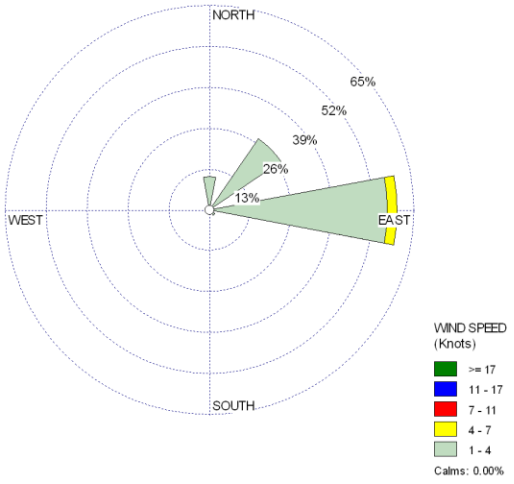

Figure 1 Wind Rose for January 2010

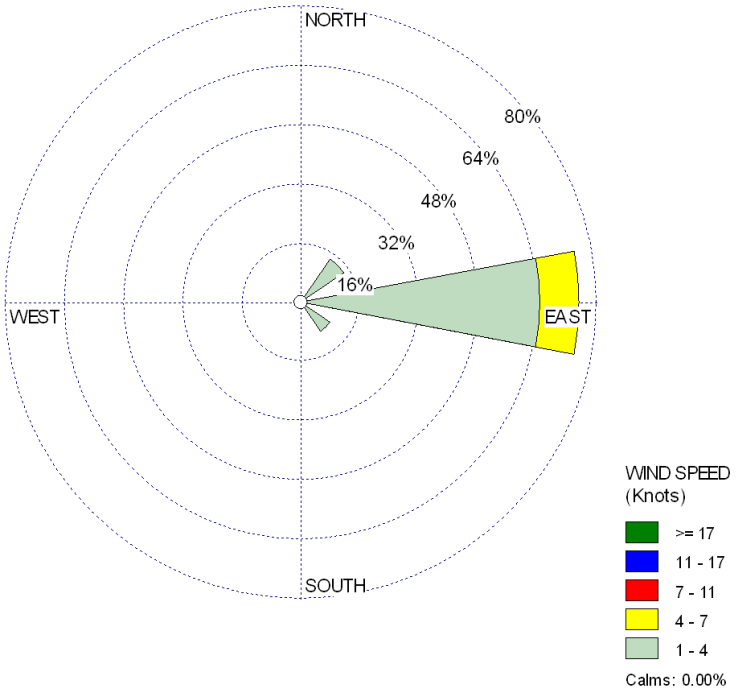

Figure 2 Wind Rose for February 2010

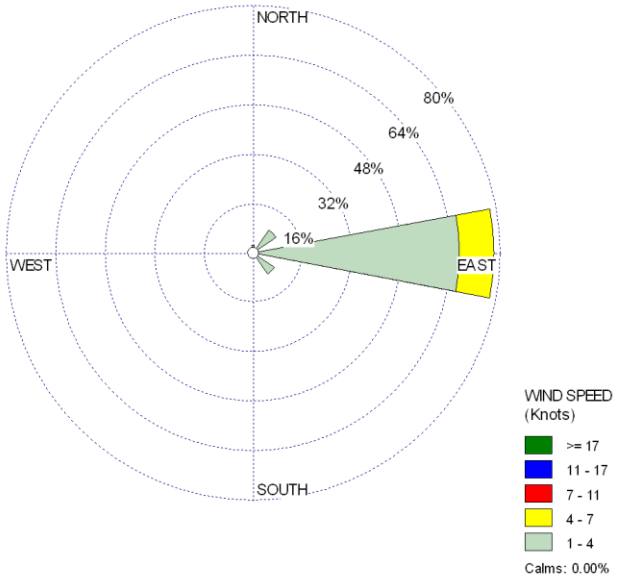

Figure 3 Wind Rose for March 2010

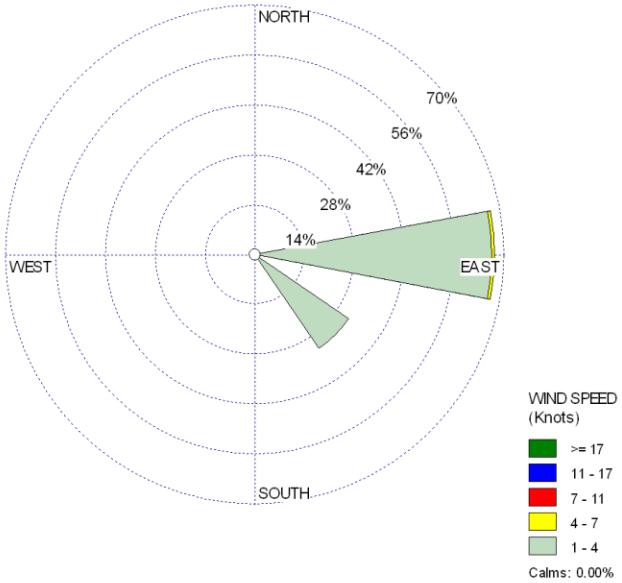

Figure 4 Wind Rose for April 2010

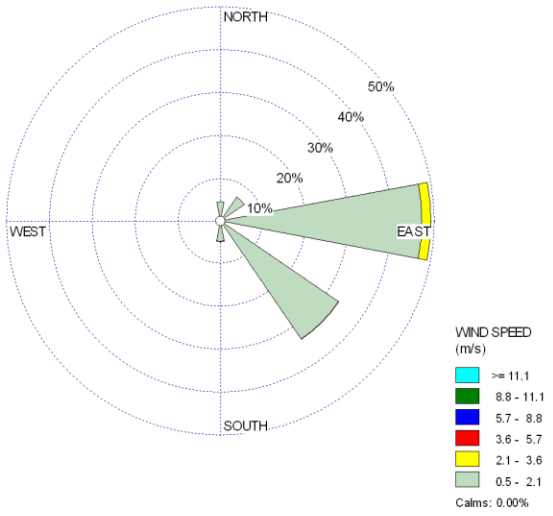

Figure 5 Wind Rose for May 2010

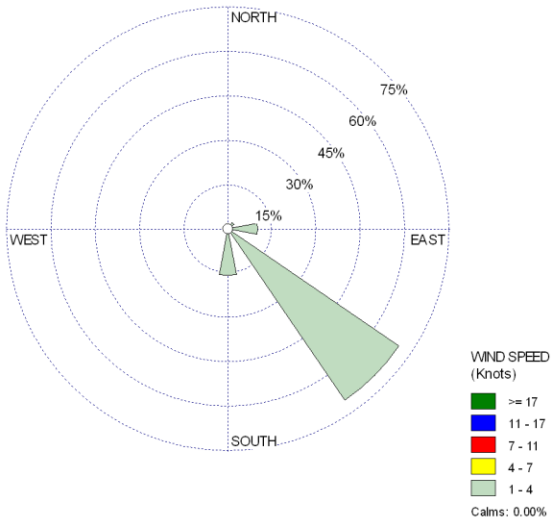

Figure 6 Wind Rose for June 2010

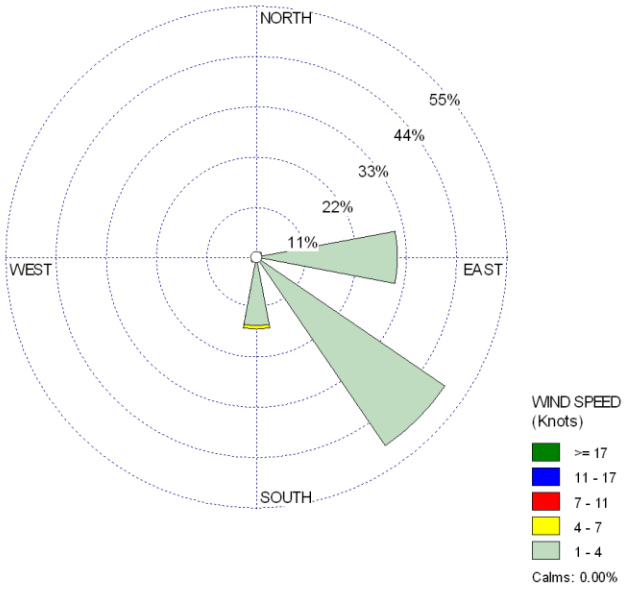

Figure 7 Wind Rose for July 2010

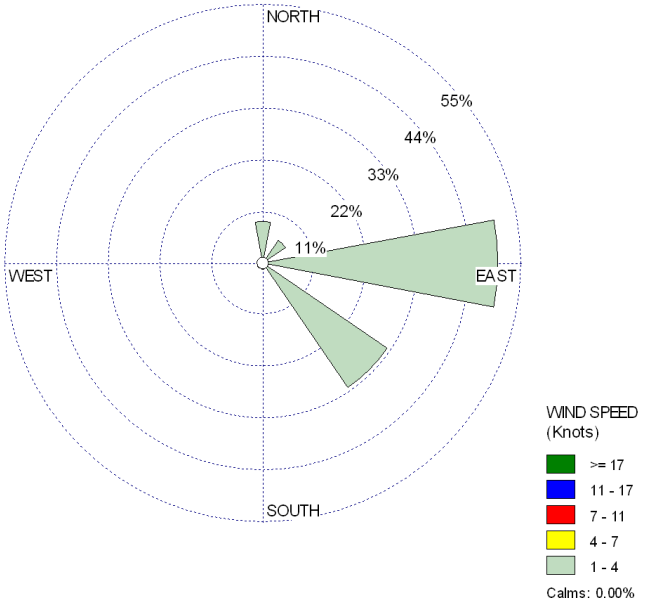

Figure 8 Wind Rose for August 2010

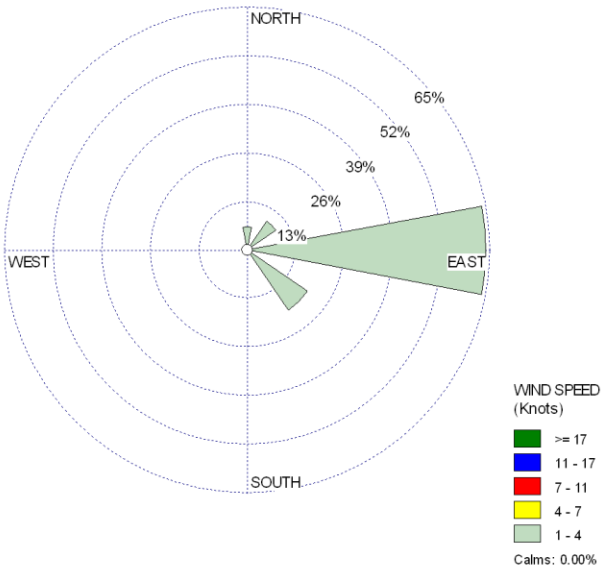

Figure 9 Wind Rose for September 2010

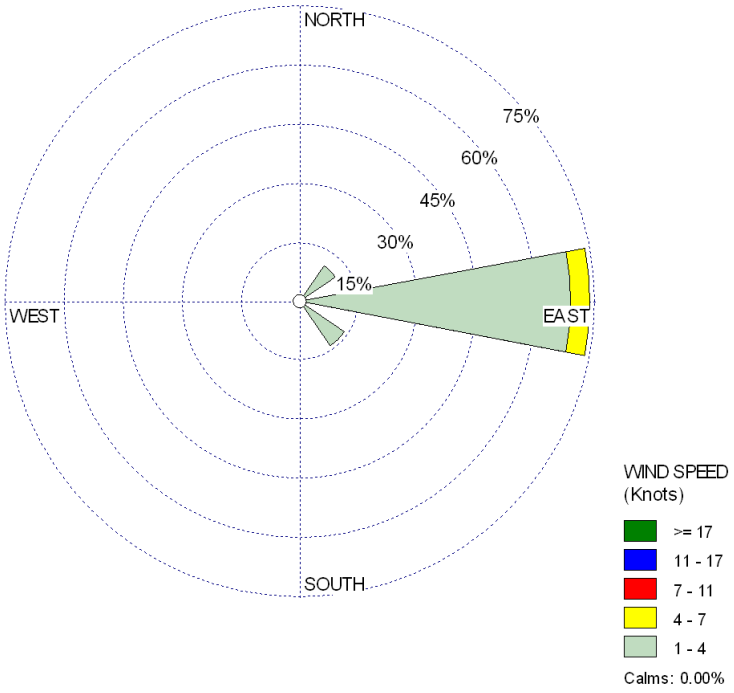

Figure 10 Wind Rose for October 2010

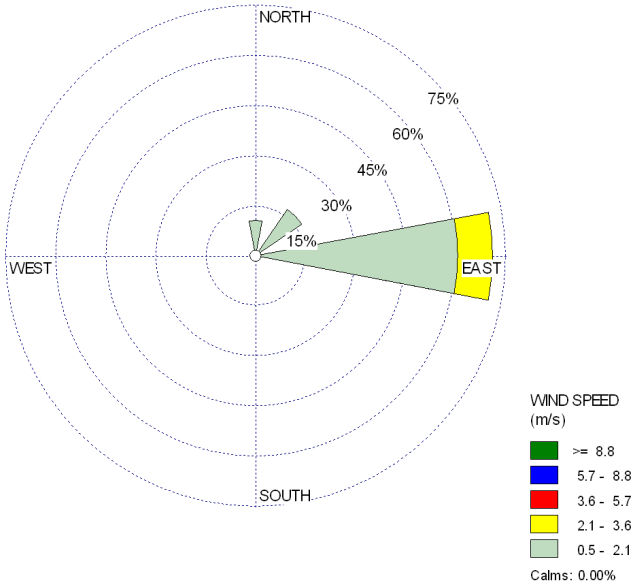

Figure 11 Wind Rose for November 2010

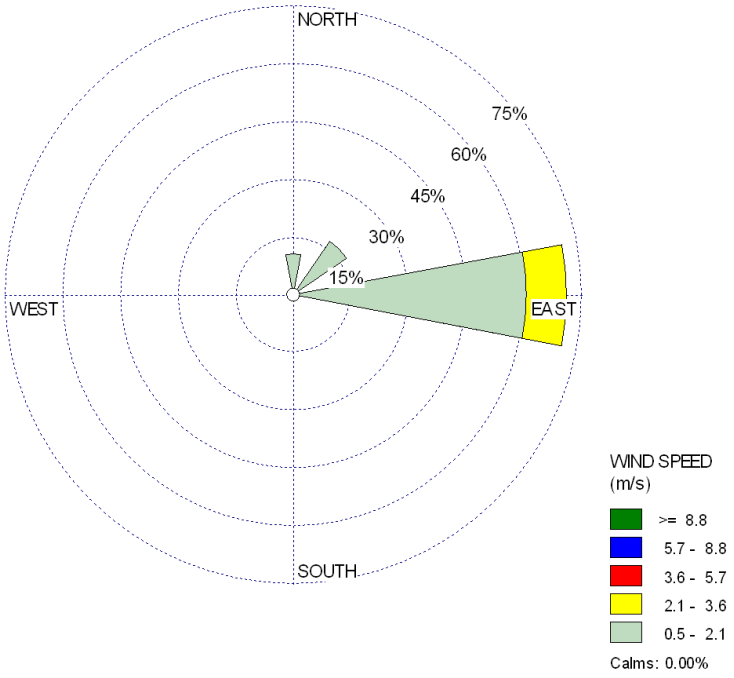

Figure 12 Wind Rose for December 2010

The information in Figures 1 to 12 may be summarized as in Table 4.

Table 4: Frequency of the prevailing wind at the proposed site

Season	**Prevailing Wind Direction**	**Prevailing Wind Speed**
Short rains	ESE	1-3.6 m/s
Hot	ENE	1-3.6 m/s
Long rains	ESE	1-3.6 m/s
Cold	ESE	1-2.1 m/s

It may be noted that the eastern sector of the proposed plant will experience less noise pollution in view of the prevailing wind direction for all the four seasons.

4.2 Noise level simulations

The net noise level is simulated using equation (1) above for all the three scenarios using the following consideration and assumptions:

(i) The noise levels are reduced by 3 dB upon doubling of distance (equation 2)

(ii) The points S1, S2,….S8, are assumed to be perpendicular to the respective line sources

(iii) The calculated noise levels for scenarios 1, 2 and 3 are interpolated after 256 m (See Table7 in Annex 1). Linear interpolation is assumed in this case.

