

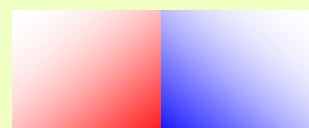


**VOLTA
RIVER
AUTHORITY**

Environmental Impact Assessment of the Kpone Thermal Power Project



FINAL REPORT



AUGUST 2012



**VOLTA
RIVER
AUTHORITY**

VRA CORPORATE ENVIRONMENTAL POLICY STATEMENT

1. VRA is committed to ensuring continuous improvement of environmental performance to minimize the impacts of all its operations on the environment, in line with the principles of sustainable development, in addition to complying with national and international environmental protection regulations.
2. In respect of the above, VRA will:
 - a. Make environmental considerations a priority in all business planning and decision-making and comply with relevant national and international environmental protection regulations.
 - b. Take reasonable steps to mitigate the impact of its actions with regard to the development, operation and management of its assets.
3. VRA will thus pursue the following specific objectives:
 - a. Develop and implement Environmental Management Systems for all its business units to:
 - i. Assess environmental impacts of processes, operations and products.
 - ii. Focus on pollution prevention and waste reduction.
 - iii. Ensure compliance with national/international environmental protection regulations.
 - iv. Set annual environmental targets to ensure continuous improvements.
 - v. Monitor and report on environmental performance as required to the appropriate stakeholders.
 - b. Ensure minimum environmental impact of VRA's projects and take adequate steps to mitigate any such anticipated adverse impacts.
 - c. Promote environmental awareness and individual sense of responsibility among its employees and provide adequate empowerment and training for personnel to perform environmental jobs satisfactorily.
 - d. Support research efforts on materials, products, processes and pollution reduction techniques that are directly related to its operations.
 - e. Contribute to the development of public policy and programmes that enhance environmental awareness and protection.
 - f. Promote open communication on environmental issues.
 - g. Undertake projects and programmes in collaboration with relevant agencies to preserve the Volta Lake resource, and reasonably restore/mitigate ecological imbalance caused by the creation of the lake.
 - h. Undertake projects and programmes to mitigate the impact on the livelihood of individuals and communities displaced or affected by VRA's developmental projects.
4. Each employee of VRA is charged to exercise his or her responsibility on behalf of VRA to assure that the intentions of this Policy Statement are diligently carried out.

SIGNED:.....

CHIEF EXECUTIVE

DATE:.....

July 21, 2005

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LIST OF ACRONYMS & ABBREVIATIONS

AVNL	-	Aqua Vitens NL
BOST	-	Bulk Oil Supply & Transportation
CAP	-	Compensation Action Plan
CAP	-	Corrective Action Plan
CCTV	-	Closed-Circuit Television
CDM	-	Clean Development Mechanism
CEMS	-	Continuous Emission Monitoring System
COD	-	Commercial Operation Date
CTGs	-	Combustion Turbine Generators
DA	-	District Assembly
DFO	-	Diesel Fuel Oil
EA	-	Environmental Assessment
EBoP	-	Electrical Balance of Plant
ECG	-	Electricity Company of Ghana
EIA	-	Environmental Impact Assessment
EIS	-	Environmental Impact Statement
EO	-	Environmental Officer
EPA	-	Environmental Protection Agency
ERM	-	Environmental Resources Management
ERP	-	Emergency Response Programme
FPS	-	Fire Protection System
GEDAP	-	Ghana Energy Development and Access Project
GIPC	-	Ghana Investment Promotion Centre
GNFS	-	Ghana National Fire Service
GoG	-	Government of Ghana
GRIDCo	-	Ghana Grid Company Limited
GWC	-	Ghana Water Company
HRSGs	-	Heat Recovery Steam Generators
HVGs	-	Heavy Goods Vehicles
JV	-	Joint Venture
KTA	-	Kpone Traditional Assembly
LGA	-	Local Government Act
MBoP	-	Mechanical Balance of Plant
MD	-	Managing Director
MW	-	Megawatts
NADMO	-	National Disaster Management Organization
NIHL	-	Noise Induced Hearing Loss
PDD	-	Project Design Document

PEC	-	Project Environmental Coordinator
PEMP	-	Provisional Environmental Management Plan
PLCC	-	Power Line Carrier Communication
PURC	-	Public Utilities Regulatory Commission
RoW	-	Right of Way
RTU	-	Remote Terminal Unit
SEO	-	Site Environmental Officer
SEP	-	Sound Emission Prognosis
SO	-	Safety Officer
STG	-	Steam Turbine Generator
TCPD	-	Town and Country Planning Department
TDC	-	Tema Development Corporation
TEOM	-	Tapered Element Oscillating Microbalance
TMA	-	Tema Metropolitan Assembly
TMS	-	Traffic Method Statement
TWA	-	Time Weighted Average
UPS	-	Uninterruptible Power Supply
VRA	-	Volta River Authority
WAGPCo	-	West African Gas Pipeline Company
WAPP	-	West African Power Pool
WHO	-	World Health Organization
WRC	-	Water Resources Commission

EXECUTIVE SUMMARY

1.0 INTRODUCTION

In order to strengthen the VRA's generation capacity, GoG has initiated the development of the Phase 1 of the Kpone Thermal Power Project (KTPP) which is a 220MW power plant consisting of 2x110MW Alstom GT11N2 (EV) combustion turbines. Under a second phase of the development of KTPP, an additional 110 MW steam component will be installed for the plant to eventually consist of a 330 MW combined cycle generation facility through the conversion of the plant to a full combined cycle status with the installation of a Steam Turbine Generator (STG) and associated Heat Recovery Steam Generators (HRSGs).

It is further anticipated that an additional generation of a 500MW will be installed in future to raise the total output of the Station to about 800MW. This resultant increase in generation capacity at KTPP will be at no additional fuel cost and without increasing carbon footprint. Given the environmental and social benefits of the project, the VRA has proceeded to register this emission reduction project under the Clean Development Mechanism (CDM), a project based mechanism of Kyoto Protocol.

Under the provisions of the Ghana Environmental Assessment Regulations, 1999, LI 1652, the construction of thermal power plants is categorized under environmentally critical projects for which an Environmental Permit is required from the Environmental Protection Agency (EPA). In order to ensure adherence to this legal requirement, an EIS Report for KTPP is required for the approval of the Ghana EPA for the purposes of the acquisition of an Environmental Permit to enable physical construction to commence. For the purpose of this environmental assessment, operation of the two gas turbines of 230 MW under the current simple cycle phase has only been considered. This Final EIS report for KTPP has therefore been prepared to meet the formal requirements of the Ghana EPA as outlined under LI 1652 and the Ghana Environmental Impact Assessment Guidelines for the Energy Sector, Volumes 1 & 2.

2.0 POLICY, LEGAL & REGULATORY FRAMEWORK

The relevant policies and regulatory framework that must be considered for the successful implementation of the project have been gathered and discussed as part of this EIS. All relevant national laws, policies, regulations, guidelines and standards that may apply to the construction of the project will be applied as required. The broad mandate for environmental protection and over-arching resources and sustainable development fall under the EPA, as the Lead Regulator. The adoption of the National Environmental Action Plan led to the enactment of the EPA Act 490 (1994) which for the first time gave legal support to Environmental Assessment implementation in Ghana, after almost fifteen years of experimentation. The passing of the Ghana Environmental Impact Assessment (EIA) Procedures into the EA Regulations (LI 1652, 1999) further consolidated EA application in Ghana.

3.0 KPONE THERMAL POWER PROJECT

The proposed KTPP will be capable of generating about 220MW of electricity and will be operated by the Volta River Authority. KTPP will comprise of the following elements:

- (a) A power generation plant, equipped with 2 x 110MW Alstom GT11N2 (EV) Gas Turbine Generators Simple Cycle Power Plant with a total of 220 MW gross installed capacity.
- (b) Approximately 500 m of new 161 kV single circuit overhead transmission line between the KTPP site to the existing Ghana Grid Company's 161 kV Akosombo – Tema Transmission Line running through Kpone.
- (c) Approximately 11.15 km natural gas pipeline running from Regulatory & Metering Substation of the West Africa Gas Pipeline Company in Tema to the KTPP site.
- (d) Approximately 2km diesel oil pipeline running from the storage depot of the Bulk Oil Supply & Transportation (BOST) to the KTPP site. The proposed pipeline is expected to be constructed within the RoW of the existing diesel pipeline from the storage depot to their storage site "Maame Water", near Akosombo, which lies about 10 meters near the western fence wall of the KTPP site.

The 2 x 110MW Alstom GT11N2 (EV) Gas Turbine Generators have already been procured from Alstom (Switzerland) and available in-country for installation. An EPC Contractor will be engaged to undertake the installation of the supplied equipment as well as the engineering, procurement and construction of the Balance of Plant (BoP) to make the Station functional. The specifications of all equipment will comply with the international standards as much as possible to ensure an economical design and compatibility with the existing facilities and equipment. All equipment will also have the minimum but necessary configuration to achieve the objectives of the Project. The plant shall be designed for a 25 calendar year life. The gas turbines will be fired principally on natural gas but distillate fuel oil will be used as an alternative.

4.0 CONSIDERATION OF ALTERNATIVE TECHNOLOGIES AND SITES

Prior to the selection of the various components of the proposed development, various alternatives have to be considered both in terms of equipment and the feasibility of the project itself during the project planning stage. Various feasibility studies have been done which has helped the EA to present alternatives in comparative form, defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative and some based upon the environmental, social, and economic effects of implementing each alternative. The locations of plant and the routes of gas pipelines and transmission lines were studied from a technical perspective, geography (flat land), land use (unused land, no residence and permanent structures), land availability (public land, road reserve), consistency with urban planning.

Alternatives addressed during environmental assessment are at the following levels of analysis:

- a) No Development Scenario
- b) Fuel Type Options
- c) Site selection Options for power generation

- d) Alternate Technology Considerations
- e) Alternate Site Considerations
- f) Transmission Planning Analysis
- g) Possibility of the Use of Alternate Mode of Transmission

5.0 DESCRIPTION OF EXISTING ENVIRONMENT

The project site is located at Nmlitsapko, about 2 kilometres off the road from the Kpone Barrier on the Tema-Aflao road (One kilometre from the barrier to the turn-off junction and about one kilometre off the junction on the Tema-Aflao road. The site allocated for the project by the Tema Development Corporation (TDC) is about 75 acres (30 Hectares) in size. The geographical coordinates of the power plant site is approximate National Grid Reference N'117900.00 – 117400.00 and E'385800.00 – 284200.00 E. The plot area is a flat plain with downgrade slope from northeast to southwest direction of trapezoidal shape. The area has a dimension of 546m in the north side and 610m in west direction with a total area of about 245,456m². The power plant site will occupy less than one-third of the land. The site in 2007 was a green field location without any facilities but currently provided with a fence wall for security.

The adjoining lands to the project site have the following uses:

- TDC's Community 25 to the south, about 150m from the power plant site.
- GRIDCo 161 kV Transmission Lines to the west: about 300-500m from the site.
- A number of houses mainly under construction to the east and north: minimum of about 150m from the site.
- A number of physical developments are within the RoW between the associated 161 kV transmission lines and the plant site. These properties are to be acquired by the VRA, making their owners project affected persons.

Twelve (12) boreholes were sunk by percussive drilling at various locations at the site, including where the oil tank farms are to be located. The final boreholes depths varied between 2.6m and 6.1m. It must be noted that within the depths investigated, no evidence of ground water was encountered. Subsequently, there is no data on ground water quality for the proposed location of oil tank farms.

In order to properly represent the climate spanning the project sites, data on relative humidity, temperature, rainfall, and wind speed covering the period 2004-2012 was obtained from the Tema Weather Station: 654730 (DGAT), located on Latitude: 5.61, Longitude: 05 and Altitude: 14. Data was supplemented with information earlier obtained from the Ghana Meteorological Services Department.

The hottest periods of the year in Tema are in the months of February and March with daytime temperatures reaching up to 35 °C. This is the period preceding the onset of the rains. The mean monthly temperature during this time is about 29°C. July and August are relatively cooler months with mean temperatures of 25 °C or even lower at night.

From the analysis carried out on the air quality data, the average ambient dust level for the particulate matter <10microns (respirable dusts/PM₁₀) for the four points range from 43 to 54µg/m³ and that for the Total Suspended Particulate (TSP) ranges from 102 to 129µg/m³ as against the E.P.A ambient air quality guideline value of 70µg/m³ for PM₁₀ and 230µg/m³ for T.S.P. respectively. Minimum and maximum wind speeds recorded during the period of measurement are 0.43 and 2.6 m/s. The predominant wind direction was NNE – SW. It can be concluded that entrained dust is not a problem at the project site. Dust levels measured did not exceed the EPA recommended limits of 70µg/m³ for respirable dust (PM₁₀) and 230µg/m³ for total suspended particulate matter.

Results obtained from neighbouring communities, i.e. Nmlitsakpo, Bediako/Saki, After 25, Point of Maximum outfall, TDC serviced Plots, showed that the concentrations of Nitrogen dioxide (NO₂), Total suspended particulates (TSP), PM₁₀ and Carbon Monoxide were well within the Ghana EPA's recommended limits for residential areas. The concentration of Sulphur dioxide (SO₂), however exceeded the daily (24hrs) recommended limit at Saki-Bediako and TDC Serviced Plots locations. Readings at the third location (Point of maximum fallout) also exceeded the 24-hour recommended limit for SO₂ in residential areas on 2 days. This increase can be attributed to the open burning of household wastes in the area. Nonetheless, the hourly (1hr) concentrations were all lower than the EPA's guideline of 700 µg/m³. Noise levels were below EPA daytime recommended level of 70 dB (A) for industrial areas. It can be concluded from above that there is no noise pollution in the project area.

Almost all of the project sites are located in suburbs/industrial areas and there are no special habitats for endangered fauna or flora. It is important to note that there are no environmental sensitive areas within the project area. The vegetation in the project site consists mainly of coastal savannah grassland with small clumps, short grass, and stunted shrubs. The common types of grass dominating the area are *Digitaria horizontalis* and *Axonopus compressus*, and the most common shrubs are *Chromolaena odorata* and *Securinega virosa*. Animals found within the project area of influence include lizards and termites.

The nearest towns and communities to the project site are Community 25 (To the east of the project site) and Nmlitsakpo Community (to the west of the project site), Bediako/Saki, After 25 and the TDC serviced plots. There are 1,000 plots located within the Community 25, which will eventually be home to approximately 4,200 people. The entire 1,000 serviced plots are located on the south of the site. Nmlitsakpo is projected to have about 70,000 people (TDC and TMA Estimate). Most of the plots are yet to be developed. Socio-economic data has been provided in the report.

6.0 IDENTIFICATION OF POTENTIAL ENVIRONMENTAL IMPACTS

Apart from it being a site-specific project whose impacts would be generally confined to specific areas of influence, the KTPP can also be considered a 'linear' project. The potential impacts from such a project would affect a much wider area of influence. Thus one of the major issues for the EIA would be expected to arise from the acquisition of the right-of-way (RoW) for the project. The diverse location of the various sections of the transmission line project enhances the potential adverse impacts of the project. In recognition of this fact and in

fulfilment of the requirements of permitting and funding agencies, the VRA has incorporated this EIA in its project cycle.

This section of the EIS Report deals with the methodology used to assess the potential impacts of the KTPP and the results from the application of this methodology to the project, using project information and baseline data available at the time this report was prepared. It also deals with the main potential environmental concerns likely to arise from the development. It has been prepared to cover three continuous stages, namely, Pre-construction Phase, Construction Phase, Demobilisation and Operational Phase (Occupancy Stage). The general and localized issues of concern as per the above mentioned stages are discussed.

7.0 PROPOSED ENVIRONMENTAL IMPACT MITIGATION MEASURES

This Section of the report will outline ways and measures to help reduce, and if possible eliminate the adverse impact identified. This section further describes the proposed mitigation measures that would be adopted to minimise the predicted impacts identified in the previous chapter. The impacts identified so far are typical of thermal power plants and transmission line projects. Mitigation measures provided under this section complements on-going environmental and social management practices that are underway by VRA. The mitigation measures that have been proposed to minimise potential adverse environmental impacts and maximise beneficial impacts that are associated with the implementation of the project is presented. To ensure that environmentally sound practices are adhered to and in order to safeguard the safety and health of persons or any group of persons working on the project during project implementation, the following mitigative measures are proposed for significant potential impacts at the pre-constructional, constructional and operational phases.

8.0 MONITORING

A monitoring programme has been developed to determine impacts on the physical, biological and socio-economic/cultural environments within the project's area of influence and around the proposed power plant and associated facilities. A description of the environmental monitoring activities showing parameters, methodology, period for monitoring, location and responsibilities is presented. The monitoring results are expected to indicate whether the predictions of potential environmental impacts are accurate and also whether the mitigation measures proposed for the management of the impacts are appropriate and adequate. The programme will also serve as an early warning system by revealing unforeseen impacts and allowing additional corrective measures to be implemented to arrest the situation and ensure that irreversible damage is not caused. The programme is also expected to provide useful guidance for the successful planning and implementation of future thermal plants / transmission line projects that will be undertaken by the VRA.

9.0 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN

Environment around construction areas shall certainly been affected during construction period. The main sources of unfavourable effect and pollution to surrounding environment during the construction period will come from not only all activities of all members of the work force during the construction of the project but also from some natural sources such as storm water during the construction period, and the direct sources such as employee's activities to flora and fauna, wastewater, exhausted gas, noise, floating dust, construction garbage,

domestic garbage and etc. Aiming at above-mentioned unfavourable sources, VRA will take relevant measures at the utmost to decrease adverse effects and pollution to surrounding environment during the construction period.

The Provisional Environmental Management Plan (PEMP) provides measures in a manner that would cause minimum temporary and permanent disfigurement to the existing natural beauty and amenities of the area. It details active remedial measures and monitoring activities to be continuously carried out to prevent or minimize impacts on the physical, biological and socio-economic/socio-cultural environments as well as to promote occupational safety and health of employees. It provides insight into the environmental management activities that are anticipated and the action plan that will be implemented to take care of problems that will arise from plant activities. The institutional arrangements for project environmental management including the proposed project management organisational chart, training programmes, and standardised environmental documentation procedures would also be included in this section with estimates of implementation costs. The appointment of an Environmental Officer-Compliance & Monitoring by VRA for the project as well as qualifications and responsibilities would be outlined in the PEMP.

It is imperative for VRA to educate all members of its working force to comply with all relevant laws, ISO14001 and all requirements of the project to adopt all necessary control procedures in each area before work is allowed to proceed.

VRA will make human resources available for environmental management and enhancement. In addition, financial provision shall be made to ensure that mitigation measures (including compensation), monitoring and training programmes are effectively implemented. VRA will make the necessary budgetary provisions to cover all commitments for the transmission project, including compensation. Budgetary provision has also been made for compensation; however, actual cost will be outlined in detail in the Valuation Report.

10.0 CONSULTATIONS WITH KEY STAKEHOLDERS

Extensive consultations have been carried out with Project Affected Persons (PAPs), state agencies and Service providers and these have been reported herein. Indeed, a public hearing was organised by the EPA at the project site on April 29, 2010. This forum was to help create an opportunity for VRA and the public to interact to address key issues and other public concerns of the proposed project particularly, the compensation issues and initial concerns raised by some residents and Project Affected People (PAPs) of Community 25 about the project. A Stakeholder hearing was undertaken on May 30, 2012 at the KTPP site, to enable all local stakeholders, including neighbouring industries and communities to provide comments on the project as it was being registered under the Clean Development Mechanism (CDM), a project-based mechanism for the greenhouse gas emission reduction under the Kyoto Protocol.

11.0 DECOMMISSIONING & SITE CLOSURE PLAN

The proposed site for the thermal power plant at Kpone has been acquired by VRA for the project as well as for future expansion. The power plant elements are designed to a life expectancy of 25 years. It is anticipated that the thermal station elements will be continuously maintained and repaired and will be operated for several decades. The lifespan of the associated transmission towers is also typically 50 years. The project elements may be upgraded and/or renewed based on cost/benefit analysis and new technologies. Because of its long life span, the circumstances under which the KTPP might be ultimately decommissioned are difficult to foresee. It is anticipated that the associated facilities will be continuously maintained and repaired.

However, a Decommissioning and Site Closure Plan (DCP) is required to guard against the remote possibility that the project ceases to operate and the facilities are abandoned by VRA. In the event of this, the potential would exist for impacts from abandonment of the equipment of the thermal station such as aesthetic impacts and potential trespassing and safety concerns. The purpose of this conceptual DCP is to describe the general objectives for the post project land use, and the planning processes leading to development of a final DCP.

12.0 CONCLUSION

VRA believes that the EIS has sufficiently dealt with the significant issues on the ground. It is hoped that the report will meet the expectations of the EPA and warrant the issuance of Permit to enable VRA to commence the project. VRA commits to collaborate with EPA to jointly manage the environmental and social concerns related to the thermal power plant project and shall submit environmental reports to the EPA as required. In conclusion, it is affirmed that VRA is committed to ensuring continuous improvement of environmental performance to minimize the impacts of all its operations on the environment, in line with the principles of sustainable development, in addition to complying with national and international environmental protection regulations. This is an undertaking VRA is firmly committed to and shall adhere to it.

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Final

1.0 INTRODUCTION

1.1 Volta River Authority

The Volta River Authority (VRA) was established under the Volta River Development Act 1961 (Act 46) as a public-owned corporate utility with the primary function of generating electric power, first by the development of the hydroelectric potential of the Volta River and the construction and operation of a transmission system for the supply of electrical energy for industrial, commercial and domestic use in Ghana.

Currently, VRA operates a total installed electricity generation capacity of 1,985.5 Megawatts (MW). This comprises of two hydroelectric plants on the Volta River, with installed capacities of 1,020MW and 160MW at the Akosombo and Kpong Generating Stations, respectively, and complemented by a 330MW Combined Cycle Thermal Plant at Aboadze, near Takoradi. A further 220MW Thermal Plant, Takoradi International Company is owned as a joint venture with TAQA, from Abu Dhabi in the United Arab Emirates. The VRA has also developed a number of thermal plants in Tema which forms the Tema Thermal Power Complex (TTPC). Tema. These include an 80MW Mines Reserve Power Station (TTPC Station 1), 126MW Tema Thermal 1 Power Station (TTPC Station 2), both commissioned in 2008 and a 49.5 MW Tema Thermal 2 Power Station (TTPC Station 3).

As part of efforts to increase in augmenting the existing power generation capacity to ensure adequate and reliable power supply in the country, VRA has begun the construction of a 132 MW combined cycle plant called Takoradi Thermal Power Station Expansion Project (T3). The T3 is to be further expanded with an additional 132 MW (combined cycled power plant) to the already planned 132 MW plant. The construction of the additional 132 MW Plant is expected to commence by June 2012, and would be completed within twenty (20) months. VRA is also in the process of developing a 220MW Kpone Thermal Power Plant, located at Kpone, near Tema.

Again, the VRA intends to convert the 126 MW (ISO) Open Cycle Gas Turbine and a second 126 MW (ISO) Gas Turbine under installation by an Independent Power Producer (CENIT Energy) at the Tema Thermal 1 Power Station to a 330 MW Combined Cycle Thermal Plant. The procurement processes for the engagement of a Contractor for the TT1PS Expansion Project are currently underway. The Domunli Thermal Power Project is being formulated as a green field development to generate in the first phase 450MW of power harnessing natural gas from the Jubilee and other oil fields in the Tano Basin in line with VRA's strategic interest to maintain its market share and remain competitive. VRA has also embarked on a Renewable Energy Development Programme which aims at developing about 160 MW of installed renewable energy capacity by 2015, made up of 150 MW Wind Power and 10 MW Solar Power.

In 1987, as part of the arrangements to expedite the Northern Grid Extension and Systems Reinforcement Project, the Volta River Development Act 1961 (Act 46) was amended to extend VRA's mandate to distribution of electricity in Ghana. VRA subsequently created a Northern Electricity Department (NED) to implement the northern distribution zone component of the National Electrification Project. NED was initially developed as an integral part of a larger scheme, designated the Northern Electrification & System Reinforcement Project to

extend the national electricity grid to northern Ghana. Currently, NED is the sole distributor of electricity in the Brong-Ahafo, Northern, Upper East, Upper West, and parts of Ashanti and Volta Regions of Ghana and has a customer population of over 300,000 and a load demand of about 120MW.

VRA is currently undergoing a major re-structuring in the context of the Ghana Government Power Sector Reforms. In view of this, the Volta River Development Act, Act 46 of 1961 was amended by the Volta River Development Act, Act 692 of 2005. Following the enactment of the Amended Act, the power transmission function of the VRA has been transferred to a transmission utility company known as Ghana Grid Company Limited (GRIDCo). GRIDCo was incorporated on December 15, 2006 as a private limited liability company under the Companies Code, 1963, Act 179 and granted a certificate to commence business on December 18, 2006. The company became operational on August 1, 2008 following the transfer of the core staff and power transmission assets from VRA to GRIDCo. GRIDCo is now responsible for the entire national power evacuation and transmission infrastructure that VRA had hitherto managed together with power generation.

Again as a result of the Power Sector Reforms, NED has been made a subsidiary of VRA and is operating under the name Northern Electricity Distribution Company (NEDCo). A Managing Director for NEDCo was appointed in June 2011. NEDCo became operationalized in May 2012. VRA is expected to continue to provide NEDCo with both financial and other resources, including human resource, until such a time that it becomes a viable and self-sustaining entity.

1.2 Background and Project Need Statement

The projected power demand for Ghana in 2010 is 1,905MW, inclusive of 25% Capacity Reserve Margin. This is expected to increase at an average rate of 6.7% to 2,615 MW. With the projected capacity additions and 25% capacity reserve margin, the 2010 capacity shortfall of 61 MW is expected to increase to 1,060 MW in 2020. For now, the energy supply from existing power plants in Ghana as at the beginning of 2010 was 10,259 GWh. The Sunon Asogli plant is expected to generate 1,340 GWh due to gas availability and this translates to a total energy supply of 10,816 GWh in 2010. This is expected to grow at an average rate of 6.3% to 21,146 GWh in 2020. With projected generation plant additions, energy supply shortfall of 759 GWh (87 MWc) is anticipated in 2017, which may increase to 3,693 GWh (422 MWc) in 2020. In the short term (2011), an energy shortfall of 185 GWh (21 MWc) is projected.

The GoG sees the availability of adequate, secure and reliable energy to drive productive value-added industries and services as a critical input to achieving its Golden Age of Business and the poverty alleviation strategy. Subsequently, power generation has to be increased to meet its demand. The current average annual increase of 7% in electricity demand without a corresponding addition of power generation has resulted in a tight demand-supply balance in Ghana with no reserve margin that results in periodic blackouts throughout the country. The VRA had to resort to load shedding during these periods as well as importation of power from La Cote d'Ivoire. These situations would be repeated over and over if power generation in the country is not increased to meet its demand.

In order to strengthen the VRA's generation capacity, GoG has initiated the development of the Phase 1 of the Kpone Thermal Power Project (KTPP) which is a 220MW power plant consisting of 2x110MW Alstom GT11N2 (EV) combustion turbines. Under a second phase of the development of KTPP, an additional 110 MW steam component will be installed for the plant to eventually consist of a 330 MW combined cycle generation facility through the conversion of the plant to a full combined cycle status with the installation of a Steam Turbine Generator (STG) and associated Heat Recovery Steam Generators (HRSGs). It is further anticipated that an additional generation of a 500MW will be installed in future to raise the total output of the Station to about 800MW. This resultant increase in generation capacity at KTPP will be at no additional fuel cost and without increasing carbon footprint. Given the environmental and social benefits of the project, the VRA has proceeded to register this emission reduction project under the Clean Development Mechanism (CDM), a project based mechanism of Kyoto Protocol.

KTPP is one of the various medium term (2009-2015) national energy supply expansion strategies formulated during the 2nd Quarter of 2007 by the Ministry of Energy as a response to the energy crisis in the country at the time. The development of the KTPP is in line with the National Energy Policy to achieve installed power generation capacity of 5000 MW by 2015 and also increase electricity access from the current level of 66% to universal access to affordable electricity by 2020. KTPP is part of the Government of Ghana's effort towards reducing the current generation deficit in the country, and also ultimately ensuring the provision of inexpensive electricity for Ghana. Subsequently, GoG considers the implementation of the KTPP as critical in meeting Ghana's future energy needs.

1.3 Project Objectives

KTPP is being built to furnish power to the national grid to supplement existing hydro and thermal generation and to provide required base load capacity in times of water shortages affecting hydro generation capacity. The objectives for the development of KTPP are to:

- Ensure energy supply sufficiency in the short to medium term (2012 to 2015) and avert electricity shortfall in Ghana in the event of low rainfall.
- Increase thermal generation capacity in Ghana's energy mix by 230MW in the short term.
- Utilise the environmentally cleaner fuel (Natural Gas) from the West African Gas Pipeline to generate electricity from thermal energy to supplement that generated from the Akosombo and Kpong Hydroelectric Power Plants, and the Aboadze and Tema Thermal Plants
- Ensure sustainable development through increase in generation capacity at no additional fuel cost and without increasing carbon footprint.
- Provide Ghanaian residences, and industrial and commercial establishments in Ghana with safe and regular electricity supply to augment the increasing demand for power and reduce the perennial problems of power cuts
- Provide employment and training opportunities for the local community
- Facilitate GoG's objective of meeting the power needs of residents
- Ensure a reasonable return on investment for the developer

1.4 Purpose of the Environmental Assessment Study

Under the provisions of the Ghana Environmental Assessment Regulations, 1999, LI 1652, the construction of thermal power plants is categorized under environmentally critical projects for which an Environmental Permit is required from the Environmental Protection Agency (EPA). The Environmental Impact Assessment Guidelines for the Energy Sector, Volume 1, dated August 2010, indicates that all oil fired power plants with installed capacity equal or exceeding 15 MVA as well as natural gas fired electric power plant with installed capacity equal or exceeding 500 kVA requires an Environmental Assessment (EA) study and the preparation of an Environmental Impact Statement (EIS) Report.

It is therefore a legal requirement in Ghana that development projects such as KTPP should be subjected to an Environmental Assessment (EA). Among the notable reasons for the preparation of the EIS are to:

- Facilitate the understanding and determination of the likely implications of the project, the relevant considerations, planning and mitigation options, that will ensure that the project is implemented in an environmentally sound and sustainable manner.
- Provide sufficient information to justify the environmental and social aspect, approving, modifying, selecting other alternatives or rejecting in respect to financing and the execution of the project.
- Act as the basis of identifying the main measures which will accompany the implementation of the project and associated facilities concerning environmental aspects.
- Ensure systematic management of environmental impacts during project construction and operation.
- Meet specific environmental legislative requirement(s) and demonstrate compliance with current environmental, health and safety criteria funding agencies requirements.
- Form the basis for consideration for environmental approval and permit from the EPA for the implementation of the proposed project.
- Create awareness among all employees on environmental management.
- Ensure continuous improvement of environmental performance for consideration in EPA's annual Continuous Environmental Improvement (CEI) award.

In order to ensure adherence to this legal requirement, an EIS Report for KTPP is required for the approval of the Ghana EPA for the purposes of the acquisition of an Environmental Permit to enable physical construction to commence. VRA subsequently engaged the services of Business Strategies & Solutions to undertake the environmental assessment and prepare the required EIS document. Following the submission of the Draft EIS by the firm, EPA made suggestions in areas to be reviewed prior to finalising the document. An in-house VRA environmental team was subsequently tasked to revise the document using EPA's review comments. This Final EIS report for KTPP has therefore been prepared by the in-house VRA Team to meet the formal requirements of the Ghana EPA as outlined under LI 1652 and the Ghana Environmental Impact Assessment Guidelines for the Energy Sector, Volumes 1 & 2. For the purpose of this environmental assessment, operation of the two gas turbines of 220 MW under the current simple cycle phase has only been considered.

1.5 Information Sources

The EA is intended to event or minimise potentially adverse environmental impacts and enhance overall quality of the project as it allows environmental issues to be addressed in a timely and cost effective way during the project design, preparation and implementation. As a feasibility study tool, the EA can help reduce overall project cost, assist in completing the project on schedule and help design the project in a manner which is acceptable to all stakeholders. The general methods used in this environmental assessment for the development of the EIS involved an extensive review of baseline environmental data for the project area. Field visits to the project site were undertaken for an assessment of the existing environment. Both primary and secondary data were collected.

Primary data was collected on the economic characteristics and ecological details. The secondary data to supplement the primary data was collected through a wide literature review, including internet search on the project as well as the project area, both published and unpublished. A number of background documents, correspondences and diagrams/figures on the project were obtained and reviewed as well as various minutes on meetings to discuss the most appropriate materials and route for the associated transmission lines as well as the gas and diesel pipelines. Some of the documentations include Project Technical Specifications, Design Criteria & Basic Design Report, Survey Report for the Gas Pipeline, Air Dispersion Modelling Report, Geotech Survey Report, Valuation Report, Air Quality Baseline Assessment Report, Sound Emission Prognosis, etc.

Most of the data on plant species, fauna, soils, water, geology, etc. were collated from interviews and documentations, especially the 2010-13 Medium Term Development Plan for the Tema Metropolitan Assembly prepared within the context of the Ghana Shared Growth & Development Agenda. Others are research data and environmental assessments documents within the project area. The preparation of the EIS has also been guided by several examples of EAs' prepared for power related projects in Ghana and other countries in the African Region.

2.0 POLICY, LEGAL & REGULATORY FRAMEWORK

The relevant policies and regulatory framework that must be considered for the successful implementation of the project have been gathered and discussed as part of this EIS. All relevant national laws, policies, regulations, guidelines and standards that may apply to the construction of the project will be applied as required. The broad mandate for environmental protection and over-arching resources and sustainable development fall under the EPA, as the Lead Regulator. The adoption of the National Environmental Action Plan led to the enactment of the EPA Act 490 (1994) which for the first time gave legal support to Environmental Assessment implementation in Ghana, after almost fifteen years of experimentation. The passing of the Ghana Environmental Impact Assessment (EIA) Procedures into the EA Regulations (LI 1652, 1999) further consolidated EA application in Ghana.

Details on the Policy, Legal & Administrative Frameworks in Ghana to be adhered to under the project are as follows:

2.1 Acts & Regulations

a) ***The Environmental Protection Agency Act (1994) Act 490***

It has been realized that the failure of many environmental policies in many countries has generally been as a result of exclusive concentration on the development of policies, laws and standards to the neglect of implementation including compliance and enforcement. Consequently, the Environmental Protection Agency (EPA) Act 1994 (Act 490) was promulgated by the Government of Ghana to replace the erstwhile Environmental Protection Council Decree (NRCD 239). The Act provided the Agency with the compliance and enforcement powers necessary for the achievement of the environmental policy objectives.

Act 490 established the authority, functions, structure and funding of the EPA and gave mandate to the Agency to ensure compliance of all investments and undertakings with all laid down Environmental Assessment (EA) procedures in the planning and execution of development projects, including compliance in respect of existing ones.

b) ***Environmental Assessment Regulations (1999) LI 1652***

In order to give effect to provisions of the Act on environmental management, the Environmental Assessment Regulations 1999 (LI 1652) was enacted in February 1999, consistent with Section 28 of the Act 490. The LI sets out the requirements for environmental permitting, environmental impact assessment (EIA), the production of preliminary environmental reports (PERs) and subsequent environmental impact statements (EISs), environmental certificates and environmental management plans (EMPs).

The legislative functions conferred on EPA by the Act, included the authority to request from categories of undertakings, enterprises, construction or development an environmental impact assessment and/or environmental management plan to regulate the type, quantity, conditions or concentrations of substances that may be released into the environment. The Environmental Impact Assessment (EIA) procedure is not only a

regulatory tool to be enforced pursuant to Section 24 of LI 1652, but also a compliance promotion tool to ensure effective preventive, minimisation and mitigation of potential impact of industrial developments existing prior to and after the coming into force of LI 1652.

Construction and operation of thermal power plants such as KTPP is one of the undertakings for which an EIA is mandatory.

c) Volta River Development Act, 1961 (Act 46)

The Volta River Authority (VRA) was established on April 26, 1961 under the Volta River Development Act, Act 46 of the Republic of Ghana with the core business to generate and supply electrical energy for industrial, commercial and domestic use in Ghana. Part 4, Section 17 (2) (d) of the Act authorizes the VRA to acquire land necessary “for the proper discharge of the Authority’s functions.” Act 46 enjoins the VRA to pay monetary compensation or resettle affected persons as may be applicable so as to ensure that those whose properties are affected by its operations are adequately catered for.

VRA started with the development of the hydroelectric potentials of the Volta River and the construction and maintenance of a nation-wide grid transmission system. Today, it has expanded into thermal generation to complement inadequate capacity for hydro generation. The VRA also supplies power to neighbouring utilities in Benin, Togo and La Cote d’Ivoire through the transmission system of GRIDCo. VRA will be part owner of KTPP.

d) Volta River Development Act, 2005, Act 692

Ghana’s Power Sector Reforms culminated in the passing of the Amendment to VRA Act 46 in 2005. By the Volta River Development Act, 2005, Act 692, the power transmission functions of the VRA was transferred to a transmission utility company known as Ghana Grid Company Limited (GRIDCo).

GRIDCo is now responsible for the entire national power evacuation and transmission infrastructure that VRA had hitherto managed together with power generation and would be also responsible for the transmission component of the KTPP.

e) Energy Commission Act (1997), Act 541

Act 541 established the Energy Commission and provided for its functions relating to the regulation, management, development and utilization of energy resources in Ghana; provide for the granting of licenses for the transmission, wholesale supply, distribution and sale of electricity and natural gas; refining, storage, bulk distribution, marketing and sale of petroleum products and to provide for related matters.

The provisions of the Energy Commission’s ‘PUBLIC NOTICE – EC N. 003’ require the VRA to register the proposed project with the Commission and to obtain a permit prior to the commencement of construction of the proposed project. This permit is subject to the granting of an Environmental Permit by the EPA. A “Licensing Manual for Service Providers in the Electricity Supply Industry” was developed and issued by the Energy Commission of Ghana in 1996 to formally establish the framework for licensing electricity production, supply,

and distribution and sale services in the power sector of Ghana as stipulated by the Energy Commission Act (Act 541), 1997.

The Energy Commission is expected to provide license for the KTPP.

f) *Electricity Company of Ghana (ECG), Act 461 of 1997*

The Electricity Corporation of Ghana (ECG) was established by a decree (NLC Decree No.125) in 1967 and replaced the Electricity Department of the Ministry of Works and Housing. However, under the provisions of the Statutory Corporations (Conversions to Company) Act, 1993 (Act 461), ECG has since 1997 been converted into a limited liability company called Electricity Company of Ghana. Prior to 1987, ECG was responsible for distributing electricity throughout Ghana when it receives bulk supply from the VRA. The ECG's responsibility for distribution is now limited to the Ashanti, Western, Central, Eastern, Greater Accra and Volta Regions.

g) *Public Utilities Regulatory Commission (PURC) 1997, Act 538*

The Public Utilities Regulatory Commission (PURC) 1997, Act 538 requires the PURC to set up guidelines for pricing of power generated by utility companies taken into consideration assurance of financial viability of power produced, investor interests and best use of natural resources.

PURC shall be responsible for pricing of the electric power to be generated from KTPP.

h) *Factories, Offices and Shops Act (1970) Act 328*

Act 328 promotes and ensures the health, welfare and safety of persons employed in the country as well as the responsibilities of the employer. Under the Act, employers are required to ensure that a safe and healthy workplace is provided for the safety, health and welfare of all employees.

Implementation and operations of KTPP is expected to be done in consonance with Act 328.

i) *Pesticides Control and Management Act, 1996, Act 528*

The Act was enacted to provide for the control, management and regulation of chemicals and pesticides in Ghana and to provide for related matters. It provides the EPA the powers to register and classify chemicals, to determine Restricted and suspended chemicals, to license and approve dealers, and to ensure enforcement and penalties. The Act states that no person shall import, export, manufacture, distribute, advertise, sell or use any chemical in Ghana unless the chemical has been registered by the Environmental Protection Agency in accordance with this Act.

j) *Labour Act No (2003) Act 651*

Part XV, Section 118 (1) and (2a-h) of the Act enjoins employers to ensure that every worker employed by him or her works under satisfactory, safe and healthy conditions, and is further obliged to provide necessary information, instructions, training and supervision to ensure the health and safety at work of those other workers engaged in a particular work.

k) National Museums Decree (1969) NLCD 387

NLCD 387 provides for the care of any archaeological finds. This is the law governing the activities and operations of the National Museums and Monuments Board. Procedures to be followed on the discovery of any such artefacts are outlined in NLCD 387.

l) Volta River Authority (Transmission Line Protection) Regulations, 1967 (LI 542)

VRA (Transmission Line Protection) Regulations, (1967) LI 542 provide security for VRA Transmission Lines and ensure public safety. Define “transmission line right of way” and prohibit/restrict a number of activities in the RoW including farming, cultivation, mining and construction of buildings, which are only allowed with prior consent from the VRA.

m) Volta River Authority (Transmission Line Protection) (Amendment) Regulation, 2004

VRA (Transmission Line Protection) (Amendment) Regulation, 2004 (LI 1737) which provides for the right of way distances for 69 kV, 161 kV, 225kV, 330 kV transmission lines. The RoW for 225 kV and 330 kV transmission towers is 40 meters, whilst that of 69kV and 161 kV is 30 m. This regulation prohibits a number of activities in the RoW including mining, construction of buildings, and cultivation of some types of crops.

n) Electricity Transmission (Technical, Operational And Standards Of Performance) Rules, 2008 L.I. 1934

LI 1934 provide rules and define the national interconnected transmission system; and establish the requirements, procedures, practices and standards that govern the development, operation, maintenance and use of the high voltage national interconnected transmission system. The rules are to ensure that the transmission system provides a fair, transparent, non-discriminatory, open access, safe, reliable, secure and cost efficient transmission and delivery of electricity.

o) L.I. 1937: Electricity Regulations, 2008

The purpose of these Regulations is to provide for (a) the planning, expansion, safety criteria, reliability and cost effectiveness of the national interconnected transmission system; (b) the regulation of a wholesale electricity market; (c) the market operations of the electricity transmission utility; (d) the technical operations of the electricity transmission utility; (e) minimum standards and procedures for the construction and maintenance of facilities and installations; (f) the protection of the mains and electrical installations and services; (g) the protection of life and property and the general safety of the public in respect of electricity services; (h) minimum reserve margins to satisfy demand; and (i) the development and implementation of programmes for the conservation of electricity.

p) Ghana National Fire Service Act of 1997 (Act 537)

The Ghana National Fire Service Act of 1997 (Act 537) states that a Fire Certificate shall be required for premises used as a public place or place of work. The owner or occupier of the premises shall apply to the Chief Fire Officer for a Fire Certificate, which will be valid for 12 months from the date of issue and subject to renewal. Hospitality facilities require a fire certificate.

q) Fire Precaution (Premises) Regulations, 2003, LI 1724

LI 1724 among other requirements requires that adequate measures are taken to eradicate potential sources of fire outbreaks and that a fire certificate be acquired for any project or facility.

r) The Constitution of the Republic of Ghana, 1992

The 1992 Constitution gives maximum protection to individual property rights. Private properties are only to be taken where there is compelling reasons for the state to interfere with such rights. Article 20 establishes that no property “shall be compulsorily taken possession of or acquired by the State” unless it is, among various purposes, “to promote the public benefit”.

The Constitution also provides that where private lands are surrendered for public good, the affected owners must not be made worse off. It states that “Compulsory acquisition of property by the State shall only be made under a law which makes provision for (a) the prompt payment of fair and adequate compensation; and (b) a right of access to the High Court by any person who has an interest in or right over the property. Further, “where a compulsory acquisition or possession of land affected by the State in accordance with clause (1) of this article involves displacement of any inhabitants, the State shall resettle the displaced inhabitants on suitable alternative land with due regard for their economic well-being and social and cultural values”.

s) New Lands Commission Act (2008) Act 767

Act 767 integrates the operations of public service land institutions under the Commission in order to secure effective and efficient land administration and to provide for related matters. The new Lands Commission is made up of the following divisions:

- Survey & Mapping Division
- Land Registration Division
- Land Valuation Division
- Public & Vested Lands Management Division

t) Immovable Property Rate Regulations (1975) LI 1049

LI 1049 applies for the purposes of valuation of immovable property.

u) Lands Statutory Way leaves Act, (1963) Act 186

Act 186 provides for entry on any land for the purpose of the construction, installation and maintenance of works of public utility, and for the creation of rights of way for such works. The owner/occupier of the land must be formally notified at least a week in advance of the intent to enter, and be given at least 24 hours' notice before actual entry. (An authorized person may enter at any time for the purpose of inspecting, maintaining, replacing or removing any specified works (Section 5). Any damage due to entry must be compensated in accordance with the established procedure, unless the land is restored or replaced. (In the case of roads, not

more than one-fifth of a plot may be taken and the remainder must be viable, or the entire plot must be taken; Section 6-3(b).

v) *The Lands (Statutory Way leaves) Regulations, 1964 (LI334)*

LI 1334 law restates the principles of the Lands (Statutory Way leaves) Act of 1963, and establishes provisions for Way leave Selection Committees to determine the optimal routing and to ensure that the selected way leaves are consistent with town and country planning.

w) *State Lands Act (1962) Act 125*

Act 125 vests in the President the authority to acquire land for the public good. The President “may, by Executive Instrument, declare any land specified in the instrument to be land required in the public interest” (Sect. 1-1). On the publication of an Instrument, the land shall, without any further assurance than this subsection, vest in the President on behalf of the Republic, free from any encumbrance whatsoever” (Sect. 1-3). The State Lands Act 1962 places responsibility for registering a claim on the party affected, for it recognises that it is only the affected person who can best establish the nature of his or her interest among others.

The State Lands Act, 1962 defines the terms “cost of disturbance”, “market value”, “and replacement value” and other damage (Sect. 7). “‘Cost of disturbance’ means the reasonable expenses incidental to any necessary change of residence or place of business by any person having a right or interest in the land.” “‘Market value’ means the sum of money which the land might have been expected to realize if sold in the open market by a willing seller at the time of the declaration made under section 1 of this Act.” “‘Replacement value’ means the value of the land where there is no demand or market for the land by reason of the situation or of the purpose for which the land was devoted at the time of the declaration made under section 1 of this Act, and shall be the amount required for reasonable re-instatement equivalent to the condition of the land at the date of the said declaration.” Finally, “‘other damage’ means damage sustained by any person having a right or interest in the land or in adjoining land at the date of the declaration made under section 1 of this Act, by reason of severance from or injurious affection to any adjoining land.”

x) *State Lands Regulations (1962) LI 230*

Established for the purpose of inspecting and making recommendations as to the suitability or otherwise of any land proposed to be acquired.

y) *Local Government Act 462 of 1993*

The Local Government Act 462 of 1993 devolves central administrative authority to the district level and fuses governmental agencies in any given region, district or locality into one administrative unit through the process of institutional integration, manpower absorption, composite budgeting and provision of funds for the decentralised services. The Act provides that Ghana shall have a system of local government and administration which shall, as far as practicable, be decentralized.

The Act accords local governments “functions, powers, responsibilities and resources”; support for “the capacity of local government authorities to plan, initiate, co-ordinate, manage and execute policies in respect of all matters affecting the people within their areas”; and a “sound financial base with adequate and reliable sources of revenue”; staff that is “subject to the effective control of local authorities.” **Article 241(3)** of the Constitution states that “Subject to this Constitution, a District Assembly (DA) shall be the highest political authority in the district, and shall have deliberative, legislative and executive powers.” **Art. 21(2) e.** of the LGA states that “The DA Executive committee is expected to “develop and execute approved plans of the units, area and towns and sub-metropolitan districts.”

z) Investment Code, PNDCL 116, 1985

The 1985 Investment Code, PNDCL 116, requires that the Ghana Investment Promotion Centre, which is the government agency for the promotion and coordination of private investment in the Ghanaian economy must in its appraisal of enterprise, have regards to any effect the enterprise is likely to have on the environment and the measure proposed for the prevention and control of any harmful events to the environment before giving approval for its establishment.

aa) Water Resources Commission Act, 1996

The Water Resources Commission Act, 1996 was to establish a Water Resources Commission, to provide for its composition and functions on the regulation and management of the utilization of water resources in Ghana and for related matters. The Commission shall be responsible for the regulation and management of the utilization of water resources and for the co-ordination of any policy in relation to them. The Commission shall propose comprehensive plans for the utilization, conservation, development and improvement of water resources; initiate, control and co-ordinate activities connected with the development and utilization of water resources; grant water rights; collect, collate, store and disseminate data or information on water resources in Ghana; require water user agencies to undertake scientific investigations, experiments or research into water resources in Ghana; and monitor and evaluate programmes for the operation and maintenance of water resources.

2.2 National Policy Documents

a) National Energy Policy

The National Energy Policy outlines the Government of Ghana’s policy direction regarding the current challenges facing the energy sector. The document provides a concise outline of the Government’s policy direction in order to contribute to a better understanding of Ghana’s Energy Policy framework. It is hoped that the document will facilitate the effective management and development of the energy sector as well as provide the public with information about the Government’s policy goals. The energy sector vision is to develop an “Energy Economy” to secure a reliable supply of high quality energy services for all sectors of the Ghanaian economy and also to become a major exporter of oil and power by 2012 and 2015 respectively.

b) National HIV/AIDS STI Policy (2004)

The National HIV/AIDS STI Policy has been developed to address the very serious health and developmental challenges posed by HIV/AIDS. The policy provides the framework for Ghana's strategy to reduce the spread of HIV infection. It provides the necessary statement of commitment around which a legislative framework will be built for an Expanded Multi-sectoral Response to reduce further spread of the epidemic, and for the protection and support of people infected with HIV/AIDS in Ghana.

Subsequently, a National HIV/AIDS Strategic Framework for Ghana has been formulated in recognition of the developmental relevance of the disease. Ghana, by this document has joined the global community in a united effort to combat the epidemic. The Strategic Framework document is updated periodically and it provides for a "Workplace HIV Policy". Ghana has now developed a National HIV/AIDS Strategic Plan 2011-15.

2.3 Guidelines

- a) Environmental Impact Assessment Guidelines for the Energy Sector (2010), Volume 1 has been prepared to ensure the sustainable use of energy resources and also contribute towards sound environmental management in the energy sector. Volume 2 of the Guidelines provides systematic procedures on EIS preparations for the energy sector as well as guidelines on common potential impacts and mitigation measures.
- b) Environmental Assessment in Ghana, A Guide (1996) produced by the EPA provides detailed guidance on the procedures to be adhered to when undertaking an EA.
- c) Environmental Quality Guidelines for Ambient Air (EPA) provides advice on maximum permissible levels of a variety of air pollutants. Guidelines are provided in *Table 1*.
- d) Environmental Quality Guidelines for Ambient Noise (EPA) provides advice on the maximum permissible noise levels. The permissible ambient noise levels guidelines of the EPA are presented in *Table 2*.
- e) Ghana's EPA Guidelines for discharges into natural water bodies provide maximum permissible concentrations for a number of parameters. Some guidelines are provided in *Table 3*.

Table 1: Environmental Quality Guidelines for Ambient Air

Substance	Time Weighted Average (TWA)		Averaging Time
Nitrogen Dioxide (NO ₂)	400 µg /m ³	Industrial	1 hour
	150 µg /m ³		24 hours
Sulphur Dioxide (SO ₂)	900 µg /m ³	Industrial	1 hour
	150 µg /m ³		24 hours
	80 µg /m ³		1 year
Particulate Matter (PM ₁₀)	70 µg /m ³	Industrial	24 hours
Total Suspended Particles (TSP)	230 µg /m ³	Industrial	24 hours
	75 µg /m ³		1 year
Smoke	150 µg /m ³	Industrial	24 hours
	50 µg /m ³		1 hour
Carbon Monoxide (CO)	100 µg /m ³	Industrial	15 minutes
	60 µg /m ³		30 minutes

Substance	Time Weighted Average (TWA)		Averaging Time
	30 $\mu\text{g}/\text{m}^3$		1 hour
	10 $\mu\text{g}/\text{m}^3$		8 hours

Table 2: EPA Guidelines for Ambient Noise

Zone	Description Of Area Of Noise Reception	Permissible Noise Level In Db (A)	
		DAY 0600 – 2200	NIGHT 2200 – 0600
A	Residential areas with negligible or infrequent transportation	65	48
B1	Educational (School) and health (hospital clinic) facilities	55	50
B2	Area with some commercial or light industry	60	55
C1	Area with some light industry, place of entertainment or public assembly and place of worship such as churches and mosques	65	60
C2	Predominantly commercial areas	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial areas	70	70

Table 3: EPA's Effluent Quality Guidelines for Discharges into Natural Water Bodies for Thermal Plants¹

Parameter	EPA Limit
pH	6-9
TDS(mg/l)	1000
COD(mg/l)	250
Total Suspended Solids (mg/l)	50
Oil & Grease (mg/l)	5
Conductivity(mg/l)	1500
Turbidity(mg/l)	75
Lead (mg/l)	0.1
Iron (mg/l)	2
Copper (mg/l)	0.5
Zinc (mg/l)	2
Total Chromium (mg/l)	0.05

¹ Reference EPA AKOBEN Program data forms

g) Guidelines for electric and magnetic fields

Electro-Magnetic Fields (EMF) can be produced wherever there is a voltage or a flow of electricity, and occur both naturally and as a result of man-made products, including transmission lines. In recent years there has been much debate on the potential human health effects of EMFs, in particular in relation to electromagnetic forces generated by transmission lines. However, major research programmes throughout the world have not shown any proven causal link between ill health and EMFs. Limits for electric and magnetic fields have been published by a number of authorities including the World Health Organization (WHO), the International Commission on Non Ionizing Radiation Protection (ICNIRP) and the National Radiological Protection Board (NRPB). The two most frequently used guidelines are those produced by ICNIRP (supported by the WHO) and the NRPB. These limits are detailed in Table 4.

Table 4: NRPB and ICNIRP Guidelines

	NRPB		ICNIRP	
	Electric (kV/m)	Magnetic (μ T)	Electric (kV/m)	Magnetic (μ T)
Public	12	1600	5	100
Occupational	12	1600	10	500

The NRPB produced guidelines on restrictions on exposure to static and time-varying EMFs in 1993. Their recommendations are based on biological data relating to thresholds for well-established direct and indirect effects of acute exposure. These guidelines have been widely accepted in the UK. For both sets of guidelines, the recommendations to restrict exposure are based on the interactions of EMFs with body tissues and are termed basic restrictions. Compliance with the basic restrictions cannot, however, be generally determined directly. Investigation levels (NRPB) / Reference levels (ICNIRP) are therefore recommended as values of measurable field quantities for assessing whether compliance with the basic restrictions has been achieved. The current advice from the NRPB is that, apart from standard safety clearances, no special precautions near to power lines are necessary to guard against EMFs. At the European Union level, a Council Recommendation to limit the exposure of the general public to electromagnetic fields was adopted in July 1999, based on the guidelines of the International Commission on Non Ionizing Radiation Protection.

h) World Bank's Operational Directive

The World Bank Group (WBG) and other lending and insurance institutions set criteria, policies and guidelines for environmental review and assessment that must be adhered to before their participation in projects. In order to ensure compliance with current international best practice, the EIA study for the KTPP is being carried out in accordance with the policies, safeguard procedures, and guidance of the World Bank Group. The World Bank screens projects based in their possible environmental impacts, in order to classify them as A, B or C. A thermal power development project is normally classified as a Category A project, owing to the potentially significant adverse environmental and social impacts, and this triggers a full environmental assessment. Detailed advice and guidance on the conduct of environmental assessment is provided publicly by the World Bank in its Environmental Assessment Sourcebook.

World Bank Pollution Prevention and Abatement Handbook 1998: Part III of the Handbook (which includes sections on new Thermal Power plants and rehabilitation of existing plants), provides guidelines for pollution reduction as well as maximum emissions levels normally achievable through combination of cleaner production and end-of-pipe treatment. The guidelines are designed to protect human health, reduce mass loadings to the environment, and draw on commercially proven technologies among others.

The International Finance Corporation (IFC) is a member of the World Bank Group, which also includes the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), and the Multilateral Investment Guarantee Agency (MIGA). IFC's business is investment in private sector projects through loans, equity investment, and other financial instruments. It is IFC policy that all its operations are carried out in an environmentally and socially responsible manner.

To this end, IFC projects must comply with applicable IFC environmental, social and disclosure policies. In addition, IFC applies World Bank Group environmental, health and safety guidelines to all projects. In sectors where no appropriate IFC policies or guidelines exist, IFC applies relevant internationally recognized standards. Furthermore, the project sponsor must ensure compliance with host country requirements.

The IFC produces a number of Guidance Notes and other reference documents providing advice on undertaking EIA. Those of relevance to the KTPP include:

- Guidance Note A - Checklist of potential issues for an Environmental Assessment.
- Guidance Note B - Content of an Environmental Impact Assessment report.
- Guidance Note C - Outline of an Environmental Action Plan.

Detailed advice and guidance on the conduct of environmental assessment is provided publicly by the World Bank in its Environmental Assessment Sourcebook. Since financial support from development partners is envisaged for the KTPP, the EIA has been undertaken in accordance with their requirements.

2.4 VRA's Occupational Safety, Health & Environmental Policies

a) VRA Corporate Environmental Policy Statement²

The *VRA Corporate Environmental Policy Statement* commits the organization to ensuring continuous improvement of environmental performance to minimize the impacts of all its operations on the environment, in line with the principles of sustainable development, in addition to complying with national and international environmental protection regulations.

² See Page (i)

b) VRA Environmental & Social Frameworks

VRA in order to carry out its obligations under the Environmental Assessment Regulations Agency LI 1652 and the Ghana Energy Development and Access Project (GEDAP) prepared an “Environmental & Social Management Framework” document outlining how the Ghanaian Environmental Assessment Regulations are followed during construction and operations of its power projects.

In addition, a “Land Acquisition & Resettlement Policy Framework”³ which establishes broad principles, organizational arrangements and fair criteria to be applied in acquiring various interests in land and handling the attendant impacts on Property Affected Persons was also prepared and is under implementation. The document identifies categories of project-affected persons (PAPs), modes of land acquisition, format and content of a resettlement action plan (RAP), compensation matrix, valuation of affected properties and the assessment/payment of compensation entitlements. Other details of the document include the time frame for payment of compensation, conflict resolution or grievance procedure, monitoring and evaluation and records management. The Framework defines in specific terms the major legal and regulatory framework governing land acquisition for power generation and transmission activities in Ghana. Even though these frameworks were prepared under GEDAP, they are relevant for all VRA’s projects.

c) VRA Corporate Health & Safety Policy

The VRA Corporate Health & Safety Policy commits the organisation to ensuring that all employees work in an injury-free environment where safety is paramount with continuous drive to improve on safety. All VRA personnel are to make health and safety a way of life. A Corporate Safety Rules & Standards Protection Code documents have subsequently been prepared to inform, educate and ensure adherence.

The VRA’s Safety Rules provides information on major safety areas as follows:

- General safety rules for workers engaged in construction, operation or maintenance work;
- Safety guidelines related to the use of tools and equipment;
- Safety procedures associated with the transportation and of personnel and materials;
- Safety procedures relating to Transmission line work;
- Safety procedures for materials handling, storage and disposal.

d) VRA Corporate “Workplace HIV/AIDS Policy”

VRA has developed a “Workplace HIV/AIDS Policy” to serve as a guide to both employees and Management in their endeavours to mitigate the impact of HIV/AIDS in both VRA and its business environment and work locations.

³ See Appendix 1 for “Land Acquisition & Resettlement Policy Framework

3.0 KPONE THERMAL POWER PROJECT

This Section provides a description of the Kpone Thermal Power Project components, considering the construction, demobilisation, operation and maintenance stages of all elements of the project. The decommissioning stage of the project is provided under Section 11.0.

3.1 General Definition of Project

The proposed KTPP will be capable of generating about 220MW of electricity and will be operated by the Volta River Authority in conjunction with a Joint venture partner. KTPP will comprise of the following elements:

- (e) A power generation plant, equipped with 2 x 110MW Alstom GT11N2 (EV) Gas Turbine Generators Simple Cycle Power Plant with a total of 220 MW gross installed capacity.
- (f) Approximately 500 m of new 161 kV single circuit overhead transmission line between the KTPP site to the existing Ghana Grid Company's 161 kV Akosombo – Tema Transmission Line running through Kpone.
- (g) Approximately 11.15 km natural gas pipeline running from Regulatory & Metering Substation of the West Africa Gas Pipeline Company in Tema to the KTPP site.
- (h) Approximately 2km diesel oil pipeline running from the storage depot of the Bulk Oil Supply & Transportation (BOST) to the KTPP site. The proposed pipeline is expected to be constructed within the RoW of the existing diesel pipeline from the storage depot to their storage site "Maame Water", near Akosombo, which lies about 10 meters near the western fence wall of the KTPP site.

