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## 12 Conclusions

An Environment and Social Impact Assessment (ESIA) process for the proposed Lamu coal-fired power plant and ancillary infrastructure has been undertaken in accordance with the EIA Regulations published in Legal Notice 101 of June 13<sup>th</sup>, 2003, in terms of the Environment Management and Coordination Act 1999 (EMCA), the African Development Bank Integrated Safeguards System (ISS) and the International Finance Corporation (IFC) Performance Standards on environmental and social sustainability.

The essence of any ESIA process is aimed at ensuring informed decision-making and environmental accountability, and to assist in achieving environmentally sound and sustainable development. In terms of EMCA, the entitlement to a clean and health environment is evident under clause 3 which states that *"every person is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment"*.

In assessing the environmental feasibility of the proposed project, the requirements of relevant legislation has been considered, including inter alia, those of:

- The Constitution of Kenya 2010;
- Environment Management and Coordination Act, 1999 (EMCA) and its subsidiary legislation which includes:
  - Environment Impact Assessment and Audit Regulations 2003;
  - Water Quality Regulations 2006;
  - Waste Management Regulations 2006;
  - Environment Management and Coordination (Noise and Excessive Vibration Pollution)(Control) Regulations 2009; and
  - Air Quality Regulations 2014.
- Energy Act 2006
- The Physical Planning Act, Chapter 286 of 1996
- Occupational Safety and Health Act, 2007 (OSHA) and its subsidiary legislation including:
  - L.N. 40: The Building Operations and Works of Engineering Construction Rules 1984;
  - L.N. 31: The Factories and Other Places of Work (Safety and Health Committee) Rules 2004;
  - L.N. 24: The Factories and Other Places of Work (Medical Examination) Rules 2005;
  - L.N. 25: The Factories and Other Places of Work (Noise Prevention and Control) Rules 2005;
  - L.N. 59: The Factories and Other Places of Work (Fire Risk Reduction) Rules 2007;
  - L.N. 60: The Factories and Other Places of Work (Hazardous Substances) Rules 2007;
  - The Work Injury Benefits Act 2007 No. 13 of 2007.

## **Conclusions**

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- The Land Act 2012;
- The County Government Act 2012;
- The Public Health Act;
- The Water Act;
- The National Museums and Heritage Act 2006; and
- The Fisheries Act.

This relevant legislation has informed the identification and development of appropriate management and mitigation measures that should be implemented in order to minimise potentially significant impacts associated with the project.

The conclusions of this ESIA are the result of comprehensive studies and specialist assessments. These studies were based on issues identified through the ESIA process and the parallel process of public participation. The public consultation process has been rigorous and extensive, and every effort has been made to include representatives of all stakeholders within the process.

### **12.1 Evaluation of the Proposed Project**

The preceding chapters of this report provide an assessment of the predicted environmental impacts on specific components of the social and biophysical environment as a result of the proposed project. This chapter concludes the ESIA Study by providing an evaluation of the most important environmental impacts identified through the process. In so doing, it draws on the information gathered as part of the ESIA process and the knowledge gained by the environmental consultants during the course of the ESIA and presents an informed opinion about the proposed project.

In order to meet the objectives as set out in the Energy Policy 2004, the Draft Energy Policy 2015 and the 5000+MW power generation program in Kenya, as well as to meet developmental and socio-economic objectives in Kenya, the country needs to optimally use the available energy resources. As at December 2014, Kenya's installed generation capacity was 2173MW of electricity; the Least Cost Power Development Plan (LCPDP) estimates that power demand using the reference case ranges from 1370MW in 2012 to 3034MW in 2018 to 14446MW in 2030 and 21,075MW in 2033; as such, Kenya Power is as the distribution company needs to provide the growing electricity demand.

In order for Kenya to meet the growing electricity demand, the Ministry of Energy and Petroleum (MoEP) needs to diversify its energy mix. Subsequently, the MoEP is investigating a variety of options including conventional pulverized fuel power plants, natural gas-fired power plants, nuclear power plants, renewable energy technologies (mainly geothermal, wind and solar projects), and import options within the East African Power Pool.