It is observed from Table 5 the noise levels are within the limits at all measurement points apart from S1.

Table 5 Simulated Noise Levels

Sampling Point	ΔX (m)	ΔY (m)	Distance From S1 (m)	Distance From Line Source	Noise Levels at Line Source	Max. Baseline Noise Levels at Point	Baseline + Plant Noise at Point
S1	0	0	0	0	81.6	73	82.2
S2	254	106	275	225	78.4	52	52.7
S3	144	263	300	280	81.6	51	51.3
S4	-158	295	335	315	81.6	50	50.1
S5	-471	58	475	425	73.25	54	54.0
S6	-452	-189	490	440	73.6	51	51.0
S7	-117	292	315	295	73.6	51	51.0
S8	310	-298	430	410	84.5	53	53.0

In scenario 2 (Table 6), when the highest day time background noise of 73 dB is added to the projected sound levels, the situation worsens as compared to the scenario 1 and 3.

In summary, the simulated noise levels at the 8 measured points (Figure 12, Table 5) are tabulated below for the three scenarios. These values are calculated using Equation 1 and 2 above. Computed noise levels at other points are presented in the Annex 1

Table 6: Simulated Noise Levels at the Noise Monitoring Points

Site Number	Background Sound		Sound level: Scenarios 1 and 3	Sound level: Scenario 2
	Min.	Max.		
S1	43	73	81.6	82.2
S2	43	52	51.18	54.6
S3	44	51	54.08	55.8
S4	43	50	53.67	55.2
S5	42	54	43.68	54.4
S6	41	51	43.86	51.8
S7	41	51	45.91	52.2
S8	42	53	55.46	57.4

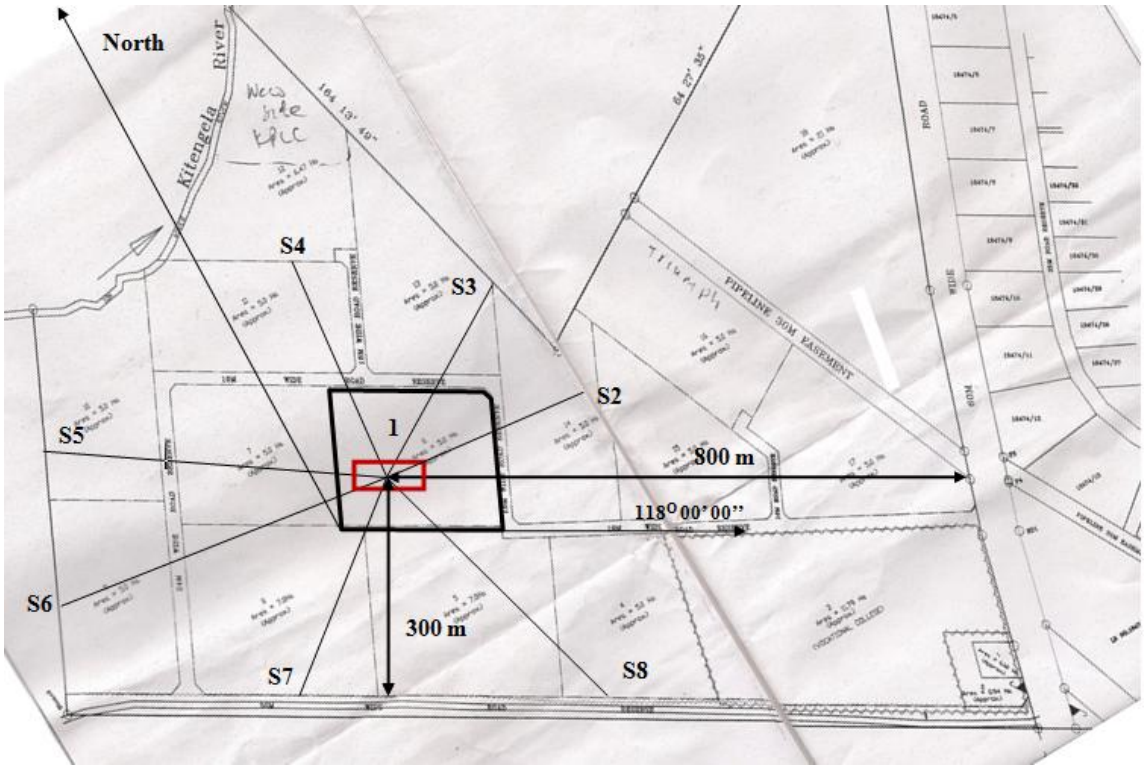

Figure 12 Location of Noise Monitoring Points

5. CONCLUSION

The spatial noise distribution meets the Kenyan Regulatory Noise standards within the environs of the facility. However, within the facility vicinity the noise levels may occasionally approach the limits especially under stable atmospheric conditions at night. This would require the necessary mitigation measures such as construction of noise barriers to help reduce the relatively elevated noise levels in the proximity of the plant.

ANNEX 1

The monitoring positions are shown in the following figure. The corresponding noise levels are given in Tables 7 and Table 8.

