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4 Description of the project

4.1 Introduction

This chapter provides a description of the proposed 1,050MW coal fired power plant to be built and operated in the Kwasasi area of Hindi division, Lamu County, Kenya. It discusses (i) types of technologies available for coal fired power generation, and (ii) a description of the type of technology that will be used for the proposed power plant.

The Proposed Development will generate up to 1,050MW gross electrical output. The Proposed Development will be capable of producing circa 981.5MW net electricity through the use of coal from various sources. The difference between the net and gross outputs consists of parasitic load and emergency standby generators. The coal will be procured based on a Government to Government negotiated price and will be a pass through cost to the consumer.

It is envisaged that the Proposed Development will have a design life of 30 years and an operating life of up to 50 years and so decommissioning would be currently anticipated to commence in approximately 2070.

4.2 Approval of project by County Executive and Assembly of Lamu

The proposed coal fired power plant is situated in an area where the land tenure is defined as Community Land. The County Governments Act, 2012 states that any project of national significance shall before being approved, be subjected to mandatory public hearings. Subsequent to this, the County Assembly shall considered and approved or rejected.

For the proposed coal fired powered plant, extensive public/stakeholder consultation meetings were held throughout the ESIA phase to discuss the project and its impacts. Subsequently, APCL presented a Concept Paper to the County Assembly of Lamu on June 23, 2015 for consideration.

On July 8, 2015, the County Assembly considered the proposed coal fired power plant and in accordance with the powers vested to it under the Kenya Constitution 2010 and the County Governments Act, 2012, approved the following:

- Construction of the 1,050MW coal fired power plant;
- Lease of an 880 acre parcel of land in the Kwasasi area; and
- Concession of 2000 acres for limestone mining in Witu.

The County Assembly further requested the National Land Commission to commence the land allocation process and submit the land allocation and compensation scheme to them for consideration and approval.

On July 14, 2015, the County Government of Lamu approved the development and operation of the 1,050MW coal fired power plant and the concession area in Witu for limestone mining.

Copies of the approval letters from the County Assembly and County Executive of Lamu are provided in Appendix 14 of this ESIA Study.

4.3 Overview of the project

The proposed Lamu coal power plant will have a nominal plant gross output of 1,050MW and will utilize three (3) coal fired thermal generating units, each producing a minimum net electrical output of 350MW. The plant will be capable of firing on a variety of coals as indicated in table 3-5. Light Diesel Oil will be used for start-up purposes.

The heavy components for the coal fired power plant will be delivered to the site by sea tanker and will be unloaded at either a new purpose-built jetty or an existing jetty or a temporary construction phase landing site. Light Diesel Oil will be delivered to the site by road tanker from Mombasa. Suitable fuel storage and fuel transfer/unloading provisions will be provided as part of the balance of plant.

The electrical output from the units will be exported to the grid system via a new 400kV substation to be built by KETRACO. This will be constructed and should be completed in advance of the required back-energization date for the coal power plant.

The condenser is based on a once through cooling system, utilizing seawater as a cooling medium. The seawater will be extracted from the Manda Bay via a dedicated seawater intake canal system, which will be constructed as part of the construction works. Cooling water from the condenser outlets will be returned to the Manda Bay via a dedicated submerged pipe and outfall system.

The flue gases from the boilers will pass through electrostatic precipitators to remove particulate matter and be treated in a wet flue gas desulphurization (FGD) plant, utilizing a seawater scrubbing technique. The process will utilize seawater which has already passed through the condenser as part of the plant cooling system supplemented by seawater taken directly from the intake. The FGD process will be designed to remove a significant percentage of the Sulphur dioxide contained within the flue gases, in order to comply with current IFC (International Finance Corporation) Environment, Health and Safety (EHS) Guidelines for thermal power plants.

The IFC requirements for NOx emissions will be fully met by supply of low NOx combustors for the boilers. A provision has been made for SCR equipment utilizing a urea/ammonia based system to achieve the required emissions levels.

Water used by the site shall be provided through a dedicated desalination and water treatment plant. This plant will produce potable (drinking) water, demineralized water (for make up to the boiler) and service water for general use on site. The desalination plant will be of the sea water reverse osmosis (SWRO) type.

Coal will transported to Manda Bay via ocean going vessels to one of the three new berths currently under construction in the Kililana area. From the berth, coal will be crushed and transported via a land based conveyor to the coal stockyard within the power plant.

Limestone for the wet flue gas desulfurization system will be transported via sea from Kiongwe near Mpeketoni in Lamu County to the power plant.

An outline of the process will be as follows:

- Coal will be delivered to a berth in Manda Bay via large ocean going vessels; from here, the coal will be transported on a land based conveyor system to the power plant site.
- The coal will be unloaded from the conveyor system and stored in the coal stockyard; a stacker reclaimer will be used to stack the coal within the stockyard;
- There will 3 x 350 MW supercritical boilers which will generate and supply steam to generators for production of electricity;

- The fuel will be moved from the coal stockyard to each of the three boilers where it will be combusted, generating gases and bottom ash residues;
- Bottom ash will settle at the bottom of the boiler and will be disposed in the ash yard;
- The steam generated through each boiler will be passed through a steam turbine to generate electricity for use within the power station and for export to the national grid;
- Flue gases will be cleaned in the Electrostatic Precipitator (ESP) and Flue Gas Desulfurization (FGD) system to control emissions of particulates and sulfur oxides; and
- The cleaned exhaust gases will be released to atmosphere via a stack circa 210 m high.

The facility will operate 24 hours per day, seven days per week with programmed offline periods for maintenance.

4.4 Characteristics of the Power plant

The main characteristics of the proposed power plant are as follows:

- The power plant shall have a nominal plant gross output of 1,050MW and shall utilize three (3) coal fired thermal generating units, each producing a minimum net electrical output of 350MW. The plant shall be capable of firing on a variety of coals as indicated in Table 3-5. Light Diesel Oil will be used for start-up purposes.
- The heavy components for the coal fired power plant will be delivered to the site by sea tanker and will be unloaded at either a new purpose-built jetty or existing jetty or a temporary construction phase landing site. Light Diesel Oil will be delivered to the site by road tanker from Mombasa. Suitable fuel storage and fuel transfer/unloading provisions will be provided as part of the balance of plant.
- The electrical output from the units will be exported to the grid system via a new 400kV substation to be built by KETRACO. This will be constructed and should be completed in advance of the required back-energization date for the coal power plant.
- The condenser is based on a once through cooling system, utilizing seawater as a cooling medium. The seawater will be extracted from the Manda Bay via a dedicated seawater intake canal system, which will be constructed as part of the construction works. Cooling water from the condenser outlets will be returned to the Manda Bay via a dedicated submerged pipe and outfall system.
- The flue gases from the boilers will pass through electrostatic precipitators to remove particulate matter and be treated in a wet flue gas desulphurization (FGD) plant, utilizing a seawater scrubbing technique. The process will utilize seawater which has already passed through the condenser as part of the plant cooling system supplemented by seawater taken directly from the intake. The FGD process will be designed to remove a significant percentage of the Sulphur dioxide contained within the flue gases, in order to comply with current IFC (International Finance Corporation) Environment, Health and Safety (EHS) Guidelines for thermal power plants.
- The IFC requirements for NOx emissions will be fully met by supply of low NOx combustors for the boilers. A provision has been made for SCR equipment utilizing a urea/ammonia based system to achieve the required emissions levels.
- Water used by the site shall be provided by a dedicated desalination and water treatment plant. This plant will produce potable (drinking) water, demineralized water (for make up to the boiler) and service water for general use on site. The desalination plant will be of the sea water reverse osmosis (SWRO) type.

4.5 Power plant design parameters

The design of the Proposed Development has followed an iterative process based on preliminary environmental assessments, engagement with contractors and equipment providers and past experience of the EPC Contractor on similar types of power plants successfully built and operated. In particular, the design for the Proposed Development has been shaped by lessons learned from the evolution and construction of similar types of power stations in different parts of the world.

Given below are various parameters and specifications to which the coal power plant is being designed.

Given below in table 4-1 are site particulars for the proposed coal fired power plant.

Table 4-1 Site particulars

Item	Description	Units	Particulars
1	SITE AMBIENT DATA		
1.1	Site location		Kwasasi, Hindi division, about 20km north of Lamu town
1.2	Site elevation above sea level		6 – 12m (average)
	Design ambient conditions (site rating)		
1.3	Design ambient pressure	Bar (a)	1.013
1.4	Design ambient temperature (dry bulb)	°C	30.4
1.5	Design relative humidity	%	70
	Ambient temperature (dry bulb)		
1.6	Highest maximum (recorded)	°C	36.6
1.7	Maximum yearly average	°C	31.4
1.8	Maximum daily average	°C	36.6
1.9	Design maximum temperature	°C	40
1.10	Lowest minimum (recorded)	°C	21.7
	Relative humidity		
1.11	Minimum	%	52
1.12	Yearly average	%	70
	Precipitation		
1.13	Mean annual rainfall	mm	1050
1.14	Max 24 hour rainfall	mm	656
	Wind speed		
1.15	Prevailing wind direction		S
1.16	Average wind speed	m/s	3.4
1.17	Max 10 year wind speed	m/s	15.4

Item	Description	Units	Particulars
1.18	Maximum recorded wind speed	m/s	15.4
	Seismic		
1.19	Seismic zone classification		Not seismically active
2	WATER SUPPLY DATA		
2.1	Raw water source		Manda Bay
2.2	Raw water type/designation		Sea water
2.3	Seawater conditions relative to MSL		Survey Time: From 2015/4/28 17:20 to 2015/5/27 11:40
	a) Minimum temperature	°C	27.2
	b) Maximum temperature	°C	30.3
	c) Design temperature	°C	27
	d) Design high water	m	3.55
	e) Mean high water	m	2.44
	f) Mean low water	m	0.2
	g) Design low water	m	-0.39
3	SEAWATER ANALYSIS		
3.1	Total plate count (at 37°C)	cfu/ml	Not detected
3.2	pH		7.87
3.3	Appearance in water		Unobjectionable
3.4	Odor		Odorless
3.5	Total dissolved solids	mg/l	37,570
3.6	Sulfate (as SO ₄)	mg/l	1055.75
3.7	Chloride (as Cl)	mg/l	22,592.99
3.8	Nitrate (as NO ₃)	mg/l	1.5
3.9	Total hardness	mg/l	1341.17
3.10	BOD ₅ (at 20°C)	mg/l	41.21
3.11	Total suspended solids	mg/l	2
3.12	COD	mg/l	87
3.13	Dissolved oxygen	mg/l	5.80
3.14	Oil and grease	%wt	Nil
3.15	Nitrite (as NO ₂)	mg/l	Nil
3.16	Methyl orange alkalinity	mg/l CaCO ₃	120.0

Item	Description	Units	Particulars
3.17	Phenolphthalin alkalinity	mg/l CaCO ₃	20.0
3.18	Ammonia (as NH ₃)	mg/l	11.87
3.19	Ammonia (as N)	mg/l	9.76
3.20	Conductivity at 25 ^o C	μS/cm	57800
3.21	Fluoride (as F)	mg/l	3.36
3.22	Specific gravity (Pyknometer)		1.0265
3.23	Free carbon dioxide	mg/l	Nil
3.24	Aluminum (as Al)	mg/l	<0.04
3.25	Iron (as Fe)	mg/l	<0.007
3.26	Manganese (as Mn)	mg/l	<0.002
3.27	Potassium (as K)	mg/l	503.44
3.28	Sodium (as Na)	mg/l	15,684.50
3.29	Barium (as Ba)	mg/l	<0.002
3.30	Total Phosphorus (as P)	mg/l	Nil
3.31	Strontium (as Sr)	mg/l	<0.0005
3.32	Silica (as Si)	mg/l	34.63
3.33	Magnesium (as Mg)	mg/l	181.79
3.34	Calcium (as Ca)	mg/l	237.31
3.35	Bicarbonate (as CaCO ₃)	mg/l	90.0
3.36	Carbonate (as CO ₃)	mg/l	40.0
4	ELECTRICAL SYSTEM PARAMETERS		
4.1	Transmission system	kV	400
4.2	Nominal voltage	kV	240
4.3	Nominal frequency	Hz	50-60
4.4	Frequency variation	Hz	10

4.5.1 Fuel specifications

4.5.1.1 Coal specification

A coal study was undertaken by APCL for the proposed coal power plant. In order to carry out the coal study, specifications of coal as provided in the Request for Proposal by the Government of Kenya were provided to the Consultant. Subsequently, given in Table 4-2 are the specifications to which the coal power plant in Lamu will be designed.

Table 4-2: Coal specifications

Parameter	Imported coal		Kenyan coal
	Eskom	New Vaal	
Calorific value (MJ/kg) LHV	21	16	18
Mass fraction of ash in coal as received – A_{ar} (%)	30	40	30
Mass fraction of volatile in coal as received – V_{ar} (%)	23	16	30
Total organic carbon (%)	44	36	55
Mass fraction of water in coal as received – M_{ar} (%)	4	6	11
Mass fraction of Sulfur in coal as received – S_{ar} (%)	1	0.5	2.4
Relative density			1.28

4.5.1.2 Light diesel oil specification

The light diesel oil specifications proposed for the black start generator and auxiliary boiler is given in Table 4-3.