The 2 x 110MW Alstom GT11N2 (EV) Gas Turbine Generators have already been procured from Alstom (Switzerland) and available in-country for installation. An EPC Contractor will be engaged to undertake the installation of the supplied equipment as well as the engineering, procurement and construction of the Balance of Plant (BoP) to make the Station functional. The specifications of all equipment will comply with the international standards as much as possible to ensure an economical design and compatibility with the existing facilities and equipment. All equipment will also have the minimum but necessary configuration to achieve the objectives of the Project. The plant shall be designed for a 25 calendar year life. The gas turbines will be fired principally on natural gas but distillate fuel oil will be used as an alternative.

Under a second phase of the development of KTPP, an additional 110 MW steam component will be installed for the plant to eventually consist of a 330 MW combined cycle generation facility through the conversion of the plant to a full combined cycle status with the installation of a Steam Turbine Generator (STG) and associated Heat Recovery Steam Generators (HRSGs). It is further anticipated that an additional generation of a 500MW will be installed in future to raise the total output of the Station to about 800MW. This EIA study will however cover only the first phase of the project development.

3.2 Project Location⁴

The project site is within the VRA land situated at Nmlitsapko, about 2 kilometres off the road from the Kpone Barrier on the Tema-Aflao road (One kilometre from the barrier to the turn-off junction and about one kilometre off the junction on the Tema-Dawhenya road to the project). Specifically, its location is in the northern section of Community 25, Kpone in the Tema Metropolitan Assembly in the Greater Accra Region of Ghana. The size of the power plant site is about 75 acres (30 Hectares) in size. The power plant and its associated facilities will occupy less than one-third of the land.



Plate 1: KTPP site with BOST tank farms in the background

The land was selected such that it is strategically located close (about 500m) to the Ghana Grid Company's 161 kV transmission line and about 2 kilometres north of the Bulk Oil Supply & Transportation (BOST) Company Limited bulk petroleum storage tank farm (See Plate 1), off the Tema – Aflao highway to allow for a cost effective interconnection to these facilities.

3.3 Technical Description of Project

Construction of KTPP shall be divided in 4 main lots, as follows⁵:

- a) Lot 1: Procurement and Installation of Gas Turbine Generator with its auxiliaries:
- b) Lot 2: Mechanical Balance of Plant (MBoP)
 - Natural Gas System
 - Liquid Fuel System
 - Fuel Oil Storage System
 - Instrument and Service Air System
 - Water and Waste Water Treatment System
 - Fire-fighting and Detection System
- c) Lot 3: Electrical Balance of Plant (EBoP)
 - Station Service and Unit Systems
 - Switchyard
 - System and Equipment Protection
 - Control Rooms
 - Local Operator Panels

⁴ Site Map Showing Plot Area Boundary Line is enclosed as part of Appendix 2

⁵ Map Showing Equipment Lay-out Plan for KTPP is enclosed as part of Appendix 2

- Environmental Monitoring (Continuous Emission Monitoring)
- d) Lot 4: Civil Works
 - Laboratory
 - Site development
 - Upgrading of access road to Site
 - Gas Turbine Building
 - Gas Turbine Foundation
 - Exhaust Stack Foundation
 - Transformer Area
 - Switchyard Foundation
 - Control & Switchgear Building
 - Diesel Generator Building
 - Plant Roads
 - Storm water drainage
 - Sanitary Sewerage System
 - Sanitary Wastewater System
 - Boundary Fencing and Gates
 - Parking Area
 - Gate house
 - Administration Building
 - Building for Employees' Facilities
 - Workshop and Plant Maintenance Building comprising of the following:
 - Central Area
 - Mechanical Workshop
 - Electrical Workshop
 - Welding Workshop
 - Instrument Shop
 - Tool Crib and Parts Storage
 - Waste Oil Storage
 - Service Rooms
 - Fire Trucks Garage
 - Yard Maintenance Equipment Storage

Building and structures for the thermal power plant i.e., the walls, partitions, structural elements, floors, ceilings, roofs and exits shall be constructed of approved non-combustible materials and protected to afford the required fire-resistance rating. Every room intended for occupancy shall be provided with natural and artificial light and natural and mechanical ventilation. Habitable rooms shall have a ceiling height of not less than 2,400mm. Access to exits shall have a minimum clear ceiling height of 2,400mm. Every building and structure shall have appropriate numbers of exits to provide safe and continuous means of egress to a roadway or an open space with direct access to a street. All buildings shall have at least two exits from each floor. These exits shall be

placed as remote from each other as is practical, with due consideration for potential process hazards in the building. All electrical rooms shall have two means of egress.

Unless otherwise stated, the latest editions of North American codes and standards (e.g., OSHA, ASTM, ACI, ASME, ISA, API, UBC, and BOCA) are to be used on KTPP, further, the latest edition of Ghana Building Code is also to be utilised on the project.

3.4 Plant Duty

3.4.1 Good Engineering Design

3.4.1.1 General

The works shall be designed for ease of operation and maintenance. Appropriate concern shall be given to the working environment, safety and operator efficiency. The Works shall be designed, arranged and illuminated to encourage plant cleanliness and to prevent the egress, spreading and/or accumulation of dust, fumes, heat, dirt and noise. The generator shall be provided with the means to control the intended production using reliable technology with the most efficient use of human effort (both physical and mental), without undue exposure to hazardous substances and risks of accident. The Works shall be designed to discourage unsafe and inefficient operation and to allow the operator to concentrate on performing the required duties without distraction from uncontrolled or abnormal conditions. The Works shall also be designed to cope with upset conditions. The design process shall involve an analysis of the hazards involved and shall include the development of safe operation and protection from hazardous conditions.

The control system philosophy shall be based on safe and efficient operation of the total generating facility including auxiliary systems using control rooms to permit safe start-up operation and shutdown, and rapid operator response to anomalies. The power generating system and equipment shall be protected by a coordinated safety system that shall trip the generating units in safe and orderly fashion in the event of equipment failure or a major electrical system upset.

3.4.1.2 Process

Process design shall account for start-up, shut down, full-load operation, part-load operation, and upsets with respect to Safety economics, Cleanliness, and Control of effluents and discharges. All process water shall be recycled for reuse whenever possible. The process design shall include suitable design factors so that all equipment shall unless otherwise indicated be capable of handling upset process flows 1.20 times normal flows.

3.4.1.3 Layout of Plant and Equipment

The layout of plant and equipment shall be organized such that workers shall not pass through hazardous areas for normal access to and from operating areas. Access to equipment shall be well planned with adequate floor area or appropriate platforms and stairs provided. The platform layouts shall be designed to shorten and simplify routes between equipment requiring common operator access and egress to operating areas and equipment. Stairs rather than ladders shall be used. Adequate draw out and lay down areas adjacent to the equipment shall be provided for maintainability, lifting beams, monorails, cranes, hoist wells, equipment

washing facilities, drains, and compressed air stations shall be provided such that required maintenance and clean-up can be conducted efficiently. Concrete floors are preferred. A smooth finish shall be provided in dry areas and a non-slip finish with good drainage in wet areas. Natural lighting shall be used where possible and shall be supplemented by artificial lighting to achieve appropriate lighting levels. Where required, noise abatement shall be employed by using acoustic-absorbing baffles or noise barriers around equipment. Inherently noisy equipment shall be isolated in separate rooms or buildings. Trees shall be used to provide visual screening and assist sound attenuation.

3.4.2 Facilities

3.4.2.1 Generating Facility

The generating facility will comprise the main power generating equipment of combustion turbine generators (CTGs) and related auxiliary equipment. The CTG area equipment comprises the Combustion Turbine Generator (CTG) units, generator transformers, auxiliary equipment, controls, and the power plant. The CTGs shall be provided as part of a combined cycle power block that includes one Steam Turbine Generator (STG). The CTGs shall be suitable for firing, as the primary fuel, Diesel Fuel Oil (DFO) or Natural Gas when it is available at site. The primary cooling shall be provided by ambient air. Forced air cooling finned coils are preferred because of a shortage of water. The coil surface and the operating air temperatures shall be suitable under all specified ambient air temperatures. The compressed air facility and diesel generator will be located in the service building and the transformers shall be located outdoors.

3.4.2.2 Extent of Facilities

The generating facility shall include, but not be limited to the following:

- A CTG facility consisting of all systems and equipment for functional, simple cycle operation, and provision for conversion to combined cycle operation, including
- CTG units and associated auxiliaries including air filters, silencers, ducting, instrumentation, local panel and controls, cooling systems, tuning gear, starting systems, acoustical panels, ventilation, lubricating oil systems, fuel systems compressor and turbine wash systems, water injection systems and excitation systems.
- Exhaust plenums, expansion joints, transition pieces, stacks
- Compressed service air and instrument air distribution systems
- Equipment enclosures for protection of the CTG and related auxiliary equipment
- Foundations for equipment and enclosures
- Concrete floor slab laydown areas around the CTGs
- Overhead travelling cranes, craneways, supporting structure and associated foundations
- Closed loop cooling systems for auxiliary plant
- Emergency diesel generating plant
- Plant auxiliary electrical systems, including the Uninterruptible Power Supply (UPS) and Direct Current System
- Service building for the plant compressed air system and the emergency diesel generating plant

- The central control facility
- Balance of Plant
- Provision shall be included in the generating facility layout for the future combined cycle system
- Transmission Yard and Trans Control Building

3.5 Project Activities

The construction of the plant will involve the following activities:

3.5.1 Pre-construction Phase

3.5.1.1 Land Acquisition/Compensation Issues

The proposed project site of 30 Hectares was acquired from the Tema Development Corporation by VRA in the 1970s and earmarked for the project as well as for future expansion. In 1999, the Tema Development Corporation (TDC) granted a lease of 60 year term with an option to renew for further 20 years in respect of the site. The VRA has paid compensation and continues to pay the ground rent since the right of entry was granted. The VRA has since been in effective occupation of the site.

However, prior to project commencement, it was noted that various farmers had cultivated annual crops on the site. There were also various temporal structures built by squatters on the land. Various housing units are also located within the proposed RoW of the associated transmission line and these would have to be demolished to allow for the construction of the transmission line. Demolishing of structures that would be associated with the project would result in displacement of communities, loss of business, properties and incomes, social stress, social and psychological disruption for the affected individuals and families. This potential adverse effect on land ownership and land-use requires mitigation measures to minimize the impact on individuals, communities and stools. This will need to be properly managed through compensation, sensitization and information sharing, establishment of a grievance procedure, etc.

3.5.1.2 Preparation of EIA for Environmental Permit

EIS preparation is mandatory to allow for the commencement of the physical construction for such a project. Various activities have been undertaken regarding the acquisition of Environmental Permit for the project including the finalisation of this EIS document.

3.5.1.3 Consultations with Relevant Agencies and Service Providers

Extensive consultations have been carried out with Project Affected Persons (PAPs), State Agencies and Service providers and these have been reported herein. Indeed, a public hearing was organised by the EPA at the project site on April 29, 2010. This forum was to help create an opportunity for VRA and the public to interact to address key issues and other public concerns of the proposed project particularly, the compensation issues and initial concerns raised by some residents and Project Affected People (PAPs) of Community 25 about the project. A Stakeholder hearing was undertaken on May 30, 2012 at the KTPP site, to enable all local stakeholders, including neighbouring industries and communities to provide comments on the project as it was being registered under the Clean Development Mechanism (CDM), a project-based mechanism for the

greenhouse gas emission reduction under the Kyoto Protocol. Details of the consultations undertaken so far are provided in Chapter 10 of this report.

3.5.1.4. Site Clearing / Land Preparation

The land has currently been cleared and a security fence wall erected around the entire site as a form of a security measure to protect the site from intruders (See *Plate 2*). Land preparations for construction activities are however yet to be done as this is dependent on the engagement of a contractor for the works.

The existing grade having an elevation of approximately 45m above mean sea level which needs to be levelled and compacted to the designed elevation. The site shall be cleared of existing facilities and obstructions together with their foundations. Vegetation, scrub, or similar material shall be uprooted completely and disposed of and the area cleaned up in an acceptable manner. The main site preparation activities for KTPP shall largely comprise of additional ground works on the allocated site, namely land raising/grading and excavations for the Combustion Turbine Generations (CTG) foundations. The major excavations for KTPP are those required for the CTG foundations. Excess material generated during excavations will be either re-used or placed with other spoil material in the allocated area within the power plant site. This area may subsequently be used as a construction laydown area. Site preparation activities are scheduled to commence within six months of project initiation and will continue for four months.

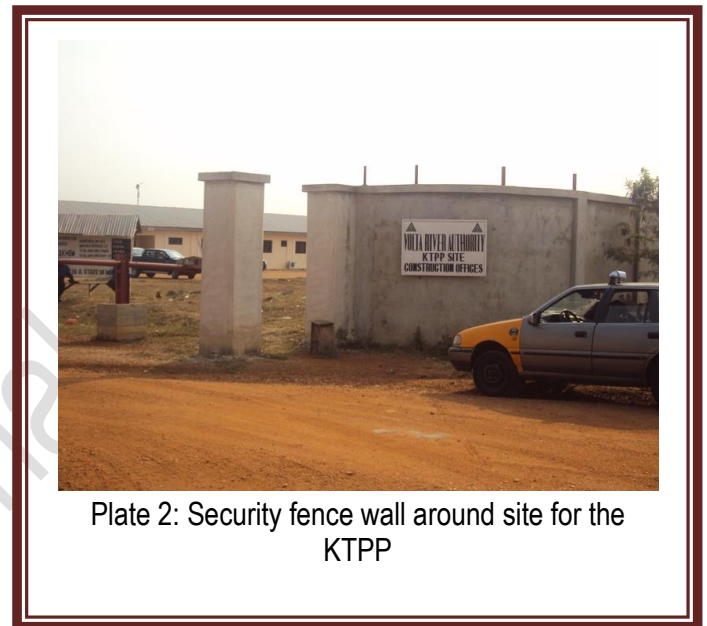


Plate 2: Security fence wall around site for the KTPP

The final arrangement of the power plant shall be determined to suit the major equipment including those to be installed under combined cycle system and future expansion works, the site conditions and the requirements of project schedule. The preparation shall include clearing, grading, drainage and storm water management, erosion and flood protection, access and site roads, berms, fencing, security and landscaping. Grading and protection of the site shall be designed to prevent flooding of the power plant and associated facilities. All roads including access and site roads shall be paved and shall, as a minimum requirement, be designed for the same loading as major Ghana highway roads.

Road to the project site is also in existence and this comprise of an un-tarred road which shall be used as-is during construction. VRA shall however upgrade the road with an asphaltic concrete with street lights after the construction of the power station to allow for all defects arising from heavy equipment transportation to be corrected.

The main issues of concern are erosion, emission of dust, safety and to a minimum extent, impact on flora and fauna.

3.5.2 Construction Phase

3.5.2.1 Construction Overview

The following activities will be undertaken during construction:

- Civil works to prepare the site;
- Delivery and installation of plant;
- Installation of and connection to the transformer;
- Erection of fuel supply tanks and interconnecting pipe work;
- Installation of fire water tanks and fire protection system;
- Installation of oily waste separator;
- Installation of drainage facilities;
- Installation of a fence around the site (this has been completed);
- Connection to grid

The detailed design and specification for the power plant and associated facilities (transmission lines and gas/diesel pipelines) shall be based on the current available designs for the construction and operation of KTPP. The civil works will include the full detailed design, preparation of construction drawings, site levelling, construction, completion and maintenance of main and any ancillary buildings, equipment supports, associated structures, foundations and services, cableways and ducts and trenches. The contractor will prepare comprehensive method statements for all major construction activities and submit these to VRA for approval prior to the commencement of the relevant activity. Site preparation will include vegetation clearing, earthworks and the removal of soil/rock to level the site and to install the foundations and services for the power plant and associated equipment. No piling is required. The project would install potable water tanks and demineralised water tanks for the production of demineralised water for plant operations. Estimated average construction vehicle movements are 20 trucks and 10 cars per day.

The following activities will require water during construction: concrete mixing, flushing, testing and filling of cooling systems and fire fighting system. Raw water for constructional purposes will be supplied by the contractor in tankers and kept in water storage facilities which shall be provided on site to meet constructional requirements at all times. The contractor is responsible for supplying potable water for drinking purposes, waste disposal facilities and sanitary facilities during construction.

The project will consume about 30Kwh mainly for site operation, lighting purposes and constructional work, during the constructional period. Power for construction and project activities will be obtained from the existing 33kV power system lines of the Electricity Company of Ghana (ECG) at the site which was connected by the

Ministry of Energy on behalf of VRA as well as a 135kV Stand-by generator. Transformers will be installed for the operations of the thermal plant.

As at now, the Commercial Operation Date (COD) is yet to be fixed, however, the total period from the notice to proceed / advance payment to the commissioning phase is estimated to be about fourteen (14) months, further, the issuances of Provisional Acceptance of Certificate for the two turbines are also expected to be completed by close of the nineteenth (19) month. It is anticipated that construction activities will be undertaken within normal working hours. Due to the tight schedule, some activities may be undertaken out of the normal working hours; this will be agreed with VRA.

3.5.2.2 Engineering Procurement & Manufacturing

The initial contractor of the project was Zakhem International Construction Company. It is expected that following the completion of the joint venture arrangements, contractual arrangements may change and different firms may be engaged for the project constructional activities. However, it is hoped that Zakheim will be maintained. At that stage, an Engineering, Procurement & Construction (EPC) Contractor will be responsible for engineering, manufacturing and/or procuring the power plant and associated components. It is expected that the Project Contractors would carry out all civil works in connection with the proposed KTPP. Building materials required for construction of the plant are varied. Some of the important ones include cement, steel rods, electricity cables, plumbing materials, sand, laterite, stones, and roofing materials, among others. These will be obtained from local sources, and will be hauled to the project site. The main issue here is acquisition of such raw materials of appropriate quality to ensure the integrity of the various structures.

The 2 x 110MW Alstom GT11N2 (EV) Gas Turbine Generators have already been procured from Alstom (Switzerland) and available in-country for installation. The majority of plant components will be manufactured and procured internationally as they are not available for purchase in Ghana. Such equipment will be procured taken into consideration, past importation records of such equipment, the operation and maintenance capability of the VRA and other relevant matters. In addition, the necessary spare parts, testing instruments, maintenance tools and operation and maintenance manuals will be provided as part of the project.

The specifications of the new equipment will comply with the international standards as much as possible to ensure an economical design and compatibility with the existing facilities and equipment. The equipment will also have the minimum but necessary configuration to achieve the objectives of the Project. It is expected that the materials and equipment will be stored either within the existing KTPP site or at the storage site of VRA's Procurement Department or in selected warehouses in Tema, whichever may be agreed upon with the contractor. The main issues of concern are the sources of some of the materials, delivery of the materials and the disposal of waste materials.

With respect to labour, about 200 construction workers both skilled and unskilled would be required. Unskilled construction workers will be sourced from local villages, skilled labour will be obtained nationally and highly skilled workers and supervisors will be sourced from overseas.

The contractor will be contractually required to follow best environmental practices and exercise due care in order to limit adverse impacts on the surrounding human and natural environment. Indeed, as a policy all contractors hired by VRA are required to prepare comprehensive method statements for all major construction activities and submit these to VRA. Apart from submitting such method statements, it must be noted that whether an Environmental Impact Statement (EIS) and/or an Environmental Management Plan (EMP) is prepared for a particular project, it is important that before the order to commence any works the Contractor is also required to prepare a Contractor's Management Plan as well as a Health & Safety Plan for each subproject within a Lot as specified in this EIS document. The Contractor's Management Plan shall spell out how they will achieve environmental targets and objectives specified in the EIS/EMP.

The Contractor shall implement all measures necessary to restore the sites to acceptable standards and abide by environmental performance indicators specified in the Projects EIS/EMP to measure progress towards achieving objectives during execution or upon completion of any works. These practices and associated mitigation measures are discussed in details in Section 7 of this EIS. Furthermore, VRA will undertake environmental monitoring programs during the various stages of the project to assess the effectiveness of the mitigation measures. Further details are contained in Sections 8 and 9.

3.5.2.3 Transportation of equipment to the sites

The equipment procured will be landed at the Port of Tema and will then be transported overland to the project site, about 20 km away, making careful packing of the equipment essential to avoid any problems at the transportation stage. After clearance from the port, these materials and equipment will be transported by road to the designated storage site. These materials and equipment could be bulky and may require specialized vehicles with security to ensure safety during transportation. Access to the power plant site will be via existing routes used for KTPP. Materials and equipment procured locally or nationally will be transported directly to the storage site. It must be noted that locally procured materials will not be bulky and unwieldy. They will therefore not require any specialised vehicles. During construction, the materials will be transported to the site via public roads and access tracks. Issues on traffic and transportation effects are critical with such activities.

3.5.2.4 Construction of Site Office and Store

A site office is in existence for the VRA workers required for the supervision of the construction of the thermal power plant. These same offices shall be used by staff operating the plant. A temporary site office would also be constructed of wooden materials and of containers for the contractors, construction engineers and technicians, and for storage of



Plate 3: Storage site at KTPP for constructional materials

construction materials (See *Plate 3*). No residential facilities are planned for the construction at the power plant site, and it is anticipated that most of the construction workforce will be coming from Tema and Ashaiman. The temporary site office and storage facility will be demobilised after the construction phase. The main issue of concern is the safety at construction site.

3.5.2.5 Construction of Thermal Power Plant

The construction of the power plant will involve extensive civil and mechanical installation works. The civil works would involve grading and compacting of site, construction of foundations for the gas turbine, generators, and other balance of plant, as well as plant site roads. The main issues of concern are the safety at construction, noise and dust generation. Construction works such as grading, excavation, backfilling, paving, and turbine/balance of plant foundation construction entail the use of heavy duty equipment transporting quarry materials to construction site and evacuating excavated material off site. These activities will result in the emission of dust.

The drainage, sanitary and sewerage systems will be constructed to accommodate KTPP requirements. The embankment, its slopes and drainage facilities shall all be within the boundaries of the project site depicted by the benchmarks provided on the site plan included in the enquiry drawings. Rainfall run-off and general drainage of the Power plant, substation yard, customer service area, car parking and landscaped areas shall be carried by appropriately sized reinforced concrete perimeter open channel drains to an appropriate outfall as shall be approved by VRA. To prevent possible flooding of the power plant in extreme precipitation conditions, e.g. 50-year return period flood, the final level of the compacted laterite base course of the plant embankment shall be at least 0.3m above existing ground levels of the adjoining areas. Cable trenches shall be provided with adequate slopes and their invert levels shall be such that the trenches can be drained through an appropriately sized PVC pipes into the nearest point in the perimeter drains where gravity flow can be achieved.

In order to prevent flow of water into the plant and control buildings, cable trenches shall be sloped and drained away from such buildings. VRA in conjunction with the Contractor shall study the project site and determine the need to provide additional drainage to divert runoff from the catchment area away from the plant site. When it is determined that catchment drainage is required to minimize the risk of the substation against flooding, VRA shall liaise with the local planning authority and provide a suitable design for construction by the contractor. In addition, the design of the cable entry into the plant and control room shall be such that they are as much as possible, water and air tight.

3.5.2.6 Development of Site Yard and Fire Buffer Zone

The yard surface is defined, as any area of the site not occupied by the parking area, buildings, foundations, cable ducts, or by other structures or equipment. Appropriately designed trench-drains to direct run-off to the perimeter drains shall be provided to drain off plant / substation yard areas cut-off by cable trenches. The layouts of driveways shall be determined by the arrangement of buildings, power plant, transformer and other foundations. Such driveways shall have a width of 5 meters. The Contractor shall provide suitable access

driveways up to the off-loading bays of the control building. In addition, provision must be made for other access roads necessary for the proper movement, installation and post construction maintenance of all the major installed plant indicated on the conceptual drawings.

The Contractor shall provide adequate access and facilities for the delivery and removal of plant equipment, including transformers. These shall be designed to safely withstand all jacking of point loads, etc., and adequate haulage bollards or rings shall be provided where necessary. Where driveways or transformer accesses pass over services like cables trenches or duct banks, special designs shall be incorporated to prevent damage to such services. The design and construction of driveways shall take full account of the information provided by the Site Investigation and embankment soil test results. The switchyard shall then be finished with a 100mm thick course of 25-50mm broken stones or chippings. There shall be no special treatment required for areas earmarked for driveways other than that which is required for the general finishing of the entire plant yard.

Planting of trees to serve as a fire buffer zone (15 m from fence wall around entire power plant) as well as greening of the site for aesthetic purposes has been made part of the design specifications. Green grass shall also be grown on black soil (of appropriate thickness) as part of the landscaping required for the project. The Contractor shall water and care for the grass until it has taken firm roots and fully covered the landscaping area before handing over to VRA.

3.5.2.7 Construction of Natural Gas System

The main fuel to be used shall be that of natural gas from the West Africa Gas Pipeline Company. A survey of the gas pipeline corridor was carried out by Arcscale Consulting, an architectural and engineering firm in Accra on the contours, features and spotlights in the corridor in July 2008 and the full report is attached⁶.

From the reconnaissance survey carried out on the gas pipeline alignment, the site starts from the Tema Regulating and Metering Station of the West Africa Gas Pipeline Company, close to the Atlantic Ocean and south east of the KTPP Site of Community 25. The route traverses along the VALCO fence, crosses the Tema – Kpone Road then passes by the Mines Reserve Power Plant. Thereafter, it follows the GRIDCo transmission lines up to the GRIDCo Volta Substation and crosses the Tema – Dawhenya - Aflao road. The alignment continues by the Tema Golf Park through the

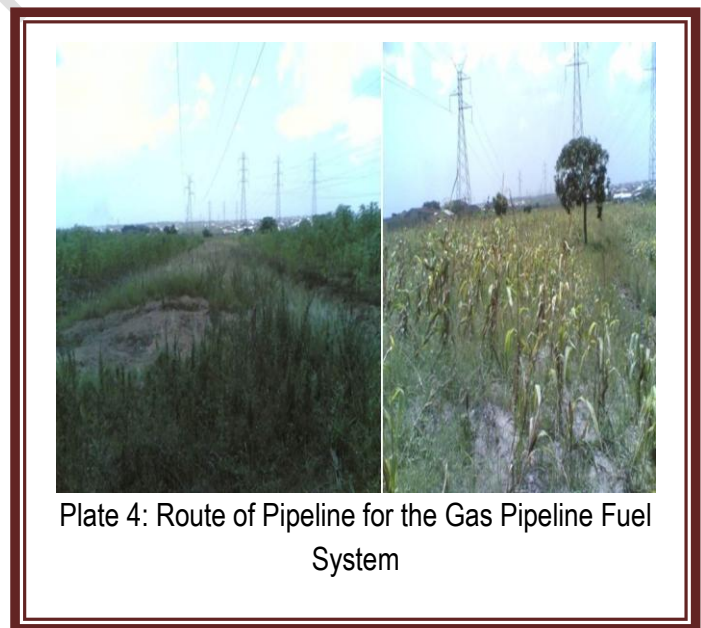


Plate 4: Route of Pipeline for the Gas Pipeline Fuel System

⁶ Gas Pipeline Survey Report is attached as Appendix 3

Bethlehem Village and turns right close to terminal point 1 (TPI) of the KTPP site and to the plant site. The total traversed distance is 11.15km.

The route for gas pipeline to the KTPP site is planned to be mainly within the existing GRIDCo 161 kV transmission line (See Plate 4). The reason for this route selection was to avoid intruding into lands belonging to other people. It must be mentioned that the line only had a small level of economic activity. This could be estimated at less than 10% of the route. The main activity observed was farming of corn and cassava.

Topographic survey has been at cross sections at 25 meter intervals. All features such as pylons, walls, roads, drains etc. have been captured in the survey. Bench marks have been established to assist in the setting out during construction. Based on the topographic survey, maps have been produced showing spot heights, contours and features. The results of the survey have been presented in both electronic and hard copy. The spot heights elevations obtained for the survey have all been referenced to the National Level Data in Ghana. The main difficulties are the crossing of the Tema – Aflao Road which is a dual carriageway and asphalted surfacing and the lack of many details around the GRIDCo Substation. These areas and others may require attention during the design of the pipeline and subsequent construction.

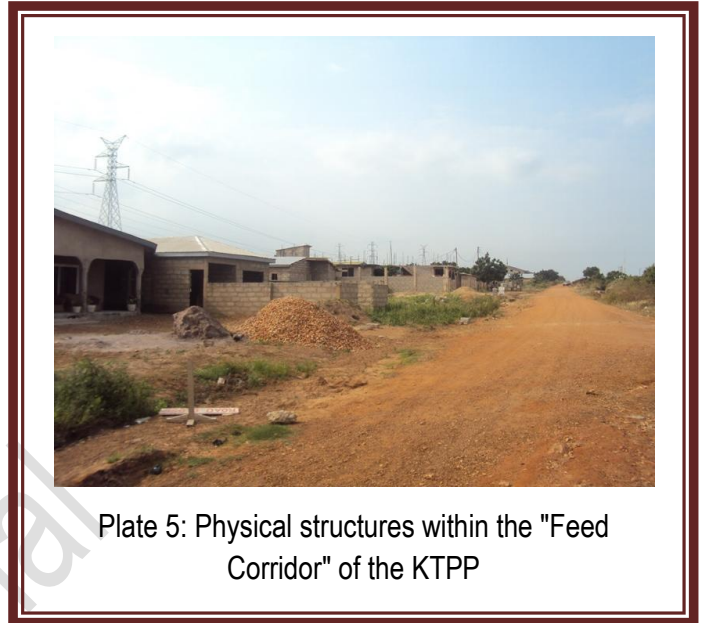


Plate 5: Physical structures within the "Feed Corridor" of the KTPP

The area adjacent to the KTPP site which we have called "Feed Corridor" or the Pickup between road and pylons have a number of completed and uncompleted structures. The "Feed Corridor" measures 173m on the north, 800m on the west, 127m on the south and 929m on the east adjoining Community 25 to Bethlehem Village road. According to the Report, 38 housing structures were identified during the survey as part of the physical structures plotted on the map. Thirty of the houses had been completed and eight were uncompleted and are all located within the RoW of the proposed Transmission line facility. These houses are to be impacted upon by the project and would be demolished to pave way for constructional activities of the transmission lines (See Plate 5).

3.5.2.8 Construction of Liquid Fuel System

Currently, it is expected that the main fuel to be used shall be natural gas to be supplied by the West Africa Gas Pipeline Company. However, the gas turbine generators shall also be fired with distillate oil as backup fuel in case of absence of fuel gas supply and during pressure drop in the gas supply system. The distillate oil will be supplied by the Bulk Oil Supply & Transportation (BOST) Company pipeline. VRA shall acquire a dedicated tank at the storage site of BOST at Community 25, Kpone. There is currently an existing diesel pipeline

running close (about 10 m) to the KTPP site which is from the BOST Storage site to the “Maame Water” site near Akosombo. It is expected that the diesel pipeline for the KTPP shall be constructed within the RoW of this pipeline and then shall tee off to the KTPP Site⁷. A detailed drawing on the pipeline route is to be prepared by the project contractors upon award of contract and the line route is confirmed and agreed upon. VRA in August 2012 formally requested for a meeting with BOST to discuss project implementation strategies⁸.

One (1No.) 200% fuel oil treatment plant shall be capable of treating fuel oil to meet the quality requirements for gas turbine units as per recommendation of the gas turbine manufacturer. The fuel oil treatment plant shall be having multiple treatment lines so that the stand-by line will always be available to switchover for treatment process. The raw fuel oil shall be thoroughly mixed with water (preferable dematerialised water from demineralised water plant) to dilute and transfer the soluble alkaline salts and heavy metal from the fuel into the water phase. The water phase shall then be separated and discharged as an effluent. The fuel/water separation process shall be accomplished by centrifugation. Two (2) storage tanks, each with 14,000m³, with a resulting storage capacity allowing for about 14 days of base load distillate oil operation of two gas turbines shall be available on site. The storage tanks will be vertical circular single shell type with fixed cover and with steel ladder to enable transfer of distillate oil from the tanks. The two (2) oil storage facilities shall be provided with bunds of sufficient height to retain the full content of the tank capacity in case a spill occurs.

The forwarding pump station transferring the distillate oil to the gas turbines by means of three (3) 50% distillate oil forwarding pumps, of which each is designed to satisfy the need of two gas turbines a rated load. The second pump is provided as a standby and will be switched on in emergency cases. The pumps will be centrifugal horizontal type installed and arranged in a forwarding pump station near the storage tanks. The system shall also comprise of duplex oil filters each of 3 x 50% capacity in the upstream of the forwarding pumps as well as two (2) 100% filling pumps transferring the distillate oil to the day tank of emergency diesel generator and fire fighting diesel foam pump.

3.5.2.9 Construction of Transmission Line System

Various discussions have been held between VRA and GRIDCo to determine the transmission system requirements for the evacuation of power from the plant and evaluate the impact of the generation on the transmission system. The current plan for the transmission system component is to cut into three (3) circuits of the existing lines and divert them into the switchyard of the new KTPP Plant. The existing Kpong Generating Station to Volta Switchyard single circuit 'Hawthorn' conductor line as well as 1No double circuit 'Mistletoe' conductor lines from Akosombo to Volta switchyard in Tema are to be diverted into and out of the new switchyard at KTPP site.

The distance between the new switchyard and the existing lines is approximately 500m. The switchyard design is a breaker and half scheme with three (3) fully equipment diameters and three (3) half equipped diameters.

⁷ See Appendix 2 for Plot Plan of KTPP

⁸ See Appendix 11 for copy of letter

This will ensure in the first phase, 6 line bays (3 in and 3 out), 2 Generator Bays and 1 Step-down Transformer bay for local distribution. The switchyard layout is however to be designed such that there is space to accommodate future expansion of the plant. The transmission line voltage is 161kV. The plant output voltage is 11kV which is to be stepped-up to 161kV. The interconnection to the public grid will be made between the new 161 kV power plant switchyard and the public 161 kV grid. However, the interconnection is not in the scope of the power plant. Telecommunication equipment including Power Line Carrier Communication (PLCC) link and fibre optic interface with Remote Terminal Unit (RTU) to transmit all necessary information between the station and the load dispatch centre will be provided. The detailed design and specification for the transmission line components shall be in line with the existing GRIDCo system.

Construction activities for the transmission line system will involve the following:

- Site survey;
- Route clearance and access;
- Civil works (i.e. excavation of the foundations, setting of tower templates and concreting of foundations);
- Assembling of towers;
- Tower erection;
- Mounting of the insulator strings;
- Conductor and earth wire stringing;
- Sagging of conductors and earth wire;
- Mounting of accessories;
- Earthing of towers; and
- Inspection and commissioning.

Currently, detailed line route survey works have been completed and this provided information on exact areas or stretch where the Right of Way (RoW) of the line will be traversing. Consideration of alternative routing of the GRIDCo connection is constrained by lack of RoW as the areas adjoining have all been built up. The clearance of the 30m-wide wayleave will be undertaken by hand clearance and mechanical means e.g. bulldozers. This is a very short connection and hence steel tubular monopole structures will be appropriate for constructing the diversions. Once the towers are erected, the conductors and earth cables will be strung and tensioned with specialized equipment to achieve the design sag.

Once the route of the transmission line has been established, the land lying within the RoW will be subject to provisions of the Way leaves laws, which prohibit a number of activities in the RoW, including mining, construction of buildings and cultivation or farming. Due process would be followed in the acquisition of the RoW. Conventionally, farmers will be allowed to harvest any crops within areas to be acquired prior to the securing of the RoW.

3.5.2.10 Construction of Road & Paved Areas

All roads shall be designed for minimum HS20-44 or H20-44 loading. The design of the roads shall be based on the following minimum requirements:

- All main roads to be single carriage way, minimum 6 m wide,
- Secondary and security roads along the perimeter fence to be 3 m wide,
- Corner radii shall be designed to suit the vehicles which will use the roads for plant erection, operation and maintenance and shall not be less than 10m for main roads and 8m for secondary roads. However in area where pit tanker / long vehicles movements is anticipated, minimum radius shall be 12m.

The clearance between any structure, post and any other obstruction adjacent to the access road shall be not less than 1.0 m from the edge of the access roads. The maximum longitudinal slope shall be 7% except where ramps are required into buildings and a gradient not exceeding 10% may be used. Vertical curves shall be provided at all changes of gradient than 0.5%. Various distinct parking areas shall be provided for visitors near the gate house, for power plant staff and personnel near the administration building, the employee's facilities building and the central control building and for the workshop and store in the area of the workshop building. All paved areas shall receive sufficient inclination in the range of 1%.

Road lighting inside the plant shall be provided to all site roads and parking areas using approved lanterns mounted on 10m columns in a staggered (where appropriate) arrangement at maximum 50m spacing for roads to provide the standard illumination specified and shall be designed to acceptable standard approved by VRA.

3.5.3 Testing and Commissioning

All systems will undergo a full functional and safety test to ensure that they are fit for purpose. The contractor will be responsible for functional testing, commissioning, performance testing and reliability testing of the complete plant. Testing and commissioning will require 24 hour operations.

3.5.4 Demobilisation

Upon, completion of the construction phase any temporary infrastructure will be removed and the areas rehabilitated. The Contractor shall carefully remove in a manner to prevent damage, all equipment and materials specified or indicated to be salvaged and reused. Salvaged items specified to be reused in the work shall be stored and protected until reuse. Salvaged items not to be reused in the Work, but to remain the Owner's property, shall be delivered in good condition to the Owner at its storage area on-site in accordance with the requirements of the contract agreement documents.

The work camp will be immediately decommissioned at the end of the constructional activities. The wooden structures, which will be raised as offices, workshop, accommodation and storage rooms will be dismantled and the planks of wood, doors and other materials will be carted away for re-use at other project sites of the contractor. The concrete floors will also be removed and disposed of at an approved landfill site. All mobile toilet facilities for the construction site workers will be removed from the site on completion of constructional

works. Constructional equipment will all be transferred to the contractor's premises. The work campsite will then be filled, levelled and re-vegetated.

The Contractor shall perform final clean-up prior to substantial completion. Such final clean-up shall include the following:

- Removal of dirt and unsightly substances from all visible surfaces and area.
- Removal of deleterious substances from all parts of the work.
- Washing of all windows.
- Inside work "broom clean", including side and overhead fixtures.
- Removal of Contractor's temporary structures, tools, equipment, supplies, surplus materials, and underground utilities.
- Repair of roads, walks, fences, and other items damaged or deteriorated because of Contractor's operations.
- Grading, raking, smoothing, replacing vegetation, and other operations necessary to restore to original or better condition at areas affected by Contractor's operations.

The Contractor shall provide additional clean-up as required to remove items and clean areas affected by work performed by Contractor from Substantial Completion to Final Completion. Such demobilisation processes would be undertaken in accordance with environmental laws and standards in place at the time of decommissioning.

3.5.5 Operational Phase

The operational phase activities will consist of the routine gas turbine operation and maintenance activities, in addition to the operation and maintenance of all other balance of plants such as the fuel treatment plant, de-mineralized water system, compressed air system, neutralisation plant and the waste oil treatment as well as the gas conditioning and treatment system be routine in nature and will include the consumption of fuel (diesel or Natural Gas), which will arrive at the plant via pipelines to produce electricity using turbines and generators (alternators).

The KTPP Plant shall have a dual fuel capability and shall have the ability to operate on gaseous and/or liquid fuel. Natural Gas pipeline will be connected to the plant from the on-point of West African Gas Pipeline Company. With respect to liquid fuel, DFO for the plant will be delivered by pipeline connecting to existing pipeline belonging to the BOST. The DFO will be stored on site and will undergo 'mild' preparation/treatment prior to its usage in the plant. The treated fuel (diesel or gas), which is mixed with atmospheric air that has been filtered and compressed, would be ignited in the combustion chamber of the CTG Unit. The resultant mass flow provides the necessary force to turn the gas turbine, which is coupled to a generator. The exhaust gases at the start of the plant's operations would be discharged into the atmosphere through an exhaust stack of about 30metre high, and at about 550 °C. This operation is termed as Simple Cycle.

A safety and monitoring equipment shall be in place for the change over from oil to gas and vice-versa. With this, whenever the fuel gas pressure (measured before the main gas shut-off valve) drops below the pre-set minimum value, the pressure measurement sets off an alarm and simultaneously activates the program for

changing over to liquid fuel. Whenever the gas pressure (measured after the trip valve) drops below the pre-set minimum value during the change-over process before operation on liquid fuel has been enabled, the pressure measurement initiates an emergency trip of the gas turbine.

The main issues of environmental concern during operations include stack emission, noise, oil spillage and leakage of oil during maintenance activities as well as impacts arising from fire outbreak such as atmospheric emission of smoke and other combustion products.

3.5.5.1 Operational Regime

In the early years of operation, the plant is expected to be on base load duty. Thereafter plant operations will be highly dependent on the hydrological conditions experienced at the time. As a result, the mode of operation could vary widely. In years of high inflows to the Volta Lake, the thermal plant could be operated at for peaking purposes. In periods of drought, the plant could be operated at full output for the entire year. For hydrological conditions between the two extremes, the plant may operate in a variety of modes depending on the availability of other generating units. As the load demand of the system grows with time, the mode of plant operation is expected to become increasingly “base load”.

3.5.5.2 Raw Materials and Operational Supplies for Power Production

The types, uses quantities, and packaging of raw materials and operational supplies for the operation of the KTPP are presented in *Table 5* below:

Table 5: Main Raw Materials and Operational Supplies

Raw Materials	Use	Packaging	Quantity
Diesel	Combustion		Annual quantities are dependent on the operational regime in the years such as plant availability, start-ups and shutdowns
Natural Gas	Combustion		
Sulphuric Acid	Demineralised water preparation	Polyethylene drums	
Sodium Hydroxide	Demineralised water preparation	Polyethylene drums	
Q-600	Oily Waste Separator	Polyethylene drums	
Ultra Coolant	Gas Turbine Cooling	Polyethylene drums	
Flouroprotein Foam, Concentrate, 3%	Fire fighting	Polyethylene drums	
Compressor Cleaning Flux	GT Compressor Cleaning	Drums	

3.5.5.3 Natural Gas Treatment System

It is expected that a Gas Conditioning Facility shall be constructed at the KTPP to utilise natural gas from the Interconnection Facility from the Regulatory & Metering Station of the West Africa Pipeline Company (WAPCo). The natural gas shall be transported to the KTPP site from the Regulatory & Metering Station through underground pipelines. At the Gas Conditioning Facility, the natural gas shall be conditioned to enable delivery of gas that meets the Gas Turbine specification continuously on a stable manner. It shall consist of an

Emergency Shut Down (ESD) Valve (works in both automatic and manual mode) at the inlet of the Gas Conditioning Facility which isolates the system in case of an emergency.

From the inlet valve skid, the gas passes through a knock-out drum to separate larger solid particles and liquid from the gas. This is followed by the inlet filter/scrubber system to remove fine particulate matter and moisture from the gas before flowing through the metering system. The gas is then heated in an indirect water bath heater before pressure reduction to prevent the system from the Joule-Thompson effect. Before the gas finally gets to the Gas Turbine, there is a gas chromatograph which analyses the composition of the gas at programmable intervals. The gas quality specifications are as indicated in *Table 6*.

Table 6: Pipeline Receipt Gas Quality Specification

Composition (by vol %)	Maximum	Minimum
Methane	95	85
Ethane	10	0
Propane	8	0
Butane + Paraffine (C4+)	5	0
Total Inert (CO ₂ + N ₂)	12	0
O ₂ (by volume)	10 ppm	0
Water Content	7 lbs/MMscf	0
H ₂ S (by volume)	4 ppm	0
Total Sulfur	28 ppm	0 ppm
Higher Heating Value	1150	950 Btu/scf
Wobbe Index (HHV Basis)	52	47 megajoules/m ³
Delivery Temperature	49°C (120°F)	27°C (81°F)
CO ₂	8	0
N ₂	6	0
Solid, Dust, Gums, Other Solids	Free by normal commercial standards	

3.5.5.4 Water and Waste Water Treatment System

Fresh water (potable) will be supplied to KTPP to the fence boundary from pipes of the Ghana Water Company Limited. Fresh water shall be used for drinking, service, domestic, demineralisation and fire fighting. The water will be supplied at a sufficient flow rate and pressure to the water tank. The capacity of the fresh water tank shall be sufficient for all kinds of usage. This tank will be a watertight reinforced concrete structure constructed underground and on top of which pumps will be installed to pump out water to where required. The concrete wall will be designed to resist soil pressure and chloride protection system will be applied inside.

At the handover point a main shutoff valve will be installed. Following the main shutoff valve, a valve station will be provided which will comprise of a pressure reducer (if necessary), non-return valve, provision for a water meter and a shutoff valve with drain cocks. From the valve station to the water tank, the pipe will be laid

underground along the shortest possible. Pipe material for the underground pipe will be stainless steel or HDPE. The maximum amount of fresh water needed for KTPP is around 3,000m³/day. Considering three days storage for drinking, service, domestic and demineralisation, volume of fresh water tank is approximately 12,000m³. The amount of water demand and waste water to be released at KTPP is outlined in *Table 7*.

Table 7: Water Demand and Amount of Waste Water

Type of water	Daily requirement
Potable and Service Water	70 m ³ /day (Minimum)
Demineralized Water	2,400 m ³ /day (Maximum)
Fire Fighting	3,000 m ³ /day
Waste Water from Domestic Use	60 m ³ /day (Maximum, including future expansion)
Oily Waste Water	10 m ³ /day (Maximum)
Chemical Waste Water	210 m ³ /day (Maximum)

Water and waste water treatment system shall meet plant requirements. The system shall be designed so that to satisfy fresh water demand both in quality and quantity and the treated waste water shall meet EPA regulations on effluent standards. No significant pollution load is expected from these waste waters however, their quality shall be monitored for to assess compliance with the quality guidelines established by the Ghana EPA for the discharge of waste waters into the environment. The design requirements are summarized in *Table 8*.

Table 8: Design requirements for Water & Waste Water Treatments

Design Requirements	Unit	Data
Fresh water		
Quality		According to fresh water analysis ⁹
Demineralized water production		
Conductivity	µS/cm	0.5
Silica SiO ₂	Mg/l	0.1
Chemical Waste Water Treatment		
pH effluent	pH	6-9

Potable water shall be distributed from the water tank to the various buildings by means of underground pipes. A water distributor will be provided to facilitate shutoff of specific sections without other sections. Water supply pipes will enter the buildings at ground floor level. At the entrance point in each building a master isolation valve will be provided. A concealed valve will be provided in each sanitary room such as office, public toilets, special area, pantries, cafeterias, etc.

⁹ See Appendix 5 for Fresh Water Quality data from AVRIL

3.5.5.4.1 **Demineralised Water Treatment System¹⁰**

The demineralised water treatment system is designed to produce 2,000m³/day. Taking into account production rate, the maximum fresh water required for demineralisation plant is around 2,400m³/day. The demineralised plant shall consist of 3 x 50% trains. Considering the storage capacities provided with the demineralised water storage tanks and assuming sufficient spare parts in stock, they will be two tanks each of volume 3000 m³ for repair/maintenance to ensure total availability of demineralisation plant.

Each train comprises one transfer pump and one mixed bed exchanger unit. The transfer pump will be controlled by the level in the demineralised water storage. For the demineralization process, the raw water is taken through a reverse osmosis (RO) to remove both positive and negative ions such as calcium, potassium, iron, sulphates, silica and carbonates which would otherwise destroy CT turbine parts and increase the incidence of hot corrosion. The regeneration of the working mixed bed exchanger unit is actuated when the conductivity increases. The regeneration itself shall be operated automatically. The standby unit will be put into operation when the regeneration of the working mixed bed exchanger starts.

The quality of demineralised water should be clear, colourless and free from solids in suspension and is expected to be as follows:

Dissolved Solids	-	> 10 ppm
Silica	-	0.1 mg/l
pH	-	5.0-7.5
Electrical conductivity	-	0.5µS/cm

The demineralised water produced will be sent to the two (2No.) 3000m³ demineralised water storage tanks. The flow to the tank is controlled by the level. The demineralised water supply pumps (two on duty, one standby) will be used for NOx, GT compressor washing, etc. The pumps will be controlled by the pressure in the demineralised water network. There is currently no data available for the evaporation rate of the demineralised water.

3.5.5.4.2 **Waste Water Treatment System¹¹**

The waste water treatment will be designed to treat domestic waste water and the discharge of the system is transferred to sewage treatment plant. The sewage treatment plant will be designed to treat 60m³/day domestic water and 210m³/day chemical coagulation discharges. The sewage treatment plant shall be designed to treat waste water in compliance with the EPA waste water pollution standards.

The sewage treatment plant shall comprise of one (1) Imhoff tank where domestic waste water shall flow by gravity into it for primary treatment (settling) shall take place. In addition, the excess sludge from the aerobic biological treatment will settle here. The settled sludge will be removed periodically (e.g. 4 times per year by

¹⁰ Flow Diagram of Water Treatment Systems is enclosed as part of Appendix 4

¹¹ Flow Diagram of Waste Water Treatment Systems is enclosed as part of Appendix 4

tanker for disposal. In addition, it shall also comprise of one (1) aerobic biological treatment plant where secondary (biological) treatment will take place. The excess sludge will be removed from the effluent and will be sent to the Imhoff tank.

For domestic waste water drainage, all sanitary fixtures shall be drained by means of building waste water drainage system to the main sewer outside the building. The vertical down pipes shall be mounted inside the building in shafts where applicable. The downpipes shall connect to the underground pipes at the lowest level of the building, which can either be the basement or the ground floor. Connections to the sanitary fixtures shall be no hub cast iron pipes and fittings for sanitary application. Connection pipes shall be installed recessed inside installation walls, under plaster or in shafts. The underground drain water pipes underneath the base slabs of the buildings will be U-PVC drainage pipes. The main domestic waste water pipe will terminate in the waste water treatment plant. Chemical drains and inorganic waste water are treated with chemical coagulation and then disposed-off to the sewage treatment plant. Inorganic waste water will mix with organic waste water in imhoff tank.

From VRA's experience in operating similar power plants at the Tema Thermal Power Complex and that of the Takoradi Thermal Power Complex, typical quality of effluents to be discharged from the Waste Water Treatment Plant is provided in

Table 9 and this will be largely similar to that at KTPP.

Table 9: Typical Effluent Quality of Waste Water Treatment System from VRA's Thermal Power Plants

Parameter	Neutralization Sump	EPA Limit
pH	7.8-8.9	6.0-9.0
Temperature Increase (°C)	26-29	<3°C above ambient
Oil & Grease (mg/l)	No Visible Sheen	5
Conductivity(μS/cm)	109-200	1500
Chemical Oxygen Demand (mg/l)	12.5-16.0	250
Total Dissolved Solids (mg/l)	72-132	1000
Lead (mg/l)	<0.05	0.1
Iron (mg/l)	<0.05	2
Copper (mg/l)	<0.05	0.5
Zinc (mg/l)	<0.05	2
Total Chromium (mg/l)	<0.05	0.05
Total Residual Chlorine	<0.2	250

3.5.5.4.3 Oily Waste Water Treatment System

The specified properties of the DFO to be used for KTPP and produced at Tema Oil Refinery are provided in Table 10.

Table 10: Specifications of Diesel Fuel Produced at Tema Oil Refinery

No.	Parameters	Method	Limits	Results
1	Density @ 15DEC C KG/L	ASTMD 1298	0.860 MAX	0.8569
2	Evaporated @ 360 DEG C %VOL	ASTM D 86	85 MIN	92.8
3	Colour ASTM	ASTM D 1500	2.5 MAX	L 1.5
4	Total Sulphur % WT	ASTM D 129	0.5 MAX	0.434
5	Flash Point (PMCC) DEG C	ASTM D 93	60 MIN	75
6	Kinematic Viscosity @ 37.8DEG C, CST	ASTM D 445	5.5 MAX	3.53
7	Total Acid Number, MGKOH/G	ASTM D 974	1.0 MAX	0.09
8	ASH, % WT	ASTM D 482	0.1 MAX	Less Than 0.01
9	Pour Point DEG C	ASTM D 97	12 MAX	MINUS 9
10	Cetane Index	ASTM D 976	48 MIN	48.96
11	Conradson Carbon Residue (ON 10 % Vol. Distillation Residue) % WT	ASTM D 189	0.20 MAX	0.05
12	Water By Distillation, % VOL	ASTM D 95	0.05 MAX	Less Than 0.05
13	Water %VOL + SEDIMENT – V/V%	ASTM 1796	0.05 MAX	< 0.05
14	COPPER CORROSION 2 HRS@ 100DEG C	ASTM D 130	3 MAX	1b
15	Sodium (Na) AND Potassium (K) –MG/KG	AAS	1 MAX	0.41
16	Calcium (AS CA) – MG/KG	AAS	2 MAX	< 0.05
17	Vanadium – MG/KG	AAS	0.5 MAX	< 0.05
18	Lead (AS PB) – MG/KG	AAS	0.5 MAX	0.3
19	Copper (AS CU) – MG/KG	AAS	0.2 MAX	0.05
20	Sediments/ Particulates (MG/L)	D 4807	20 MAX	5.2
21	Gross Heat Of Combustion HHV BTU/LB	IS 1448 P:7	REPORT	19460
22	Gross Heat Of Combustion LHV BTU/LB	IS 1448 P:7	REPORT	18274

Distillate Fuel Oil shall be delivered to the plant by pipelines and stored in two (2No.) 14,000m³ storage tanks. To minimise the potential for the drainage of oil into surface water, all oil tanks will be bunded. The boundary will be designed to contain 110% of the largest tank's contents to avoid spillage in case of tank failure. All liquid fuel storage tanks shall be above ground and shall be enclosed by bund walls specially designed to contain all the content of the tank in case of a spill. The bunds shall have concrete floors which makes it easier to recover spilt fuel and also to prevent oil from contaminating the soil.

The oil-water separation mainly comprises:

- One (1) oil-water separator with sludge trap

- One 1) oil transfer pump
- One (1) waste oil storage tank

The diesel fuel oil is taken through the process of centrifuging to separate the aqueous components from the oil and thereby remove the sludge, soluble metals such as sodium and potassium and water¹². Oily waste water will be collected in the catch basins of the oil tanks and drained towards the oil separator. Oily waste water will flow by gravity to the oil-water separator. Waste from the oily water sumps will also be collected and stored in the waste oil tank. Oily waste water will be treated by means of oil-water separation and discharged to drainage system. The oil-water separator will be designed according to DIN 1999 or an equivalent standard. Suspended solids stored in the sludge trap will be removed periodically (e.g. 4 times per year) by tanker for disposal.

The separated oil will be pumped to the waste oil storage tank. The waste oil transfer pump will be controlled by the oil level in the separator. When the oil level exceeds the permitted limit, the oil-water separator lever controller will close automatically and an alarm will be given. Wastes in the waste oil tank will be periodically removed by licensed contractor approved by VRA for recycling as in all other VRA owned thermal plants.

As indicated, an amount of 10 m³/day of oily waste is assumed as maximum. From our experience in operating similar power plants at the Tema Thermal Power Complex and that Takoradi Thermal Power Complex, typical quality of effluents to be discharged from the Oily Water Separator System is provided in **Table 11** and this will be largely similar to that at KTPP.

Table 11: Typical Effluent Quality of Oily Water Separator from VRA's Thermal Power Plants

Parameter	Oily Water Separator	EPA Limit
pH	6.9-7.3	6.0-9.0
Temperature Increase (°C)	27-30	<3°C above ambient
Oil & Grease (mg/l)	No Visible Sheen	5
Conductivity(μS/cm)	14,000-16,000	1500
Chemical Oxygen Demand (mg/l)	18.0-25.0	250
Total Dissolved Solids (mg/l)	9,240-10,560	1000
Lead (mg/l)	<0.05	0.1
Iron (mg/l)	8.0-10.0	2
Copper (mg/l)	<0.05	0.5
Zinc (mg/l)	<0.05	2
Total Chromium (mg/l)	<0.05	0.05
Total Residual Chlorine	<0.2	250

¹² Flow Diagram of Fuel Oil System is enclosed as part of Appendix 4

3.5.5.5 Safety and Security Systems

To prevent unauthorized access to the power plant and to provide safe working conditions, a combination of lighting, fencing, gates, communication network, closed-circuit television (CCTV) monitoring, first aid room, and guard facilities shall be provided. No additional provision for conversion of the simple cycle plant to a combined cycle plant is required in the safety and security systems.

Lighting shall consist of area lighting, road lighting and full illumination of the oil tank area. All areas inside the fence shall be illuminated by high pole lighting. A wall fence has currently been constructed around the entire project site. Further, a chain link fence will be provided around Transmission Yard and Gas Receiving Station. The main plant access shall have electrically operated sliding gates. Other access points shall have locked gates to maintain the same level of security as the associated fencing.

The communication network shall consist of telephone and a two-way radio system at the main access gatehouses. The plant perimeter, gate areas and critical plant areas, such as, but not limited to the storage facility, warehouse, maintenance building, etc., monitored by a Closed Circuit Television system. Monitors shall be located in the gatehouse and the control room. The first aid room shall be provided as part of the employee building. A manned gatehouse shall be provided at the main plant access gate to serve as the guard facilities.

3.5.5.6 Fire Protection System

A Fire Protection System (FPS) shall be designed to provide protection to the plant site and construction camps for personnel, equipment, buildings and Site residential property in the event of fire, in accordance with the applicable National Fire Protection Association (NFPA) Codes and Ghana national and local fire regulations. The source of water for the FPS water supply pumps shall be from fresh water reservoir. A pressurized piping distribution system shall be provided to supply each area and building with a supply of firewater as required. The FPS system shall comprise generally the following:

- Fire pumps
- Fire Hydrants
- Sprinkler systems
- Standpipe systems
- Dry type deluge system portable fire extinguishers carbon dioxide (CO₂) system, foam system

Details of the FPS are outlined below¹³:

3.5.5.6.1 Fire Protection System Description

The Fire Protection System (FPS) shall be designed to provide protection to the plant site and construction camps for personnel, equipment, buildings and Site residential property in the event of fire, in accordance with

¹³ See Appendix 4 for Flow Diagram on Fire Fighting System

the applicable Ghana National Fire Service Codes and Ghana national and local fire regulations. The source of water for the FPS water supply pumps shall be from fresh water reservoir. A pressurized piping distribution system shall be provided to supply each area and building with a supply of firewater as required.

The FPS system shall comprise generally of Fire pumps, Fire Hydrants, Sprinkler systems, Standpipe systems, Dry type deluge system portable fire extinguishers carbon dioxide (CO₂) system, and foam system. For the construction site, the potable water system will provide a supply of water to the fire hydrants. Provision shall be made in the fire protection systems for conversion of the simple cycle plant to a combined cycle plant. The reserve volume for the fire protection system in the fresh water reservoir shall be sized to provide the total system design fire water flow for the design duration with one half of the reservoir out of service.

3.5.5.6.2 Fire Pumps

Two, horizontal split-case, double suction type pump shall be provided, each capable of supplying 100% of peak flow designed and installed. One pump shall be complete with electric motor drive and the other pump equipped with an emergency diesel drive. A jockey pump shall be provided to maintain system pressure at all times. A fuel tank with a 6-hour supply shall be provided adjacent to the diesel drive. A fill line shall be provided to the day tank from the start-up/shutdown fuel storage tank. The fire pumps shall be located in the fresh water pump house.

3.5.5.6.3 Distribution System

The fire protection system pumps shall take a supply from the fresh water reservoir. A back flow preventer shall be provided to prevent water or other fluids from the fire protection system discharging back into the fresh water reservoir. The fire main shall be overhead where possible. When underground, it must be provided with cathodic protection to counter external pipe corrosion. The pipeline shall be designed and constructed in accordance with the FPS piping specifications. Fire hydrants shall be provided within the power plant at spacing and locations in accordance with authorities having jurisdiction but not more than 150m apart, minimum 12 m clear from buildings and maximum 90 m from the building protected. Areas assigned a wet standpipe system shall be equipped with a portable fire extinguisher in each hose cabinet as standard equipment.

3.5.5.6.4 Carbon Dioxide (CO₂) System

A carbon dioxide fire protection system shall be provided.

3.5.5.6.5 Foam System

A foam system shall be provided at the fuel storage tank facility.

3.5.5.6.6 Piping

Underground and exposed piping systems shall be provided. Water flows through the piping systems shall be based on the highest demand water requirement to the specific area.