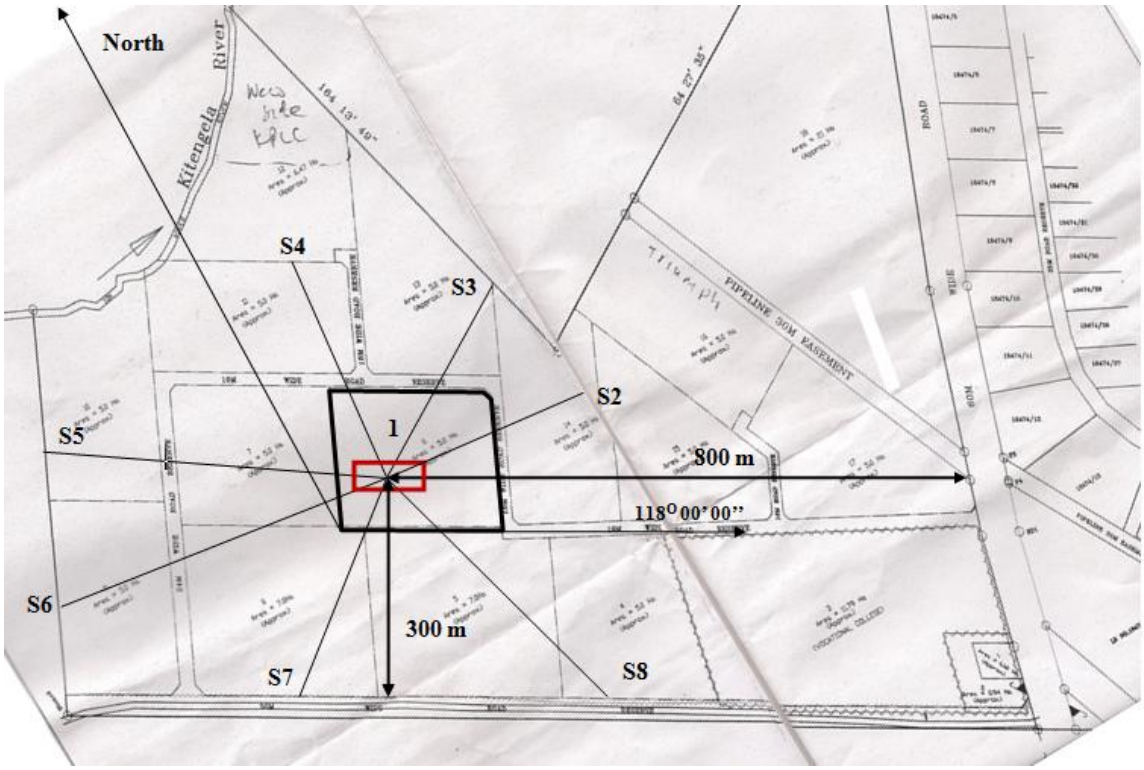

Table 7: Calculated Noise Levels at Various (Doubled) Distances Using Equation 2

	Noise levels (dB) at various distances from source (with respect to equation 2)										
	0	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**128**	**256**	**512**
S1	81.6	78.6	75.6	72.6	69.6	66.6	63.6	60.6	57.6	54.6	51.6
S2	78.4	75.4	72.4	69.4	66.4	63.4	60.4	57.4	54.4	51.4	48.4
S3	81.6	78.6	75.6	72.6	69.6	66.6	63.6	60.6	57.6	54.6	51.6
S4	81.6	78.6	75.6	72.6	69.6	66.6	63.6	60.6	57.6	54.6	51.6
S5	73.3	70.3	67.3	64.3	61.3	58.3	55.3	52.3	49.3	46.3	43.3
S6	73.6	70.6	67.6	64.6	61.6	58.6	55.6	52.6	49.6	46.6	43.6
S7	73.6	70.6	67.6	64.6	61.6	58.6	55.6	52.6	49.6	46.6	43.6
S8	84.5	81.5	78.5	75.5	72.5	69.5	66.5	63.5	60.5	57.5	54.5

Table 8: Calculated Noise Levels At Various (Doubled) Distances Using Equation 1

	Distance From Line Source	Interpolated Noise Level (Scenario1)	Max Background Noise	Baseline + Plant Noise at Point
S1	0	81.6	73	82.2
S2	275	51.18	52	54.6
S3	300	54.08	51	55.8
S4	335	53.67	50	55.2
S5	475	43.68	54	54.4
S6	490	43.86	51	51.8
S7	315	45.91	51	52.2
S8	430-	55.46	53	57.4

Appendix 3.3 Air Quality Simulations

AIR QUALITY SIMULATIONS

1. Scope of Study

The site will be required to comply with various air pollution limits, which are discussed below. This assessment aims to model existing source strength and to predict boundary air pollution levels before and after the proposed extension to verify compliance with the limits, and to provide the operator with air pollution maps of the site and adjoining land area within a radius of 20 km.

2. ASSESSMENT CRITERIA

2.1 World Health Organization

In the World Bank/IFS document '**Environmental, Health and Safety guidelines for thermal power plant 2008**, guideline limit values for in reducing the health impacts of air pollution specific environments are provided. Levels below the limits are considered necessary to minimize any temporary or long term adverse health effect attributable to exposure to the air pollutants. The values form the basis of many international environmental air quality limits and are summarized in Table 1, below.

Table 1: World Bank Emission Limits for Diesel Driven Thermal Power Plants

Combustion Technology / Fuel	Particulate Matter (PM)	Sulphur Dioxide			Nitrogen Oxides (NOx)		Dry Gas, Excess O2 Content (%)
Reciprocating Engine	NDA	DA	NDA	DA	NDA	DA	
Liquid Fuels (Plant >50 MWth to <300 MWth)	50	30	1,170 or use of 2% or less S fuel	0.5% S	1,460 (Compression Ignition, bore size diameter [mm] < 400) 1,850 (Compression Ignition, bore size diameter [mm] ≥ 400) 2,000 (Dual Fuel)	400	15%

General notes:
- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; S = sulfur content (expressed as a percent by mass); Nm^3 is atone atmospheric pressure, 0 degree Celsius; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack. Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- (a) Compression Ignition (CI) engines may require different emissions values which should be evaluated on a case-by-case basis through the EA process.

Source: Table 6 (A) - Emissions Guidelines (in mg/Nm^3) Environmental, Health, and Safety Guidelines for Thermal Power Plants (World Bank, 2008)

3. METHODOLOGY

3.1 Input Emissions Data

SO_2 - 1170 mg/m^3 (World Bank Emission Limits, 2008)

NO_2 - 1850 mg/m^3 (World Bank Emission Limits, 2008; for bore size $\geq$ 400 mm emission which is more conservative than for bore size $\leq$ 400 mm)

Particulate Matter (PM)= 50 mg/m^3 (World Bank Emission Limits, 2008)

Hydro carbons 180 ppm v/v = 143 mg/m^3

CO - 350 ppm v/v = 432 mg/m^3

3.2 Air pollution Model

3.2.1 Model Description

HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model, the computer-based air pollution modeling package used for Modeling can provide an accurate representation of air pollution levels. The HYSPLIT is a system for computing both simple air parcel trajectories and complex dispersion and deposition simulations. In this case the model calculation method is a hybrid between the Lagrangian approach, which uses a moving frame of reference as the air parcels move from their initial location, and the Eulerian approach, which uses a fixed three-dimensional grid as a frame of reference.

The pollutant concentrations are calculated on a fixed grid. Simulation output results are complex air concentration contour patterns.

Calculations are performed on archive meteorological data from the runs the Global Data Assimilation System (GDAS) ran by United States National Weather Service's National Centers for Environmental Prediction (NCEP) . The GDAS is run 4 times a day, ie, at 00, 06, 12, and 18 UTC. Model output is for the analysis time and 3, 6, and 9-hour forecasts. NCEP post-processing of the GDAS converts the data from spectral coefficient form to 1 degree latitude-longitude (360 by 181) grids and from sigma levels to mandatory pressure levels. Model output is in GRIB format. The archive data file contains the data in synoptic time sequence, without any missing records. Therefore it is possible to position randomly to any point within a data file. Each file contains data for one week except for files containing data past the 28th of the month.

3.2 Wind and Atmospheric stability simulations

Wind and atmospheric stability are the most crucial for air quality modeling. Each one of them is discussed separately.

3.2.1 Atmospheric stability.

The tendency of the atmosphere to resist or enhance vertical motion and thus turbulence is termed **stability**. Stability is related to both the change of temperature with height (the lapse rate) and wind speed. A neutral atmosphere neither enhances nor inhibits mechanical turbulence. An unstable atmosphere enhances turbulence, whereas a stable atmosphere inhibits mechanical turbulence. The turbulence of the atmosphere is by far the most important parameter affecting dilution of a pollutant; the more unstable the atmosphere, the greater the dilution.

Three hourly average stability classes, for the period January 2009 to December 2010, are defined for different meteorological situations, characterized by wind speed and solar radiation (during the day) and cloud cover during the night. The so called Pasquill Pasquill, 1961.The Pasquill stability classes and the Pasquill-Gifford (PG) classes for fluctuations in wind direction and the vertical temperature gradient are tabulated below.

Table 2: Pasquill Stability Classes

A: Extremely unstable conditions	D: Neutral conditions
B: Moderately unstable conditions	E: Slightly stable conditions
C: Slightly unstable conditions	F: Moderately stable conditions
G: Extremely Stable	

Table 3: Meteorological Conditions Defining Pasquill Stability Classes (PSC).

	Daytime Insolation			**Night-time conditions**	
Surface wind speed (m/s)	**Strong**	**Moderate**	**Slight**	**Thin overcast or > 4/8 low cloud**	**<= 4/8 cloudiness**
< 2	A	A – B	B	E	F
2 – 3	A – B	B	C	E	F
3 – 5	B	B – C	C	D	E
5 – 6	C	C – D	D	D	D
> 6	C	D	D	D	D

Source: Pasquill, 1961.

NOTES:

a) Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.
b) Night refers to the period from 1 hour before sunset to 1 hour after sunrise.
c) The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

Table 4: PG Classes for Fluctuations in Wind Direction and the Vertical Temperature Gradient.

Pasquill Class	Sigma Theta (degrees)	Delta T/Delta Z (Deg C/100 m)
A	25	-1.9
B	20	-1.9 to -1.7
C	15	-1.7 to -1.5
D	10	-1.5 to -0.5
E	5	-0.5 to 1.5
F	2.5	1.5 to 4.0
G	1.7	>4.0

All the computed PSC values for the two years are tabulated in Annex 1 below.

The frequency distribution of the stability classes for the two years is established with a view to determining the month with the highest frequency of Stability classes E, F and G (stable conditions). In this way, the worst case scenario of air pollution dispersion and deposition can be understood.

3.2.2 Wind

Wind circulation patterns also affect the transport and dilution of air pollutants. The Site of the proposed power plant is characterized by four weather seasons (Table 5) which dictate the dispersion and transport of pollutant patterns over the site through the distinct wind pattern. Hourly wind speed and direction data, from Kenya Meteorological Department (KMD) and the GDAS, for the period January 2006 to December 2010 is analyzed. The hourly wind speed and direction frequency distributions are computed using WRPLOT software for generating wind rose.

Table 5: Seasons within the Study Area

Season	Months
Short rains Season	September – Nov (SON)
Hot season	Dec. – Feb (DJF)
Long rains	March - May (MAM)
Cold season	June – Aug. (JJA)

3.2 DISPERSION CALCULATION

The Hysplit model is a hybrid technique to compute pollution dispersion using both Langrangian and Eulerian approaches. A Lagrangian model can compute air concentrations through either of two assumptions. In a puff model, the source is simulated by releasing pollutant puffs at regular intervals over the duration of the release. Each puff contains the appropriate fraction of the pollutant mass. The puff is advected according to the trajectory of its center position while the size of the puff (both horizontally and vertically) expands in time to account for the dispersive nature of a turbulent atmosphere. In a Lagrangian particle model, the source can be simulated by releasing many particles over the duration of the release. In addition to the advective motion of each particle, a random component to the motion is added at each step according to the atmospheric turbulence at that time. In this way a cluster of particles released at the same point will expand in space and time simulating the dispersive nature of the atmosphere. In a homogeneous environment the size of the puff (in terms of its standard deviation) at any particular time should correspond to the second moment of the particle positions.

An hybrid approach is incorporated into this version of the model, in which the calculation uses particle dispersion in the vertical direction and puff dispersion in the horizontal. This approach was adopted for the air quality modeling. The stability and mixing coefficients were the then computed from the meteorological data.

The source term and runtime parameters were configured as illustrated in Table 6 below. It should be noted that a stack height of 65 m was used. This is captured in the table as the release top and release bottom. A continuous source configuration was adopted by ensuring that the release duration and total duration were equal.

The standardized volume of emission rates for a fuel burn of 4.4kg/s (which is c.185MWth input) was computed as 160.4 Nm3/s. Using the WB/IFC Limit emission limits (Table 1), the mass emission rates for SO_2, NO_2 and particulate matter were computed (Table 6).

Table 6: Source Strengths for Simulations

Substance	Emission Rate (g/s)
SO_2	187.7
NO_2	296.7
PM	88
HC	143
CO	432

4. BACKGROUND AIR POLLUTION CLIMATE

The measured background pollution levels are to be very low.

5 SIMULATED AIR POLLUTION LEVELS

5.1 Wind patterns

Analysis of wind speed and direction in performed using Frequency Wind Rose. Wind roses typically show the frequency of wind direction at a single location on a 16-point compass over an extended period of time. In addition, rings are plotted that represent the wind speed frequency for seven wind speed classes identified by color. The wind rose can be helpful in predicted when conditions might be favorable for poor air quality episodes at the location given that certain wind directions and speeds transport more pollutants to an area than other wind directions and speeds. Figure 1 below is the wind Rose representing the wind patterns for period January 2006 to December 2010. It illustrates the prevailing wind speeds and directions during the five years period. The wind is characterized by about 60% of easterly wind of speeds mainly varying within 1 t0 4 knots.