Table 4-3: Light Diesel Oil specifications

Property	Units	Limits	
		Minimum	Maximum
Cetane number		51.0	
Cetane index		48.0	
Density at 15°C	kg/m ³	820	870
Density at 20°C	kg/m ³	817	867
ASTM color		-	3.5
Polycyclic aromatic hydrocarbons	% (v/v)	-	11
Sulfur content	mg/kg		50
Flash point	°C	66	
Carbon residue (on 10% distillation residue)	%(m/m)		0.15
Ash content	%(m/m)		0.01
Water content	mg/kg		200
Copper strip corrosion (3 hour at 50°C) rating		Class 1	
Oxidation stability	g/m ³		25
Lubricity, corrected wear scar diameter (wsd 1.4) at 60°C	µm		450
Viscosity at 40°C	mm ² /s	2.0	5.3
Cloud point	°C	To be reported	

Property	Units	Limits	
		Minimum	Maximum
Cold filter plugging point (CFPP)	°C	-	12
Sediment	%(m/m)	-	0.01
Neutralization value:		Nil	
Strong acid No. (KOH)	mg/g		Nil
Total acid No. (KOH)	mg/g		0.5
Distillation		To be reported	To be reported
• Initial boiling point	°C		
• Recovered at 250°C	%(v/v)	-	65
• Recovered at 350°C	%(v/v)	85	-
• 95% recovered at °C	%(v/v)	-	360
• Final boiling point	°C	-	400

4.6 Details of the Proposed Power Plant

The proposed power plant will comprise a coal fired power station and associated buildings, structures and plant, including:

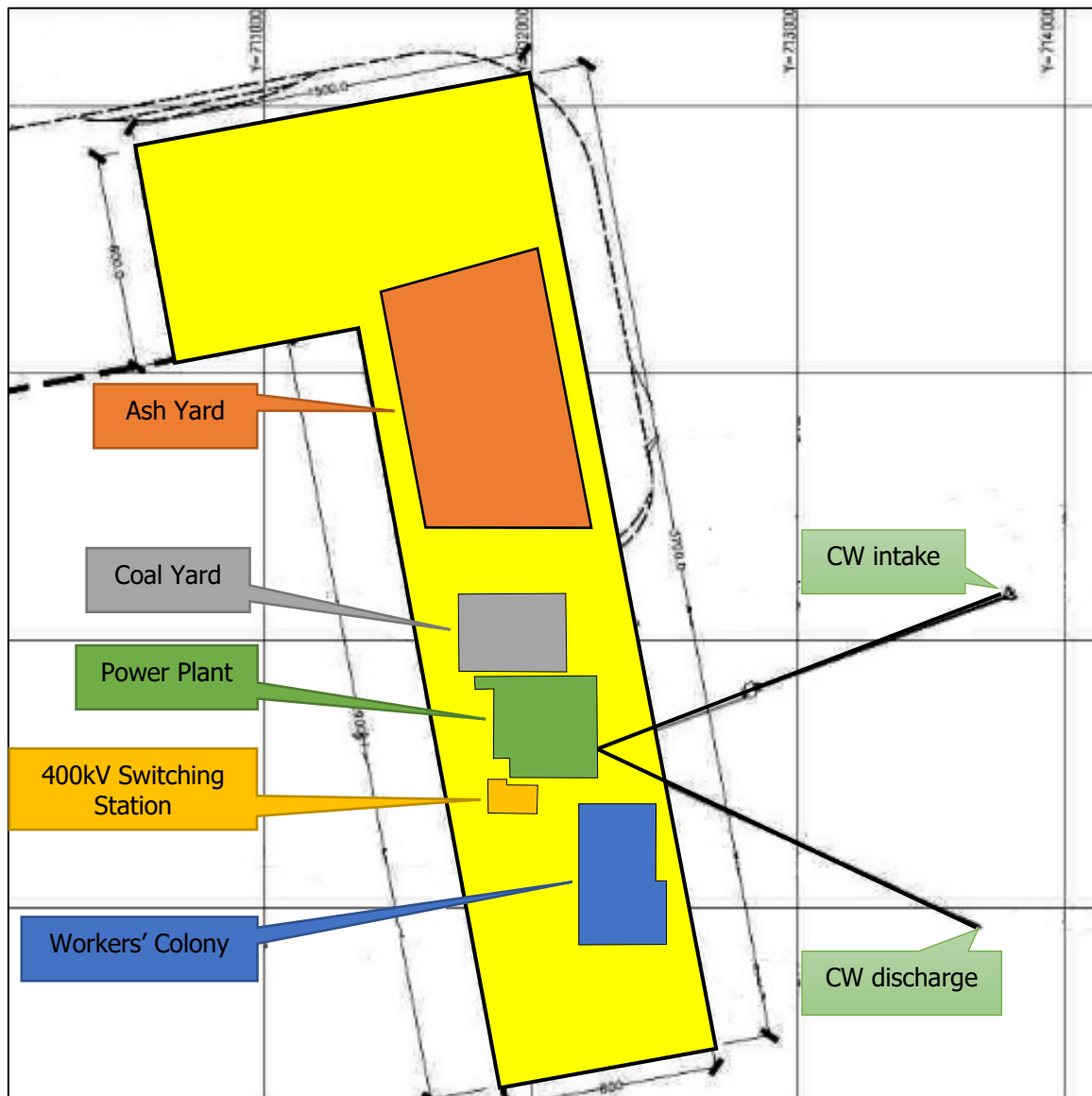
- 3×350MW high-pressure supercritical units with condensing steam turbines operating at base load capacity;
- Coal receiving system including a coal berth, coal handling equipment and a conveyor system approximately 15km long;
- Coal stock yard which will have 38 days’ storage, including 20 days of Security Stock;
- Ash yard having a storage capacity of 15 years’;
- Limestone receiving system and gypsum handling system;
- Once-through sea water cooling system;
- Flue gas air quality conditioning equipment including a chimney. This includes a flue gas desulphurization system and electrostatic precipitators;
- Sea water desalination facilities to meet the demand for the power plant’s process water, service/fire water as well as water for domestic use;
- Sub-station and switchyard facilities up to the 400 kV overhead line gantries for power evacuation into the KETRACO 400 kV system.
- Distributed control system (DCS) which will be used for monitoring and control of plant operation;
- Buildings, roads, and other structures for the Project;
- Auxiliary boiler and black-start diesel generator (DG); and
- A permanent workers’ colony for the operational phase of the project having a capacity to accommodate 250 – 300 persons.

Key features of the balance of plant will include:

- A vehicular access road, pedestrian footpaths and routes;
- Security gatehouses and barriers;
- A Heavy Goods Vehicle holding area;
- Staff and visitor car parking;
- An outage contractor compound;
- An effluent treatment plant;
- Telecoms and utilities apparatus and connections;
- A foul sewer drainage and treatment system;
- External lighting;
- Fencing, boundary treatment and other means of enclosure;
- Signage;
- CCTV and other security measures; and
- Hard and soft landscaping and biodiversity enhancement measures.

A site plan showing the location and components of the coal power plant is given in Figure 4-1.

Figure 4-1: Site plan showing the proposed coal power plant site



4.6.1 Coal supply and delivery to project jetty

4.6.1.1 Coal supply

The proposed 1,050MW coal power plant is designed to utilize a variety of coal specifications as provided in the Request for Proposal document issued in 2013/2014. The RFP provided specifications for one type of Kenyan coal and two types of South African coal.

The coal consumption will depend on the calorific value of the coal to be used in the power plant. Based on the design coal calorific value of 21MJ/kg – 27MJ/kg (net as received basis), the power plant will consume between 2.4Mt and 3.1Mt. On average it is envisaged that the power plant will burn about 2.8Mt of coal per annum.

Based on a coal supply and transportation study done by others, there are six possible locations from which the coal can be sourced namely Australia, Colombia, Indonesia, Mozambique, Russia and South Africa. Based on an analysis conducted under the above study, it is recommended that the power plant should source its long term supply from the geographically closest and least cost source countries of Mozambique and South Africa. It is also possible to source coal from Indonesia and Australia.

Based on the above, coal deliveries are expected to occur from large mining companies in South Africa and Mozambique. Two alternative types of vessels could potentially be used for delivery of the coal namely a Supramax type vessel having a cargo capacity of 53,000 tons and a self-unloading rate of 12,000 tons per day or a Capesize vessel having a cargo capacity of 169,000 tons and an unloading rate of 20,000 tons per day.

Coal can be delivered in Supramax or Capesize vessels from either Richards Bay, South Africa or Nacala, Mozambique. Coal will likely be delivered in geared Supramax vessels that will arrive on average once every six to seven days. The one way voyage time for such vessels from Richards Bay to Manda Bay is approximately 14.6 days while from Nacala to Manda bay, the voyage time is 10.4 days.

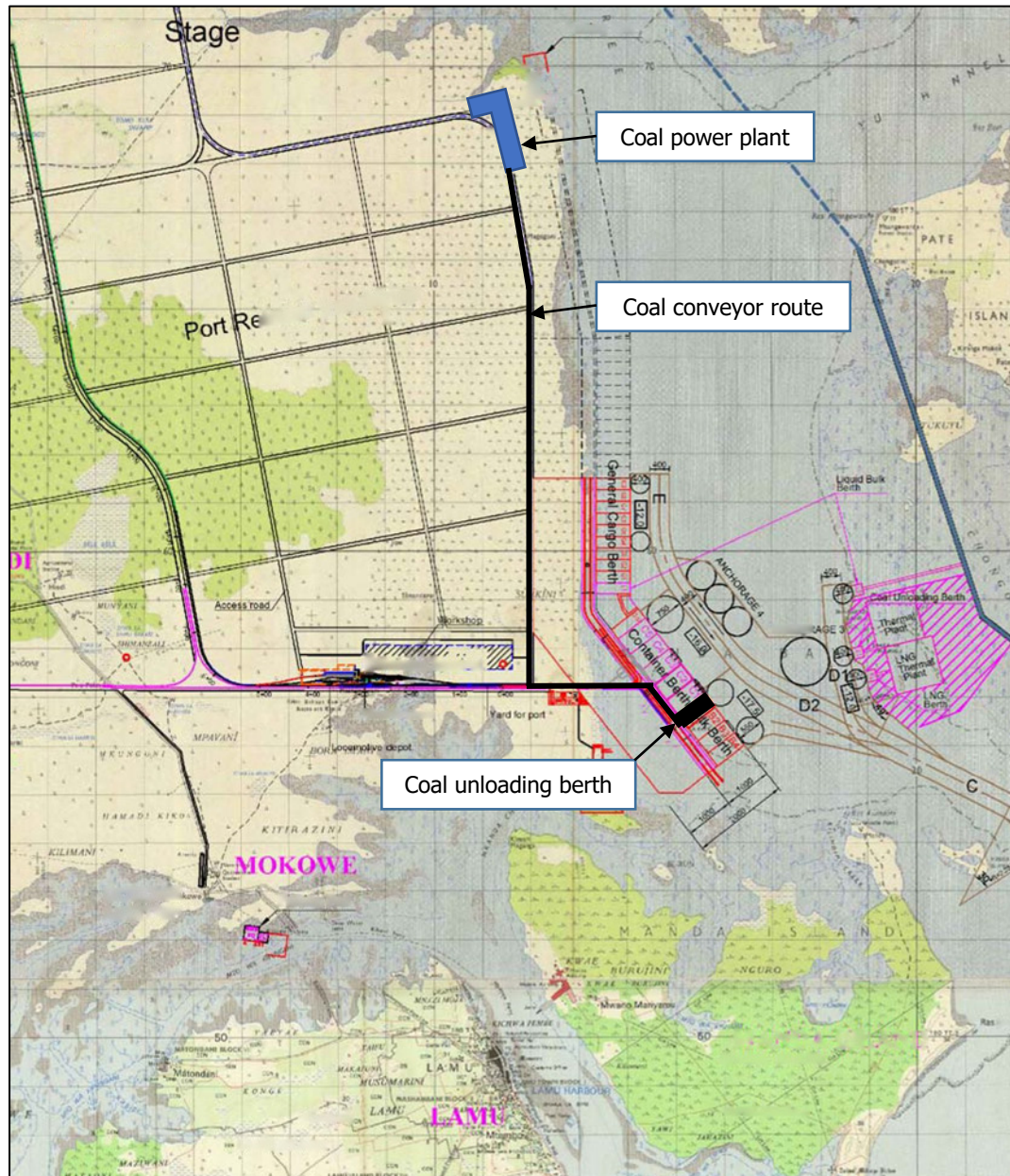
The design of the power plant also includes a provision for receiving coal using rail cars. This will allow the power plant to utilize the coal discovered in various parts of the country when commercially viable to mine. The design of the rail system will be done in future.

4.6.1.2 Coal delivery to project site

Initially, the design of the project included a purpose built coal jetty for receiving coal in bulk. However, this changed in January 2016 when the Ministry of Energy and Petroleum (MOEP) directed that coal for the power plant be imported using one of the three berths currently under construction by the Central Government in the Kililana area. An approximate location of the coal unloading berth and coal conveyor routing is shown in Figure 4-2. The design of the coal conveyor system is currently in the design phase and was unavailable at the time of undertaking this ESIA Study and consequently, no environmental and social impacts have been identified or assessed.

In general, coal will be unloaded from the coal carrier by the ship's unloading gear to a hopper and transferred to a conveyor system. Through a series of transfer towers, the coal will be transhipped to the coal stockyard within the proposed power plant. The project is designed with the option of receiving coal via rail if and when the Kenyan coal becomes available.