3.5.5.7 Electricity

Electric power for the operational phase shall be from the station itself.

3.6 Project Benefits

Whilst the principal sponsor of the project is the Government of Ghana, this project should be seen also as a regional project. In fact the construction of the 220 MW KTPP, with future expansion to 500MW, and its connection into the national grid is key to the development of the West African Regional Electricity Market.

KTPP will have a significant impact on the macro-economic base of Ghana. Some of its inherent benefits are as follows:

- This project will utilise natural gas from the West Africa Gas Pipeline and therefore reduce, otherwise the flaring of gas and thereby reduce the amount of CO₂ emissions which contribute to the effect of global warming.
- The Project will create jobs during the construction and operations and will create up to more than 300 jobs for both skilled and unskilled staff.
- The Project is likely to increase VRA's revenue base through lower cost of generation and strengthen VRA's position for competition in the power generation sector.
- The Project will increase thermal generation capacity at a reasonable price to complement hydro generation.
- The Project will also contribute vital electrical power infrastructure and will significantly support the development of the Ghanaian economy and stimulate industrialization in Ghana and the West African sub-region.
- The stimulus to regional trade and improved export tariffs will also benefit Ghana's export activities.
- Access to possible markets in the West Africa sub-region would be improved.
- Ghana's position as the gateway for power into West Africa will be enhanced.
- The enhanced interconnection will further demonstrate the benefits of an interconnected electricity system and the ability to develop generation projects on a least-cost integrated resource planning
- Increased access to the West Africa Power Project market will assist in the longer term development of the country's abundant sources of hydropower resources providing significant long-term benefits to the industrial performance of the whole of western Africa.
- Diversified growth plan strategy for Ghana will be enhanced.
- The technical performance of GRIDCo will be enhanced reducing the impact of fault-related disturbances.
- The project will remove a capacity constraint that is denying GRIDCo from some much-needed additional revenues in the short term.
- A significant increase in wheeling revenue will accrue to GRIDCo without the need for additional capital investment on their part.

3.7 Financing Details

Within the National Energy Policy, it has been indicated that the challenge in the energy sector has been how to attract investments to build the necessary infrastructure for the generation, transmission and distribution of electricity throughout the country as that is essential to ensuring the sustainable development of the sector. It is noted that creating the right environment for private-public partnerships in the development of new power plants is essential to the growth of the power sector. The biggest obstacle to achieving this is the issue of cost-recovery, a challenge that this policy tries to directly address.

The project is estimated to cost about US \$225.00 Million. VRA has decided to make budgetary provision to cover the implementation of the Preparatory Works and Start-Up Activities aimed at improving the chance of completing the project on schedule.

An EPC Contractor will be responsible for the engineering, procurement, transportation, erection on site (including civil works), installation, testing, commissioning and guarantee of the thermal power plant and associated facilities. Where appropriate, the contractor will use local subcontractors. The contractor will be responsible for any sub-contractors. VRA shall be responsible for operating the power plant whilst GRIDCo will be responsible for operation and maintenance of the transmission line component.

3.8 Project Schedule

Construction of KTPP was initially scheduled to be completed by July 2010. However, in the 1st Quarter of 2009, GoG indicated their inability to provide funding to complete the project. This cash flow constraint resulted in the suspension of the project whilst alternate funding was being explored. Subsequently, GoG took a decision to relocate the ALSTOM Gas Turbine Generators for KTPP to Bonyere under the “**Domunli Thermal Power Project**” to harness the much cheaper natural gas that will be associated with the oil extraction activities within the Jubilee Fields for power generation by 2012. This was in order to utilise the natural gas for power generation as envisaged under the gas monetisation policy. The decision to relocate the equipment in 2009 was to overcome the then gas supply constraints in Tema and to harness the prospective gas from the Jubilee Oil Fields. This decision subsequently brought activities under the KTPP largely to a halt and this consequently delayed work on the EIA preparation.

However, as a result of continuous gas availability in Tema as a result of operations of the West Africa Gas Pipeline Company by close of 2010, the decision to re-locate the plants under the KTPP to Bonyere has been reversed and works under KTPP has re-commenced. VRA Management in the 2nd Quarter of 2011 took a decision to continue the implementation of the project at its current location at Kpone, thus requiring the completion of the EIA process to facilitate the acquisition of the Environmental Permit for physical construction to begin.

As at now, the Commercial Operation Date (COD) is yet to be fixed, however, the total period from the notice to proceed / advance payment to the commissioning phase is estimated to be about fourteen (14) months, further, the issuances of Provisional Acceptance of Certificate for the two turbines are also expected to be completed

by close of the nineteenth (19) month¹⁴. Most of the pre-construction feasibility activities are on-going. It is expected that all preconstruction activities will be completed before the actual construction works begin. This includes, but not limited to the acquisition of the Environmental Permit and compensation payment.

Final

¹⁴ Project Milestone Schedule is enclosed as Appendix 6

4.0 CONSIDERATION OF ALTERNATIVE TECHNOLOGIES AND SITES

4.1 Introduction

A description of the proposed KTPP has been provided in Chapter 3 of this report. However, prior to the selection of the various components of the proposed development, various alternatives have to be considered both in terms of equipment and the feasibility of the project itself during the project planning stage. Various feasibility studies have been done which has helped the EA to present alternatives in comparative form, defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

Some of the information used to compare the alternatives is based upon the design of the alternative and some based upon the environmental, social, and economic effects of implementing each alternative. The locations of plant and the routes of gas pipelines and transmission lines were studied from a technical perspective, geography (flat land), land use (unused land, no residence and permanent structures), land availability (public land, road reserve), consistency with urban planning.

Alternatives addressed during environmental assessment are at the following levels of analysis:

- a) No Development Scenario
- b) Fuel Type Options
- c) Site selection Options for power generation
- d) Alternate Technology Considerations
- e) Alternate Site Considerations
- f) Transmission Planning Analysis
- g) Possibility of the Use of Alternate Mode of Transmission

4.2 The “No Development Scenario”

As shown in *Table 12*, the construction of KTPP in Ghana is one of the planned mid-term generation additions to meet increasing demand and ensure energy security for national development and enhance investor confidence in the economy and the project is already behind schedule.

Table 12: Mid-term Planned Generation Facilities of Ghana

Description of On-going Projects	Installed Capacity	Dependable Capacity	Timing	Fuel type
Bui Hydro Power Project - BPA	400MW	340MW	2014	Water
Takoradi 3 (T3) - VRA/GoG (Phase 1)	132MW	120MW	2012	LCO/Gas/Diesel
Kpone Thermal Power Plant (KTPP) - VRA/GoG	230MW	200MW	2015	Gas/Diesel
Takoradi 2 (T2) Expansion- VRA/TAQA	110MW	110MW	2015	Steam
VRA Solar Power Project	10MW	0MW	2012	Solar

VRA Wind Power Project	150MW	0MW	2015	Wind
Description of Planned Projects				
Osonor/TT1PP Expansion - VRA/IPP	110	100MW	2015	Steam
Takoradi 3 (T3) - (Phase 2)	132MW	120MW	2015	LCO/Gas/Diesel
Domunli Thermal Project	450MW	450MW	2016	Gas
Pwalugu Hydro Project	48MW	48MW	Jan. 2018	Water

Taking no action in the development of KTPP would, naturally, be a feasible option. The advantages of the “No Development” scenario are:

- That land that would otherwise be occupied by power plant and the associated gas/diesel/transmission line system would continue to remain available; in some instances, the population employs this land for income-earning activities (e.g., agriculture). With the reduced need for land acquisition and development, the likelihood of people being displaced would be reduced.
- No increase in likelihood of environmental impacts. Potential impacts that may be avoided if the “No-Project Alternative” were implemented include habitat disruption as well as potential contamination associated with construction activities.

If construction does not take place, delivery of electricity and distribution will continue to be poor resulting in social dissatisfaction, fall of economic development and poor quality of life in Ghana as a whole. It should be remembered that hospitals, schools, hotels, industries, banks, residential houses all need cheap and quality electricity to function well. One does not need to calculate the figure, but if one can refer to the cost people incur when there is a load shedding, it is possible to get a feeling of how beneficial the supply of reliable energy is.

The country will also be deprived of investment opportunities as a result of the lack of access to cheap electrical power sources and this will pose a serious obstacle to its developmental goals as well as a major blow to regional integration and sustainable development. In addition, Ghana will stand to lose foreign currency that will accrue as a result of the sale of power to neighbouring countries.

In spite of the fact that the “No Development Scenario” may not relocate anybody, it does not guarantee that the existing environmental quality will continue to be maintained. At the same time the large society of people in the local area, Kpone and Tema in general do not benefit rather they are going to lose in terms of development, quality of life, increased pollution and deforestation in some areas. The toll of fuel-wood and production of charcoal have already depleted the natural resources around many of the urban centres. Other electricity source alternatives (Solar and wind energy) are still expensive or rather not feasible in the meantime. If

businesses, homes and workshops are not getting quality grid electricity, they will embark on using diesel/petrol generators that will continue to pollute the air.

In addition to the disadvantages of the “No Development” option discussed, it must be noted that ultimately, “stopgap” solutions to the energy demand of Ghana could be expected to be developed, such as the use of diesel generating sets or the establishment of oil fired thermal plants. These solutions are likely to be less efficient and more environmentally damaging, and to have significantly lower net benefits (or even have net economic costs)

The 'Do-Nothing' alternative would mean that VRA cannot meet its short, medium as well as long-term commitment to the energy demand in Ghana. The “No Development” alternative therefore does not represent an option that meets the best interests of Ghana and its development agenda.

4.3 Fuel Type Options

Power generation options can be considered by fuel type. This might be geothermal, solar, hydro (storage or run-of-river), wind, coal, oil (various grades), natural gas, Liquefied Petroleum Gases (LPG), other petroleum based fuels (e.g. methanol, refinery residues, condensates from natural gas production), or some combination of the above. The plant may be leased, rented or purchased and may be located on land or water.

The following options were not considered feasible to meet the needs of the country's immediate energy demands due to the size of the required generation capacity, lack of experience in their development in Ghana and/or the lack of presence of the raw material in Ghana, and are therefore not considered in greater detail in this EIS:

- **Geothermal** - no major geothermal reserves that would provide sufficient generation capacity are known to exist in Ghana;
- **Solar** - cost prohibitive, not feasible for large scale alleviation of shortfall generation. In 2011, four (4) sites were identified in Northern Ghana and currently various studies are on-going for solar generation in Northern Ghana under the VRA Renewable Energy Development Phase 1.
- **Wind** - no large scale wind power developments have been undertaken in Ghana, however, under the VRA Renewable Energy Development Phase 1, various sites have been identified in coastal Ghana for the development of a total of 150 MW plants.
- **Coal** - no infrastructure exists in Ghana for coal production, use, transport or importation.

The following fuel types were identified as options likely to provide sufficient generation capacity in the short to medium term, and are therefore considered in detail below:

- Liquid Fuel
- Hydro-power
- Natural Gas

4.3.1 Liquid Fuel Options

Ghana's only crude oil refinery, situated at Tema about 24 kilometres from the capital, Accra was originally named the Ghanaian Italian Petroleum (GHAIP) Company. The Government of Ghana became sole shareholder of GHAIP in April 1977 and in 1991 the name was changed to the Tema Oil Refinery (TOR). The Tema Oil Refinery is presently authorized by its Regulations to carry on business as refiners and sellers of petroleum.

It is a complex refinery with a capacity of 43,000 bpd. Ghana plans to expand the capacity of the Tema Oil Refinery from 45,000 barrels per day (bpd) to 145,000 bpd by 2013 as the country moves towards commercial oil production. Expansion of the state-owned Tema Oil Refinery would cost \$150 million-200 million and would be financed by syndicated international loans with the participation of some local banks. Plans to increase the capacity of the refinery in the West African nation have been given fresh impetus following major oil discoveries in 2007 in the Tano and West Cape Three Points.

The Tema Oil Refinery is currently responsible for providing fuel oil for VRA's thermal projects in Tema. However, the cost of energy production and equipment maintenance associated with liquid fuel does not make the use of liquid fuel attractive if VRA is to remain competitive as well as attract private sector participation and to overcome the perennial power shortages.

4.3.2 Hydropower Options

Ghana currently has two hydroelectric plants on the Volta River, with installed capacities of 1,020MW and 160MW at the Akosombo and Kpong Generating Stations. Again, GoG by Act 740 of 2007 has established the Bui Power Authority (BPA) and charged it with the development, operation and the management of the Bui Hydroelectric Project at the Bui Gorge in north-western Ghana and any other potential hydropower sites on the Black Volta River. The Bui Hydroelectric Project when completed will have a maximum installed capacity of 400 MW and a net average annual energy production of 969 Gigawatt Hour/Year (GWh/yr). Currently, it is expected that the project will be completed in the first quarter of 2013, under an Accelerated Project Schedule.

Many different schemes for increasing hydropower generation capacity have been studied in the country. A wide ranging study of all conceivable options, both larger scale and mini, is currently being carried out to promote the development of potential hydroelectric power sites in the Volta River Basin as a way of enhancing energy supply security. With this strategy, the Government aims to expand generation capacity to support its programme of accelerated rural electrification as well as to support the economic development of Ghana.

VRA, on behalf of GoG, has commenced feasibility studies, including preliminary EIA, for an update on the technical and commercial viability of these schemes. In line with this, a request for "Expression of Interest" for consultancy services for feasibility study was issued in July 2010 for the following potential hydroelectric projects:

- Pwalugu Hydroelectric Power Project on the White River
- Kulpawn Hydroelectric Power Project on the White River
- Daboya Hydroelectric Power Project on the White River
- Juale Hydroelectric Power Project on the Oti River

These and many other schemes present varying benefits and costs but none are achievable within the short to medium term to overcome the country's energy demand. It must be noted that some of the large hydropower schemes also may not be feasible on environmental grounds, depending on the scale of the proposed project and the sensitivity of the site. Due to the need to investigate the environmental impact of large schemes in detail, all hydropower options for increasing power production are long-term solutions.

The extensive list of potential projects will be reduced to a smaller number of more attractive options for more detailed evaluation. The more detailed evaluation will involve the appraisal of the options against a framework of considerations such as guaranteed dry season capacity, cost per kWh produced, environmental and social impacts and concept for integration into the transmission grid.

4.3.3 Gas Options

Ghana is endowed with four sedimentary basins where hydrocarbon accumulation can be found. These basins are offshore Western Basin, Central Basin, Eastern Basin and onshore Voltain Basin. In 2007, the Mahogany and Hyedua wells in the West Cape Three Points concession area were discovered which proved the existence of an active petroleum system in the deepwater area. Preliminary evaluation proved that these oil wells, lying in two separate concession blocks, are of common origin. The wells were therefore unitised to be developed as a single field named Jubilee Field to mark the coincidence of the discoveries with Ghana's Golden Jubilee year.

GNPC has adopted the policy of monetization of all gas discovered in the country. This policy means operators would have to re-inject produced gas into the reservoir until the country has put infrastructure in place to utilize it. In line with this policy, GNPC is looking at the reduction of associated gas from the Jubilee Fields on a large scale as an important opportunity to increase gas utilisation in Ghana by replacing imported and the more expensive crude oil; for power generation.

GNPC plans to commercialize the Jubilee Field associated natural gas, in furtherance of the objectives of:

- Producing natural gas liquids which can be sold on the international market and delivering dry gas for power generation in Ghana,;
- Sizing the gas infrastructure to enable the monetization of Jubilee field gas and other indigenous natural gas reserves in its vicinity;
- Ensuring that infrastructure is in place to coincide with first oil to avoid gas flaring and;
- Facilitating the economic development of Ghana with the availability of reliable supplies of natural gas.

Gas to be generated is estimated from 120 million cubic feet /day to 240 million cubic feet /day, and later gas from other offshore fields. GNPC is therefore looking at the production of associated gas from the Jubilee

Fields on a large scale as an important opportunity to increase gas utilization in Ghana by replacing imported and the more expensive crude oil for power generation. The National Ghana Gas Company was formed in 2011 with the responsibility of transportation and development of infrastructure in the oil and gas sector.

Again, the West African Pipeline Company (WAPCo) has currently constructed an over 650.0 km gas pipeline transmission system, known as the West African Gas Pipeline (WAGP), onshore and offshore from Nigeria to Ghana. In Ghana, there are Regulating & Metering (R&M) stations at Tema, and Takoradi (the terminus of the main trunkline). Upon completion, WAGP is expected to deliver an initial volume of 140 million standard cubic feet per day but will have the ability to transport a maximum volume of 462 million standard cubic feet per day and delivery amounts will increase as the market demand increases over time. The transport of natural gas to Benin, Ghana, and Togo will help to alleviate the energy needs of these countries, promote investment in thermal energy facilities, and encourage economic growth. WAGPCo in early 2010 commenced the delivery of natural gas in commercial quantities from Nigeria to Ghana.

Existing thermal plants in Tema and Takoradi (both public and private) are either capable of or can be switched from oil to gas firing, generating important economic and environmental benefits. TTPS and TT1PP are currently utilising gas from the WAGP. Infrastructure is under development for TT2PP to commence generation using both Liquid fuel and natural gas. VRA currently provides part of its contracted gas from WAGPCo to Sunon Asogli to produce 200 MW to feed the national grid.

This means that gas powered thermal generation is now an immediate to medium term solution to the country's electric power energy demand. Thus the likelihood of gas being selected as the fuel for thermal power plants is now very high on the national agenda. As such, the selection and development of a site for the provision of immediate generation capacity that at the same time provides access for gas delivery is the focus of GoG due its technical and commercial viability. It is on this basis that the Kpone Thermal Power Plant has been conceived

Within the context of the environmental impacts for the usage of gas for the operations of thermal projects, must be noted that there will be no potential significant impact on the physical, biological and socio-cultural environments within the sphere of environmental influence of the Station. Some positive environmental issues identified in the usage of gas for thermal projects, such as the Tema Thermal 1 Power Project (TT1PP) are:

- Reduction of NO_x emissions to about 50% of present values and SO₂ to about 1% of current levels resulting in a reduction of impact on environment, health and vegetation.
- Reduced burning of waste oil only in the event of no gas supply and resort to oil usage
- Uninterrupted gas supply would reduce quantity of oil use and associated oil spill.
- Frequency of oil deliveries would be drastically reduced as well as the likelihood of oil spill.

4.4 Alternative Technology Considerations

Thermal power is the only option that can be implemented within the timeframe available for the immediate to medium term solution to the country's electric power energy demand. In addition to fuel types, thermal generation can be considered by plant type:

- Heavy fuel oil reciprocating engines;
- Heavy fuel oil/gas turbines;
- Gasoil/gas turbines;
- Methanol/gas turbines;
- Diesel/gas reciprocating engines.

As gas is currently available in Ghana, only those plant types that can utilise natural gas as well as heavy fuel oil/diesel oil would be appropriate for the KTPP. The availability of plant is also a consideration, which will determine whether the plant is purchased or hired and if the plant can be delivered within the project schedule.

4.4.1 General Electric Frame 9E Gas Turbine

The GE 9E GTs such as those installed at TTPP, Aboadze and TT1PP, Tema; utilize a dry low NO_x (DLN) combustion system. DLN combustion is designed to achieve guaranteed NO_x levels of 25ppm (at 15 per cent O₂) without the use of any form of diluent injection for NO_x reduction when firing on gas. Water injection is required, however, to ensure low NO_x levels when firing on crude oil and distillate oil.

The DLN-1 system, as installed on the 9E fleet since 1994, achieves low NO_x levels by fuel staging, with lean air-fuel ratios dependent on premixing of the fuel with air. The DLN combustor has six individual nozzles in the primary combustor and one nozzle in the secondary zone. NO_x emission levels of 25ppm can be achieved on gas fired units without the parts life reduction associated with water or steam injection. Carbon monoxide (CO) emissions of 15ppm can be achieved, rising to 25ppm at 50 per cent gas turbine load.

The combustion system is of the reverse-flow type and consists of canted combustion chambers arranged around the periphery of the compressor discharge casing. This system also includes the fuel nozzles, spark plug ignition system, flame detectors, and crossfire tubes. Hot gases, generated from burning fuel in the combustion chambers, are used to drive the turbine.

4.4.2 Alstom GT11N2 Gas Turbine

The latest member of the Alstom GT11 family, the GT11N2 gas turbine is a single-shaft design which, as a simple-cycle packaged unit is well rated at base load. In combined-cycle applications greater than 50% thermal efficiency is possible. With its nominal speed of 3600 rpm, it drives and converts a 60-cycle generator through a reducing gear arrangement to a 50 Cycle generator. The gas turbine module consists of a 14-stage axial compressor; a 4-stage turbine and a single top-mounted silo-type dry low NO_x combustor with EV (Environmental) Burner technology and it employs a water injection system for NO_x Control.

From the Exhaust Stack Dispersion Modelling carried out with the GT11N2 gas turbine fitted with the EV (Environmental) Burner technology with respect to natural gas and distillate fuel firing, predicted pollutant concentrations for NO_x attributable solely to the plant would be below the Ghanaian and WHO air quality guidelines.

The thermal NO_x are generated in the liner in which the temperature is higher than 1800°C. The NO_x generation is tightly linked to the temperature and any slight temperature drop involves a significant decrease of the NO_x without affecting the combustion efficiency. The water injection in the liner is made to reduce the temperature in the primary zone. The injection rate (water to fuel ratio) is a function of the requested reduction of the NO_x emission level. The water injection affects the gas turbine performances positively by increasing output.

Since both technologies utilize low NO_x burners and ensure relatively low emissions compliant with WHO and Ghanaian Allowable limits, delivery period, cost, efficiency and other factors such as the need to diversify technology types in the generation station plant were therefore considered for selection of the Alstom GT11N2 over GE Frame 9E technology.

4.5 Alternative Site Considerations

Currently, the choice of location of the plant for the KTPP is a balance between proximity to the “fuel” source and proximity to a point of access to the electricity grid, minimising the electric system impact of a substation failure and key load centres. In addition, the time required to negotiate for the property rights to a site not owned by VRA is an important consideration in the installation of generation capacity. Between grid connection and fuel delivery, the proximity to the load centre is generally more important owing to the costs and time involved in making any initial connection to the grid and more importantly, the long-term stability and cost of grid operation.

A number of alternative sites were considered for the KTPP. These included:

4.5.1 Coastal Site West of Kpone Township.

This area would need extensive site preparation prior to construction and would therefore delay implementation. Moreover the land size is not adequate for the installation of facilities for the expansion of the facility to 300 MW or more.

4.5.2 Decommissioned Site at Takoradi

Even though this site is close to the fuel storage tanks of BOST, it has the disadvantage of the direct evacuation of only 12MW of the 220 MW generation capacity of the proposed plant into the ECG system.

4.5.3 The Decommissioned SRPP Site at Tema

The Strategic Reserve Power Plant (SRPP) site was considered as a candidate location at the onset of project planning because of its proximity to and availability of crude and diesel fuel oil from the already existing storage

tanks at Tema Oil Refinery and New Tema ECG substation providing convenience of tie-in to the national grid for the evacuation of the power. However, the site has been utilized for the construction of the Tema Thermal 1 Power Plant (TT1PP) and the Tema Osonor Plant (TOPL) which is at initial developmental stage mainly because of its proximity to and availability of crude and diesel fuel oil from the already existing storage tanks at Tema Oil Refinery.

4.5.4 VRA site in the vicinity of Dawhenya

Since the KTPP plant can be operated on Natural Gas and Diesel Fuel, this 75 acres site was considered the most suitable site for the project because of its proximity to the diesel storage facilities of the Bulk Oil Storage and Transport Company (BOST) at the Accra Plains Depot (APD). Secondly, the 161KV transmission line from Akosombo to the Volta Substation at Tema runs parallel to the western border of the site, hence it has the advantage of locating the switchyard close to the existing lines and the construction of only a short transmission system (approximately 500m) for the evacuation of power from the station.

The size of land available makes possible the expansion of the plant from Open to Combine Cycle Plant without the need for additional space.

4.6 Transmission Planning Analysis

A major benefit of locating the plant in Tema is the reduction of incremental transmission losses since the plant will be close to the major load centers of Accra and Tema. The site is flat and approximately 400m to the east of the Kpong GS-Volta (Z18V) line which runs parallel to the six (6) Akosombo-Volta (A1V – A6V) lines.

There are four (4) options for integrating the plant. These are

- New line to the Volta substation, about 4 km from the site
- New Line to the New Tema substation, about 7 km from the site
- New line to the Smelter substation, 9.2 km from the site
- Breaking into existing lines 400m west of the site

The four (4) options are discussed below.

Option 1: New line to the Volta substation

The Volta substation, which VRA's only switching station, has space for just one more line into the station. Acquiring a right of way from the proposed site into the substation will be a challenge considering the level of development around the station and the introduction of the 330 kV line from Aboadze as well as the construction of the KTPP. Moreover, adding a 330 MW plant to the grid via a single line seriously reduces the reliability of the plant as the loss of the line isolates the plant. Constructing a new line to the Volta substation was therefore ruled out.

Option 2: New line to the New Tema substation

The New Tema substation which is just about 3km south of the Volta substation. There is presently no space at the New Tema substation for the termination of new lines and thus eliminates the possibility of evacuating power from the plant to the New Tema substation.

Option 3: New line to the Smelter substation

Even though the Smelter substation can be modified so that power from the plant is evacuated to the station, possible disruptions to the operations of Valco and the difficulty of acquiring a right-of-way into the Smelter station make this option unattractive.

Option 4: Breaking into Existing Akosombo-Volta Lines

The six Akosombo-Volta lines (A1V – A6) are Lilac, 403mm² All Aluminium Conductors (AAC) with the ability to carry more than 200MVA each. The Kpong GS-Volta (Z18V) line is a Hawthorn, 604mm² All Aluminium Conductor (AAC) with a thermal limit of 273MVA. Under present peak load conditions, the line with the heaviest loading is the Hawthorn and it carries 116.5 MVA which is about 42.7% of its rated capacity. The Lilac conductors are each loaded up to 39.2% of the rated thermal limit and the introduction of thermal plants in the Tema area will further reduce the power flow on these lines. Some of these lines can therefore be rerouted to KTPP Site to evacuate power from the plant.

Choice of integration scheme

The recommended scheme for integrating the plant into the transmission system therefore is to re-route some of the lines going into the Volta substation from Akosombo and the Kpong generating station through the thermal plant (Option 4). This option most importantly eliminates the need for acquiring a right of way and construction of long transmission lines.

4.7 Possibility of the Use of Alternate Mode of Transmission

VRA intends to use overhead cables on steel lattice towers for the project. Another alternative means of transmission is underground cables. However, laying of transmission lines in underground cables over long distances is not practicable and might entail financial and environmental costs that might be too high to bear. Again, buried lines require high levels of insulation and are difficult to install over steep terrain or within wet valleys and are expensive to maintain. Installation of long runs of buried, high voltage line is therefore cost prohibitive. The Project will therefore utilise overhead cables.

Apart from the visual positive impact of underground cables, underground cables do have a number of additional negative impacts that are not associated with overhead lines. The most important are highlighted below:

4.7.1 Construction Impacts

4.7.1.1 Ecological

While overhead transmission lines may be considered unsightly, they do not impact the environment in the manner underground lines would when crossing large expanses of land. Electrical lines pass over wetlands and

fragile ecosystems and it becomes easier to avoid injury to those areas when the lines are overhead as opposed to digging up trenches to bury electrical lines. For overhead lines, the only land and habitat really lost is the land around the tower base and the access routes for construction, whereas the underground cable option affects the width of the entire cable route. A greater degree of land will be sterilized with an underground cable due to the restrictions that would need to be placed upon all subsoil activities as well as the planting of trees and bushes along the entire route length for safety purposes. An underground option would also require large areas of land to be set aside to accommodate cable joint bays. The removal of trees and shrubs along the route leads to irreversible ecological damage.

4.7.2 Operational Phase Impacts

4.7.2.1 Visual

Overhead lines impact on the landscape in rural settings and affect scenery in tourist centres and their impact is however only more pronounced in urban settings. Underground cables show impacts at sealing end points as well as at points where cable cooling systems are sited.

4.7.2.2 Noise

The most notable noise during normal operation is the hissing sound due to the corona effect. This type of noise will however be minimized by the use of bundle line conductors instead of single conductors. An underground cable system would have given constant audio noise from cable cooling stations.

4.7.2.3 Water Pollution

There will be no water pollution from the overhead line itself. Had the entire sub-transmission system been an underground one, pollution would have been expected from cable fluid leaks.

4.6.2.4 Agricultural Impacts

The settlers and other subsistence farmers will be advised not to carry out any farming practices within the way leave. This restriction applies to both system, but is usually supposed to be more rigidly applicable to the cable systems.

4.7.2.5 Outage Time Impacts

The time required to locate and mend a cable fault is significantly greater for underground cables than that of an overhead line resulting in reduced system security and availability.

4.7.3 Cost

When deciding whether to put transmission lines overhead or underground, installation costs become a primary concern for power companies. The advantage in initial capital costs goes to overhead lines. Cost becomes a primary concern of power companies when determining how to construct transmission lines. As has been experienced throughout the whole of Africa, the economic case for the utilization of an underground circuit cannot be normally justified at this voltage level and this is certainly the case for this project. According

to various sources, it costs five to 15 times more to install transmission lines underground, making it prohibitive and rarely used except in densely populated urban areas where overhead is not feasible. *Table 13* provides the cost of transmission line technology per kilometer. From these construction costs per kilometer when added with compensation costs of a particular section (area) will help to determine the least cost option. However, the final decision will consider the social impact and comments or concerns from stakeholders.

Table 13: The cost of overhead towers and underground cables

Type	Underground cable	Overhead Towers Compact design	Overhead Steel Poles
Cost per Km	US \$100,000	US \$84,500	US \$25,000

With the cost of underground cables being over 400% higher than the equivalent capacity of overhead steel pole, the level of investment needed would be beyond the ability of GoG and the project would not be able to be developed. Again, experience in Africa has shown that underground cables attract a high degree of vandalism. The mineral content of pieces of underground cable at this voltage level could attract vandals leading to both costly replacement as well as unnecessary disruptions in power delivery.

Underground power lines are more costly to repair. In addition, it generally takes longer to repair than overhead lines due to the difficulty in reaching the underground problem. Delays in repairs create many problems, including power outages, and with transmission lines, a cascading effect due to the many customers served by one set of transmission lines. Maintenance costs have to be calculated along with the initial capital installation expenses when determining whether or not to go underground so the advantage on repair costs goes to the overhead transmission lines.

The environmental and financial impacts highlighted above prove beyond reasonable doubt that the overhead transmission system is more environmentally friendly and economically the better choice.

5.0 DESCRIPTION OF EXISTING ENVIRONMENT

5.1 Location of the Project

The project site is located at Nmlitsapko, about 2 kilometres off the road from the Kpone Barrier on the Tema-Aflao road (One kilometre from the barrier to the turn-off junction and about one kilometre off the junction on the Tema-Aflao road to the project. The site allocated for the project by the Tema Development Corporation (TDC) is about 75 acres (30 Hectares) in size. The geographical coordinates of the power plant site is approximate National Grid Reference N'117900.00 – 117400.00 and E'385800.00 – 284200.00 E¹⁵.

The plot area is a flat plain with downgrade slope from northeast to southwest direction of trapezoidal shape. The area has a dimension of 546m in the north side and 610m in west direction with a total area of about 245,456m². The power plant site will occupy less than one-third of the land. The site in 2007 was a green field location without any facilities but currently provided with a fence wall for security.

The adjoining lands to the project site (See *Plate 6*) have the following uses:

- TDC's Community 25 to the south, about 150m from the power plant site.
- GRIDCo 161 kV Transmission Lines to the west: about 300-500m from the site.
- A number of houses mainly under construction to the east and north: minimum of about 150m from the site.
- A number of physical developments are within the RoW between the associated 161 kV transmission lines and the plant site. These properties are to be acquired by the VRA, making their owners project affected persons.

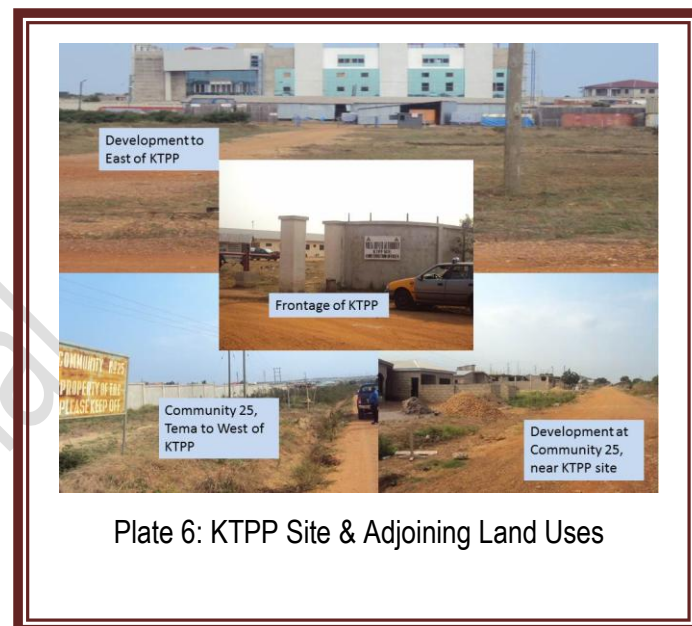


Plate 6: KTPP Site & Adjoining Land Uses

¹⁵ Site Map of KTPP is enclosed as part of Appendix 2

5.2 Site Topography & Drainage

The site for the proposed Kpone Thermal Power Plant slopes in the approximate North-South direction at an average gradient of the order of 1.5%. It is rather close to the Kpone-Ada/Aflao Road Barrier and to the Tank Farm of the BOST. The difference in elevation between the highest and lowest points on the site is about 10m over a distance of about 600m. There are no apparent drains or stream on the site. The closest water body is a seasonal stream located about 2.48 kilometres from the site (See *Plate 7*). This water body is mostly dried out except during the rainy season where water is seen to flow through the drainage channels into the sea. VRA intends to construct a drainage pipe from the site to this water body to serve as recipient of the treated effluent from the power plant.



Plate 7: Closest stream to KTPP Project Site

5.3 Site Geology & Soils

Tema is underlain by rocks of Dahomeyan series (Late Pre-Cambrian), consisting principally of Gneisses and Schists, which are in turn intruded in the places by rocks of the Togo Series (Early Pre-Cambrian) made up of quartzites, Schists and Phyllites. The rocks of this geological system occur essentially as alternating belts of basic and acidic gneisses. The report of the geotechnical investigations carried out at the site for the proposed project in February 2008 is attached¹⁶.

Based on the results of the geotechnical investigations, which consisted of 12 boreholes by percussive drilling and seismic refraction test over the site as a whole, the following conclusions concerning the project site for the KTPP were made:

- The borehole logs suggest that the subsurface profile may be divided into three layers:
 - Layer 1 is the top soil not exceeding 0.5 metres
 - Layer 2 is medium to dense silty sand with some clay and gravel up to 2.7m thick
 - The weathered rock may be encountered at shallow depths varying between about 1.2 and 3.0 metres and hardens further with depth

¹⁶ See Appendix 7 for the Geotech Survey Report for KTPP

- The seismic refraction test identified three zones: a top zone of sandy material underlain by a weathered zone which is in turn underlain by the bedrock. The top and weathered zones correspond to the three layers of the borehole logs
 - The weathered zone is within 8.8 metres depth and the bedrock is encountered between 5.0metres and 19 metres
 - The average compression velocity within the weathered zone is 1356m/s while that in the bedrock is in the excess of 3,600m/s.
- The subsurface profile was fairly similar across the whole site investigated
- The subsurface material has high bearing strength

5.4 Ground Water Quality

EPA in their review comments, requested for ground water data quality for the proposed location of the oil tank farms. It must be noted that a geotechnical survey was undertaken by A Plus Consult Limited at the KTPP site and a report submitted in February 2008¹⁷. Twelve (12) boreholes were sunk by percussive drilling at various locations at the site, including where the oil tank farms are to be located, that is at site BH-D2 and BH-S10¹⁸. The boreholes were 150mm in diameter and were sunk using 1.5ton Pilcon Wayfarer Drilling Rig. The drilling could not attain the target depth of 10m on account of the hardness of the formation, but each hard formation was provided by chiselling for hours to attain as far as possible, a penetration of at least 1.5m. The final boreholes depths varied between 2.6m and 6.1m. It must be noted that within the depths investigated, no evidence of ground water was encountered. Subsequently, there is no existing data on ground water quality for the proposed location of oil tank farms for input into the EIA document.

5.5 Climate

In order to properly represent the climate spanning the project sites, data on relative humidity, temperature, rainfall, and wind speed covering the period 2004-2012 was obtained from the Tema Weather Station: 654730 (DGAT) ¹⁹, located on Latitude: 5.61, Longitude: 05 and Altitude: 14. Data was supplemented with information earlier obtained from the Ghana Meteorological Services Department.

5.5.1 Temperature

The hottest periods of the year in Tema are in the months of February and March with daytime temperatures reaching up to 35 °C. This is the period preceding the onset of the rains. The mean monthly temperature during this time is about 29°C. July and August are relatively cooler months with mean temperatures of 25 °C or even lower at night. The average temperature regime in Tema from 2004-2012 have been presented in the *Table 14*.

¹⁷ See Appendix 7 for Geotechnical Survey Report

¹⁸ See Appendix 2 for Site Map of borehole coordinates

¹⁹ <http://www.tutiempo.net/en/Climate/Wa/08-2010/654040.htm>

Table 14: The Monthly Average Temperature (°C) for Tema

PERIOD	2004	2005	2006	2007	2008	2009	2010	2011	2012
January	28.7	27.9	28.4	28.2	ND	ND	28.6	28.6	28.6
February	29.3	29.7	29.4	29.6	ND	ND	29.7	29.5	28
March	29.9	29.0	28.7	29.3	ND	ND	29.5	29.1	29.5
April	28.9	29.4	28.4	28.8	ND	ND	30.2	29.7	28.6
May	28.2	28.1	28.2	28.6	ND	ND	ND	28.4	28.1
June	26.6	26.5	26.8	26.8	ND	ND	ND	27.1	26.5
July	25.4	25.6	25.9	25.8	26.5	25.9	25.4	25.4	
August	25.2	24.7	25.1	25	ND	25.4	25.9	24.9	
September	26.8	26.7	25.6	25.5	ND	25.9	27.2	26.6	
October	27.5	27.4	26.8	27.7	ND	27.7	ND	27.4	
November	28.9	28.5	28.3	28.6	ND	28.7	26.8	28.9	
December	27.8	28.6	28.7	28.4	ND	28.9	30	29.9	

5.5.2 Rainfall

Tema lies within the dry equatorial climatic region of Ghana. This area, which is part of the Accra Plains, is one of the driest parts of the country. It experiences two rainfall maxima in the months of May/June and September/October. The period between January and April is comparatively dry with maximum desiccation taking place in many soil formations during this period.

Table 15 shows monthly average rainfall data from 2004-2012 in Tema.

Table 15: Mean Monthly Rainfall (mm) – Tema

PERIOD	2004	2005	2006	2007	2008	2009	2010	2011	2012
January	6.5	4.4	0.5	39.1	ND	ND	0	0	0
February	11.0	2.0	8.0	13.0	ND	ND	0	0	0
March	13.8	184.5	28	12.4	ND	ND	29.0	0	0
April	27.1	24.6	168.8	175.3	ND	ND	15.0	0	9.9
May	91.8	94.1	239.7	76.8	ND	ND	ND	1.3	0.0
June	55.7	147.1	138.2	293.5	ND	ND	ND	48.5	3.1
July	16.1	44.9	5.4	72.0	0	0	42.9	88.1	
August	31.9	1.4	11.4	6.2	ND	0	0.5	0.5	
September	73.6	22.7	105.6	37.5	ND	0	0	0	
October	55.5	43.6	5.1	65.2	ND	0	ND	80.01	
November	24	41.3	59.9	30.7	ND	0	0	0	
December	0	0.2	6.1	0.1	ND	14.0	0	0	

5.5.3 Relative Humidity

The variation in Relative Humidity at Tema is minimal and sometimes erratic due to the daily influence of the sea and the land breezes. The values range between 80 % during the night to about 60% at daytime, and falls to less than 30% during the dry season (Dec-Jan), when the dry North-East Trade winds reach the coastline. Data gathered from 2004-2012 in Tema has been presented in Table 16.

Table 16: Mean Humidity Data (%) for Tema

PERIOD	2004	2005	2006	2007	2008	2009	2010	2011	2012
January	74	61	75	67	ND	ND	80.8	59.4	79.3
February	70	74	68	69	ND	ND	77.6	72.0	77.4
March	69	74	72	71	ND	ND	77.0	76.5	76.1
April	76	76	77	72	ND	ND	76.0	77.8	79.5
May	76	78	75	73	ND	ND	ND	80.3	77.0
June	79	82	82	78	ND	ND	ND	84.8	85.0
July	81	82	81	85	80	85.0	92.0	87.6	
August	81	83	77	82	ND	82.6	85.8	87.9	
September	78	79	81	79	ND	82.5	ND	82.2	
October	77	75	75	76	ND	77.3	ND	79.1	
November	73	73	72	72	ND	76.1	81.0	76.3	
December	74	74	75	67	ND	76.3	72.5	76.0	

5.5.4 Wind Direction and Speed

The general wind direction in Tema is in the South-westerly direction. Data accessed for the period 2009-2012 is presented in Table 17.

Table 17: Wind Speed (Km/hr)

Month	2009	2010	2011	2012
January	ND	7.1	8.7	11.1
February	ND	13.3	14.8	14.2
March	ND	6.4	13.4	11.6
April	ND	15.2	12.2	12.8
May	ND	ND	11.3	10.6
June	ND	ND	11.3	11.4
July	13.9	15.6	12.8	
August	14.6	12.9	15.8	

Month	2009	2010	2011	2012
September	12	17	17.3	
October	12.5	ND	15.3	
November	7.6	9.8	13.4	
December	9.5	11.9	8.7	

5.6 Air Quality

The main releases to air from the plant shall be Oxides of Nitrogen (measured as NO_x) and Particulate matter (TSP or PM₁₀). Since the plant uses distillate fuel oil, Sulphur Dioxide (SO₂), CO₂, CO would not be direct products of the combustion of the DFO. Treated fuel is pumped from the storage tank to the CTGs combustion chamber where it is burnt with compressed air. The product of the combustion is directed unto a turbine to drive the generator that is coupled by a shaft. Within the Single phase cycle, the exhaust gases shall be released into the atmosphere. It is expected that in future during the combine phase cycle, they would be channelled to a heat recovery steam generator, which in turn shall produce steam to drive a turbine and a generator at high pressure.

5.6.1 Ambient Air Quality at KTPP Site

Ambient dust, gases and noise levels were measured at four designated monitoring points. The monitoring points were located at the northern, eastern, southern and western boundaries of the project site. Respirable particulate matter with effective size of 10 microns and well as total suspended particulate matter was measured. However, it would be noted that the day-to-day measured levels of the particulate matter and noise levels can vary, and propagation will vary considerably with weather conditions (especially wind speed, direction and rainfall). The result of this study applies only to the day and time of the specific measurements.

Samples were taken at a minimum height of 2 meters above the ground level to prevent the collection of ground level dust temporarily made airborne by gusting winds. Particulate matter (PM₁₀) and Total Suspended Particulate (TSP) were sampled/collected using MiniVol samplers set to a flow rate of 5L/min. Particulate matter collection units were placed at the 4 locations as mentioned earlier. Samplers were oriented in the direction of wind flow. Pumped air was siphoned through a quartz filter paper, mounted in the sampling units and sampling undertaken for 24 hours at each of the location.

The filter papers were removed and taken to the laboratory for analyses by gravimetric method and the dust level calculated using Equation 1. The weighing scale was calibrated using standard weight for each monitoring period. All sampled filters were stabilised in desiccators and pre-weighed before sampling. All sampled filters were removed from the sampling unit and weighed again (post weighed). Sampled filters were removed from the sampling unit and weighed three times, and averaged to ensure accuracy after sampling.

Differences in weight (W_2-W_1) were used to calculate the concentrations of the PM in $\mu\text{g}/\text{m}^3$ using the formula below.

$$\text{Eq. 1: Concentration of dust in } \mu\text{g}/\text{m}^3 = \frac{(W_2-W_1) \times 10^6}{X_r \times T}$$

Where:

W_1 = Initial weight of filter paper

W_2 = Final weight of filter paper

X_r = Average flow rate

T = Duration of sampling

Sampling was made for 24 hours.

Results obtained are provided in Table 18.

Table 18: Ambient Particulate Matter measured, Summary 5th – 8th Feb 2008

Location	PM ₁₀ ($\mu\text{g}/\text{m}^3$)	TSP ($\mu\text{g}/\text{m}^3$)
Southern Boundary	50	102
Northern Boundary	43	118
Eastern Boundary	48	129
Western Boundary	54	105
EPA Air Quality Limit	70	230

From the analysis carried out on the air quality data, the average ambient dust level for the particulate matter <10microns (respirable dusts/PM₁₀) for the four points range from 43 to 54 $\mu\text{g}/\text{m}^3$ and that for the Total Suspended Particulate (TSP) ranges from 102 to 129 $\mu\text{g}/\text{m}^3$ as against the E.P.A ambient air quality guideline value of 70 $\mu\text{g}/\text{m}^3$ for PM₁₀ and 230 $\mu\text{g}/\text{m}^3$ for T.S.P. respectively. The prevailing weather conditions during the period of measurement varied, and ranged from sunny, dusty to overcast. The predominant wind direction at the time of measurement was from North East to South West, and particulate matter/ dusts accumulated on unsettled areas/ vegetation. Minimum and maximum wind speeds recorded during the period of measurement are 0.43 and 2.6 m/s. The predominant wind direction was NNE – SW. It can be concluded that entrained dust is not a problem at the project site. Dust levels measured did not exceed the EPA recommended limits of 70 $\mu\text{g}/\text{m}^3$ for respirable dust (PM₁₀) and 230 $\mu\text{g}/\text{m}^3$ for total suspended particulate matter.

5.6.2 Air Quality at Neighbouring Communities

As requested by EPA in their review comments on the Draft EIS, VRA commissioned a baseline to monitor ambient air in three locations within neighbouring communities around the project site²⁰. The three locations are Saki-Bediako, TDC Serviced Plots area, and the North East Point of maximum Fallout. Ambient air quality parameters were measured using the AEROQUAL AQM 60 Air Quality Station.

At each location, readings were taken for one hour in the morning, one hour in the afternoon and one hour in the evening. The ambient air quality parameters measured were:

- Nitrogen Dioxide (NO₂),
- Sulphur dioxide (SO₂), and
- Carbon monoxide CO,
- Particulate Matter, PM₁₀, and
- Total Suspended Particles (TSP),

The results obtained showed that the concentrations of Nitrogen dioxide (NO₂), Total suspended particulates (TSP), PM10 and Carbon Monoxide were well within the Ghana EPA's recommended limits for residential areas. The concentration of Sulphur dioxide (SO₂), however exceeded the daily (24hrs) recommended limit at Saki-Bediako and TDC Serviced Plots locations. Readings at the third location (Point of maximum fallout) also exceeded the 24-hour recommended limit for SO₂ in residential areas on 2 days. This increase can be attributed to the open burning of household wastes in the area. Nonetheless, the hourly (1hr) concentrations were all lower than the EPA's guideline of 700 µg/m³.

5.7 Noise Level

Noise monitoring was carried out at four sites within the project area using High Precision Sound Level Meter. The meter is calibrated for each period of measurement and the calibration value recorded. A summary of the daytime noise levels measured is presented in *Table 19*. The night time equivalent ambient noise levels range from 32.1 dB (A) to 36.3 dB (A) as shown in *Table 20*. The measured daytime equivalent ambient noise level within the site at the time of monitoring ranged from 41.4 and 50.5 dB (A). The maximum noise level for the receptor neighbouring communities was 67.3 dB (A) as shown in *Table 21*. These equivalent noise levels were below EPA daytime recommended level of 70 dB (A) for industrial areas. Values measured at the time of assessment are lower than EPA recommended levels. It can be concluded from above that there is no noise pollution in the project area.

²⁰ See Appendix 8 for Air Quality Baseline Assessment Report

Table 19: Daytime Ambient Noise Levels

Location	Leq	L10	L50	L90	Lmax	Lmin	Lpeak	EPA Limit
North	41.4	44.2	37.9	34.1	69.0	31.0	113.6	70.0
South	50.5	50.5	47.1	40.9	73.0	36.3	110.8	70.0
East	47.2	45.3	37.9	35.3	68.4	32.5	124.0	70.0
West	45.7	45.2	35.6	32.4	63.8	30.3	109.0	70.0

Table 20: Night Time Ambient Noise Levels

Location	Leq	L10	L50	L90	Lmax	Lmin	Lpeak	EPA Limit
North	32.1	31.8	33.7	32.4	41.3	30.4	82.7	70.0
South	34.2	32.5	33.6	34.0	43.1	31.5	61.7	70.0
East	36.3	33.6	34.8	35.4	42.4	32.3	67.3	70.0
West	33.7	31.2	33.5	33.3	39.2	30.9	58.3	70.0

Table 21: Day time Noise levels Monitoring Results in Neighbouring Communities

Location	Geo-coordinates	Noise level dB(A)		
		Average Noise Levels	Maximum Noise Levels	Permissible Noise level
Western Corridor (Saki/Bediaku)	N 05° 44' 09.6" E 000° 00' 12.3"	52.47	67.3	70.0
Southern Corridor (Ababase)	N 05° 43' 35.0" E 000° 00' 24.4"	49.27	58.7	70.0
North Eastern Corridor	N 05° 44' 14.2" E 000° 00' 50.0"	39.01	48.1	70.0
Eastern Corridor (TMA Service Plots)	N 05° 43' 57.6" E 000° 00' 59.7"	46.77	57.7	70.0

5.8 Flora & Fauna

Information on birds and other animals was gathered from existing literature on reported species as well as observations in the field. Transects for bird counts were not employed as very few bird species were observed on the site during the reconnaissance. Animals found within the project area of influence include lizards and termites.

Vegetative cover is sparse and is dominated by a few isolated mature trees, as the land has been cleared. The habitat was open with new growth scrubland. The vegetation in the project site consists mainly of neem trees and coastal savannah grassland with small clumps, short grass, and stunted shrubs. The common types of grass dominating the area are *Digitaria horizontalis* and *Axonopus compressus*, and the most common shrubs are *Chromolaena odorata* and *Securinega virosa*.

There are no rare, threatened or endangered plants or animal species on the site, and the dominant trees recorded are common to savannah grasslands and with a wide distribution, regionally and/or globally.

5.9 Environmental Sensitive Areas

Environmentally Sensitive Areas are defined by the presence of key natural features. The Environmental Assessment Regulation, 1999, LI 1652 as well as the Environmental Assessment Guidelines for the Energy Sector Volume 1 defines designate areas that are classified as environmentally sensitive. None of the project sites for KTPP (i.e., power plant, gas/diesel pipeline and Transmission line) is located within any protected areas. Almost all of the project sites are located in suburbs/industrial areas and there are no special habitats for endangered fauna or flora. It is important to note that there are no environmental sensitive areas within the project area.

5.10 Access Road & Traffic

The project site is accessed from the Tema-Dawhenya, on the main Aflao road, about 2 kilometres from the Kpone Barrier. The access road to the site is tarred to about 85%, by the Tema Development Corporation (TDC) as entry to Community 25, off the Tema-Dawhenya Road. The area is also accessible from the west side by a gravel road (See *Plate 8*). The estimated average hourly traffic on the access road is 23.0 vehicles (6am-6pm). The vehicles are mainly dumper trucks hauling laterite to and from construction sites in Community 25 and surrounding areas.

5.11 Water and Electricity Supply

Potable water supply to the site is through existing municipal water system of the Ghana Water Company. The electricity during construction will be provided by Electricity Company of Ghana by the means of the existing 33kV power system at the site which was connected by the Ministry of Energy on behalf of VRA (See *Plate 9*) as well as a 135kV Stand-by generator.

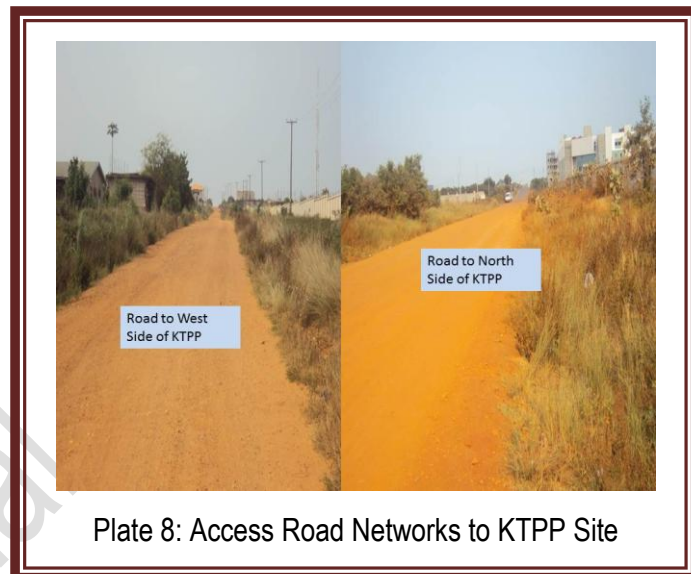


Plate 8: Access Road Networks to KTPP Site



Plate 9: Existing ECG 33kV power system at the KTPP site

5.12 Socio-economic Data of Immediate Impact Area

This section presents a description of the social and economic characteristics of the Immediate Impact Area (IIA), which is the area where we anticipate any impacts of the immediate constructional and occupancy activities on the local people, will be felt.

5.12.1 Immediate Impact Area

The nearest towns and communities to the project site are Community 25 (To the east of the project site) and Nmlitshakpo Community (to the west of the project site).

5.12.2 Population

There are 1,000 plots located within the Community 25, which will eventually be home to approximately 4,200 people. The entire 1,000 serviced plots are located on the south of the site. Nmlitshakpo is projected to have about 70,000 people (TDC and TMA Estimate). Most of the plots are yet to be developed.

5.12.3 Number of Interviewees

The number of interviewees for the socio-economic data is 43 people (See Table 22). The data on the interviewees e.g. residence, age, sex, employment status, etc. are found in the Figures below:

Figure 1: Age & Sex of Interviewees

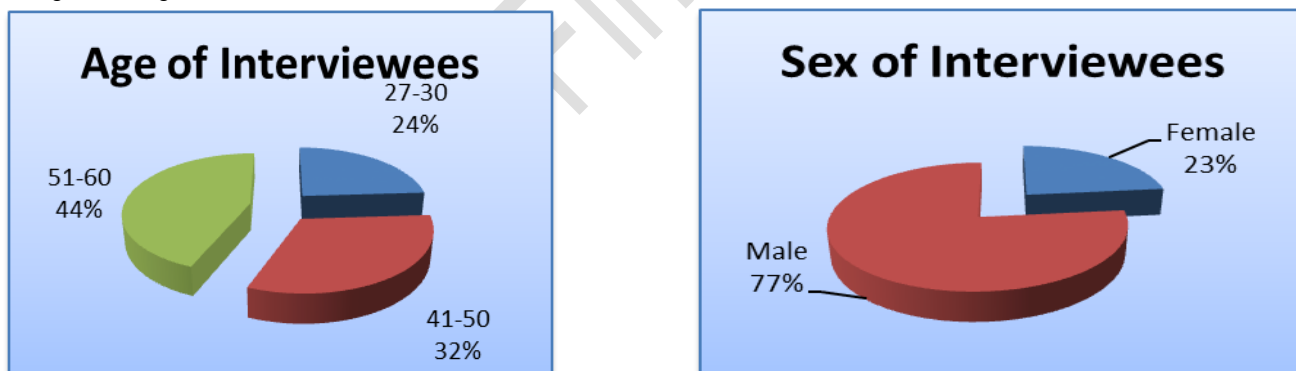


Figure 2: Residence & Employment Status of Interviewee



Table 22: Occupation of Interviewees

Accountant	2
Administrator	2
Banker	2
Barber	1
Clearing Agent	1
Cocoa Clerk	1
Computer Technician	1
Contractor	2
Electrician	2
Farmer	12
King maker	1
Nurse	1
Sales Person	2
Security	1
Statistician	1
Student	3
Surveyor	1
Trader	2
Photographer	1
Acting Regent	1

5.12.4 Household Size

The data on Household Size of interviewees is:

- Minimum : 1 person
- Maximum : 50 persons
- Average : 6.95 persons
- Median : 5 persons

5.12.5 Knowledge of the Project

93% of the interviewees indicated that they had a clear knowledge of the project that was going to take place in the site.

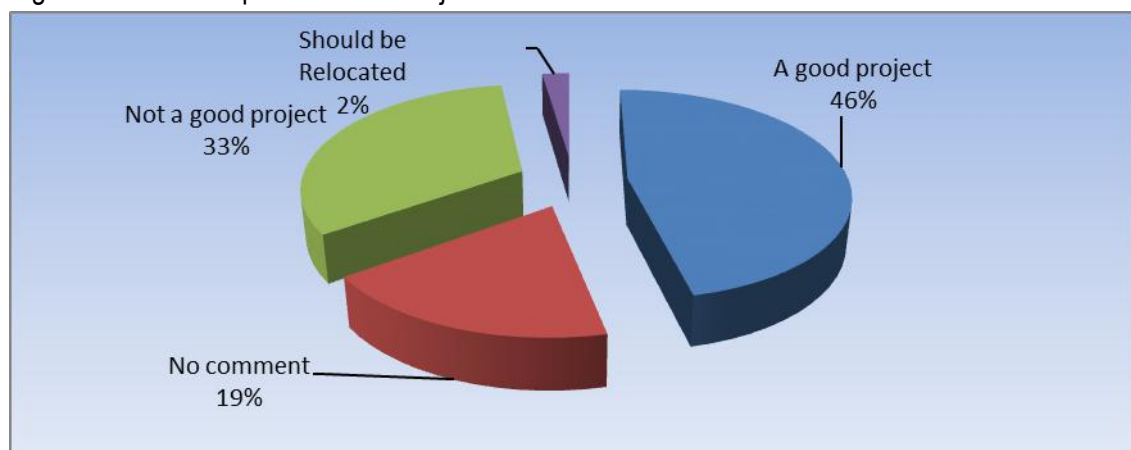
5.12.6 Contact with Officials Explaining the Project

On the issue of contact with officials explaining the project, 88% indicated that some explanation has been given them. 97% of the people in the know of the project said explanations were given to them by officials from VRA. The rest indicated friends as source of information.

5.12.7 General Opinion on the Project

The computed general opinions of interviewees on the project are provided in Figure 3.

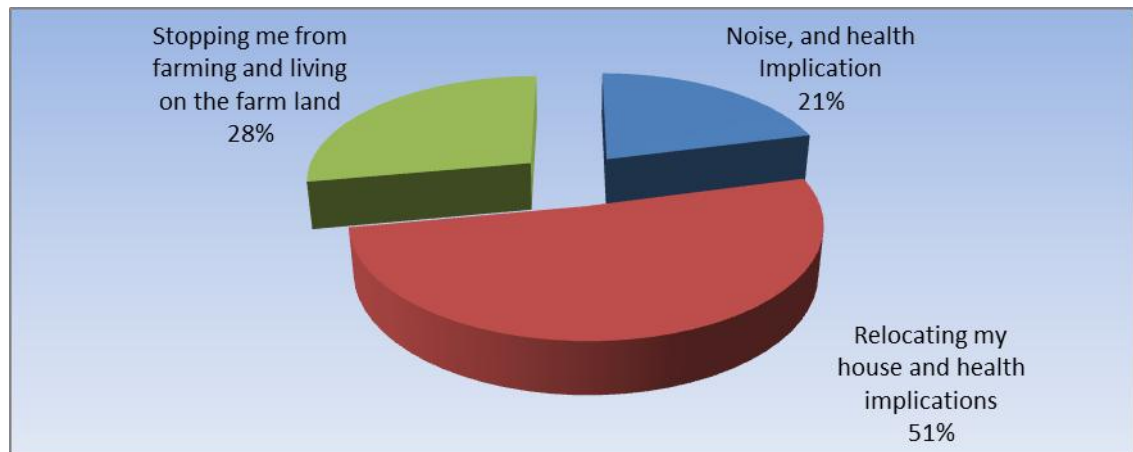
Figure 3: General Opinion on the Project



5.12.8 Effect of the Project on livelihoods

On the issue of the effect of the project on their livelihoods, 12% of the interviewees indicated that there would not be any effect. The rest gave the reasons in the chart below as potential effect.