The 5000+MW constitutes reasonable future electricity demand forecast from the proposed steel industry, Standard Gauge Railway, Konza Technopolis City and the LAPSET projects in Lamu. For base load capacity, the selection of the preferred alternative from those being investigated is required as a matter of urgency to enable the Government of Kenya to provide the needed electricity for the first unit of the chosen plant to be commissioned in 2019. The construction of the proposed new coal-fired power station in Kwasasi is part of the above process.

The need to construct a new coal-fired power station in order to assist Kenya Power in adequately providing for the growing electricity demand was identified through the Least Cost Power Development Plan (LCPDP). This is Kenya's blueprint for the development of power generation from a variety of sources in order to meet the growing electricity demand in the country. Through screening and feasibility studies undertaken by the MoEP, the construction of a new coal-fired power plant in the Kwasasi area of Hindi/Magogoni sub-county, Lamu County was identified one of the feasible options.

The power plant in Kwasasi area is proposed to operate at an installed capacity of approximately 1,050MW (3 x 350MW) with potential expansion in the long-term. The exact output will depend on the generating technology utilized, the specification of the equipment installed, and the ambient operating conditions. The ancillary infrastructure includes facilities such as ash dumps, coal stock yards, the construction of a coal conveyor belt from a berth and jetty to be built for the project, a desalination plant to supply water during the construction period and the establishment of a temporary construction camp.

The major environmental impacts associated with the proposed project as discussed in the ESIA include:

- Overall benefits associated with the establishment of the proposed power station and ancillary infrastructure, in terms of assisting in meeting the electricity demand in the short- and long-term, with a short lead time to operation.
- Potential impacts on air quality and human health as a result of emissions from the facility.
- Potential impacts on surface and groundwater resources as a result of the proposed project.
- Potential visual impacts associated with the proposed project and associated impacts on tourism potential.
- Potential noise impacts.
- Potential impacts on heritage sites.
- Potential impacts associated with the transportation of components during construction and fuel during operation.
- Potential impacts on flora, fauna and ecology.
- Potential impacts on soils
- Potential social impacts.

No fatal flaws were identified since the impacts can be mitigated to acceptable levels.

## 12.2 Proposed mitigation measures

From the findings of the specialist studies undertaken, the following mitigation measures are proposed to be implemented in order to minimize any potentially significant impacts:

### 12.2.1 Surface and groundwater quality

A groundwater monitoring program should be established on the project site selected for development. The requirements of this monitoring program should be agreed with the relevant authorities (County Government of Lamu and NEMA). A suite of management measures have been proposed and include:

The quality of water entering the groundwater. This could be managed by:

- Monitoring groundwater quality and water levels;
- Ensuring proper design and sufficient capacity of the ash yard to prevent overflow/spillage;
- Constructing a clay base to minimize seepage from the ash yard facility; and
- Installing down gradient groundwater monitoring wells to monitor quality and water levels.

Quality of surface water on site. This could be managed by:

- Separating clean and dirty runoff;
- Minimizing disturbed areas during construction;
- Installing and maintaining controls, including berms and furrows; and
- Sloping topography to prevent ponding.

Sewage treatment plant. This could be managed by:

- Correctly sizing, designing and constructing the effluent treatment plant (ETP);
- Maintaining the ETP regularly;
- Monitoring the effluent discharge in compliance with the water quality regulations in Kenya (L.N. 120 Water Quality Regulations, 2006);
- Maintenance of an annual valid Effluent Discharge License (EDL) issued by NEMA.

Fuel (bunker) oil in water migrating off site. This could be managed by:

- Containing oil in bunded area;
- Ensuring clean up protocols in place and followed;
- Installing oil traps and separators; and
- Keeping accurate oil records (purchased, disposed and recycled).

Insufficient water supply. This could be managed by:

- Design and installation of an adequately sized desalination plant;
- Implementing water use or water wastage minimization; and
- Reducing water demand.

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Coal stockyard (i.e. storage of coal on site). This could be managed by:

- Constructing clay base;
- Separating clean and dirty runoff;
- Installing and maintaining surface water controls;
- Sloping topography to prevent ponding; and
- Monitoring groundwater levels and quality.