Figure 4-2: Coal receipt and approximate conveyor routing



4.6.2 Coal storage yard

The proposed power plant is expected to use about 10,000 metric tons of coal per day when the power plant is at full operation. Subsequently, there will be two coal storage yards divided into four stockpiles and having a capacity of 420,000tons. This will provide supply of 30 days for the 3 boilers operating at 100% boiler Maximum Continuous Rating (MCR) load (based on Kenya coal). The storage capacity includes a 20 day security stock to meet the RFP requirements and ten days active or operational reserve.

2 bucket wheel stacker and reclaimer will be equipped in each coal yard. Each has a stacking capacity of 1500t/h and reclaiming capacity of 1000t/h. 3 bulldozers and 2 front loaders will be supplied to facilitate coal movement in areas out of the arm reach of the stacker/ reclaimers. Two ground reception bunkers will also be supplied to allow for emergency unit loading in the event of stacker/ reclaimer outages. A single reversible belt conveyor in each coal storage yard will be supplied. The belt will have a width of 1400mm, and an operating speed of 2.5m/sec for a capacity of 1500t/h. Figure 4-3 shows a preliminary layout of the coal stock yard.

Figure 4-3: Coal stockyard indicative layout

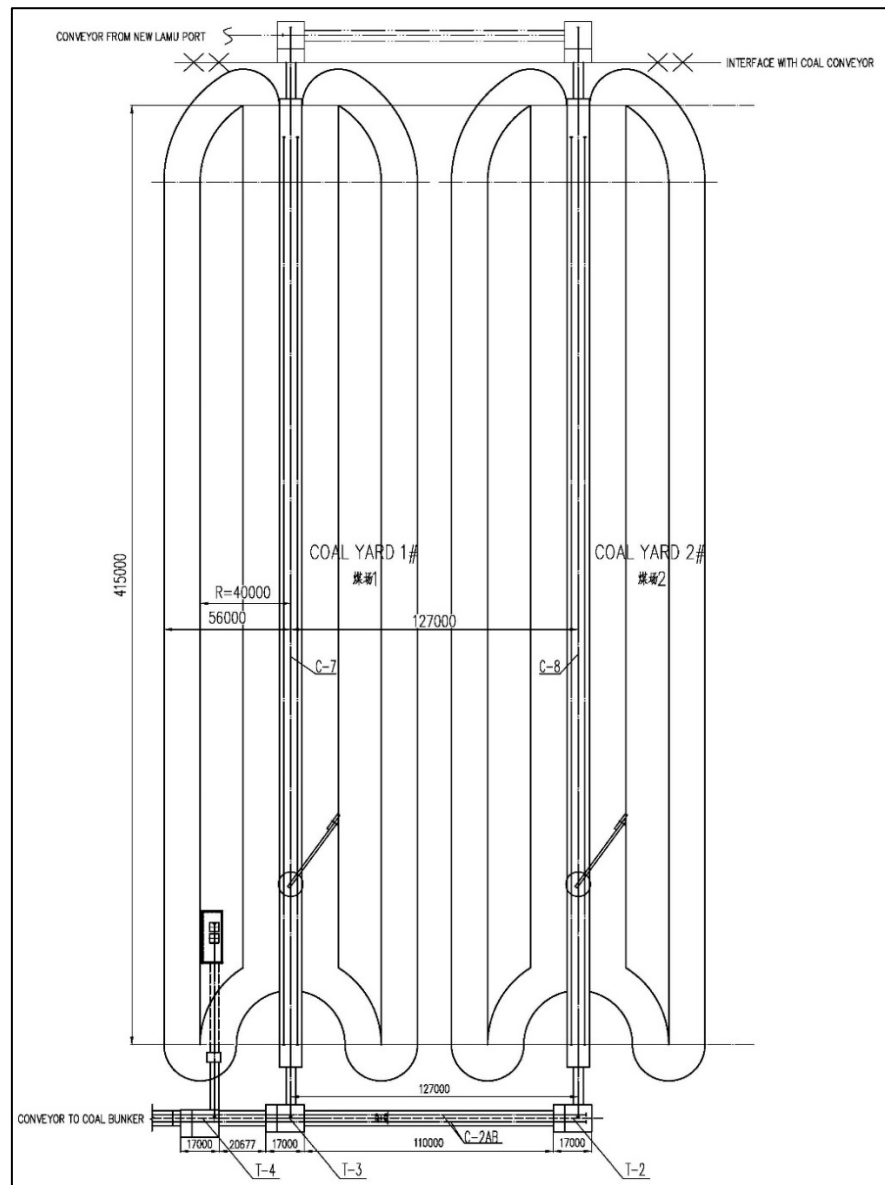


Figure 4-4 shows an image of a typical coal stock yard with bucket stackers/reclaimers; Figure 4-5 shows a cross-section of the coal stock yard for the proposed coal power plant in Lamu while Figure 4-6 shows preliminary details of the coal stockyard foundation.

Figure 4-4: Image of typical coal stockpiles and bucket stackers/reclaimers



Figure 4-5 Cross-section of coal yard

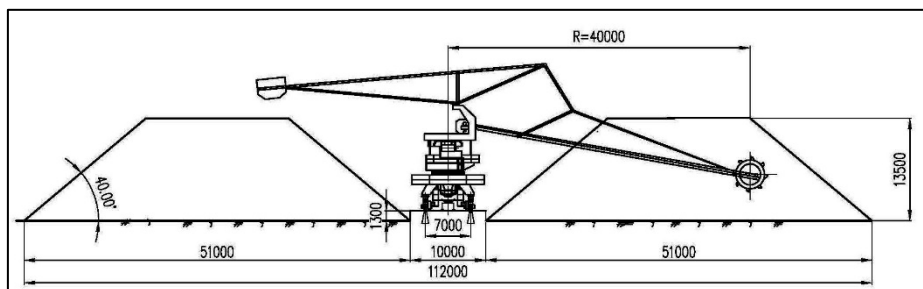
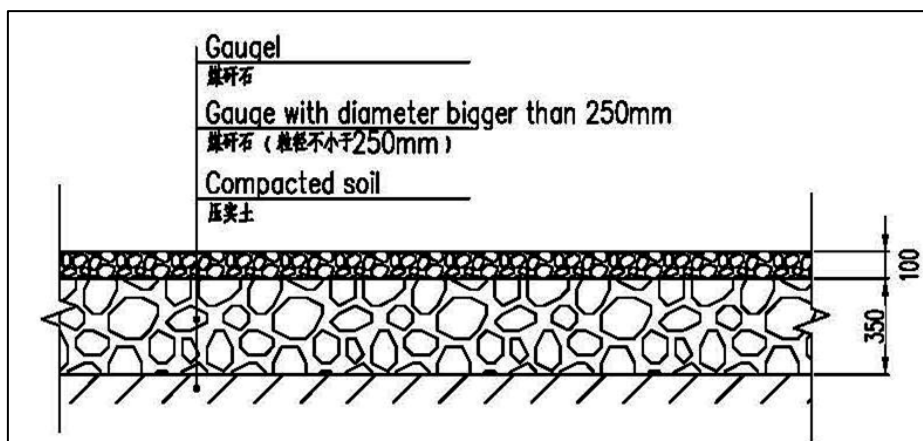


Figure 4-6: Coal stockyard preliminary foundation details



In order to facilitate movement of coal in areas that the stacker/reclaimer is unable to reach, the project will employ bulldozers and front wheel loaders (see Figure 4-7). Additionally, the project will use a compactor and water spray system for long term storage of coal. Two ground reception bunkers will be provided to allow for emergency unit loading in the event of stacker/reclaimer outages.

Figure 4-7: Front end wheel loader in operation within a coal stock yard



A trough design conveyor system or a closed pipe will be used to convey the coal from berth to the stock yard and another similar system to convey the coal from the stock yard to the boiler unit bunkers. The speed of the conveyor system will be controlled to avoid spillage of coal and/or prevent belt lift-off.

The sections of the conveyor system that are exposed to natural weather will be provided with smooth galvanized continuous covers and wind guards for the return belt. Drip pans will be provided wherever the conveyor crosses roads or goes over buildings.

For unintended events or consequences, the conveyor system will be provided with a pull type emergency stop switch on either side.

A coal processing system will be provided for the power plant. This system will contain screens and hammer crushers to mill the coal to the required size; the imported coal is expected to have a nominal of $\leq 300\text{mm}$ and shall be crushed to the required size of $\leq 30\text{mm}$.

Magnetic separators will be used to remove any metals prior to coal processing, for example, suspension magnets which can extract iron and iron-bearing components from bulk materials. Magnetic separators remove iron tramp, and protect conveyors, grinders, mills and other processing equipment against wear and damage.

To control dust to the air from the coal storage area, a permanent water sprinkler system shall be provided. The coal storage area will need a coal setting basin that can be cleaned with a loader and sump pumps in a separate bay for handling overflow and runoff.

The entire coal handling system, including the coal conveyors, shall be completely encapsulated by dust proof enclosures. At areas where dust formation is expected, e.g. at transfer points, dust shall be collected by suction systems with filters. Collected dust shall be returned to the main coal flow.

4.6.3 Power plant

The principal components of the power plant are as follows:

Coal preparation equipment: Prior to consumption in the power plant, coal would pass through preparation equipment such as crushers and pulverisers'. These processes would take place in closed areas to minimize the release of dust.

Pulverized coal-fired boiler(s): Three supercritical pulverized coal-fired boilers will be constructed at the project site to produce steam for the steam turbine generator(s). The boilers would be designed to maximize efficiency and minimize air pollution during the combustion process. For an initial period of say 5 – 10 years, the boilers will be fuelled by imported coal and use low sulphur diesel as fuel for start-up and flame stabilization;

Steam turbine generator(s): Each pulverized coal-fired boiler would have a dedicated steam turbine generator. The steam turbine generators would use steam produced by the boilers to drive electric generators. Each steam turbine generator is expected to have a nominal generating capacity of 350MW. The maximum net generating capacity of the three combined steam turbine generators is expected to be approximately 1,050MW. The steam used in the steam turbine generators would exhaust from the steam turbine generator into a condenser.

Condenser(s): A condenser would attach to each steam turbine to receive exhaust steam. Inside the condenser, the exhaust steam would condense to its liquid state for reuse in the boiler.

Plant electric switchyard: An electric switchyard will be located on the power plant site to step up the voltage of electricity produced to 400 kilovolts (kV). The switchyard may include circuit breakers, disconnect switches, generator step-up transformers, auxiliary power transformers, steel structures and a control building. KETRACO will build a 520km long double circuit transmission line from the power plant to the Kenya Power Nairobi Control Center (NCC) from where electrical power will be distributed to the country and beyond.

Water treatment: The power plant would include water treatment facilities for raw water, feed water to the plant, condensate and once through cooling water in order to maintain water quality for the process equipment. The water treatment facilities would include a desalination plant, water treatment building, water storage tanks, chemical storage tanks, clarifiers and demineralizers.

Additional facilities: the power plant area may also include various buildings to house equipment and conduct administration, operations and maintenance activities; warehouses; electrical switchgear buildings; various pumps, motors and fans; fuel and chemical storage tanks/areas; lime/limestone, ammonia and mercury sorbent storage and handling equipment; fire protection, security and safety systems; stormwater facilities; continuous emissions monitoring systems; and back-up electric generators.

4.6.4 Air pollution control equipment

The emissions control equipment for each pulverized coal-fired boiler would consist of low nitrogen oxide burners, wet flue gas desulfurization and electro-static precipitators. Exhaust gases from the boilers would flow through the emissions control equipment before being discharged to the atmosphere through the stack(s). The emissions control equipment is efficient in reducing nitrogen oxide, sulphur dioxide, particulate matter and hazardous air pollutants such as mercury. The systems would be designed to meet or exceed the World Bank Group's 2008 air emission guidelines stipulated within their document titled "EHS Guidelines for Thermal Power Plants".

Pulverized coal-fired boiler stack(s): The power plant will include a pulverized coal-fired boiler stack connected to each boiler; the three stacks will be contained within a reinforced concrete chimney whose height will be approximately 210m tall. Each of the pulverized coal-fired boiler stacks will be connected to a state-of-the-art Continuous Emissions Monitoring System (CEMS) for recording the exit concentration of pollutants of concern.

4.6.5 Ash yard

An ash yard will be built to receive the coal combustion residuals such as bottom ash, fly ash and gypsum emanating from the power plant combustion processes. The ash yard is located towards the north of the power plant as shown in Figure 4-1. The annual ash and gypsum reject load of one unit will be about 592,900m³. The ash yard dimensions are approximately 900m x 1270m which is adequate for storing ash and gypsum for a period of 15 years. The elevation of the ash pile will reach an elevation of about 25.8m with a volume of 26,740,000 m³ for the three boiler units.

According to the preliminary design, the ash yard will be designed to prevent sub-surface soil and groundwater contamination by leachates. The design of the ash yard permeability will comply the Chinese standard GB 18599-2001 titled "Standards for pollution control on the storage and disposal site for general industrial solid wastes". This standard states that if the permeability coefficient of the natural base layer is greater than 1.0×10⁻⁷cm/s, there should be natural or artificial material to build an impermeable layer whose thickness should produce an anti-seepage capacity which is equal to that of a clay layer having a permeability coefficient of 1.0×10⁻⁷cm/s and be at least 1.5m thick.

For the proposed coal fired power plant, the impermeable layers of the ash yard foundation will be composed of three layers namely, (a) a compacted clay layer made by compacting soil or undisturbed soil after mechanized compaction layer by layer; (b) a geomembrane liner whose permeability coefficient is less than 1.0×10⁻⁷cm/s; and (c) a protection layer which is made out of a sand bed having a thickness of 200mm. A typical image of the foundation is given in Figure 4-8.