Figure 4: Potential Effect of the Project on livelihoods



5.12.9 Discussion with Project Officials on Compensation

On the issue of Compensation, 81% of the interviewees indicated that there have been discussions with officials of the VRA on compensation.

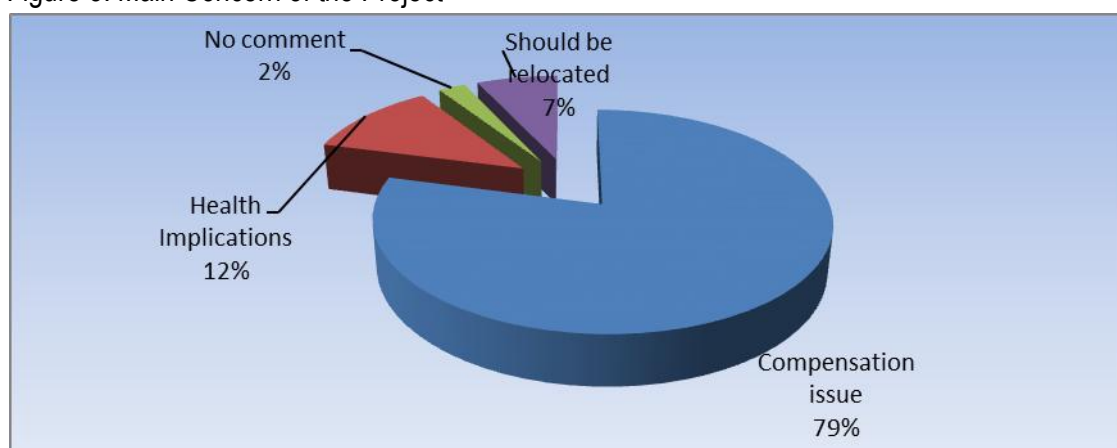
5.12.10 Potential Benefits from the Project

Regarding the potential benefits to be derived from the project, 44% of the interviewees indicated that they would obtain electricity and the rest stated that they would not benefit in any way.

5.12.11 Main Concern of the Project

With reference to the main concerns that they have, the interviewees indicated the computed answers in the chart below. It can be concluded that the issue of compensation is dearest to them.

Figure 5: Main Concern of the Project



5.12.12 Medical Data from Dawhenya Medical Centre

The nearest medical centre to the project site, which is the Dawhenya Medical Centre was visited to collect data on the major or prevalent diseases as shown in *Table 23*. Below is the information on the disease statistics of the area. The population of the project site to Dawhenya is estimated 70,000 people.

Table 23: Medical Data from Dawhenya Medical Centre

	Disease	2005	2006	2007
1	Malaria	593	702	618
2	Acute Respiratory Infection	80	61	103
3	Diarrhoea	80	28	38

The medical officer attributed the increase in the respiratory infection to the increase in the dust level in the area as a result of quarry activities and other constructional activities going on in the area.

5.13 Socio Economic Data on Broader Impact Area

The Broader Impact Area (BIA) is the area outside the IIA where socio-economic impacts during the construction and operation phase will be felt. This shall basically be the Tema Metropolitan Assembly. The power plant, gas pipeline and associated transmission facility are all to be located in the Tema Metropolitan Assembly (TMA). The compilation of area data for TMA has been done based on extensive literature review.

TMA is a coastal municipality situated about 30 kilometres east of Accra, the capital city of Ghana. The Assembly shares common boundaries with the Accra Metropolis on the west, the Ga Municipalities on the North West and the Dangme West District on the northern and eastern borders. The Greenwich Meridian 0° longitude passes through the city of Tema. The Municipality covers an area of 396 km² made up of 163 km² (45%) government acquired area, and the remainder (55%) belongs to traditional authorities, stools and families. TMA lands belong to the indigenous Ga people.

5.13.1 Demographic Characteristics

The 2000 Ghana Population Census and Household Survey put the total population of the Metropolitan at 511,459 made up of 252,109 males and 259,350 females. The Metropolitan is also known to have a high population growth rate of 2.6%. Ashaiman, which is a migrant community, has the highest population growth rate in Ghana (4.6%). The Metropolitan is also polarized into urban (90%) and rural (10%) settlements with population, economic and social conditions following distinct patterns.

5.13.2 Economic Development

TMA has the country's biggest port and harbour facilities situated in Tema, the capital of the Metropolitan Assembly. Tema is also the leading industrial city in the country. Tema is thus the most important production sector of the country in terms of local revenue generation as well as employment opportunities with companies such as The Volta Aluminium Company (VALCO), Ghana Textile Printing Company (GTP), Ghana Ports and

Harbours Authority (GPHA), and the Ghana Agro Foods Company Ltd. (GAFCO), each employing more than 1000 people. There are over 400 factories in Tema which have been categorized into 8 major areas – Chemical, Textiles, Food Processing, Engineering, Paints, Fish Cold Stores, Printing and Woodwork industries

5.13.3 Tema Harbour

The Tema Harbour which officially opened to traffic in February 1962 is the hallmark of economic activities in the Metropolitan. It has the main Harbour, the Fishing Harbour, Shipyard and Dry-dock which is capable of docking both large and medium size fishing vessels. There is also a canoe beach where smaller boats/canoes land. Recently, an outreach Clinic for Maternal and Child Health/Family Planning (MCH/FP) services has been located there.

5.13.4 Commence

Being a port city, commercial activities are carried out extensively in Tema with goods ranging from consumables to automobiles, though trading in foodstuffs appeared to be the most common activity. The Community 1 market serves as the most important daily market in the Metropolitan, with a few markets of relatively less significance dotted in other parts of the Metropolitan, such as Community 2, Ashaiman and Tema Manhean.

5.13.5 Services

A number of light industrial estates have been zoned for use by persons engaged in mechanical repair sector, namely Kpone Light Industrial estate, Community 9 Light Industrial Area.

5.13.6 Mining & Quarrying

Stone quarrying and sand winning activities are carried out in rural areas of the Metropolitan, notable among them are gravel winning at Kpone, sand winning at Santeo, Zenu, Katamanso, Appolonia.

5.13.7 Agriculture Sector

Agricultural activities in the Tema area are growing due to the collapse of much of the formal economy. The activities that can be identified in the Tema Municipal area are the following: -

5.13.8 Fishing and Fish Processing

This is one of the major economic activities especially for the indigenous inhabitants of Tema; the latter being the income generation and processing activity, mainly for women.

5.13.9 Livestock Production

Raising of poultry and pigs in the peri-urban area is done for sale to urban market. Cattle rearing is common in the rural segments

5.13.10 Food Crop Production

Food crops such as maize, cassava and cowpeas are cultivated in the rural segment of the TMA. Irrigated market oriented production of vegetables such as okra, tomatoes, onion, cabbage etc. are practised and usually along main drains and water bodies.

5.13.11 Tourism Resources

The major tourist and cultural sites are the beaches, the harbour and the 'Meridian Rock', which is believed to be located at the exact centre of the world. A point at the Presbyterian Church in Community One has been selected to represent it and it serves as a tourist site.

5.13.12 Education

The Educational system in the Metropolitan has undergone tremendous changes due to the Government's new educational policy. The Ministry of Education gives the policy direction on all educational matters in the country and the Ghana Education Services (GES) implements these policies. The TMA Directorate of Education handles educational matters relating to Basic school in the Metropolitan. TMA boasts of more than six hundred (600) educational facilities, there are still many children who have no access to these educational facilities in the urban centres. The number of pupils in a classroom exceeds 40 compelling most schools to run the shift system. Besides, most teachers prefer to teach in urban areas leading to lack of teachers for the rural communities.

5.13.13 Health

There are six (6) government and twenty-eight (28) private health facilities available in the Metropolitan. There are 69 satellite clinics organized by the staff of the Government facilities. These facilities are available for dealing with various occupational related health problems. Services rendered include Maternal and Child Health (MCH), Family Planning, Home Visits, Supervision of Traditional Birth Attendants (TBAs) and Psychiatric Health.

5.13.14 Road Network

Tema has an extensive network of arterial roads. Road network within Communities 1– 22 consists of collector and access roads. Roads at Ashaiman are inadequate, whilst storm, roadside drains and pedestrian facilities are insufficient. Roads in the newly developed and depressed areas at Kpone, Baatsonaa, and Adjiriganor etc. have earth/gravel surfaces and are in poor conditions with some portion of the road network non-existent. The existing roads have no drains. The total length of roads within the Metropolitan is 418.05km, constituting 24.4%. The remaining 75.6% is classified as local roads.

5.13.15 Water Supply

Majority of settlements within the Metropolitan have access to pipe-borne water from the Kpong water works. The rural parts of the Metropolitan have some settlements still lacking pipe-borne water facility and depend on water from streams, rivers and wells.

5.13.16 Electricity

Adequate provisions have been made for the supply of electricity for the urban community. Industries in Tema consume the largest part of all electricity power generated in the country. The Volta Aluminium Company (VALCO) for instance, consumes a greater portion of the total power produced by the Akosombo dam

5.13.17 Transport Facilities

There are private and commercial transport systems operating in the Municipality including, a web of taxi services which are available on a 24-hour basis. Heavy-duty trucks and Lorries come from all over the country carting goods to and from the harbour and the industries in Tema.

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6.0 IDENTIFICATION OF POTENTIAL ENVIRONMENTAL IMPACTS

6.1 Introduction

The project site is located at Mmlitsapko, about 2 kilometres off the road from the Kpone Barrier on the Tema-Aflao road (One kilometre from the barrier to the turn-off junction and about one kilometre off the junction on the Tema-Aflao road to the project. The site allocated for the project by the Tema Development Corporation is about 75 acres (30 Hectares) in size. The power plant will occupy less than one-third of the acquired site. Associated with the project is a 500m 161 kV Transmission System which will have a “*transmission line right-of-way*” of an area extending for a distance of fifteen (15) metres on either side from the centre line of the transmission towers.

The project also comprise of the construction of a natural gas pipeline that starts from the Tema Regulating and Metering Station of the West Africa Gas Pipeline Company, close to the Atlantic Ocean and south east of the KTPP Site of Community 25. The total distance to be traversed by the gas pipeline is approximately 11.15km. An approximately 2km diesel oil pipeline running from the storage depot of the Bulk Oil Supply & Transportation (BOST) to the KTPP site is also to be constructed. The proposed pipeline is expected to be constructed within the RoW of the existing diesel pipeline from the storage depot to their storage site “Maame Water”, near Akosombo, which lies about 10 meters near the western fence wall of the KTPP site.

Thus apart from it being a site-specific project whose impacts would be generally confined to specific areas of influence, the KTPP is also considered a ‘linear’ project. The potential impacts from such a project would affect a much wider area of influence. Thus one of the major issues for the EIA would be expected to arise from the acquisition of the right-of-way (RoW) for the project. The diverse locations of the various sections of the transmission line project enhance the potential adverse impacts of the project. In recognition of this fact and in fulfilment of the requirements of permitting and funding agencies, the VRA has incorporated this EIA in its project cycle.

This section of the EIS Report deals with the methodology used to assess the potential impacts of the KTPP and the results from the application of this methodology to the project, using project information and baseline data available at the time this report was prepared. It also deals with the main potential environmental concerns likely to arise from the Development. It has been prepared to cover three continuous stages, namely:

- Pre-construction Phase
- Construction Phase
- Demobilisation
- Operational Phase (Occupancy Stage)

The general and localized issues of concern as per the above mentioned stages are discussed.

6.2 Methodology

The main factors used in determining whether an impact may occur at each intersection between a project activity and a specific environmental medium include:

- Literature reviews (desk study);
- Field observations;
- Discussion with project proponents;
- Discussion with health, safety, and environment departmental officers and schedule officers;
- Consultations with local experts;
- Consultations with stakeholders;
- Experience from similar projects worldwide;

The impact assessment methodology used for this project consists of five major steps:

Step 1:	Identification and description of project activities and their interaction with environmental media;
Step 2:	Comprehensive preliminary identification of potential impacts;
Step 3:	Screening or comparative assessment of impact importance; identification of impacts that are likely to be significant (i.e., identification of focus areas for further study) through application of a basic set of impact significance criteria to the preliminary information available about each impact;
Step 4:	Detailed assessment of the identified focus area impacts characterization techniques; quantification of impacts to the extent possible and rigorous qualitative characterization of impacts that cannot be quantified; and
Step 5:	Final assessment of the severity levels of impacts through application of the results of the rigorous quantitative and qualitative characterization of impacts developed in Step 4 to a set of objective impact severity criteria; identification of impacts warranting mitigation.

The potential impacts associated with each focus area are qualitatively, and where possible quantitatively shall be described and evaluated under the four phases of the project cycle: Pre-constructional, Constructional, Operational and Decommissioning phases. An evaluation of the residual, i.e. remaining, impacts after implementation of the mitigation measures shall also be undertaken.

6.3 Results of impact identification process

The proposed project may potentially result in impacts on the environment, socioeconomic conditions, and/or health and safety. Each of the specific compartments of the environment listed below in *Table 24* could potentially be affected by the impacts resulting from one or more of the project activities that have been discussed. *Table 25* sets out the key project issues that have been identified based on consultation and as a result of the scoping process. It shows the expanded impact identification matrix for the various phases (and project activities) of the project cycle which identify the focus areas by project phase and activity as well as affected media. Focus areas are indicated by 0, -1, -2 or 2+ as well as colour coded as provided in the key

below. By the key, if the row associated with a particular activity is 0 or without any colour shade, the impacts from that activity are considered to be negligible, or of lower significance and screened out of further consideration.

Key:

-2	Potential significant adverse impact. A serious impact which, if not mitigated, is potentially sufficient by itself to prevent the implementation of the project.
-1	Potential effect, expected to be insignificant. An acceptable impact for which mitigation is desirable but not essential; the impact by itself is insufficient even in combination with other low impacts to prevent construction.
0	No potential impact or insignificant impact. The impacts from that activity are considered to be negligible, or of lower significance and are screened out of further consideration.
2+	Potential significant beneficial impact. An impact that provides direct socio-economic benefit

Table 24: Summary of key impacts of KTPP

Phase of project	Power generation plant and associated step-up substation site	Gas/Diesel/Transmission line site
Pre-constructional	<ul style="list-style-type: none"> ➤ Compensation ➤ Socio-economic and local community impacts 	<ul style="list-style-type: none"> ➤ Compensation ➤ Socio-economic and local community impacts
Construction phase	<ul style="list-style-type: none"> ➤ Compensation ➤ Socio-economic and local community impacts ➤ Traffic and Transport ➤ Soils ➤ Public and occupational health and safety ➤ Noise ➤ Air quality (dust) ➤ Waste ➤ Water quality and resources 	<ul style="list-style-type: none"> ➤ Compensation ➤ Socio-economic and local community impacts ➤ Traffic and transport ➤ Soils ➤ Public and occupational health and safety ➤ Noise ➤ Air quality (dust) ➤ Waste ➤ Water quality and resources
Demobilisation	<ul style="list-style-type: none"> ➤ Traffic and transport ➤ Air quality and noise ➤ Public and occupational health and safety ➤ Solid Wastes 	<ul style="list-style-type: none"> ➤ Traffic and transport ➤ Air quality and noise ➤ Public and occupational health and safety ➤ Solid Wastes
Operation phase	<ul style="list-style-type: none"> ➤ Socio-economic and local community impacts 	<ul style="list-style-type: none"> ➤ Socio-economic and local community impacts

Phase of project	Power generation plant and associated step-up substation site	Gas/Diesel/Transmission line site
	<ul style="list-style-type: none"> ➤ Landscape and visual impact ➤ Public and occupational health and safety Air quality (Emissions) ➤ Wastes (Soli/Liquid) ➤ Noise ➤ Water quality and resources 	<ul style="list-style-type: none"> ➤ Landscape and visual Impact ➤ Public and occupational health and safety ➤ Waste (Vegetation) ➤ Land use

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Table 25: Impact identification matrix

ACTIVITIES	BIO-PHYSICAL ENVIRONMENT									HEALTH & SAFETY		SOCIO-CULTURAL ENVIRONMENT						
	Geology, Soils	Climate, Air Quality	Noise	Water Resources	Flora & Fauna	Traffic & Transport	Ecological sensitive sites	Population	Cultural Heritage	Occupational Safety & Health	Public Safety	Historical resources	Visual Intrusion	Infrastructure	Land tenure, Ownership	Land use	Employment	Agriculture
Pre-Constructional Phase																		
Project Feasibility Study	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Line Route Survey	0	0	0	0	-1	-1	0	0	0	-1	0	0	0	0	-1	-1	-1	-1
Environmental Impact Study	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acquisition of Land & RoW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	-2
Constructional Phase																		
Source of Raw Materials	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0
Clearing of Site & Access Tracks	-1	0	-1	-1	-1	-1	0	0	0	-1	0	0	0	0	-2	-2	2+	-2
Transportation of equipment to Site	-1	0	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	1	0	0
Civil works	-2	-2	-2	-2	-2	-1	0	0	0	-1	0	-1	-1	0	-1	-1	2+	-2
Installation of plant and associated facilities	-2	-2	-2	-2	-2	-1	0	0	0	-1	0	-1	-1	0	-1	-1	2+	-2
Erection of fuel supply tanks and interconnecting pipe work	-2	-2	-2	-2	-2	-1	0	0	0	-1	0	-1	-1	0	-1	-1	2+	-2
Clearing of RoW for Gas/diesel/Transmission Line	0	0	-1	-1	-1	-1	0	0	0	-1	0	0	0	0	-2	-2	2+	-2
Clearing of RoW Corridor	-1	0	-1	-1	-1	-1	0	0	0	-1	0	0	0	0	-2	-2	2+	-2
Excavation of foundations	0	0	-1	-1	0	-1	0	0	0	0	0	0	0	0	-2	-2	0	-2
Erection of Towers/Pipes	0	0	0	0	0	-1	0	0	0	-1	0	0	-1	0	0	0	0	0
Stringing Lines/ Building of pipeline	0	0	0	0	0	-1	0	0	0	-1	0	0	0	0	0	0	0	0
Demobilisation	0	0	-1	0	0	-1	0	0	0	-2	0	0	0		0	0	0	0

ACTIVITIES	BIO-PHYSICAL ENVIRONMENT									HEALTH & SAFETY		SOCIO-CULTURAL ENVIRONMENT						
	Geology, Soils	Climate, Air Quality	Noise	Water Resources	Flora & Fauna	Traffic & Transport	Ecological sensitive sites	Population	Cultural Heritage	Occupational Safety & Health	Public Safety	Historical resources	Visual Intrusion	Infrastructure	Land tenure, Ownership	Land use	Employment	Agriculture
Testing & Commissioning	0	0	-1	0	-1	-1	0	0	0	-2	0	-1	-1	0	-1	-1	0	-1
Operational Phase																		
Landscaping	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plant Operations & Maintenance	-1	-2	-1	-1	-1	-1	0	0	0	-2	-1	0	-1	0	-1	-1	2+	-1
Gas/Diesel/transmission Line Maintenance	0	0	0	-1	-1	-1	0	0	0	-1	0	0	0	0	-1	-1	2+	-1

Key: 0 No potential impact or insignificant impact. 2+ Potential significant beneficial impact. -1 Potential effect, expected to be insignificant. -2 Potential significant adverse impact.

6.4 Pre-Construction Phase

The elements of the project that has currently been carried out during this pre-construction stage are the preparation of a detail design drawings, specification for the construction of the civil and structural ancillary buildings, equipment supporting structures and fencing, land surveying and pillaring to identify the route to be taken by the proposed gas pipeline and transmission line and payment of compensation to property affected persons. The acquisition of the Project Environmental Permit is subject to the submission of the EIS Report and approval by the EPA. These activities are expected to have negligible impacts on the environment and will therefore require no mitigation measures.

Land for the construction of the power plant has already been acquired. The major pre-construction activities anticipated that requires mitigation includes the acquisition of land for the transmission line; this is because it will ultimately lead to loss of property and possible land use conflicts. Other key issues are consultations with relevant agencies and service providers, and site preparation.

6.4.1 Consultations with Relevant Agencies and Service Providers

The support and involvement of service providers e.g. electricity and water companies, and government agencies are essential to the smooth implementation of the project. There is the potential of conflict and misunderstanding with PAPs, and these have to be exhaustively addressed and resolved prior to the implementation of the project.

6.4.2 Land Acquisition/Compensation Issues

The power plant site at Kpone has been acquired by VRA for the project as well as for future expansion. Compulsory land acquisition (expropriation of property for the project) and demolishing of structures that would be associated with the accompanying linear projects for KTPP can result in displacement of communities, loss of business, properties and incomes, social stress, social and psychological disruption for the affected individuals and families. This will result in the prohibition of activities such as mining, construction of buildings, crops cultivation and farming in the RoW.

Various houses and crops are to be impacted upon by the project and would be demolished to pave way for constructional activities of the project. The major impact is associated with compensation that would have to be paid to project-affected persons. Disputes over compensation measures may be raised by PAPs informally with local notables or VRA staff or, failing resolution at the informal community level, formally with the Commission for Human Rights and Administrative Justice (CHRAJ) and, ultimately, the courts. The issue of modalities for payment of compensation has been addressed in meetings with neighbouring communities, farmers on the land, among others.

This potential impact has been considered in the EIA report.

6.4.3 Potential Impact on Cultural Heritage

Potential impacts may arise from site excavation that may disturb or damage cultural heritage. The power plant is located within an area of disused, overgrown vegetated land leased by VRA from the government. Neighbouring lands have various physical structural developments. The area is not known to have sites with cultural heritage at or immediately adjacent to the proposed site. The project is unlikely to have an impact on cultural heritage and this has not been considered in the EIA report.

6.4.4 Potential Impact on Site/Land Preparation

Site clearance, topsoil removal, compacting, cutting and filling could affect the natural drainage pattern of the site and can lead to the incidence of erosion.

6.5 Construction Phase

This Section considers the environmental impacts of activities of the KTPP during construction. It assesses the potential impacts on all resources and receptors so that the scale of overall impact of the project can be elicited.

6.5.1 Source of Constructional Materials

The construction industry has been one of the fastest growing industries in the past decade. Varieties of materials are used in this industry. Those of relevance, as far as potential impacts are concerned, are cement, lumber, sand, water and stones. For example, the extraction of chain-sawn lumber is illegal in Ghana. Its usage could cause depletion and degradation of the forest.

This potential impact is seen as insignificant to the project and has not been considered in the EIA report.

6.5.2 Potential Impact on Socio-economic and local communities

Construction activities can potentially have a positive socio-economic impact by the provision of temporary employment opportunities and an improvement in local economies generated by an increased demand for local goods and services. Conversely, construction activities can also have a negative impact on local communities through the impact of an influx of construction workers, which may place pressure on local resources, affect social dynamics and culture, and exacerbate health problems, etc.

The assessment of the significance of the positive or negative impact on socioeconomics is based on the number of workers likely to be employed, where these workers are recruited from, their cultural background and the period over which new workers will be in the area and thus potentially improve or put undue pressure on local resources. Although exact details of the construction workforce are not available at present, it must be noted that Ghanaian sub-consultants and people from the local area will be used where skills permit to undertake construction works at the power plant site. The project is expected to create employment for about 200 people e.g. artisans, drivers, labourers and supervisors in

Tema and surrounding towns. Carpentry, steel bending, block laying, Security, and other construction and related works are expected to benefit from the Development. This will provide significant benefits in terms of temporary employment opportunities.

This will also have a positive knock on effect on the local economy through the purchase of local foodstuffs and goods by the temporary construction workforce throughout the construction period. The significance of these benefits will depend on the number of national as opposed to local workforce numbers employed and consequent likely increase in the demand for products. Although a workforce of about 200 would represent a significant temporary influx to the small villages in the vicinity of the project site, it is likely that a significant proportion of the temporary workforce would be employed locally. Furthermore, as temporary staff will be required for a number of different jobs, the 200 workforce will be required throughout the duration of the construction period and not at any one time, thus reducing the overall impact on local resources and on local communities.

The HIV/AIDS pandemic is a severe one that should continue to engage the attention of authorities in all sectors and in the management of the workers. Findings of international studies of HIV/AIDS in work places suggest that the construction sites of such projects are a breeding ground and a vehicle for the HIV/AIDS epidemic. People working on the project have to be mobile, they have to spend much time away from their homes and satisfy their sexual needs on the road. With any influx of temporary workers there is a significant risk of spreading HIV/AIDS; specific measures will need to be undertaken by the contractor to minimise this risk. Migration from short term or long term, increases opportunities to have sexual relationship with multiple partners, thus becoming a critical factor in the propagation of HIV/AIDS. Although awareness of the disease is said to be very high amongst the Ghanaian population, behavioural change lags far behind this awareness. This is likely to be the case among the workers as well and there will be need for education for the workforce and monitoring of incidence of HIV among community members.

The project would boost trading among construction allied industries e.g. cement and iron rods production and other building materials manufacturers, suppliers and distributors. Other businesses such as the catering services springing up on the fringes of construction sites would also benefit immensely.

In addition, there are both direct and indirect potential socio-economic benefits resulting from the project. These are employment arising primarily during the construction phase with limited opportunities during pre-construction and operation and improvement of roads during the construction phase.

6.5.3 Potential Impact on Noise and Vibration

During construction, activities such as the use of equipment, the preparation of the site and traffic movements have the potential to generate noise impacts. Thus, the main potential impact is from vehicle and construction noise affecting local residents. The main noise generating activities are:

- Delivery traffic to and from the lay down areas and to the construction sites;

- On site construction activity with fabrication and construction of the towers and stringing of the lines;

Heavy duty machinery and vehicular movement, friction between vehicles and the road surface, driver behaviour, vehicles' horns, resonance of traffic and piling increase ambient noise levels and vibration shall occur far beyond the immediate transmission line corridor. The effects of excessive noise and vibration include human welfare and physiological disruption, hearing impairment and communication problems. These may cause elevated stress levels and associated behavioural and health problems. They can also cause auditory fatigue, sleep disorders, and even contribute to learning problems in children. Vibrations can damage roadside structures, particularly makeshift or lightly constructed buildings.

The estimated average hourly traffic on the access road is 23.0 vehicles (6am-6pm). The vehicles are mainly dumper trucks hauling laterite to and from construction sites in Community 25 and surrounding areas. For traffic noise, overall daily traffic movements are predicted to be low as the delivery requirements for men and materials at any one site are low. However this is likely to represent a large increase over the current traffic volumes due to the very low current number of movements. The potential therefore exists for impacts to be felt by inhabitants along the transport routes due to this change. The overall total traffic volumes will be low and will be restricted to daytime only. As such, the noise increases over the current baseline along these routes will be adverse but temporary in nature and minor in significance.

During the construction period, the use of such equipment and machinery as concrete mixers, poker vibrators, dumpers, and drilling equipment and machinery, among others could generate noise in the project area. The operations on site are also not intrinsically noisy, i.e. excavation of foundation, mixing of concrete, bolting of steel work, vehicle movement for delivery of men and materials and stringing of the lines. In addition to this, good site practice can minimise noise generation and the restriction of operations to the working day will avoid noise generation during the most sensitive, night time, period. Noise also has the potential to disrupt wildlife habitats and movement in sensitive areas. It is generally accepted that predicted noise levels from the development need to be compared with existing background levels at particularly sensitive residential locations close to the site. A preliminary noise survey has been undertaken to identify impacts of noise from the proposed project.

The most significant health effect associated with noise of high intensity over prolonged periods or very loud intensity noise for relatively brief periods (Impact Noise) is physical damage to the ears known as Noise Induced Hearing Loss (NIHL). Noise levels in workplaces exceeding 85-dB (A) on an eight-hour Time Weighted Average (TWA) are injurious to the ears. The threshold of hearing tends to increase with length of exposure to high intensity noise. Other recognised effects of noise are irritability, headache, and sleep disturbances and increased risk of accidents due to interference with communication. In order to prevent NIHL to workers exposed to high noise intensities, maximum exposure duration are recommended according to the intensity are provided in *Table 26* and *Table 27*.

Table 26: Recommended maximum exposure duration²¹

Sound Level (dBA)	Maximum Exposure Duration per day in hours
90	8
92	6
95	4
97	3
100	2
102	1.5
105	1
110	0.5
115	0.5 or less

Table 27: Ghana EPA Guideline Levels for Noise Exposure

Cumulative period for which intermittent noise is present in any hour	Maximum allowable adjustment above the permissible ambient level (dB _A)
More than 15 minutes	± 0
Exceeding 5 minutes but not exceeding 15 minutes	-5
Exceeding 1 minute but not exceeding 5 minutes	-10
Not exceeding 1 minute	-15

This potential impact has been considered in the EIA report.

6.5.4 Potential Impact on Air Quality

Air pollution may adversely affect the health of people engaged directly or indirectly in the project activities. The effects are due largely to particulates from vehicular emissions and constructional equipment powered by gasoline or diesel as well as silica in dust from the earth agitated by constructional equipment and vehicles plying on un-tarred roads. The resultant effects are acute respiratory disorders, lung and heart diseases, the type of ailment depending on the size of particulates as well as the materials adsorbed on them. The use of construction equipment and vehicles will result in the emission of dust and fugitive emissions, and contaminants adhering to dust particles. These may arise from:

- On-site earth-moving operations for foundations and excavation;
- Use of construction equipment;
- Vehicles movement over bare ground in dry weather;

²¹ Source: Hass Hearing Centre

- Dust being blown off vehicles and spillage from vehicles;
- Wind blowing over bare ground within and adjacent to the construction site.

Again, the use of construction equipment and vehicles will result in the emission of dust and fugitive emissions and contaminants from construction plant and vehicles that may give rise to odour. The potential for dust to be emitted during construction is strongly dependent on the type of activities taking place, on wind speed and on whether winds carry emitted particles towards sensitive receptors, such as residential properties. Apart from the dust particles that will be generated, vehicular emissions that will emanate from the haulage trucks is also a potential source of air pollution. Vegetation clearing, construction of access routes, excavation and haulage of heavy machinery and construction materials to and from one location to the other along the tower corridor has the propensity to impact negatively on air quality. It is however expected that such impacts will be localised especially during the rainy season but has the potential to be widespread during the dry harmattan season occurring from December – February.

Particulate matter on the project site could increase considerably during the construction phase. This could be caused by the removal of topsoil and vegetation, the movement of vehicles and equipment and the construction activities in general. The increase in particulate matter on the site would decrease gradually over the construction period. More minor impacts can arise from the excavation of materials during construction, during access track grading and gaseous emissions from plant and vehicles used during the construction process. However these are minor sources, will not have a significant impact. By virtue of the nature of a power transmission line the operational phase will not result in any significant dust generation. These activities are therefore too infrequent to cause a significant impact. There is no potentially significant air quality impacts associated with the pre-construction activity.

This potential impact has been considered in the EIA report.

6.5.5 Potential Impact on Transport and Traffic

The project site is within the VRA land situated at Nmlitsapko, about 2 kilometres off the road from the Kpone Barrier on the Tema-Aflao road (One kilometre from the barrier to the turn-off junction and about one kilometre off the junction on the Tema-Dawhenya road to the project). The Tema-Dawhenya road is a dual carriageway and asphalted surfacing used by many vehicles to and from Tema. Estimated average construction vehicle movements are 20 trucks and 10 cars per day. Constructional materials will be conveyed along the asphalted Tema-Dawhenya Road, and then off this road to the project site. In addition to this are the equipment and machinery, which would be delivered to be installed at the site, via sea to Tema Port and then by road to the project site on the Tema-Dawhenya Road. Aggregates from Shai Hills would however be conveyed on the main Akosombo – Afiencya Road, and then from the turn-off junction on the un-tarred road of Afiencya-Dawhenya Road and tee-off at the branching off this road to the KTPP site. There is a bridge on the Afiencya-Dawhenya Road and loads on these vehicles will have to be monitored in line with Ghana's axle load policies and control to ensure the integrity of this bridge, because it can collapse if the loads control measures are not put in place.

The gas pipeline and transmission line will encounter various roads, some with asphalted surfacing. It is only the Tema – Dawhenya Road at the turning to the Volta substation in Tema Road that the natural gas pipeline and transmission line will be crossing as a result of the construction of KTPP. With respect to the transmission line, there will be no digging through any of these roads. In all areas through road networks, pylons will be constructed to carry the cables overhead across these various road networks. However, there will be the need for a special road crossing, through digging of a tunnel under the Tema-Dawhenya Road for the burying of the gas pipeline.

Potential impacts on traffic and transport during construction will arise as a result of additional traffic movements associated with the transportation of equipment to the plant site, from workforce movements to and from the site and as a result of the removal of wastes from the site. Impacts can occur in the form of:

- Disruption of transport links, including delays and congestion brought about by an increase in overall traffic numbers due to construction traffic movements.
- Conflict with other road users, including pedestrians and public transport (buses, taxis, etc.) as a result of delivery of equipment and plant to the site.
- Specific annoyance due to additional heavy goods vehicle movements.
- Localised disruption as a result of the construction of new roads.
- Risk of accidents along delivery roads and on the site.

In terms of total traffic generated by the construction phase, daily movements will be low. The requirement will only be for the delivery of workers at the start and end of each day and the construction materials during the working day, both to the depots and to the construction sites. This will present an increased safety risk but with the application of proper mitigation measures particularly the speed controls through villages, this increased risk should be minor. Administrative measures would have to be put in place to stagger the delivery of construction equipment and materials to the construction sites, and the delivery of materials and equipment would be carried out during off-peak hours.

The delivery of construction materials and equipment and machinery could create a degree of traffic and accidents in the routes to the project site. Building materials supply to the site would be frequent for sand, stones, cement, and blocks, especially during early stages of the construction period

Access to public services and traffic by the local people can be affected. The construction works will be done by humans at limited areas and in short-term. The adverse impact is not serious and limited. Construction observers will direct the local people and traffic passing safely. Taking account of the low overall total traffic movement that will occur, impacts are predicted to be adverse but temporary and insignificant in magnitude. The improvement of the main access routes for this project has the potential for positive impacts relating to improved access from the neighbouring communities to the main road network. There can be serious disruptions to local traffic and also accidents during the construction period. This may result from the transportation of machinery and materials to the project site and also during the stringing of the transmission lines across roads. The situation can be aggravated without carefully planned

detours and road closures. The effect of traffic disruptions includes increased travel time, congestion, social stress and agitations. However, this is expected to be minimal as the traffic densities in most of the communities where the transmission line project will traverse are low.

In order to assess the potential impact of traffic if roads were used to transport the equipment to the site, the following shall be undertaken to:

- Identify sensitive receptors along potential transport routes;
- Identify periods during which deliveries should be avoided.

This potential impact has been considered in the EIA report.

6.5.6 Potential Impact on Public Safety and Occupational Health & Safety

The transportation of heavy plant and equipment through the townships and settlements and the presence of unprotected excavations could pose potential safety problems for the local populace. Materials and equipment used for the construction work could be harmful, when not handled with care. There is the possibility of reversing heavy duty equipment, loose nail scattering on the site as result of its usage, and movement of material from one point to another. These activities could pose danger to both workers and visitors to the site. The construction of cesspits and underground tanks for effluent treatment and water storage could also be hazardous tasks. The possibility of workers or visitors to the site falling into the pits cannot be overruled. Loose scaffolds and debris falling from heights could also be harmful to workers. Other potential hazards include injury from sharpened tools and instruments and dust effect on workers.

Thus, potential public and occupational health and safety impacts will arise from the following:

- Construction activities undertaken by construction workers;
- Delivery of equipment to the site;
- Official visitors;
- Unofficial access by the public.

Accidents constitute one of the most important risks in such construction activities resulting in injuries. These are likely to arise from moving machinery in the course of operation, unguarded parts of equipment and a disregard for health and safety measures. These are likely to pose risks to the workers. Injuries may also arise from road traffic accidents during haulage of construction machinery and materials to the site. This has the potential of harming both workers and road users, including pedestrians. Other sources of injuries to workers are: accidental falls from height, noise, vibration and heat, falling/swinging objects and also lubricants some of which contain solvents with potential to cause skin irritation and allergies, respiratory disorders and acute poisoning.

There are unlikely to be any significant public health and safety issues at the site, the main impact on the public being associated with the movement of heavy goods vehicles to and from the site. Without mitigation measures, all construction sites present a risk to occupational health and safety. The contractor is required to prepare a Health & Safety Plan to be reviewed and approved by VRA prior to the start of construction on site. Construction equipment will be stored at a site to be secured and guarded by the contractor.

This potential impact has been considered in the EIA report.

6.5.7 Potential Impact of Waste Generation

The construction stage of the project would produce solid waste. This is expected to come from pieces of wood, steel, plastic tubes and blocks and the topsoil. Different forms of solid and liquid waste including excavation spoils, vegetative matter, damaged cables, sewage, garbage, pieces of wood, steel, plastic tubes and blocks and the topsoil will be generated. Also included in the solid waste are the polyethylene bags and paper that will serve as carrier bags and waste packaging materials for workers as well as empty water sachets. Liquid waste from spilled oil, chemicals and paints are likely to be generated.

In summary, the following wastes are likely to be generated as a result of constructional activities for the KTPP

- Clearance and excavation wastes: clearance of site vegetation and removal of soils, inert construction materials and residues, spoil, etc.
- General construction wastes: reject and excess material, drainage from wastewater and site run-off, containers etc.
- Other hazardous wastes may result from spillages from construction equipment.
- Other wastes: from offices, food preparation wastes, sanitation etc.

The Design Specification will require that water/liquid retaining structures should be in accordance with BS 8007 "Design of Concrete Structures for Retaining Aqueous Liquids" as appropriate or equivalent international or Ghana standard. Due to the nature of the site and the works to be undertaken, general construction wastes and hazardous wastes are predicted to be low. Septic tanks will be installed on the site for the construction period. During the civil works, the period when the largest workforce numbers will be on site, it is possible that these tanks could supply a workforce of up to 200 people, although this total number is unlikely to occur at any one time during this period. Sewage wastes will be removed from the site and disposed of in an appropriate manner by an approved contractor.

This potential impact has been considered in the EIA report.

6.5.8 Potential Impact on Soils

The preparation of the power plant site could have an adverse impact on soils through topsoil compaction, rutting and mixing as a result of excavation of the site for civil works; and the movement of equipment on site during construction.

The main impact on soils will be as a result of the excavation of the site for the foundations of the site. Contamination of soils may also arise through the spillage of lubricants, oils and machine fuel during construction activities. Top soil removal, excavations, vehicular traffic impact on the un-tarred access routes, etc. has the potential to engender the sheet erosion by exposing the soil to soil erosion agents.

6.5.9 Potential Impact on Water Quality and Resources

Construction of the power plant could have an impact on water quality as a result of alteration of the existing drainage characteristics of the site during site preparation and construction. Water will be required during construction for some construction activities, such as dust suppression measures, and for potable water supply. The main potential impacts on groundwater arise if deep excavations are required during construction that need dewatering or if fuels and oils leak or are spilt during construction and operation causing potential groundwater contaminations.

Construction of the thermal plant and civil works involves both deep and shallow excavation to support the electrical equipment to be installed. Construction of the power line itself involves only shallow excavation for support foundations with concrete blocks for the pivot tower foundations, plus a concrete anchor block for each of the four stay wires. Currently, a geotechnical survey has been completed on the site and the report indicates that there is no groundwater available up to a depth of 6m at the site where the oil tank farms are to be situated.

Erosion, resulting from vegetation clearing and excavations can lead to downstream siltation resulting from run-offs with high sediment load. This will ultimately lead to contamination of water resources. Water pollution may also result from spillages, leaking fuel and grease from construction machines. Contamination of water resources could also result from the spillage of lubricants, oils and machine fuel during construction activities and from the disturbance of soils and dust which is washed off into local water courses. Increased demand for water during construction could put pressure on local water resources.

This potential impact has been considered in the EIA report.

6.5.10 Potential Impact on Landscape & Visual Intrusion

Landscape impact assessment is based on two principal aspects. First is the alteration of the landscape character of an area including impacts on recognised features of landscape importance either nationally, e.g. National Parks or locally, such as Forest Reserves. The second aspect is impact on public views of the site either from residential properties or areas of public access, e.g. footpaths, and from public roads.

The construction of KTPP will result in both temporary and permanent visual impacts. Temporary impacts are the siting of construction equipment and the resulting clearing of areas to construct the power plant. These will be mitigated by the control of clearing to the area in the construction limits and quick re-vegetation upon completion of construction.

Permanent impacts are the conversion of urban landscape to an industrialised thermal power plant, with associated transmission line component.

During construction, there will be several temporary visual impacts, such as exposed earth, jobsite equipment, and vegetation loss. The power plant may have an adverse visual impact as a result of tall construction equipment affecting views to the site from properties and amenity sites. The Buffer zone on the sides of the KTPP Site have been selected to minimise overall visual impact to sensitive receptors. The main construction equipment that will potentially be visible during construction will be the equipment to move the plant and substation into place. Views into the site from the nearest sensitive receptors (local communities) are therefore screened by trees and shrubs in the Buffer zones.

The development of the power plant will involve major earth and civil works that may impact the local topography and therefore alter the physical landscape features of the area. Again, the transmission line will involve construction of 35m high steel lattice towers. Both these features of the development have the potential to affect the landscape setting and character of the area. Impacts on landscape character arising from the imposition of the transmission line towers into the existing landscape setting shall be minimal as transmission towers already exist in the area. The constructional activities have the potential to impact on scenic landscape values at the project site.

This potential impact has been considered in the EIA report.

6.5.11 Potential Impact on Flora & Fauna

Potential impacts on flora and fauna during construction will be limited to the direct loss of habitat as a result of the footprint of the plant and tower base and the construction laydown area as well as disturbance and/or damage to habitats and species as a result of construction activities e.g. through smothering of plants by dust, movement of vehicles and construction workers to and from the site.

The proposed plant site is located in an area of disturbed, disused land. The construction of the plant will result in the permanent loss of approximately 10 hectares of vegetation, representing about one-third of the total project site for the power plant. Route for the gas and diesel pipelines and the transmission line also have some forms of vegetation, including crops within the RoW for these linear projects. There are no sensitive habitats or plant species within the power generation plant site as well as the Row for the gas and diesel pipelines and the transmission line. Therefore, although a large area of habitat will be permanently lost the overall significance of the impact is low due to the low conservation value of the habitat within the site area.

This potential impact has been considered in the EIA report.

6.6 Operational Phase

This Chapter identifies the impacts associated with KTPP during the operational phase. Greater details are provided for key impacts associated with both the power plant site and the transmission line site

6.6.1 Potential Impact on Socio-economic and local communities

There is currently an imbalance between demand and the ability to supply electricity, thus the operation of the KTPP will provide generation capacity to address the current electricity demand-supply deficit in Ghana, and in particular will address the urgent need for new generation capacity by the next dry season. The installation of approximately 230MW thermal power plant will improve system reliability and allow VRA to significantly reduce the level of load shedding experienced in recent years, especially during the dry season. This will result in benefits to the Ghanaian economy by providing a more reliable electricity supply to the southern interconnected system, which serves the mining companies.

The costs of the project will not be directly passed onto the customers. Furthermore, the improvement in system reliability will significantly reduce the need to run private diesel generators that are currently being used by customers during load-shedding periods. This will have a positive impact on air quality through the reduction of air emissions in urban areas and will reduce the cost of electricity for customers currently running diesel generators at their own expense.

Operation of the plant may also result in employment opportunities, both directly at the station and indirectly through improved electricity supply to the southern region of Ghana. It would enhance the emergence and development of businesses e.g. suppliers/distributors of foodstuff, among other service providers. The development could increase income for this group of enterprises.

Operation of the power plant could have an impact on land use by disturbing access to land uses through the operations themselves or indirectly through traffic movements. The proposed site of the power plant is within an area of developed structures. As natural gas and water will be pumped to the site, movement of traffic to and from the site will be limited primarily to that of workers vehicles and waste fuel or diesel tankers. These movements are unlikely to have a significant impact on current access along the road leading to the power plant site. This access road, off the Tema-Dawhenya road, will be re-habilitated.

Due to the skilled nature of the operation, highly experienced VRA staff will be needed to operate the power plant. It is anticipated that approximately 30 permanent staff will be required, who will likely be recruited internally. There may also be some employment opportunities in the local area associated with cleaning security, etc. at the site, and an improvement in the local economy associated with demand from the new workforce at the site. Again, due to the skilled nature of the operation, GRIDCo staff will be used to operate and maintain the transmission line site. There may be limited opportunities for local employment associated with clearance of the wayleave vegetation for maintenance

purposes e.g. to maintain access for maintenance workers and to maintain the vegetation within acceptable height limits to avoid damage to the line from falling trees.

6.6.2 Potential impact on Noise and Vibration

During operation the main sources of noise are likely to be the exhaust stacks, exhaust diffuser, air inlet, turbine building and main transformers. High noise levels as a result of operation of the plant are a health concern to the workers while external noise at the plant boundary is a disturbance to the local community.

A noise impact assessment has been done to assess the potential impacts on noise as a result of operation of the power plant. The Acoustics and Vibration Group of Bureau Veritas (BV) was contacted by Zakhem International Construction Ltd to undertake a Sound Emission Prognosis (SEP) of the proposed Single Cycle Power Plant (SCPP) in Tema. The summary of the report, which is attached as Appendix 8, is found below.

The erection of the SCPP has been divided into three phases. This report presents the SEP for the construction and the operation of Phase 1 of the project in which two gas turbine generators in open cycle configuration plus auxiliary equipment will be installed. Sound power level data has been provided to BV and also some sound power levels have been calculated based on the data provided. The noise data obtained has been utilised to develop a noise model of the plant using the CadnaA noise modelling package. Some assumptions have been made with regard to the location of site plant during the construction and the operational phases of the project.

The predicted results, presented in this report, include overall sound pressure levels for two scenarios, construction, and operation at different locations around the perimeter of the site, plus partial noise emissions of each piece of equipment at the highest risk area, north-west boundary. The sound pressure levels predicted for both scenarios have been assessed against the planning noise limits and noise control mitigation measures have been recommended in order to allow closer compliance with the planning requirements at the site boundary.

In conclusion, the noise levels predicted within the whole site extent comply with the maximum allowable noise level of 85 dB(A) at one metre from the equipment in operation. However, noise levels at the north and west areas marginally exceed the boundary noise limit by 2 – 4 dB, this is due to the proximity to the GT ancillaries and the step-up transformers.

6.6.3 Potential Impact on Air Quality

KTPP is expected to be operating on natural gas and diesel. Combustion of Natural Gas and Diesel implies emission of flue gases. During operation, the combustion of natural gas and or distillate oil (when in use) will give rise to emissions of sulphur oxides, nitrogen oxides, carbon monoxide and carbon dioxide and particulate matter. These emissions are of potential concern to human health and local ecology, and in relation to their potential contribution to greenhouse gas levels.

Sulphur dioxide has been directly linked to acid rain which has been responsible for alteration of certain aquatic ecosystems, damage to vegetation, and deterioration of building materials. Sulphur dioxide is also detrimental to health as it is known to aggravate asthma, lung and heart disease. Carbon dioxide is a greenhouse gas, with increased levels in the atmosphere being linked to global warming. Oxides of nitrogen are one of the components of photochemical smog and high levels of NO₂ are thought to increase the risk of respiratory diseases and contribute to heart, lung, liver and kidney damage and eye irritation. High NO_x levels also cause damage to vegetation. High particulate emissions can be detrimental to vegetation, be responsible for health problems and are aesthetically displeasing. Concentrations of contaminants emitted from the stacks of significant sources have to meet certain limits to mitigate the potential impacts.

Environmental Resources Management (ERM) of the UK was contacted to undertake Air Dispersion Modelling and provide an assessment of the impact on local air quality of the Kpone Thermal Power Plant. The summary and conclusions from ERM's report, which is attached as Appendix 9, is provided below.

The power plant is expected to comprise two gas turbines initially with a total electrical capacity of 230 MW. The capacity of the power plant may be increased at a later date with the addition of a third gas turbine and/or Heat Recovery Steam Generators (HRSGs) and steam turbine to increase the generating capacity of the initial gas turbines. The gas turbines would operate principally using natural gas but distillate fuel oil could be used as an alternative during periods when natural gas is unavailable. Modelling of emissions for both fuels has been provided. In addition, a stack height selection study has been undertaken for the gas turbine stack.

The assessment was undertaken using the latest version of the United States Environmental Protection Agency (US EPA) ERMOD Prime Dispersion Model (version 07026). The pollutants considered for the assessment were the oxides of nitrogen, carbon monoxide, fine particles and sulphur dioxide. The impact of the power plant on local air quality was assessed by comparison to Ghanaian and World Health Organization ambient air quality guidelines.

For natural gas and distillate fuel firing, all predicted pollutant concentrations attributable solely to the plant would be below the Ghanaian and WHO air quality guidelines. A stack height assessment of 25m, 30m, and 40m indicated that the preferred 30 m stack height for the gas turbines is acceptable and increasing the height above 30 m would have little additional benefit. However, emissions from the gas turbines are thermally very buoyant. It would be noted that the addition of HRSGs and steam turbines will result in emissions at lower temperatures and with substantially reduced buoyancy. Therefore, for future operation in the combined cycle mode, the additional stack heights associated with the HRSGs will more likely need to be higher than the height required by the gas turbines stacks.

Oxides of nitrogen (NO_x) will be the principal pollutant emitted from all options considered. Carbon monoxide emissions will be low when the combustion units are operating efficiently but this emission has been considered for completeness.

For natural gas firing, emissions of fine particles (PM₁₀) and sulphur dioxide (SO₂) will be negligible but will be higher for distillate fuel oil. Therefore, these two pollutants have also been included in the dispersion modelling assessment.

Background air quality data for the area is very limited (four days monitoring at the site boundary) and may not be characteristic of local air quality. However, given the limitations of these data, a comparison of predicted concentrations arising from the operation of the power plant with existing levels of pollutants is provided. This indicates that the contribution of the power plant emissions to existing background air quality would not result in an exceedance of the Ghanaian guidelines or the WHO target values. There is a predicted small exceedance of the WHO guideline value but this is due principally to the elevated background concentrations of PM₁₀ rather than from emissions from the power plant. Predicted Maximum Concentrations of Emissions for KTPP is presented in *Table 28*.

Table 28: Predicted Maximum Concentrations of Emissions for KTPP

Averaging Period	Fuel Type		Guideline	
	Natural Gas	Distillate Fuel Oil	Ghana	World Bank
Nitrogen Dioxide (NO ₂)				
Maximum 1-hour Mean (µg m ³)	5.1	9.6	400 (Industrial) 200 (residential)	200
Maximum 24-hour Mean (µg m ³)	4.3	8.0	150 (Industrial) 60 (residential)	-
Maximum Annual Mean (µg m ³)	1.5	2.7	-	40
Sulphur Dioxide (SO ₂)				
Maximum 1-hour Mean (µg m ³)	-	6.0	900 (Industrial) 700 (residential)	-
Maximum 24-hour Mean (µg m ³)	-	2.1	150 (Industrial) 100 (residential)	20
Maximum Annual Mean (µg m ³)	-	0.85	80 (Industrial) 50 (residential)	-
Carbon Monoxide (CO)				
Maximum 1-hour Mean (µg m ³)	1.2	2.8	30	30
Maximum 8-hour Mean (µg m ³)	1.0	2.3	10	10
Maximum 24-hour Mean (µg m ³)	0.44	0.99	-	-
Maximum Annual Mean (µg m ³)	0.18	0.40	-	-
PM ₁₀				
Maximum 1-hour Mean (µg m ³)	-	2.9	-	-
Maximum 24-hour Mean (µg m ³)	-	1.0	70	50

Averaging Period	Fuel Type		Guideline	
	Natural Gas	Distillate Fuel Oil	Ghana	World Bank
Maximum Annual Mean ($\mu\text{g m}^3$)	-	0.41	-	20

The modelled results showed that the maximum concentrations occur approximately 1km north-east of the gas turbines (800 m north-north-east of the site boundary). It is recommended that a suitable site close as possible to this area should be selected for locating the ambient monitoring station. The community for this site is known as "After 25". This site is proposed for the physical location of the ambient air quality monitoring station.

In addition, Envilogica Consult in 2012 was engaged to monitor ambient air in three locations around the site prior to the commencement of its operations. The three locations are Saki-Bediako, TDC Serviced Plots area, and The North East Point of maximum Fallout. The ambient air quality parameters measured were, Nitrogen Dioxide (NO_2), Sulphur dioxide (SO_2), Carbon monoxide (CO), Particulate Matter, PM_{10} , and Total Suspended Particles (TSP). Each community was assessed for morning, afternoon, and evening for a 7 days period. The levels recorded for most of the parameters were within the limits set up by the Ghana EPA except SO_2 , which reported daily concentrations higher than the EPA guideline, although the hourly levels were all lower than the guideline. Full report of the study is attached as Appendix 8.

6.6.4 Potential Impacts on Traffic and transport

Road to the project site shall be upgraded with an asphaltic concrete with street lights after the construction of the power station to allow for all defects arising from heavy equipment transportation to be corrected. The operation of the Plant has the potential to give rise to changes in road traffic levels on the roads within the vicinity of the Power station as a result of worker vehicle movements, deliveries and the removal of wastes from the site. The main source of potentially significant additional traffic during operation will be that of site workers vehicles. A permanent workforce of approximately 30 staff is expected at the power station. It is unlikely that all operating staff will have cars; therefore the actual increase in personal vehicle movements is expected to be low.

6.5.5 Potential Impact on Public Safety, Occupational Health & Safety

Some occupational safety and health hazards are expected during the operational phase of the project during maintenance activities by the workers. These hazards could be from falling and/or swinging objects, potential collapse of towers due to rainstorms or vandalism, electrocution, falling from heights and snakebites. These hazards pose potential threat to the safety and health of the workers. Mitigation measures have however been proposed to minimize these potential hazards.

Operation of the plant could have an impact on the general public and workers through general operation activities and as a result of accidental spills and fires. The KTPP site will be secured from the general public; therefore the risk to the

general public during operation of the plant and switchyard will be minimal. The site for the thermal power plant will be fully secure with wall fence and will have one principal entry/exit with a guardhouse. Appropriate warning signs will also be provided at the site where there is a risk to health and safety.

VRA staff will operate and maintain the plant once it has been commissioned. VRA's Corporate Health and Safety procedures will be in place and enforced for operation and maintenance. It is estimated that 30 permanent operating staff will be required. Working within the power plant poses a risk to VRA workers if no mitigation measures were employed.

Natural Gas and fuel oil are to be delivered to the site via guarded and insulated pipes. Fuel has to be properly stored and protected against leakages in a fire protective storage area. Notwithstanding, there is the possibility of Fuel Oil Spillage in the project site, which could be due to Equipment failure and Transportation within the premises. The fuel tank area for the storage of diesel oil will be fully bunded and able to contain at least 110% capacity of the largest single tank. Facilities will be available to contain oil and protect the environment in the event of a catastrophic failure (e.g. explosion) of the transformer.

Fire risks are not avoidable with any human activity, especially in the case of a thermal plant, where combustible materials are stored and used. Life and property in and around the plant would be affected should fire outbreak take place. A comprehensive fire detection and protection system will be installed to cover all equipment on site that could constitute a fire risk. In addition to the measures integrated into the design of the power plant and substation site, VRA will prepare a Health and Safety Plan and an Oil Spill Contingency Plan for the site in accordance with corporate strategy.

Potential public safety hazards are enhanced for a project such as the proposed power plant project when the local populace has not been properly educated with regard to the potential hazards. In addition to the hazards posed to the public due to transportation of equipment and materials, other hazards such as potential exposure to Electromagnetic field (EMF) effects, potential collapse of poles and electrocution will exist during this phase of the project. The falling of a live electrical conductor could cause severe burns of any object on which it falls. An electrical conductor could fall from the towers as a result of either a mechanical failure of an insulator string on the tower or snapping of the conductor itself. The mechanical failure of an insulator string could be the result of a lightning stroke, rusting of insulator pins or a heavy object falling on the transmission line. The failure of a conductor joint could also cause snapping of the conductor. Strict adherence to the non-encroachment requirement of the right of way will reduce the potential risks to public safety. These potential hazards require mitigation to ensure the safety of the public.

One other potential impact of the proposed project is the perceived danger of transmission lines. Issues relating to electromagnetic fields are not normally understood by the public. The misconception that EMFs may cause cancer or harm children could create fear and perhaps panic among the local populace. This issue has been discussed below.

6.5.5.1 Electromagnetic Field (EMF) Effects

Electromagnetic fields (EMF) (properly called Electric and Magnetic fields) occur whenever a voltage is present or whenever a current is flowing. In nature EMF effects occur, as in lightning and in other phenomena such as the northern lights (aurora borealis) caused by the interaction of solar wind and the earth's magnetic field.

Since the early 1880s when public electricity supplies were introduced, man has lived increasingly in electric and magnetic fields that vary with time (oscillate). However, electricity transmission, distribution and generating equipment are by no means the only source of man-made EMF. Such fields are everywhere, and are created by wiring circuits in homes, including currents that are induced in water and gas pipes. In addition, all electrical appliances and equipment, together with electric trains and other forms of transport, even the motorcar, all produce EMF. It is almost impossible to avoid man-made electric and magnetic fields.

Over the last two decades, debate has raged on over the impact of electro-magnetic fields (EMF) on human health. Power lines in particular have become a focus for conflicting conclusions. The Environmental Health Division of the Minnesota Department of Health (USA) has collated the current available results of research into EMF and health carried out worldwide. The information is readily available at their web site www.health.state.mn.us. In *Table 29* below, the conclusions from the available research information have been duly summarised and presented.

Table 29: Summary of Research Findings on EMF and Health

No.	Research Institution	Country	Year	Main Conclusions
1	American Physical Society	USA	1995	No plausible biophysical mechanisms for the systematic initiation or promotion of cancer by power line fields have been identified.
2	National Research Council	USA	1997	The conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human health hazard.
3	National Institute of Environmental Health Science	USA	1999	The scientific evidence suggesting that EMF exposures pose any health risk is weak. However EMF exposure cannot be said to be entirely safe.
4	Institute of Electrical and Electronic Engineers + Engineers in Medicine and Biology	USA	1999	There is not enough relevant scientific data to establish whether common exposure to power-frequency fields should be considered a health hazard. There is general agreement that more research is needed to define safe limits of human exposure to EMF.

No.	Research Institution	Country	Year	Main Conclusions
5	National Radiological Protection Board	UK	2001	Laboratory experiments have provided no good evidence that EMF causes cancer. However the possibility remains that intense prolonged exposure to EMF can increase the risk of leukaemia in children.
6	International Agency for Research on Cancer	10 Countries US, UK, Japan etc	2001	There is no evidence that EMF is associated with childhood leukaemia, and there is no consistent relationship between EMF and childhood brain tumours.
7	Health Council of the Netherlands	Holland	2001	It is not likely that children (or adults) living near to high voltage power lines are at risk through exposure to EMF generated by those lines.
8	Japan EMF Research Program	Japan	2001	There is little evidence of any adverse effects from EMF exposure. Very high intensity EMF (over 10000 times higher than real-world environments) can have certain biological effects, which are positive.

Source: Minnesota Department of Health, Environmental Health Division: www.health.state.mn.us

According to the International Commission for Non-Ionisation Radiation Protection (ICNIRP), research evidence for EMF causing long-term, chronic, diseases such as cancer is not clear and therefore there are no guidelines based on this potential risk. The guidelines are based on short term, immediate health consequences such as stimulation of the peripheral nerves and muscles, and micro-shocks.

Only the higher voltage transmission lines at 400 kV would, under steady-state conditions, and directly beneath the lines, create a magnetic field maximum of 100 μ T (the ICNIRP reference value). However, typical values are approximately a tenth of this field value. The same applies to electric field for 400 kV transmission lines, where maximum, steady-state, values could be above the reference value of 5 kV/m but the typical values might only reach this. The magnetic and electric fields drop rapidly with the distance from the centrelines of the power line.

Human health impact

In the light of the findings presented in Table 18, it is not expected that the proposed 161 kV Bui Transmission System will have any adverse impacts on human health. During the field surveys, the various community groups were briefed in very simple terms on the current state of knowledge about EMF effects in order to allay their fears.

Fear impact

Perhaps the most serious impact is that due to fear, i.e. the perceived danger of the transmission lines. In some developed countries, the “fear impact” has been known to affect property prices and mobilise local action against the construction of new transmission lines. The public does not generally understand electromagnetic fields. They cannot be felt, tasted, seen, or touched. Most of the people interviewed were more concerned with electrocution (electric shocks) and they were admonished to comply strictly with the warning signals to be posted by VRA on the towers.