### 12.2.2 Thermal effluent

Currently, there is no legislation in Kenya for regulating thermal discharges from power plants or similar utilities that use water for cooling purposes. Subsequently, a marine discharge study for the proposed Lamu Coal Power Plant was undertaken to verify and confirm compliance with the International Finance Corporation (IFC) General Environmental Health and Safety (EHS) Guidelines related to the discharge of heated effluent into the sea. The heated effluent refers to the warm cooling water returned to the sea from the power station process cooling water systems.

Section 1.3 of the IFC General EHS Guidelines states that for general liquid effluent quality, *the temperature of wastewater prior to discharge should not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.*

Based on four circulating water (CW) discharge outfall locations and seven diffuser designs, it was established that the IFC requirements above are complied with in all cases except for one diffuser design (staged perpendicular) which will not be considered further.

Based on an environmental and engineering analysis, the EPC contractor was provided with a design criteria for the CW outfall location in order for them to undertake a recirculation study. Based on the results of the recirculation study, the EPC contractor will locate the CW intake location.

A 3D thermal plume hydrodynamic modeling study will be undertaken for the CW outfall location provided to the EPC Contractor once they complete their recirculation study. The objective of undertaking the advanced hydrodynamic modeling is to define the far field mixing zone based on the CW outfall location provided to the EPC contractor. The comprehensive report of the 3D hydrodynamic modeling will be an addendum to this ESIA Study.

### 12.2.3 Terrestrial fauna and flora

APCL is developing a portion of the total 880 acres of land that is required for the proposed Lamu coal power plant; it was established that there are few mitigation measures on terrestrial fauna and flora that can be recommended which will ameliorate potential impacts associated with the footprint of the facility. Faunal species generally move away from areas of high activity by themselves and repopulate in surrounding areas of suitable habitat.

General recommendations for terrestrial fauna and flora include:

- Contain all construction and operational activities within the boundaries of the specified areas;
- Utilize trees that normally grow to extensive heights for screening effects;
- Implement a collection and re-establishment program of bulbs and geophytes for rehabilitation purposes;
- Endeavor to contain human movement and activities within the construction camp, prevent peripheral impacts on surrounding natural habitat; and
- Develop and implement an alien invasive species control and monitoring program starting during the construction phase and to be carried over into the operational phase.

Risk of fire: The risk of accidental wild fires during the construction phase are considered to be medium especially during the dry summer months. Subsequently:

- Accidental fires should be prevented through proper sensitization of the EPC contractor and their workers towards the associated risks, dangers and damage of property;
- An emergency preparedness and response plan should be developed and implemented to fight accidental fires, should they occur. Mutual aid should be considered with the County Government of Lamu and the County Commissioner's office;
- The use of open fires for cooking of food etc. by construction personnel should be strictly prohibited; enclosed areas for food preparation must be provided; and
- Use of branches of trees and shrubs for fire making purposes must be strictly prohibited.

#### **12.2.4 Air Quality Impacts**

An air dispersion modeling study was undertaken for the Lamu coal power plant boilers and black start generators using the US EPA approved methods, AERMOD and CALPUFF. CALPUFF was used to model the boiler emission scenarios while AERMOD was used to model the black start generator scenarios.

Construction phase emissions include:

- Earthmoving operations (associated with land clearing and site preparation);
- Construction and delivery vehicle emissions (diesel powered equipment, cranes, excavators, barges and ships); and
- Power generation at the worker camps, laydown areas and the Project site.

Once the coal power plant becomes operational, the key emission sources include the coal-fired boilers, materials handling and storage (including coal storage and ash yard) and wheel-entrained dust from vehicles travel along site roads. Other emission sources, which though not anticipated to represent routine releases (will be operational for less than 500 hours per year) include the diesel-fired start-up and emergency generators and auxiliary boiler.

The modeled pollutants of concern included nitrous oxides, sulfur oxides, particulate matter, mercury vapor and trace metals. The results of the modeling were compared with the latest European ambient air quality standards.