Figure 4-8: Image showing typical barrier lining system for ash yard



In addition to the above, the project will install at least ten groundwater monitoring wells around the external perimeter of the ash yard. These wells will be used for monitoring the quality of groundwater during the operational phase of the project. The monitoring wells will be made of galvanized steel pipes having slits in the pipes. The borehole casing will be surrounded with clastic stones for filtering.

The ash yard will be surrounded by a 7.0m wide ring road with drains and an ash water treatment pool. The ash yard will be equipped with facilities for sprinklers to spray water periodically depending on the condition of the piled ash to avoid dust emissions. The permanent slope of the ash yard will be maintained taking into consideration stability requirement. Suitable measures will be undertaken in the detailed engineering design to avoid erosion of ash pile during monsoon and collapse of portion of ash pile.

4.6.6 Ash handling system

A pressurized dense phase pneumatic conveyance system is planned to remove ash collected. The ash collected in the ESP hoppers will be emptied into the transport system through a system of segregating valves. The collected ash will be conveyed to 3x12m diameter storage silos.

Bottom ash will be conveyed to bottom ash silo through dry slag conveyor. Pyrites in the mills will be conveyed by an electric vehicle after emptying the mills via a pneumatically operated dump gate to the vehicle bin.

4.6.6.1 Fly ash handling system

A fly ash conveying system will be installed on each unit with the capability to handle 150% of the expected daily maximum ash collection for the design coal and 120% at the maximum design ash collection temperature. Ash temperature from the ESP will be considered to be at not more than 120°C. The effective storage capacity will be designed to be not less than 1400m³. A wet mixer and dry ash unloader will be provided at the silo unloading chute for dustless transport to the pile.

4.6.6.2 Bottom ash handling system

A dry mechanical bottom ash disposal system will be installed on each boiler. The capacity of each system will be sized for not less than 250% of maximum expected bottom ash collection. The system will include a dry slag conveyor, slag crusher and bucket elevator. The bottom ash dropping from the shaft will be conveyed to ash silo through the dry slag conveyor, slag crusher and bucket elevator. The ash silo bottom half facilitates unloading ash for removal.

4.6.6.3 Compressed air system

Separate air systems are provided for the ash handling system and one for instrumentation and house service air will be provided. All of the compressors will be located in one building along with air drying and filtering, and receiver vessels.

4.6.6.4 Mill rejects system

The design of the mill rejects or pyrites collection system considered saving investments, simplifying system, power saving, and maintenance fee deduction, and the small quantity of mill rejects. The mill rejects system for this project is designed to be removed with an electric vehicle. The mill rejects shall be exhausted continuously from coal mill to mill rejects hopper. The inlet valve of mill rejects hopper shall be closed when it is full. Then the outlet gate of mill rejects hopper shall be opened so that the mill rejects can be exhausted to mobile mill rejects hopper. The mobile mill rejects hopper shall be transferred into the tippler out of boiler house by fork-lift truck. The last procedure shall be the transfer to ash disposal area by the auto-dumper and relevant processing.

4.6.7 Solid waste disposal

An on-site solid waste disposal facility will be constructed and operated for the disposal of coal combustion by-products including fly ash, bottom ash, economizer ash, scrubber by-products and coal rejects. Additionally, the solid waste disposal facility will treat inert, non-hazardous industrial wastes generated onsite including construction and maintenance debris.

Some types of waste (for example, office wastes, oil, liquids, etc.) would be hauled to an offsite disposal facility licensed by NEMA. Wastes generated during construction activities would be recycled to the extent practical.

The solid waste disposal facility would be designed in accordance with applicable international standards. The facility would include environmental protection measures to prevent the release of contaminants to the environment, including surface and ground water. Such measures would include a bottom liner and leachate collection and control system, a surface water runoff management system with a sediment retention basin, and a ground water quality monitoring program. The monitoring program will consist of wells located up-gradient of the solid waste disposal facility to obtain samples representative of background water quality, and other wells located down-gradient of the disposal facility to ensure the detection of potential contaminants. Samples will be collected quarterly at the wells during project operation and into the post-closure period and analyzed for a list of targeted elements of environmental concern associated with South African or Kenyan coal.

4.6.8 Water supply system

The power plant would require water for construction, process, cooling, potable, and fire protection purposes. Under normal operating conditions, the water use rates would typically be as stated in Table 4-8.

Table 4-4: Approximate water demand from various project sources

Type of water system	Approximate quantity generated
Maximum circulating water	42,168 m ³ /hour
Make-up water flow	1,100 m ³ /hour
Oily wastewater system	96 m ³ /day
Coal wastewater system	192 m ³ /day
Sanitary sewage system	96 m ³ /day
Desulfurization wastewater system	480 m ³ /day

4.6.9 Workers' housing

During the construction phase, it is anticipated that there will be 2000 – 3000 workers at the project site. Temporary worker accommodation will be provided for a significant number of these workers.

The power plant site would include an onsite construction worker housing area with the facilities necessary to support up to 1,000 workers during construction. The remaining 1000 – 2000 workers of the peak construction work force would reside in offsite housing.

The onsite construction worker housing facilities would be located within the power plant site. Onsite community facilities would include housing, kitchen/dining facilities, water and fire protection facilities, sanitary facilities, medical facilities, security and administrative facilities, recreational facilities, and parking. Recreational facilities may include indoor facilities such as TV rooms, game rooms, and gym area and outdoor facilities such as basketball courts and ball fields. Medical facilities would be limited to first response and will include an ambulance station onsite.

Modular, dormitory style community housing facilities would be used as the living quarters to accommodate 1000 or more workers onsite. Each dormitory would be prefabricated and erected on a concrete slab. Each dormitory would include private or communal wash/toilet areas.

The primary infrastructure to support the construction worker housing would be potable water systems, sanitary wastewater treatment, and electric power and communication lines. Potable water would be provided using the water supply system for the power plant. Sanitary wastewater would be collected and treated with an onsite package wastewater treatment plant.

Electric power would be established through the use of diesel generators, as required.

Parking areas would be provided throughout the construction area and surfaced with crushed aggregate or gravels. Refuse materials would be collected regularly and transported to an offsite, licensed landfill by a NEMA registered road contractor.

Upon completion of power plant construction, modular housing and buildings would be removed from the power plant site. Selected facilities used to support the onsite housing may be converted to permanent use to support the permanent operations and maintenance of the power plant. Depending on the size of the power plant initially built, future expansion of the plant would require the re-establishment of the construction worker housing on the power plant site.

During the operational phase, it is envisaged that there will be up to 500 workers who will be based within the power plant. An area of about 7 Ha within the project site has been set aside for housing the operational phase workers.

4.6.9.1 Ash handling and storage system

One of the coal combustion products (CCPs) is fly ash and bottom ash. Fly ash will be generated from the Electrostatic Precipitators (ESPs) connected to each boiler, while bottom ash will be generated as a result of the coal burning process. CCPs can be used for road paving, manufacture of concrete blocks, manufacture of cement, etc.

For the removal of bottom ash, a mechanical dry type ash conveying system shall be installed. The function of the bottom ash handling system is to collect, store, and transport bottom ash from boiler furnace to bottom ash storage silo (see Figure 4-9 for a bottom ash silo). The system will include a dry bottom ash hopper, dry slag conveyor, slag crusher and bucket elevator. The bottom ash (slag) falls by gravity into the bottom hopper of the combustion chamber and shall be conveyed to the bottom ash silo through the dry slag conveyor, slag crusher and bucket elevator. The ash system will be able to be isolated from the furnace to allow for repairs with the unit on line.

For the removal of fly ash from the Electrostatic Precipitators (ESPs), a pneumatic pressure conveying system shall be provided. Fly ash will be conveyed by means of dense phase pneumatic pressure conveying system from ESP hoppers and economizer hoppers to the fly ash silo. An image of a fly ash silo is shown in Figure 4-10.

Description of the Project

Bottom ash and fly ash shall be transported and dumped to the ash yard through trucks. The truck ash unloading area shall be equipped with dust control measures such as fencing and water misting stations. Ash in storage on the ground shall be treated or covered to prevent emissions of dust from the pile.

Figure 4-9: Bottom ash silo with truck loading facility



Figure 4-10: Fly ash silos under construction



The ash yard shall be designed to store bottom ash, fly ash, gypsum and mill reject. Trucks will convey bottom ash and fly ash from the power plant to the ash yard. Gypsum which will be generated through the wet flue gas desulfurization (FGD) process, will similarly be conveyed to the ash yard. The ash yard is located towards the north of the power plant and will be designed for storing ash and gypsum for a period of 15 years' plant operation.

4.7 Supporting facilities

4.7.1 Site access

From Mokowe jetty, the site can be accessed through the C112 road to Bobo Primary School and from here, there is a narrow access track about 15km long which leads to the project site as shown in Figure 4-11; the distance between Mokowe to the project site is approximately 28km. another alternative is to use an access track that runs northwards along the Kenya Navy base boundary to the project site.

The environmental and social impacts of the access road will be considered when a route selection has been determined and a Variation to the EIA License will be applied.

Figure 4-11: Access routes to the project site from Mokowe jetty



4.7.2 Diesel oil supply and storage system

For the black start generators and auxiliary boiler there will be a light diesel oil (LDO) storage and piping system. The LDO area will have up to three (3) above ground storage tanks each having a capacity of 500m³, a fuel off-loading area, etc.

The fuel oil system shall be designed to unload, store, and transfer LDO for boiler (unit) startup, and to supply the emergency diesel generator, black start diesel generator and diesel-driven fire pump.

Adequate grounding pads shall be provided on each tank for connection to the ground grid.

4.7.3 Water intake and plant feed

The proposed coal fired power plant will require water for a variety of purposes such as:

- Boiler makeup including losses from sampling, etc.;
- Make up to auxiliary cooling and air conditioning systems;
- Service water for various purpose;
- Firefighting reserve water; and
- Potable water for plant, staff colony and social services.

In order to meet clean water requirements for the power plant, a sea water reverse osmosis (SWRO) system will be installed which will abstract water from Manda Bay. As part of the Proponent's corporate social responsibility, the SWRO system will contain a potable water outlet at the fence of the project for the Kwasasi community's needs; it will be the responsibility of the County Government to tap the water from the outlet provided by the Proponent and distribute water to the residents living in the Kwasasi area.

The raw seawater will be treated by dosing flocculation and clarification in a raw water pre-treatment station and then delivered to the desalination plant. The coagulant dosing system and coagulant aid dosing system will each be provided with a dissolving tank, solution tank, dosing pumps and related control system; additionally, a mechanical clarifier will be provided.

After pre-treatment such as coagulation, clarification and sedimentation, the raw sea water will be sent to the desalination and demineralization plant, with the following flow path: self-cleaning filter, ultrafiltration (UF) and first stage SWRO. The output water will be stored in tanks, and be transferred to the process water systems via dedicated pumps; flow into potable water basins and firefighting water basins will be through gravity.

The Total Dissolved Solids (TDS) of the produced water will meet the requirements of service water and potable water (KEBS and WHO water quality standards). The treated water of the first stage reverse osmosis will be forwarded to various facilities, i.e., coal handling plant, HVAC system, cooling water for CW pump, etc.

Potable water from the SWRO will flow into a potable water basin by gravity. From the potable water basin, the distribution of water will be through separate pumps for the power plant and staff colony. Fire water from the first stage RO will flow into fire water storage basins by gravity.

To meet the water quality requirement of the steam-water cycle, a second reverse osmosis pass will be made. From the first stage, the SWRO will permeate into the water tank through the feed pump.

The output water from second stage RO will be stored in tanks, and be transferred to the demineralization system. The water will then be processed through a cation exchanger, anion exchanger and mixed bed exchanger to produce boiler quality water. The demineralized water plant shall be designed with redundancy for each unit such that when one set of equipment is in maintenance, the other will be adequate to meet the requirements of system operation. A neutralization system including tank, pumps, pH instrumentation and controls will be included.

To prevent bio-fouling of the once-through cooling system, plant feed water system to SWRO and potable water system, sodium hypochlorite solution will be dosed. The sodium hypochlorite will be generated by electrolyzing the concentrated sea water from SWRO system. If necessary, salt addition system will be provided.

Under normal operating conditions, the water balance for the power plant indicates that there will be a net zero discharge into the environment. The reused water system will supply water to following:

- Wash and dust suppression water to Coal Handling Plant
- Water for FGD
- Wash and spray water for Ash Handling plant

4.7.4 Compressed air system

The coal fired power plant will be equipped with compressed air for the ash handling, instrument air and service air systems respectively. The service air system shall supply compressed air for general cleaning, maintenance, atomization etc. services to following locations:

- Compressed air at various locations throughout the power house building, boiler area and mill area.
- Supply compressed air to the coal tripper room.
- Provide a compressed air supply to all remote areas including (but not limited to) the ESP, FGD, water treatment, ash handling, waste disposal, circulating water Intake area and coal handling areas.
- The service air system shall also provide to the requirements of atomizing air, if required for LDO burners of the boiler.

Additionally, the instrument air system shall supply clean and dry oil-free air for the operation of various pneumatically controlled valves, transmitters, controllers, positioners, dust collectors and HVAC equipment in the main building and to all remote areas of the plant.

4.7.5 Firefighting and detection system

The proposed coal fire power plant including the workers colony will have an elaborate fire protection system. The fire protection system will include a water firefighting system, portable fire extinguishers, chemical fire extinguishing system, foam fire extinguishing system and fire alarm and detection system. The fixed firewater protection system will include an indoor and outdoor fire hydrant system and water spray system.