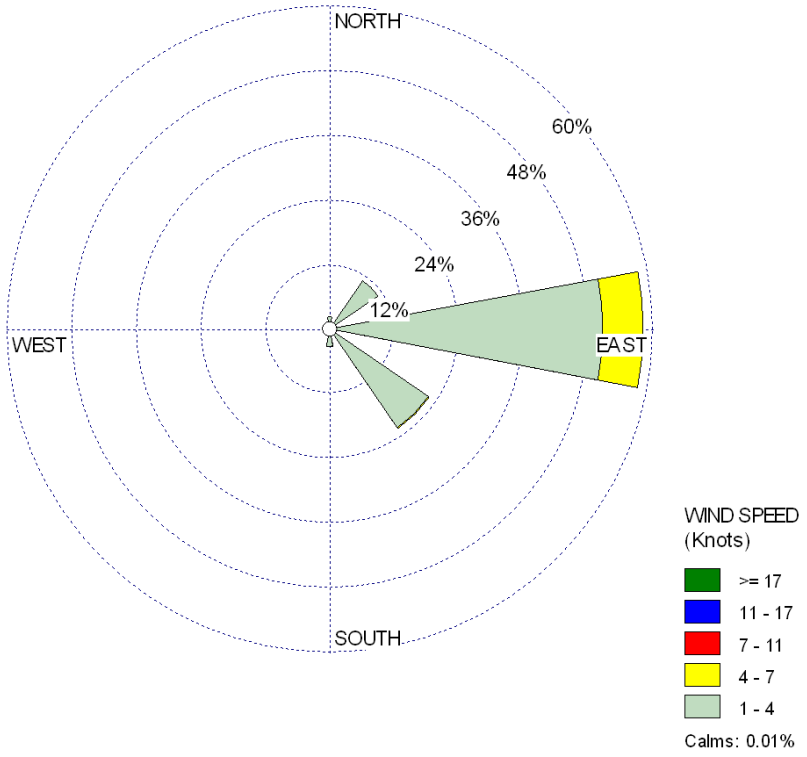

Figure 1: Wind Rose for January 2010 to December 2010

Figures 2 to 13 illustrate wind roses computed using hourly wind speed and direction for each month of the year, for the period 2006 to 2010. It may be observed from the wind roses that the plant will transport and disperse air pollutants generally westwards, and specifically to the Northwest and Southwest of the plant.