Corona Discharge

Transmission lines are known to experience ‘corona discharge’ and this tends to increase with the increasing voltage. Since the transmission project is intended to operate ultimately at 161,000 volts it is essential to consider this phenomenon as an issue of environmental relevance. Corona is defined as a discharge occurring at the surface of a conductor or between two (2) conductors of the same transmission line, accompanied by ionisation of the surrounding atmosphere. Corona is frequently luminous (spark of light) and produces noise of a hissing character. Corona is known to produce Ozone, but this is unstable and reacts quickly with other gases.

Corona is caused by the electric field next to an object exceeding the breakdown value of air. The starting voltage for corona is typically 30 KV/cm radius. This may be lowered by the presence of dust, water particles and sharp edges on the object. Corona causes loss of power as energy is lost in the discharge process. Corona also encourages corrosion of the line conductors as the reaction with the surrounding air sometimes produces nitrous acid (in the presence of adequate moisture). Corona is also known to cause radio interference on radio sets and TV sets in close proximity to high voltage transmission lines.

The moist environment in the forest areas tends to promote corona discharge and therefore every care shall be taken in the design, construction and operation of the transmission line to ensure that corona discharge is minimised. This shall be achieved by avoiding sharp edges and ensuring that adequate protection is built into the design of insulators and other power line accessories.

In conclusion, it is indicated that transmission lines are highly unlikely to create an electromagnetic field above the ICNIRP guidance values even at the highest risk location, i.e. straight beneath the line. With the rapid decay in EMF with distance, at the edge of the wayleave all international standards should be met. It is therefore concluded that the impacts of EMF on community health is long term, local, but insignificant in magnitude. However, there is the need to provide mitigation measures that will be required to address the notions that EMFs may cause cancer or harm children and the resulting fear and possible panic among the local populations.

6.6.6 Potential Impact of Waste Generation

Operation of the plant will result in the generation of general plant wastes and commercial wastes. These wastes, if not treated properly, may result in the contamination of the site, pose a health risk to workers, and/or be dumped illegally. The operation of the plant will not generate solid waste from its direct processes. It is expected that a limited amount of

waste will be generated during this phase from vegetative matter, cans, packaging materials, insulators etc. Solid waste is expected to emanate mainly from the administration as office wastes. Solid wastes generally could be an eyesore and cause environmental problems together with their associated health hazards if proper and adequate measures are not put in place to segregate, evacuate and dispose or recycle it.

Liquid waste will also be generated from the possible washing of various items that may be used. Liquid wastes arising from the plant processes are:

- Oil sludge;
- Waste lubricating oil;
- Oily water wastes; and
- Sewage.

It is, however, not anticipated that liquid wastes from the various washings will be generated in significant quantities. Accidental spillage of oil, fuel or paints will however need to be managed. Measures have been proposed for the management of these wastes.

6.6.7 Potential Impact on Soils

Oil storage tanks would be located on the tank farm, thus there is the potential of leakage of oil into the ground which could impact on ground water. However, result from the geotechnical survey indicates there is no groundwater available at the site. Meanwhile, all oil tanks shall be banded as indicated to prevent leakage and contamination of the soil.

The operation of the transmission line and gas pipeline has the potential to impact on soils as a result of maintenance activities to gain access to the site and in the periodic clearance of vegetation within the wayleave exposing soils to rainwater erosion. Clearance of the vegetation greater than 3m height within the wayleave for maintenance purposes is unlikely to have an impact on soils as the vegetation will be cleared by hand and left on site. There is unlikely to be an impact on soils, and organisms living within these soils, as a result of electricity and magnetism arising from the operation of the line. No mitigation measures are proposed as the operation of the transmission line is unlikely to have an impact on soils and no mitigation measures is proposed for the transmission line.

6.6.8 Potential Impacts on Water Quality & Resources

Water is required during the operation of the plant for domestic use; cooling water make up (very small amounts); and fire-fighting system in an emergency. The operation of the demineralised water plant would result in the production of waste water, which could be alkaline or acidic because of the use of sulphuric acid and sodium hydroxide for the regeneration of the cation and anion resins. In addition to this waste water, treated waste water would also be discharged after neutralisation.

Operation of the power plant will have the potential to cause impacts to water quality as a result of:

- Surface water drainage: generation of uncontaminated drainage such as storm water and uncontaminated runoff.
- Oil/water drainage: generation of potentially contaminated water from runoff from machine areas and wash-down area, accidental spills.
- Foul water drainage: generation and disposal of sanitary waste from the workforce.

In terms of water resources, use of water during operation of the plant could put pressure on local water supplies. The total amount of water likely to be required during operation is determined as 3000m³/day which is quite significant. Considering three days storage from drinking, service, domestic and demineralisation, the volume of the fresh water tank is approximately 12,000m³. Water for operational purposes will be sourced from the Ghana Water Company. However, this could be such that it would not put pressure on local water resources used by nearby communities. Furthermore, the nature of the design of the power plant, i.e. the use of cooling radiators, minimizes the impact on water requirements.

As indicated earlier, there is no available groundwater within the depths of up to 6 m where the oil tank farms are to be situated. Thus the potential of leakage of oil into the soil leading to groundwater contamination is not likely. Due to the nature of the proposed power transmission line development, groundwater issues are not of potential significance and do not require any significant mitigation measures.

Impacts on water quality during the operational phase have been discussed in this EIA Report.

6.6.9 Potential Impact on Landscape & Visual Intrusion

The proposed power generation plant and associated transmission structures has the potential to cause impacts to the landscape and visual aesthetics of the area. The site allocated for the power plant project by the Tema Development Corporation is about 75 acres (30 Hectares) in size. The project will occupy less than one-third of the land. A fence wall has been constructed around the entire 30 hectares of land at the site and there are no totally open views in to the site. Further, a fire buffer zone comprising of forest trees is to be developed within the fence wall.

The power plant stack of 30 m will be visible from most angles. However, the plant is sited in a built up residential area so it is anticipated that the landscape character will not be altered significantly as a result of the power plant site and transmission line.

Both the gas and diesel pipeline will be buried underground and therefore would not have any visual impact after construction and during operations. A new overhead transmission line could have a significant adverse visual impact as a result of the line and the tower structures, and indirectly as a result of the clearance of the buildings, vegetation and crops within the wayleave to accommodate the line. The extent of the impact on the character of the landscape and

visual impact will depend on the nature of existing land uses and whether there are any sensitive views that will be altered by the removal of vegetation (especially taller vegetation) and the new transmission line structures. Bulk transmission line already exist in the project area connecting to the GRIDCo Substation at the New Tema Substation, subsequently the transmission line component is not expected to significant impact on landscape and visual intrusion. Potentially sensitive receptors include the local residents along the access road.

Impacts on landscape and visual intrusion during the operational phase have been discussed in the EIA Report. The landscape assessment shall focus on land use, landscape and visual impacts of the proposed power plant and the transmission line.

6.6.10 Potential Impact on Flora & Fauna

Operation of the plant could potentially have an impact on flora and fauna as a result of damage due to the movement of workers and vehicles on and around the site and long term impacts as a result of air emissions. Emissions from the power plant during operation are addressed in Section 7.4.3. There are no sensitive habitats or species on the site, therefore the significance of any impact would be low. The plant site has been fenced and therefore all operations will take place within this boundary. There will be sufficient turning space within the plant site for vehicles. No movements outside of the site boundary are therefore anticipated.

7.0 PROPOSED ENVIRONMENTAL IMPACT MITIGATION MEASURES

7.1 Introduction

Environmental impacts can occur during both the construction and operation phases of the project implementation. This Section of the report will outline ways and measures to help reduce, and if possible eliminate the adverse impact identified in [Chapter 6](#). This section further describes the proposed mitigation measures that would be adopted to minimise the predicted impacts identified in the previous chapter. The impacts identified so far are typical of thermal power plants and transmission line projects. Mitigation measures provided under this section complements on-going environmental and social management practices that are underway by VRA. The mitigation measures that have been proposed to minimise potential adverse environmental impacts and maximise beneficial impacts that are associated with the implementation of the project is presented. To ensure that environmentally sound practices are adhered to and in order to safeguard the safety and health of persons or any group of persons working on the project during project implementation, the following mitigative measures are proposed for significant potential impacts at the pre-constructional, constructional and operational phases.

7.2 Pre-Construction Phase

7.2.1 Consultations with Communities & Relevant Agencies

Consultations have also been carried out with affected communities on the project. A public hearing was held on April 29, 2010 to consult project affected persons as well as key stakeholders on the project. Again, a stakeholder hearing was undertaken on May 30, 2012 at the KTPP site, to enable all local stakeholders, including neighbouring industries and communities to provide comments on the project. This formed part of the process of registering the project under the Clean Development Mechanism (CDM).

The issue of consultations with communities and relevant agencies have been dealt with extensively under Section 10.0. This is being done with a view of collating social information as well as informing them about the project and its impacts on the community members. VRA shall consult with all relevant individuals, communities, state agencies, institutions at each stage of the project to ensure effective collaboration and smooth project implementation.

7.2.2 Land Acquisition/Compensation Issues

The Lands Act provides for payment of compensation and resettlement of displaced people, whose lands or landed property are affected by projects being undertaken by Government. Although the land is legally owned by VRA, there were people visibly farming and squatting on the power plant site for years. People, whose livelihood and/or existence are affected by a project, would be liable for compensation. VRA has identified the project-affected persons (PAPs) at the power plant site, "Feed corridor" as well as under the proposed transmission line in order for issues of compensation to be appropriately addressed. The issue of compensation has been addressed in meetings with neighbouring communities, squatters on the land, among others. A public hearing was held on April 29, 2010 to further consult project

affected persons as well as key stakeholders and to discuss issues of land acquisition and compensation. It must be noted that there is no associated resettlement programme under KTPP.

Direct compensation is to be paid to all property affected persons who would be expected to relocate on their own. Due to their location, it is likely that the construction of the associated gas and diesel pipelines may not require any compensation payment as there is very little economic activity within the RoW of these lines. Further, by convention, farmers will be allowed to harvest any crops within areas to be acquired prior to the securing of the RoW. Valuation of affected properties at the power plant site as well as under the proposed transmission line has been completed and a Valuation Report prepared. A detailed Valuation Report was prepared to guide compensation payment. VRA has made money available for compensation payment from its own financial resource and compensation has been effected.

Due to the huge compensation amount for the buffer area, payment was staggered into three tranches. The first payment took place on October, 2009, the second in December, 2009 and the third January, 2010. About 90% of all property affected persons have been paid (See *Table 30*). Compensation list is attached in this report; however, names have been withheld for confidentiality purposes.²² PAPS were made to produce documentary evidence of ownership before payments were made and were given up to March, 2011 to move out of the site. Compensation activities were done in line with the VRA Land Acquisition & Resettlement Framework (LARF).

Table 30: Status of Compensation Payment

Category	Properties	Location	No. of PAPS	Amount	% of Total Compensation
Paid PAPS	Crops	Marathon Site	10	10,328.94	0.59%
	Squatters		2	3,003.76	0.17%
	Buildings/Lands	Buffer Zone	60	1,545,090.55	88.39%
Total Paid Compensation			72	1,558,423.25	89.15%
PAPS who have not received compensation	Crops				
	Squatters	Marathon	2	18,634.88	1.07%
	Buildings /Lands	Buffer Zone	7	148,160.38	8.48%
Outstanding compensation for unidentified PAPS			4	22,878.36	1.31%
Total Outstanding Compensation			13	189,673.62	10.85%
TOTAL COMPENSATION				1,748,096.87	100%

²² See Appendix 10 for Compensation list

Some challenges were however faced during the execution of the compensation process. A Project Affected Person with a Project ID. VRA/MAR/65 turned down the offer of compensation and has since refused to move out. Again, another person with a project ID VRA/MAR/56 claimed he was not aware that VRA was acquiring the buffer zone. At the time of referencing his property was at the roofing stage. He declares that since he was not aware, he went ahead to render the building and completed the roofing. This are expected during such projects and negotiations are on-going to ensure a successful implementation of the compensation component of the project.

From experience, most questions involve disputes over the physical inventory counts and subsequently, grievance resolution procedures have been put in place with the sole objective of minimising disputes that may arise in relation to the compensation payments. Community members have been directed to channel all grievances to VRA through Nii Daniel Tetteh Oglie, Chief of Nmlitsakpo. The Community Chief is expected to head the Grievance Committee to be established at Kpone and responsible for relaying grievances to VRA. VRA shall maintain a Public Relations Unit responsible for a public information and sensitization campaign in order to inform stakeholders in the project area on issues related to compensation and land acquisition. On-going public consultations would be held with PAPs as well as the relevant Chiefs, Opinion Leaders, and Governmental Agencies with the aim of providing information on the project and issues relating to compensation.

The grievance/dispute processing and settlement mechanism will be based on the following:

Traditional dispute resolution

Dissatisfied claimants would be invited for negotiation together with the traditional authorities of the area or Assembly members of the area in order to arrive at acceptable figures.

Submission of counter proposals

Although field valuation is generally accurate, there may be disputes to the figures arrived at. Such disputes shall be typically brought to the attention of the VRA staff. The second stage of the mechanism is to request the claimant to submit counter proposals supported by valuation opinion prepared by private valuers of their choice. The private reports will be considered by VRA in conjunction with the Land Valuation Division to ensure that claimants are treated fairly. At such meetings efforts will be made to arrive at amicable settlements in order to ensure that the third stage of the dispute resolution is not triggered. VRA, in consultation with the LVD, shall then decide each instance on a case-by-case basis.

Resort to Legal action

PAPs may raise issues formally when informal mechanisms fail to redress the concern. PAPs may, in the event of dissatisfaction with the decisions taken in the instances discussed above or without resort to any of the instances above resort to legal action to have the dissatisfaction resolved. If the issue cannot be resolved at this level, the aggrieved

party has, in theory, access to redress through the judicial system, although in fact judicial resolution is expensive and time-consuming. Given the mechanisms described above, it is unlikely that disputes will end up in the law courts.

7.2.3 Site/Land Preparation

Following the completion of payment of compensation for crops and temporal structures at the site for the power plant in 2007, VRA has cleared and constructed a security fence wall around the entire site as a form of a security measure to protect the site from intruders. The contractors would ensure that the site clearance, topsoil removal, compacting, cutting and filling, and foundation construction follow each other in order to avoid or minimize the incidence of erosion.

7.3 Construction Phase

The constructional phase of the project involves activities that have the potential to impact significantly on the physical, biological and socio-cultural/socio-economic environments within the project's area of environmental influence. This Section considers the environmental impacts of the KTPP during construction. It addresses potential impacts on all resources and receptors so that the scale of overall impact of the project can be elicited. The identifiable net changes in key environmental issues have been assessed.

The following mitigation measures have been proposed for the significant potential impacts:

7.3.1 Contractors' obligations and legal requirements

The EPC Contractor is to prepare method statements and environmental mitigation plans for review prior to commencement of constructional activities. Method statements shall cover, among others, the following key issues;

- a. Sourcing and transportation of materials
- b. Storage of material at site
- c. Movement of vehicles to and from site, and during work at site
- d. Construction practice affecting:
 - ✓ Erosion Control
 - ✓ Noise and Vibration
 - ✓ Waste Management/minimization
 - ✓ Contaminated Materials and Wastes
 - ✓ Emergency Response Procedures
 - ✓ Air Quality
 - ✓ Water Quality
 - ✓ Litter
 - ✓ Storage of Chemicals and Fuels
 - ✓ Cleanliness of the road from mud etc. from site traffic;
 - ✓ Hours of work in the vicinity of dwellings;
 - ✓ Movement and generation of surface water;

- ✓ Pedestrian and vehicle diversion and safety;
- ✓ Siltation and blockage of drains and river courses; and,
- ✓ The level of monitoring to be undertaken.

Recommendations will be made regarding any modifications that are necessary to achieve the desired level of environmental protection. Throughout the construction period, regular site inspections will be made to monitor the effectiveness of environmental protection measures, as well as to check that no previously unforeseen impacts are occurring. In the event of the latter, recommendations will be made for additional environmental protection measures to be adopted. The frequency of site inspections will vary depending on the nature of works being carried out at any one time. In general, attention will be concentrated on those operations and locations where the most potentially damaging impacts might be anticipated, with particular attention being paid to earthworks sites. The frequency of inspection will be highest at the initiation of works at each site, so that any problems can be recognized at an early stage, and remedial works or procedures can be implemented before irreparable damage has occurred.

Notwithstanding the Contractor's obligation under the above clause, the Contractor shall implement all measures necessary to restore the sites to acceptable standards and abide by environmental performance indicators specified in the PER to measure progress towards achieving objectives during execution or upon completion of any works.

7.3.2 Source of Constructional Materials

Lumber would be obtained from Forestry Commission approved sawmills. The contractors would avoid chain sawn timber. Aggregates for the construction phase of the project would be obtained from licensed quarries, close to the project site like the Shai Hill (about 40km from the site) to avoid travelling long distances with such aggregates and its concomitant traffic impacts.

7.3.3 Impact on Socio-economic and local communities

To maximise employment opportunities, the following mitigation measures will be implemented:

- The contractor should ensure that local people are employed where skills permit.
- The contractor will be required to prepare a statement of intent detailing how local employment opportunities will be addressed and the procedure for application for jobs.
- The contractor will ensure that no child labour is used, in accordance with international and local labour laws.

To minimise the pressure on local resources and local communities due to influx of construction workers, the contractor is required as part of the Design Specification to be responsible for arranging and providing all living accommodation, services and amenities required by his employees.

In addition, the following mitigation measures will be undertaken:

- The contractor should seek to secure accommodation for temporary workforces.

- The contractor should make provision for local residents to benefit from selling the workforce food and other services such as laundry, transport, retail goods etc. wherever possible.
- To ensure that local levels of HIV/AIDS are not exacerbated, the contractor will brief employees on health risks. This should be included as an action within the Health & Safety Plan prepared by the contractor.

As a result of the mitigation measures proposed overall it is considered that there will be a minor temporary negative impact on local resources as a result of the influx of temporary workers. Moreover, the measures will have a positive impact of medium significance as they will result in the employment of local workers and indirectly will have a positive effect on the local economy through the consumption of local foodstuffs and other materials and services.

No new roads or accesses will be opened up, and the areas surrounding the KTPP site are developed areas, therefore the problems of increasing bushmeat hunting that may occur in more remote regions as a result of an influx of workers is not considered to be a significant issue for the KTPP.

7.3.4 Impact on Noise & Vibration

Noise impacts from constructional activities will be temporary- limited only to the constructional phase of the project. All equipment/plants and vehicles will be new. Thus their ability to generate undesirable sound will be very low indeed. When making order of equipment, requirement for low noise equipment should be priority in order to decrease noise impact. All such equipment and vehicles will undergo periodic routine maintenance to reduce vibrations and other faults that ultimately lead to the generation of noise. Particular attention will be paid to all noise-reducing devices or mufflers to ensure that they are in good working condition to minimize noise generation.

Routine machine operation and tractor-trailer transport are not anticipated to produce noise levels significantly in excess of routine highway noise levels, or approximately 60 dB (A), however, workers in either case will be issued protective gear during working hours to offset any risk of hearing loss. In all cases, noise travel will be least during daylight hours when air density is least, and therefore all of the above-referenced noise producing activities will be kept to daylight hours of operation. All moving and reciprocating parts will be well oiled to reduce friction and subsequent noise as much as possible. This is beneficial not only for noise attenuation, but also for an increased life span of our machines, since wear and tear will be drastically reduced.

The unnecessary tooting of horns during transportation of equipment and materials through settlements will be avoided as much as possible. Construction site workers will also be advised to avoid unnecessary noise making. In addition, night time work especially near communities will be avoided as much as possible to prevent undue noise impacts on local communities. Construction crew near noisy machinery and power tools will be provided with earmuffs to protect them from hearing loss damage. Noise levels shall be monitored at areas where work is on-going. Expected worker noise exposure levels shall be in line with the USA Department of Labour OH&SA as provide in Table 31.

Table 31: Acceptable Employee Noise Exposure Levels²³

Duration of Noise Exposure (Hours)	Sound Pressure Level (dB)
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

Maintenance practices such as the following shall be practiced to reduce noise levels:

- Replacing worn or loose machine parts.
- Performing high noise operations during hours when people are less likely to be affected.
- Maintaining and lubricating equipment to eliminate rattles and squeaks.

Engineering controls, such as replacing noisy materials, considering the noise level of new equipment or processes before purchasing or implementing, placing heavy machines on rubber mountings, using sound absorbing acoustical tiles or baffles shall also be done as a means of reducing noise levels. All stationary machinery and equipment will be mounted on vibration-damping foundations. These measures will be enforced for all new installations. Workers will not be allowed to be in direct contact with machine which vibrates as an operational necessity. This is to help reduce whole body or segmental vibration.

The level of noise nuisance from constructional activities will be monitored. The Contractor will be required to use only plant which meets specified noise parameters, as stated in the contract documents. No driven piling works will be permitted within specified distances of noise sensitive premises unless 'silent' driving plant is employed. In general it is anticipated that no piling works will be permitted to be undertaken outside daylight hours

With the adoption of the above mitigation measures, the impacts of noise generated during the construction of the power plant site are likely to be minimal. It is expected that the full implementation of the measures outlined above will minimize the potential noise impacts on the workers as well as the local communities.

²³ USA Department of Labour Occupational Health & Safety Administration

7.3.5 Impacts on Air Quality

Particulate matter on the project site could increase considerably during the construction phase. This could be caused by the removal of topsoil and vegetation, the movement of vehicles and equipment and the construction activities in general. The increase in particulate matter on the site would decrease gradually over the construction period. The workers at the construction site would be provided with nose masks/filters and water would be sprinkled regularly onto the site.

There are unlikely to be any significant odours from the construction of the power generation plant. The contractor is required by the Design Specification to undertake the following mitigation measures:

- To take precautions to keep all existing and new temporary and permanent roadways clear of any spillage from construction traffic. Any such spillage, including excessive earth or any other materials brought in on the wheels to tracks of site vehicles or traffic, should be cleared immediately.

In addition, the following mitigation measures will be implemented:

- The contractor will maintain construction equipment in good running condition. When practical, engines should be switched off when not in use.
- Where appropriate, the contractor will enforce a maximum speed limit over all unmade surfaces.
- Where appropriate, the contractor will cover loads of friable material during transportation.
- Where appropriate, the contractor will manage stockpiles to limit erosion and emissions of dust.
- Where practicable, site roads and construction vehicle tyres will be wetted to reduce dust generation. A washing bay with appropriate drainage will be provided for this purpose.

With the adoption of the above mitigation measures, the impacts on air quality generated during the construction of the power plant site are predicted to be minimal. Operation of the transmission line is unlikely to have an impact on air quality.

7.3.6 Transport and Traffic

Most traffic will occur around the project site, where the roads are in good condition and relatively wide. The main sensitive receptors between KTPP project sites are residences and pedestrians along the main road. Without mitigation measures, the impact on public safety could be significant. No new access roads are to be constructed under the project.

The contractor is required as part of the Design Specification to undertake the following mitigation measures:

- Identify a preferred route to deliver equipment to the power generation plant site.
- The preferred route will be agreed with VRA prior to any deliveries.
- Advise VRA of the movement of abnormal loads and provide full details of such loads to VRA.

In addition to the above, the contractor will be required to prepare a Traffic Method Statement (TMS). This statement will:

- Identify the preferred route/by-pass to the site,
- Detail the delivery schedule of Heavy Goods Vehicles (HGVs) and other significant traffic movements;
- Identify any significant environmental impacts associated with the preferred route;
- Outline the mitigation measures to be undertaken, taking into account measures set out in the EIS and local Ghanaian legislation;
- Details method for implementation of the TMS.

The TMS will be approved by VRA prior to delivery of equipment to the site. It is recommended that heavier equipment be delivered to a site closer to the construction site to minimise impacts on road traffic in and around Tema.

To minimise disturbance and damage at the power plant site, the following mitigation measures will be implemented:

- The contractor will restrict delivery hours of HGVs along the access route to the plant site to daylight hours to minimise disturbance to residents, unless otherwise agree with VRA.
- The contractor will designate speed limits on all traffic accessing and egressing the site and along the access road to the site.
- Also, warning notices like “**NO ENTRY**” or “**NO TRESPASSING ALLOWED**” will be placed at entry to the plant site. In addition, random security patrols will be carried out to ensure that the local people do not unduly endanger their safety.
- All vehicles are to be directed by appropriate contractor to the nominated work areas
- All vehicles prior to leaving site must be checked by a contractor representative for cleanliness and washed down if required
- Construction vehicles are not permitted on site without approval from the Contractor
- All extracted material, such as excavation spoils or rubbish, is to be covered prior to leaving site
- Transportation of hazardous materials will be carried out in accordance with Authority Requirements, Contractor’s Safety Plan and VRA Safety Requirements
- The maintenance and cleaning of vehicles and construction plant will not be carried out in areas from where oil or washing may be discharged into a watercourse, street gutter or stormwater drainage system. Waste arising from such activities will be collected and disposed of off-site in a manner approved by the EPA
- A truck wheel washing facility will be maintained for the effective cleaning of wheels prior to trucks leaving site
- Fuelling of vehicles, earthmoving plants and mobile equipment will not be carried out without an operator or driver being in attendance at all times
- To restrict traffic and noise impacts, trucks transporting materials from the site will be confined to the main road system and avoid local roads as far as is practicable

To avoid the risk of accidents, the following mitigation measures will be implemented:

- The contractor will restrict deliveries of HGVs to daytime hours along unlit roads, unless otherwise agreed by VRA.
- The contractor will develop procedures for on-site traffic movement and parking at the site.
- The contractor will arrange for the training and testing of heavy equipment operators and drivers, with records kept of all training.
- The contractor will erect warning signs along all access roads also used by the general public,

Pedestrian management methods to be put in place shall be the following:

- All pedestrians have the right of way, especially outside the fenced wall of KTPP site.
- Pedestrian thoroughfares around exterior of site to be maintained and clearly marked
- All visitors will report to the VRA office to sign visitor register
- All visitors must sign out on leaving the site
- All visitors must be suitably attired to enter the site e.g.; proper footwear, hardhat etc
- An inducted person must accompany all visitors to the site
- No private car parking will be available within the site. Visitors will be advised to park in the surrounding public car parks
- The construction area will be suitably segregated from the public and adjoining pedestrian areas
- Access to, from and around the workface is to be via defined access routes detailed in the induction process

The mitigation measures proposed above will be incorporated into all contract documentation. If the equipment requiring HGVs are delivered by road from Tema, the residual impact on traffic will be of medium significance during the delivery period, as will the impact associated with periods of the construction that also require significant traffic movements. Delivery of equipment by HGV from the Tema port or landing facility closer to the plant and through appropriate by-passes would significantly reduce the impact on traffic and transport between the port and the KTPP site.

Constructional activities for the associated linear projects of KTPP (gas/diesel pipelines and transmission lines) across public roads will cause temporary traffic disruptions. The main concern regarding to the construction of the gas pipeline is its crossing under the Tema-Dawhenya-Aflao Road. A tunnel is to be dug to contain the gas pipeline using a special crossing design methodology. VRA shall ensure coordination with the Ghana Highway Authority and Department of Urban Roads to minimise interference between installation and operation following guidelines of the **“Road Reservation Management: Manual for Coordination” (June 2001)**. A Notice of Work shall be given as outlined in Appendix 1 of the manual and is to be accompanied by a sketch of the location plan. Thus in all cases, where the project will impact on public roads due notification to the general public and appropriate authorities (GHA, Urban Roads and/or TMA) will be given as required.

Reasonable traffic control schemes e.g. diversion routes, speed control measures, high quality warning signs, traffic wardens etc. will be implemented by the contractor to regulate and maintain flow of traffic at the intersection. The work would be coordinated with the Ghana Highways Authority and the Tema Metropolitan Assembly. Concerning the path of the gas pipeline, in order not to intrude into other people's land, the pipeline's route was fixed within the existing RoW of GRIDCo 161 kV transmission lines. About 10% of the route's length has farming of cassava and corn as the main economic activities. These activities would not be affected once the pipeline is in place, but the issue of compensation, if any, would cover the payment of crop loss due to the pipeline construction.

7.3.6 Impact on Public Safety & Occupational Health & Safety

VRA believes that its human resource is its greatest asset. It will therefore proactively pursue measures at promoting safety, health and welfare of its workforce. Relevant national policies, labour laws and codes of conduct concerning employment shall be applied to regulate behaviour of workers in the local communities. Measures shall be designed and adhered to regarding employment and workforce policies to mitigate environmental, health and social impacts that are associated with the influx of formal and informal workers by the Contractor. Local employment and sourcing policies are used to give priorities to people within the project affected areas.

A Safety & Health Plan (SHP) shall be prepared by the Contractor and approved by VRA and shall be in line with VRA's Corporate Safety Policy. Education and awareness training are given to every worker upon employment. VRA shall promote the need for safety awareness in all aspect of the work by conducting safety awareness programmes and campaigns, displaying posters and signs and using audio visuals. Weekly and monthly safety meetings shall be held for the workers of VRA and the Contractor.

VRA will ensure that Contractor carries out the work in compliance with the relevant provisions of the Factories, Offices and Shops Act, 1970 Act 328) and the Contractor Safety Rules to minimize the potential occupational safety and health hazards and prevent or minimise accidents. To further minimize the potential safety and health hazards, the VRA will ensure that the contractor employs properly trained and experienced operatives and adhered to all technical specifications relevant to safety measures in the execution of the works. In addition, the contractor will be expected to provide an "All Risk Insurance" cover for the contractor, subcontractors, project management staff and all other employees.

VRA/Contractor shall conduct formal induction sessions for all people on site, including issuing each of its employees and employees of its subcontractors with an induction health and safety booklet, and during the contract, continue with on-going training onsite health and safety matters. Road safety signs are put at the appropriate places to prevent accidents. Dangerous construction sites are always flagged with caution reflectors.

Materials and equipment used for construction work and installation of plant and machinery would be marked to explain their potential impact. Workers would be made to always use helmets on site and other safety measures with regards to

construction and installation works would be enforced. Reasonable practical precautions would be taken and instructions given in the identification, use, handling, storage, transport and disposal of materials at the construction site.

With the implementation of the contractor's construction Health and Safety Plan, audited by VRA, the occupational health and safety risks associated with the construction of the power plant site will be minimised. The overall impact on occupational and public health and safety is predicted to be of low significance. The specific issues considered are discussed below.

7.3.7.1 Occupational Noise

Construction workers working with or near noisy equipment like pumps and power tools will be provided with earmuffs to protect them against noise-induced hearing loss damage.

7.3.7.2 Machine safety

All potentially hazardous machinery such as lifting appliances (cranes, forklifts, etc) and unfired pressure vessels (compressors, etc.) will undergo statutory examination by a certified engineer. This will ensure that accidents due to material failure are pre-empted. All electrical cables of mobile or hand-held machines (electric hand drills, temporary lights) will be examined for flaws in insulation and when any flaws are detected the cables will be promptly replaced.

7.3.7.3 Sanitary/Welfare Facilities

Mobile toilet facilities will be provided for construction workers. This is to ensure that decent and comfortable places of convenience are provided for the workers and also to prevent environmental pollution with human waste. In addition, lifting of excessive weights at the workplace will be prohibited. Lifting appliances (e.g. cranes and forklifts) will be provided for lifting heavy objects. First aid facilities and good drinking water will be made available for the use of workers in accordance with the Factories, Offices and Shops Act, 328, 1970. Raincoats, Wellington boots, etc., will be provided for construction workers who will be working in rainy or wet conditions.

VRA has assigned medical centres in the country for treating its workers in the event of any illness, including exposure to contamination and occupational injuries. Some of these centres are in Tema and all VRA project staff shall utilise these health facilities, when required. The Contractor shall be responsible for providing affordable health care for its workers.

7.3.7.4 Injuries from falling/swinging objects

Protective clothing such as hard hats and safety boots will be provided for all employees at the proposed project site for protection against falling and/or swinging objects. Vegetation felling will be done by competent and adequately trained workers. Adequate warning will be given to ensure that safety of workers is not compromised.

7.3.7.5 Accidental falls from height

Due to the hazard of potential accidental falls from heights during construction works all workers who will be required to climb and work on the towers will be provided with the necessary safety equipment such as body harnesses, (climbing belts). Fall hazards must be minimized through the use of fall prevention or fall protection. Fall prevention refers to using permanent engineering controls so that hazards associated with working at elevated locations are reduced or eliminated. Fall prevention measures to be adhered to are as outlined below:

- a) Employees on a walking/working with an unprotected side or edge that is 1.2m or more above a lower level shall be protected from falling by the use of a guardrail system or a personal fall arrest system.
- b) Employees working on an aerial lift that is 1.2m or more above a lower level shall wear personal fall arrest systems, with the lanyard attached to the boom or basket.
- c) Employees on walking/working surfaces shall be protected from falling through holes more than 1.2 meters above lower levels by the use of a guardrail system, a personal fall arrest system, or covers.
- d) Many falls occur because portable ladders are not placed or used safely. Ladder users are at risk of falling if a ladder is not safely positioned and moves or slips from its supports. A stairway or ladder shall be provided at all worker points of access where there is a break in elevation of 48 cm or more and no ramp, runway, embankment, or personnel hoist is provided.
- e) VRA shall ensure that only well-trained and experienced personnel work at heights on the towers.

7.3.7.6 Snakebites

Construction workers will be protected from the potential hazard of snakebites by providing them with safety boots long enough to cover the leg up to the knee. Workers will be required to wear these boots at all times during working hours.

7.3.7.7 Public Health

With the introduction of migrant workers, mitigation measures will be required to minimize the potential danger of the spread of sexually transmitted diseases (STDs) including HIV AIDS. Health professional from the VRA Health Services Department shall undertake HIV/AIDS education for the workforces of the contractors and consultants. The measures shall include the distribution of IEC materials and sale of condoms at subsidised prices to the workforce. The workers will also be continually educated about the dangers of indulging in casual unprotected sex.

7.3.8 Impact on Waste Generation

The following wastes are likely to be generated at the power generation plant site:

- Clearance and excavation wastes: clearance of site vegetation and removal of soils, inert construction materials and residues, spoil, etc.
- General construction wastes: reject and excess material, drainage from wastewater and site run-off, containers etc.

- Hazardous wastes: Other hazardous wastes may result from spillages from construction equipment.
- Other wastes: from offices, food preparation wastes, sanitation etc.

The objectives of the managing waste are based on the hierarchy of avoidance/reduce, re-use, recycle, treat and dispose. To re-use and/or recycle a minimum of 80% of all Hard Waste Material, and Soft Waste Material generated on the construction site, thus achieving up to 80% reduction/avoidance in waste to landfill. Best Practice should be adopted wherever possible, to achieve waste minimisation and reduction. Key areas that will be targeted in the Waste Management Plan are:

- ✓ To avoid, whenever possible, the generation of wastes
- ✓ Demolition Materials (including hazardous building materials i.e. asbestos)
- ✓ Construction Materials
- ✓ Excavated Fill Materials
- ✓ Domestic & Human Waste
- ✓ Wastewater
- ✓ Litter generation due to construction activities

In addition the project will:

- ✓ liaise with Subcontractors to identify areas where they can reduce waste and reuse materials in
- ✓ their respective trades;
- ✓ meet local, state and federal waste minimisation legislation and environmental standards;
- ✓ prevent pollution and damage to the environment; and
- ✓ protect the safety and health of our employees, site personnel and the public

With respect to waste management, the following measures shall be put in place to help keep a clean site and reduce environmental pollution:

- Adequate numbers of containers shall be provided with covers to keep rain out or to prevent loss of wastes when it is windy.
- Solid and hazardous waste containers shall be properly labelled to identify them to ensure that toxic liquid wastes (used oils, solvents and paints) are not disposed of in solid waste containers. Additionally, the project personnel have been trained on proper collection and disposal methods of different types of solid wastes.
- Construction waste and domestic waste are collected, removed and disposed of only at designated areas.
- Wherever possible, production of construction waste and domestic waste has been minimized by reusing and reusing leftover materials wherever possible and also through proper planning and design.
- Construction workers shall be instructed in proper construction waste and domestic waste storage and handling procedures.

- If scrap metal occurs, these scraps shall either be reused or sold to companies whose business activity is dealing with scraps.
- Wood and cardboard wastes shall be reused if possible.
- Disposing of domestic waste on the construction site is prohibited for workers and visitors.
- Domestic rubbish field have been established as planned, and regularly disinfected.
- Sanitary facilities have been well planned and cleaned daily.
- Construction work camps and surroundings shall be kept in clean and neat conditions at all times.
- Collected domestic waste and construction waste will not be store in the vicinity of drainage systems or watercourses.
- No waste shall be disposed of or buried on the site. Illegal dumping, either at the construction camp, along public roads or in the surrounding areas, or into the river will not be allowed.

The following measures shall be put in place to help reduce pollution from concrete related wastes:

- The wastewater and runoff from concrete batching plants (mobile and stationary plants) will be clarified by settlement ponds and the alkali level of waste water and run off will be neutralised to prevent water pollution.
- Waste generated from concreting activities will not be allowed to flow into drainage ways, and receiving waters.
- The amount of daily concrete production will be determined according to the construction schedule. Mixing excess amounts of fresh concrete will be avoided by planning of order volumes for each. The person in charge will control the quality and the amount produced concrete to avoid excess concrete production.
- Concrete transit mixers will be washed out only in designated areas. It will not be permitted to wash into drainage lines, open ditches or into watercourses. Designated areas with sign boards – “concrete washout areas” will be located near batching plants, where settlement ponds will be constructed.
- For concrete additives, material safety data sheet (MSDS) will be obtained from the manufacturer. The MSDS will be used to obtain information on hazards and safety precautions, the specific information on how to deal with spills.
- Both employees and subcontractors shall be instructed about concrete waste management techniques
- Hardened concrete waste will be disposed of according to solid waste management procedures.

The contractor will be required to have and to promote a policy of a clean worksite and good disposal practices, with advice and training available to its workforce achieve this. With the adoption of the outlined mitigation measures, the impacts of wastes generated during the construction of the power plant site and transmission line are predicted to be of low significance.

7.3.9 Impacts on Soils

Activities during the constructional phase will expose the disturbed ground surface, which is at least temporarily unprotected, to the agents of soil erosion such as heat, wind and rain. Erosion of soil from exposed unprotected land surfaces will be minimized by limiting land clearance to minimum area requirements for the constructional activities.

Contamination of soils may also arise through the spillage of lubricants, oils and machine fuel during construction activities. The potential risk of contamination of soils as a result of spillages, especially those associated with refuelling may be high if not controlled. Also, the erection of towers/tower footings on steep slopes will be avoided as much as possible to prevent slip erosion.

To minimize the impact on soils, the following mitigation measures will be implemented:

- The contractor will be responsible for ensuring that construction activities are restricted to designated work areas to avoid damage and disturbance outside of the power plant site.
- Existing access roads will be used to reach the sites wherever available.
- The contractor will strip and store topsoil separately from subsoil.

To minimize the potential contamination of soils, the following mitigation measures will be implemented:

- The contractor will locate temporary storage tanks on impervious bases and will use drip trays during re-fuelling of equipment.
- The contractor will have available on site all equipment and materials required to execute a clean-up.

This potential impact will, however, be short-lived or temporary since it is expected that the exposed areas will be covered quickly by vegetative re-growth to stabilize the soil and minimize erosion. Thus the overall impact on soils at the power plant site is anticipated to be low. The significance of the impact of contamination on soils, with the above mitigation measures, is also anticipated to be low. VRA will apply erosion control practices such as re-grading, compaction and early re-vegetation to promote soil conservation.

7.3.10 Impacts on Water Quality & Resources

Construction of the power plant could have an impact on water quality as a result of alteration of the existing drainage characteristics of the site during site preparation and construction. Contamination of water resources could also result from the spillage of lubricants, oils and machine fuel during construction activities and from the disturbance of soils and dust which is washed off into local water courses.

The contractor is required by the Design Specification to undertake the following mitigation measures:

- The contractor will agree arrangements for the disposal of aqueous effluents during construction and commissioning phases with VRA.
- The contractor shall prepare separate construction Emergency Oil Spill Plan
- All oil tanks will be bunded to contain 110% of the largest tank's contents.

In addition, the following mitigation measures will be undertaken:

- The contractor will locate temporary storage tanks on impervious bases and use drip trays during refuelling of equipment. Any temporary refuelling tanks must be bunded.

- The contractor will have available on site all equipment and materials necessary to execute clean up.

With respect to the construction of associated linear projects, clearing and grading of access and tower corridor tracks and the excavation of tower base areas will be limited to the minimum area requirements. Other measures proposed in other sections of this report for minimizing erosion and managing excavated materials, wastewater from excavations and accidental spillage of oil, fuel and paints are valid for the prevention of pollution of water bodies.

Under this project, the Contractor will not be required to use culverts across water bodies to allow for access in order to avoid blockage of streams, rivers and other water bodies. Under no circumstances must water bodies be blocked to provide for construction access. VRA will not employ herbicides/weedicides for weed control or vegetation clearing hence any potential pollution from this source is eliminated.

With the adoption of the above mitigation measures, the impacts on water resources and water quality generated during the construction of the power plant site are predicted to be low.

7.3.11 Impacts on Landscape & Visual Intrusion

The plant may have an adverse visual impact as a result of tall construction equipment affecting views to the site from properties and amenity sites. The main construction equipment that will potentially be visible during construction will be the equipment to move the plant, transmission lines and associated gas and diesel pipelines. However, as the plant is located within a built-up area, the potential for additional adverse impacts to landscape and visual character during construction will be limited.

Currently, views into the site from the nearest sensitive receptors, the Kpone suburb is screened by a wall fence around the perimeter of the project site. With respect to the plant, the contractor will ensure that all existing trees and bushes outside the boundary of the power plant site are not damaged or destroyed as a result of construction activities. The construction of the power plant will not result in a significant incremental deterioration in views in the vicinity of the site as the fence wall and trees around the perimeter of the power plant site limit the potential visual impact.

Construction of the associated linear projects will also have an impact on landscape and visual aesthetics due to clearance of vegetation, presence of construction equipment such as winches and erection of towers. The significance of the visual impact of construction activities along the routes are dependent on the change in the landscape character from that which exists and proximity of the works to sensitive receptors such as residential properties. Visual impacts during construction will be temporary and for a short time period. The contractor will ensure that workers and equipment remain within designated working areas and access will only be allowed along designated access roads to avoid additional damage to adjacent vegetation, crops and/ or residential properties. No felling of trees or crops will be permitted outside of the wayleave, without prior permission of VRA.

7.3.12 Impact on Flora & Fauna

The Contractor is required by the Design Specification to undertake the following mitigation measures:

- Damage to the natural environment of the area during construction must be kept to a minimum and special care will be taken to avoid permanent damage.
- Bushes and trees will not be cut except where necessary for the execution of the Works and then only after the sanction of VRA has been obtained.
- The contractor will undertake landscaping within the boundary of the power plant site, using natural plant species. Landscaping will be to the approval of the VRA. .

There will be a minor impact on flora and fauna due to the permanent loss of approximately 75 acres of habitat as a result of the clearance of the plant site. The mitigation measures proposed will ensure that the natural vegetation adjacent to the site is not disturbed, thus retaining a vegetation basis for local species of mammal, birds and insects. Overall, the significance of the impact on flora and fauna will be low.

7.4 Operational Phase

This section of the report presents the proposed mitigation measures put forward to minimise the significant potential environmental impacts that are expected to be associated with the operational or maintenance phase of the proposed project.

7.4.1 Impact on Socio-economic and Local Communities

Potential impacts associated with operation of the plant are:

- Improvement in electricity supply;
- Employment opportunities, both directly at the site and indirectly through improved electricity supply

The project will have indirect benefits that include impulses to socio-economic development, reduced losses to industry, commerce and economic activities and savings in foreign currency. The long-term direct positive impact is availability of good and reliable electricity. This will boost up the economic growth of the area and will increase the employment opportunities to the local population. Automatically the quality of life style will be changed.

Due to the skilled nature of the operation, highly experienced VRA staff will be needed to operate the power plant site. It is anticipated that approx. 30 permanent staff will be required, who will likely be recruited internally. There may also be some employment opportunities in the local area associated with cleaning security, etc., at the site, and an improvement in the local economy associated with demand from the new workforce at the site. VRA will make every effort to recruit local people where their skills are appropriate for the job. The KTPP will have a positive impact on socio-economics, of medium significance. Seen in the context of the overall business strategy for the improvement of the electricity infrastructure, this project plays a major part in meeting short-term electricity demand.

In terms of water resources, use of water during operation of the plant could put pressure on local water supplies. Same goes for the use of electric power. Officials of both Electricity Company of Ghana (ECG) and Aqua Vitens NL (AVNL) Ghana were consulted on the project. Both establishments confirmed that extensive consultations have been made with officials of VRA. On the part of ECG, they confirmed the installation of two (2) 200KV transformers, coming from two different sources for the project. ECG stated that the transformers were more than sufficient and in no way would their consumption affect the power distribution to the community. AVNL stated that they have even laid pipes to the project site and the 3,000 m³ daily consumption was in line with its daily discharge for the area. Thus the operations of the project would not impact on the use of these 2 utility services by the local populace.

7.4.2 Impact on Noise & Vibration

As indicated, the measured daytime equivalent ambient noise level within the site at the time of monitoring ranged from 41.4 and 50.5 dB (A). These equivalent noise levels were below EPA daytime recommended level of 70 dB (A) for industrial areas. It can be concluded from above that there is no noise pollution in the project area. Values measured at the time of assessment were lower than EPA recommended levels.

It is recommended that KTPP fence line noise levels attributable to site operations do not exceed 55 dB in order to ensure acceptable noise levels at noise sensitive receptors in the vicinity of the plant. However, it is more sensible to establish monitoring stations at representative locations and base noise limits on the periods and guidelines detailed by Ghana EPA. Expected worker noise exposure levels shall be in line with the USA Department of Labour OH&SA as provided in Table 31.

Noise control mitigation measures are needed to reduce the boundary noise levels closer to 55 dB(A). The proposed measures are replacing the current air intake silencer with a higher performance unit and screening the step-up transformers with acoustic louvers. It is indicated also that an additional extract fan be installed on the GT enclosure, it would be fitted with a downstream attenuator capable of offering sufficient attenuation to ensure that the total sound power level of the enclosure is not increased. With regard to the workers, it is proposed that they are provided with personal protective equipment.

Noise measurements will be undertaken when plant is commissioned to ensure that the actual noise levels are not excessive. Monitoring at the KTPP boundary sites will continue, but for the purposes of noise control only. It must be noted that the results of noise surveys will be used to determine if further mitigation measures are necessary. The system of meetings and reporting initiated during the site preparation and construction stages of KTPP will continue during full operation to coordinate the control of noise emissions.

7.4.3 Air Quality

During operation, the combustion of diesel oil and natural gas will give rise to emissions of sulphur oxides, nitrogen oxides, carbon monoxide and carbon dioxide and particulate matter. These emissions are of potential concern to human health and local ecology, and in relation to their potential contribution to greenhouse gas levels. The emissions, according to the air modelling, are not expected to exceed the Ghanaian guidelines. This notwithstanding, it was recommended from the ERM report that an operational monitoring of the power plant is necessary. A Continuous Emission Monitoring System (CEMS) and ambient ground level concentration analysers shall be installed to monitor emissions from the plant.

The plant is expected to operate on natural gas. This is expected to lower the nitrogen dioxide emission levels from the plant from 2000 mg/mNm³ to just 500 mg/Nm³, reducing the above increments to ambient air quality by a factor of 4. Sulphur dioxide emissions would cease as the sulphur content of natural gas is negligible. As indicated, within the context of the environmental impacts for the usage of gas for the operations of KTPP, it must be noted that there will be no potential significant impact on the physical, biological and socio-cultural environments within the sphere of environmental influence of the Station. Some other positive environmental issues identified would be:

- Reduced burning of waste oil only in the event of no gas supply and resort to oil usage
- Uninterrupted gas supply would reduce quantity of oil use and associated oil spill.
- Frequency of oil deliveries would be drastically reduced as well as the likelihood of oil spill.

The modelled results showed that the maximum concentrations occur approximately 1km north-east of the gas turbines (800 m north-north-east of the site boundary - See Plate 10). It is recommended that a suitable site close as possible to this area should be selected for locating the ambient monitoring station. The community for this site is known as “After 25”. This site is proposed for the physical location of the ambient air quality monitoring station. Discussions are on-going with the site owner for the development of the ambient air quality monitoring station at this site.

Baseline data on air quality at three locations are Saki-Bediako, TDC Serviced Plots area, and The North East Point of maximum Fallout has been compiled and would continue during the operational phase. Monitoring of nitrogen oxides (NO_x), sulphur dioxide (SO₂), carbon monoxide (CO), fine particles (PM₁₀) as well meteorological



Plate 10: Site at “After 25” Community for KTPP Ambient Air Quality Monitoring Station

observations would be undertaken at the ambient air quality monitoring station. The requisite training for building in-house capability in the use of the air-quality model software, in addition to the interpretation and application of model results for predicting potential environmental impacts and mitigation measures shall be provided.

The basis of the ambient air quality monitoring programme is to provide scientifically robust and long term air quality monitoring data around the project site in order to characterise the air quality in the communities in the immediate vicinity of the site. It is recommended that monitoring of oxides of nitrogen (NO_x), carbon monoxide (CO), sulphur dioxide (SO₂) and fine particles (PM₁₀) are carried out. For the characterisation of air quality around the project site, with regard to pollution dispersion and pollution sources, meteorological observations would also be undertaken.

Monitoring sites shall be selected such that they are representative of the point of maximum plant outfall and where the plant emission is predicted to make a significant contribution to ground level pollutant concentrations. The precise location of the monitoring station would take account of local factors and the following criteria would be used as far as possible:

- availability of the site in the long term;
- security against theft or vandalism of equipment, or other interference;
- availability of an electricity supply and telephone line, preferably with independent metering;
- representative topographic features;
- representative meteorological conditions;
- separation from local pollution sources and human activities

In addition, any specific site would comply with the following criteria

- The site would allow free ventilation around the inlet, i.e., away from obstructions such as buildings, vegetation, etc.
- The sample inlet would be below open sky and not overhung by trees or buildings
- The sample inlet would be between 2 m and 5 m above ground level.
- The site would be protected from human or animal interference.
- There would be no major sources of pollution (busy roads, large generators, domestic fires, etc.,) within 50 m of the site.

Furthermore, the monitoring and meteorological equipment would be located away from buildings that may have an influence on the measurements. This would be a distance equivalent to three times the nearest building height or, alternatively, the meteorological equipment would be mounted on a mast that is three times the height of the nearest building. Maximum concentrations occur approximately 1 km northeast of the gas turbines. A suitable site as close as possible to this area would be selected for locating the monitoring station.

The monitoring station would comprise the following:

- air conditioned purpose built housing or space within an existing building;
- suitable benching or racking for equipment;
- air quality monitoring instrument(s);
- meteorological equipment mounted on a mast;
- automatic and manual calibration and zero check equipment for all instruments;
- sample manifold, if applicable;
- data logger for storing data;
- modem and telephone line for remote access to data, where practicable

The type of instrument selected would be based on proven analytical techniques for the pollutants measured and the following techniques are recommended:

- Chemiluminescence for nitric oxide (NO) and nitrogen dioxide (NO₂);
- UV fluorescence for sulphur dioxide (SO₂);
- IR absorption for carbon monoxide (CO); and
- Tapered element oscillating microbalance (TEOM) or beta attenuation mass (β - gauge) for particles fitted with a PM₁₀ sampling head.

The actual make of analysers to be used would be commercially available, well proven in service and suitable for long-term unattended operation. The monitoring station would also be equipped with instruments for recording meteorological observations. The meteorological equipment would comprise the following:

- wind vane for recording wind speed and direction;
- temperature probe;
- relative humidity probe; and

The monitoring equipment would be calibrated using traceable transfer gas calibration standards. These would be traceable to national or international standards. Maintenance visits to the monitoring station would be undertaken weekly or fortnightly. These visits will comprise the following:

- manual pre-calibration checks to determine the operational status of the equipment on arrival at site;
- manual calibration of analysers;
- where appropriate, changeover of filters;
- post-calibration checks, to assess the operating condition of the equipment; and
- safety and security inspection.

The pre-calibration, post-calibration and maintenance of equipment would be carried out in accordance with the manufacturer's instructions and by suitably trained staff. All equipment would be serviced by suitably qualified personnel

and in accordance with the instrument manufacturer's instructions. Servicing would be carried out every six months. Support for the repair of instrumentation, would thus be required, within Ghana would be available. Servicing and repair support would ensure that the loss of data for periods of longer than one week is avoided.

7.4.4 Impact on Traffic & Transport

The operation of the power plant has the potential to give rise to changes in road traffic levels on the roads within the vicinity of the plant as a result of worker vehicle movements, deliveries and the removal of wastes from the site. The diesel, potable water, fire water and demineralised water will all be pumped to the power plant site from dedicated pipelines thus avoiding the impact associated with the movement of HGVs to and from the site. The main source of potentially significant additional traffic during operation will be that of waste oil removal tankers and the plant site workers vehicles.

A permanent workforce of approximately 30 staff is expected at the plant site. It is unlikely that all operating staff will have cars; therefore the actual increase in personal vehicle movements is expected to be low. There will be speed restrictions on traffic entering and egressing the site and along the access road to the site. Further, there will be restriction of movement of HGVs to daylight hours where possible. The overall increase in traffic movements as a result of the operation of the plant is considered to be minimal.

7.4.5 Impact on Public Safety & Occupational Health & Safety

Operation of the plant could have an impact on the general public and workers through general operation activities and as a result of accidental spills and fires. The KTPP site will be secured from the general public; therefore the risk to the general public during operation of the plant and switchyard will be minimal. The site for the thermal power plant will be fully secure with wall fence and will have one principal entry/exit with a guardhouse. Appropriate warning signs will also be provided at the site where there is a risk to health and safety.

VRA staff will operate and maintain the plant once it has been commissioned. VRA's Corporate Health and Safety procedures will be in place and enforced for operation and maintenance. It is estimated that 30 permanent operating staff will be required. Working within the power plant and substation poses a risk to VRA workers if no mitigation measures were employed. Natural Gas will be delivered to the site via guarded and insulated pipes from the Regulating & Metering Station from the WAGPCo site.

Fuel has to be properly stored and protected against leakages in a fire protective storage area. Notwithstanding, there is the possibility of Fuel Oil Spillage in the project site, which could be due to Equipment failure and Transportation within the premises. The fuel tank area for the storage of diesel oil will be fully bunded and able to contain at least 110% capacity of the largest single tank. Facilities will be available to contain oil and protect the environment in the event of a catastrophic failure (e.g. explosion) of the transformer.

Fire risks are not avoidable with any human activity, especially in the case of a thermal plant, where combustible materials are stored and used. Life and property in and around the plant would be affected should fire outbreak take place. A comprehensive fire detection and protection system will be installed to cover all equipment on site that could constitute a fire risk. In addition to the measures integrated into the design of the power plant and substation site, VRA will prepare a Health and Safety Plan and an Oil Spill Contingency Plan for the site in accordance with corporate strategy.

VRA in collaboration with GRIDCo will carry out the operation and maintenance of the proposed transmission line based on accepted international standards, such as those of the International Electro technical Commission (IEC) and VRA's Corporate Safety Rules. A potential positive public safety impact is the possible use of transmission lines and towers as landmarks to aid in "navigating" when driving through the countryside since they are clearly marked on Ghana's topographical maps.

7.4.5.1 Fire Protection

Fire risks are not avoidable with any human activity, especially in the case of a thermal plant, where combustible materials are stored and used. The measures are to ensure that that reasonable and adequate life safety measures are incorporated in the project designs and structures, e.g.:

- Automatic Sprinkler Systems would be installed throughout the buildings
- Heat and smoke detection devices would be installed in all areas and would be directly connected to the electrical system with a separate circuit supplied by a back-up power supply or would be equipped trickle charged batteries.
- The detectors would be connected to the central control alarm system, which would have an annunciator panel connected to the fire detection system.
- Alarms would be clearly audible throughout the development
- Design of the structure would incorporate facilities to evacuate occupants with minimum risk to life from smoke, fumes or panic
- An Emergency Response Programme would be in place. It would cover evacuation procedures, employee training, inspections and coordination with the Ghana National Fire Service
- The designs of the development would be reviewed as per a Fire Protection and Life Safety Audit. The findings and recommendations from the audit would be used as basis for establishing a Corrective Action Plan

7.4.5.2 Emergency Preparedness & Response Plans

The storage of gas, diesel, and chemicals on the development could mean fire and explosion risk to the structures, visitors, and workers. Reasonable life and property safety measures would be incorporated into the design and structures and management procedures of the storage facilities. The proposed measures are:

- Construction of containment bunds and raised platforms around fuel/chemical storage facilities
- Regular and periodic inspection of storage facilities

- Preparing Emergency Response & Preparedness Plan/Procedure
- Documentation and reporting of fuel/chemical spillage incidents

An Emergency Response and Preparedness Plan will cover the following major topics:

- Fuel Oil Spillage
- Spillage of Chemicals
- Wastewater Drainage
- Flammable Gases-Natural Gas

7.4.5.2.1 Fuel Oil Spillage

The objectives of the measures and emergency response programme are to contain any spillage occurring or which has occurred, clean up any spillage in the factory, salvage any quantity of spilled material recoverable and restore the affected surrounding into or near its natural state.

The programme's scope covers Spillage in the project premises by equipment failures and Spillage during transportation within project premises. The actions for Volatile flammable liquids are:

- The designated Officer or his delegate must immediately condone off area of spillage.
- The Officer must order stoppage of the use of naked flames, spark creating devices or very hot surfaces 50 meters away from the scene especially on the leeward side of the affected area.
- The Officer or his delegates must deploy abundant material to arrest the advancement of the spill.
- The spillage must be physically removed.

The actions for Non Flammable Greasy Liquids are:

- The Officer shall build earth barriers to contain the spill.
- Qualified personnel must remove any spill.
- Clean up remnant with degreasers and wash down the drains

Reporting the Incident or Accident is carried out as specified below:

- The incident or accident reported to the Plant Manager by the Environmental, Health and Safety Manager (EO) or one authorized by him on his absence immediately after such has occurred or is occurring.
- The Plant Manager or his authorized deputy can inform the Director, Thermal Generations who in turn inform the Director, Technical Services
- The Director, Technical Services after due consultation with the Deputy Chief Executive will inform the Government Agencies, EPA, and National Disaster Management Organization, of any spillage that could affect the environment.

Record of the incident/accident and action taken is documented by the Environmental Advisory Committee

7.4.5.2.2 Spillage of Flammable Gases-LPG Natural Gas, Acetylene

The objectives of the measures and emergency response programme are to prevent fire hazard in the plant, safeguard personnel in the affected area and disperse gas as quickly as possible. The programme's scope covers Leakage in the factory premises due to equipment failure, malfunctioning or wrong handling, Leakages during transportation within factory premises, and Leakage during charging / refilling of gas tanks.

The actions for the emergency procedure are:

- Technician or personnel within the vicinity to inform the EO/ The Officer or any of his superior.
- Superior informs all persons within the vicinity to stop works that can initiate fire-grinding, hot, heating welding or any other activity that may generate sparks of fire.
- Personnel to be asked to evacuate the area immediately.
- Fire fighters with proper equipment must then ventilate the place immediately by opening all doors and windows.
- No one except emergency personnel with proper equipment is allowed in the area until it is certified safe.
- Investigate the incident and take corrective action

Reporting the Incident or Accident is carried out as specified below:

- The incident or accident reported to the Plant Manager by the Environmental, Health and Safety Manager (EO) or one authorized by him on his absence immediately after such has occurred or is occurring.
- The Plant Manager or his authorized deputy can inform the Director, Thermal Generations who in turn inform the Director, Technical Services
- The Director, Technical Services after due consultation with the Deputy Chief Executive will inform the Government Agencies, EPA, and National Disaster Management Organization, of any spillage that could affect the environment.

Record of the incident/accident and action taken is documented by the Environmental Advisory Committee.

7.4.5.2.3 Spillage of Hazardous Chemicals

The objectives of the measures and emergency response programme are:

- To prevent damage to the environment
- To clean up any spillage that may have occurred
- To ensure the affected surrounding to near or its original natural state

The programme's scope covers Spillage of Chemicals and Spillage during handling or storage. The actions for the emergency procedure are:

- Arrest the spread of the spill with earth barriers

- Remove any acids within the vicinity of the spill
- Lift the spill with earth or sand
- Neutralize if it is soda with solution of hydrochloric acid and vice versa
- Wash area with plenty of water
- Dilute the recovered products with plenty of water and neutralize before final disposal

Reporting the Incident or Accident is carried out as specified below:

- The incident or accident reported to the Plant Manager by the Environmental, Health and Safety Manager (EO) or one authorized by him on his absence immediately after such has occurred or is occurring.
- The Plant Manager or his authorized deputy can inform the Director, Thermal Generations who in turn inform the Director, Technical Services
- The Director, Technical Services after due consultation with the Deputy Chief Executive will inform the Government Agencies, EPA, and National Disaster Management Organization, of any spillage that could affect the environment.