The source of fire water will be fresh water from the seawater desalination system. An appropriately sized firefighting water storage tank will be provided as the special use for storing firefighting water. There will be two fire pumps, an electric duty pump and a diesel standby one; the fire hydrant system will maintain a residual pressure through two electric jockey pumps (1 service and 1 spare) and one pressure tank.

A fire station with an adequate number of fire trucks will be provided for the power plant and colony protection.

4.7.6 Station lifting and hoisting equipment

Lifting and hoisting equipment will be provided in areas where equipment heavier than 500kg is installed. A rigging steel beam will be provided in areas where any equipment/component weighing from 45 kg to 500 kg is installed and needs to be handled during maintenance.

4.7.7 Wastewater treatment plant

A wastewater treatment plant will be installed at the power plant and will take wastewater produced from the turbine building, surface drainage (except rainfall drainage) and domestic and sewage waste water from the whole site for treatment. The design of the wastewater system will take cognizance of the effluent discharge limits promulgated under Kenya's Environment Management and Coordination (Water Quality) Regulations, 2006 as well as the World Bank's EHS Guidelines for effluent quality from thermal power plants. An annual Effluent Discharge License (EDL) will be applied for by the Employer.

The wastewater treatment system shall be designed to collect and treat the various process effluent produced within the plant during normal, start up and shut down condition.

Wastewater collected from the various area of the plant will be pre-treated separately and transferred to the waste water treatment plant. Wastewater from the storage tank shall be directed to an inclined plate sedimentation tank (or clarifier) via a pipe mixer and flocculation tanks through wastewater transfer pumps. Treated water from the inclined plate sedimentation tank (or clarifier) shall be transferred to the final neutralization pond by gravity and reused inside the plant.

4.7.8 Heating, ventilation and air conditioning (HVAC) system

A heating, ventilation and air conditioning (HVAC) system will be installed at the power plant and specifically at the powerhouse, auxiliary buildings, non-plant buildings within the plant's boundary and dust extraction system.

The indoor heating, ventilation and air-conditioning of other plant buildings, workshop and structure will have design parameters that comply with the relevant technical requirement, process requirements, Technical Code for Heating, Ventilation and Air Conditioning Design of Fossil Fuel Power Plant and Technical Specification for Design of thermal Power Plants.

4.7.9 Hydrogen generation system

A hydrogen supply system will be designed to produce hydrogen gas at a pressure, purity and dryness suitable for use in the turbine generator cooling systems. For the hydrogen

cooling system, a salt water hydrogen generation system will be designed as the supply source of hydrogen.

4.7.10 Nitrogen and carbon dioxide cylinders

The power plant will require the use of nitrogen and carbon dioxide for various activities. Nitrogen will be used for equipment blanketing for corrosion protection while carbon dioxide will be used for fire protection and for purging the generator hydrogen cooling system.

The power plant would include up to three generating units, which will be constructed sequentially. This section describes the activities that will be undertaken for constructing the proposed 981.5MW coal fired power plant.

4.8 Hazard prevention and emergency planning

4.8.1 Health and Safety

APCL aims to protect human health by safely and responsibly managing site activities. APCL has developed a framework Health, Safety and Environment (HSE) management system which the EPC contractor will be required to align with.

During the construction phase, the EPC Contractor and its sub-contractors shall comply with the requirements of Kenya's Occupational Safety and Health Act, 2007 (OSHA) and all its applicable subsidiary legislation. The EPC contractor will be required to develop and implement a comprehensive written Safety and Health (S&H) management plan for preventing accidents and injuries arising out of work related activities. The S&H management plan should be developed based on the requirements of OHSAS 18001 or the proposed ISO 45000 standard for S&H management systems. The S&H plan will be developed to include all activities undertaken on-site within the power plant as well as off-site. The EPC contractor will employ suitably qualified S&H professionals to manage this crucial function and the will be headed by a S&H Manager.

During the operational phase of the project, the Operations and Maintenance (O&M) Company will develop and implement a formal Environmental and Social Management System (ESMS). The ESMS will be aligned with the requirements of the OSHA, International Finance Corporation (IFC) E&S Performance Standards and recognized international best practices for the safe management of a coal power plant.

4.8.2 Emergency response planning

The proposed power plant will be required to have in place an Emergency Response Plan (ERP) for credible emergency scenarios during the construction and operational phases respectively. The ERP shall be specific to the project site and developed based on realistic potential emergency scenarios. In general, the ERP will be comprehensive and contain the following aspects:

- Identification of the emergency scenarios (based on an emergency response risk assessment);
- Specific emergency response procedures (based on the outcome of the identification of specific emergency scenarios);

- Trained emergency response teams (providing initial and refresher training of the entire emergency response team based on a training needs analysis);
- Emergency contacts and communication systems/protocols (including communication with Affected Communities and media when necessary);
- Procedures for interaction with government authorities including mutual aid and response agreements (first responders, public health, Safety and Health, environmental authorities);
- Permanently stationed emergency equipment and facilities (e.g., first aid stations, firefighting equipment, spill response equipment, personal protection equipment for the emergency response teams);
- Protocols for the use of the emergency equipment and facilities;
- Clear identification of evacuation routes and muster points;
- Emergency drills and their periodicity based on assigned emergency levels or tiers (drills undertaken for various emergency scenarios on a regular basis, say bi-monthly);
- Decontamination procedures and means to proceed with urgent remedial measures to contain, limit and reduce pollution within the physical boundaries of the project property and assets to the extent possible.

The EPC Contractor will develop and implement a construction phase ERP based on a formal emergency response risk assessment; during the operational phase, the O&M Company will develop and implement an ERP also based on a formal emergency response risk assessment.

As there will be activities undertaken off-site and associated with the proposed power plant, it is imperative that the ERP contain the management of off-site emergencies. The respective communities should be involved in emergency response management as part of APCL's community awareness and outreach program.

The contents of the ERP for each phase of the project will contain the following elements as a minimum:

- Administration (policy, purpose, distribution, definitions, etc.);
- Organization of emergency areas (command centers, medical stations, etc.);
- Roles and responsibilities;
- Communication systems;
- Emergency response procedures;
- Emergency resources;
- Training and updating;
- Checklists (role and action list and equipment checklist); and
- Business Continuity and Contingency.

4.9 Construction program and methods

APCL has appointed The Power Construction Corporation of China (POWERCHINA) as the EPC contractor for the proposed Lamu coal power plant; POWERCHINA may appoint subcontractors to undertake the associated civil works. APCL is committed to ensure the safe working environment for all employees and contractors. A Construction Method Statement (CMS) will be prepared by the EPC contractor. This CMS will set out the key measures to be employed during the main works phase to control health and safety and minimise the impacts on the local environment.

The entire site preparation and construction programme is anticipated to take approximately 42 months from commencement to commissioning. Figure 4-12 shows an indicative construction programme.

The specific activities associated with the construction of the project will be determined following detailed engineering design. A general description of the possible activities that may be required as part of the construction of the land based facilities is provided below. It should be noted that construction activities may be conducted sequentially, in parallel or in phases, as appropriate. The specific sequence and activities will be determined by the EPC contractor during and following detailed engineering design.

4.9.1 Preliminary works

The preliminary works for the construction of the proposed power plant and other land based facilities are generally expected to include the following activities:

- Construction of access roads to the site;
- Installation of required utilities for construction;
- Construction of a water desalination plant for construction related activities;
- Construction of a sanitary and process waste collection disposal system;
- Construction of a wastewater handling system to control run-off from the site;
- Site clearing, grubbing and grading;
- Construction of temporary construction facilities and site office;
- Surfacing of construction laydown areas;
- Construction of roads within the site;
- Construction of all foundations and sub-structures, including shoring and superstructures for all buildings and process units;
- Construction of storm drainage system;
- Construction of seawater circulating water intake and discharge structures; and
- Construction of cable and pipe trenches and ducts.

Erosion control and dust suppression measures will be implemented to reduce the potential environmental effects of activities on the creek in the north of the project site and Manda Bay. All plant, equipment, buildings and services would be supplied, erected, operated and maintained in accordance with Chinese, Kenyan and US standards.

4.9.2 Surveying and clearing

The project site including the construction laydown area will be surveyed to accurately determine actual contours in order to optimize cut and fill operations consistent with layout requirements of the power plant parts.

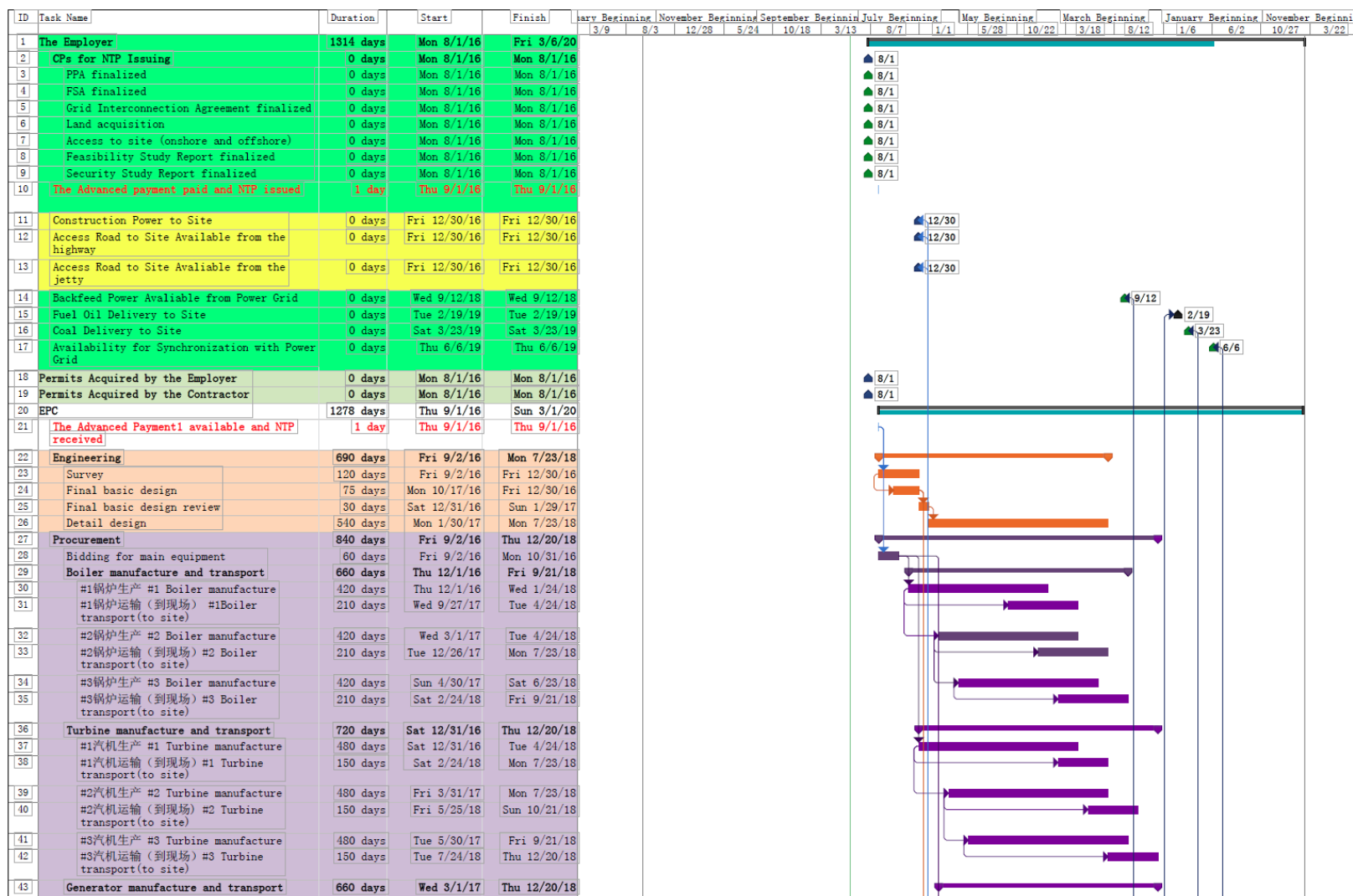
Clearing would be required to establish the land based aspects of the project. Merchantable wood would be sold to local contractors. All cleared merchantable timber will be sold and any remaining cleared vegetation will be stored on site for disposal.

Site leveling will be accomplished using a combination of machines (dozers and scrapers). It is expected, depending on the final location of the power block, that the majority or all of the excavated material will be used in the site leveling.