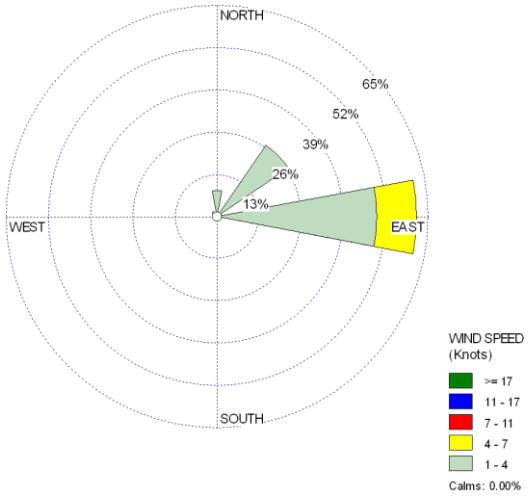

Figure 2 Wind Rose for January 2006- 2010

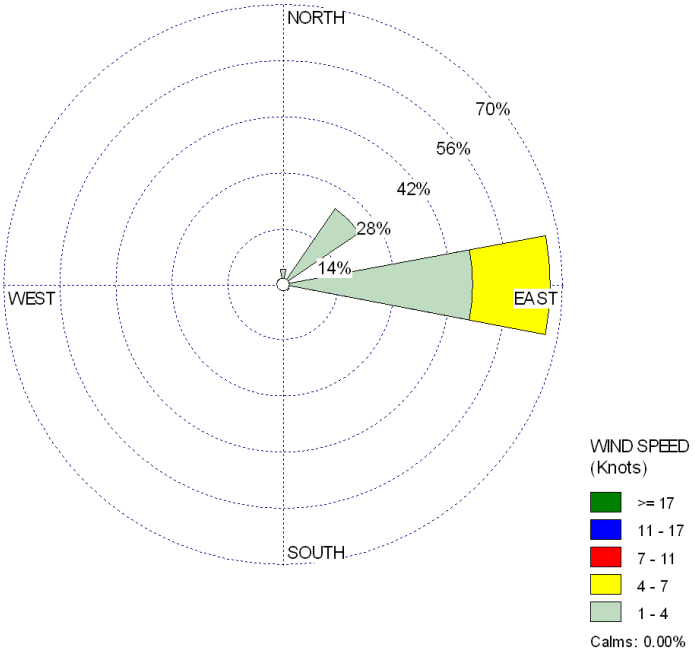

Figure 3 Wind Rose for February 2006- 2010

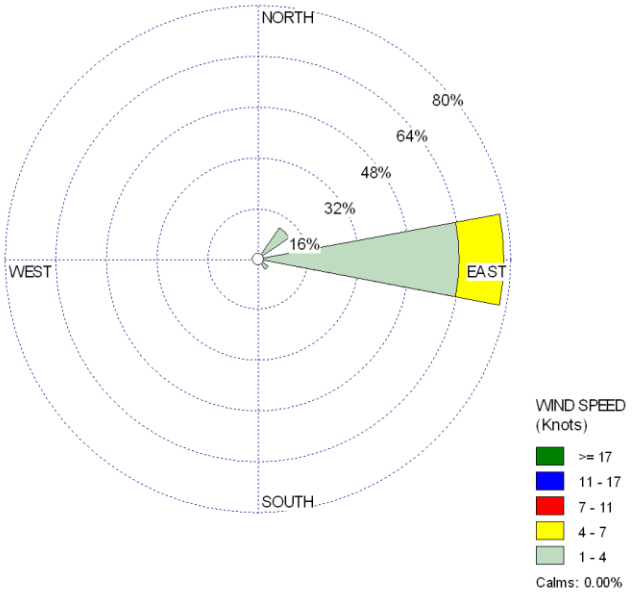

Figure 4 Wind Rose for March 2006-2010

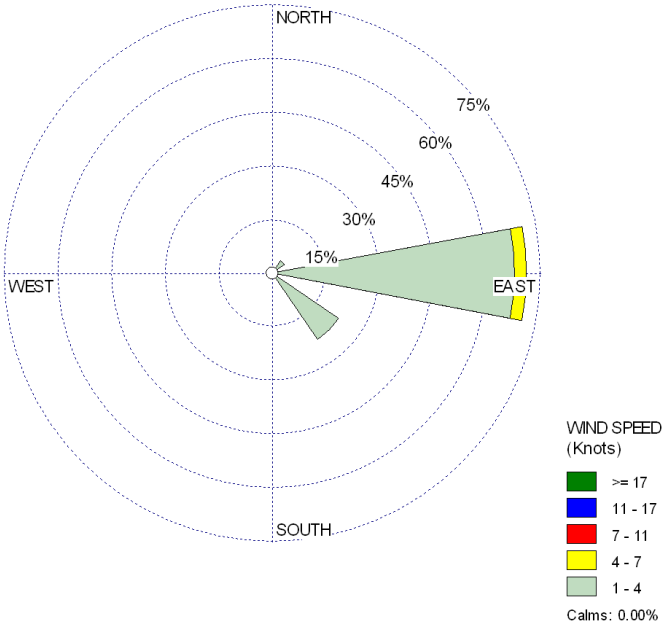

Figure 5: Wind Rose for April 2006-2010

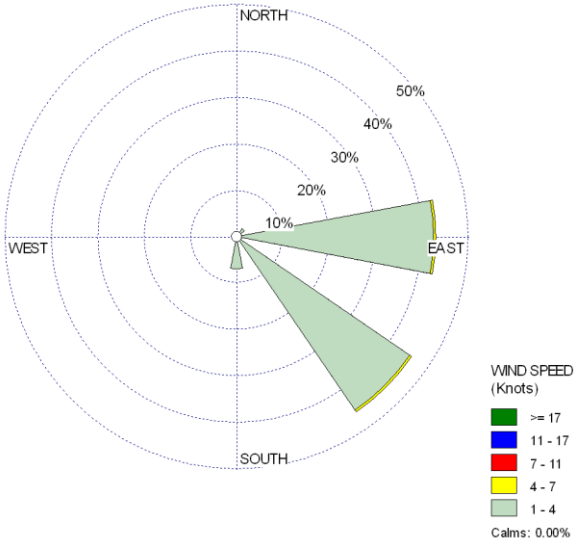

Figure 6: Wind Rose for May 2006-2010

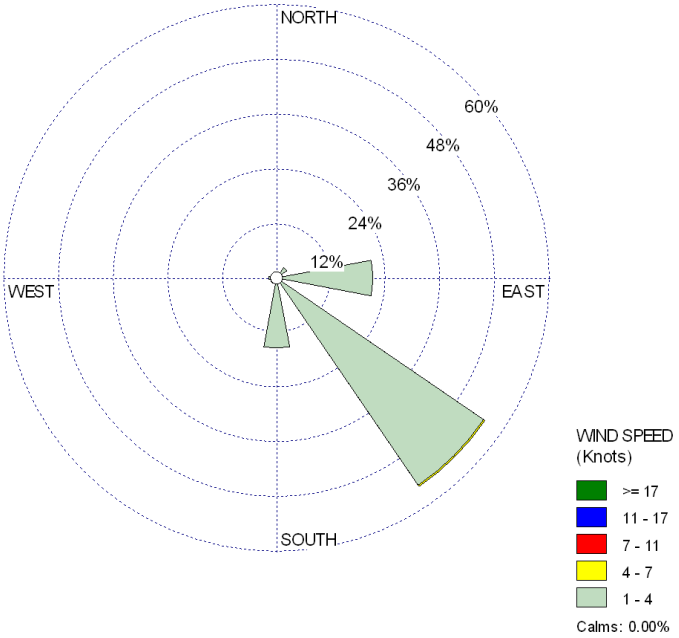

Figure 7: Wind Rose for June 2006-2010

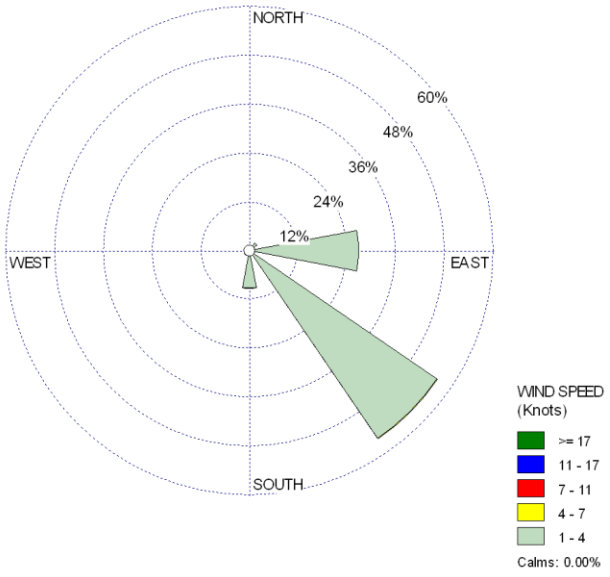

Figure 8: Wind Rose for July 2006-2010

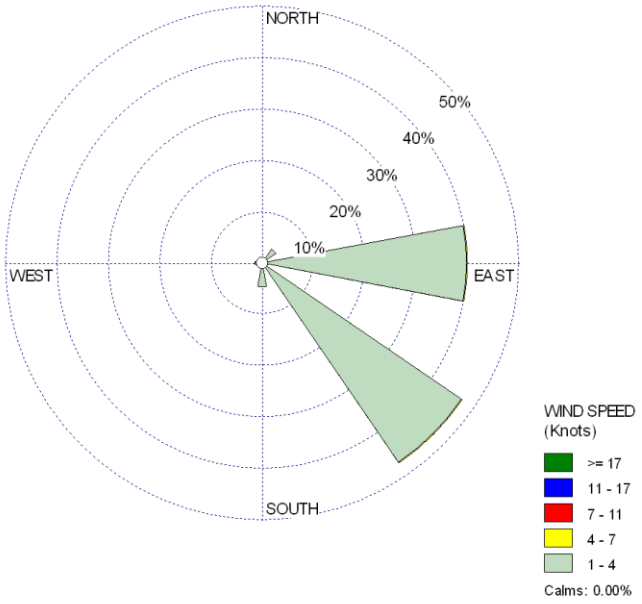

Figure 9: Wind Rose for August 2006- 2010

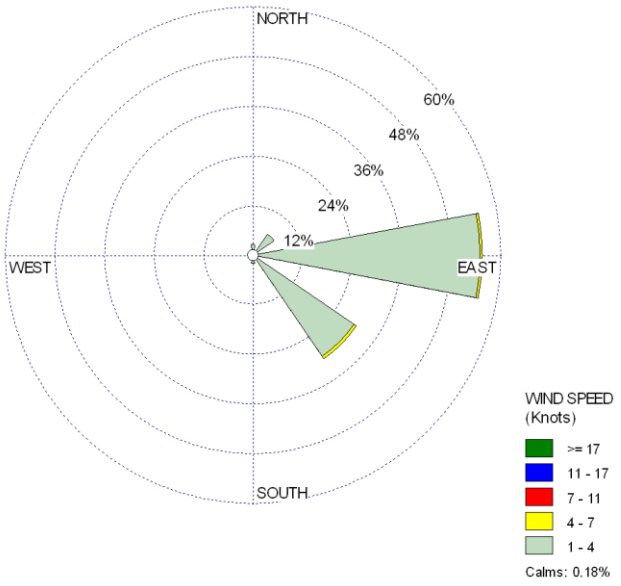

Figure 10: Wind Rose for September 2006-2010

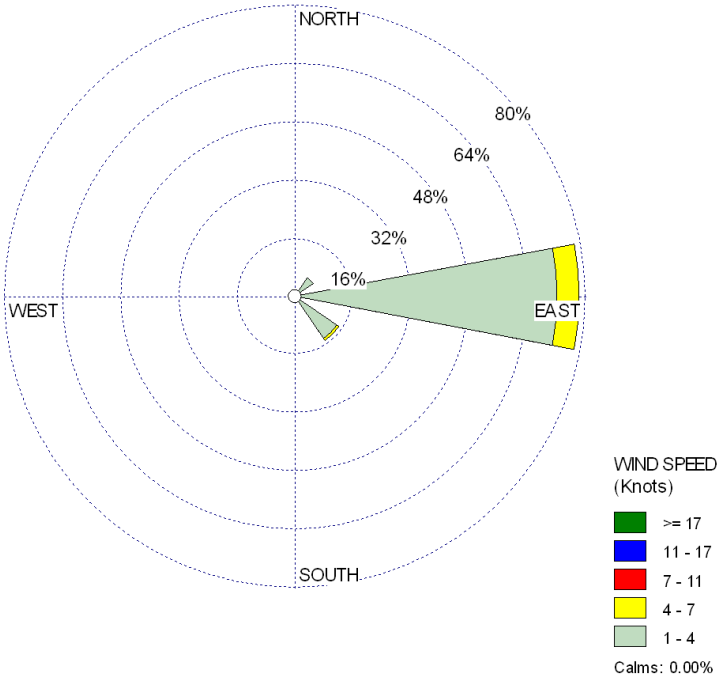

Figure 11: Wind Rose for October 2006- 2010

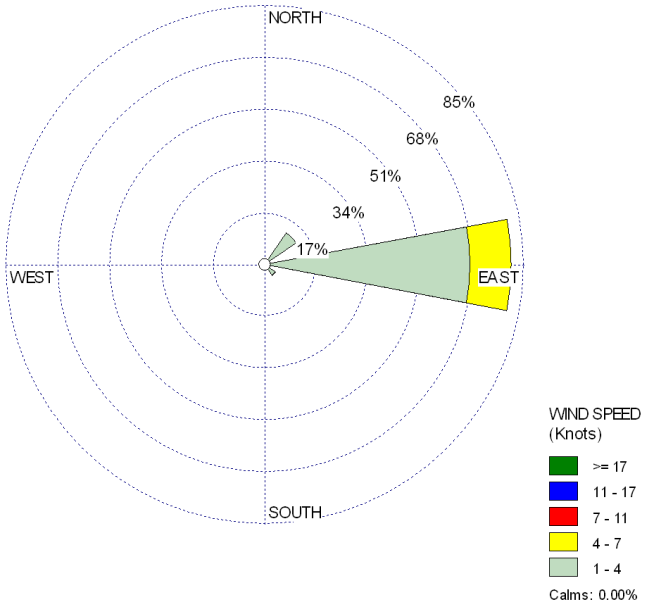

Figure 12: Wind Rose for November 2006- 2010

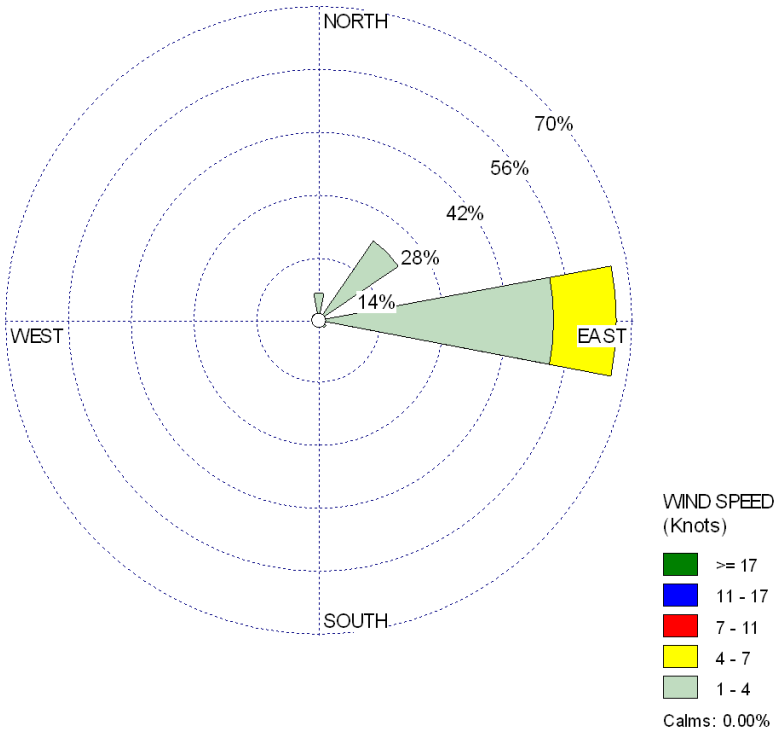

Figure 13: Wind Rose for December 2006- 2010

Figures 2 to 13 may be summarized as follows:

Table 7: Wind Rose analysis

Season	Prevailing wind direction (frequency)	Prevailing wind speed
Short rains	ESE	1-7 knots
Hot	ENE	1-7 knot
Long rains	ESE	1-7 knots
Cold	ESE	1-4 knots

It may be noted that the cold season has the lowest wind speeds. This implies that the pollution dilution is least during this season. Consequently, the worst pollution deposition levels would be expected during this season.

5.2 Stability analysis

Analysis of stability classes computed using the HYSPLIT software for the period January 2009 to December 2010 reveal that the frequency about 20 to 26% of the year is characterized by stable condition which favour poor dilution of atmospheric pollutants.

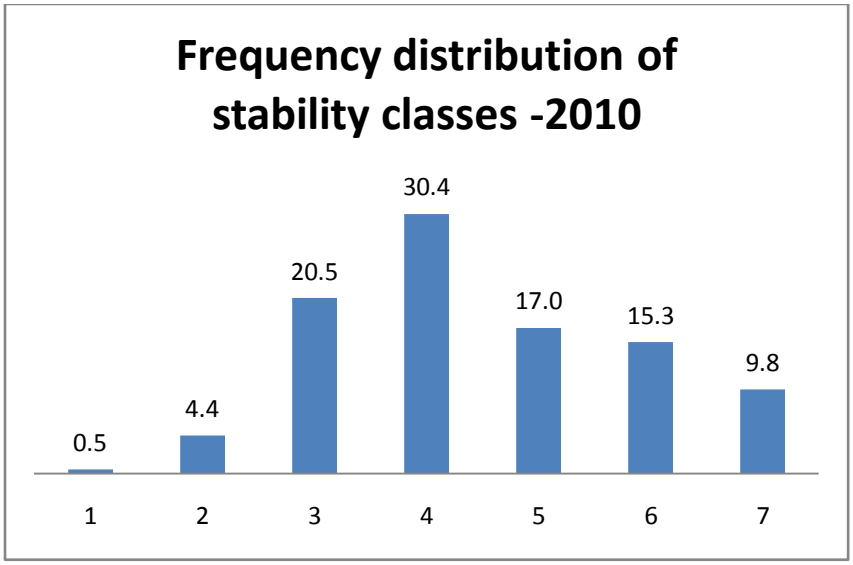

Figure 13a

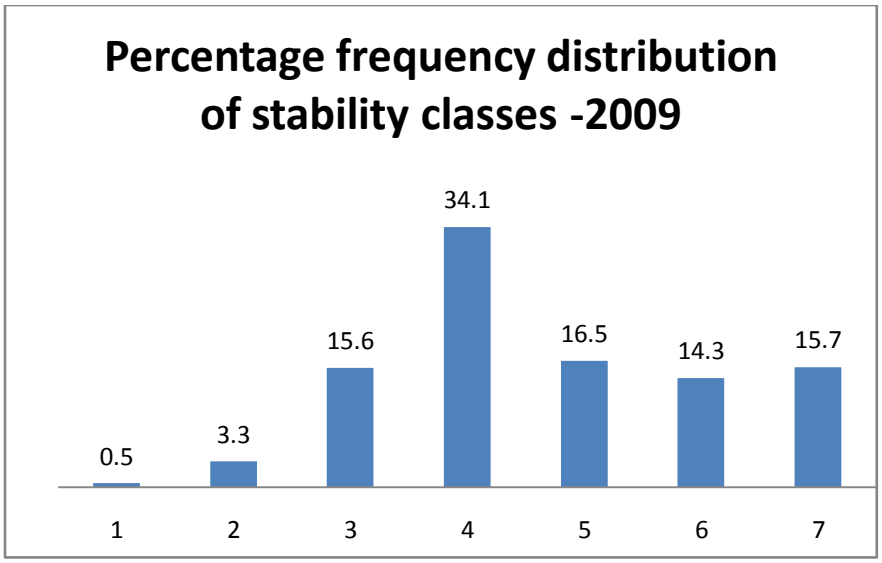

Figure 13b:

Figure13: Frequency distribution of stability classes for years 2009 and 2010

The extremely stable conditions only occur about 0.5% of the year. They occur during early morning when there is strong temperature inversion. This suggests that the plant should take mitigating measures during early mornings of particularly the cold seasons to minimize adverse effect of the pollution exposure to biological systems within the vicinity of the plant.

Analysis of extreme stability for the sake of establishing the worst case scenarios is performed by considering the temporal distribution of the hour with slightly stable, moderately stable, and extremely stable conditions. It is observed that the cold season has the highest frequency of stable conditions (Figures 14a and 14b). This confirms the observation made regarding the frequency wind rose analysis. It may therefore be noted that the cold season is potentially more hazardous for the air pollution deposition than the other seasons.