Record of the incident/accident and action taken is documented by the Environmental Advisory Committee.

7.4.5.3 Electromagnetic field (EMF) effects

According to the World Environmental Library, WEL 1.1, information derived from prolonged observations and experiments in numerous countries indicate that the electric and magnetic fields around power transmission and distribution facilities exhibiting frequencies between 50 and 60 Hz have no harmful effects on human health. Magnetic field strengths below 0.4 mT at 50 – 60 Hz induce no detectable biological reaction in humans. The magnetic fields acting on the ground below overhead lines develop maximum field strength of only 0.055 mT for frequencies between 50 and 60 Hz. Hence potential effects of EMFs on human health are non-existent according to current knowledge. In order to debunk the misconception that EMFs may cause cancer or harm children and minimize fear and avoid panic among the local populations, the VRA will undertake public education and create awareness in the local communities wherever such concerns are expressed.

The transmission line poses potential public health and safety hazards when the local populace has not been properly educated with regard to the potential hazards, such as collapse of towers, which actually occurs only rarely. In addition to the hazards posed to the public due to transportation of equipment and materials, other hazards such as potential exposure to Electromagnetic field (EMF) effects, potential collapse of towers and electrocution exists. These potential hazards require mitigation to ensure the safety of the public. Since the hazardous effects (e.g. falling on people and electrocution) of the collapse are normally felt only within the RoW public safety is ensured by restricting public access to the right-of-way. In line with existing VRA/GRIDCo practice, the towers will be clearly marked with a red inscription on white background - **“DANGER – 161,000 Volts”** to ward off trespassers and prevent them from exposing themselves to the potential dangers of electrocution. Operational staff will also be appropriately trained to operate the natural gas

delivery system. Sufficient warning signs will be erected within the area. The towers will be made safe from climbing by the erection of barbed wire around the towers.

Regular maintenance will minimize corrosion and wearing out of parts of the steel poles and their accessories. GRIDCo already has a comprehensive, planned and emergency maintenance programmes for the existing transmission lines. The same level of care to the new transmission lines to be constructed shall apply. Security patrol will be conducted on sections of the transmission line especially the outskirts of urban areas and towns, which are more prone to acts of vandalism. It is expected that the patrols will ensure early detection of any acts of vandalism and signs of tower corrosion. Prompt and necessary remedial actions will be taken to repair the structures to forestall the possible collapse of towers.

An electrically grounded person touching an ungrounded metallic object or a conductor in a static or oscillating field may draw electric current from the object and may experience a micro shock from a spark discharge. This potential effect will be minimized by VRA by multiple earthings. Protective multiple earthings minimize the chances of people getting electric shocks and the chances of such shocks being fatal.

7.4.6 Impact on Waste Generation

Operation of the plant will result in the generation of general plant wastes and commercial wastes. These wastes, if not treated properly, may result in the contamination of the site, pose a health risk to workers, and/or be dumped illegally.

Wastes arising from the plant processes are:

- Distillate oil sludge;
- Waste lubricating oil;
- Oily water wastes; and
- Sewage.

A waste oil tank will hold the waste diesel sludge, the waste lubricating oils and the oil water sump wastes to be produced. The contents of this tank will be removed from the site by licensed operators. Foul water will go to a septic tank. The waste from the septic tank will be disposed of in an environmentally acceptable manner by a licensed operator approved by VRA. The procedures for the disposal of this waste will be contained in the operational site environmental management plan, and will be incorporated into any contract between VRA and the licensed operator.

However, VRA has opted for waste reuse with private companies to dispose of the waste oil on a regular basis at KPHP, just like with the other thermal plants. Currently the most utilised method is the waste reuse method in which industries which utilize the waste oil from the plant as raw material for their operations has been registered and is supplied with the waste oil as and when available. Waste oil/sludge shall therefore be recycled by selling it to companies that use it as a raw material for their processes. There shall be a 100% reuse of the waste oil and no incineration shall be done at the Plant. VRA has identified licensed operators for the disposal of its oily wastes from thermal plants and it shall be

implemented for the KTPP. All relevant consignments of waste for disposal will be recorded, indicating their type and other relevant information, prior to being sent off-site.

As shall be specified in the project description, foul water will go to a septic tank. The waste from the septic tank will be disposed of in an environmentally acceptable manner by a licensed operator approved by VRA. The procedures for the disposal of this waste will be contained in the operational site environmental management plan, and will be incorporated into any contract between VRA and any licensed operator. VRA will include in any operational contract that the operator must comply with respect to national guidelines regarding to the disposal of oil wastes to licensed sites. VRA will audit the operator's practices.

The mitigation measures with regards to waste water are:

- Inspecting the tanks to ensure that there are no leakages/spillages
- Installing a waste water treatment plant as part of the project and sampling of effluent prior to entry into Municipal Drain for acidity, alkalinity and Oil/grease
- Preparing Emergency Response & Preparedness Plan/Procedure, and
- Keeping records

With respect to solid waste, garbage bins of the right sizes shall be provided for the different types of solid wastes e.g. Wood pieces, Metals, Glass, Plastic, Paper, and Food Remains. The quantity of solid waste generated at the Plant during the operational phase will not be much. Solid waste from plant operation that cannot be recycled is collected and taken to an approved off-site waste disposal facility. It is estimated that an average of about 300 Kg shall be removed from the plant monthly and disposed of via the municipal waste system by handlers commissioned by Tema Metropolitan Assembly. Solid waste collection would be recorded for reporting and documentation purposes. It is also expected that a limited amount of waste will be generated during the operational phase of the transmission line and this shall be from vegetative matter, cans, packaging materials, insulators etc.

7.4.7 Impact on Soil

The operation of the associated linear projects, gas/diesel pipeline and transmission line, has the potential to impact on soils as a result of maintenance activities to gain access to the site and in the periodic clearance of vegetation within the wayleave exposing soils to rainwater erosion. Clearance of the vegetation greater than 3m height within the wayleave for maintenance purposes is unlikely to have an impact on soils as the vegetation will be cleared by hand and left on site. There is unlikely to be an impact on soils, and organisms living within these soils, as a result of electricity and magneticity arising from the operation of the line.

No mitigation measures are proposed as the operation of the transmission line is unlikely to have an impact on soils.

7.4.8 Impact on Water Quality & Water Resources

Water is required during the operation of the plant for Domestic use, Cooling water make up (very small amounts) and fire-fighting system in an emergency. The total amount of water likely to be required during operation is approximately 3000 m³ / day. Although this is a significant amount of water, it will only be required when the plant is operational, i.e. predicted for 6 months of the year. Furthermore, the nature of the design of the power plant, i.e. the use of cooling radiators, minimizes the impact on water requirements. Water will be supplied from an existing source from the Ghana Water Company and so will not put pressure on local water resources.

The operation of the power plant will have the potential to cause impacts to water quality as a result of:

- Foul water drainage: generation and disposal of sanitary waste from the workforce.
- Surface water drainage: generation of uncontaminated drainage such as stormwater and uncontaminated runoff.
- Oil/water drainage: generation of potentially contaminated water from runoff from machine areas and wash-down area, accidental spills.

Foul Water Drainage: For domestic waste water drainage, all sanitary fixtures shall be drained by means of building waste water drainage system to a sewer outside the building. Foul water will drain directly to a septic tank and will not be deposited directly into the Municipal drain but off loaded by a licensed contractor to be engaged by VRA. Vertical down pipes shall be mounted inside the building in shafts where applicable. The downpipes shall connect to the underground pipes at the lowest level of the building, which can either be the basement or the ground floor. Connections to the sanitary fixtures shall be no hub cast iron pipes and fittings for sanitary application. Connection pipes shall be installed recessed inside installation walls, under plaster or in shafts. The underground drain water pipes underneath the base slabs of the buildings will be U-PVC drainage pipes. The main domestic waste water pipe will terminate in the waste water treatment plant.

Oil/Water Drainage: The turbines at KTPP are to run on DFO, specifically diesel extra oil, that shall be taken through an oil treatment facility to reduce the base sediment and water levels and the soluble salt content before introduction into the combustion chambers. As indicated earlier, the diesel fuel oil is taken through the process of centrifuging to separate the aqueous components from the oil and thereby remove the sludge, soluble metals such as sodium and potassium and water. Oily waste water will be collected in the catch basins of the oil tanks and drained towards the oil separator. Oily waste water will flow by gravity to the oil-water separator. Waste from the oily water sumps will also be collected and stored in the waste oil tank. Oily waste water will be treated by means of oil-water separation and discharged to drainage system. The oil-water separator will be designed according to DIN 1999 or an equivalent standard. Suspended solids stored in the sludge trap will be removed periodically (e.g. 4 times per year) by tanker for disposal. The separated oil will be pumped to the waste oil storage tank. The waste oil transfer pump will be controlled by the oil level in the separator. When the oil level exceeds the permitted limit, the oil-water separator lever controller will close automatically and an alarm will be given.

Effluents to be discharged from the Oily Water Separator System shall drain into the water treatment system. Wastes in the waste oil tank will be periodically removed by licensed contractor approved by VRA for recycling as in all other VRA owned thermal plants.

Surface Water Drainage: A surface water drainage system will be designed by the contractor that will effectively drain the site and discharge into the Waste Water Treatment System. Although there will be an increase in runoff from the hard surfaces at the site, the overall impact is likely to be low in relation to the high rainfall and runoff totals experienced in this area.

The waste water treatment will be designed to treat domestic waste water and the discharge of the system is transferred to sewage treatment plant. The sewage treatment plant will be designed to treat 60m³/day domestic water and 210m³/day chemical coagulation discharges. The sewage treatment plant shall comprise of one (1) Imhoff tank where domestic waste water shall flow by gravity into it for primary treatment (settling) shall take place. In addition, the excess sludge from the aerobic biological treatment will settle here. The settled sludge will be removed periodically (e.g. 4 times per year by tanker for disposal. In addition, it shall also comprise of one (1) aerobic biological treatment plant where secondary (biological) treatment will take place. The excess sludge will be removed from the effluent and will be sent to the Imhoff tank. The sewage treatment plant shall be designed to treat waste water in compliance with the EPA waste water pollution standards before draining into an open drain system, lined with oil absorbent pads, that shall be connected to the nearest drainage course located about 2.4 km from the plant as the receiving media of the effluent (see *Plate 11*). Oil absorbent pads (See *Plate 12*) are expected to absorb any oily waste available in the final effluent prior to discharge into the nearby drainage course. This is to ensure that water quality of the receiving body is not significantly adversely affected during operation. Typical quality of effluents to be discharged from the Waste Water Treatment Plant is provided in



Plate 11: Existing drainage course close to KTPP Site



Plate 12: Typical oil absorbent pad in an open drain at TTPS

Table 9.

The contractor is required by the Design Specification to undertake the following mitigation measures that will address water quality during operation:

- All aqueous emissions will be in compliance with Ghanaian standards. This will be monitored through (a) visual inspections of the clean water drainage at least once a week for oil or grease and (b) water quality sampling of the clean water drainage once a month during operation of the plant.
- Where site roads and hardstanding are drained, the water will pass through an oil/water separator fitted with oil detectors and automatic isolation valves. The discharge of the oil/water separator will contain no visible oil or grease.
- All buildings will be provided with roof drainage for disposal of stormwater and connected to site stormwater drainage system.
- The oily wastewater drainage system design will include bunded areas and an oily water sump. Facilities will be provided to contain oil in the event of a catastrophic failure of the transformer. Bunds provided in transformer compounds, oil storage areas etc., will have an impounding capacity of 1.25 times the largest possible oil spillage that could occur.
- Drip trays will be provided under all equipment where drips of fluids are likely to occur.
- All oil tanks will be bunded to contain 110% of the largest tank's contents.
- An Emergency Oil Spill Plan, outlining measures for addressing oil spills, will be developed by VRA.

The mitigation measures proposed as part of the design and operation of the power plant and site will ensure that the overall impact on water quality and water resources during operation will be low.

7.4.9 Impact on Landscape & Visual Intrusion

The power plant stack of 30 m will be visible from most angles. However, the plant is sited in a built up residential area so it is anticipated that the landscape character will not be altered significantly as a result of the power plant site and transmission line. The power plant may have an adverse visual impact as a result of tall construction equipment affecting views to the site from properties and amenity sites.

Optical impairment of the landscape by the presence of the power plant and transmission towers and lines is unavoidable and could be regarded as a residual impact. The galvanised towers tone down after two to five years of operation to a dark grey colour. The 'glare effect' will therefore be minimal and unnoticeable. The contractor will ensure that all existing trees and bushes outside the boundary of the power plant site are not damaged or destroyed as a result of construction activities.

A fence wall has been constructed around the entire 30 hectares of land at the site and there are no totally open views in to the site. Further, a fire buffer zone comprising of forest trees is to be developed within the fence wall and around the power plant. Trees native to the area shall be planted at the frontage of the plant to act as windbreaks, noise buffer

and to reduce the visual effect of having a power plant located at the site.

7.4.10 Impact on Flora & Fauna

Operation of the plant could potentially have an impact on flora and fauna as a result of damage due to the movement of workers and vehicles on and around the site and long term impacts as a result of air emissions. Emissions from the power plant during operation are addressed in Section 7.4.3. There are no sensitive habitats or species on the site, therefore the significance of any impact would be low. The plant site has been fenced and therefore all operations will take place within this boundary. There will be sufficient turning space within the plant site for vehicles. No movements outside of the site boundary are therefore anticipated. Workers and operational vehicles will operate within the site boundary and designated site access roads to prevent damage to vegetation outside the site. The significance of the impact of the plant operations on flora and fauna is considered to be low.

Final

8.0 MONITORING

8.1 Introduction

Monitoring will be a key activity during project implementation. The significance of monitoring stems from the fact that the inputs derived from the environmental and social assessment into the project design and planning, including mitigation measures are based largely on "predictions". It is essential that the basis for the choices, options and decisions made in formulating or designing the project and other environmental and social safeguard measures are verified for adequacy and appropriateness. Monitoring verifies the effectiveness of impact management, including the extent to which mitigation measures are successfully implemented.

Monitoring specifically helps to:

- Improve environmental and social management practices;
- Check the efficiency and quality of the EA processes; and
- Provide the opportunity to report the results on safeguards and impacts and proposed mitigation measures implementation to regulatory bodies such as the EPA and the Energy Commission.

8.2 Monitoring Programme

A monitoring programme has been developed to determine impacts on the physical, biological and socio-economic/cultural environments within the project's area of influence and around the proposed power plant and associated facilities. The monitoring results are expected to indicate whether the predictions of potential environmental impacts are accurate and also whether the mitigation measures proposed for the management of the impacts are appropriate and adequate. The programme will also serve as an early warning system by revealing unforeseen impacts and allowing additional corrective measures to be implemented to arrest the situation and ensure that irreversible damage is not caused. The programme is also expected to provide useful guidance for the successful planning and implementation of future thermal plants / transmission line projects that will be undertaken by the VRA.

The VRA Environment & Sustainable Development Department currently has available a wide range of both portable hand-held and laboratory based equipment for environmental monitoring purposes. The equipment shall be mobilised on the project for monitoring of the various environmental parameters identified. Further, an Environmental Management Plan (EMP) shall be prepared to help document relevant processes and personnel. VRA as well as the Contractor's Environmental Team members will be trained adequately to understand and appreciate the choice of parameters, sampling sites, methods of sampling/measuring and analysis and frequency of monitoring. Progress Environmental Reports (Monthly, Quarterly and Annual) are to be prepared for the project which will specifically provide information on the project environmental, health and safety activities.

The EPA has embarked on the AKOBEN Environmental Performance Rating & Public Disclosure (EPRD) Programme to measure the environmental and social performance of companies, including thermal generating companies. EPA is

aiming at ensuring continual improvement and maintenance of good environmental performance of such companies, in order to minimize risks to environment and the communities around their sites.

Consequently, the EPA has developed relevant forms for use as part of self-monitoring reports that companies are required to produce and submit to the EPA. Data types required include Plant Details, Effluent Quality, Air Emissions, Ambient Air Quality, Water Use, Energy-Use and Production & Employment. EPA is expected to undertake environmental auditing with regard to these criteria which shall be used to rate the environmental performance of companies. VRA shall ensure that parameters to be monitored during the construction and operational phases of KTPP shall be in line with the requirements of the AKOBEN Environmental Performance Rating & Public Disclosure (EPRD).

A description of the environmental monitoring activities showing parameters, methodology, period for monitoring, location and responsibilities is presented in *Table 33*. The monitoring programme has been developed for the following parameters:

8.3 Pre-Construction Phase

8.3.1 Cultural Heritage

A review of the archaeological potential of the sites for the thermal power plant and associated facilities shows minimum impact on cultural heritage. However, in the event of any potential find, VRA shall employ qualified archaeologist to review archaeological potential of the site and in consultation with the EPA and/or the Museums and Monuments Board, appropriate mitigation measures shall be recommended, if required.

8.3.2 Compensation & Resettlement

As indicated in Chapter 2, VRA is implementing a “**Land Acquisition & Resettlement Policy Framework**” which establishes broad principles, organizational arrangements and fair criteria to be applied in acquiring various interests in land and handling the attendant impacts on Property Affected Persons. Currently, VRA has completed the identification of all potential project affected persons and has undertaken valuation of all crops and physical structures impacted by the project. The implementation of compensation measures program is being managed by VRA. It must be noted that the cost of the compensation and rehabilitation measures is also being borne by VRA and forms part of the project cost. Payments of compensation to all affected persons were largely completed by close of 2010.

Monitoring and evaluation of compensation of project-affected persons will be carried as long as required to ensure that all affected persons have been identified and payment of adequate compensation duly effected. The Monitoring and Evaluation (M&E) mechanism provides the basis to assess the overall success of the compensation and the effectiveness of the various processes and measures. The general objectives for the monitoring and evaluation procedures are:

- Monitoring of specific situations of economic/social difficulties arising from the resettlement/compensation process undertaken by the VRA.
- Evaluation of the compliance of the actual implementation with objectives and methods as set in this document, and of the impact of the resettlement/compensation programme on incomes and standard of living.

These two processes will run simultaneously – the internal monitoring process runs as part of day to day activities and is used to ensure that the compensation measures are meeting the objectives outlined in this EIS. It is however expected that issues of compensation will be concluded within a period of five (5) years from the date of commencement of payment.

8.3.3 Noise

Pre-construction noise emission prognosis has been carried out to prepare the basis for monitoring during the project construction and operational phases. The first report has been discussed in Chapter 5 and the second is herewith attached as Appendix 8.

8.3.4 Air Quality Monitoring

Pre-construction air quality and dispersion modelling was carried out to prepare the basis for monitoring during the project construction and operational phases. The first report has been discussed in Chapter 5 and the second is herewith attached as Appendix 9.

8.4 Construction Phase

8.4.1 Source of Raw Materials

The monitoring of the sources of raw materials would be carried out with a visit and inspection of the raw materials their sources e.g. quarry site, sawmills and districts, where sand is obtained. The Contractor will carry out the inspections as and when required and report made available to the VRA.

8.4.2 Socioeconomic and local community impacts

The following mitigation measures will be implemented and monitored:

- The contractor should ensure that local people are employed where skills permit. The contractor will be required to prepare a statement of intent detailing how local employment opportunities will be addressed and the procedure for application for jobs.
- The contractor will be responsible for arranging and providing all living accommodation, services and amenities required by his employees.
- The contractor should make provision for local residents to benefit from retail goods and food and providing other services such as laundry, transport, etc. wherever possible, to the workforce.

- To ensure that local levels of HIV/AIDS are not exacerbated, the contractor will brief employees on health risks. This should be included as an action within the Health & Safety Plan prepared by the contractor. Even though this monitoring programme could be useful, the VRA will ensure, through its educational programme that safe sex is practised by the construction teams so that incidences of the disease due to activities of the construction crew is prevented.

8.4.3 Noise & Vibration

Noise generated during construction of the project will be primarily associated with vehicle movements, generators, heavy machinery (eg: Excavators) and hand-held machinery and tools. Some additional vehicle noise may be generated by the thoroughfare of vehicles using transport corridors to and from the site. Noise will be monitored periodically during the construction period.

The objectives of the noise monitoring will be:

- ✓ To minimise the generation of noise and vibration from construction activities occurring on site and its impact on site operations and workers.
- ✓ To minimise the generation of noise and vibration from construction activities occurring on site and its impact on the neighboring residents, businesses and associated building structures.
- ✓ To establish and maintain good relations with community and neighboring sites.

The Contractor shall be required by the tender document to undertake the following mitigation measures:

- All construction equipment will meet the specifications for noise suppression required by local regulations and international standards and be well maintained by the contractor.
- The contractor will undertake noise monitoring at the sensitive receptors once during commissioning with engines at full load to test that noise levels of the plant are compliant with the design specification.

In addition, the following mitigation measures are to be implemented and monitored:

- The contractor will be required to ensure that construction activities do not cause significant noise nuisance impacts, as measured by the number of complaints received.
- The contractor will restrict the movement of noisy vehicles to daytime hours, except where otherwise agreed with VRA.
- The contractor will limit noisy activities to daytime activities, except where otherwise agreed with VRA

Noise pollution levels will be measured once every week close to the areas where construction activities are being carried out including settlements such as indicated earlier. An integrating noise meter that conforms to the latest edition of American National Standards Institute (ANSI) S1.43 shall be used. The Project Environmental Officer (EO) will maintain records of noise monitoring activities and include such results in progress environmental reports.

When planning for construction work that will include vibration work, the contractor will make all practical efforts to protect vibration sensitive buildings and the amenity of the occupiers of buildings. During leisure hours, vibration disturbance from construction operation must be kept to a minimum. The basis for this vibration management strategy will be to limit the times that certain vibration producing activities may be carried out. No pile driving or blasting will be performed as part of the proposed construction works program.

8.4.4 Air Quality (Dust Emissions)

The contractor is required by the Design Specification to undertake the following mitigation measures to control emissions of dust:

- To take precautions to keep all existing and new temporary and permanent roadways clear of any spillage from construction traffic. Any such spillage, including excessive earth or any other materials brought in, should be cleared immediately.

In addition, the following mitigation measures will be implemented and monitored:

- The contractor will maintain construction equipment in good running condition. When practical, engines should be switched off when not in use.
- Where appropriate, the contractor will enforce a maximum speed limit over all unmade surfaces.
- Where appropriate, the contractor will cover loads of materials that can fly out during transportation.
- Where appropriate, the contractor will manage stockpiles to limit erosion and emissions of dust.
- Where practicable, site roads and construction vehicle tyres will be wetted to reduce dust generation. A washing bay with appropriate drainage will be provided for this purpose.

Dust monitoring will be carried out visually with its corresponding sprinkling of water to keep down the dust. The Casella AMS 950 Air Monitoring System will be used to monitor particulate matter concentrations at relevant places at the power plant construction site. Static sampling methods are to be employed for this exercise, since the standards/guideline limits are founded upon static sampling. All measurements will be taken downwind of the suspected sources of generation of the dusts. The Project Environmental Officer (EO) will maintain records of dust monitoring activities and include such results in progress environmental reports.

8.4.5 Transport & Traffic

The following mitigation measures will be implemented:

- The contractor shall be required to prepare a Traffic Method Statement (TMS).
- VRA will undertake a further consultation meeting with stakeholders in the road sector following preparation of the EIS and prior to the start of significant construction activities that shall impact on any section of a road.
- The contractor will restrict delivery hours of HGVs along the access route to the plant site to daylight hours to minimise disturbance to residents, unless otherwise agree with VRA

- The contractor will designate speed limits on all traffic accessing and egressing to the site and along the access road to the site.
- The contractor will develop procedures for on-site traffic movement and parking at the site.
- The contractor will arrange for the training and testing of heavy equipment operators and drivers, with records kept of all training.
- Road markings and signs to be made by the contractor will be in accordance with relevant Ghanaian standards.

The following parameters/activities will be monitored:

- Speed limits of vehicles especially within settlements. Random checks on speed limits of vehicles will be carried out daily.
- Loading of vehicles. Vehicle loading procedures will be monitored at all loading points to ensure that materials and equipment are properly secured in truck/vehicles.
- Covering of vehicles conveying dust-generating materials. Random checks will be carried out daily on vehicles.
- Trucks/vehicle conditions and maintenance (i.e. road worthiness of vehicles). Daily checks on conditions of vehicles. A monthly check will also be conducted on vehicles to ensure that maintenance schedules are adhered to.
- Vehicular accident records. All vehicular accidents or dangerous occurrences relating to vehicles will be recorded in the accidents record book or register.

Traffic composition, density and proper use of designated access routes will be periodically surveyed by the Environmental Officer on and off site during the site preparation/construction and operation of KTPP. In particular, monitoring of the procedures set up to manage the transport of wide/unusual loads will be undertaken to assess their effectiveness and identify any further requirements need to limit traffic disruption during such journeys.

Road safety issues will be monitored through feedback from other authorities and training of KTPP staff will be amended accordingly to ensure maximum awareness of implications of speeding is achieved. The attendance at road safety awareness meetings by KTPP staff and other target groups will be monitored and their success at getting road safety information across to staff will be assessed using group interview and individual questionnaire methods.

8.4.6 Public Safety & Occupational Safety and Health Issues

The contractor is required by the Design Specification to undertake a number of Health and Safety measures, including the following:

- The contractor will comply with all relevant international and local standards, acts, regulations, codes and statutory instructions with respect to Health and Safety.
- The contractor will also comply with the Health Safety Environment (HSE) procedures of VRA.
- The contractor will submit a Health and Safety Plan, to be approved by VRA prior to start of construction.

- The contractor will be responsible for managing, supervising and monitoring health and safety on site, and that of any sub-contractors.
- The contractor will provide qualified first aid cover for minor treatment and will ensure that at least two persons amongst the site staff are trained in first aid. A suitable facility will be maintained to cater for first aid requirements. The first aid equipment will include a defibrillator, and two members of site staff will be trained on its correct use.
- The contractor will fence off the site and take all reasonable precautions to safeguard the health and safety of all persons, employees or general public, from all construction and construction related activities.
- The contractor will propose methods for security of sites, to be approved by VRA prior to construction.
- The contractor will provide adequate and appropriate training.

The above measures will be monitored by the VRA Project Environmental Officer to ensure compliance by the contractor. Further, reports on all HSE activities are to be discussed on a weekly basis as part of project progress review. In addition, the availability and use of personal protective equipment will be closely monitored continuously during both the constructional and operational phases. All employees who refuse to use the protective equipment provided will be properly sanctioned. To ensure that personal protective equipment is always readily available, all equipment will be promptly replaced. Regular safety tests as recommended by manufacturers will be conducted on equipment such as cranes and winches.

Occurrences of accidents that affect public safety or worker safety will be monitored and recorded whenever they happen. The frequency and severity of such occurrences will be recorded. This will eventually indicate whether additional mitigation measures are required to make the system safer.

8.4.7 Waste Generation

The contractor is required by the Design Specification to undertake the following mitigation measures:

- The contractor will be responsible for ensuring that all waste arising from the works is deposited, treated, kept, disposed of and carried in accordance with the provisions of relevant national and local environmental protection acts and also in accordance with any additional instructions outlined by VRA.
- The burning of waste will not be permitted.
- The contractor will ensure that only a licensed waste collector will transport all waste arising from the works.
- For the control of substances hazardous to health, no dangerous or noxious waste products, chemicals or materials will be disposed of, on or off the site without the approval of the appropriate authorities. The contractor will be responsible for the disposal of all normal, hazardous or controlled waste in a manner strictly in accordance with current legislation and any consent given to VRA or the contractor by the relevant authority.

In addition, the following mitigation measures will be implemented and monitored:

- The contractor will ensure that waste generated are kept to a minimum and are re-used on site where appropriate.

- No waste other than inert waste will be disposed of on site, at the approval of VRA.
- No solid or liquid waste will be disposed of directly to a watercourse.
- The contractor will be required to have and to promote a policy of a clean worksite and good disposal practices, with advice and training available to its workforce to achieve this.

The Project Environmental Officer shall monitor solid waste to be generated from the construction activities on a monthly basis. Steel scrap and wood pieces are to be recycled or sold to recyclers or dealers to ensure that metal wastes are managed efficiently. The collection and use of wooden wastes as fuel wood by the local communities will be monitored on a regular basis. The management of other solid wastes will be monitored on weekly basis to ensure that the wastes are collected promptly and disposed of at appropriate public waste dumping sites. The clean-up of accidental spills of oil, fuel and paints whenever they occur will be monitored to ensure that the clean-up is promptly and properly done.

8.4.8 Water quality and resources

The following mitigation measures are to be implemented:

- The contractor to agree on arrangements for the disposal of aqueous effluents during construction and commissioning phases with VRA.
- All oil tanks will be bunded to contain 110% of the largest tank's contents.
- The contractor will locate temporary storage tanks on impervious bases and use drip trays during re-fuelling of equipment. Any temporary refuelling tanks must be bunded.
- The contractor will have available on site all equipment and materials necessary to execute clean up.

There shall be no impact on the existing local drainage channels from the project site during construction and therefore no impact is anticipated on water quality and no water quality monitoring is required. The above activities and requirements shall be monitored by the EO.

8.4.9 Landscape & Visual Intrusion

Impact on landscape and intrusion shall occur as a result reduced visual character due to the presence of large construction equipment. During the construction phase, the contractor will ensure that workers and equipment remain within designated working areas and access will only be allowed along designated access roads to avoid additional damage to adjacent vegetation, crops and/ or residential properties. No felling of trees or crops will be permitted outside of the wayleave, without prior permission of VRA.

The above activities and requirements shall be monitored by the EO.

8.4.10 Flora & Fauna

The project will result in the permanent loss of less than 10 hectares of vegetation within the power plant site. Vegetation loss with respect to associated gas and transmission lines are temporal and minimal. There are no protected habitats or species. During the constructional phase, clearing of vegetation cover will be monitored carefully to ensure that the minimum area requirements are not exceeded. Individual tree felling activities will be monitored to ensure that environmental and safety measures proposed under mitigation are fully implemented. Dumping shall be monitored on weekly basis to ensure that it is done at the appropriate spoil areas. Monitoring will also ensure that fire is not used for vegetation clearing. These measures are also relevant for vegetation maintenance during the operational phase.

The above activities and requirements shall be monitored by the EO.

8.5 Operational Phase

8.5.1 Impact on Socio-economic and Local impact

Additional monitoring will be carried out to ensure that the assumptions made concerning the ability of the current transport/community infrastructure to cope with the demands placed on it remain the same during the project life. This will comprise a review of available local social statistics produced by other organizations, and assessing the feedback from the community meetings; the objective of which will be to ensure that no decline in living standards occurs due to the construction off KTPP and VRAs operations as a whole.

If the monitoring shows that the mitigation measures in place are not effective, additional measures may be required or those in existence will be strengthened. It is outside the scope of this EIA to suggest what additional measures may be necessary should those in place fail. These issues will be addressed as required.

The consumption of water, electricity, fuel and natural gas will be monitored monthly by the Project Environmental Officer, and records maintained. Details on levels of employment shall also be monitored. The records will be employed in returns and reports to EPA as required by the EPA AKOBEN EPRD.

8.5.2 Noise

The purpose of the noise monitoring program will be to demonstrate compliance with the noise limits set and to provide information for any necessary mitigation measures. Monitoring of noise levels would start by ensuring that measures to replace the current air intake silencer with a higher performance unit and to screen the step-up transformers with acoustic louvers have been implemented, and that an additional extract fan is installed on the GT enclosure, fitted with a downstream attenuator capable of offering sufficient attenuation to ensure that the total sound power level of the enclosure is not increased.

Noise will be monitored weekly during the first six months and thereafter, once every month. The areas/points for the noise measurements are:

- Boundaries: All the four boundaries of the project site
- Gas Turbine Area (1m distance from the enclosure of the gas turbine)
- Fuel Treatment Facility
- Transformers (1m distance from the transformer)
- Sensitive receptors such as the Nmlitsakpo community

Staff will be trained in the use of sound level meters and interpretation of results. An integrated sound level meter will be purchased as this will allow the downloading of data direct to the computer for detailed analysis, when required.

Results of monitoring will be circulated to senior management on the site on where results indicate noise levels are a problem. The Environmental Officer of KTPP will maintain records of all noise monitoring activities and incorporate data into returns and reports to EPA.

8.5.3 Air Quality

The flue gas characteristics will be determined using a Continuous Emission Monitoring System (CEMS). CEMS equipment will be installed on the KTPP units to ensure that emission concentrations remain within emission limit values. The monitoring station will be located on the Combustion Turbine Generator Exhaust Stack and will monitor and record SO₂, NO_x, and CO. Emission test results will be summarized in an Annual Emissions Report (AER) for the plant.

Ambient air quality monitoring will be undertaken at the Ambient Air Monitoring station for SO₂ and NO_x located at "After 25" Sub-community (800 m north-north-east of the site boundary). The location of this station is considered appropriate to identify potential air quality impacts on the local communities. The Ambient air quality monitoring station will also be equipped with appropriate spare parts to minimize data loss due to equipment malfunction. A PM₁₀ analyser shall also be installed at the same location for particulate monitoring.

8.5.4 Traffic & Transport

Traffic composition, density and proper use of designated access routes will be periodically surveyed by the Environmental Officer on and off site during the operation of KTPP. In particular, monitoring of the procedures set up to manage the transport of wide/unusual loads will be undertaken to assess their effectiveness and identify any further requirements need to limit traffic disruption during such journeys.

Road safety issues will be monitored through feedback from other authorities and training of KTPP staff will be amended accordingly to ensure maximum awareness of implications of speeding is achieved. The attendance at road safety awareness meetings by KTPP staff and other target groups will be monitored and their success at getting road safety information across to staff will be assessed using group interview and individual questionnaire methods.

The access road to site is a public road and VRA would not be able to monitor the vehicles that shall ply this access road to site. However, this access road shall be tarred and asphalted and this shall bring pollution from dust under control. Further, inside the Plant fence line, check points and road signs shall be developed to regulate movement of public vehicles and records of all vehicles entering or leaving the site are kept at the security office. There shall be road ramps and speed reduction signs at the entrance to the Plant to warn drivers to obey the mandatory 20km/h speed limit.

8.5.5 Public Safety & Occupational Safety and Health Issues

The safety health and welfare of the workers is of paramount importance to the VRA. Monitoring shall therefore be carried out on occupational safety and health within the plant during its operational phase. Parameters to be monitored shall include, but not limited to:

8.5.5.1 Personal protective equipment

The provision and use of PPEs shall be monitored on a monthly basis to ensure workers are well protected against the hazards of the workplace. All employees who refuse to use the protective equipment provided will be properly sanctioned. To ensure that personal protective equipment is always readily available, all equipment will be promptly replaced. Regular safety tests as recommended by manufacturers will be conducted on equipment such as cranes and winches.

8.5.5.2 Good Housekeeping

Management will ensure that good housekeeping is maintained at all times on the premises. All weeds springing up through the stone carpet of the substation shall be physically removed. The buffer zone of the power plant shall also be monitored on a daily basis to ensure that there is always a fire break at the perimeter. The premises will be monitored to ensure that potential nesting places of birds are kept free of bird nests that are likely to cause electrical faults.

8.5.5.3 Fire Preparedness Monitoring

Just like all other VRA Thermal facilities, requirements shall be put in place at KTPP for performing inspections, operational tests, and preventive maintenance on all fire suppression, detection and alarm systems, smoke control systems, emergency and exit lighting, fire and exit doors, and all other fire protection and life safety systems or equipment. The Station shall rely on fire protection and life safety systems in its facilities to provide protection of life and property and to ensure the continuity of important missions established by VRA. In order to sustain this level of protection, all fire and life safety systems are to be maintained to ensure high reliability through an effective inspection, testing, and preventive maintenance program. Subsequently, fire protection and life safety systems and equipment are to be inspected, tested, and maintained in compliance with the manufacturer's recommendations and the attached appendices. A Fire permit has already been obtained for KTPP from the Ghana National Fire Service.

Fire preparedness and fire protection still receive enormous attention at the Station in view of the very large volumes of highly flammable materials that shall be site at any time. VRA fire officers' shall conduct frequent patrols in order to be ready to confront any fire hazard before it ignites. Additionally, there shall be conspicuous signs warning employees about fire hazards at the Station and various kinds of fighting systems are installed ranging from high pressure CO₂ for protecting the gas turbine, a deluge system around the entire Plant, a foam system for the crude oil tanks and potable extinguishers at selected points.

The Station will be monitored once a year to ensure that all installed fire extinguishers and water hydrants are in working conditions and that all extinguishers have been recharged as required by the Factories, Offices and Shops Act (Act 328). The perimeter of the Station shall also be inspected to ensure that the vegetation barrier (fire buffer) created against bush fires is well maintained.

8.5.6 Waste Generation

8.5.6.1 Wastewater

Site wastewater discharges, including runoff and discharge from the neutralisation will be regularly monitored to verify compliance with environmentally permissible limits. Sampling frequency shall vary according to the batch by batch discharges from operation of the various balance of plant. The sampling/analysis to be carried out is presented in Table 32.

Table 32: Wastewater Sampling Programme

Parameter	Neutralization Sump	Oily Water Separator	Final Entry of Storm Water into Existing Drain	EPA limit
pH	x	x	x	6.0-9.0
Temperature Increase (°C)	x	x	x	< 3°C above ambient
Oil & Grease (mg/l)	x	x	x	5
Conductivity(μS/cm)	x	x	x	1500
Hardness as CaCO ₃ (mg/l)	x	x	x	500
Total Suspended Solids	x	x	x	50
COD (mg/l)	x	x	x	250
Turbidity (NTU)	x	x	x	75
Total Dissolved Solids (mg/l)	x	x	x	1000
Lead (mg/l)	x	x	x	0.1
Iron (mg/l)	x	x	x	10
Copper (mg/l)	x	x	x	5
Zinc (mg/l)	x	x	x	10

Total Chromium (mg/l)	x	x	x	0.1
Total Residual Chlorine	x	x	x	250

8.5.6.2 Solid Waste Generation

The composition of solid waste at the Station during the operational phase shall largely comprise of card boxes, office waste paper, rags, food leftovers and food packs which are mostly non-toxic. Metal scraps from the Station shall be carted to the Procurement Department where it shall be sold to registered scrap dealers in accordance with the Authority's disposal policy. Solid waste shall be removed regularly from site by licensed contractors and disposed of via the Metropolitan solid waste system. The quantities of the waste to be removed from site shall be monitored. The records will be employed in returns and reports to EPA.

An audit of the site waste management practice and procedures will be undertaken on an annual basis to ensure satisfactory measures are in place and there are no pollution or health concerns. Where significant issues are found, the audit will recommend measures to improve the situation and appropriate actions will be taken.

8.5.6.3 Borrow Areas

The re-vegetation of borrow areas will be monitored to assess the success of restoration to former conditions. Where re-vegetation is not successful, further measures will be taken to reinstate the area to prevent unsightly scarring and long-term erosion problems.

8.5.7 Spillage of Fuel and Chemicals

Storage and handling facilities of fuel oil and chemicals will be inspected daily. The inspection will note any deterioration of equipment and containers and signs of leakage or spills. All fuel pipelines, gauges and monitoring equipment will be inspected regularly to ensure that the equipment is functioning properly and repairs will be carried out as the need arises. The Chemical Safety Data Sheet for each chemical will be used for the management of all risks associated with their spillage or leakage.

VRA by regulations has opted for waste reuse with private companies to dispose waste oil on a regular basis at its thermal plants. Currently the most utilized method is the wastes re-use method in which industries which utilize the waste oil from the plant as raw material for their operations have been registered and are supplied with the waste oil as and when available. There shall be 100% reuse of the waste oil and the quantity of waste oil given out for re-use shall be monitored.

VRA shall prepare an Oil Spill Contingency Plan for KTPP to mitigate any adverse impacts in the event of oil spill. Meanwhile, all liquid fuel storage tanks shall be above ground and are enclosed by bund walls specially designed to contain all the content of the tank in case of a spill. The bunds shall have concrete floors which makes it easier to

recover spilt fuel and also to prevent oil from contaminating the soil. The oil tanks shall be secured in fenced tank farms which shall be secured by a security gate which safety warnings posted on them.

Finally, records of all oil/chemical spillage or leakage including time of occurrence, estimated quantity, and clean up, etc. will be maintained.

8.5.8 Landscape & Visual Intrusion

Once the landscape planting proposals have been fully implemented after construction of KTPP has been completed, the plants will be regularly assessed to check that successful rooting has taken place, and any damaged or dead plants will be replaced.

8.6 Monitoring Cost

For purposes of achieving a very high level of compliance with regard to implementation of all environmental commitments, the VRA/Contractor shall make budgetary allocations towards all environmental programmes. Financial commitments shall be made from these allocations on program-by-program basis. It is only the coordination costs that shall be included in the running cost of E&SDD. Detailed budget for achieving environmental compliance shall therefore form part of VRA Corporate budget. A breakdown of the budget for the monitoring is provided as part of the activities under the Environmental Management Plan and is shown in Table 35.

Table 33: Environmental Monitoring Plan

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
Cultural Heritage							
Review archaeological potential of power plant site	Minimise impact on cultural heritage	Employ qualified archaeologist to review archaeological potential of the site and recommend mitigation measures if required.	Preconstruction	Power plant site and access routes for gas pipeline, diesel pipeline and transmission line	Implementation of recommendations of independent archaeologist	VRA Environmental Officer	VRA Environmental Officer
Compensation & Resettlement							
Compensation Methodology	Minimise impacts on affected persons. Ensure transparent and equitable process of compensation.	Implement VRA "Lands Acquisition & Resettlement Framework"	All periods	Affected persons along the transmission line route	Grievance, monitoring and evaluation procedures as described in the Compensation Action Plan	VRA and Lands Valuation Division	VRA and Lands Valuation Division
Environmental Management							
Environmental management	Ensure compliance with EIS	Appoint Project Environmental Officer to monitor contractor performance against method statements and mitigation measures as set out in this EIS.	Construction	Power plant site and RoW / Access routes of associated facilities	Feedback to Contractor	VRA	VRA
Preparation of an Environmental Plan	Ensure compliance with EIS.	Provision of an Environmental Plan detailing the procedures to be undertaken by the contractor during construction to ensure compliance with the EIS. The Environmental Plan should include the procedures for all activities below, except where a separate document is expressly	Construction	Power plant site and RoW / Access routes of associated facilities	Review and approval by VRA Environmental Manager prior to construction start	Contractor	Contractor

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
		required from the contractor (for example, construction Health & Safety Plan).					
Traffic and transport							
Prepare Traffic Method Statement	Public and worker safety. To minimise disruption	The contractor will prepare a Traffic Method Statement (TMS) for power plant and associated works. The TMS shall include a strategy for delivering equipment's and persons to and from the construction areas, and measures to reduce accidents. A delivery schedule showing the periods of delivery for HGVs should also be provided.	Construction	All access roads and laydown areas	Review by VRA Environmental Manager prior to delivery start	Contractor	Contractor
Review Traffic Method Statement	To ensure mitigation measures have been taken into account.	VRA to review contractors TMS against mitigation measures set out in the EIA.	Construction	All access roads and laydown areas		VRA Environmental Officer	VRA Environmental Officer
Implementation of and compliance with Traffic Management Statement	Public and worker safety. To minimise disruption.	Visual inspection of site and traffic records in accordance with measures set out in the TMS.	Construction	All access roads and laydown areas		Contractor	Contractor
Public highways: abnormal loads	Damage to highway structures	The contractor is required to undertake a survey of existing structures and present methods to avoid damage from delivery of abnormal loads to VRA, prior to delivery of abnormal loads.	Construction	Highways identified for transporting abnormal loads	The contractor will make good any damage to structures and road surfaces caused by	Contractor	Contractor

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
					transporting heavy loads. VRA to approve proposals		
<i>Socio-economics and local community impacts</i>							
Consultation with affected persons and interested parties	Dissemination of project information. Public safety. Minimisation of disturbance	Residents and relevant authorities to be informed of project schedule and periods of delivery following preparation of the EIA.	Construction	Project Affected persons and interested parties		VRA Resettlement Officer	VRA Resettlement Officer
Preparation of statement of intention on local employment opportunities to be included in Environmental Plan.	Provide employment opportunities locally wherever possible	The contractor should prepare a statement of intention on local employment opportunities in accordance with mitigation measures set out in Section 7.3.2 for power plant and associated works.	Construction	Local villages near the power plant construction site	Approval by VRA Environmental Manager	Contractor	Contractor
Prepare statement of intention on accommodation procedures to be included in Environmental Plan	To minimise pressure on local resources and local communities Provide appropriate accommodation for incoming temporary workforce	The contractor should prepare a statement of intention on accommodation procedures in accordance with mitigation measures set out in Section 7.3.2.	Construction	Power plant site and adjacent towns and villages	Approval by VRA Environmental Manager	Contractor	Contractor

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
Use local goods etc. wherever practical	Boost local economy and minimise impact of any influx of workers	Local goods should be purchased wherever possible, in accordance with the mitigation measures set out in Section 7.3.2	Construction	Local villages near the power plant construction site		Contractor	Contractor
Preparation of household survey report	To report on the socio economic status of project affected persons and identify whether economic displacement will occur	Household surveys undertaken by qualified sociologists.	Preconstruction	Project affected persons along transmission line		VRA	VRA
Waste							
Waste management procedures to be included in Environmental Plan	Minimise environmental impact of generation and disposal of wastes on and off site.	The waste management procedures will include: ▮ How wastes will be dealt with, in accordance with the Design Specification and mitigation measures as specified in Section 7.3.7; ▮ How compliance will be monitored; and ▮ Corrective action procedures.	Construction	Power plant construction site	Approval by VRA Environmental Manager	Contractor	Contractor
Compliance with Waste management procedures set out in Environmental Plan	Minimise environmental impact	Visual inspections and records to measure compliance in accordance with procedures set out in Environmental Plan.	Construction	Power plant construction site	Maintain records and undertake follow-up corrective measures as required.	Contractor	Contractor
Installation of	Ensure	VRA Environmental Manager to ensure that	Construction	Power plant	Approval by VRA	VRA	VRA

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
foul water septic tank	compliance of Contractor with EIS requirements	contractor has installed septic tank prior to construction through visual inspection.		construction site	Environmental Manager	Environmental Officer	Environmental Officer
Noise							
Noise management procedures to be included in Environmental Plan	Public and occupational health	The Environmental Plan will include: ▯ Noise management procedures in accordance with mitigation measures as specified in Section 7.3.6. ▯ A schedule of noisy activities. ▯ Method of measuring compliance e.g. register of complaints. ▯ Corrective action procedures.	Construction	Power plant site and RoW / Access routes of associated facilities	Maintain and review records and undertake follow-up corrective measures as required	Contractor	Contractor
Noise levels during operation of the plant	To test compliance of plant noise levels with World Bank guidelines	Noise monitoring at the sensitive receptors once during commissioning with engines at full load.	During commissioning	Sensitive receptors as selected	Review of results to ensure compliance. Corrective action as required.	Contractor	Contractor
Air Quality							
Procedures to Minimize impacts on air quality to be included in Environmental Plan	Public and occupational health.	The Environmental Plan will include: ▯ Air quality management procedures in accordance with mitigation measures as specified in section 7.3.4 ▯ Method of measuring compliance. ▯ Corrective action procedures.	Construction	Power plant site and RoW / Access routes of associated facilities	Approval by VRA Environmental Manager	Contractor	Contractor
Compliance with	Public and	Compliance with air quality	Construction	Power plant	Maintain and	Contractor	Contractor

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
air quality	occupational health.	management procedures set out in the Environmental Plan, including: ▯ Daily inspections of construction areas for excessive nuisance dust to monitor compliance. ▯ Spot visual inspections of exhaust and vehicle loads.		site and RoW / Access routes of associated facilities	review register of complaints, and undertake follow-up corrective measures.		
Soils							
Soil management procedures to be included in Environmental Plan	Maintain soils in good condition and minimise environmental impact	The Environmental Plan will include: ▯ Procedures for soil protection in accordance with mitigation measures specified in section 7.3.8. ▯ Method of measuring compliance. ▯ Corrective action procedures.	Construction	Power plant site and access routes	Approval by VRA Environmental Manager	Contractor	Contractor
Compliance with soil management procedures set out in Environmental Plan	Minimise environmental impact	Compliance with soils management procedures set out in the Environmental Plan, including visual inspections.	Construction	Power plant site and RoW / Access routes of associated facilities	Maintain and review register of complaints, and undertake follow-up corrective measures.	Contractor	Contractor
Water Quality & Resources							
Water Quality & Resources management to be included in Environmental Plan	Erosion control	The Environmental Plan will include: ▯ Procedures for water quality and resources management in accordance with mitigation measures as specified in Section 7.3.9 ▯ Method of measuring compliance. ▯ Corrective action procedures.	Construction	Power plant site and RoW / Access routes of associated facilities	Approval by VRA Environmental Manager	Contractor	Contractor
Compliance with	Minimise	Compliance with Water Quality &	Construction	Power plant	Maintain and	Contractor	Contractor

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
Water Quality & Resources management procedures set out in Environmental Plan	environmental impact	Resources management procedures set out in the Environmental Plan, including visual inspections.		site and access routes	review register of complaints, and undertake follow-up corrective measures.		
Prepare separate construction Emergency Oil Spill Plan	Minimise environmental and health/safety impact in an emergency	Implement mitigation measures as specified in Section 7.3.9. The Construction Emergency Oil Spill Plan will include information on the proper handling of pollutant spills and the procedures to be taken in the event of a pollutant spill. It will also specify training of construction personnel.	Construction	Power plant site	Approval by VRA Environmental Manager	Contractor	Contractor
Implement construction Emergency Oil Spill Plan	Minimise impact of accidental spills.	Implement the emergency oil spill plan in case of emergency.	Construction	Power plant site and areas impacted	Requirements as set out in the emergency spill plan	Contractor	Contractor
Public and Occupational Health & Safety							
Preparation of construction health and safety plan	Public and worker health and safety	Preparation of Health and Safety plan in accordance with the Design Specifications and in accordance with the mitigation measures as specified in section 7.3.6	Construction	Power plant site and RoW / Access routes of associated facilities	Review of H&S Plan by VRA Project Director / Environmental Manager	Contractor	Contractor
Review of H&S plan	Public and worker health and safety	Review of H&S plan against VRA requirements	Construction	Power plant site and RoW / Access		VRA Project Director / Environmental	VRA Project Director / Environmental

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
				routes of associated facilities		Manager	Manager
Implementation of and compliance with construction H&S plan	Public and worker health and safety	Visual inspection of site and accident records in accordance with measures set out in the H&S Plan.	Construction	Power plant site and RoW / Access routes of associated facilities	Accident records and corrective action procedure.	Contractor	Contractor
Flora and fauna/landscape and visual							
Design of power plant to design specification	Minimise visual impact	Design of plant in accordance with mitigation measures set out in the Design Specification and in accordance with section 7.3.11	Construction	Power plant site	Approval by VRA Environmental Manager	Contractor	Contractor
Procedures to minimise damage to existing flora and fauna to be included in Environmental Plan	Minimise impact on existing vegetation to maintain a visual barrier between properties and the site	The Environmental Plan will include: □ Procedures to minimize damage to flora and fauna in accordance with mitigation measures as specified in Section 7.3.11. □ Methods of measuring compliance, including visual inspections.	Construction	Power plant Site and immediately adjacent area	Review of procedures and corrective action procedure.	Contractor	Contractor
Landscaping within plant site boundary	Improve aesthetics of site	Planting of native species within the power plant site boundary.	Construction	Power plant Site boundary	Approval by VRA Environmental Manager	Contractor	Contractor
Environmental management							
Preparation of site Environmental Management Plan	Ensure compliance with EIS	Preparation of site Environmental Management Plan in accordance with corporate policy	Operation	All sites		VRA	VRA

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
Air Quality							
Compliance with Ghana and World Bank air quality emissions / ambient air guidelines	Public and occupational health. Minimise impacts on flora and fauna.	Performance testing by contractor.	Operation	Power plant Site	Mitigation measures as required.	Contractor	Contractor
Compliance with Ghana and World Bank air quality emissions / ambient air guidelines	Public and occupational health. Minimise impacts on flora and fauna.	Monitoring of CEMS / ambient air quality at designated Monitoring stations as set out in section 7.4.3	Operation	Power plant Site	Mitigation measures as required.	VRA	VRA
Socio-economics and local community impacts							
Employ workers from the local area wherever possible.	Provide employment opportunities locally	Implement mitigation measures as set out in Section 7.4.1	Operation	Local villages near the power plant construction site	Mitigation measures as required.	VRA	VRA
Noise							
Compliance with Ghana and World Bank noise guidelines and mitigation measures	Public and occupational health	Maintain and review register of complaints. Monitoring of noise levels at sensitive receptors. Unrepresentative noise sources during each monitoring period will also be recorded.	Operation	Power plant site and sensitive receptors	Review of results against Ghana and World Bank guidelines. If the results are not sufficient to determine whether noise levels are within the required	VRA	VRA

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
					guidelines, a second monitoring period will be undertaken. Corrective action as required.		
Water quality and resources							
Compliance with Ghana and World Bank guidelines	Minimise environmental impact	Monitoring of compliance during operation of the plant: (a) visual inspections of the clean water drainage at least once a week for oil or grease (b) Water quality sampling of the clean water drainage once a month.	Operation	Clean water drainage at power plant site	Maintain records and undertake follow-up corrective measures as required.	VRA	VRA
Control of pollutants	Minimise water pollution	Implement mitigation measures as specified in Section 7.4.8	Operation	Power plant site and access routes		VRA	VRA
Prepare Operation Emergency Oil Spill Plan	Minimise environmental and health/safety impact in an emergency	Implement mitigation measures as specified in Section 7.4.8	Operation	Power plant site and associated activities	Implementation of Emergency Oil Spill Plan and review/update of Procedures following accidents.	VRA	VRA
Public and occupational health and safety							
Preparation and implementation of operational Health	Public and worker health and safety	Preparation of Health and Safety plan in accordance with VRA policy	Operation	Power plant site and associated	Maintain records and review of procedures	VRA	VRA

ENVIRONMENTAL MONITORING PLAN							
Action / Parameter to be monitored	Reason	Method	Period	Location	Follow-up	Responsible for instigation	Responsible for execution
and Safety plan				accesses	following major accidents.		
Identification and implementation of hazard management procedures	Reduce and manage significant natural and man made hazards	Inclusion of VRA policy hazard management procedures in accordance with mitigation measures as specified in section 7.4.5 and in the operation Health and Safety Plan.	Operation	All sites	Maintain records and review of procedures following major accidents.	VRA	VRA
Waste							
Waste management procedures in accordance with Ghana guidelines.	Minimise environmental impact	Implement mitigation measures as specified in section 7.4.6	Operation	Power plant site	Maintain records and undertake follow-up corrective measures as required.	VRA	VRA
Disposal of wastes	Ensure waste is disposed of to a licensed tip	VRA Plat Manager/ Environmental Manager to review contracts between VRA and waste operators to ensure that the contract binds waste operator to disposing of waste in accordance with TMA procedures.	Operation	Power plant site	Periodic review of waste operator contracts	VRA	VRA
Traffic and transport							
Minimise impact on local residents	Public safety	Implement mitigation measures as specified in section 7.4.4	Operation	Power plant site access road	Record of all accidents and corrective action procedure	VRA	VRA
Flora and fauna/landscape and visual							
Avoidance of damage to flora and fauna outside site boundary	Minimise impact on flora and fauna	Implement mitigation measures as specified in Section 7.4.10	Operation	Power plant site and adjacent land	Visual inspections and corrective action as required.	VRA	VRA

9.0 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN

9.1 Purpose of the Environmental Management Plan

Environment around construction areas shall certainly be affected during construction period. The main sources of unfavourable effect and pollution to surrounding environment during the construction period will come from not only all activities of all members of the work force during the construction of the project but also from some natural sources such like storm water during the construction period, and the direct sources such as employee's activities to flora and fauna, wastewater, exhausted gas, noise, floating dust, construction garbage, domestic garbage and etc. Aiming at above-mentioned unfavourable sources, VRA will take relevant measures at the utmost to decrease adverse effects and pollution to surrounding environment during the construction period.

The Provisional Environmental Management Plan (PEMP) provides measures in a manner that would cause minimum temporary and permanent disfigurement to the existing natural beauty and amenities of the area. It details active remedial measures and monitoring activities to be continuously carried out to prevent or minimize impacts on the physical, biological and socio-economic/socio-cultural environments as well as to promote occupational safety and health of employees. It provides insight into the environmental management activities that are anticipated and the action plan that will be implemented to take care of problems that will arise from plant activities. The institutional arrangements for project environmental management including the proposed project management organisational chart, training programmes, and standardised environmental documentation procedures would also be included in this section with estimates of implementation costs. The appointment of an Environmental Officer-Compliance & Monitoring by VRA for the project as well as qualifications and responsibilities would be outlined in the PEMP.

It is imperative for VRA to educate all members of its working force to comply with all relevant laws, ISO14001 and all requirements of the project to adopt all necessary control procedures in each area before work is allowed to proceed.

9.2 Policy on Environment

VRA has developed a Corporate Environmental Policy²⁴ which aims at safeguarding the environmental quality and mitigating or offsetting the adverse impacts on the environment of all its activities in conformity with national and international environmental protection standard and regulation in a sustainable manner.

9.3 Environment Management Objectives and Targets

The objective of the EMP is to

- Establish and provide basic guidelines, policies, and procedures which shall be used in establishing, administrating, and maintaining the environmental program as may be required by EPA and the other relevant parties.

²⁴ See Cover page

- Detail work programs to prevent or reduce adverse environmental effects; and
- Confirm financial commitment to environmental management through budget estimates, schedules, staffing and training requirements and other necessary support services to implement the mitigation measures.

The targets of this EMP are to:

- Comply with all applicable laws, regulations, ordinances, statutes, rules, and codes governing environmental requirements and conduct the works based on the requirements of all permits issued. .
- Provide all documentation required by all levels of governing authority concerning environmental requirements.
- Provide and maintain effective planning and field control measures for the construction activities.

9.4 Environmental Management System

In order to maintain control over the implementation of the project and also ensure that commitments made in the EIS are acted upon in a comprehensive and acceptable manner, an Environmental Management System and Training Programme is developed in this section. This programme will help to identify personnel, responsibilities and training requirements for the Project Environmental Management Team to be constituted.