ESIA Study for 1,050MW Coal Fired Power Plant, Lamu County, Kenya

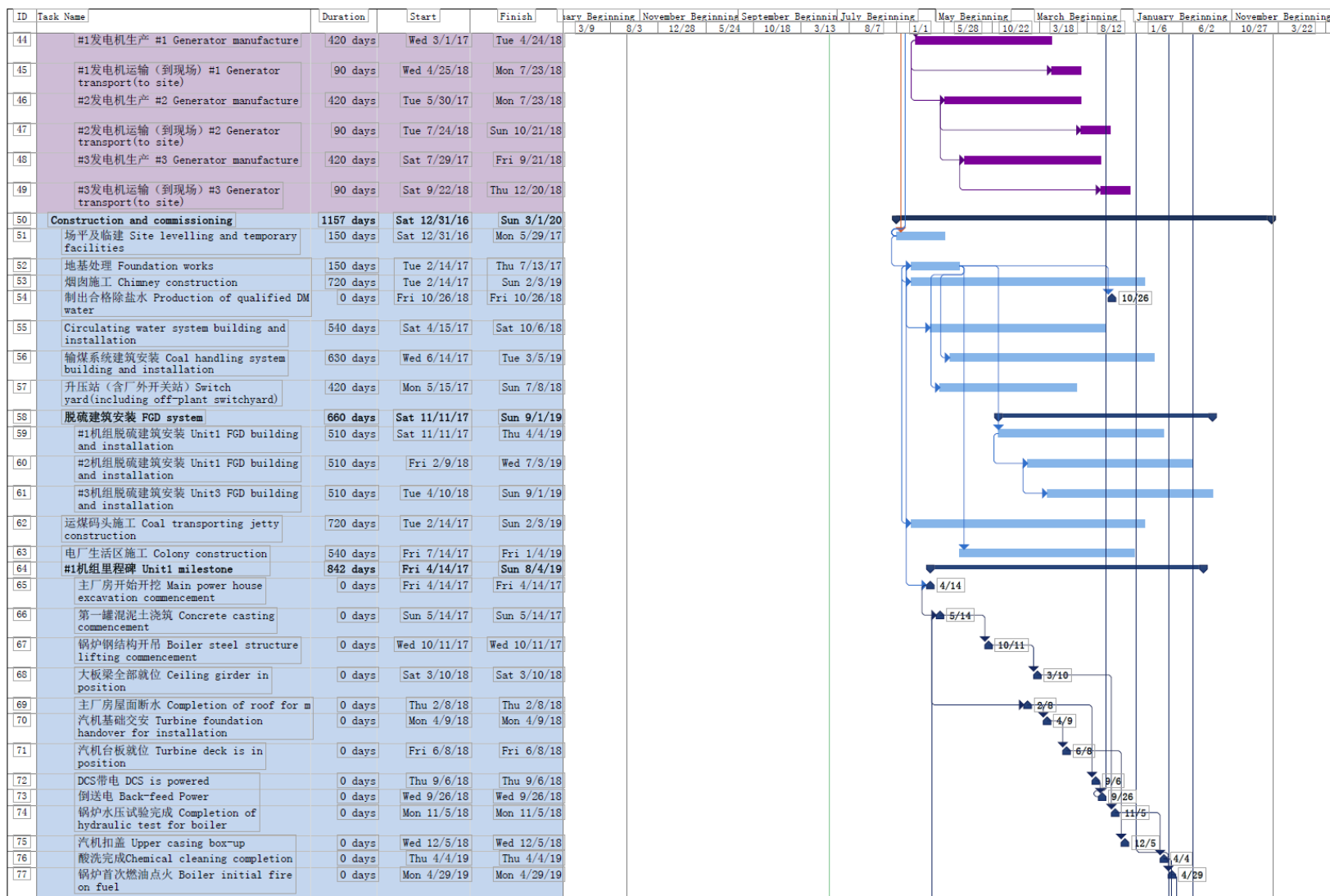
Description of the Project

Figure 4-12: Proposed Construction Schedule for coal power plant



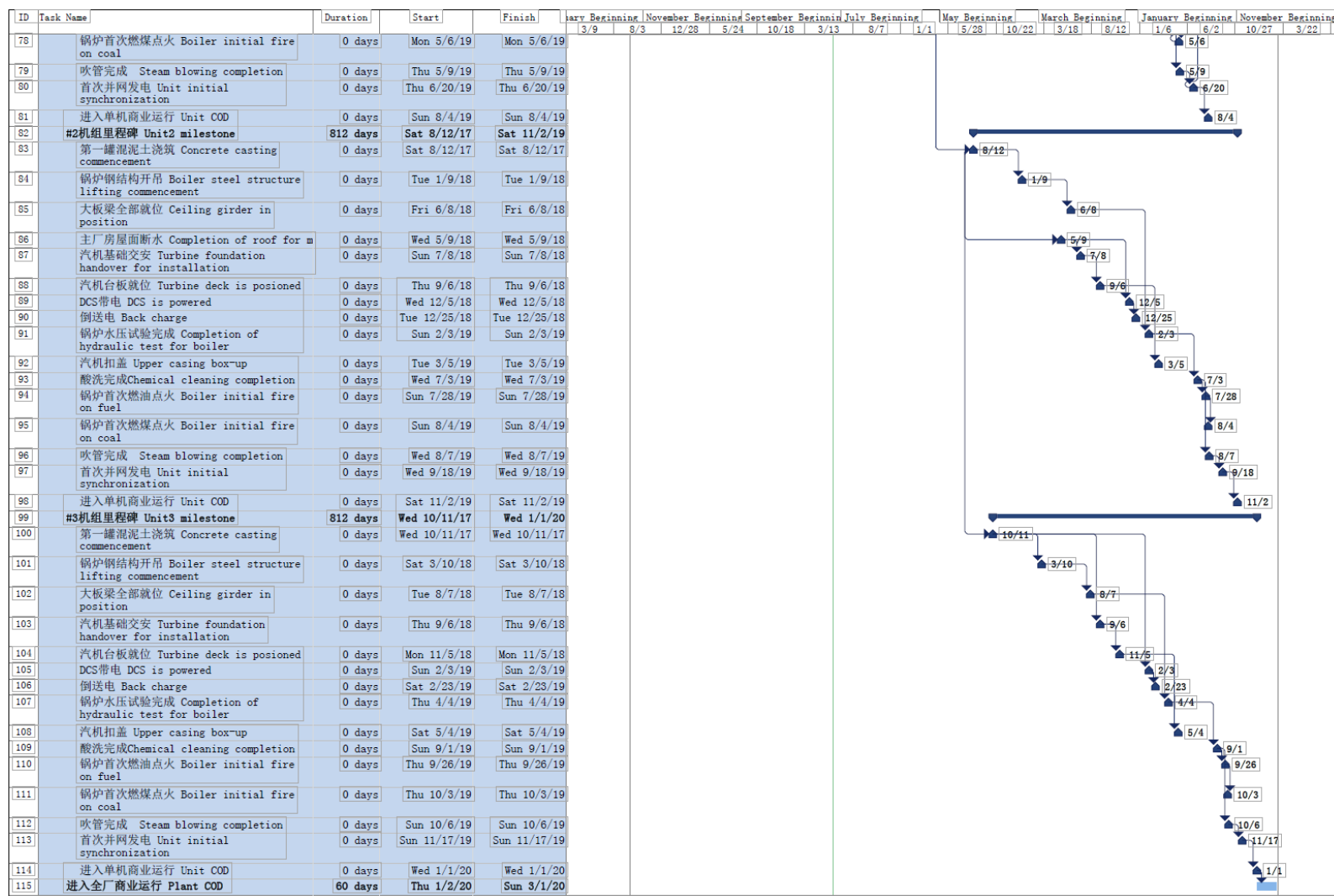
ESIA Study for 1,050MW Coal Fired Power Plant, Lamu County, Kenya

Description of the Project



ESIA Study for 1,050MW Coal Fired Power Plant, Lamu County, Kenya

Description of the Project



4.9.3 Grading and levelling

Any top soil removed during site clearing and subsequent grubbing will be stock-piled on site. The top soil will be reused during landscaping operations and site contouring once construction is complete.

Site grading will be required to establish building and power plant hardstanding, roads, car parks and balance of plant facilities. Engineering fill, gravel and rock will be sourced from nearby existing borrow pits or quarries.

The watering needs of the project (e.g. watering for dust suppression, concrete production, etc.) during construction will be sourced from the desalination plant.

4.9.4 Borrow pits

One or more borrow areas would be established to provide earth and rock materials during site preparation and throughout the construction process. The materials would be used for concrete and asphalt mixes, road base, lining of dikes, and rock surfaced areas. A fence, berm, or signs would be established at the borrow area entry to prevent public access. Upon completion of construction, the borrow area(s) would be re-contoured and reclaimed in accordance with good industry international practices.

The location of the borrow pit(s) will be based on lab tests to determine the suitability of earth and rock for construction of the power plant. This will be determined during the detailed engineering design phase of the project.

4.9.5 Construction of temporary facilities

The project will develop a plan to accommodate the work force and management staff. This will comprise a camp site for the EPC contractor, APCL complete with accommodation blocks, offices, lunch rooms, wash rooms, amenity areas, parking lots, warehousing facilities and maintenance areas.

The approximate construction areas envisaged for the temporary facilities are as follows:

- A temporary office area of 4400m² for centralized office work.
- Equipment and material storage area, including: 3000m² Storage House, 5,000m² Storage Shed, 18,000m² Storage Yard 1 and 15,000m² Storage Yard 2;
- 2 concrete Plant (including gravel storage yard), each with planned area of 8,000m².
- A steel and formwork workshop and a daily use material storage yard, with a total planned area of 6,000m².
- Areas for Pre-assembly, each with an area of 8400m².
- A tool room for construction teams, with a planned area of 6,000m².

Facilities containing toilet and washrooms will be serviced using bio-digesters for treatment. Such bio-digesters which meet the NEMA effluent discharge requirements, have been used extensively in the Turkana area by companies such as Tullow Oil during the exploration campaign. Portable toilets will also be used where needed and will be contracted to a supplier who will be responsible for their maintenance and disposal of the waste.

It is envisaged that an on-site batch ready mix concrete plant will be required for the project and will be constructed near the power plant facilities.

The EPC contractor requires approximately 4MW of electrical power to run the various electrical plant and equipment used for construction of the power plant project. The Kenya Power will provide an electrical connection to the site via a 33kV overhead distribution line from the Hindi sub-station; the routing of the electrical poles will follow existing roads in which case no new wayleaves need to be negotiated. Diesel generators may be used if temporary power is unavailable from the local supply network or on unserved areas of the site.

4.9.6 Physical construction and equipment installation

Following construction of the temporary facilities, physical construction of the land based facilities will be completed.

4.9.6.1 Pile driving

Given the subsurface soil conditions and bearing capacities at project site, the design philosophy is to use mass concrete foundations anchored to the bedrock where necessary. Significant piling may be necessary within the project site if the bedrock is not close to the surface and the soils are not geotechnically stable. Piles will be driven using conventional impact pile drivers and the number of piles required will be confirmed during the detailed design phase.

Where piling is required, piling times will be controlled to minimize risk to construction workers and noise. Piling activity will be carried out during daylight hours, Monday to Saturday, wherever feasible.

4.9.6.2 Pouring of footing and foundations

The construction of the footings and foundations will require concrete mixed in an on-site batch plant thus reducing the need for truck traffic on local roads; it will still be necessary to transport sand, cement and aggregate to the project site.

Pouring of footings and foundations will be made using conventional formwork and similar methods. Rebar cages will be pre-fabricated wherever possible for direct placement to the foundations. The use of system formwork will be maximized to minimize wood consumption and waste. For large pours or pours of group foundations, concrete pumps will be used. Small concrete component will be pre-cast (e.g. manholes, sleepers).

4.9.6.3 Erection of building and structures

The construction of buildings and structures will be conducted using conventional materials (e.g. steel, wood, fiberglass, sheet metal and similar materials) and using conventional construction methods. Some buildings will be pre-engineered and pre-fabricated off-site and transported to the site (e.g. security buildings). To reduce the construction time, pre-fabricated components will be imported to the site to the extent possible, and erected on site. Mobile cranes will be used to erect and complete the assembly of heavy plant components and equipment.

Buildings and ancillary facilities will be constructed using standard methods and built to applicable codes, with reference to public safety, fire protection and structural sufficiency. The primary purpose of the codes is the promotion of public safety through the application of appropriate uniform building standards.

4.9.6.4 Large module construction and transportation

Major pieces of machinery, units and other equipment whose weight is between 40 and 250 tons would be fabricated in China and delivered to the power plant site as packaged units for installation. Such major components (e.g. main transformers, stators, rotors) would not be constructed on site, but constructed off-site in a modular fashion, transported to the site and assembled after delivery. The off-site fabrication of large modules as opposed to building on-site provides for more timely construction and reduces the need for large volumes of labour resources on-site that might otherwise be difficult to supply from Lamu County or Kenya.

The large modules will be delivered to the project site via barge or ship, unloaded at a barge unloading facility (location yet to be decided), and transported to the project site via a heavy haul road. Alternatively, some smaller modules and equipment may also be delivered to the site by truck using the existing C112 road from Mombasa to the project site.

Large modules of the power plant will be constructed and commissioned to the extent practical in module fabrication yards in China and elsewhere depending on the capacity, capability and transport logistics of each module yard. The large modules will be delivered mostly by sea and off-loaded at the barge landing facility to minimize traffic associated with equipment deliveries as well as prevent damage to road infrastructure from these very large and heavy units. From the barge landing facility, the large modules will be transported to the power plant site using self-propelled transporters and heavy lift cranes. Once in position, the modules will be laid on their foundation, erected, connected to the process (i.e. final structural, piping, mechanical, electrical and instrumentation connections) and tested prior to commissioning.

4.9.6.5 Construction of site access roads, heavy haul road and on-site roads

Road construction requires the creation of a continuous Right-of-Way (ROW) overcoming geographic obstacles and having grades low enough to permit vehicle travel and to meet road construction standards. Most of the road infrastructure and network to access the proposed project site does not exist and consequently, existing roads will need to be upgraded and some may need to be re-routed and/or upgraded by widening, improving the sub-base, and resurfacing and finishing to serve as a suitable access road to the power plant.

In the case of the heavy haul road, a shallow grade will be maintained in order to facilitate the movement of the self-propelled modular transporters. The radii and gradient should be designed and staked out to best suit the natural ground levels and minimize the amount of cut and fill.