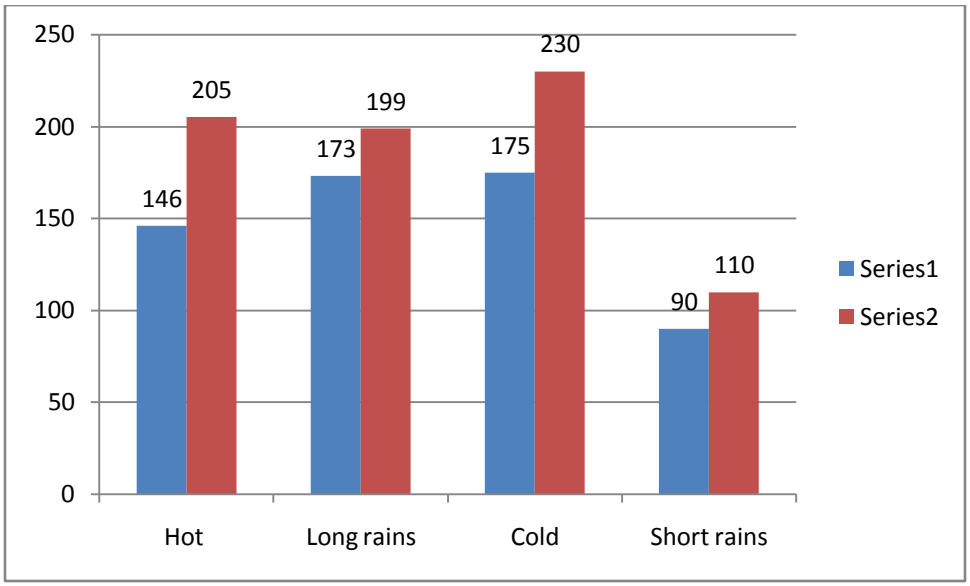

Figure 14a

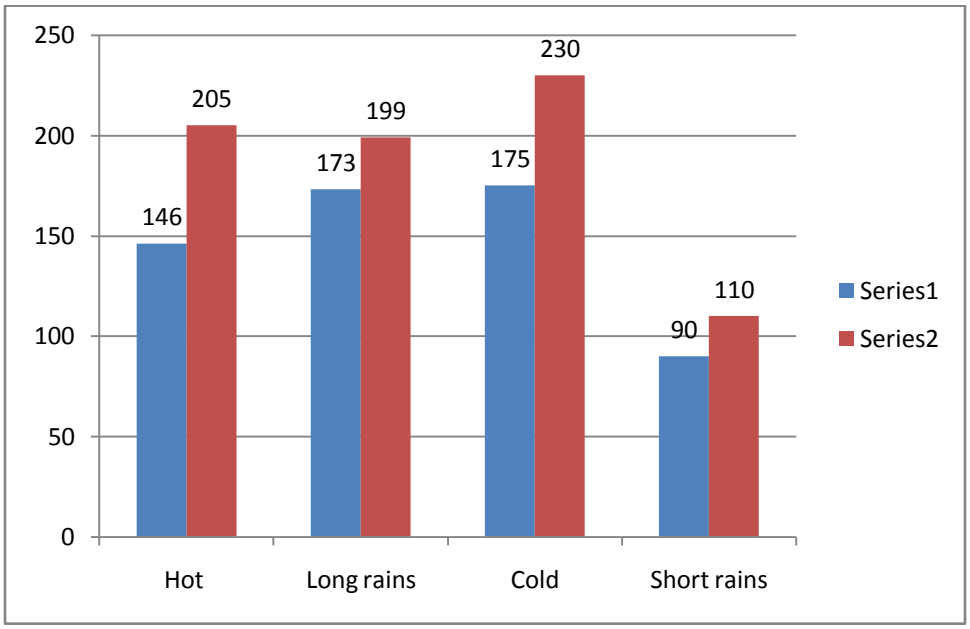

Figure 14b

Figure 14: Number of stable hours per month (a) and season (b). Series 1 is year for the 2009 and series is for the Year 2010.

It may be noted that there significant variability can occur within the season. For instance in 2010, May had the highest stable hours for the year. By scrutinizing the stability data it is evident that the dates 11th to 13th May were characterized by relatively many hours of stable conditions at night.

5.3 Air pollutants

The Table 8 below presents a summary of the results of the maximum level Centre line concentrations of the five pollutants. A complete set of the values is in the annex 2.

Table 8: Simulations of centre line concentrations downwind

Pollutant	Date	Centre line concentration (in µg/m^2) at the ground level downwind at a distance of:					
		500m	1km	5km	10km	15km	20km
SO_2	01 Jan 2006	$1x10^1$	$1x10^1$	$1x10^1$	$1x10^1$	$1x10^1$	$1x10^1$
NO_2	01 July 2010	$1x10^1$	$1x10^1$	$1x10^1$	$1x10^1$	$1x10^1$	$1x10^0$
PM	01 Dec 2007	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$
HC	01 April 2009	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$
CO	15 Aug 2008	$1x10^{-3}$	$1x10^{-3}$	$1x10^{-3}$	$1x10^{-3}$	$1x10^{-4}$	$1x10^{-4}$

Examples of the dispersion and transport of these pollutants is graphically illustrated by Figures 15a to 15d below.