The Project Environmental Management Team will be responsible for the following:

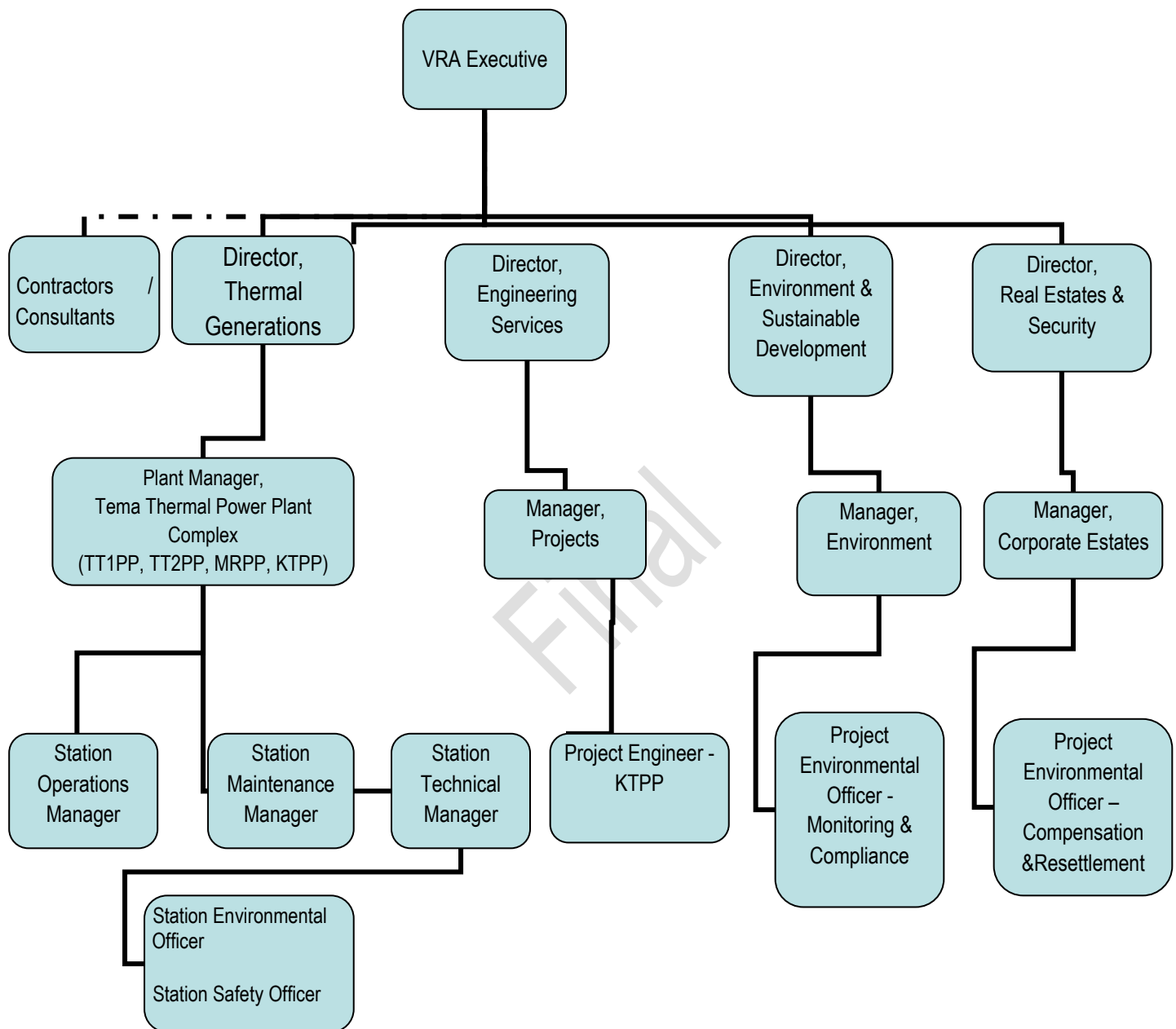
- Ensuring project's compliance with all relevant environmental, social, health and safety regulations
- Liaising with all relevant regulatory bodies and organisations- EPA, Factories Inspectorate Department, Energy Commission (Inspectorate Unit), Department of Urban Roads, Project Affected Persons, etc.
- Formulation and review of environmental and social policies and practices associated with projects
- Liaising with relevant VRA departments on all health, environmental, safety and social matters connected to projects
- Assist in the education and training of project staff in environmental, social and safety awareness
- Make budgetary provisions for projects' environmental programmes
- Undertake environmental and social monitoring activities for projects

Budget for environmental management is provided as part of project and corporate budget for VRA.

9.5 Environmental Management Structure

VRA's organizational chart, which has been put in place to enhance the implementation of the PEMP, is shown in the *Figure 6*. The chart details the position of the Environmental Officer as well as other officers of the project that play various roles in the implementation of the PEMP. In the absence of the jobholder, the relevant manager or subordinate undertakes the assigned duties or delegates as required.

Figure 6: Environmental Based Organisational Chart



The Director, Engineering has overall responsibility regarding the implementation of the PEMP as well as the environmental protection procedure on site. The Director, Engineering will issue clear instructions to Departments, through the Director, E&SD, which shall impact on environmental protection, to ensure that no unnecessary damage or environmental pollution is created during the construction.

The KTPP Project Manager shall be responsible for, among others:

- The definition and implementation of the station's environmental policy
- The level of environmental management compliance the project achieves
- The availability of trained and capable workers to manage, perform and verify work affecting the environment
- Provision of budgetary allocation, financial resources and logistics

The KTPP Project Manager has been empowered to order the cessation of work if he feels that it is unnecessarily detrimental to the environment.

All Line Managers are responsible for:

- Organising and managing personnel reporting to them,
- Ensuring that the requirements of the Environmental Management System as detailed in the company's environmental policy are implemented and maintained in their area of responsibility

The Environmental Officer-Compliance & Monitoring is the project's representative from the Environment & Sustainable Development and reports through the Director, Environment & Sustainable Development of VRA. The responsibilities of the Environmental Officer include:

- Monitoring all environmental and social programmes for the operation phase of the project, including those related to bio-physical and socio-economic/cultural components.
- Working closely and coordinating efforts with the EPA and other enforcement bodies to ensure full compliance with all legal and regulatory requirements.
- Organising activities to motivate and maintain the interest of project staff in environmental and social issues and assisting to increase project staff awareness of environmental issues through training programmes and review meetings.
- Coordinating investigations into/of all types of accidents.
- Conducting environmental and social audits in accordance with project monitoring guidelines.
- Working closely with contractors to ensure that all monitoring and mitigation guidelines recommendations for the project are strictly adhered to. This includes compliance with all health, social and safety guidelines outlined and following strictly VRA's environmental policy guidelines.
- Developing a work plan for the implementing of the EMP.
- Make budgetary provisions for projects' environmental programmes.

- Establishing and running a reporting system on progress (or otherwise) in implementing mitigation measures (including contractor's obligations), training, etc.
- Production of Environmental Reports.

Despite these responsibilities, site supervisors within their own sections are responsible for the working methods, which are adopted in the working practices and must be made aware of the serious consequences of any lapses in the implementation of the environmental protection procedure. Again, site operatives are responsible for their own actions in so much as they may be detrimental to the environment, usual aids such as notices must be strategically placed in order to remind everyone on site of their responsibilities.

A number of other project activities will also need to be managed by VRA. The Environmental Officer will be responsible for ensuring that the Compensation Action Plan prepared for the project is implemented. On completion of the compensation process, the VRA will produce a report to detail this process.

The environmental management activities for the operation of KTPP will be incorporated into VRA's Corporate Environmental Management System and implemented by the Thermal Generation Department as well as the Environment & Sustainable Development Department.

9.6 General Health and Safety Procedures

Procedures relating to occupational safety and health will be guided by the Factories, Offices and Shops Act, 328, (1970) which is buttressed by the occupational safety and health recommendations in the EIS. The relevant environmental and occupational safety and health issues to be covered include:

- Manual lifting
- Hearing protection
- Protective equipment
- Good housekeeping
- Fire prevention
- Prevention of falls from heights
- Electrical hazards
- Machinery safety
- Welding safety
- Head protection
- Feet protection
- Provision of first aid items

All occupational safety and health provisions in the Factories, Offices and Shops Act 328, (1970) shall be complied with during the implementation of the project. The mitigation measures recommended in the EIS will also be fully implemented.

9.7 Fire Prevention System

The general fire precautions to be taken include:

- Provision of a stand by fire tender
- The posting of “no smoking” signs at fire sensitive areas (e.g. fuel storage areas at the work camp, etc)
- Provision of appropriate and adequate number of fire extinguishers
- Proper storage of rags used in cleaning hands and containing flammable liquids (e.g. in metal containers for safe disposal)
- Handling of flammable materials by competent persons only
- Provision of emergency fire alarm systems

In addition, fire prevention training would be carried out for selected project employees. At the end of the training, the personnel would have adequate knowledge of all fire prevention systems recommended in the EIS.

9.8 Pollution prevention

Proper management of effluent, waste oils/lubricants, excavated earth materials and paint as recommended in the EIS will be enforced. Measures to be adopted will include:

- Monitoring of effluent quality
- Collection, storage and disposal of waste oils and lubricants
- Proper management of excavated materials
- Prevention and management of oil, fuel and paint spills

To ensure the success of pollution prevention, the environmental team will be trained to identify and appreciate what hazards there are in relation to improper storage and disposal of polluting substances.

9.9 Vegetation Management Plan

During construction, vegetation clearing is done within the right of way and access tracks. These activities result in loss of vegetation cover. Some effects of vegetation loss are:

- Exposure of some streams thus increasing the rate of evaporation.
- Clearing of vegetation and compaction of soils could lead to death and displacement of some faunal species.
- Soils within the project area would be prone to erosion when cleared at high spots and when subjected to the weight of heavy plants and machinery
- Falling trees may cause extensive damage to vegetation/crops in the landing area.

Mitigation measures

Measures to be employed to ensure a reduction of erosion, restoration of embankments, re-vegetation:

- Mechanical control will be used for all vegetation clearing.
- Compaction of soils along the graded tracks will be reduced by regulating the number of passes of heavy trucks to and from the sites.
- The Contractor will place warning notices (“NO ENTRY”, “NO TRESPASSING ALLOWED” etc.) at entry to access roads. In addition, random security patrols shall be carried out.

9.10 Socio-economic Impacts Mitigation Measures

Relevant national policies, labour laws and codes of conduct concerning employment are being applied to regulate behaviour of workers in the local communities. Measures have been designed and adhered to regarding employment and workforce policies to mitigate environmental, health and social impacts that are associated with the influx of formal and informal workers by the Contractor. Local employment and sourcing policies are used to give priorities to people within the project affected areas.

Generally, all the workers shall have access to primary health care. Periodic community awareness training shall be given to the workforce regarding Sexually Transmitted Diseases (STDs) and traffic safety regulations. Food vendors from the local communities can sell their food to workers at designated places at within the Site. Most of the local communities therefore can earn their income through the sale of cooked food to workers.

9.11 Change Management

During the implementation of the project, change may be required to address unforeseen or unexpected conditions or situations. A typical example is the decision by Government to relocate the 2x110MW Alstom GT11N2 (EV) combustion turbines to Bonyere site in the Western Region under the proposed Domunli Thermal Power Project in 2010 and the rescinding of this decision in 2011. This has virtually delayed the execution of the project and this has the potential of causing anxiety especially for property affected persons.

A change management process will be applied to ensure environmental and social issues are addressed as part of any significant changes to project procedures, processes, design or activities. This will be undertaken as part of the site-specific Environmental Management Plan and will be the responsibility of the project Environmental Officer. VRA also recognizes that environmental and social issues that are to be covered under this EIS could change as the project proceeds. The EO shall facilitate the environmental component of the change management responsibility.

The EO shall undertake the following:

- Review internal environmental reports
- Discuss significant issues as they arise
- Make decisions about modifications to mitigation and monitoring needs and requirements

- Advice on external reporting on environmental and social issues, as required

9.12 Monitoring

The monitoring parameters and the recommended frequency proposed will be strictly adhered to. The parameters to be monitored will be:

- Source of raw materials
- Cultural Heritage'
- Identification of project-affected persons and compensation payment
- Noise & Vibration
- Air Quality (Emissions/Ambient Air/Particulate Matter)
- Traffic & Transportation effects
- Public safety and Occupational safety and health issues
- Waste Management (Solid & Liquid waste)
- Water Quality & Resources (including Ground Water)
- Landscape & Visual Intrusion
- Flora & Fauna
- Structural failures

It must be noted that the baseline established by the EIS will enable VRA to indicate the thresholds that will signal the need for corrective actions and the detection limits. Sampling sites shall be the same sites used for the establishment of baseline data. The Environmental Team members will be trained adequately to understand and appreciate the choice of parameters, sampling sites, methods of sampling/measuring and analysis and frequency of monitoring.

9.13 Training & Development

VRA Management is committed to ensuring that there is environmental awareness amongst all workers. It therefore provides training for all workers in environmental aspects of their work and maintains record of such training programmes. Currently at VRA, training is carried out in both the formal and informal manner and is coordinated by the Training & Development Section of the Human Resources Department. Some of such programmes include attending formal training courses, workshops and conferences, lectures on environmental issues at general plant meetings, showing of environmental videos and slides, drills on oil spill prevention and management, as well as other on-the-job activities.

Formal training programs in all aspects of plant operation, maintenance and management will be developed and implemented for KTPP staff. These programs will be comprehensive and include training in environmental, health and safety procedures. This will ensure safe and efficient operation of the plant. The project shall produce training needs

assessment matrix on an annual basis and this shall include the relevant job functions and the different types of technical knowledge required to operate the EMP. This shall be achieved by:

- Identifying the issues and procedures that employees need to be trained in and the key roles that they will require training.
- Filling out a training needs matrix to ensure that training is targeted to a specific audience.
- Ensuring that, as a minimum, all workers (including new recruits) receive basic training in environmental awareness and the elements of the EMP.

Environmental training and awareness program shall be established to enhance the understanding of all staff, supervisors, workers and subcontractors pertaining with EMP and environmental impacts and mitigation measures. From commencement of the work, VRA shall undertake continuous environmental education for the employees, training staff in effective waste handling and management procedures, conduct regular and frequent HIV/AIDS awareness for the workers. Environmental issues shall be discussed between superiors and their subordinates during the periodic meetings.

Proof of various trainings to enhance environmental performance must be outlined in training reports for the project. It is important that system is put in place to ensure that if a worker misses a key training session, it is flagged up and rescheduled for a later date. Procedures for recording training needs and keeping records of attendance must be kept at all times by relevant staff.

To ensure the successful implementation of all the environmental management programmes, a training programme is recommended for the project Environmental Management Team and key personnel of the contractor. The first environmental training for the employees shall be combined with new recruitment training. The training programme will cover the creation of environmental awareness and occupational safety and health issues. The main issues of concern will be:

a. Environmental Awareness

The areas earmarked for environmental awareness creation include:

- Proper usage and definitions of basic environmental terminologies
- Ghana EIA procedures, provisions of Act 490 (1994) and LI 1652, (1999)
- Environmental laws, regulations and environmental compliance in Ghana
- General environmental policies
- Introduction to environmental management planning
- Environmental impact assessment
- Mitigation measures
- Monitoring plans

- Environmental audit
- EA case studies

b. Occupational safety and health

The relevant areas for consideration are:

- The Factories, Offices and Shops Act 328, (1970). The provisions for safety, health and welfare.
- Fire prevention and fighting methods

9.13.1 Information, Education and Communication (IEC)

In addition to the provision for continuous public education during the project and subsequent posting of "Warning Signs", sustained information, education and communication (IEC) programmes to ensure overall community safety shall be implemented on regular basis. The purpose of the IEC programme is to remind community members about project related risks and activities that will endanger their lives as well as the need to adhere to warning signs.

9.14 Proper and adequate records keeping

VRA will keep a General Register in the prescribed form as required by the Factories, Offices and Shops Act, 1970 for the duration of the project. Records that will be kept, as prescribed by the abovementioned law will include, inter alia:

a. Accidents and dangerous occurrences

Particulars to be entered in the Register will include the following:

- i. Date of mishap
- ii. Name(s) of employees involved
- iii. Sex and Age
- iv. Usual Employment
- v. Precise occupation at the time of mishap
- vi. How mishap was caused
- vii. Period of disablement

b. Testing and examination of fire warning systems

Particulars to be entered in the Register will include the following:

- i. Description of fire warning system
- ii. Date of test or examination
- iii. Particulars of defects found
- iv. Particulars of action taken and date

c. Particulars of Pressure vessels and lifting appliances

Particulars to be entered in the Register will include the following:

- i. Date of last thorough examination
- ii. Maximum safe working pressure
- iii. Particulars of defects (if any) reported by the certified engineer/surveyor
- iv. Particulars of action taken to remedy defect indicated in iii. (If applicable)
- vi. Name and other particulars of engineer/surveyor including signature

9.15 Contractors' obligations and legal requirements

It must be noted that whether VRA prepares an Environmental Assessment (EA) Report and/or an Environmental Management Plan (EMP) for a particular project, it is also a requirements in VRA tender documents that before the order to commence any works the Contractor shall prepare a Contractors' Management Plan for each subproject within a Lot. The Contractors' Management Plan shall spell out how the Contractor will achieve environmental targets and objectives specified in the EA/EMP.

The Contractors' Management Plan shall include, to the extent practicable and reasonable, all steps to be taken by the Contractor to protect the environment in accordance with the current provisions of national environmental regulations and/or the EIA/EMP for this project. The Plan will state the mitigation measures to be employed, the procedures for compliance and corrective action measures in the event of non-compliance. Basic information required includes the following:

- a. Accommodation Procedures
- b. Statement of intention on employment of local people
- c. Waste Management Procedures
- d. Noise Management Procedures
- e. Air Quality Management Procedures
- f. Soil management procedures, including rehabilitation and soil erosion prevention
- g. Water Quality & Resource Management Procedures;
- h. Procedures to manage impacts on flora and fauna
- i. Cultural Heritage Management Procedures
- j. Worksite/Camp Site Waste Management Procedures
- k. Material Excavation and Deposit Procedures
- l. Traffic Method Statement:
- m. Disposal of Relocated Elements
- n. Health and Safety Plan
- o. Procedures for Repair of Private Property

p. Construction Emergency Oil Spill Plan

To facilitate implementation of the Contractors' Management Plan, it is required that each contractor should identify an appropriately qualified Site Environmental Officer (SEO), acceptable to VRA, who will be responsible for implementation of the measures set out in Contractors' Management Plan. The SEO will be identified in the Contractors' Management Plan. The SEO's key responsibilities will include the following:

- ensuring that all environmental protection procedures are followed;
- co-ordination of environmental monitoring of site-related activities in respect of the contractors obligations and take a proactive role in the event of any changes in the Environmental Plan;
- Liaison and reporting with the VRA Environmental Officer.

The contractor will undertake all measures necessary to ensure that his staff and sub-contractors comply with the measures set out in the Contractors' Management Plan, and will be responsible for ensuring their compliance with such Plans. These procedures will include the need for any monitoring to measure compliance, and the measures to be taken in the case of non-compliance.

Notwithstanding the Contractor's obligation under the Contractors' Management Plan, the Contractor shall implement all measures necessary to restore the sites to acceptable standards and abide by environmental performance indicators specified in the Projects EIS/EMP to measure progress towards achieving objectives during execution or upon completion of any works.

9.16 Emergency Preparedness & Response

The basis for emergency response and planning is firstly incident prevention, and secondly rendering any incidents harmless. The priorities for protection in an emergency situation are the following:

- a. Human life and health;
- b. The environment;
- c. Assets belonging to VRA or the contractor;
- d. Maintenance of normal operations on site.

Emergency response plan shall be prepared to manage effectively a wide range of incidents that may occur at the project site. This includes emergency plans for fire, storm, chemical spills and road accident, and other emergency as identified which may affect the project. The protection of the environment shall be primarily dealt with in this plan.

VRA shall also take all reasonable measures to prevent contamination of water air or land as a result of any incident, to reduce such contamination if it is unavoidable and to remediate any contamination that has occurred during the works.

The Contractor is mandated to immediately report any significant incidents to the VRA Project Manager, who shall in turn inform the Director, Technical Services.

9.16.1 Responsible Personnel

The person responsible for emergency response shall be the Site Safety Officer. Personnel are required to familiarize themselves with all emergency procedures. Such procedure shall be displayed at notice boards where appropriate, and made available to all. The alarms and procedure will be regularly tested (at no less than 3 months interval) for effectiveness, and where necessary, the procedures will be updated and additional training given to personnel.

Teams of employees will be selected and trained to be involved in handling emergency situation. These teams will be called into action in times of emergency, and will be given other authorities beside their usual work responsibilities.

9.16.2 Road Accidents

In the event of road traffic accident, the appropriate channel of information shall be established for the line managers, road accident emergency team leaders, in addition to the relevant authorities associated with the accidents, such as the police, hospital, fire brigade, etc.

The Road Accident Emergency Response team will activate their response plan according to the situation, aside from providing medical attention, transporting the injured for medical attention, removing the accident Vehicles after the necessary investigation has been done, and dealing with the relevant authorities, the aim is to bring the situation back to normalcy soonest possible. In all respect, traffic management procedure will be activated where the appropriate emergency procedures such as temporary diversion of traffic, the deployment of flagman, installation of traffic diversion signs, barricades or traffic cones, blinkers lights and any other traffic safety requirements as instructed by the authorities will take precedent.

9.16.3 Emergency Pre-Plans

All work areas shall be equipped with a layout plan for emergency purpose, locations of Assembly Areas, locations of emergency equipment and names of fire fighting team members, first aid team members and emergency contact numbers.

In case of an emergency, the following steps shall be undertaken:

- Sound the Emergency Alert
- Switch off all equipment, machinery and electrical appliances.
- Alert other members/ workers of the emergency.
- Leave the emergency area and go to the allocated Assembly area.
- Supervisors/Foremen shall perform a Headcount and ensure that all personnel are accountable for.
- Report to the Rescue Leader should any personnel is found missing.
- Alert the Rescue Team Leader and Members.

- All Rescue Team Members shall report to the Rescue Team Leader for instructions.
- Rescue Team Leaders shall report to the Emergency Controller on the status of the emergency.
- Emergency controller shall decide on the next action to be taken or should any external parties be involved.

9.16.4 Duties of Emergency Controller

- The Emergency Controller shall take control of full operation of the emergency;
- The Emergency Controller shall give instructions to Rescue Team Leaders in performing the rescue operation;
- The Emergency Controller shall decide and call for additional help when required;
- The Emergency Controller shall station himself in the office and call for external help when required;
- All communications shall be by phone, or any other available means.

9.16.5 Duties of Rescue Team

- Attend emergency when required by the Emergency Controller
- Access and advise the Emergency Controller of the situation
- Arrange for road diversion when required
- Arrange for First Aid when necessary
- Arrange for Fire Fighting Crew when required
- Ensure access route to Emergency area is clear for Emergency Vehicles
- Request for additional help when required
- Arrange personnel for crowd control

9.16.6 Procedures for Environmental Incident/Accident investigation

Understanding the causes and circumstances involved in adverse incidents is essential in making changes to prevent future occurrences. It is paramount that all incidents and accidents are reported and investigated in order to understand how and why incidents occur, identify root causes, and develop countermeasures to prevent future occurrences. When injuries occur, access to prompt medical attention and effective case management is crucial to limiting the number of days lost and insuring the employee receives timely medical treatment and returns as soon as possible to healthy and productive employment.

The primary purpose of investigating accidents and work injuries is to determine the cause so that the necessary action can be taken to prevent re-occurrence. To have an effective Accident Prevention Programme, therefore all accidents whether or not they result in injuries must be reported so that necessary preventive measures can be instituted.

Investigations following an accident should be conducted soon after the accident as can be arranged. This will ensure that statements are made while the incidents are still fresh in people's mind. Details of accidents and incident investigations and reporting to be followed for this project can be found in Chapter 4 of the VRA Corporate Safety Handbook (2001), and is summarized below and outlined in *Table 34*:

- Serious accidents and serious and fatal work injuries shall be investigated by a Committee of at least three persons appointed by the Director, Project & Systems Monitoring. The Committee shall have a chairman appointed by the Director, Project & Systems Monitoring and shall have the Chief Safety Officer as secretary/member.
- The Committee appointed by the Director, Project & Systems Monitoring shall be required to investigate the circumstances of the accident and the unsafe act or acts which caused or contributed to the accident and submit its findings in writing in quadruplicate to the Director, Project & Systems Monitoring. The report shall include appropriate recommendations for the prevention of a recurrence of such incident.
- On the receipt of the report of the Committee of Enquiry, the Director, Project & Systems Monitoring, shall study the report and make final recommendations covering all aspect of the accident. The recommendations should not however include disciplinary action against any employee involved. The Director, Project & Systems Monitoring shall forward a copy of the report together with his recommendations to the Chief Executive and a copy to the Project Manager/Contractor.
- The Manager, Safety shall maintain an Accident records file for each employee and shall be responsible for compiling accident statistics as may be required by the Director, Project & Systems Monitoring.

Table 34: Definitions of incidents based on the severity of injury or property damage, the notification procedures and requirements and defines who investigates the incident.

CATEGORY AND DEFINITION	WHO INVESTIGATES	NOTIFICATION REQUIREMENTS
<i>Catastrophic</i> Fatality, permanent total disability, hospitalization of 3 or more personnel for the same incident, a hazardous materials that causes mortal injury or irreparable environmental damage, or property damage	Investigation conducted by Committee of Enquiry in conjunction with Chief Safety Officer, appointed by the Director, Project & Systems Monitoring	The first person with knowledge of the catastrophic incident will report immediately to the Safety Officer, also if appropriate, directly to 911. Also report as soon as possible but no later than 2 hours to the Safety Officer who will report to the Director, Project & Systems Monitoring through the Manager, Safety
<i>Serious</i> Any hospitalization, injury or illness of 2 or more personnel from the same incident, permanent partial disability, a hazardous materials incident causing reparable but long term damage to the environment, a radiological event causing non-	Investigation conducted by Safety Officer, and at the discretion of Director, Project & Systems Monitoring	The first person with knowledge of the serious incident will report immediately to the Safety Officer and directly to 911 if appropriate. Also report as soon as possible but no later than 24 hours to the facility/ organization director and Safety Officer. Safety Officer will report to the Director, Project & Systems Monitoring

CATEGORY AND DEFINITION	WHO INVESTIGATES	NOTIFICATION REQUIREMENTS
compliance, any fire and property damage.		through the Manager, Safety, at least within 48 hours of the incident.
<i>Recordable but not meeting the serious or catastrophic criteria</i> Occupational injury or illness causing a lost workday other than the day of the incident, restricted work activity or job transfer, unconsciousness, medical treatment, significant injury or illness that does not result in lost time or restricted work activity.	Investigation conducted by Safety Officer	Supervisor of the injured employee will report immediately to the facility Safety Officer who will investigate. The supervisor will complete a VRA Medical Form 39 and forward to Safety Officer within 3 days. The Safety Officer will sign and forward original to Director, Project & Systems Monitoring within 6 days of the incident.
<i>Reportable but not recordable</i> Occupational injuries/illnesses not resulting in a lost workday other than the day of the mishap (first aid, treated and released), property damage, hazardous materials release under reportable quantities, or near misses.	Investigation conducted by Safety Officer	Employees and supervisors will report all suspected hazards, near misses and non-recordable occupational injuries and illnesses to their supervisor and the facility/organization Safety Officer.

9.16.7 Fuel Oil Spillage

The objectives of the measures and emergency response programme are to contain any spillage occurring or which has occurred, clean up any spillage within the plant, salvage any quantity of spilled material recoverable and restore the affected surrounding into or near its natural state.

The programme's scope covers Spillage in the project premises by equipment failures and Spillage during transportation within project premises. The actions for Volatile flammable liquids are:

- The designated Officer or his delegate must immediately condone off area of spillage.
- The Officer must order stoppage of the use of naked flames, spark creating devices or very hot surfaces 50 meters away from the scene especially on the leeward side of the affected area.
- The Officer or his delegates must deploy abundant material to arrest the advancement of the spill.
- The spillage must be physically removed.

The actions for Non Flammable Greasy Liquids are:

- The Officer shall build earth barriers to contain the spill.

- Qualified personnel must remove any spill.
- Clean up remnant with degreasers and wash down the drains

Reporting the Incident or Accident is carried out as specified below:

- The incident or accident reported to the Plant Manager by the Environmental, Health and Safety Manager (EO) or one authorized by him on his absence immediately after such has occurred or is occurring.
- The Plant Manager or his authorized deputy can inform the Director, Thermal Generations who in turn inform the Director, Project & Systems Monitoring
- The Director, Project & Systems Monitoring after due consultation with the Deputy Chief Executive will inform the Government Agencies, EPA, and National Disaster Management Organization, of any spillage that could affect the environment.

Record of the incident/accident and action taken is documented by the Environmental Advisory Committee

9.16.8 Spillage of Flammable Gases-LPG Natural Gas, Acetylene

The objectives of the measures and emergency response programme are to prevent fire hazard in the plant, safeguard personnel in the affected area and disperse gas as quickly as possible. The programme's scope covers Leakage in the plant's premises due to equipment failure, malfunctioning or wrong handling, Leakages during transportation within plant premises, and Leakage during charging / refilling of gas tanks.

The actions for the emergency procedure are:

- Technician or personnel within the vicinity to inform the Site Safety Officer/ The Officer or any of his superior.
- Superior informs all persons within the vicinity to stop works that can initiate fire-grinding, hot, heating welding or any other activity that may generate sparks of fire.
- Personnel to be asked to evacuate the area immediately.
- Fire fighters with proper equipment must then ventilate the place immediately by opening all doors and windows.
- No one except emergency personnel with proper equipment is allowed in the area until it is certified safe.
- Investigate the incident and take corrective action

Reporting the Incident or Accident is carried out as specified below:

- The incident or accident reported to the Plant Manager by the Environmental, Health and Safety Manager (EO) or one authorized by him on his absence immediately after such has occurred or is occurring.
- The Plant Manager or his authorized deputy can inform the Director, Thermal Generations who in turn inform the Director, Project & Systems Monitoring

- The Director, Technical Services after due consultation with the Deputy Chief Executive will inform the Government Agencies, EPA, and National Disaster Management Organization, of any spillage that could affect the environment.

Record of the incident/accident and action taken is documented by the Environmental Advisory Committee.

9.16.9 Emergency Response Plan for Hazardous Chemical Spill

The following materials may be available on site and can be considered as hazardous: petroleum products, septic wastes, paints, stains, wood preservatives, pesticides, acids, solvents, motor oil, lubricants, hydraulic fluid, detergents, batteries, glues, acetylene, cement, mastics/adhesives, medical wastes, etc. There is a potential of spillage of any of these hazardous materials and there is the need to prepare a procedure for an emergency preparedness plan in the event of hazardous chemical spills.

A. Purpose

The purpose of the procedure is to define a plan of action for potential hazards associated with the power plant and associated facilities including accidental spills of all hazardous materials in accordance with the material data safety sheet (MSDS) and international standards. The objectives of the measures and emergency response programme are:

- To prevent damage to the environment
- To clean up any spillage that may have occurred
- To ensure the affected surrounding to near or its original natural state

B Scope

The programme's scope covers Spillage of Chemicals and Spillage during handling or storage. The procedure covers the actions to be implemented in the event of substantial spillage or accidents caused by hazardous materials. The actions for the emergency procedure are:

- Arrest the spread of the spill with earth barriers
- Remove any acids within the vicinity of the spill
- Lift the spill with earth or sand
- Neutralize if it is soda with solution of hydrochloric acid and vice versa
- Wash area with plenty of water
- Dilute the recovered products with plenty of water and neutralize before final disposal

C Notification procedure

The notification procedure indicates the measures to be taken on discovering the spill, and the personnel to be informed. This will enable trained personnel and outside agencies to respond quickly. Reporting the Incident or Accident is carried out as specified below:

- The incident or accident reported to the Plant Manager by the Environmental, Health and Safety Manager (EO) or one authorized by him on his absence immediately after such has occurred or is occurring.
- The Plant Manager or his authorized deputy can inform the Director, Thermal Generations who in turn inform the Director, Project & Systems Monitoring
- The Director, Project & Systems Monitoring after due consultation with the Deputy Chief Executive will inform the Government Agencies, EPA, and National Disaster Management Organization, of any spillage that could affect the environment.

Record of the incident/accident and action taken is documented by the Environmental Advisory Committee.

i) First notification

Upon the discovery of a spill, the person discovering the spill, the **First Notifier**, must immediately contact the Site Safety Officer. They should attempt to provide the following information:

- a) Time of discovery
- b) Possible Spill Material
- c) Quantity of Spill Material
- d) Area of land or lake involved in the spill event
- e) Estimate of whether or not the spill is on-going
- f) Actions which have been taken

Using the above information, together with knowledge of the volumes of hazardous material available for the project, available personnel, and visual observations, the Site Safety Officer will make a determination of the severity of the spill event and the notification procedures to be implemented using the Hazardous Material Spill Notification Flowchart outlined in *Figure 7*. It is the responsibility of the Site Safety Officer to collect the above information to determine the source and cause of the discharge. It is anticipated that any hazardous chemical will be of very limited quantities and therefore any accidental spillages will be minor and will be well contained without any offsite notification.

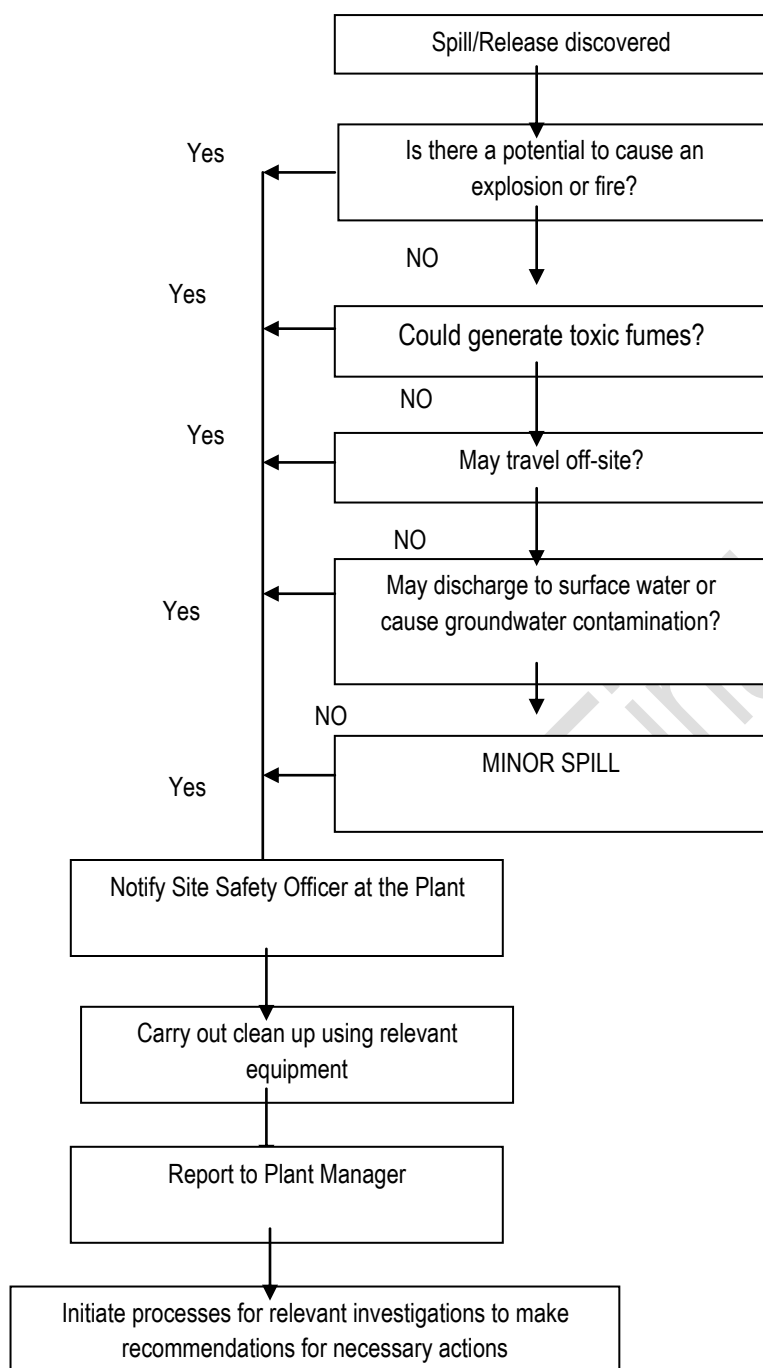
ii) The OIC shall: -

- a) Immediately move logistics as appropriate to the site of the incident.
- b) Contain the spill and prevent its spread
- c) Undertake the spill clean-up

Take appropriate steps to inform the Project Environmental Officer for any relevant internal or external action to be taken.

- D.** If any accident or incident detrimental to the environment occurs, the cause(s) of the accident / incident and the aspects of the action plan that could be improved shall be identified through VRA's accident investigation procedures and plans to correct the hazard or amend the EMP shall be made.

Figure 7: Hazardous Material Spill Notification Flow Chart



9.16.10 Procedures for Handling Raw Materials/Products

All materials handling and storage shall be performed in accordance with the requirements contained in the Material Safety Data Sheet (MSDS) and as outlined under Section IX “Material Handling, Storage & Disposal” of the VRA Corporate Safety Rules, 2001. Since injuries may result from improperly handling and storing materials, it is important to be aware of incidents that may occur from unsafe or improperly handled equipment and improper work practices when handling and storing materials.

Some hazards associated with materials handling are outlined below to make all workers aware of the consequences:

1. Back injury is the number one injury associated with improper material handling.
2. Heavy or unbalanced loads could fall and injure employees, especially head and feet.
3. Vehicle becomes unbalanced and overturns with driver not wearing seat belts.
4. Improper or unsafe use of material handling equipment could cause injury or property damage.
5. Falls from working platforms or ladders could occur.
6. Damaged or poorly maintained equipment could cause injury.
7. Battery charging and filling pose significant risks.
8. Loading docks pose numerous risks for injury or property damage including:
 - falls from unguarded dock edges,
 - slips/trips due to wet or icy surfaces,
 - caught between/under due to crowded staging areas, unbalanced loads,
 - collision due to numerous pieces of moving equipment or vehicles,
 - tip over due to steep inclines improperly traversed,
 - lift platforms could fail or operate improperly,
 - Wheeled vehicles could roll if not properly secured, or damage to vehicles could occur due to tight manoeuvre room,
 - Overhead doors may open or close unexpectedly,
 - Hazardous chemicals with their commensurate risks may be involved during loading/unloading operations
 - Any fuel-operated material-handling vehicle poses the risk of fire and explosion.
 - Material handling equipment used in cramped spaces or populated areas pose significant hazards of injury or property damage.

9.16.10.1 Moving Loads (General)

- a. Check the load first to decide how best to move it—forklift, hand truck, hoist, conveyor, manually, etc. Then check the route to be taken and remove obstacles, or find another route if the obstacle cannot be moved. Make sure there is space for the load at its destination and that equipment, platforms, elevators, etc. are rated to handle the load weight and bulk.

- b. Forklifts, hand trucks, dollies, or other material handling equipment (MHE) carrying unbalanced loads or loads that obstruct the operator's view may be dangerous to the operator and any other employees in the area. Place loads carefully so they are stable and will not fall off or tip the equipment over. Load heaviest objects at the bottom and secure/strap any bulky or awkward items. Ensure operator has sufficient view in direction of movement.
- c. Whenever MHE are equipped with seat belts, operators should wear them.
- d. Consider a ground guide when negotiating bulky loads through narrow aisles or crowded spaces.
- e. When operating on a ramp or steep incline, employees shall keep loads downhill to prevent the load from rolling over them if they lose control.
- f. Employees shall inspect material handling equipment before each use
 - Check the framework for obvious signs of damage such as broken welds or fractured boards.
 - Check the tires for large pieces missing from solid tires and air missing from pneumatic tires.
 - Ensure accessories (e.g., handle extensions, nose plate extensions, stair climbers, etc.) are properly attached.
 - Inspect straps and ratchets for damage or deterioration. Test wheel brakes to ensure they work.
 - If damage/defects are noted, remove the equipment from service and tag with a "Do Not Use" sign until it is repaired.

9.16.10.2 Manually Moving Loads

- a. Manual lifting and moving loads is a major potential source of back injuries among workers. When manually moving materials, employees shall follow proper lifting techniques. Employees shall seek additional assistance when:
 - A load is so bulky they cannot grasp or lift it;
 - When they cannot see around/over the load;
 - When the load is too heavy to handle for one person, and
 - When a worker cannot safely handle the load manually.
- b. Supervisors shall assist employees in reducing the potential for back injuries by employing the following lifting principles whenever possible:
 - Eliminate the need to handle materials manually by using/installing mechanical lifting aids (e.g. lift truck, conveyor, hoist, etc.);
 - Manually move the loads with a handling aid (e.g. cart, dolly, etc.);
 - Reduce the size or weight of the objects lifted;
 - Change the height of a pallet or shelf.

- c. Using safe manual lifting techniques may reduce back injuries such as pulls and disc impairments. Leg muscles are stronger than back muscles, so workers should lift with their legs and not with their back.

9.16.10.3 Forklifts/Powered Industrial Trucks

- a. Trucks shall have a label indicating acceptance by a nationally recognized testing laboratory. No one shall be permitted to make modifications or additions affecting the capacity or safe operation of a powered industrial truck without the manufacturer's prior written approval. Any modifications and additions shall be added to the truck's capacity, operation, and maintenance information and postings.
- b. Powered industrial trucks operating in potentially hazardous atmospheres must be approved for that purpose and have additional safeguards for use.
- c. Because of the fire hazard, only electrically powered material handling equipment will be used in museums, collections areas and populated spaces. Newly purchased forklifts will be battery powered. Large, gas-powered equipment required for lifting extremely large exhibits may only be used when no visitors are present.
- d. Trucks shall not be parked and left unattended in areas occupied by or frequented by the public.
- e. Forklifts/powered industrial trucks shall be inspected prior to use. Keep on hand the last five (5) checklists for auditing purposes to ensure documentation of inspections.
- f. Forklifts/powered industrial trucks have a high centre of gravity and may tip over if not driven slowly and carefully by trained, authorized operators. Materials lifted incorrectly or placed improperly on the forks may easily slip, causing a hazard to the operator and any other employees in the area. When picking up materials with a forklift/powered industrial trucks, operators shall:
 - Follow the manufacturer's operational instructions.
 - Keep forks and loads low and tilted back while moving.
 - Centre the load on the forks as close to the mast as possible, which minimizes tipping or chances of the load falling.
 - Do not overload forklifts/powered industrial trucks because it will impair the controls and cause tipping. Do not put extra weights on the rear of a counter-balanced forklift/powered industrial truck to allow an overload.
 - Adjust the load to the lowest safe position when travelling.
 - If the load obstructs the operator's forward view, then the operator shall travel with the load trailing the vehicle. Consider the use of a ground guide if needed.
 - Pile and cross-tier stacked loads correctly.

- g. Additional safety precautions for forklifts/powered industrial trucks:
- Provide sufficient head room under overhead installations, lights, pipes, and sprinkler systems.
 - Forklifts shall be equipped with a cage over the operator's seat to protect them from shifting or falling loads. The forklift shall also be equipped with a vertical load back rest extension when the load presents a hazard to the operator.
 - Forklifts shall be equipped with a back-up alarm and a horn. When a forklift is used inside a building it must have a strobe light attached to its roll cage.
 - Be careful when approaching doorways, aisle crossings, and other intersections—sound a warning signal whenever pedestrians or other moving equipment are operating in the same area. When more than one forklift is operating in the same area, follow the rules of the road- e.g. yield to the right, stop at intersections and clear before proceeding, etc.
 - Where applicable provide signage to warn pedestrians to be on the look-out for powered industrial trucks and stay out of the way when truck is in use.
 - Park a forklift with the forks lowered and tilted flat, brake set, and keys removed. Block the wheels if the truck is parked on an incline. These precautions will be followed when an operator will be more than 7.62 metres away from the vehicle or the vehicle is out of sight.
 - Set the brakes when using the truck to load/unload materials. The dock/board/bridge plate shall be secured so they will not move when equipment drives over them.
 - Additional riders are prohibited on forklifts/powered industrial trucks.
 - Never stand or walk under the raised part of a forklift/powered industrial truck.
 - Do not put arms/legs between the uprights of the mast or outside the running lines of a forklift/powered industrial truck.
 - Locate battery-charging installations in designated areas, and ensure fire extinguishers are within 7.62 metres meet when charging. This area must be designated as a "No Smoking" area. Spill control supplies must be available for neutralizing and flushing spilled electrolyte. The battery-charging equipment shall be protected from truck damage. Provide ventilation of battery-charging gases.
 - Disconnect battery before repairing an electrical system.
 - Provide auxiliary directional lighting on forklifts/powered industrial trucks when the general lighting is less than 2 lumens/square foot.

9.16.10.4 Hoist

- a. It is required that all hoisting equipment be inspected initially according to standards set by the individual manufacturer.
- b. Inspections:
 - Prior to First Use/Major Alteration: Following assembly and erection of hoists, and before being put in service, an inspection and test of all functions and safety devices shall be made under the supervision

of a Competent Person (one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them). A similar inspection and test shall be required following major alteration of an existing installation.

- Daily (or prior to use) inspections: Daily (or prior to use if hoists are not used daily) inspections shall be performed by the operator at the start of each shift, or at the time the hoist is used for the first time during each shift. The inspection regimen shall include, but not be limited to, an examination of the chain for wear, twists, excessive dirt, broken links, and proper lubrication. Hooks shall be inspected for deformations, cracks, damage, and properly operating latches.
- Frequent inspections: Frequent inspections are the next level up from daily inspections. Frequent inspections shall be performed by a person who is trained, experienced, and qualified to perform hoist inspections. How often the frequent inspections are done is a function of hoist service. If the hoist is seeing normal service, then the frequent inspections should be conducted once a month. For heavy service, the frequent inspections should be weekly to monthly. Severe service applications warrant frequent inspections, daily to weekly. During frequent inspections, check the hoist more thoroughly than the operator's daily inspections.
- Periodic inspections: Periodic inspections shall be performed by a qualified inspector, and at intervals recommended by the manufacturer and according the severity of the service. Hoists shall also be inspected and tested at not less than three month intervals. Periodic inspections are more thorough than frequent inspections. Disassembly is not required for any of these inspections unless the inspection indicates a breakdown is needed. However, prior to placing the hoist back in service, load testing is required if some disassembly involving load-bearing components has occurred.

- c. The most important variables in safe hoist operation are knowledge about the hoist, the load, and safe operating practices, and the training and communication that support that knowledge.
- d. Safe hoist operation begins with proper hoist selection. The hoist must be matched to the application. Hoist capacity is of primary importance; it is critical that the hoist selected has a capacity that exceeds the weight of the load. Consider a powered hoist if the load has to be lifted a long distance or repeatedly.
- e. Ensure the hoist's load chain is long enough to reach the load. The chain must be straight and properly seated in the load sheave. Avoid tip loading unless the hook is specifically designed for point loads.
- f. Operator training shall be specific to the type of hoist the operator will be using, including information about lift capacity as well as inspections and maintenance, slip clutches, load limit devices, braking mechanisms, and wear limits. Training shall include a discussion of balanced lift points and safe rigging practices.
- g. Slings or other attachments shall be seated in the saddle of the hook and hook latches shall be present and functioning properly. The hoist's load chain shall never be used as a sling.

- h. Loads shall always be lifted slowly at first to ensure everything is seated and operating properly. Lift loads vertically, and do not side pull a load, which places additional stress on the hoist and risks uncontrolled load swings.
- i. Avoid using the hoist's travel limits to stop operation. These limits are usually not designed for regular everyday usage; they are intended for emergency use.
- j. When the hoist is coupled to a trolley, take care not to crash the trolley into the end stops on the beam. Hitting the end stops increases stress on the hoist and may cause dangerous load swings.
- k. Jogging the hoist's motor shall be minimized; it generates heat in the motor's windings, which could lead to m
- l. Supervisors shall ensure hoist operators and signal persons can communicate, especially in noisy environments where lifting operations require a hoist operator and a signal person (e.g., rigging or hook-up person) to use hand signals or voice communication. Hand signals shall be documented and posted. Except to obey a stop signal, the operator shall only respond to hand signals from the designated signal person.
- m. Before giving the signal to lift a load, the operator shall inspect their surroundings, to ensure they have a solid foundation for executing a manual lift, and that all personnel are clear of the load. The operator shall communicate their intention to begin lifting to employees in the immediate vicinity of the lift, and pay close attention to the hoist in progress. Operators shall never leave a load unattended or suspended.
- n. It is the hoist inspector's responsibility to alert maintenance workers of an inspection's findings. Hoists that do not pass inspection need to be tagged "Out of Service" and removed from the hoisting area until repaired or replaced.
- o. The employer shall prepare a certification record for frequent and periodic inspections that includes the date the inspection and test of all functions and safety devices was performed; the signature of the person who performed the inspection and test; and a serial number, or other identifier, for the hoist that was inspected and tested. The most recent certification record shall be maintained on file.

9.16.10.5 Scissor Lift Work Platforms

- a. Lifting and elevating the work platform **must** be done on flat, firm surfaces.
- b. The safety bar located inside the lifting mechanism must be used to prevent lowering of the scissor-type lift during maintenance or inspection.
- c. Do Not:
 - Elevate the work platform if it is not on a firm level surface; or
 - Exert excessive side force while the work platform is elevated;
 - Overload (the relief valve does not protect against overloading);
 - Alter or disable limit switches;
 - Raise the platform in windy or gusty conditions. (The manufacturer recommends not raising to full height or half height in windy or gusty wind conditions). The manufacturer follows a 32 km per hour wind speed as a guide. The manufacturer recommends not raising the lift if the wind speed is 32 km per hour or greater.)

- Park the work platform on high traffic sidewalks that will impede foot traffic or wheelchair traffic.
- d. **Safety Devices**
 - The guardrails must be upright and locked in place with locking pins.
 - The safety bar must be used for inspection and maintenance.
 - Do not reach through scissor assembly without ensuring that the safety bars in its proper position.
 - The operator must wear a personal protective device (positioning device system) to prevent movement past or over handrails. The personal protective device will consist of a body belt with a lanyard attached to an anchor point to ensure a 100% no-fall situation. The anchor point must be positioned so the employee cannot reach the handrail with slack in the lanyard; this will prevent an employee from being able to fall from the platform.
- e. Operators must read and completely understand the operator's manual before being allowed on a work platform.
- f. Inspect and/or test for the following daily (documentation not required):
 - Operating and emergency controls;
 - Safety devices and limit switches;
 - Tyres and wheels;
 - Outriggers;
 - Air, hydraulic, and fuel systems for leaks;
 - Loose or missing parts;
 - Guardrail systems;
 - Engine oil level; and
 - Hydraulic reservoir level.
- g. Do not operate unless proper authorization and training have been received.

9.16.10.6 Slings and Hooks

- a. Personnel using slings should adhere to the inspection and safe use criteria.
- b. Personnel using hooks for moving materials will use hooks with self-closing safety latches or their equivalent to prevent components from slipping out of the hook.

9.16.10.7 Cranes and Gantries

- a. The project may utilize overhead cranes to facilitate materials handling. Though this machinery facilitates the work, unsafe operators can put lives and property at risk.
- b. Operators of cranes and hoists must be aware of equipment limitations, inspection requirements, proper rigging, and control functions. If your department maintains and operates a crane or gantry, ensure operators are properly trained

9.16.10.8 Rated Capacity Markings

All material-handling equipment (e.g., forklifts/powered industrial trucks, conveyors, hoists, dollies, carts, etc.) shall have a rated capacity noted on it that determines the maximum weight the equipment can safely handle and the conditions under which it can handle that weight. Employers must ensure that the equipment-rated capacity is displayed on each piece of equipment.

9.16.10.9 Storage Requirements (General)

- a. Emergencies could become disasters if exits, fire alarms, power switches, sprinklers, light switches, etc., are blocked – even temporarily. Employees shall not block emergency access or equipment. Aisles and passageways must be kept clear of obstructions and slip, trip, and fall hazards. A 91 cm clearance shall be maintained around emergency equipment and the emergency equipment shall be clearly marked.
- b. Do not store materials in excess of supplies needed for immediate operations in aisles/passageways.
- c. Employers shall mark permanent aisles and passageways. Obstructions in aisles (e.g. columns, posts, etc.) shall be clearly marked.
- d. When using aisles and passageways to move materials mechanically, employees shall allow sufficient clearance for aisles at loading docks, through doorways, wherever turns must be made, etc. Sufficient clearance will prevent workers from being pinned between the equipment and objects in the workplace and will prevent the load from striking an obstruction and possibly falling on an employee.
- e. When different levels exist, ramps shall be used by vehicles moving materials.
- f. Doors shall be of sufficient height and width to accommodate material handling equipment. Aisles shall be 60 cm wider than the widest vehicle used. Exit access aisles in storage areas shall be at least 110 cm wide.
- g. There must be enough operating space for handling and stacking materials safely in all storage areas.

9.16.10.10 Storage of Hazardous Materials/Chemicals using Material Handling Equipment

- a. Read labels and Material Safety Data Sheets (MSDSs) before storing chemicals or flammable/combustible materials. Match storage conditions to material handling requirements (e.g., dry, cool, ventilated, etc.). Smoking and using open flames or spark-producing devices are prohibited in chemical storage areas. Non-compatible materials must be segregated in storage.
- b. Trash, brush, long grass, and other combustible materials shall be kept away from areas where flammable/combustible materials are handled or stored.
- c. All spills of flammable/combustible materials shall be immediately cleaned up.

9.16.10.11 Storage of Other Materials

- a. When storing materials, workers shall:

- Prevent creating hazards when storing materials by being aware of the material's height and weight; how accessible the stored materials are to the user – consider the need for availability of the material; and the condition of the storage containers. All materials stored in tiers must be stacked, racked, blocked, inter-locked, or otherwise secured to prevent sliding or collapse.
- Keep storage areas free from accumulated materials that may cause slips, trips, falls, or fires or that may contribute to harboring pests.
- If possible, place bound materials on racks and secure it by stacking, blocking, or inter-locking to prevent it from sliding, falling, or collapsing.
- Ensure stacks are stable and self-supporting. Observe height limitations when stacking materials.
- Stack bags and bundles in interlocking rows and limit the height of the stack to keep them secure.
- Block the bottom tiers of drums/barrels/kegs to keep them from rolling if stored on their side.
 - i. Stack drums/barrels/kegs symmetrically.
 - ii. Place planks, pallets, etc. between each tier of drums/barrels/kegs to make a firm, flat stacking surface when stacking on end.
 - iii. Chock the bottom tier on each side to prevent shifting in either direction when stacking two or more tiers high.
- Materials must not be stored on scaffolds or runways in quantities exceeding those needed for immediate operations.
- Additional safe material storage practices include:
 - i. Ensuring shelves and racks are sturdy and in good condition.
 - ii. Stacking all materials on a flat base.
 - iii. Placing heavier objects closer to the floor and lighter/smaller objects higher.
 - iv. Not stacking items so high that they could block sprinklers (46cm of clearance) or come in contact with overhead lights or pipes.
 - v. Using material-handling equipment or a ladder to place or remove items above your head.
 - vi. Never standing on a shelf, rack, boxes, or a chair.

9.17 Emergency Preparedness & Response Plan for Fire Fighting

9.17.1 Introduction

Critical to employee safety at KTPP is fire emergency preparation planning. The effectiveness of response during emergencies depends on the amount of planning, training, and drilling previously performed. Identifying key elements of a fire emergency preparation plan starts with the development of a fire emergency preparedness planning such as outlined in this document. All Managers and supervisors are to be familiar with all elements in this plan and have conducted training/drilling to assure that employees clearly understand their roles in fire emergencies.

9.17.2 Guide

- a. Emergency actions should include a written plan listing, in detail, the procedures to be taken in the event of a fire
- b. The following must be considered in the Fire Preparedness & Emergency Plan:
 - Information on the facilities at KTPP describing key elements of the facility that is useful for new employees and response agencies, such as Ghana National Fire Service must be available.
 - Employees must be shown how to report an emergency and this shall include activation of pull alarms or notifying the facility security center. Consideration must be given to methods of notifying local agencies such as the fire department.
 - Alarms and signals to alert employees must be identified; this may include audio alarms, highly visible lights, and/or a public address system. Management and employees must know what actions to take when an emergency alarm is activated.
 - All emergency phone numbers should be identified, listed in the emergency preparedness plan, and posted. Emergency phone numbers should include any facility numbers, local agencies, and any emergency-facility personnel. Consideration should also be given to recovery of operations.
 - All responsibilities should be clearly defined for management and employees. Management must determine its strategy for responding to fire emergencies.
 - A chain of command should be established to minimize any confusion. Personnel must be identified to coordinate the emergency-response actions.
 - Detection and alarm systems should be identified and described. Testing and preventative maintenance procedures should be included.
 - Diagrams should be developed for critical information. Evacuation routes, exit doors, fire extinguishers, and other critical elements should be visually displayed for all employees. If the fire sprinkler system or standpipe system is used, all critical controls/valves should be clearly identified.
 - Assembly areas should be established for all employees. Accounting for employees can be performed at assembly areas. All assembly areas should be established at safe distances from fire hazards and clear of emergency vehicle traffic and activities.
 - Search and rescue procedures must be established. Only trained and authorized personnel should attempt search and rescue.
 - Procedures for shutting down equipment during emergencies should be established. Equipment operators must know the proper actions to take during an emergency.
- c. Recovery strategy should include plans to restore the operations. This should include a list of contractors who can provide equipment and services for operations. Additional consideration should be given to temporary contractors who can provide manufacturing services.

- d. Employees must know the emergency routes in their work areas and be familiar with the plant layout. All employees must receive a guided tour of evacuation routes and emergency exits during orientation.
- e. Operators must know their specific procedures when an emergency arises. Safe shutdown procedures for equipment should be established to prevent equipment damage and additional hazards. Evacuating employees to a safe location is a top priority.
- f. The alarm system to notify employees of emergencies and evacuations must be clearly recognizable during emergency conditions. Horns, sirens, public announcement system and other alarm devices must alert employees of an emergency.
- g. All alarm systems and fire protection systems must be maintained and tested on a regular basis. It is recommended that alarms be tested weekly.
- h. The emergency preparedness plan should be a working document used for training and practice. The plan must be updated to reflect any changes in the workplace.
- i. Emergency routes and exit doors should be clearly posted on a wall diagram to show employees the primary and secondary emergency routes for evacuating the building. The diagram should show the employee's current position and emergency routes. Each department should display this diagram in a highly visible area.
- j. Emergency evacuation drills must be conducted to ensure employees are knowledgeable and trained on emergency plans.

9.17.3 Reference Options

Every facility should have an established set of procedures to handle fires and related emergencies. Copies of the plan should be distributed to emergency services such as fire departments.

Each facility manager must decide on the extent of employee involvement in response to an emergency, such as a fire, and decide whether or not the facility should have a fire brigade. There are five basic options. The one selected will depend on the (i) size of the facility, (ii) type of hazardous operations on the premises, (iii) number of employees available for a fire brigade organization, and (iv) type/extent of fire protection equipment available.

Options:

Option 1: Full evacuation of the facility: No employees are permitted to fight a fire -- they are to immediately evacuate upon notification by an alarm or other device. This option provides the most employee protection; however, if a local fire department is not within proximity, major property damage may result.

Options 2 through 4 deals with incipient fires (an incipient fire is one that is in the initial stage and can be controlled or extinguished with portable fire extinguishers).

Option 2: All employees must be trained to utilize fire extinguishers for incipient fires: Initial training should be conducted when the employee is hired and refresher training provided annually. This alternative provides the opportunity to prevent a small incipient fire from becoming a larger one. Employees must clearly understand their limits when this option is selected. There is risk associated with an employee attempting to extinguish a fire that has passed the point of being an incipient one. Employees may sustain injuries if they are not properly trained.

Option 3: Designated employees to fight an incipient fire in their general areas: With this option, the level of training is virtually the same as Option 2; however, only designated employees are trained and expected to fight an incipient fire. Additionally, the method of training must be hands-on.

If none of these options are practical, the facility may choose to organize a fire brigade. If so, management must then decide between these two options:

Option 4 - Organized fire brigade to fight incipient stage fires only: If this is the choice, the following are required: (i) specific procedures, training, and leadership structure; and (ii) all necessary protective clothing and fire fighting equipment. Training and education in special hazards must be provided, along with training in standard operating procedures and use of equipment. A higher, specialized level of training should be provided for the brigade leaders and instructors. This option poses a risk of injury to fire brigade members.

Option 5: Organized fire brigade to fight both incipient stage and interior structural fires: If it is decided that the fire brigade should fight both incipient stage and interior structural fires, the facility must satisfy all the items required in Option 4. In addition, brigade members must pass a physical examination, attend educational sessions at least quarterly -- with hands-on training at least annually -- and have protective clothing and breathing apparatus provided. This selection, the equivalent of a professional fire department, poses the highest risk of injury for brigade members. As such, only properly-trained brigades should assume this role.

The fire brigade members should be organized and trained to make the best use of the fire protection equipment available and to operate it effectively during an emergency. They should help evacuate all personnel not involved in handling the emergency and be able to assist the fire department to control the emergency.

The following factors may influence decisions regarding the size, complexity, and organization of a fire brigade: (i) Property size, (ii) Property accessibility; (iii) Building size; (iv) Building construction; (v) Building contents; (vi) Fire protection equipment on hand; (vii) Fire hazards; (viii) Personnel safety; and (ix) Proximity, quality, and responsiveness of local fire authorities.

9.17.4 Training

Fire Safety Education is designed to develop or change the attitudes and behaviours of men, women and children toward fire. The main objective of Fire Safety Education is to increase awareness of human actions that could lead to fires and to develop skills and knowledge to prevent fires or to minimise exposures and threats in the case of fire.