Based on the air dispersion modeling results, it was established that the air emissions from the four air dispersion modeling scenarios after mitigation measures, were in compliance with the European ambient air quality standards.

In order to continue ensuring compliance it is recommended that the following mitigation measures be applied during the construction phase:

- Diesel-powered equipment to be regularly serviced and diesel fuel quality standards for the sulphur levels will comply with local regulations for on-road vehicles; and
- A dust management and monitoring plan should be developed to control and manage dust emissions from construction work during extended dry periods.

During the operational phase, significant impacts to air quality are not expected from the operation of the Lamu Coal Power Plant. Mitigation measures recommended for the operational phase include:

- Monitoring air emissions using the continuous emission monitoring system (CEMS) installed on the stack;
- Ensure compliance with the air emission limits stipulated in the Kenyan air quality regulations (L.N. 34: Air Quality Regulations, 2014); and
- Undertaking periodic (e.g. annual) ambient air quality sampling and analysis at sensitive receptors located around the power plant.

### 12.2.5 Emission Control technologies

Various abatement technologies may be implemented to achieve the required control efficiencies.

Low nitrous oxide burners will be incorporated into the design of the boilers. The EPC Contractor's performance criteria includes design of low NO<sub>x</sub> burners that will emit lower levels of nitrous oxides than those recommended under the IFC Guidelines.

Wet Flue Gas Desulfurization (FGD) is capable of sulfur dioxide reduction with efficiencies in the range of over 90%. Historically, the highest removal efficiencies are achieved by wet scrubbers (greater than 90%), and lowest by dry scrubbers.

FGD is associated with the production, transportation and handling of the reagents used in the process (e.g. limestone). The limestone would need to be transported over road from a source within Lamu County. Further additional waste will be produced in the form of gypsum which may be disposed in the ash yard. Alternatively, gypsum can be used in the construction industry for production of wall board or in the cement industry for production of cement.

There could be specific environmental impacts associated with FGD implementation, some of which are increased water use, increased carbon dioxide emissions, increased transport impacts, increased visual impact and increased resource use. The additional environmental aspects related to the mining of limestone and the transport of limestone should be considered by the owners of the mining operation.



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An electrostatic precipitator (ESP) shall be installed upstream of the FGD/chimney and downstream of the air heaters in order to meet the environmental emission limits regulated by IFC guidelines.

The plant shall be designed to give a collecting efficiency such that the suspended particles' burden at the exit of the plant does not exceed the environmental emission limits, or as required by the FGD plant if lower levels are necessary, under all normal conditions of boiler operation, including soot blowing.

The electrostatic precipitator shall be designed to accommodate higher carbon in ash than expected from the boiler under worst conditions.

### 12.2.6 Visual/Aesthetic Impacts

A landscape and visual impact assessment was undertaken for the proposed Lamu coal power plant. The vegetation including mangrove and palm tree cover acts as a natural screen/buffer zone for the footprint of the power plant.

The view shed analysis (based on topography alone) indicates that project components will be visible to people moving within the foreground-middle ground zone (the area that can be seen for a distance of 0 - 10 kilometres) around the project. The project will be highly visible within the 5km zone around the project and a low visibility is experienced beyond the 10km zone except for the reinforced concrete chimney whose height will be approximately 210m tall and will be visible beyond the 10km zone.

The removal of natural vegetation should be limited to the bare minimum and should not be undertaken without proper planning and delineation. Individual vegetation communities should be identified and earmarked as visual absorption buffer zones. The activities and movement of construction vehicles and personnel during the construction phase should be restricted to help prevent the unnecessary destruction of natural vegetation that could play an important role in the long term mitigation of visual impacts.

Other potential mitigation measures for the proposed power plant include, maintenance and general appearance of the facility. These measures focus on the fact that if/when the facility is seen by members of the public, the general impression should be favorable. Timely maintenance of the power plant, ancillary infrastructure and the general surrounds of the property (gardens, access roads, etc.) can prevent the visual impact of degradation and perceived poor management. The most notable aspect of maintenance on this type of structure is the painting of the power station cladding. In this regard and as a further mitigation to the visual impact, overtly contrasting and bright colours should be avoided. Natural hues that complement the natural environment (i.e. light sky blue where the facility is seen against the skyline or pale green where it is seen against vegetation cover) can soften the general appearance of the power plant.