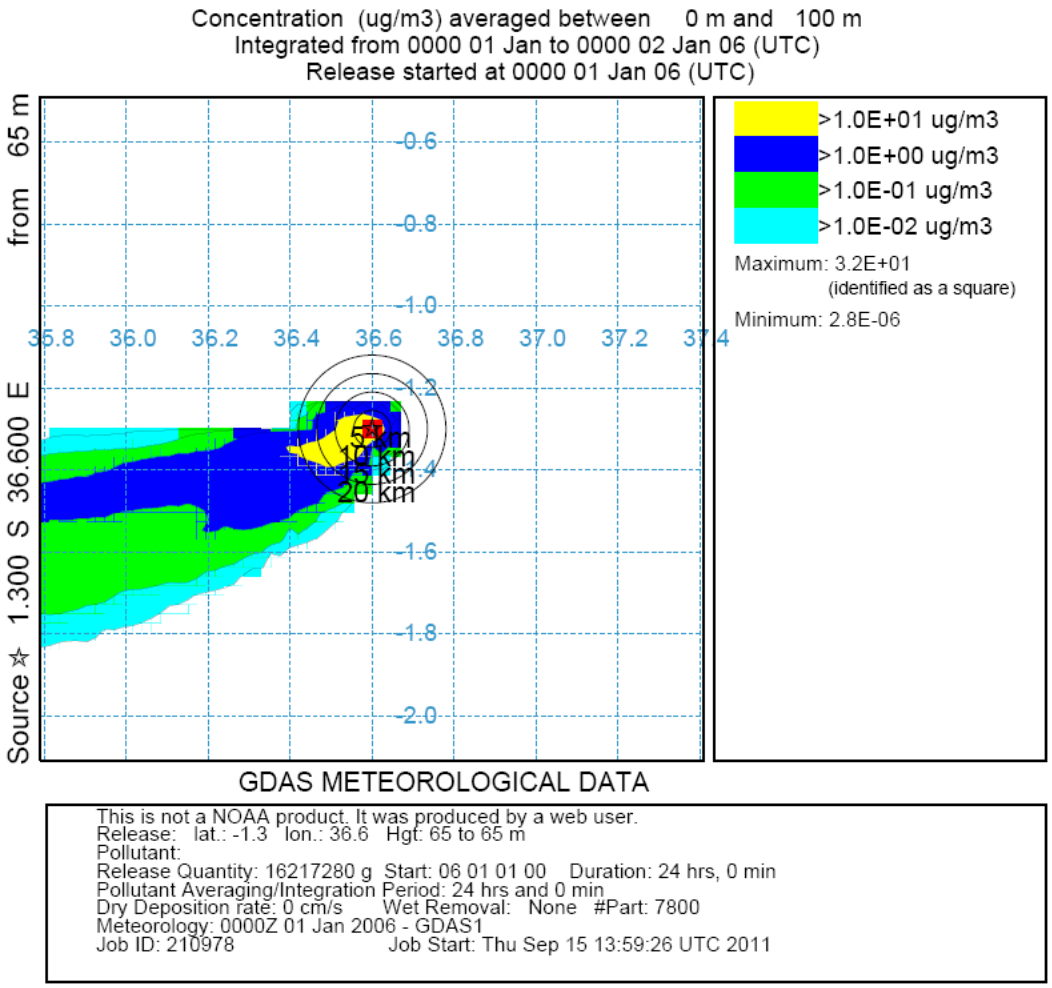

Figure 15a: SO_2

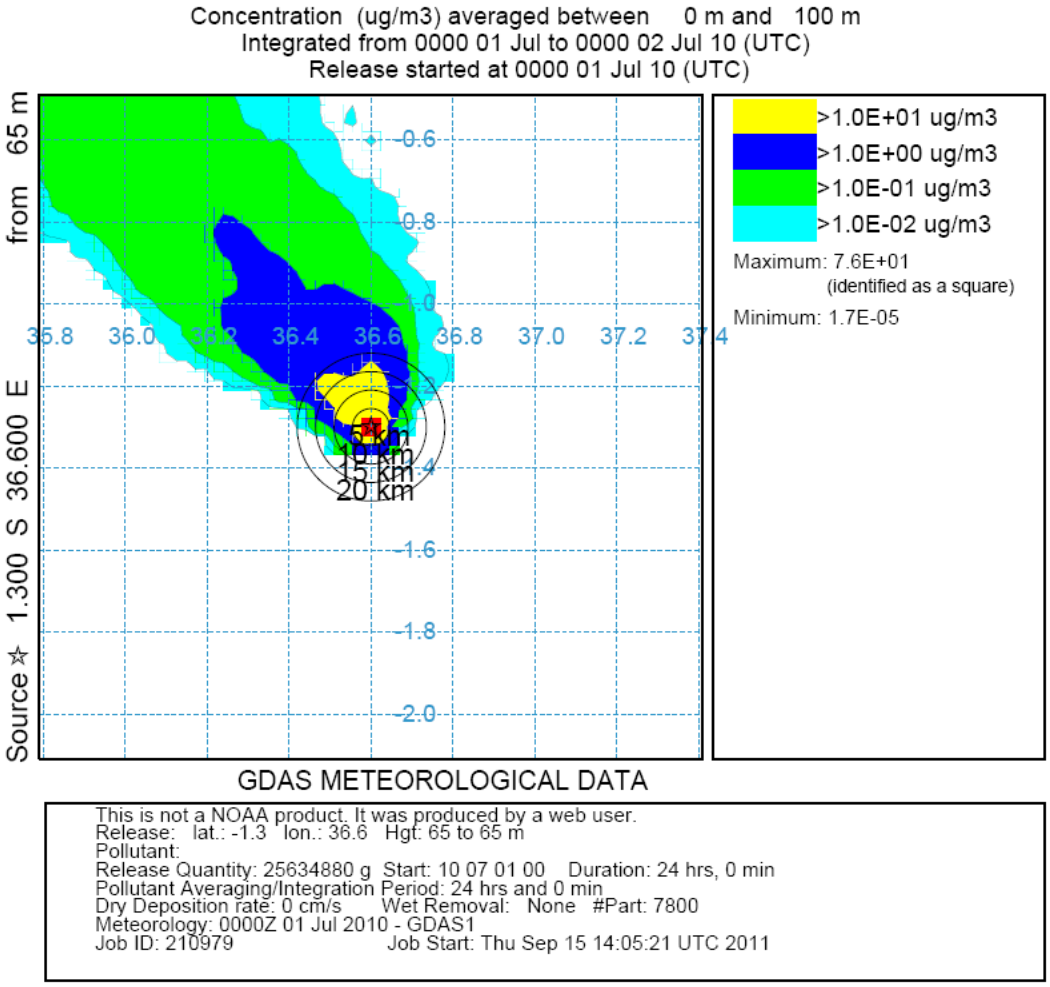

Figure 15b: NO_2

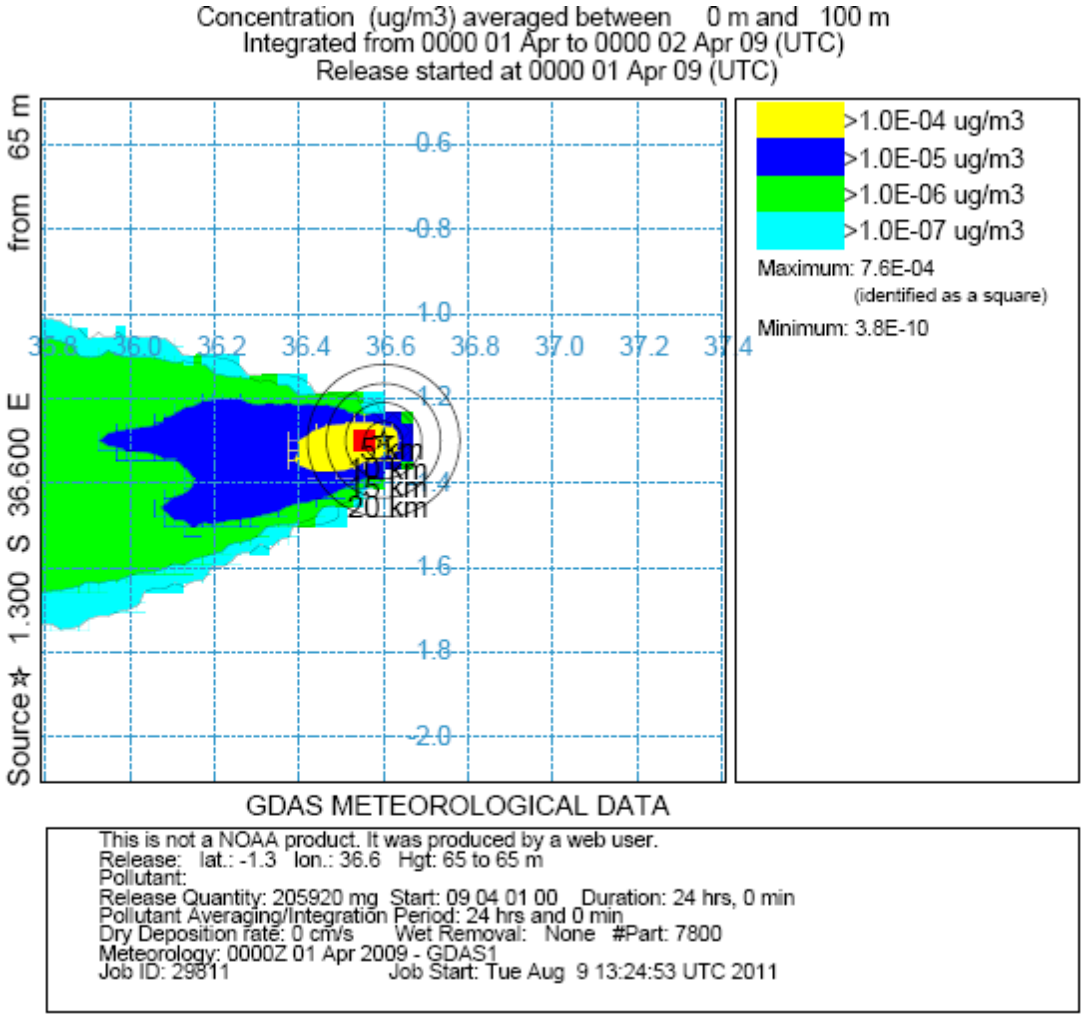

Figure 15c: HC

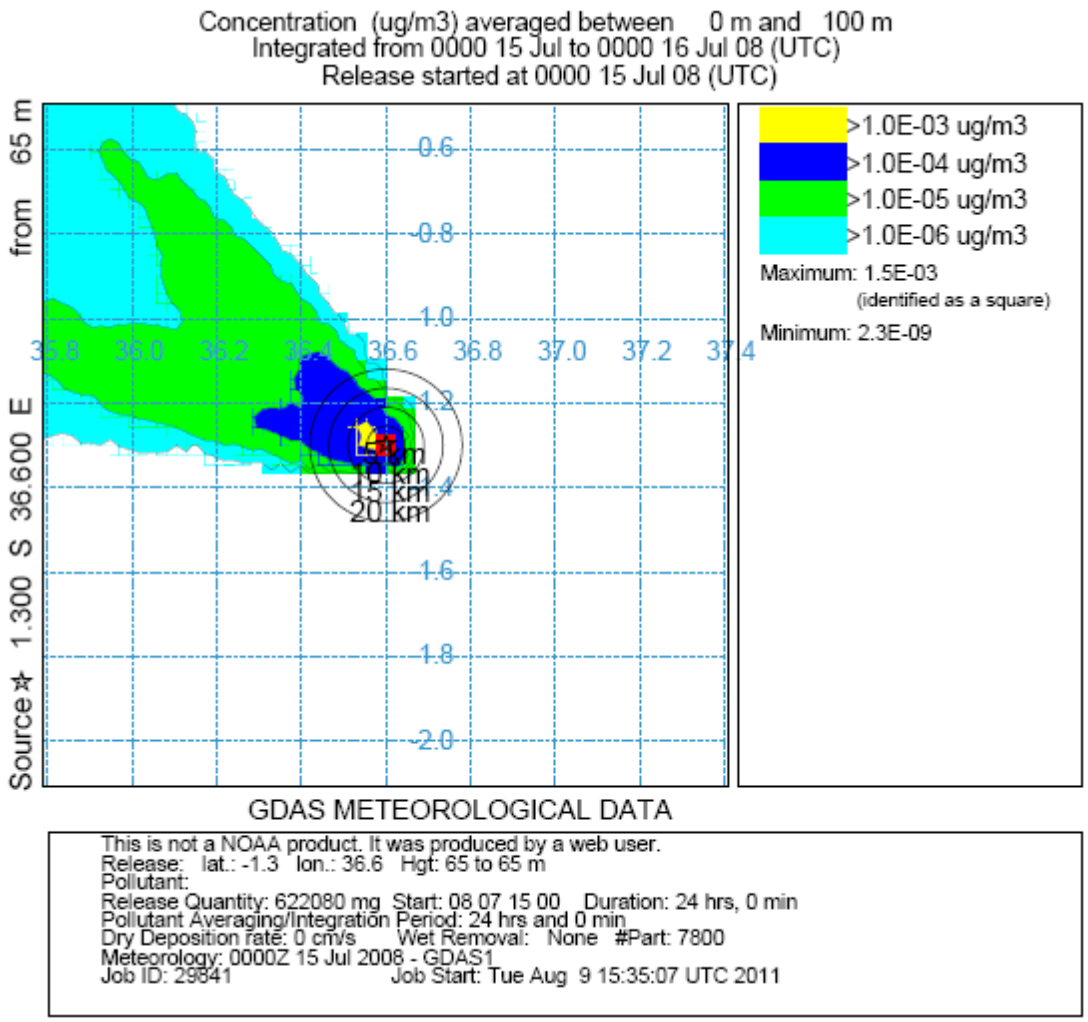

Figure 15d: CO

It is evident from Figure 1a to 15e that the concentrations dispersed and transported from the plant are very low and within the EHS standards.

Details results of the analysis of all days within the five years are presented in annex 2. In this case, the release quantity is computed as the concentration per 24 hours and the duration is also set at 24 hours. This way continuous emission

by the plant is ensured. The computed values in the annex use Table 6 for the source strengths.

Under these conditions the dispersion and transport of effluents reached beyond 20 km. However, the levels are still within the WHO limits.

6 CONCLUSIONS

The expected thermal plant emission data has been reviewed and the air pollution levels analysed and modeled. The meteorological conditions crucial in air quality management, namely: wind speed and direction, and atmospheric stability have also been analyzed. From these data, the air pollution impacts of the new plant on the surrounding area have been predicted using a computer based 2-D model.

The moderately stable to extremely stable conditions, which favor poor air pollution dilution, only occur about 3-5% of the year, during early morning when there is strong temperature inversion. This suggests that the plant should take mitigating measures during early mornings of particularly the cold seasons to minimize adverse effect of the pollution exposure to biological systems within the vicinity of the plant. Analysis of extreme stability for the sake of establishing the worst case scenarios is performed. It is observed that the cold season has the highest frequency of stable conditions.

It is predicted that, provided the source strength provisions in the project specifications are complied with, air pollution levels will not exceed EHS guidelines. Air pollution levels are therefore predicted to comply with all applicable legislative requirements.

Air pollutant concentrations should be measured at monitoring sites that are representative of population exposures.

Air pollution levels may be higher in the vicinity of specific sources of air pollution from power plants and so protection of populations living in such situations may require special measures to bring the pollution levels to below the guideline values.

ANNEX 1: Sample Stability computations

1	9	1	1	0	6.44E+01	2.26E-01	2.50E-01	3.59E+03
1.125	9	1	1	3	7.29E+01	9.93E-02	2.50E-01	1.12E+03
1.25	9	1	1	6	8.53E+02	1.99E-01	2.50E-01	1.17E+03
1.375	9	1	1	9	1.85E+03	4.98E-01	2.50E-01	3.03E+04
1.5	9	1	1	12	2.35E+03	5.33E-01	2.50E-01	3.73E+04
1.625	9	1	1	15	9.38E+02	6.03E-01	2.50E-01	8.67E+03
1.75	9	1	1	18	2.55E+02	4.88E-01	2.50E-01	1.45E+03
1.875	9	1	1	21	1.49E+02	2.63E-01	2.50E-01	3.96E+03
2	9	1	2	0	8.61E+01	2.12E-01	2.50E-01	3.15E+03
2.125	9	1	2	3	9.67E+01	1.44E-01	2.50E-01	1.59E+03
2.25	9	1	2	6	8.89E+02	1.49E-01	2.50E-01	1.27E+03
2.375	9	1	2	9	1.98E+03	5.22E-01	2.50E-01	3.14E+04
2.5	9	1	2	12	2.15E+03	5.30E-01	2.50E-01	3.44E+04
2.625	9	1	2	15	9.38E+02	5.56E-01	2.50E-01	9.61E+03
2.75	9	1	2	18	2.68E+02	4.85E-01	2.50E-01	3.02E+03
2.875	9	1	2	21	1.07E+02	1.63E-01	2.50E-01	2.21E+03
3	9	1	3	0	9.73E+01	1.67E-01	2.50E-01	2.21E+03
3.125	9	1	3	3	8.25E+01	1.59E-01	2.50E-01	1.85E+03
3.25	9	1	3	6	8.15E+02	2.70E-01	2.50E-01	1.95E+03
3.375	9	1	3	9	1.91E+03	5.32E-01	2.50E-01	2.99E+04
3.5	9	1	3	12	2.27E+03	5.31E-01	2.50E-01	3.59E+04
3.625	9	1	3	15	1.06E+03	5.57E-01	2.50E-01	9.44E+03
3.75	9	1	3	18	1.99E+02	4.53E-01	2.50E-01	1.33E+03
3.875	9	1	3	21	1.20E+02	1.32E-01	2.50E-01	1.72E+03
4	9	1	4	0	9.34E+01	7.63E-02	2.50E-01	1.14E+03

4.125	9	1	4	3	1.22E+02	1.65E-01	2.50E-01	1.65E+03
4.25	9	1	4	6	9.60E+02	2.38E-01	2.50E-01	2.93E+03
4.375	9	1	4	9	2.12E+03	5.38E-01	2.50E-01	3.08E+04
4.5	9	1	4	12	2.38E+03	5.50E-01	2.50E-01	3.61E+04
4.625	9	1	4	15	1.04E+03	5.65E-01	2.50E-01	8.41E+03
4.75	9	1	4	18	2.12E+02	4.54E-01	2.50E-01	1.05E+03
4.875	9	1	4	21	9.63E+01	2.21E-01	2.50E-01	2.64E+03
5	9	1	5	0	6.43E+01	1.89E-01	2.50E-01	2.56E+03
5.125	9	1	5	3	1.08E+02	9.93E-02	2.50E-01	1.20E+03
5.25	9	1	5	6	1.03E+03	2.42E-01	2.50E-01	1.69E+03
5.375	9	1	5	9	1.72E+03	5.67E-01	2.50E-01	2.90E+04
5.5	9	1	5	12	1.97E+03	6.14E-01	2.50E-01	3.40E+04

Appendix 3.4 Soil Analysis and Results

Methodology

Extraction Method

10g of the soil were weighed and extracted with 100ml of acetone for 30 min on a shaker. The extract was filtered and concentrated on a rotary vacuum evaporator to 5 ml. aliquot of 1.0 µl of this concentrate was injected into the GC for Total Petroleum hydrocarbons (TPH) determination and 20 µl used for HPLC determination of Toluene and Benzene.