As applicable, construction will begin with the laying of geotechnically stable sub-base bedding material. Depending on its physical and chemical properties, any excavated material may be used for road construction if not needed for construction of the power plant facilities. Fill, gravel and rock will also be sourced as needed from borrow pits and quarries in Lamu County or beyond.

The top soil and vegetation removed during the clearing and grubbing stage will be stockpiled for subsequent rehabilitation of the extraction area. The topsoil will be stripped and stockpiled nearby for possible rehabilitation of newly constructed embankments along the road. Stumps and roots will be removed and holes filled as required before the earthworks begin. Final rehabilitation after completion of road construction will include seeding and planting of vegetation.

Processes during earthworks include clearing and grubbing, excavation, embankment or roadbed construction including placing of fill materials, compacting, construction and trimming and shaping of side slopes. In cases where the sub-grade (native soil) will not support the design loads the sub-grade is improved by excavation to enhance the sub-grade performance. The embankment fill is placed by the compacted layer method, where a layer of fill is spread at a specified thickness and then compacted to a specific density and the process repeated until the desired grade is reached.

The completed roadways will be finished by paving, chip sealing or stabilized with a gravel surface depending on the serviceability requirement of the road. The type of road surface will depend on economic factors and expected usage. Safety improvements such as traffic signs, crash barriers and other forms of road surface furniture will be installed as necessary to complete the roadway.

A variety of road building heavy equipment will be used throughout the roadway construction, including bulldozers, graders, rollers, pavers and other similar heavy equipment.

4.9.7 Commissioning

Following the completion of all construction activities, the power plant and balance of plant will be commissioned with individual units or processes commissioned in sequence as they become available for commissioning and initial operation. The three units of the power plant will be commissioned in 36, 39 and 42 months respectively from the Notice-To-Proceed (NTP) date.

Commissioning of the power plant will in general involve the following steps:

- Completion of documentation of all control systems;
- Training of operators and employees;
- Checking and sign-off of control systems and instrumentation;
- Preparing utilities for use (i.e. firewater, process water, air, sewer system, etc.);
- Testing each individual 350MW power unit and associated electrical, mechanical and process control systems and associated instrumentation, to ensure readiness for operation; and
- Performance testing of the equipment to verify compliance with the performance guarantee of the suppliers.

Following commissioning, the project will be available for commercial operation.

A commissioning manual will be prepared prior to start-up of the power plant. The manual will provide detailed procedures for commissioning the power plant and balance of plant and will describe the commissioning sequence, testing program and emergency and contingency response procedures during the commissioning process.

4.9.8 Road transportation

Construction related road traffic during the construction phase of the project will be comprised of:

- Automobiles and pick-ups; and
- Trucks (light and heavy trucks for various services, heavy equipment and transport of equipment and construction materials).

Truck traffic during the construction phase will be reduced significantly as the large and heavy modules of the power plant are transported via sea to the barge off-loading facility. These modules will be transported from the shore to the project site using self-propelled modular transporters over the heavy haul road to be constructed for the project.

The EPC contractor will build a construction camp within the project site to house several expatriate and local workers. It is anticipated that during peak construction there will be over 2,978 workers working at the project site. A number of these workers will be accommodated within the construction camp while others will find accommodation outside of it. The EPC contractor will explore the means of providing transportation to workers to and from the project site and finalized during the detailed engineering design phase. Some construction related traffic will occur from passenger vehicles to the project site (e.g. from construction management personnel).

At the time of conducting this ESIA Study, minimal information was available on the use of various transport modes for movement of goods and people to and from the project site. Subsequently, a comprehensive transport study should be undertaken prior to the construction phase of the project to evaluate the impacts of transport on the project.

4.9.9 Employment and expenditure

Construction of the project is expected to commence in the last quarter of 2016 subject to receiving all regulatory approvals and securing financing.

It is envisaged that the first unit will be commissioned in 36 months from the construction commencement date, followed by the second unit in 39 months and the third unit in 42 months from the construction start date respectively.

Normal construction hours are expected to fall between 6:00am – 6:00pm Monday through Sunday. However, these hours may require adjustment because of scheduling constraints and other time-sensitive matters.

About 60% of this workforce will be Kenyan while the remaining 40% will be Chinese. During construction, direct project employment (Kenyan and Chinese workers) in various trades would average approximately 1,800 over 42 months, peaking at approximately 2,978 in the eighteenth month as shown in Figure 4-13. Figure 4-14 shows the Kenyan staff strength needs over the 42 month construction period.

Trades that will likely be required will include: boilermakers, carpenters, electricians, steel fixers, masons, surveyors, pipe fitters, instrumentation technicians, iron workers, welders and other craft workers. Additional skilled workers will be required including truck drivers, utility van drivers, heavy equipment operators, crane operators, tug operators, barge operators, industrial divers, labourers and excavator operators.

Figure 4-13: Estimated staff strength (Kenyan and Chinese) for the construction phase of the project

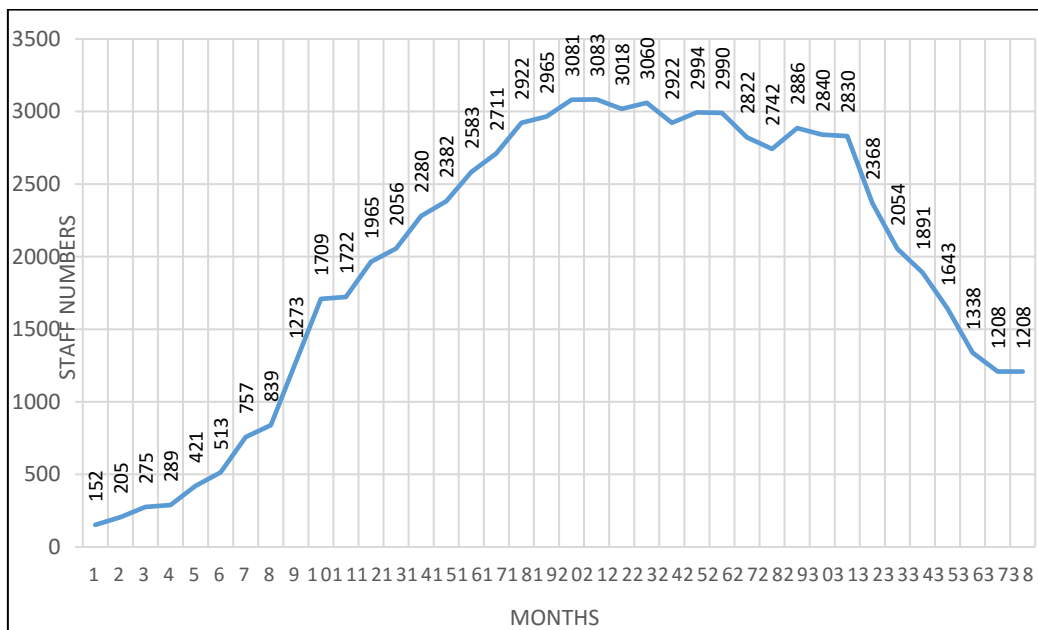
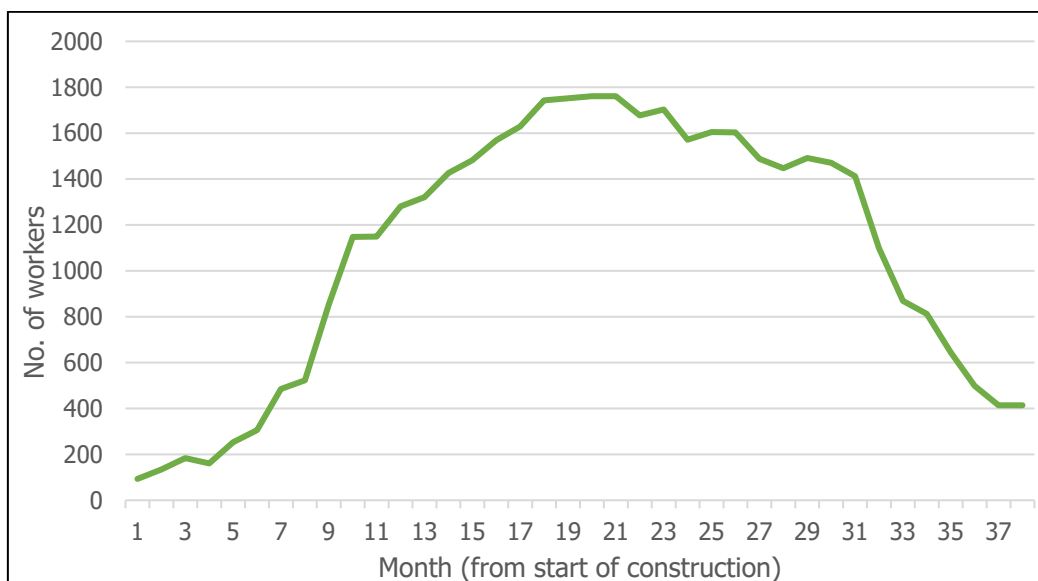


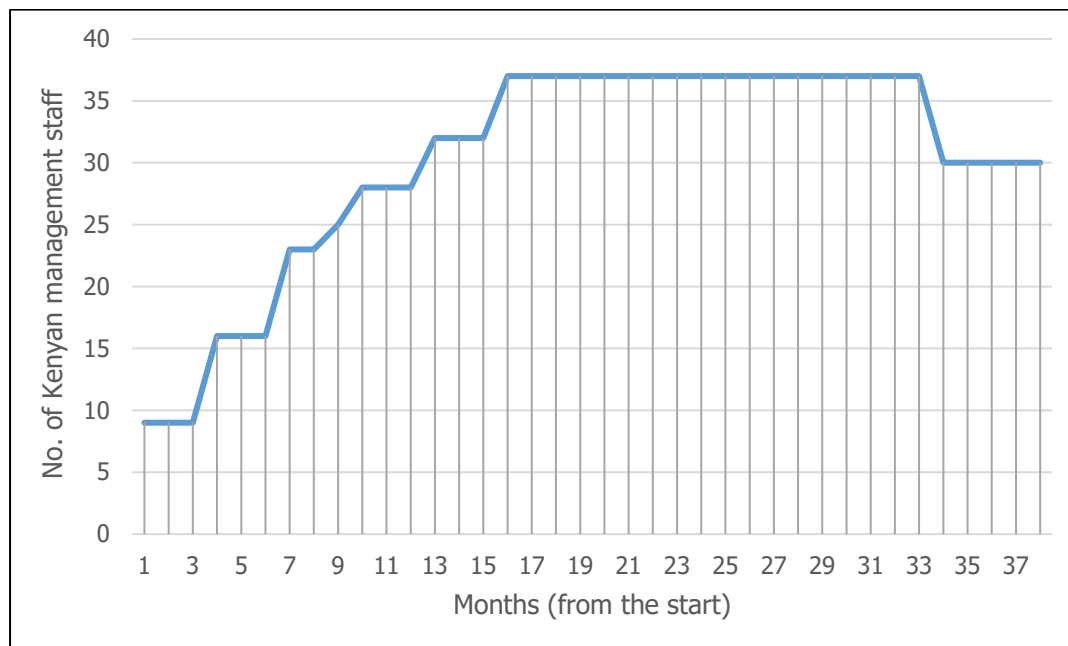
Figure 4-14: Graph showing Kenyan construction personnel requirements



In addition to the above, the Kenyan workforce that will be involved in the contract management during the construction phase are shown distributed graphically in Figure 4-15. Kenyan staff required for administrative type jobs include (i) Administration & Logistics, (ii) Safety Supervision, (iii) Engineering Technique, (iv) Material and Equipment Management, and (v) Internal Security.

The total number of construction management staff, engineers, commercial supply chain staff and project execution personnel that will also be directly employed during construction will be about 64 over the 42 month construction period of which an average of 30 persons will be Kenyan nationals.

Figure 4-15: Graph showing No. of Kenyan contract management staff



Additionally, there will be several indirect jobs and spin-off economic activities in Lamu County will result from the large influx of workers, off-site manufacturing and local expenditures associated with the project.

4.9.10 Workers' accommodation

During the construction phase, there will be a need to accommodate the EPC contractor's expatriate workers, APCL project staff, the Project Management Consultant's (PMC's) staff members and some local Kenyan construction workers over the construction phase of 42 months.

APCL is in the process of selecting a camp solutions provider for the accommodation needs of their staff and that of the PMC. The EPC contractor will construct a camp for their expatriate Chinese workers (about 1,700 persons) as well as for their Kenyan workers.

Housing and accommodation options will continue to be reviewed and assessed throughout the design phase and the selected accommodation strategy/strategies will be determined as the engineering design unfolds.

As part of the power plant, there will be a permanent workers colony that will be built to accommodate those workers that will operate and maintain the project during the operational phase. The design details of permanent workers' colony will evolve as part of the detailed engineering design of the project.

Given below are the general standards for workers' accommodation that the project will have to comply with during the construction and operational phase of the project.

The workers' accommodation will be located in order to prevent exposure to wind, fire and floods. Further, the living facilities will be designed so that their location is unaffected by environmental or operational impacts (e.g. noise, emissions, dust). In order to prevent stagnation of water, the accommodation facilities will have adequate drainage facilities to avoid accumulation of stagnant water. All living facilities will be provided with adequate ventilation and/or air conditioning systems, natural and artificial lighting.

The project will install a desalination plant which will be the source of potable water for among other things, the living and accommodation facilities. The drinking water will be stored in appropriate tanks which will be covered to prevent pollution; the potable water will meet KEBS standards for drinking water as a minimum.