Every care should be taken not to attract further unwanted attention to the power station through the construction of unnecessarily large support structures (i.e. office buildings, perimeter fences, parking garages, etc.). These structures should not impose any further on the observer, or in the case of perimeter fencing, create an air of secrecy that might be construed as wrong doing or hiding something from the public. The perimeter fence should fulfil the function of a security barrier and should not be used to try and hide the facility. Less prominent alternatives to very tall concrete fences should be investigated. These might include palisade fencing, electrified fencing, or a combination of both. The same principles regarding the painting of the core power station apply to the support infrastructure, buildings and security fences.

### 12.2.7 Cultural heritage

Based on what was found during the cultural heritage assessment and its evaluation, it is recommended that the proposed development can continue, on condition of acceptance of the following recommendations:

- Grave sites within the project area should be avoided. According to the *Boni (Aweer)* tribe who ancestrally used to occupy the Kwasasi area, grave sites were identified by them planting a *Mwongo* tree adjacent to a grave. If a grave site is found within the coal power plant project footprint area, mitigation measures should be implemented by involving the *Boni (Aweer)* in relocating the graves;
- The EPC contractor should develop and implement a "Chance finds procedure" in accordance with the
- If archaeological sites are exposed during construction work of the coal power plant, it should immediately be reported to the Lamu Museum preferably where an archaeologist is available, so that an investigation and evaluation of the finds can be made; and
- The EPC contractor and developer promote cultural heritage of Lamu and especially the outstanding universal value (OUV) of the Lamu world heritage site stone town core area of 16 hectares.

### 12.2.8 Traffic Impacts

It is anticipated that the majority (about 70%) of the abnormal loads that constitute the power plant will be imported via ships that will discharge their cargo at a temporary landing area. Some abnormal or heavy loads may be transported via road from Mombasa and Malindi to Garsen and the project site.

It is further recommended that an evaluation of the route for supply of limestone from the quarry and coal power plant be optimized including the placement of infrastructure in order to minimize environmental, social and operations costs.

### 12.2.9 Noise Impacts

A noise impact assessment was undertaken to evaluate the potential construction and operational phase noise impacts associated with the proposed project. The mitigation measures for the two phases of the project are described below.

#### 12.2.9.1 Construction Phase

The noise mitigating measures to be considered during the construction phase are:

- Construction site yards, concrete batching plants, asphalt batching plants, construction worker camps (accommodation) and other noisy fixed facilities should be located well away from noise sensitive areas adjacent to the development site;
- All construction vehicles and equipment are to be kept in good repair;
- Construction activities, and particularly the noisy ones, are to be contained to reasonable hours during the day and early evening;

- With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the EPC contractor should liaise with local residents on how best to minimize impact;
- In general, construction operations should meet the noise standard requirements of the Noise Prevention and Control Regulations (L.N. 25 of 2005) under the Occupational Safety and Health Act, 2007 and the British Standards Institute (BSi), 2008, 'BS5228 – Noise and Vibration Control on Construction and Open Sites'; and
- Construction staff working in areas where the 8-hour ambient noise levels exceed 85dBA should wear ear protection equipment provided by the EPC contractor at no cost to the workers.

#### **12.2.9.2 Operational Phase**

The design of the new power plant will incorporate all necessary acoustic design aspects required in order that the overall generated noise level from the power station does not exceed the requirements of Kenyan environmental and occupational noise limits set in the following legislation:

- Environment Management and Coordination (Noise Pollution and Excessive Vibration) Control Regulations, 2009 for environmental noise limits; and
- Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005 for occupational noise limits.

Additionally, it is recommended that parts of the worker colony exposed to noise levels in excess of 43db(A), incorporate secondary and thermal glazing in the design of the dormitory and worker camp accommodation buildings respectively.