The purpose of fire training in VRA is to establish and verify the organization's ability to prevent fires and to effectively respond to fire emergencies. Training considerations should include the following:

- a) Action to take in the event of a fire
- b) Portable fire extinguishers
- c) Familiarity with plant
- d) Operations and maintenance of equipment
- e) Alarms
- f) Hot work permits
- g) Handling of flammable liquids
- h) As a minimum, all employees should receive training in the following areas:
 - **Actions to take in the event of a fire:** When to evacuate, when to attempt to extinguish a fire, whom to notify, what equipment to shut down.
 - **Portable fire extinguishers:** The correct extinguisher and its proper operation on a particular type of fire (e.g., metals, electrical, chemical, wood, or paper). The training should be "hands-on" to give employees experience in extinguishment techniques.
 - **Familiarity with plant:** A tour of the entire facility, with emphasis on the location of exits, fire extinguishers, hazardous operations, and restricted areas.
 - **Care and maintenance of equipment or machinery they will be operating:** To reduce fire loss potential by helping to keep equipment from malfunctioning or breaking down.
 - **Alarms:** The meaning of various alarms and the actions to take when they are sounded.
 - **Hot-Work Permits:** How to protect against fire hazards caused from welding/cutting/brazing and other hot work.
 - **Flammable Liquids:** How to safely handle, use, and store flammable liquids.

In addition, certain functions, such as the following, will require specific training for the employees involved:

- **Fire Brigade:** If the facility has a fire brigade, members should be required to complete a specified training program as a condition of membership.
- **Specialized Equipment:** Some processes or machinery operations present fire loss exposures by their very nature; e.g., chemical handling or mixing. Employees involved must be thoroughly trained in the fire exposures and control measures to be followed.
- **Job Change:** Training employees when they change jobs is important as new jobs present new exposures.

- **Traffic Control:** During a fire or other emergency, persons with essential duties must be able to move to locations where they are needed. In addition, it is usually necessary to evacuate occupants quickly.

9.17.5 Drills

- a) Planning for fire emergencies requires drilling. The prevention of personal injury and loss of life are the prime objectives of emergency planning.
- b) Fire drills must be conducted to test the organization's abilities and readiness to handle a fire emergency. One of the most important elements in fire protection -- EVACUATION of employees -- can be tested.
- c) Planned and unannounced drills should be conducted, each one serving its own purpose. Planned drills focus attention on inspections and training while unannounced ones truly test your organization's response.
- d) Planning for fire emergencies requires drilling. (The prevention of personal injury and loss of life are the prime objectives of the emergency planning.)
- e) Carefully plan and periodically carry out fire drills. Train employees to evacuate the building immediately at the proper alarm/signal.
- f) All employees should recognize the evacuation signal and know the exit route they are to follow. Upon hearing the signal, they should shut off equipment and report to a pre-determined assembly point. This point generally will be located outside of the building. Primary and alternate routes should be established and all employees should be trained to use either route.
- g) When employees are assembled, the line manager of each area should account for all personnel under his/her supervision. If any employees are missing, immediately report their names to the plant Safety Coordinator so that search and rescue efforts can be initiated. Only trained search and rescue personnel with adequate protective equipment should be permitted to re-enter an evacuated area.
- h) After each drill, a meeting of the responsible managers should be held to evaluate its success and to discuss any problems that may have occurred.

9.18 Scheduling & Reporting

Reporting the results of environmental management activities allows the responsible agencies to identify if any mitigation measure is not being effective and will enable corrective action to be taken. During construction, the contractors will have the responsibility to ensure environmental reporting procedures are being undertaken. After commissioning and handover, VRA will have ultimate responsibility to ensure that environmental reporting procedures are undertaken.

The EMP shall include a documented monitoring plan, which shall detail all data handling, storage and analyses requirements. VRA shall identify the location where all data is to be held, staff responsibilities for data handling and analysis and appropriate reporting lines for ensuring management are aware of the current status of site operations. This is particularly important with respect to resettlement negotiation, compensation payment and monitoring of implementation of these activities. Compensation schemes can suffer post construction claims from unsatisfied project-affected persons and detailed records keeping of all actions are essential to try to resolve any such issues.

Results of environmental monitoring activities will be reported to allow for identification of mitigation measures that need corrective action. VRA has the ultimate responsibility to ensure environmental reporting procedures are being undertaken at the project. The Environmental Officer shall monitor all environmental activities whilst the Safety Officer monitors the health and safety activities. Results of environmental monitoring activities will be reported to allow for identification of mitigation measures that need corrective action.

From pre-construction to operation/maintenance phases, VRA will carry the ultimate responsibility of ensuring that environmental reporting procedures are undertaken. The Project Team will carry out monthly discussions on the project which will form a forum for discussions on environmental issues, and decision making with regard to further mitigation, monitoring, or changes to project activities. All environmental procedures, periodic statutory reports to regulatory agencies such as the EPA, Energy Commission should be produced and controlled in accordance with the station's document control procedure.

The following types of reports shall be produced:

- a) Monthly Regular Report: This shall comprise of monthly activity report which shall provide information on environment protection activities performed during the period.
- b) Emergency report: This shall comprise of issues to be submitted promptly in case of emergencies
- c) Topic Report: Report concerning influential environment issues.
- d) Annual Environmental Report: This shall comprise of information on all environmental activities undertaken during the year beginning from January to December and submitted to the EPA.

The Environmental Officer will report directly to the Project Engineer on all environmental activities for inclusion in the project monthly reports. The Environmental Officer shall coordinate the production of monthly, quarterly, activity as well as legally binding environmental reports such as the AKOBEN EPRD. The reports shall form the basis for the preparation of an Annual Environmental Report (AER), as a requirement of the Environmental Impact Assessment Regulations, to be submitted to the Environmental Protection Agency. The Quarterly Environmental Reports and AER must be submitted to the E&SD Department for review to ensure that accurate and appropriate information is provided. The AER shall be prepared and must be submitted to the EPA by close of March, each year.

These statutory reports when finalised must be forwarded to all relevant VRA departments, specifically, Thermal Generations Department, Engineering Services, Project & Systems Monitoring and kept by the Environmental Officer, and should be made available to every worker who require its use in the course of activities undertaken. All monitoring and reporting documents must be kept on file, as part of VRA/Contractor documentation procedures. An open door policy must be maintained by all agencies on information regarding all environmental issues; such information can be accessed by any worker for purposes of improving on work output.

9.19 Project Environmental Permit

Following the submission of EIS Reports, the EPA issues an Environmental Permit to allow for the physical construction of projects to commence. The Permit outlines various conditions that must be adhered to in project implementation. It must be noted that it is an offence under Regulation 29 of the Environmental Assessment Regulations LI 1652 of 1999 to start a project without an Environmental Permit. VRA shall comply with all project specifications, mitigations, monitoring and other environmental management provisions that would be indicated in the Environmental Permit for the **“Kpone Thermal Power Project”**. Management shall ensure that all conditions are strictly adhered to. The Environmental Officer is directly responsible for implementing the conditions outlined in the permit.

VRA is the project sponsor and will ultimately have responsibility for the operation and maintenance of the KTPP. The environmental management of KTPP shall be addressed in the development of a 3 year Environmental and Social Management Plan (ESMP), which is one of the requirements in projects environmental permits. A site-specific Environmental Management Plan will therefore be developed for the KTPP during operation. Where not otherwise covered in the ESMP, the specific procedures for the KTPP site identified in this EIS will be taken into account. VRA also recognizes that environmental and social issues covered by the PEMP during operation could change as the project proceeds. VRA accepts the responsibility of managing these changes in a pro-active manner on an on-going basis; this will be undertaken as part of the review of the ESMP.

In addition to a site-specific Environmental Management Plan in force at the site, VRA has in accordance with corporate policy developed various a Health and Safety Plans in the form of Safety Rules, Protection Code & Safe Working Practice documents which shall also be implemented on site.

9.20 Environmental Auditing

The contractors will have the responsibility for auditing their staff and any subcontractors employed by them for all activities related to the work specified in their contracts. VRA will be responsible for auditing the contractors' performance against the EAP during construction, and for auditing VRA staff performance against the site-specific Environmental Management Plan during operation.

9.21 Cost of Environmental Management

VRA will make human resources available for environmental management and enhancement. In addition, financial provision shall be made to ensure that mitigation measures (including compensation), monitoring and training programmes are effectively implemented. VRA will make the necessary budgetary provisions to cover all commitments for the transmission project, including compensation. The estimated total budget for the various environmental management activities of the Power Plant and associated facilities is shown in **Table 35**. Budgetary provision has also been made for compensation; however, actual cost will be outlined in detail in the Valuation Report.

Final

Table 35: Provisional Environmental Management Plan

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
Environmental Impact Assessment	<ul style="list-style-type: none"> EIA to be prepared in line with Ghana EPA guidelines 	<ul style="list-style-type: none"> VRA EIA Consultant 	<ul style="list-style-type: none"> Submission of Reports 	<ul style="list-style-type: none"> EPA VRA 	<ul style="list-style-type: none"> US\$120,000 	<ul style="list-style-type: none"> Pre-Construction Period
Air Quality	<ul style="list-style-type: none"> To be monitored to update existing information on the ambient conditions and provide basis for verification and assess future impacts: 	<ul style="list-style-type: none"> VRA EIA Consultant 	<ul style="list-style-type: none"> Air Modelling covering combustion products as and particulates 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> Part of EIA Cost 	<ul style="list-style-type: none"> Pre-Construction Period
Noise	<ul style="list-style-type: none"> To be monitored to update existing information on the ambient conditions and provide basis for verification and to assess future impacts 	<ul style="list-style-type: none"> VRA EIA Consultant 	<ul style="list-style-type: none"> Noise Level at the boundaries of the project site 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> Part of EIA Cost 	<ul style="list-style-type: none"> Pre-Construction Period
Site/Land Preparation	<ul style="list-style-type: none"> The site should not be cleared and left unused for a long time The site clearance, topsoil removal, compacting, cutting and filling, and foundation construction should follow each other in order to avoid or minimize the incidence of erosion. 	<ul style="list-style-type: none"> Contractor 	<ul style="list-style-type: none"> Site Inspection 	<ul style="list-style-type: none"> EPA VRA 	<ul style="list-style-type: none"> US\$20,000 	<ul style="list-style-type: none"> Pre-Construction Period
Valuation Report	<ul style="list-style-type: none"> Following valuation of affected properties, a Valuation Report would be prepared 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> EPA guidelines 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> US\$25,000 	<ul style="list-style-type: none"> Pre-Construction
Compensation Payment	<ul style="list-style-type: none"> Payment of compensation shall be made to all property affected persons 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> VRA Lands Acquisition & Resettlement Framework 	<ul style="list-style-type: none"> EPA/LVD 	<ul style="list-style-type: none"> US \$1.5 M 	<ul style="list-style-type: none"> Pre-Construction
Record Keeping	<ul style="list-style-type: none"> Record keeping and reporting are important to trends determination and decision making. Records of significant environmental issues i.e. monitoring data, accidents, occupational sicknesses, fire outbreaks, spillages, and other emergencies would be kept 	<ul style="list-style-type: none"> SO and EO 	<ul style="list-style-type: none"> Monthly Audits of the Development 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> Part of E&SDD corporate budget 	<ul style="list-style-type: none"> Monthly/Yearly/3-Yearly

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
	and reported.					
Capacity Building	<ul style="list-style-type: none"> Training the Proponent Team and Contractors on Environmental Awareness especially on the impact and mitigation measures on the issues raised herein 	<ul style="list-style-type: none"> Third Party Environmental Consultant 	<ul style="list-style-type: none"> Training Report covering also the evaluation by participants 	<ul style="list-style-type: none"> EPA PEC 	<ul style="list-style-type: none"> Venue Fees: US\$700 Tuition fees + hand-outs & certificates: US\$2000 	Prior to project Implementation
Reporting: Environmental Quality Monitoring Report	<ul style="list-style-type: none"> Returns on Monitoring data and Analysis on Effluent, Stack Emissions, Solid Waste, Accidents, Spillages, etc. to EPA 	<ul style="list-style-type: none"> EO 	<ul style="list-style-type: none"> As per EPA guidelines 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> Part of E&SDD corporate budget 	<ul style="list-style-type: none"> Monthly
Reporting: Environmental Annual Report	<ul style="list-style-type: none"> As per EPA guidelines 	<ul style="list-style-type: none"> EO 	<ul style="list-style-type: none"> As per EPA guidelines 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> Part of E&SDD corporate budget 	<ul style="list-style-type: none"> Annually
Reporting: Environmental Management Plan	<ul style="list-style-type: none"> 3-Year Plan As per EPA guidelines 	<ul style="list-style-type: none"> EO 	<ul style="list-style-type: none"> As per EPA guidelines 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> Part of E&SDD corporate budget 	<ul style="list-style-type: none"> Operational Phase Once Every Three Years
Source of Raw Materials:	<ul style="list-style-type: none"> Obtain lumber from Forestry Commission approved sawmills Avoid chain sawn timber Obtain aggregates from licensed quarries 	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Visit/Inspection of lumber and its source 	<ul style="list-style-type: none"> VRA/EO 	<ul style="list-style-type: none"> Vehicle running costs on inspection: US\$500/ Month 	<ul style="list-style-type: none"> Weekly/ Monthly
Dust Emission	<ul style="list-style-type: none"> Provide the workers at construction site with nose masks Sprinkle Water on the site 	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Visit/Inspection of construction site 	<ul style="list-style-type: none"> VRA/EO 	<ul style="list-style-type: none"> Water & nose masks costs: US\$6,000/mth 	<ul style="list-style-type: none"> Weekly/ Monthly
Noise	<ul style="list-style-type: none"> Provide the workers at the construction site with safety gadgets Noise to be monitored during construction to provide basis for verification of impacts 	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Inspection of and visits to the construction site Noise Level at the boundaries of the 	<ul style="list-style-type: none"> VRA/EO 	<ul style="list-style-type: none"> US\$1,250 once per month 	<ul style="list-style-type: none"> Monthly

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
			project site			
Occupational Hazards and Accidents	<ul style="list-style-type: none"> Materials and equipment used for construction work & installation of plant equipment would be marked to explain their potential impact Workers would be made to always use helmets on site Other safety measures with regards to construction and installation works would be enforced. Reasonable practical precautions would be taken and instructions given in identification, handling, use, storage, transport and disposal of materials at construction site 	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Visit/Inspection of construction site 	<ul style="list-style-type: none"> Factories Inspectorate VRA/EO 	<ul style="list-style-type: none"> Vehicle running costs on inspection: US\$500/ Month 	<ul style="list-style-type: none"> weekly/ monthly
Traffic	<ul style="list-style-type: none"> Administrative measures will be put in place to stagger the delivery of construction equipment and materials to the construction sites. The delivery of materials and equipment would be carried out during off-peak hours. 	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Visit/Inspection of construction site 	<ul style="list-style-type: none"> Department of Urban Roads/GHA Contractor 	<ul style="list-style-type: none"> Vehicle running costs on inspection: US\$500/ Month 	<ul style="list-style-type: none"> weekly/ monthly
Solid Waste Management During Construction Period	<ul style="list-style-type: none"> Providing garbage cans of the right sizes for different types of solid wastes e.g. wood pieces, metal off-cuts, plastic, paper, and food remains Wood boards would be sold off to be re-used at other construction sites Metal pieces and off-cuts would go to dealers, who would in turn sell them to the steel works Paper would be picked up by recyclers 	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Visit/Inspection of construction site 	<ul style="list-style-type: none"> EPA VRA/EO 	<ul style="list-style-type: none"> GH ₵3500 being Cost of 7 garbage cans 	<ul style="list-style-type: none"> weekly/ monthly

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
	<ul style="list-style-type: none"> Plastics would also go to recyclers Food remains to Farms 					
Air Quality	<ul style="list-style-type: none"> monitoring station site selection monitoring station and meteorological equipment selection and installation 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> As per Criteria in Annex Three 	Environmental Officer (EO)	<ul style="list-style-type: none"> One time cost of GH ₵88,500 	<ul style="list-style-type: none"> Construction Phase
Air Quality	<ul style="list-style-type: none"> The monitoring of oxides of nitrogen (NO and NO₂), carbon monoxide (CO), sulphur dioxide (SO₂) and fine particles (PM₁₀) are to be carried out 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> Monthly Audits of the Development 	Environmental Officer (EO)	<ul style="list-style-type: none"> GH ₵1500 being Cost of Data retrieval, processing for reports 	<ul style="list-style-type: none"> Monthly
Solid Waste Management	<ul style="list-style-type: none"> Providing enough garbage cans of the right sizes, and of different colours for different types of solid wastes e.g. Wood pieces, Metals, Glass, Plastic, Paper, and Food Remains Paper from cartons, office waste and plastics would be picked up by recyclers Other solid wastes would be evacuated by handlers commissioned by Tema Metropolitan Assembly Food remains would be sold to farms Reporting and Documentation 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> Monthly Audits of the Development 	Environmental Officer (EO)	<ul style="list-style-type: none"> Solid Waste Fee to TMA Commissioned Handlers: US\$150 per month 	<ul style="list-style-type: none"> Monthly
Stack Emission	<ul style="list-style-type: none"> Determining the flue gas characteristics will be using a Continuous Emission Monitoring System (CEMS). The monitoring station will be located on the Combustion Turbine Generator Exhaust Stack and will monitor and record SO₂, NO_x, CO, and CO₂ on 	VRA	Daily Extracts of Data Monthly Audits of the Development	Environmental Officer (EO)	One time cost of about US\$ 15,500 for the monitoring system GH ₵1500 being Cost of Data retrieval, processing for reports	<ul style="list-style-type: none"> Monthly

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
	hourly basis.					
Fire Protection	<ul style="list-style-type: none"> Ensuring that reasonable and adequate life safety measures are incorporated in the project designs and structures: Automatic Sprinkler Systems would be installed throughout the buildings Heat and smoke detection devices would be installed in all areas and would be directly connected to the electrical system on a separate circuit supplied by a back-up power supply or would be equipped trickle charged batteries. The detectors would be connected to the central control alarm system, which would have an annunciator panel connected to the fire detection system. Alarms would be clearly audible throughout the development Design of the structure would incorporate facilities to evacuate occupants with minimum risk to life from smoke, fumes or panic An Emergency Response Programme (ERP) would be in place. It would cover evacuation procedures, employee training, inspections and coordination with the Ghana National Fire Service The designs of the development would be reviewed as per a Fire Protection and Life Safety Audit. The findings and recommendations from the audit would 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> Review of Designs Monthly Fire and Life Safety Audits of the Development 	<ul style="list-style-type: none"> Factories Inspectorate VRA/EO VRA/Safety Officer (SO) 	<ul style="list-style-type: none"> Cost involved in the in equipment supply 	<ul style="list-style-type: none"> Monthly

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
	be used as basis for establishing a Corrective Action Plan (CAP)					
Noise	<ul style="list-style-type: none"> replace the current air intake silencer with a higher performance unit to screen the step-up transformers with acoustic louvers ensure that an additional extract fan is installed on the GT enclosure, fitted with a downstream attenuator capable of offering sufficient attenuation 	<ul style="list-style-type: none"> VRA Environmental Department 	<ul style="list-style-type: none"> Technical Inspection of the Installed Equipment 	Environmental Officer (EO)	<ul style="list-style-type: none"> One time cost of about US\$ 37,845 	<ul style="list-style-type: none"> Construction Phase
Noise	<ul style="list-style-type: none"> Measuring noise levels at: Sections of all the four boundaries of the project site Gas Turbine Area (1m distance from enclosure of the gas turbine) Fuel Treatment Facility Transformers (1m distance from the transformer) Maintain Records 	<ul style="list-style-type: none"> VRA Environmental Department 	<ul style="list-style-type: none"> Using a Noise Meter approved and calibrated (by Ghana Standards Board) 	Environmental Officer (EO)	<ul style="list-style-type: none"> One time cost of about US\$ 1,240 being cost of noise meter 	<ul style="list-style-type: none"> Monthly
Neutralisation Sump	<ul style="list-style-type: none"> Ensuring that there no leakages/spillages Preparing Emergency Response & Preparedness Plan/Procedure Keeping records 	<ul style="list-style-type: none"> Station Chemist 	<ul style="list-style-type: none"> Analyse each batch of demineralised water for pH and Temperature Inspection of sump/process 	<ul style="list-style-type: none"> Chemist and EO 	<ul style="list-style-type: none"> US\$1,500/ Month, being cost of chemicals for analysis 	<ul style="list-style-type: none"> Inspection to be carried out weekly/monthly
Oily Waste	<ul style="list-style-type: none"> Oil Waste to be stored and evacuated by recyclers. The recyclers filter the lubricants for re-use and to fuel boilers, produce wood preservatives, and produce turpentine Preparing Emergency Response & 	<ul style="list-style-type: none"> VRA 	<ul style="list-style-type: none"> Analyse each batch of waste treated oil for pH and Oil & Grease Inspection of storage/process 	<ul style="list-style-type: none"> Chemist and Environmental Officer (EO) 	<ul style="list-style-type: none"> To be carried out at no cost to the Project GH ¢ 10,000 being Cost of storage tanks? 	<ul style="list-style-type: none"> Inspection to be carried out weekly/monthly

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
	Preparedness Plan/Procedure <ul style="list-style-type: none"> Keeping records 					
Final Entry of Effluent into Municipal Drain	<ul style="list-style-type: none"> Sampling of Effluent prior to entry into Municipal Drain for acidity, alkalinity, and oil/grease 	<ul style="list-style-type: none"> Chemist 	<ul style="list-style-type: none"> Monthly Audits of the Development 	<ul style="list-style-type: none"> Chemist and Environmental Officer (EO) 	<ul style="list-style-type: none"> At no cost to the Project GH ₵ 500/month as cost of Sampling and analysis 	<ul style="list-style-type: none"> As and when the need arises
Spillage of Fuel/Chemicals	<ul style="list-style-type: none"> Reasonable life and property safety measures would be incorporated into the design and structures and management procedures of the storage facilities. The following measures are proposed: Inspect storage facilities Follow Emergency Response & Preparedness Plan/Procedure Keep records 	<ul style="list-style-type: none"> Operators 	<ul style="list-style-type: none"> Inspection of storage/pumping process Follow Emergency Response & Preparedness Plan/Procedure 	<ul style="list-style-type: none"> Safety Officer and Environmental Officer (EO) 	<ul style="list-style-type: none"> GH ₵3000 being Cost of Oil Spill cleanup materials 	<ul style="list-style-type: none"> Inspection to be carried out weekly/monthly
Resource Use (Water, Electricity, Fuel, etc.)	<ul style="list-style-type: none"> Monitoring Keeping records 	<ul style="list-style-type: none"> Operators 	<ul style="list-style-type: none"> Measuring quantities consumed Reporting 	<ul style="list-style-type: none"> EO and Operators 		<ul style="list-style-type: none"> Monthly
Pre-Decommissioning Assessment	<ul style="list-style-type: none"> Prior to any decommissioning of the plant, the Ghana EPA will be notified and an assessment will be carried out to identify any potential environmental impacts that need to be addressed and mitigated in the decommissioning process 	EO/EPA Officials	<ul style="list-style-type: none"> Employing EPA procedures 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> EPA fees to be determined by EPA but estimated at GH ₵9500 	<ul style="list-style-type: none"> Prior to decommissioning
Decommissioning Activities: Dismantling and	<ul style="list-style-type: none"> All combustion turbine generators will be dismantled and parts will be transported for storage at the VRA 	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Employing EPA procedures 	<ul style="list-style-type: none"> EO/EPA Officials 	<ul style="list-style-type: none"> Costs of dismantling To be determined 	<ul style="list-style-type: none"> During decommissioning

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
Removal of Structures and Machinery	Substation in Tema <ul style="list-style-type: none"> All other equipment such as Oil and Gas Pipelines, Transformers, Fuel Treatment Plant, Fuel and Water Pumps will be dismantled and transported to the substation. Water and fuel storage tanks, water pipelines, electrical cables, and office buildings will be retained at site for alternative use by VRA and other user departments e.g. GWC, TOR and ECG 				with contractors or to be included as buyers' costs	
Decommissioning Activities: Solid Waste Management	<ul style="list-style-type: none"> All solid waste resulting from the decommissioning process will be disposed of as follows: Paper from cartons and office waste would be sent to recyclers Plastics would also go to recyclers Wood waste would go to recyclers of wood into pallets for port operations Other solid wastes would be evacuated by handlers commissioned by Tema Metropolitan Assembly (TMA) or TMA's Solid Waste Department 	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Employing EPA procedures 	<ul style="list-style-type: none"> EO/EPA Officials 	<ul style="list-style-type: none"> Costs of dismantling To be determined with contractors or to be included as buyers' costs 	<ul style="list-style-type: none"> During decommissioning
Decommissioning Activities: Liquid Waste Management- Clean Up of Oil Spills/Chemical Contaminants	<ul style="list-style-type: none"> Prior to the dismantling of plant, equipment and machinery, such oil containing equipment such as combustion turbines, generators, transformers, circuit breakers, and fuel tanks and pipelines, will be drained of their oil content. The oil waste will be stored in drums and disposed of through the VRA 	<ul style="list-style-type: none"> Contractors/ 	<ul style="list-style-type: none"> Employing EPA procedures 	<ul style="list-style-type: none"> EO/EPA Officials 	<ul style="list-style-type: none"> Costs of dismantling To be determined with contractors or to be included as buyers costs 	<ul style="list-style-type: none"> During decommissioning

Potential Concerns	Guideline and/or Mitigation Measure	Responsibility for Implementation	Monitoring Indicators/ Methods	Responsibility for Monitoring	Cost Estimates	Period/Time Frame
	<p>approved methods. Any spills, which might occur during the decommissioning process, will be cleaned up as per the Emergency Response & Preparedness Plan/Procedure, using e.g. bio-degradable oil absorbent pads and materials.</p> <ul style="list-style-type: none"> Chemical contaminants will also be cleaned with appropriate cleaning materials to ensure that the project site is free from contamination. Finally, liquid waste (domestic) from the plant's sanitary facilities will be disposed of through a contract with the Tema Metropolitan Assembly's Liquid Waste Management Department. 					
Post-Decommissioning Assessment	<ul style="list-style-type: none"> EPA will be invited to carry out a post-decommissioning assessment to establish compliance with all regulatory requirements and issue a certificate to that effect 	EO/EPA Officials	<ul style="list-style-type: none"> Employing EPA procedures 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> EPA fees to be determined by EPA but estimated at 9500Ghc 	<ul style="list-style-type: none"> Prior to decommissioning

10.0 CONSULTATIONS WITH KEY STAKEHOLDERS

Consultations play a major role in identifying the potential impacts of any proposed project. Consultations with the state agencies and regulatory agencies have assisted in defining the regulatory and institutional framework within which the project should be carried out. Community consultations also assist in the identification of socio-economic and cultural impacts that needs to be considered and addressed. Stakeholder consultation to support the EA and the resettlement process specifically aims to achieve the following objectives:

- To provide information about the project and its potential impacts to those interested in or affected by the project, and solicit their opinion in this regard;
- To manage expectations and misconceptions regarding the project;
- To agree resettlement preferences and discuss concerns; and
- To ensure participation by the communities.

Information obtained during consultations makes it possible to make the inventory of the existing infrastructures and to collect the component about the landed management, the socio-economic activities, the infrastructures and expectation of the people, which shall include.

- Habitat and demography (ethnic groups, religion, migrations);
- organization socio-policy, traditional and administrative layer;
- regional infrastructures;
- medical health (life expectancy, mortality, infrastructures, causes major of disease, important regional project,
- education (education level, education type, census of the schools);
- economy (major economic activities, incomes and employment, problems, economic development);
- exploitation of the resources (the main activities; exploitation, etc);

With this method in the project, the inventory will correspond to the socio-economic influence zone/site which will result from the development of the project. Information will be obtained from the state agencies, chiefs, community leaders and members as well as private institutions. Subsequently, a program of on-going public consultation and sensitisation has been developed separately to avoid any risk of apprehension associated with this project like problem of destroying certain plantations and extension of the allotments. The steps below are being used for the public education and sensitisation component of the project in order to ensure smooth implementation of the project.

- Consultation with the relevant government agencies
- Consultation with the Chiefs and elders of the identified affected communities
- Consultation with property affected persons
- Introducing the project and making available relevant information
- Maintaining and collecting information by enquiry

This section provides details of on-going consultations undertaken so far on the project. Stakeholders consulted on the project till date is outlined below:

10.1 Environmental Protection Agency

VRA in 2007 completed and submitted the required EPA Application Form EA1 with the objective of applying for an Environmental Permit to enable the physical construction of KTPP to commence. Following EPA's screening, it was indicated that the project falls under the category for which an Environmental Impact Assessment (EIA) is required and made suggestions on issues to be addressed when preparing the EIS document. A Scoping report was requested which required the inclusion of a detailed Terms of Reference to guide the preparation of the EIA.

It was indicated that during scoping, the main environmental and social issues are to be identified; the depth of analysis required for each impact is also to be identified and stated in the TOR. The approval of the Ghana EPA of the ToR in the Scoping study was required prior to the submission of the Environmental Impact Statement. A scoping study was undertaken which involved the first stage of a baseline survey to establish the existing ecological and socio-economic situation in the project area as well as detailing out the ToR, as required by the EPA. The document was submitted to the EPA in May 2008.

EPA formally responded to the Scoping Report in their letter Ref. CE: 1878/01/04 dated September 16, 2008²⁵ and made suggestions on issues to be addressed in the EIA document. Again, EPA in December 2008²⁶, further indicated that VRA should hold a public hearing in order to provide the opportunity for VRA to present the proposed project, potential impact and proposed mitigation measures and to address key public concern. The public hearing was scheduled for Friday December 12, 2008 at the KTPP site.

VRA however submitted a Draft EIS to the EPA for review in January 2010 without holding the public hearing. EPA formally responded to the Draft EIS Report in their letter Ref. CE1878/10/07, dated February 10, 2010²⁷ and reminded VRA to hold a public hearing as had been previously requested by them prior to the review of the Draft EIS. A meeting was held between VRA and EPA officials on March 9, 2010 at the EPA Board Room to discuss and finalise arrangements for the Public Hearing. EPA subsequently organised a Public Hearing at the premises of KTPP on April 29, 2010.

Following the public hearing, EPA in May 2010 submitted review comments on the Draft EIS and requested VRA to finalise the EIS Report²⁸. EPA in their review comments requested for evidence of consultations with the following stakeholders, the Ghana National Fire Service, Electricity Company of Ghana and the Ghana Water Company. It was also indicated that the Tema Metropolitan Assembly must be consulted.

²⁵ EPA Comments on Scoping Report attached as part of Appendix 11

²⁶ EPA's directives on public hearing attached as part of Appendix 11

²⁷ EPA's response attached as part of Appendix 11

²⁸ EPAs letter to finalize EIS report attached as part of Appendix 11

EPA's review comments on the Draft EIS and Public Hearing have guided the finalisation of this EIS Report for KTPP, which is expected to address any predicted environmental and social issue associated with the construction and operation of the thermal power plant and associated facilities.

10.2 Kpone Traditional Assembly

Consultations carried out with the Kpone Traditional Council on the implementation of the project indicated that the land for the proposed project is actually not under the jurisdiction of the Kpone Traditional Council. They welcomed the project and hoped that inhabitants of Kpone would obtain employment in the project.

10.3 Project Affected Persons

The Acting Regent of the Nmlitsakpo Community, the closest community to the project site, Mr Emmanuel Tetteh Oglie was consulted on the project. Others consulted were the land owners within the sphere of the project location, Crop farmers who were formerly farming on the project site, and few indigenes of the Nmlitsakpo Community.

Data compilation of their responses to the questionnaire have been processed and analysed in the socio-economic data. The main concern of the PAPs is the issue of compensation. The VRA held series of meetings with the PAPs and the minutes of the meetings have been attached as part of Appendix 11. Some pictures of consultations with project affected persons are shown in Plate 13 and Plate 14.

10.3.1 Public Hearing on Project

Due to the levels of anticipated impact, the EPA organised a public hearing at the project site on April 29, 2010. The programme was facilitated by the EPA and mediated by the Ghana Institute of Engineers. List of stakeholders that the EPA formally invited to the Public Hearing programme is provided in *Table 36*. EPA also invited certain individuals who have made complaints to them about the implementation of the KTPP to the programme.

Table 36: List of Key Stakeholders Invited to the Public Hearing

No.	Title	Address
1	The Honourable Minister	Ministry of Energy, Accra
2	The Chief Executive	Tema Development Corporation, Tema
3	The Chief Executive	Tema Metropolitan Assembly, Tema
4	The Chief Executive	Tema Oil Refinery, Tema
5	The Chief Executive	Ghana Water Company, Accra
6	The Chief Executive	Electricity Company of Ghana, Accra
7	The Chief Executive	Ghana National Fire Service, Accra
8	The Regent of Kpone	Kpone-Nmlitstakpo Traditional Council, Kpone Township
9	The Commander	Tema Industrial Area/Kpone Police Station, Tema
10	The Director	EPA Tema District office, Tema
11	The Chief Executive	Lands Commission, Accra
12	The President	Property Owners Interim Committee, Tema

No.	Title	Address
13	The Director	EPC Contractor, Zakheim International, Tema
14	The News Editor	GT News, Accra
15	The News Editor	TV3 News, Accra
16	The News Editor	New Times Corporation, Accra
17	The News Editor	Daily Graphic, Accra

The Public Hearing provided the platform for VRA to address concerns of both the project affected communities and property affected persons²⁹. A power point presentation on the project components and status was done by a representative from the Environment & Sustainable Development Department of VRA. The presentation was done in both the English and Ga languages.

A poster presentation was also done to depict the various components of the projects including the following;

- Project Affected People and their properties - houses to be compensated for.
- Project Site and surroundings.
- Machinery – Project equipment
- Similar VRA Thermal Projects in operation – Aboadze, TT1PP, TT2PP etc.

List of attendants and the minutes of the Public Hearing were taken by the EPA as they were the organisers of the programme. Some pictures from the Public Hearing Programme are shown in Plate 15 - Plate 18.

²⁹ Publication of Public Hearing Notice attached as part of Appendix 11



Plate 13: Consultations with the Ag. Regent of Nmlishakpo



Plate 14: Land Owner Mr Mike Gajekpo



Plate 15: Cross Section of Participants at the Public Hearing



Plate 16: Cross Section of Participants at the Public Hearing

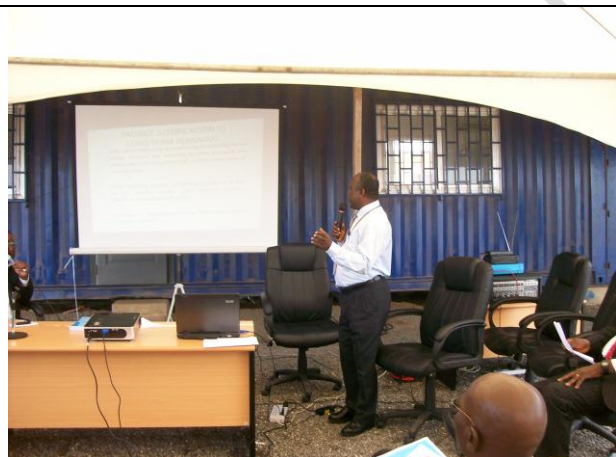


Plate 17: Mr. Amekor of VRA making a presentation at the Public Hearing



Plate 18: Mr Ebenezer Sampong of EPA facilitating at the Public Hearing

10.3.2 Local Stakeholder Hearing for the Clean Development Mechanism

Under the Clean Development Mechanism (CDM), a project-based mechanism for the greenhouse gas emission reduction under the Kyoto Protocol, local stakeholder hearing is an important procedure which shall ensure the sustainability and transparency of the project of concern. For CDM projects, a twofold stakeholder procedure is required; embracing a local and an international stakeholder consultation. Whereas the international stakeholder consultation takes places during validation at an advanced stage of the CDM project development cycle, the outcomes of the local stakeholder hearing need to be considered in the official project documentation, the so-called Project Design Document (PDD). It is the project developer's responsibility to invite the local stakeholders for an according stakeholder consultation. Within the PDD, it has to be demonstrated that comments by local stakeholders have been invited, a summary of the comments received has been provided, and a report to the designated operational entity on how due account was taken of any comments has been received.



Plate 19: Section of the General Public at the Stakeholder Hearing at KTPP

Further, as part of VRA's public consultation process for such projects, on-going detailed consultations are held with members of the affected communities located within the project's proximity as they are the most likely that persons to be impacted upon, like those whose properties will be affected by the project, reside in these communities. These consultations are done in order to discuss the communities' main concerns, main impacts to the communities, and to solicit suggestions from the communities to ensure affective implementation of compensation and resettlement measures. The consultation exercise involves public fora with traditional heads, opinion leaders and community members at designated areas in the communities. This process enables VRA to disclose the programme for the purpose of which is to ensure community participation.



Plate 20: Nii Daniel Tetteh Oglie, Chief of Nmlitsakpo, at Stakeholder Hearing at KTPP

Subsequently, the local stakeholder hearing and public consultation for VRA's thermal projects in Tema, including that of KTPP was held on May 30, 2012. This hearing was open to the general public and advertisements for the hearing were carried by the national dailies, public banners and posters³⁰. Identifiable stakeholder groups were invited by formal letters. Participants included representatives from institutions such as the Environmental Protection Agency, Tema Metropolitan Assembly, Ghana Police Service, Ghana Fire Service, Ghana Water Company Limited, Traditional Council, Community Representatives, NGOs, Media Houses and general public etc. Nii Daniel Tetteh Oglie, Chief of Nmlitsakpo, was present at the programme. List of participants is attached as part of Appendix 11. The panel comprised of representatives of VRA and CDM experts. The VRA representatives were from the Engineering Services Department, Public Relations Unit of the General Services Department and Environment & Sustainable Development Department. Upon agreement with participants, the local stakeholder consultation was held in English language, i.e. the official language of the Republic of Ghana and translated in Ga or Akan as may be required. Furthermore, all questions and comments from the stakeholders were made in English language. Hence, potential language barriers were duly considered and it was ensured that all participants had the same level of understanding of the local stakeholder consultation.

The project was presented by CDM experts and this comprised of (a) Introduction of the Clean Development Mechanism (CDM) (b) Introduction of the Stakeholder Consultation Process (c) Project Characteristics (d) Benefits of the Project and (e) Effects of the Project regarding Climate Change Mitigation. A power point presentation using an LCD Project was done. After the presentation, a vivid discussion arose where the participants expressed their interest in the project as well as their support. Answers to the various questions asked were provided by the various experts. Some pictures of the LSH are shown in Plate 19 and Plate 20.

A summary of some of the main concerns that were raised during the consultations and the answers provided at the various forums are outlined in Table 37. VRA has therefore appropriately addressed the concerns raised by the community members in this EIS Report.

Table 37: Issues raised and responses during the community consultations

ITEM	QUESTION	ANSWER
1	The Community does not agree to project implementation since in their opinion; such a project should not be located within a community.	VRA obtained land from TDC for the thermal project, thus the project is earmarked on the developmental plan. However to ensure that the communities are not impacted on, a buffer zone will be created
2	If the community agrees and there is impact on the community, will VRA stop the project	The project is developing a mitigating plan which will be approved by state agencies for implementation
3	If the project will not impact on individuals, why relocate those under the transmission line	The transmission line has safety implications due to EMF and therefore issues of right of way

³⁰ See Appendix 11 for a copy of the newspaper publication and posters

ITEM	QUESTION	ANSWER
	component	has to be addressed in line with national regulations
4	When will the baseline data be available for stakeholders' to access	The EIS Report will be published in the national newspapers and will be available at EPA offices
5	VRA has indicated that smoke will come out of the plant, and the community is aware that for smoke emissions, there are no boundaries so why is VRA proceeding with the project	The smoke or emissions will be captured and the release will be highly insignificant
6	If smoke reduction is to be implemented, why is VRA calling for stakeholders meeting to inform them	This forms part of the CDM registration process
7	A participant indicated that he was part of the development of Takoradi thermal Power Plant which has now become a tourist center and is generating a lot of income for the locals.	No Comments
8	If the Community Chief has agreed to the project, then the community members must also agree since in his opinion the Chief will not do anything untoward on behalf of the community	No Comments
9	Nii Daniel Tetteh Oglie, Chief of Mlitsakpo in his closing remarks indicated that a lot of discussions have gone on and it was based on that a final agreement was reached with VRA. He urged community members to request for community facilities that will benefit all instead of opposing the project ignorantly	No Comments

10.4 Dawhenya Health Center

Consultations were held with the nearest medical centre to the project site, which is the Dawhenya Medical Centre. Data on the major or prevalent disease was collected. This data has been supported with other literature review on the health status of the Tema Metropolitan Assembly.

10.5 Tema Development Corporation

The Tema Development Corporation (TDC) is the main custodian of the land in the Tema Metropolitan and provides serviced plots to developers. Consultation with the TDC related to grant of a lease to the marathon site and proposed development. Zakheim International construction limited, initial project contractors, for and on behalf of VRA per letter dated November 6, 2008 formally wrote to the TDC to enquire of the zoning status of the KTPP site³¹. This was followed by consultations with the Marketing, Legal and Estate Departments of the

³¹ See Appendix 11 for copy of Zakheim's letter to TDC

Tema Development Corporation (TDC). The following persons of TDC were consulted on the estimated number of inhabitants for the proposed Tema Community 25:

- Mr Abbey - Estate Manager
- Mrs Vida Asiedu Amponsah - Marketing Officer

TDC indicated that the land was earmarked for this project and given to VRA in the 1970s. The TDC consented to VRA possessing the buffer zone on condition that VRA maintains the buffer zone as green zone and ensure development that would minimize noise. It must be stated that from the site plan the TDC land ends with the boundary of the VRA Marathon Site. As indicated, TDC staff was also invited to participate in the Public Hearing programme held on April 29, 2010 and the stakeholders hearing on May 30, 2012.

10.6 Tema Metropolitan Assembly

No formal meeting has been held with officials of the Tema Metropolitan Assembly (TMA) on the project. However, TMA officials were invited to the public hearing as well as the stakeholder hearings organised in April 2010 and May 2012 respectively. The TMA is therefore fully aware of the project and have not given any objection to the proposed development.

10.7 Ghana Grid Company

As indicated, the Volta River Development Act, Act 46 of 1961 was amended by the Volta River Development Act, Act 692 of 2005 following which the power transmission function of the VRA was transferred to a transmission utility company known as Ghana Grid Company Limited (GRIDCo). Basically, majority of the staff of the erstwhile Transmission System Department of the VRA were transferred to GRIDCo. GRIDCo became operational on August 1, 2008 following the transfer of the core staff and power transmission assets from VRA to GRIDCo.

Subsequently, the current planning of the transmission system of the project was done in consultation with the staff of GRIDCo and the detailed design and specification for the transmission line components shall be in line with the existing GRIDCo system. Some of the officials of GRIDCo who have been involved in these discussions include:

- Mr. Norbert Anku - Director, Engineering
- Mr. Ebenezer Essienyi - Principal Engineer
- Mr. Ben Ntsin - Principal Engineer

10.8 Ghana Highway Authority

Constructional activities for the associated linear projects of KTPP (gas/diesel pipelines and transmission lines) across public roads will cause temporary traffic disruptions. The main concern regarding to the construction of the gas pipeline is its crossing under the Tema-Dawhenya-Aflao Road, at the Volta substation junction, at the same point where the main high voltage line from Akosombo crosses the highway. This is because a tunnel is

to be dug under the road through a special road crossing design to contain the gas pipeline, using international best practice.

Currently, VRA is yet to meet formally with the Ghana Highway Authority on the subject since full designs for the intended special crossing under the road is yet to be provided by the EPC Contractor. However, VRA has formally written to the GHA to fix a time and date for a meeting to discuss strategies for undertaken the works³². GHA is yet to respond. Minutes of the meeting and decisions taken will be made available in the Projects Annual Environmental Report.

VRA shall ensure coordination with the Ghana Highway Authority and Department of Urban Roads to minimise interference between installation and operation following guidelines of the "Road Reservation Management: Manual for Coordination" (June 2001). A Notice of Work shall be given as outlined in Appendix 1 of the manual and is to be accompanied by a sketch of the location plan

10.9 Ghana National Fire Service

Zakheim International Construction Limited, Project Contractors, for and on behalf of VRA per letter dated November 6, 2008 formally wrote to the Ghana National Fire Service (GNFS) to inspect the KTPP site and prepare a fire assessment report³³. Following this, GNFS officials (D.O. Jones Sarpong, the Regional Fire Safety Officer Tema and Mr Aboagye, the Fire Officer) visited the project site to conduct a field visit. They were taken round the project site and the project explained to them to help prepare the Fire Assessment Report. Following the preparation of the fire assessment report, the Ghana National Fire Service, per letter dated March 15, 2010 has issued a Fire Permit for the operations of KTPP³⁴. As indicated, GNFS personnel were also invited to participate in the Public Hearing as well as the stakeholder hearing programmes. Some staff from the Tema regional office present included Patrick Sallah and Emmanuel Okyere.

10.10 Electricity Company of Ghana & Ghana Water Company

Officials of both Electricity Company of Ghana (ECG) and Ghana Water Company were consulted on the project. Indeed, Zakheim International Construction Limited, initial project contractors, for and on behalf of VRA per letters, both dated November 6, 2008 formally wrote to ECG and GWC to enquire if the requirements of the plant would not affect public consumption³⁵. Again, both agencies were invited to participate in the Public Hearing programme held on April 29, 2010.

Currently, there is an existing 33kV power system line of the Electricity Company of Ghana (ECG) at the site which was connected by the Ministry of Energy on behalf of VRA. It must be noted that power for construction and project activities will be obtained from this source. ECG has confirmed that they have installed two (2)

³² See Appendix 11 for copy of VRA's letter to GHA

³³ See Appendix 11 for copy of Zakheim's letter to GNFS

³⁴ See Appendix 11 for copy of the Fire Permit

³⁵ See Appendix 11 for copy of Zakheim's letters to ECG and GWC

200KV transformers, coming from two different sources for the project. ECG has stated that the transformers were more than sufficient to supply the 30 Kwh required for the project and in no way would their consumption affect the power distribution to the community. Power for the operational phase of the plant will be from the Station itself and would not be dependent on that from ECG.

Consultations were held with Mr. Edmund Quarshie, Project Engineer Tema Regional Head Office and Mr Yendo, the Regional Engineer Tema, both officials of Ghana Water Company. GWC indicated that they have even laid pipes to the project site and the 3,000 cubic meter daily consumption was in line with its daily discharge for the area. VRA and GWC are currently concluding a Water Sales & Purchase Agreement for the project. GWC per letter Ref. No. MD403 Vol/8/59 dated January 7, 2011 forwarded a Draft Water Sales & Purchase Agreement document for review by VRA³⁶.

10.11 Disclosure Programme

As part of the consultation processes, the VRA shall disclose at various times to the general public, relevant documentation and activities for their attention and relevant action. So far, the following have been done:

- a) Following the submission of Draft EIS to the Ghana EPA in January 2010, the document was disclosed in the national newspapers in March 2010 for comments.
- b) Disclosure in the national newspapers of the Public hearing event on April 29, 2010
- c) Disclosure in the national newspapers of the stakeholder hearing event on the CDM on May 30, 2012³⁷.

³⁶ See Appendix 11 for GWC's letter on Water Sales & Purchase Agreement

³⁷ Public Disclosures on EIA exercise is attached as part of Appendix 11

11.0 DECOMMISSIONING & SITE CLOSURE PLAN

11.1 Introduction

The proposed site for the thermal power plant at Kpone has been acquired by VRA for the project as well as for future expansion. The power plant elements are designed to a life expectancy of 25 years. It is anticipated that the thermal station elements will be continuously maintained and repaired and will be operated for several decades. The lifespan of the associated transmission towers is also typically 50 years. The project elements may be upgraded and/or renewed based on cost/benefit analysis and new technologies. Because of its long life span, the circumstances under which the KTPP might be ultimately decommissioned are difficult to foresee. It is anticipated that the associated facilities will be continuously maintained and repaired.

However, a Decommissioning and Site Closure Plan (DCP) is required to guard against the remote possibility that the project ceases to operate and the facilities are abandoned by VRA. Should such a circumstance arise, the potential would exist for impacts from abandonment of the thermal plants such as aesthetic impacts and potential trespassing and safety concerns. This Decommissioning and Site Closure Plan (DCP) is being posted to provide a guide on details of the activities to be undertaken in the event of the need to de-commission the plant. The purpose of this conceptual DCP is to describe the general objectives for the post project land use, and the planning processes leading to development of a final DCP.

The specific objectives in managing the decommissioning process will be;

- ✓ To ensure that rehabilitation and decommissioning are carried out in a planned sequential manner, consistent with best practice,
- ✓ To ensure that agreed post-project land-use outcomes are achieved, and
- ✓ To avoid on-going liability

A Full Decommissioning Report is expected to be prepared in the event of any such activity for concurrence with the EPA and any other requisite state agencies.

11.2 Pre-Decommissioning Assessment

Prior to any decommissioning of the thermal power plant, the Ghana EPA will be notified and an assessment will be carried out to identify any potential environmental impacts that need to be addressed and mitigated in the decommissioning process.

11.3 Decommissioning Phase Activities

11.3.1 Liquid Waste Management-Clean Up of Oil Spills/Chemical Contaminants

Prior to the dismantling of plant, equipment and machinery, such oil containing equipment such as combustion turbines, generators, transformers, circuit breakers, and fuel tanks and pipelines, will be drained of their oil content. The oil waste will be stored in drums and disposed of through the VRA approved methods of recycling to licensed operators. Any spills, which might occur during the decommissioning process, will be cleaned up as per the Emergency Response & Preparedness Plan/Procedure, using e.g. bio-degradable oil absorbent pads

and materials. Chemical contaminants will also be cleaned with appropriate cleaning materials to ensure that the project site is free from contamination. Finally, liquid waste (domestic) from the plant's sanitary facilities will be disposed of through a contract with the Tema Metropolitan Assembly's Liquid Waste Management Department.

11.3.2 Dismantling and Removal of Structures and Machinery

During decommissioning activities, the Tema Metropolitan Assembly Town & Country Planning Department and the EPA office shall have access to the site, pursuant to reasonable notice, to inspect the results of complete decommissioning. All combustion turbine generators will be dismantled and parts will be transported for storage at the VRA Substation in Tema, which is close to the project site. All other equipment such as Oil and Gas Pipelines, Transformers, Fuel Treatment Plant, Fuel and Water Pumps will be similarly dismantled and parts transported to the VRA substation for storage. It is important to mention however that the structures such as water tanks and fuel storage tanks, electrical cable (lines), water pipelines and office buildings will be retained at site for alternative use by VRA and other departments such as Ghana Water Company, Tema Oil Refinery and Electricity Company of Ghana.

All decommissioning and restoration activities will be in accordance with all applicable state and local permits and requirements and will include the following specific activities:

- ✓ **Plant removal:** Cranes and/or other machinery will be used for the disassembly and removal of the turbines and plant equipment. Electronic components and controls such as protection devices, switches, junction and combiner boxes, transformers, auxiliary power supply and internal cables will be removed. The turbines will be lowered to the ground for disassembly and transporting. These will either be transported whole for reconditioning and reuse or disassembled into salvageable, recyclable, or disposable components.
- ✓ **Foundation removal.** All foundation materials will be removed down to a level 0.914m (or as per Ghana EPA guidelines or requirements). The remaining excavation will be filled with clean sub-grade material, compacted to a density similar to surrounding sub-grade material, and finished with topsoil.
- ✓ **Underground collection cables.** All cables buried less than 0.914m or as per Ghana EPA guidelines or requirements), will be removed. All cables buried deeper than 0.914m, will be kept in place if it is determined that their presence does not adversely impact land use and they do not pose a safety hazard.
- ✓ **Access roads and parking areas:** At the discretion of the new landowners, gravel will be removed from access roads and parking areas and transported to a pre-approved disposal location. Any drainage structures will be removed and backfilled with sub-grade material (if necessary). All road materials will be allowed to remain on-site. The ground will be de-compacted (in agricultural areas only), and allowed to re-vegetate naturally.
- ✓ **Monitoring:** A monitoring and remediation period of two years immediately following the completion of any decommissioning and restoration activities will be undertaken. If agriculture impacts are identified during this period, follow-up restoration efforts will be implemented.

- ✓ **Substation:** The Project substation is generally valuable to the local transmission owner. As per the interconnection rules of GRIDCo, the project sub-station shall revert to the ownership of the transmission owner and thus VRA does not intend to decommission the substation.
- ✓ Areas where subsurface components are removed will be graded to match adjacent contours, stabilized with an appropriate seed mix, and allowed to re-vegetate naturally,
- ✓ All town, county or state roads, impacted by Project decommissioning activity, if any, will be restored to original condition upon completion of decommissioning.

11.3.3 Solid Waste Management

All solid waste resulting from the decommissioning process will be disposed of as follows:

- Paper from cartons, office waste, wood waste and waste plastics would be sent to recyclers
- Other solid wastes would be evacuated by handlers commissioned by TMA or TMA's Solid Waste Department

11.4 Post-Decommissioning Assessment

Removal of machinery, equipment, turbines and all other materials related to the project is to be completed within one year of decommissioning. At the end of the decommissioning exercise, the EPA will be invited to carry out a post-decommissioning assessment to establish compliance with all regulatory requirements and issue a certificate to that effect. The Decommissioning Plan set forth above shall be binding upon VRA or any of its successors, insofar as it constitutes a mandatory permitting requirement under each Town's local law, and each permit shall run with the land and improvements comprising the Project. Best Practice requires that planning of thermal power plant closure be undertaken progressively throughout the lifetime of the operational phase. As such the conceptual plan will be reviewed and detail added as it becomes available. The Decommissioning and Closure Plan will be finalised and submitted to the relevant authorities for approval at least six months prior to closure of the site.

A report describing the performance of the final DCP in working towards its objectives, based on monitoring results, and the extent to which it has been complied with, will be submitted to the EPA. The report will be provided to documented stakeholders and will otherwise be publicly available on request. Files and documents used to collate information regarding closure commitments, licences, approvals and other information concerning closure will be catalogued and maintained in accordance with standard VRA practices.

11.5 Responsibility & Budget

Budgetary provision shall be made as part of VRA corporate budget for decommission and reclamation exercise at the end of project life. In order to provide such financial assurance before the end of the useful life of the equipment, VRA agrees to deliver to relevant agencies prior to the decommission and closure phase, a financial instrument with an aggregate initial face amount equal to the decommissioning cost estimate prepared and certified by a professional engineer in accordance with national and respective local laws. Costs of dismantling of the thermal power plant are to be determined with contractors or to be included as buyer's costs as indicated in *Table 35*. Subject to such estimate and certification, the anticipated formula for calculating the estimated decommissioning cost is provided in *Table 38*.

Table 38: Calculation for Decommissioning Costs

Schedule	Activity	Costs (GH ¢)	Total Costs (GH ¢)
A	Turbine & equipment Removal	(# of man hours) x (labor rate - GH ¢/hour) = GH ¢ Equipment (# of days in use) x (daily rate) = GH ¢	Total A
B	Concrete Foundation Removal	(# of man hours) x (labor rate - GH ¢/hour) = GH ¢ Equipment (# of days in use) x (daily rate) = GH ¢	Total B
C	Access Road and Buried Cable Removal	(# of man hours) x (labor rate - GH ¢/hour) = GH ¢ Equipment (# of days in use) x (daily rate) = GH ¢	Total C
D	Seeding and Re-vegetation	(# of man hours) x (labor rate - \$/hour) = GH ¢/ Equipment (# of days in use) x (daily rate) = GH ¢ Materials (cost per unit) x (# of units) = GH ¢ (seed, mulch and topsoil)	Total D
E	Total Estimated Removal Cost Per Each Turbine = GH ¢		A+B+C+D
F	Estimated Salvage Cost	Value of each Turbine = Total D = GH ¢ Value of each ancillary component = GH ¢	Total F
G	Total Value for Decommissioning Project = GH ¢		E - F

VRA hereby makes a firm commitment to rehabilitate all disturbed areas to an acceptable land use end and to ensure that at the expiry of all operations, the project area will be left in adequately safe and environmentally-sustainable condition.

12.0 CONCLUSION

The Kpone Thermal Power Project involves the construction, commissioning and operation of a 220 MW thermal plant. The plant is being built to furnish power to the national grid to supplement existing hydro and thermal generation and to provide required base load capacity in times of water shortages affecting hydro generation capacity. The plant shall be designed for a 25 calendar year life. Natural Gas will be the principal energy source for use at the plant.

The project, which is at the preconstruction stage, requires an Environmental Assessment study to be carried out in line with the Environmental Assessment Regulation, 1999, LI 1652. This Final Environmental Impact Statement Report for the “**Kpone Thermal Power Project**” has identified potential impacts on the physical, biological and socio-economic/cultural environments, occupational safety, health and welfare of the employees. Mitigative and potential remedial measures have also been outlined. Environmental Monitoring and Management Plans have been prepared to track, deal and monitor the measures proposed herein. These will be actively pursued in order to minimise or, if possible, eliminate the identified negative impacts.

The thermal power plant and associated transmission line as well as gas and diesel pipeline facilities cannot be carried out without any impacts on the environment. Indeed, some of the impacts are unavoidable. However, the mitigative measures put forward are expected, as far as possible, to be able to minimize the impacts so as to make them pose no threats to the continued sustainability of the environment. A review of the identified impacts shows that there will be some significant adverse irreversible impacts on the environment (e.g. air quality, land ownership and land-use characteristics). The emissions, according to the air modelling, are not expected to exceed the Ghanaian guidelines. Other impacts will be minimal and temporary. The benefits to be derived from the implementation of the project are immense, especially considering the problems of electricity generations experienced in Ghana.

The construction, commissioning and operation of the project will be carried out in environmentally sustainable manner so as to minimise or completely eliminate impact on the environment and human health, lifestyle and sustenance. VRA has put forward mitigation measures aimed at reducing, and if possible, eliminate the impacts afore-mentioned to ensure that the end use of the land after the expiry for the project's life span is not compromised. VRA will also compensate all persons whose properties may be affected. A Valuation Report has already been prepared in line with VRA “Lands Acquisition & Resettlement Framework” to document and guide this process. Compensation has largely been paid out to all property affected persons.

VRA believes that the EIS has sufficiently dealt with the significant issues on the ground. It is hoped that the report will meet the expectations of the EPA and warrant the issuance of Permit to enable VRA to commence the project. VRA commits to collaborate with EPA to jointly manage the environmental and social concerns related to the thermal power plant project and shall submit environmental reports to the EPA as required.

In conclusion, it is affirmed that VRA is committed to ensuring continuous improvement of environmental performance to minimize the impacts of all its operations on the environment, in line with the principles of

sustainable development, in addition to complying with national and international environmental protection regulations. This is an undertaking VRA is firmly committed to and shall adhere to it.

Final

APPENDIX

- Appendix 1: VRA "Lands Acquisition & Resettlement Framework"
- Appendix 2:
 - a) Site Map for KTPP
 - b) Plot Location Map for KTPP
 - c) Plot Plan of Equipment for KTPP
 - d) Site plan showing Borehole Coordinates
- Appendix 3: Gas Pipeline Corridor Survey Report
- Appendix 4: Flow Diagrams of KTPP
- Appendix 5: GWC Quality of Supply Water for KTPP
- Appendix 6: Project Milestones for KTPP
- Appendix 7: Geotech Survey Report
- Appendix 8: Sound Emissions Prognosis Report
- Appendix 9:
 - a) Air Dispersion Modelling Report
 - b) Ambient Air Quality Report
- Appendix 10: Compensation List for KTPP
- Appendix 11:
 - a) EPA Comments on Scoping Report in September 2008
 - b) EPA Request for Public Hearing in December 2008
 - c) EPA Request for Public Hearing in February 2010
 - d) EPA Review Comments on Draft EIS in May 2010
 - e) Zakheim's letters to TDC, ECG, GWC and GNFS
 - f) VRA's letter to GHA and BOST
 - g) Fire Permit for KTPP
 - h) Minutes of Meeting with Project Affected Persons
 - i) Publication of Notice on EIS for KTPP
 - j) Publication of Notice for Public Hearing in April 2012
 - k) Notice of Stakeholder Hearing on CDM in May 2012
 - l) Poster on CDM Stakeholder Hearing in May 2012
 - m) Attendance at CDM Hearing in May 2012

APPENDIX 1:

VRA “Lands Acquisition & Resettlement Framework”

Final

APPENDIX 2:

- a) Site Map for KTPP
 - b) Plot Location Map for KTPP
 - c) Plot Plan of Equipment for KTPP
 - d) Site Plan showing Borehole Coordinates
-

APPENDIX 3:
Gas Pipeline Corridor Survey Report

Final

APPENDIX 4:
Flow Diagrams of KTPP

APPENDIX 5:
GWC Quality of Supply Water for KTPP

Final

APPENDIX 6:
Project Milestones for KTPP

Final

APPENDIX 7:
Geotech Survey Report

APPENDIX 8:
Sound Emissions Prognosis Report

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 - b) Ambient Air Quality Report
-

APPENDIX 10:
Compensation List for KTPP

Final

APPENDIX 11:

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