The project will generate a variety of wastes and effluent during the construction and operational phases. Lamu County lacks waste management facilities and sewage treatment plants. As the project area is not served by any wastewater and waste infrastructure, the EPC contractor will install an effluent treatment plant for managing sewage generated by the project. For waste management, the EPC contractor will provide separate bins for plastics, organic wastes (e.g. food wastes) and paper. For vector control, the EPC contractor will contract a third party company for pest extermination, vector control and disinfection of the living facilities.

The workers' accommodation will comprise rooms/dormitories that are kept in good condition always through regular cleaning, ventilation and easily cleanable flooring material. Sanitary facilities will be provided in the same buildings and there shall be separate male and female facilities. Each person will have a minimum of 10m³ (volume) or 4m² (surface area) of space with a minimum ceiling height being 2.1m in each dormitory. In collective rooms, workers will be provided with some privacy using mobile partitions or curtains and subsequently, these rooms will be designed to accommodate between 2 and 8 workers; the doors and windows should be lockable and each bed will be provided with mosquito nets.

Each worker in the dormitory will be provided with his/her own bed and the practice of "hot-bedding" will be avoided. Spacing between beds will be at least 1m to allow for movement of a worker around the bed. Double deck bunks will be discouraged for fire safety and hygiene reasons and their use will be minimized. Where they are necessary, the bunks will be designed such that the space between the lower and upper bunk of the bed is between 0.7m and 1.1m; triple deck bunks will be prohibited. Workers will be provided with a comfortable mattress, pillow, cover and clean bedding; all linen will be laundered frequently and applied with mosquito repellents and disinfectants. For storage of personal effects, an individual cupboard will be provided having a volume of about 0.5m³ and 1m shelf unit. Separate storage facilities will be provided for street clothes and Personal Protective Equipment (PPE) which should include drying/airing areas.

In order to maintain good standards of personal hygiene, sanitary facilities will be provided which include urinals, wash basins and showers. The sanitary facilities will be designed to ensure that there is adequate privacy by having floor to ceiling partitions and lockable doors. The sanitary facilities will be cleaned frequently and kept in fully working condition at all times. Separate male and female sanitary facilities will be provided throughout the camp accommodation facilities.

In order to prevent the spread of infectious disease and avoid contamination, there will be a minimum of 1 toilet for 15 persons. The toilet facilities will generally be located between 30m and 60m from rooms/dormitories. Toilet rooms will be well-lit, have good ventilation and have sufficient wash hand basins.

The rooms/dormitories will be provided with an appropriate and adequate number (1 shower for 15 persons) of shower and other sanitary facilities (1 wash hand basin for every 15 persons) which will be maintained and cleaned regularly. The flooring for shower facilities will be made of washable material, non-slip surface, damp-proof and properly drained. The showers will be conveniently located and will be provided with an adequate supply of hot and cold running water.

The workers' camp will have mess facilities and a laundry. The catering contract will be outsourced to a contractor for managing the kitchens and canteens. The cooking facilities within the kitchen areas will be sufficient for preparing food and will conform to high standards of safety and hygiene. The working space for each kitchen worker will be about 1m² to 1.5m²; the dining area will be adequately furnished with tables, benches, chairs, individual drinking cups and plates. All food preparation areas will be designed to provide food hygiene practices including protection against contamination between and during food preparation. Wall surfaces adjacent to cooking areas will be made out of fire resistant materials. All kitchen floors, ceiling and wall surfaces adjacent to or above food preparation and cooking areas will be built using durable, non-absorbent, easily cleanable, non-toxic materials.

There will be a medical facility provided by the EPC contractor for the construction phase of the project. The medical facility will be located within the workers' accommodation area. Medical facilities will include provision of special facilities such as an emergency room, pharmacy, triage, etc. The on-site medical facility will be manned by sufficiently trained and adequate staff members including nurses, clinical officers, etc. Additionally, there will be first aid kits distributed throughout the project site. The contents of the first aid kits will at a minimum comply with the requirements of Legal Notice 160 of 1977 titled: The Factories and Other Places of Work (First Aid) Rules.

The project site will contain basic leisure and social facilities such as exercise and recreational facilities. Some of the facilities that will be considered include a gym, jogging tracks, TV rooms, table tennis, Pool/Billiards, etc. Additionally, the communication reception is poor in the project area; subsequently, APCL will work with either Safaricom or Airtel to install a base transmitter station within the project site to enable workers communicate with the outside world.

The project site is in an area where the predominant religion is Islam and subsequently, prayer facilities will be provided at the project site for the workers that subscribe to the faith.

4.10 Operation

Once the construction is completed and the project commissioned, the power plant will become operational. A discussion of the planned activities during the operational phase is given below.

4.10.1 Operation and maintenance of the power plant

Throughout the operational phase, the power plant performance will be monitored to meet all regulatory and lender requirements to operate such a plant. A number of hazards associated with the proposed coal power plant have been eliminated or engineered out. Subsequently, as conceived and designed, given use of best available proven technology economically viable, modern day emission control and advanced process control systems that will be built and operated at the new power plant, the process will inherently provide a high level of mitigation of the potential environmental effects caused by emissions, releases and wastes.

The majority of the power plant operations will be controlled by highly skilled and trained operators in the control room via computer-controlled sensors and systems. Operation will consist of among other things, monitoring and controlling the power plant unit systems, pressures, temperatures and environmental performance of the emissions. Operating manuals written in English will be produced for the overall process, individual units and various maintenance tasks. Proven industry practices will be followed that result in an efficient and environmentally responsible facility. The facility will be operated to comply with all regulatory requirements. An Operations and Maintenance Manual will be developed to outline the safe operation and emergency and contingency response procedures to be followed during operation of the power plant.

There will also be hands-on operation throughout the power plant which will consist of regular physical system checks, testing, inspection and maintenance. Operators will be able to continuously monitor environmental performance from the control room from the Continuous Emissions Monitoring System (CEMS), ambient air quality, and grab samplers (as applicable), and adjust the process operation accordingly to maintain acceptable power plant performance and ensure compliance with environmental legislation.

Operators will be fully aware and will keep track of personnel working in various areas of the power plant, thus contributing to security and safety throughout the facility. Appropriate work orders and a Permit-To-Work (PTW) system will be required prior to entering and executing work in any area of the power plant. A PTW will be required for any non-routine or potentially high consequence activity to be carried out in the power plant such as working at heights, confined space entry, hot works, etc.

Routine preventive and predictive maintenance will be scheduled and conducted on an on-going basis to facilitate the safe, reliable and efficient operation of the power plant and balance of plant. Any major scheduled outages will be scheduled on an as-needed basis to facilitate the ongoing maintenance of the power plant and ensure optimal performance and continuous improvement.

4.10.2 Emission control and management of effluents and wastes

4.10.2.1 Operation of environmental control systems

The various environmental control systems associated with the power plant operation (low-NO_x burners, Electrostatic Precipitators (ESPs), wet Flue Gas Desulfurization (FGD) and ambient air quality monitoring systems) will be operated to ensure the acceptable environmental performance of the power plant and balance of plant in compliance with environmental legislation. The performance of these systems will be continuously monitored by plant operators to facilitate compliance so that ambient air quality standards and objectives are not exceeded. Systems will be maintained in accordance with the Original Equipment Manufacturers (OEM's) specifications.

4.10.2.2 Operation of wastewater treatment system

The proposed power plant wastewater treatment system will be sized to treat wastewater that will be generated from the operation of the project. The wastewater treatment plant and associated systems will be operated to confirm that the effluent from the process areas is in compliance with Kenyan environmental discharge standards. Continuous and grab sampling of the effluent will be conducted and the samples analysed in the on-site laboratory for important effluent characteristics to confirm acceptable environmental performance.

Maintenance and upgrading of the wastewater treatment plant will be conducted as necessary to meet the manufacturer's specifications. Waste products (e.g. sludge) will be periodically removed by dredging or other means and disposed off through NEMA licensed road contractors.

4.10.2.3 Air quality and effluent release monitoring

The project will use a Continuous Emissions Monitoring System (CEMS) on all three flues to confirm process efficiency and conformance with environmental legislation. These systems will most likely consist of multi-component gas analysers that include sensors, digital signal processing equipment and software. Data from the gas analyser will be displayed in the control room.

Effluent from the wastewater treatment plant will be monitored for quality before being released to the environment. Based on the water balance diagram for the project, there will be no treated effluent discharged into the environment. The exception will be during the wet season where treated effluent will be discharged into the Manda Bay.

An ambient air quality monitoring program will be implemented in and around the fall-out areas identified in the air dispersion modelling study for the project. Such a program will be undertaken for the first two years of operation and if found within acceptable air quality limits, will cease thereafter.

4.10.2.4 Water supply and use

Freshwater will be used in several processes within the power plant. Under normal operating conditions, the average demand of water at maximum continuous rating will be about 408m³/h which will be supplied from the desalination plant. Of this amount, 208m³/h will be sent to the reuse water storage tank where it will be distributed for various uses. The remaining water will be used in washing water for main building (5m³/h), potable water for power plant (5m³/h), boiler feed water treatment plant (71.7m³/h), cooling water for hydrogen generation station (3m³/h), cooling water for breakwater camera (2.7m³/h), and cooling water for oil pump house (10m³/h). Another 85.5m³/h will be used for the Workers' permanent colony, potable water for the coal wharf, process water for the coal wharf, makeup water for the air conditioner, and, unforeseen water.

There will be an oily wastewater treatment station that will treat 4m³/h of oily wastewater from the transformer area, LDO tank farm, LDO pump house and washing water from the main building. The treated wastewater will be pumped to the Industrial Wastewater Treatment Station to be built at the project site.

There will be an Industrial Wastewater Treatment System which will handle about 18.3m³/h of effluent emanating from various sources including treated effluent from the domestic sewage treatment station (4m³/h), acid-alkali wastewater (0.3m³/h) from the boiler feedwater treatment plant, acid and alkali wastewater from condensate polishing regeneration system (2m³/h) and coal dust pre-settling tank (8m³/h).

4.10.2.5 Cooling water system

Under continuous maximum rating conditions, the three units will use 126,504m³/h of seawater for cooling water for the condenser and cooling water for the open cycle cooling system.

The power plant control system will regulate the cooling water flow and pumps as required to maintain optimum cooling in the condenser.

4.10.3 Roadway maintenance

The power plant access roads, heavy haul road and on-site roads will be continuously maintained to facilitate safe movement of vehicles. Maintenance procedures will be developed in the later planning stages, however, maintenance of the road network may include:

- Pavement management;
- Road repairs,
- Sidewalk construction and maintenance;
- Weed control;
- Road sweeping; and
- Litter pickup.

4.11 Decommissioning

The proposed power plant will be designed, built and maintained to operate efficiently to produce electrical power for transmission to the national grid. The expected design life of the power plant and balance of plant is 30 years or more. The life of the project may be extended if the project continues to generate and sell power at a cost effective rate, there is an active maintenance program, the power plant is refurbished or equipment replaced as needed.

For the purposes of this ESIA Study, the power plant will be operated for a period of 30 years or more and any decommissioning or abandonment has not been contemplated by APCL, nor would it be possible to predict with any certainty, the potential requirements for decommissioning or abandonment of the project this far into the future.

The operation of the project will be conducted in a manner which will minimize the potential for adverse environmental effects by following operating procedures, conducting proper preventive and predictive maintenance and implementing good housekeeping practices and environmental management practices to minimize the potential for unintentional releases, and site contamination. As such, while some remediation is likely to be necessary, it is likely that the decommissioning would be focused on the removal of the physical works, remediation and the restoration of the area to suitable environmental conditions.

When the project is nearing the end of its useful life, a decommissioning and abandonment plan will be developed in accordance with the regulations applicable at that time. The decommissioning and abandonment plan would specify the procedures that would be followed with respect to the decommissioning, removal and disposal of site equipment and structures, and for site remediation if required. The decommissioning and abandonment plan would be developed to reflect the environmental requirements in place at the time of decommissioning including consideration of the waste disposal, diversion or recycling requirements that would exist at that time.

Energy would be consumed during decommissioning. Power consumption and timeframes for this process are expected to be less than that for construction. Typical equipment for demolition of this type would include cranes, forklifts, trucks, oxy-acetylene cutting equipment and portable generators.

Where possible, materials from decommissioning would be recycled or reused to reduce the total quantity of solid waste disposed and conserve natural resources required for their production.

4.11.1 Removal of facilities and site reclamation

The activities to be conducted during decommissioning are likely to involve the removal of all physical structures and units, the disposal of wastes and transport to an appropriate disposal site, and the rehabilitation of the site to acceptable standards. The main activities associated with removal of facilities and site reclamation are expected to include but not limited to the following:

- All physical structures including the buildings, infrastructure within the power plant block, balance of plant structures such as tanks, pipelines, berths, coal conveyor system, roads and related infrastructure will be removed from the site;
- All remaining materials, equipment and supplies will be removed from the site including any remaining fuels and hazardous materials;
- All structures and disassembled materials will be stacked in designated areas for removal;
- Reusable materials no longer required by the company at other sites will be offered for sale;
- All wastes will be disposed off in an approved manner using NEMA licensed transport companies;
- When the LDO storage tank system is decommissioned, all products will be removed from the system and the tank and associated piping removed from the ground. Any contaminated soils will be removed and the site cleaned and restored;
- All hazardous wastes will be transported to approved hazardous waste storage and disposal sites. All disturbed areas will rehabilitated and re-vegetated. Re-vegetation will be accomplished with plants and trees that are common to the area.

Further specific details will be provided in the decommissioning and abandonment plan once developed at the appropriate time during the life of the facility.