#### **12.2.10 Soils**

Due to the fact the establishment of an ash dump and power station will involve permanent loss of the soil resource, it is recommended that the topsoil (approximately 300-400 mm) be removed and stored prior to construction. In this way, the soil will be available elsewhere at a later date for rehabilitation purposes. The difference between the topsoil and subsoil is not significant, so if some mixing occurs, it should not be significant.

Erodibility is not a problem in flat areas, such as the existing terrain, but if the stored topsoil were to be used for rehabilitation in sloping areas (for example on the sides of the ash dump), great care should be taken to ensure that erosion does not occur.

Mitigation measures should include:

- Immediate re-vegetation of any exposed areas;
- Seeding of indigenous grass species;
- Water supply for irrigation to aid the re-vegetation process;
- Placement of along-slope measures (berms, logs, geotextiles, etc.) to aid the process; and
- Regular monitoring to ensure the continued success of the process.

### 12.2.11 Social Impacts

Given below are the mitigation measures associated with the potential social impacts associated with the proposed coal power plant during the construction and operational phases of the project respectively.

**Table 12-1: Summary of potential social impacts and recommended mitigation measures**

Impact	Mitigation
<b>Land acquisition and involuntary resettlement</b>	The Ministry of Energy and Petroleum through the National Land Commission, should develop and implement a resettlement action plan (RAP) in accordance with the requirements of the AfDB Operational Safeguard 2 and the IFC Performance Standard 5
<b>Economic resettlement impacts</b>	Create direct job opportunities for local community members in the construction and operational phases. Minimize destruction of arable land outside the power plant site through construction phase activities
<b>Changes in demographic profile</b>	Siting of power plant facilities should aim to avoid destruction of cultural, religious, and ceremonial resources  Priority for employment and other economic opportunities should be given to the local community to minimize in-migration related adverse impacts  APCL should support cultural festivals such as the annual Lamu cultural festival, archaeological expeditions, etc.
<b>Impacts on infrastructure and utilities</b>	As part of their CSR program, APCL should consider working with the County Government of Lamu to support infrastructure development needs around the project area.
<b>Change in cultural heritage</b>	A "chance finds" procedure should be developed and implemented for the construction phase of the project  A cultural heritage management plan needs to be developed and implemented for the project
<b>Community health and safety</b>	The EPC contractor should develop and implement a formal occupational safety and health management system for the construction phase in compliance with the Occupational Safety and Health Act, 2007 (OSHA) and its subsidiary legislation and OHSAS 18001;  Prior to the commissioning of the coal power plant, the O&M company should develop and implement a formal occupational safety and health management system
<b>Increase in traffic and</b>	The EPC contractor should develop and implement a road transport safety management plan for the construction

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Impact	Mitigation
<b>related incidents</b>	phase  The O&M company should develop and implement a road transport safety management plan for the operational phase

As the table shows, many of the adverse social impacts can be optimized (e.g. maximization of employment opportunities for members of local communities). These measures should be informed by the suggestions made in the ESIA Study report, formalized in the Environmental and Social Management Plan (ESMP) and subjected to a mitigation and monitoring process throughout the construction and operational phases.

**12.3 Overall Conclusion**

The findings of the specialist studies undertaken within this ESIA provide an assessment of both the benefits and potential negative impacts anticipated as a result of the proposed project. The findings conclude that there are no environmental, health, safety and social fatal flaws that could prevent the proposed project from proceeding, provided that the mitigation and management measures are implemented.

**12.4 Overall Recommendations**

In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, the recommendations from this ESIA must be included within an Environmental and Social Management Plan (ESMP). This ESMP should form part of the contract with the EPC contractor appointed to build and maintain the proposed power plant and ancillary infrastructure. The ESMP would be used to ensure compliance with environmental specifications and management measures. The implementation of this ESMP for all life cycle phases (i.e. construction, operation and de-commissioning) of the proposed project is considered to be key in achieving the appropriate environmental and social management standards as detailed for this project.

It is also recommended that the process of communication and consultation with the community representatives is consistently maintained after the closure of this ESIA process, and, in particular, during the construction and operational phases associated with the proposed project.