GC Conditions

Column: Glass Packed With Degs 15%

Injection/Detector Temp.: 220ºc

Column Temp. Prog.:

Column Initial Temp. 50 ºc

Column Initial Time 2.0 Min

Column Prog.Rate: 5 ºc Per Min

Column Final Temp.: 200 ºc

HPLC Conditions

Column: Wakosil C18, 4.6 X250 Mm

Mobile Phase: Acetonitrile: Water 60/40

Uv Detector At 254nm

Results

Total petroleum hydrocarbons (TPH) were less than 500 mg/kg (µg/g). Therefore, full analysis in terms of assessing BTEXs and PAHs is not required.

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11th August, 2010

Our Ref. JKU/FST020/044

Dr. Gatari
University of Nairobi
Dept of Nuclear Centre
P.O. Box 29053-00625
Nairobi

RE: RESULTS FOR TOTAL HYDROCARBONS, BENZENE AND TOLUENE

The table below shows the results of Laboratory analysis as per your request. Total Hydrocarbons was done by Gas Chromatography and Benzene/Toluene was done by Liquid Chromatography.

S/No		Sample Identity			
	Parameter	A	B	C	D
1	Total Hydrocarbons (µl/g)	0.5	42.6	17.8	0.3
2	Benzene (µg/g)	nd	41.1	81.6	nd
3	Toluene (µg/g)	88.9	37.9	327.3	248.1

KEY:

nd: means not detected

Analyst-In-Charge: P.N. Karanja Signed:_____ Date: 11/8/2010

Checked by: Prof. G.M. Kenji Signed: _____ Date: 12/8/2010

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Appendix 3.5 Water Quality Report

Physical and chemical water quality analyses were conducted on a sample from Mbagathi River in the vicinity of the proposed Athi River Thermal Power Plant at the University of Nairobi Public Health Engineering Laboratories. Analysis was carried out using standard methods.

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NAIROBI
KENYA

30/7/2010

CHEMICAL ANALYSIS FOR WATER SAMPLES

SAMPLE SOURCE & DESCRIPTION: MBAGATHI RIVER AT BRIDGE CROSSING (KITENGELA AREA)

SAMPLED BY: CLIENT Prof. NJOROGE BNK CLIENT -

PARAMETER	RESULT	REMARK
P^H	7.42	
APPARENT COLOUR °H	110	
TRUE COLOUR °H	90	
CONDUCTIVITY µ/S/CM, mg/1	526	
TURBIDITY, F.T.U	44	
CALCIUM HARDNESS AS $CaCo_3$, mg/l	62	
TOTAL HARDNESS AS $CaCo_3$, mg/l	66	
TOTAL ALKALINITY AS $CaCo_3$, mg/l	147	
CARBONATE ALKALINITY, mg/l	0	
IRON, mg/l	0.4	
FLOURIDES, mg/l	0	
SULPHATES, mg/l	110	
PHOSPHATES, mg/l	0.03	
SILICA, mg/l	200	
DISSOLVED OXYGEN, p.p.m	3.2	
NITRATES, mg/l	0.8	
MANGANESE, mg/l	0	
CHLORIDES, mg/l	149	
CHROMIUM, mg/l	0	
COPPER, mg/l	0.03	
TOTAL COLIFORM/100ml	—	
TOTAL FAECAL COLIFORM/100ml	—	
DISSOLVED SOLIDS, mg/l	350	
SUSPENDED SOLIDS, mg/l	80	
TOTAL SOLIDS, mg/l	430	
BIOCHEMICAL OXYGEN DEMAND, mg/l	—	
CHEMICAL OXYGEN DEMAND, mg/l	—	
RESIDUAL CHLORINE, mg/l	—	

Results indicate significant colour, turbidity, conductivity and solids (total and dissolved) which is characteristic of the type of strata and organic matter it traverses. However, the observed hardness is not significance and the water may be classified as moderately soft (50 - 100 as $CaCO_3$ mg/l)

mainly calcium hardness. The water show very low concentrations of nutrients (phosphate and nitrates) suggesting limited contamination from agricultural sources. Similarly, the water had low concentrations of metals such as copper, manganese, iron and chromium indicating absence of industrial pollution. These results will form part of the baseline conditions.

Appendix 3.6 Traffic and Transport

Introduction

The project site is located 4 km south off the Nairobi - Mombasa Highway along the interstate Nairobi - Namanga (Tanzania) Road and 1.3 km from the interstate along an earth road. Most vehicular traffic to the site is expected to follow the 4 km stretch along the Nairobi - Namanga except possibly for disposal of excavated material and supply of quarried construction material. The pre-construction traffic along the 4 km stretch to the Nairobi - Mombasa Highway comprises mainly of trucks serving the three neighboring cement factories, commuter vehicles and personal cars. The type of vehicular traffic of concern expected during the construction, operation and decommissioning stages is as follows:

Construction

1. Heavy construction equipment delivery trucks
2. Excavated materials disposal trucks
3. Materials delivery trucks
4. Heavy plant haulage trucks

Operation

1. HFO Fuel delivery trucks

Decommissioning

1. Heavy construction equipment delivery trucks
2. Demolition waste haulage trucks
3. Heavy plant haulage trucks

The impacts from this traffic and recommended mitigation measures are discussed here below.

Issue I: Transport of HFO, Supplies and Waste

Impact 1: Disruption of traffic along the main HFO transport route

Heavy fuel oil will be transported by heavy tank trucks from the Port of Mombasa to the project site, a distance of about 650 km. The trucks will follow Mombasa Road except for the 4 km stretch from Mombasa Road turn-off at Athi River to the EPZ site on Nairobi – Namanga Road. It is expected that there will be one tanker per hour in each direction.

The impact of the traffic varies according to the position along the route. The section from Mombasa to Athi River has heavy truck traffic transporting goods between the port and the rest of the country. In this section, the addition of one truck per hour will not have a significant impact on the traffic.

As mention in the introduction, the 4 km stretch from Mombasa Road to the EPZ site has high volume of traffic comprising mainly of trucks serving the three neighboring cement factories, commuter vehicles and personal cars. The HFO tank trucks will add to the traffic congestion problem but their contribution will be insignificant. Waste and supplies are expected to generate traffic of one truck per day which is not significant.

Mitigation measures that could be incorporated to ensure a continued limited impact include the use of transport routes outside peak times and normal working hours. Transport of HFO should occur at night (after 20.00) and over the weekends. Hence to ensure minimal impact from other plant related traffic, vehicle movements should be planned to coincide with off-peak periods.

Impact 2: Damage of road network from the junction to the site

The transport of FHO will require one truck in each direction every hour; this may cause some damage to the present road network.

Mitigation measures to reduce the potential damage to the roads include the use of appropriate vehicles for transportation. Axle loads must be within the Kenya legislation and within the design limits of the road surfaces. Drivers and machinery operators should aim to stick within the prescribed speed limits and drive conservatively.

Impact 3: Risk of Accidents and Injury or loss of life

There is high incidence of traffic accidents in Kenya, mostly as results of *matatus and bodaboda* (public transport) and careless pedestrians. The route from the junction to the site passes through a number of built up residential areas and past factories. There is high risk of traffic accidents during the life of the plant.

Mitigation measures to reduce the potential from traffic accidents should include the enforcement of strict speed limits. There should be driver testing and training to ensure the highest level of skills. Use should be made of traffic calming / control measures such as speed bumps and rumble strips in areas of high risks. Traffic warning signs should be erected at strategic locations. Vehicles should wherever possible restrict movement to off peak periods.

Impact 4: Production of fugitive dust from road entrance

The constant flow of traffic at the junction to the site (1.3 km) will cause entrainment of fugitive dust.

Three types of measures may be taken to reduce emissions from the unpaved road access road: (a) measures aimed at reducing the extent of unpaved roads e.g. paving, (b) traffic control measures aimed at reducing the entrainment of material by restricting traffic volumes and reducing vehicle speeds and (c) measures aimed at binding the surface material or enhancing moisture retention, such as wet suppression and chemical stabilization (EPA, 1987).

Impact 5: Impact on ecological function

The constant movement of tankers, particularly at night has the potential to impact on the local ecology. A large number of animals are killed at night as they cross roads under dynamic traffic. Reptiles and birds are particularly prone to this impact.

Mitigation to prevent animal mortality includes; driver training, reduced speeds, alertness and general awareness.

Issue II: Pollution from Tanker Traffic

Impact 1: Impact of noise on human health

The noise associated with 30 ton tankers has the potential to impact on human health. Movement of heavy vehicles at night may impact heavily on the sleeping patterns of local community.

There are standard mitigation measures to ensure that vehicle noise is kept within acceptable limits. Vehicles should be well maintained and serviced with standard exhaust and muffler. Drivers

should stick to designated speed limits. Roads should be kept in good conditions. To mitigate against disturbance of the residents of neighboring Kitengela Town at night time fuel deliveries will be carried out during daylight hours.

Impact 2: Impact of exhaust emissions on human health

The exhaust emissions associated with HFO tankers has the potential to impact on human health.

There are standard mitigation measures to ensure that vehicle emissions are kept within acceptable limits. Vehicles should be well maintained and serviced with standard exhaust and muffler. Recommended fuels should be used.

APPENDIX 4. Equator Principles

APPENDIX 5. IFC Performance Standards

APPENDIX 6. WHO Air Quality and Health

APPENDIX 7. EHS for Thermal Power Plant

APPENDIX 8. ESIA TERMS OF REFERENCE (TOR)

The following were the study Terms of Reference.

1 Establish the suitability of the proposed location of the proposed MSD Power Project in Athi River.

2 A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.

3 A description of the technology, procedures and processes to be used, in the implementation of the project.

4 A description of materials to be used in the construction and implementation of the project, the products, by-products and waste to be generated by the project.

5 A description of the potentially affected environment.

6 Conduct specialized baseline surveys on air, water, soil and noise pollution in the proposed project area

7 Assessment of ground and surface water sources for the proposed thermal power

8 A description of environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.

9 To recommend a specific environmentally sound and affordable wastewater management system.

10 Provide alternative technologies and processes available and reasons for preferring the chosen technology and processes.

11 Analysis of alternatives including project site, design and technologies.

12 Development of an Environmental Management Plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.

13 Provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the course of project construction, operation and decommissioning.

14 Propose measures to prevent health hazards and to ensure safety in the working environment for the employees and the neighboring community.